FLOOD RISK ASSESSMENT & SUDS REPORT FOR WARREN CREEK, THE WARREN, CAVERSHAM, RG4 7TQ

DOCUMENT NUMBER: C3007-R1-REV-D

PREPARED BY

Table of Contents

1. SITE DETAILS 3
1.1 Site Location 3
1.2 Proposed Development 4
1.3 Geology of The Area 5
2. PLANNING POLICIES 7
2.1 National Planning Policies 7
2.2 Local Planning Policy 7
3. FLOOD RISK 8
3.1. Flood Zones 8
3.2. Vulnerability Classification 9
3.3. Development Planning Background and Environment Agency Data 10
3.4 Flooding from Land (Overland Flow) 13
3.5 Flooding from Groundwater 14
3.6 Flooding from Sewers 15
3.7 Flooding from Reservoirs, Canals, or Other Artificial Sources 15
4 RESIDUAL RISK AND MITIGATION MEASURES 16
4.1. Residual Risks 16
4.2. Mitigation Measures 17
4.3. Safe Access and Egress 18
5. SUSTAINABLE URBAN DRAINAGE SYSTEMS 20
6. PROPOSED SuDS SOLUTION 25
7. SuDS PROPOSALS FOR DEVELOPMENT 27
8. TIMESCALE AND MAINTENANCE OF DRAINAGE WORKS 29
9. CONCLUSIONS 33

APPENDICES

APPENDIX A – DRAWINGS

APPENDIX B – MODELLED FLOOD LEVELS FROM THE ENVIRONMENT AGENCY

APPENDIX C – SURFACE WATER RUNOFF CALCULATIONS

1. SITE DETAILS

Site Name	Warren Creek
Site Address	Warren Creek, The Warren, Caversham, RG4 7TQ
Purpose of Development	Residential
Existing Land Use	Brownfield
OS NGR	469863E, 175084N
Country	England
Local Planning Authority	Reading Borough Council

1.1 Site Location

The location of the project site is shown in Figure 1 below.



Figure 1- Location of Project Site (Source: OS Opendata).

1.2 Proposed Development

This report is created with the understanding that Warren Creek is the permanent home of the current owners. They are committed to maintaining this plot as their home whatever decisions are made here. They are considering permitted development rights and rebuilding/full renovation of the current home. Therefore, this report looks to quantify the impact of the proposal against the current situation.

4 aspects of the current situation are particularly considered;

- The current building has a 17m foundation perpendicular to the river that starts just 3m from the river. This is creating significant deflection and constriction of the flood route as described in Paragraph: 048 of the Guidance for Flood Risk and Change
- The foundations of the current building provide no flood plain capacity. This has eliminated 93m2 of flood plain situated beside the riverbank.
- Whilst opportunities to offset a new build by removing earth towards the entrance would be possible, the road suffers from subsidence and this activity has the potential to exacerbate further road subsidence in the future.
- The current building sits on a 70cm plinth. This has historically afforded protection, but in January 2024 flood water was less than 2cm from breaching the house.

The proposal involves the erection of a replacement single dwelling on the same plot but situated further back to reduce the risk of fluvial flooding and aid flood water flow.

The ground floor level of the proposed dwelling will be raised 300mm above the modelled flood level, including an allowance for climate change. This will address the increasing flood risk and remove the current safety to life issue.

The proposed dwelling will be raised on stilts, up to the modelled flood level, providing a large floodplain increase as long as the known concerns associated with under building voids can be acceptably addressed.

The owners are eager to collaborate, amend and evolve the design to address concerns.

With regards to the void below the house, the absence of lips that encourage silt build up, wide aperture mesh that limits waste build up, planning terms which force the void not to be used as storage and an ongoing program for cleaning and maintenance will go a long way to ensuring the void remains fully effective. The owner can accept or offer all of these.

1.3 Geology of The Area

According to the British Geological Survey, the superficial deposit at the site is of the Alluvium member, as shown in Figure 2 overleaf. The bedrock at is of the Seaford Chalk Formation, as shown in Figure 3 overleaf.

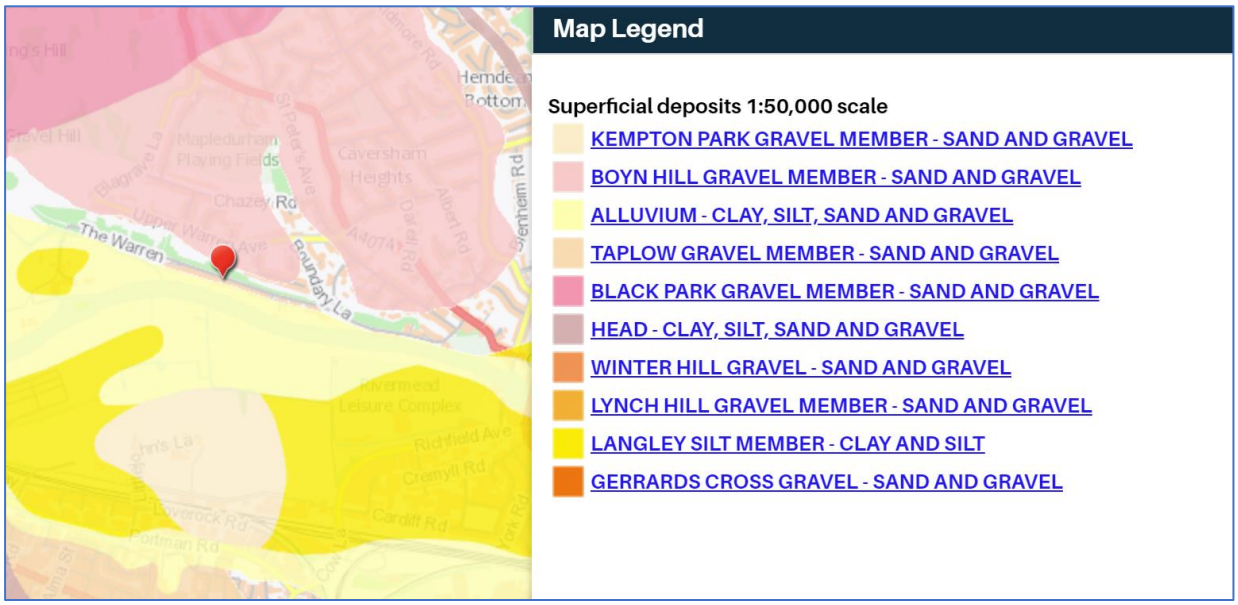


Figure 2 - Superficial Deposits at the site. (Source: British Geological Survey website (contains British Geological Survey materials © NERC2024).

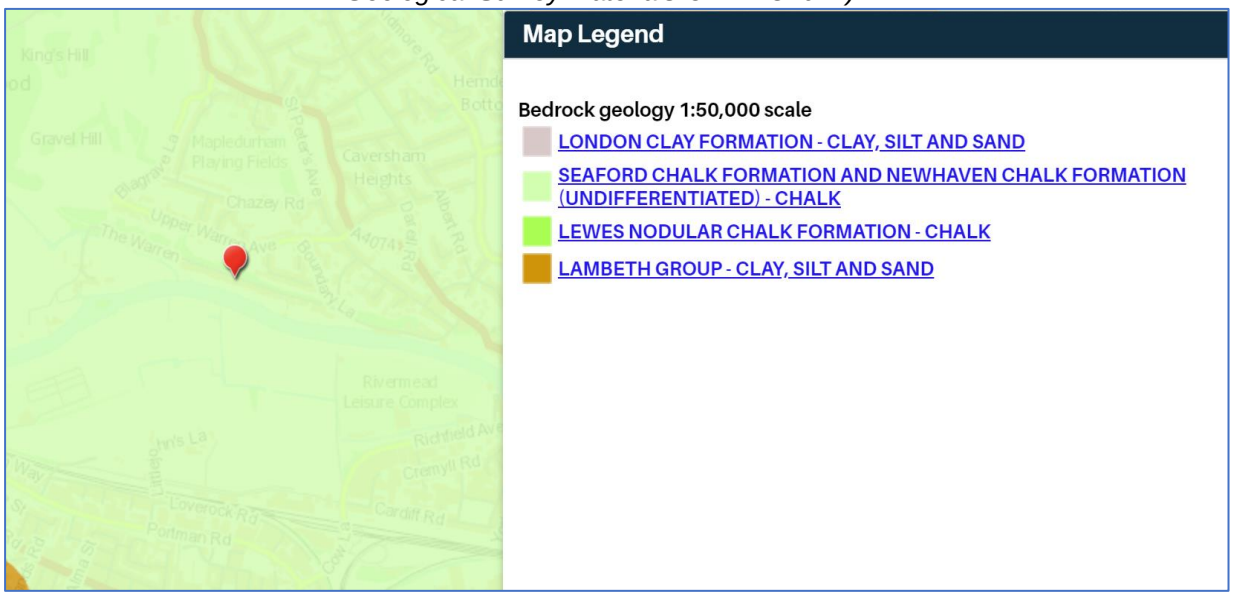


Figure 3 - Bedrock at the site. (Source: British Geological Society Website (contains British Geological Survey materials © NERC2024).

2. PLANNING POLICIES

2.1 National Planning Policies

- NPPF's Technical Guidance States:

"The effect of development is generally to reduce the permeability of at least part of the site. This markedly changes the sites response to rainfall. Without specific measures, the volume of water that runs off the site and the peak run-off flow rate is likely to increase. Inadequate surface water drainage arrangements in new development can threaten the development itself and increase the risk of flooding others."

2.2 Local Planning Policy

The report has been written in conjunction with the following local planning policies:

- Reading Borough Council Strategic Flood Risk Assessment Report

3. FLOOD RISK

The probable causes of flooding set out in NPPF are considered in this section in relation to flood risk to the site itself and the effects of the development of the site on the flood risk elsewhere.

3.1. Flood Zones

As described by the Flood risk and coastal change Technical Guidance to the National Planning Policy Framework, “inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.”

The document defines areas at risk of flooding as meaning “land within Flood Zones 2 and 3; or land within Flood Zone 1 which has critical drainage problems, and which has been notified to the local planning authority by the Environment Agency”.

The document describes flood risk as meaning “risk from all sources of flooding – including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.”

Flood zones for planning purposes refer to the probability of flooding from the sea and rivers only.

Table 1 summarises the flood zones used in the Flood risk and coastal change Technical Guidance:

Flood Zone	Description
Zone 1 – low probability	Land assessed as having a less than 1 in 1,000 annual probabilities of river or sea flooding (<0.1%).
Zone 2 – medium probability	Land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% - 0.1%) in any year.
Zone 3a – high probability	Land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
Zone 3b – the functional floodplain	Land where water has to flow or be stored in times of flood, as identified by local planning authorities in their Strategic Flood Risk Assessments, in agreement with the Environment Agency.

Table 1- Flood risk and coastal change Flood Zone Guidance

3.2. Vulnerability Classification

The Flood risk and coastal change guidance outlines flood risk vulnerability classifications for a range of development types.

The document describes the classification as being “based partly on Department for Environment, Food and Rural Affairs and Environment Agency research on Flood Risks to People (FD2321/TR2) and on the need of some uses to keep functioning during flooding.

Based on the Flood risk and coastal change guidance, Table 2 summarises the vulnerability classification of the proposed site:

Site Use	Vulnerability Classification
• Hospitals • Residential institutions such as residential care homes, children's homes, social services homes, prisons, and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs, and hotels. • Non–residential uses for health services, nurseries, and educational establishments. • Landfill* and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.	More Vulnerable

Table 2- Flood risk and coastal change guidance, Flood Risk Vulnerability Classification (More Vulnerable).

3.3. Development Planning Background and Environment Agency Data

Figure 4 overleaf, shows the indicative flood map for flood risk from rivers or the sea, which was downloaded from the Environment Agency's website, September 2023.

This indicative map suggests the site is located within Flood Zone 3. Flood Zone 3 is an area where there is a 0.5% chance of occurring in any year for flooding from the sea, or a 1% chance of occurring for fluvial (river) flooding.

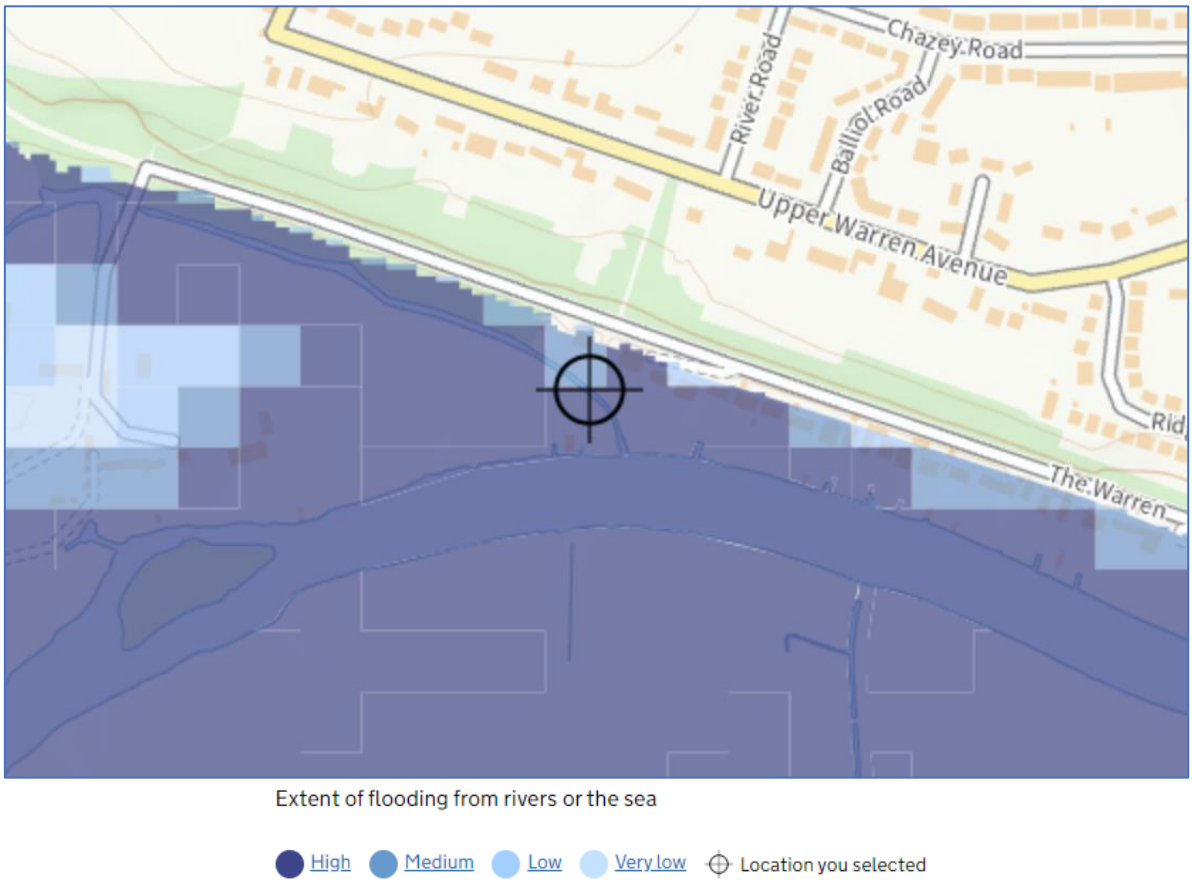


Figure 4 – Environment Agency Flood Map for flooding extent from rivers and sea for the proposed development

The Environment Agency were contacted to obtain site specific modelled flood levels, in order to ascertain the risk of flooding from the Rivers and the Sea to the site.

These modelled flood levels show that the proposed development site is within a Flood Zone 3, with a 1 in 100 annual probability of fluvial flooding in any year.

The site is not protected by flood defences, and there is a history of fluvial flooding at the site. That said the client is looking to build a replacement dwelling on their own land to replace their existing home, which is currently very close to the river bank, as

well as although being raised above the external ground level, is not actually much above the modelled floor level for the 1 in 100 year plus 35% fluvial flooding event.

Flood point data was provided at the location of the proposed replacement dwelling with a modelled flood level for the 1 in 100 years plus 35% climate change event of 39.13mAOD. Therefore, the client has proposed the finished floor level of the proposed replacement dwelling to be raised 300mm above this flood level, to 39.430mAOD. Furthermore, to ensure. at the proposed dwelling does not impede any flood flow routes, the house will be built on stilts with clear voids throughout the bottom of whole building, up to the modelled flood level to allow floodwater to flow under the building.

Therefore, no flood storage compensation will be required, and the fabric of the building will be safe, as well as there being no risk of flooding to the proposed dwelling. A drawing showing the voids on the ground floor of the building have been provided in Appendix A.

Furthermore due to the finished floor level of the building being located 300mm above the modelled flood level, no mitigation or resilience measures will be required for the main house, however some are mentioned further in this report further on in this report for the structure below the finished floor level, and there will be issues with access and egress to the building during an extreme flooding event, which will be discussed further on in this report.

Drawings showing the proposed finished floor levels of the garage and house are provided in Appendix A.

3.4 Flooding from Land (Overland Flow)

There are areas showing a low to high risk of surface water flooding at the proposed development site, however the majority of these areas of flooding will have a depth of less than 300mm, with a very small area at the front of the site showing a flooding depth of between 300mm and 900mm, during an extreme surface water flooding event.

Therefore the building being raised 300mm above the modelled flood level for the fluvial flooding will be more than sufficient to deal with surface water flooding, and the surface water run off produced as a result of the development proposals will be dealt with through the use of Sustainable Urban Drainage Systems, and therefore will reduce the risk of flooding at the site and elsewhere.

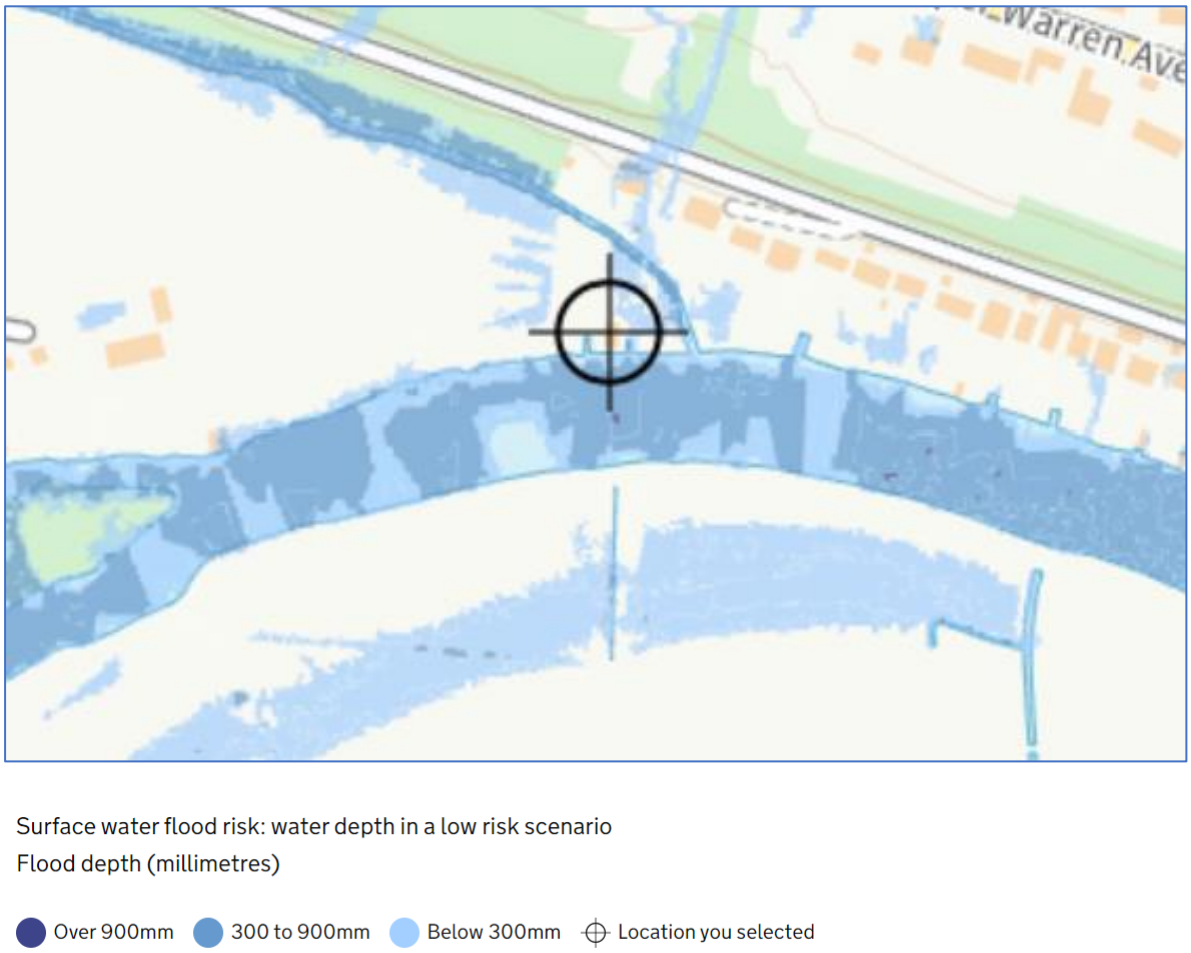


Figure 5 – Environment Agency Surface Water Flood Map for the proposed development.

3.5 Flooding from Groundwater

The Environment Agency's website confirms that groundwater flooding is unlikely in this area.

3.6 Flooding from Sewers

There is no risk of flooding from any sewers at the proposed development site, and there has been no history of sewer flooding at the proposed development site.

3.7 Flooding from Reservoirs, Canals, or Other Artificial Sources

The Environment Agency's Flood map shown in Figure 6 below, shows the site to be at risk of any reservoir, however flood warnings are in place, and there has been no loss of life from reservoir flooding.

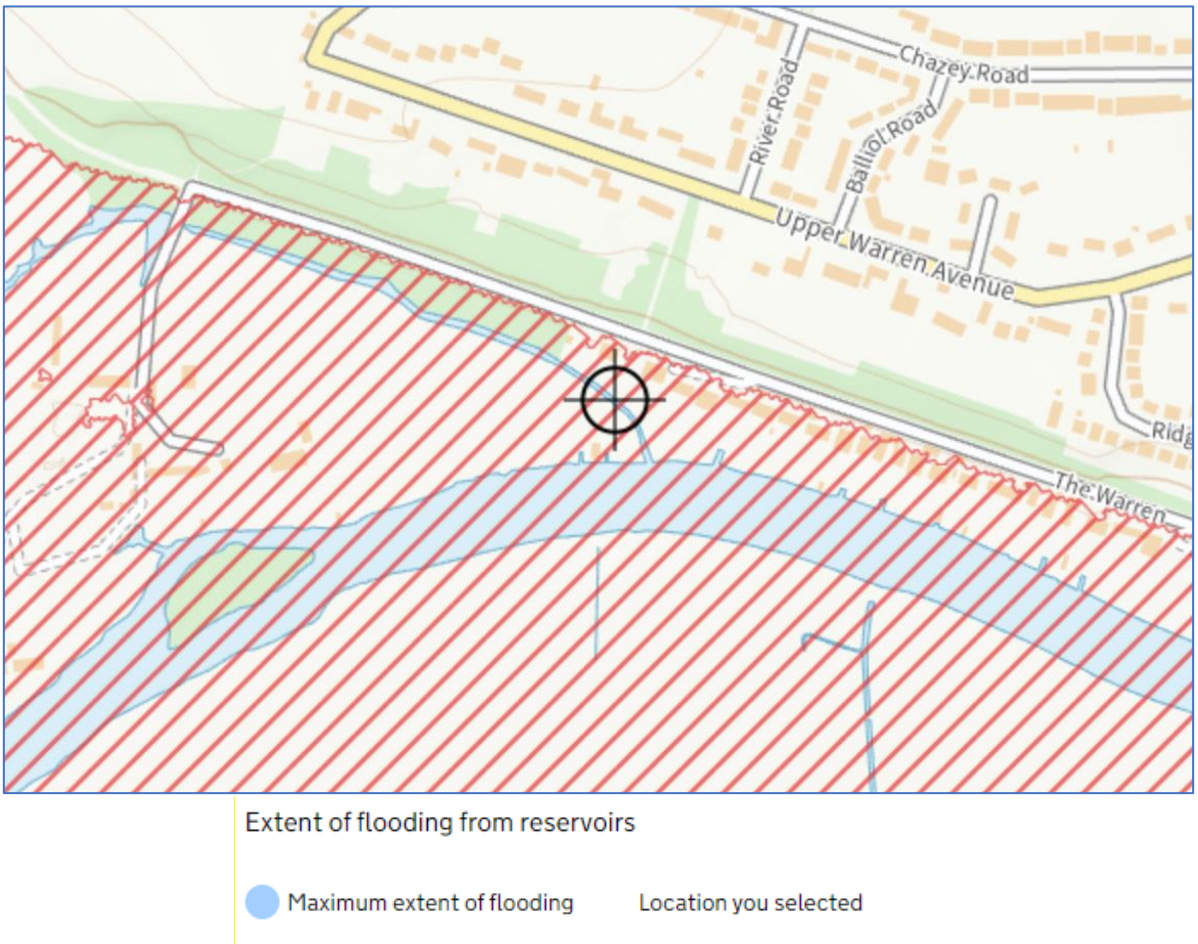


Figure 6 – Environment Agency Flood Map from reservoirs for the proposed development

4 RESIDUAL RISK AND MITIGATION MEASURES

4.1. Residual Risks

As discussed in this report, the site is located within the Environment Agency's fluvial Flood Zone 3, which comprises land assessed as having a 1% (1 in 100) annual probability of fluvial flooding in any year. There is also a risk of surface water flooding, where the majority of the depths of flooding will be less than 300mm.

As discussed previously in this report, the proposed finished floor level of the ground floor accommodation of the proposed dwelling is raised 300mm above the modelled flood level for the 1 in 100 year plus 35% event, and the building will be raised on stilts to allow flood water to flow through, including the stairs which will be slatted , therefore there is no obstruction to flood flow routes and no flood storage compensation will be required.

A safe area of refuge is available on the ground floor as this is above the modelled flood level, and the owners of the dwellings will be asked to sign up to Flood Warnings direct, which they are currently signed up to, so that the residents can remain in the building once a flood warning has been received.

4.2. Mitigation Measures

The ground floor and above of the building is not at risk of flooding, however the garage is, therefore various resilience measures will be incorporated into the fabric of the garage, as well as the structure of the house below the ground floor. Fixtures and fittings will be put in place to ensure that if any flood water does enter the ground floor during a flood event, the impact of floodwater on the property will be minimal. These measures will ensure drying and cleaning is simpler, and that the structural integrity of the building is not compromised, and ultimately, they will reduce the time required until the property can be re-occupied.

The resilience measures to be adopted, are as follows:

- Air vents to be located as high as possible.
- Flood warning alarm system.
- Using Floodproof windows and doors for the garage.
- Electricity consumer unit and to be located as high as possible in the garage, with all feeds to go down the building from the ceiling.

- Non return valves to be used in drainage design to prevent back up of flow.

- Adequate sealing of joints between the internal units in the garage is required to prevent any penetration of water behind fittings.

- Heating systems such as boiler units and ancillary devices to be installed as high as possible.

- Walls will have closed-cell cavity insulation and a damp proof course up to the first-floor level.

4.3. Safe Access and Egress

As discussed, access and egress to the site will not be feasible during an extreme fluvial event, and the occupants would be advised to sign up to flood warning direct in order to receive a flood warning and seek refuge in their dwelling and stay there until the flooding stops. Unless they are informed otherwise by the emergency services

The owners of the dwellings would receive a copy of this report as a part of their deeds and therefore would be also asked to keep and emergency supply bag of tinned and dry food in the event of an extreme flood event where they cannot leave this building.

Should a flood warning be received whilst they are away from their building, they will be advised to remain away until told otherwise by the Environment Agency.

5. SUSTAINABLE URBAN DRAINAGE SYSTEMS

The total site area is 2239m^2, and the impermeable areas of the site prior to development is 494.8m^2. Following the development at this site, the proposed impervious space will be 243.5m^2. This will show an improvement of 151.3m^2. The proposal is therefore a 30.6% improvement over the existing.

Pre and post development surface water runoff calculations showing the peak flow rate leaving the site can be found in Appendix C.

Surface water arising from a developed site should, as far as practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.

Reducing the rate of surface water discharge from Urban Sites is one of the most effective ways of reducing and managing flood risk.

Traditional piped surface water systems work by removing the surface water from our developments as quickly as possible, however this can cause various adverse impacts:

- Increased downstream flooding, and sudden rises in flow rates and water levels in local water courses.

- Reduction in groundwater levels dry weather flows in watercourses.

- Reduce amenity and adversely affect biodiversity due to the surface water run-off containing contaminants such as oil, organic matter, and toxic materials.

SuDS are defined as a sequence of management principles and control structures designed to drain surface water in a more sustainable fashion than conventional piped drainage techniques. SuDS should utilise the environmental, ecological and social benefits.

These include:

- Protection and enhancement of water quality – As well as providing on-site attenuation, SuDS treat the water, resulting in an improved quality of water leaving the site. This is achieved when the water passes through the fine soils and the roots of specially selected plants, pollutants washed of the hard landscaping by rainfall will be safely removed before the water reaches the natural water course.

- A sympathetic approach to the environmental setting by providing the opportunities to create habitats for flora and fauna in urban watercourses and open spaces.

- Meeting the amenity and social needs of the local community and residents in the creation of attractive green spaces.

The various types of SuDS include:

Permeable paving	
Soakaways	
Swales and basins	
Bioretention/ rain gardens	
Green roofs and rainwater re-use	
Infiltration trenches and filter drains	
Ponds and wetlands	

Preferably a combination of these techniques should be used as part of the surface water management train, and it is important for all stakeholders, such as developers, architects, landscape architects and engineers, to work together at the planning stage in order to determine a feasible solution.

The SuDS management train is shown in Figure 7 below, this has been followed when proposing the proposed Sustainable Urban Drainage Systems for this site.

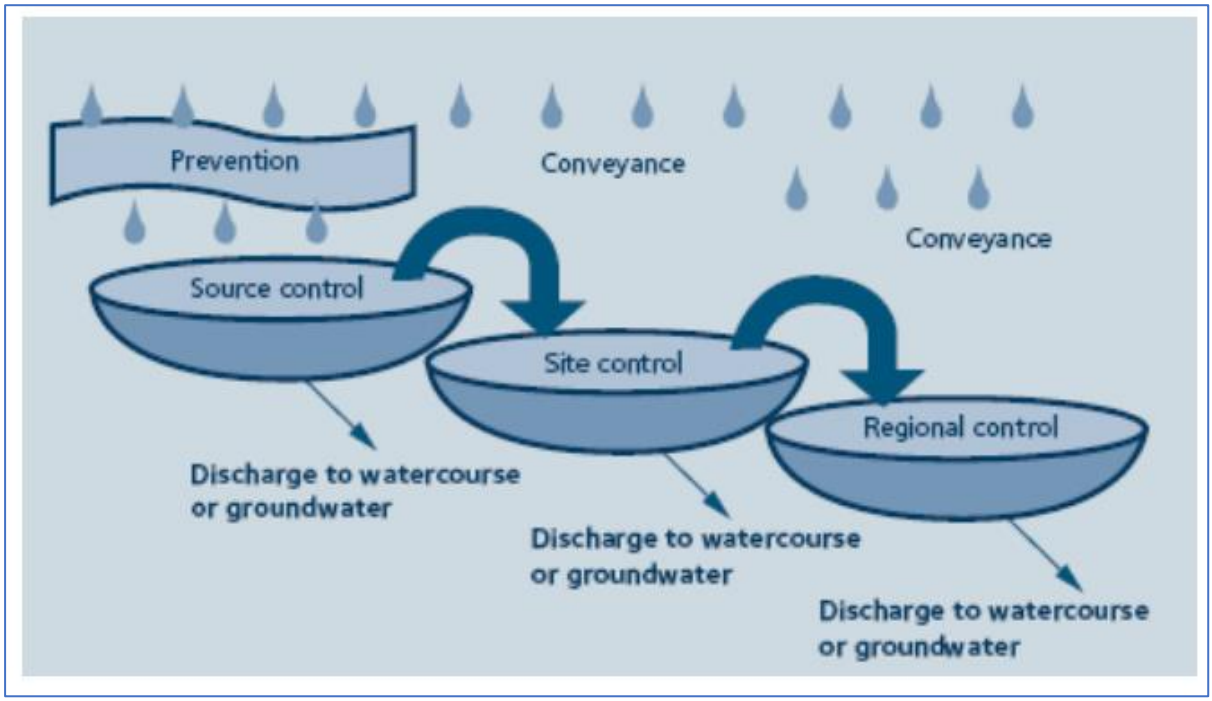


Figure 7 – SuDS Management Train

6. PROPOSED SuDS SOLUTION

In order to ensure that the SuDS management train has been followed, two wall mounted rainwater harvesting tanks will be provided at the dwelling, and one at the garage. The roofs are pitched, therefore green or sedum roofing could not be provided.

All proposed hardstanding areas will be formed of porous surfacing, with the new driveway to be formed of gravel, underlain by a hydrocarbon removing geotextile membrane and the road and carparking areas, with the surface water runoff from any sloped areas to be caught by slot drains.

The preferred method of dealing with remaining surface water from the above SuDS components would be to treat and deal with it at source using soakaways, however due to the geological makeup of the soils these are not possible on this site.

Therefore, the remaining surface water runoff will be conveyed into one, below ground crate system attenuation tank with restricted flow leaving the site and discharging into the creek at a rate of 1 l/s which is higher than the existing site's greenfield rate, in order to avoid blockages, as per the calculations provided in Appendix C.

Hydrograph storage calculations were carried out for the 1 in 100-year storm event plus 45% climate change event. These show that, 22.4m^3 of storage is required within the site, with the restricted discharge to be conveyed by gravity to the river.

We believe the Sustainable Urban Drainage System hierarchy has been considered fully, with as much of the surface water runoff to be treated at source, and any overflows from these SuDS components being dealt with at source also, which represents a 98% reduction in surface water run off for the 1 in 100 year storm event. A SuDS layout and location plan has been provided in Appendix A.

7. SuDS PROPOSALS FOR DEVELOPMENT

In accordance with the CIRIA SuDS Manual C753, the SuDS hierarchy has been considered in relation to the site-specific constraints and its surroundings. Table 3 below outlines the hierarchical approach considered for the development at Warren Creek, The Warren, Caversham, RG4 7TQ.

Sustainable Drainage Proposal	**Description**	**Constraints/Comments**	**Appropriate**
Rainwater Use as a Resource	Use of rainwater runoff for reuse, e.g. Rainwater harvesting tanks, Blue Roofs for irrigation	Three wall mounted rainwater harvesting tanks will be provided at the new buildings.	Yes
Rainwater Full Infiltration to Ground (Source Control)	Infiltration devices and/or soakaways. Surface water runoff stored on site and gradually percolating into receiving ground	Due to the geological makeup of the ground Infiltration on this site is not an option.	No
Rainwater Partial Infiltration to Ground (Source Control)	Installation of permeable/porous surfacing	Porous paving has been proposed at all new hardstanding areas to deal with surface water run off for low storm event	Yes
Rainwater attenuation in green infrastructure features for gradual release	The onsite storage of all surface water runoff which can then be gradually conveyed to a nearby watercourse, sewer, or infiltration into the ground. Forms of green infrastructure features: Green	The roofs are pitched therefore green, or sedum roofing cannot be provided and due to the site levels, any discharge from ponds would have to be pumped, therefore we have proposed underground tanks	No

	Roofs, Raingardens, Ponds, Swales, Detention basins, Infiltration Trenches, and Raingarden Planters		
Rainwater discharge direct to a watercourse	All surface water runoff on site discharged at a restricted rate to a nearby watercourse	The remaining surface water runoff will be attenuated and discharged into the adjacent river at restricted rate of 1 l/s	Yes
Controlled rainwater discharge to a surface water sewer or drain	All surface water runoff on site is discharged at a restricted rate to a nearby surface water sewer or drain, all rainwater runoff stored in below ground attenuation features. E.g. oversized pipes or geo-cellular tanks	N/A	N/A
Controlled rainwater discharge to a combined sewer	All surface water runoff on site discharged at a restricted rate to a nearby surface water sewer all rainwater runoff stored in below ground attenuation features. E.g. oversized pipes or geo-cellular tanks	N/A	N/A

Table 3: SuDS hierarchy

8. TIMESCALE AND MAINTENANCE OF DRAINAGE WORKS

All drainage works shall be completed prior to first occupation and there shall be no adoption of any of the drainage works within the site, and a management company will be responsible to oversee the long-term maintenance of the communal drains.

The following outline maintenance strategy sets out recommended timescales for maintenance of the proposed drainage works, in line with CIRIA SuDS Design Guide:

- Regular inspection will comprise the inspection and cleaning of catchment, gutters, filters, and tanks to reduce the likelihood of contamination, this is recommended to be carried out every 3 to 6 months.

- The catch pit chamber to the attenuation should be checked and emptied regularly to ensure there is no silting up of the system.

- Regular jet-washing of permeable block paving can be used to keep joints and voids clear; this should be carried out every 3 to 6 months.

The following table outlines the maintenance requirements for the porous paving:

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

Table 4: Operation and maintenance requirements for pervious pavements.

The following table outlines the maintenance requirements for the Attenuation Tank:

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

Table 5: Operation and maintenance requirements for attenuation storage tanks.

The following table outlines the maintenance requirements for the rainwater harvesting systems:

Maintenance schedule	Required action	Typical Frequency
Regular maintenance	Inspection of the tank for debris and sediment build-up, inlets/outlets/withdraw devices, overflow areas, pumps, filters.	Annually (and following poor performance)
	Cleaning of tank, inlets, outlets, gutters. Withdrawal devices and roof drain filters of silts and other debris	Annually (and following poor performance)
Occasional maintenance	Cleaning and/ or replacement of any filters	Three monthly (or as required)
Remedial actions	Repair of overflow erosion damage or damage to tank	As required
	Pump repairs	As required

Table 6: Operation and maintenance requirement for RWH systems.

The following table outlines the maintenance requirements for the flow control chambers:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect from surface and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then 6 monthly intervals
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	Orifice plates within plastic chambers or vortex controls to be jetted from the surface after heavy rainfall events to remove any debris or silt	As required
	Empty catchpits upstream of SuDS features to ensure no debris is passed downstream	3 months or as required
Remedial actions*	In the event of a blockage, a vortex flow control can be removed from the chamber via the lifting cabled located at the access, this will be cleaned at surface level and reinstalled into its original location	As required
	In the event of a blockage, the orifice plate should be jetted from surface, and if blockage is not cleared the orifice plate can be removed by removing fixing bolts. These fixing bolts should be checked and replaced if needed.	As required
Monitoring	Following installation, it is important that any extraneous materials i.e. building materials: granular backfill, in-situ pour concrete etc are removed from the unit and the new flow control chamber is fully jetted down	Upon installation
	Inspect/check chamber channel for any debris or silt build-up. Upstream chambers should be checked at the same time as these monitoring works to ensure network is operating at full capacity.	Annually

Table 7: Operation and maintenance requirement for flow control chambers

*All Remedial Works should be carried out by a competent and certified contractor, with no entry or removal of parts to be undertaken by landowner.

If upstream network of flow control chamber is regularly maintained, little maintenance is required within the chamber as there are no moving part.

9. CONCLUSIONS

This report has been produced to demonstrate that the proposed development will not increase risk to life and will not increase flood risk to the site itself or areas adjacent to the site.

The reason for the client to provide this new dwelling is due to the fact that he is aware that the existing dwelling is at a risk of fluvial flooding, and therefore he has proposed a new dwelling set further back from the existing dwelling.

The ground floor level of the proposed dwelling will be raised 300mm above the modelled flood level, including an allowance for climate change. The existing dwelling currently acts like a flood barrier wall of 16 metres between the river and the site, whereas the proposed dwelling will be raised on stilts, up to the modelled flood level, and therefore the proposals actually decrease flood risk elsewhere, as well as providing the client with a dwelling that is not at risk of flooding, or which could risk the lives of the residents.

There is a risk of fluvial flooding, to the site, however the proposed dwelling will not be at risk of flooding and provides protection to the residents as well as the fabric of this new build. Which cannot be said about the existing dwelling, which is not safe from fluvial flooding.

It can therefore be concluded that the proposed development will be safe for the lifetime of the development, will not increase risk to life and will reduce the risk of flooding at the site itself and elsewhere by controlling runoff generated by the site.

The proposals will not impact on any known flood flow route or flood storage area, and in fact by removing the existing dwelling, the client is removing a building that acts like a 16-metre flood barrier.

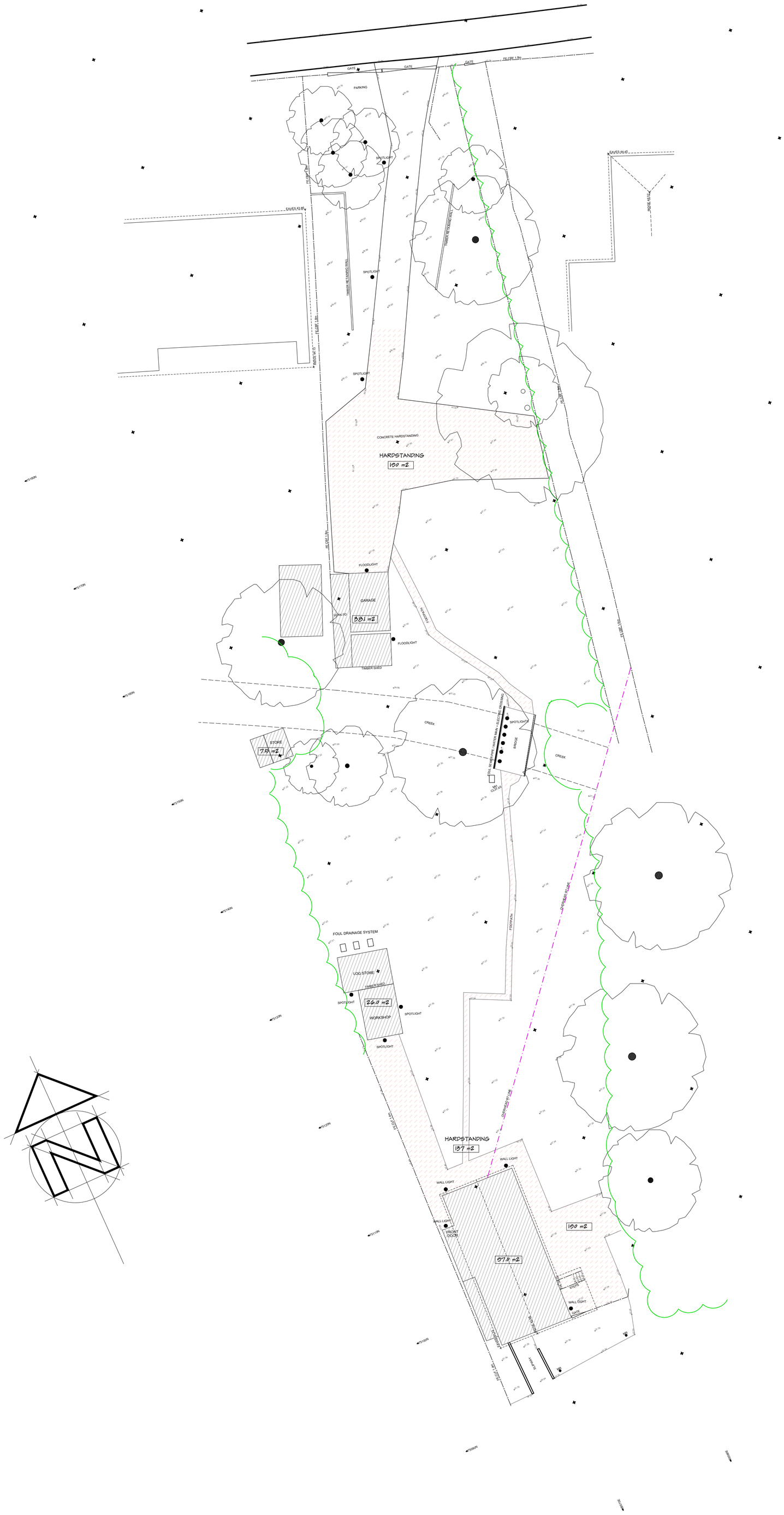
A suitable Sustainable Urban Drainage systems solution has been proposed which follows the SuDS hierarchy and represents a 98 % reduction in surface water run off for the 1 in 100-year storm event.

The owners have made it clear that a home will remain on this plot regardless of the outcome of the planning application. The current home is sub-optimal for the floodplain in multiple ways.

It is therefore in the interest of the floodplain to agree something that improves volume storage and flow.

This report demonstrates that the current proposal delivers meaningful gains in all areas of capacity, flow, and safety (subject to suitable under house void design and conditions).

APPENDIX A – DRAWINGS



1:200 scale Bar
This Drawing has been produced for printing onto A1 size paper,
If printing on A3 please use the scale below for reference.

0m 1m 2m 4m 8m 16m

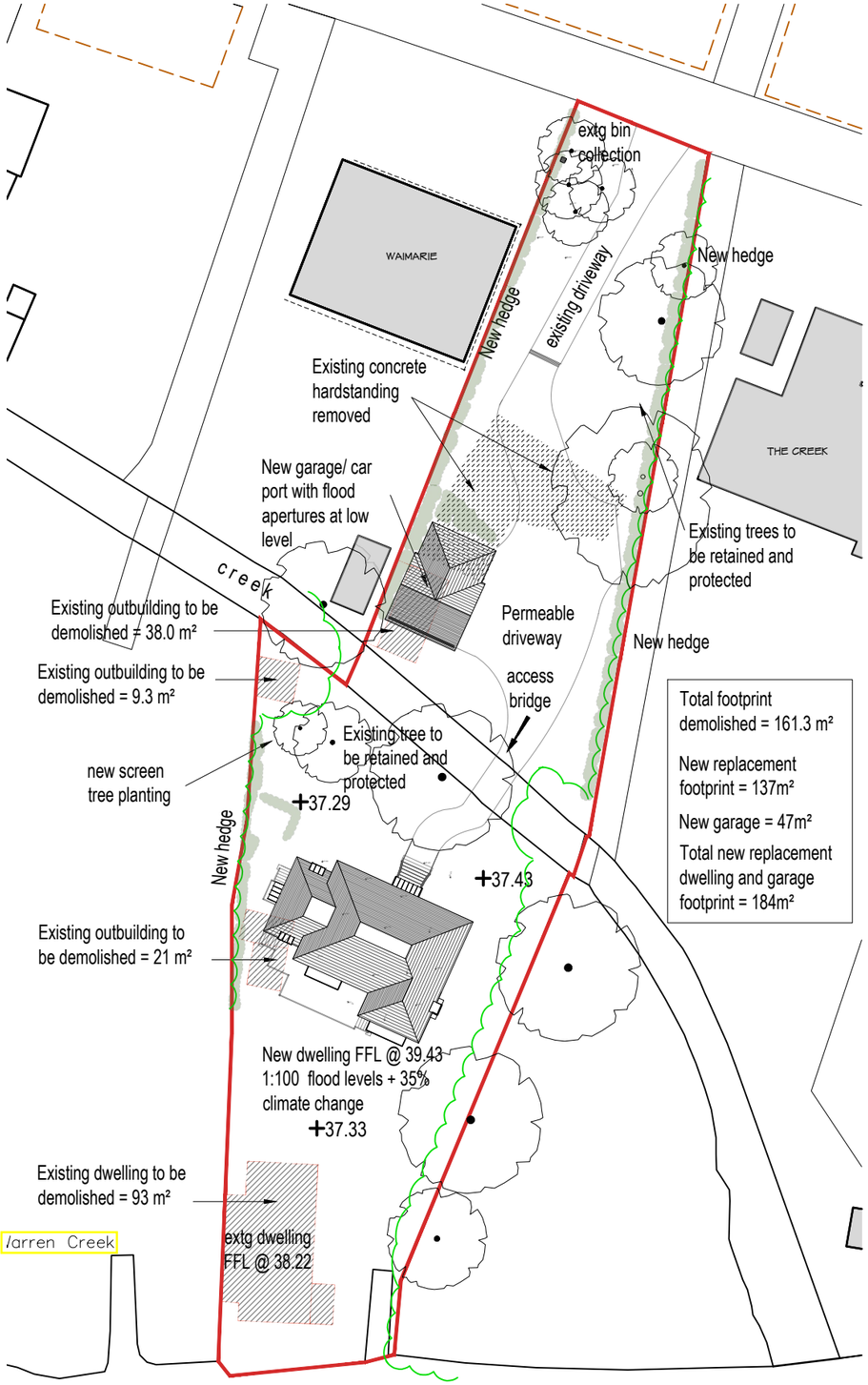
REV	COMMENTS	DATE

SHAUN·TANNER
ARCHITECTURE & PLANNING
www.stlarchitecture.co.uk studio@stlarchitecture.co.uk 0118 989 0808

CLIENT Mr R. Arnold
PROJECT Warren Creek, The Warren
Caversham, Reading, RG4 7TQ
DRAWING Proposed Foundation Plan

STATUS survey DATE May 2023
SCALE 1:200 DRAWN ST CHECKED NO 3863/120 REV .

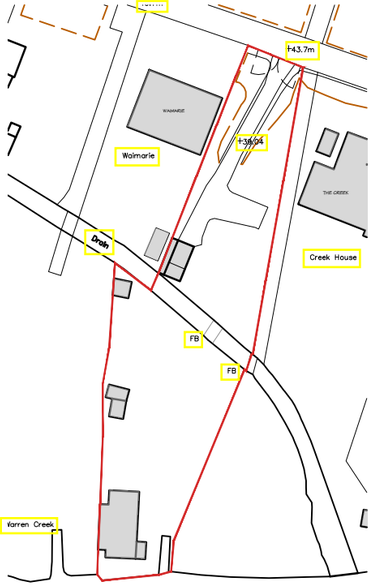
THIS DRAWING MUST NOT BE SCALED UNLESS ISSUED FOR PLANNING PURPOSES. ALL DIMENSIONS ARE TO BE VERIFIED PRIOR TO SETTING OUT, COMMENCING WORK, OR PRODUCTION OF FABRICATION DRAWINGS. REPORT ANY DISCREPANCIES TO THE SUPERVISING OFFICER IMMEDIATELY. ©



Block plan 1:500

1:500 scale Bar
This Drawing has been produced for printing onto A3 size paper,

0m 5m 20m
2.5m 10m 40m



Location plan 1:1250

1:1250 scale Bar
This Drawing has been produced for printing onto A3 size paper,

0m 12.5m 50m
6.2m 25m 100m

REV	COMMENTS	DATE
D	GATES REMOVED	22/04/24

SHAUN·TANNER ARCHITECTURE & PLANNING
www.stlarchitecture.co.uk studio@stlarchitecture.co.uk 0118 989 0808

CLIENT Mr R. Arnold
PROJECT Warren Creek, The Warren
CAVERSHAM, READING, RG4 TQ
DRAWING BLOCK AND LOCATION PLAN

STATUS PLANNING DATE May 2023
SCALE 1:500/1:1250 DRAWN CHECKED NO 3863/220 REV D

THIS DRAWING MUST NOT BE SCALED UNLESS ISSUED FOR PLANNING PURPOSES. ALL DIMENSIONS ARE TO BE VERIFIED PRIOR TO SETTING OUT, COMMENCING WORK, OR PRODUCTION OF FABRICATION DRAWINGS. REPORT ANY DISCREPANCIES TO THE SUPERVISING OFFICER IMMEDIATELY. ©

CREEK

BRIDGE

CREEK

+37.56

+37.19

+37.38

+37.29

+37.32

+37.24

+37.28

+37.36

+37.35

+37.36

+37.33

+37.31

+37.33

+37.36

+37.35

+37.37

+37.36

+37.32

3 NO. QUERCUS ILEX
100MM DIA 3/3.5M HIGH

+37.32

+37.29

+37.39

+37.32

+37.35

+37.35

+37.43

+37.48

LAWN

LAWN

AIR SOURCHE HEAT PUMP

BIN STORE

+37.30

+37.36

+37.39

PROPOSED NATIVE HEDGE

PROPOSED NATIVE HEDGE

PROPOSED NATIVE HEDGE

+37.43

+37.51

+37.38

+37.42

+37.36

+37.34

+37.34

PLAY ROOM

UTILITY ROOM

FFL + 39.43

ENTRANCE HALL

WC

STUDY

BOOT ROOM

LIVING ROOM

KITCHEN

+37.37

+37.33

+37.37

DINING ROOM

+37.34

+37.33

+37.33

1:100 scale Bar
This Drawing has been produced for printing onto A3 size paper,

0m 0.5m 1m 2m 4m 8m

REV	COMMENTS	DATE

SHAUN·TANNER
ARCHITECTURE & PLANNING
www.stlarchitecture.co.uk studio@stlarchitecture.co.uk 0118 989 0808

CLIENT Mr R. Arnold
PROJECT Warren Creek, The Warren
Caversham, Reading, RG4 7TQ
DRAWING Proposed Ground Floor Plan

STATUS Planning DATE May 2023
SCALE 1:100 DRAWN ST CHECKED NO 3863/221 REV A

THIS DRAWING MUST NOT BE SCALED UNLESS ISSUED FOR PLANNING PURPOSES. ALL DIMENSIONS ARE TO BE VERIFIED PRIOR TO SETTING OUT, COMMENCING WORK, OR PRODUCTION OF FABRICATION DRAWINGS. REPORT ANY DISCREPANCIES TO THE SUPERVISING OFFICER IMMEDIATELY. ©

CREEK

BRIDGE

CREEK

LAWN

LAWN

EN SUITE

EN SUITE

W

W

W

W

W

BEDROOM

BEDROOM

BEDROOM

LANDING

AC

E-S

E-S

DRESS

1:100 scale Bar
This Drawing has been produced for printing onto A3 size paper,

0m 0.5m 1m 2m 4m 8m

REV	COMMENTS	DATE

SHAUN·TANNER
ARCHITECTURE & PLANNING

www.stlarchitecture.co.uk studio@stlarchitecture.co.uk 0118 989 0808

CLIENT Mr R. Arnold
PROJECT Warren Creek, The Warren
Caversham, Reading, RG4 7TQ
DRAWING Proposed First Floor Plan

STATUS Planning DATE May 2023
SCALE 1:100 DRAWN ST CHECKED NO 3863/222 REV A

THIS DRAWING MUST NOT BE SCALED UNLESS ISSUED FOR PLANNING PURPOSES. ALL DIMENSIONS ARE TO BE VERIFIED PRIOR TO SETTING OUT, COMMENCING WORK, OR PRODUCTION OF FABRICATION DRAWINGS. REPORT ANY DISCREPANCIES TO THE SUPERVISING OFFICER IMMEDIATELY. ©

CREEK

BRIDGE

CREEK

PATH WAY

3 NO. QUERCUS ILEX
100MM DIA 3/3.5M HIGH

LAWN

LAWN

AIR SOURCHE HEAT PUMP

BIN STORE

PROPOSED NATIVE HEDGE

PROPOSED NATIVE HEDGE

PROPOSED NATIVE HEDGE

TERRACE

1:100 scale Bar
This Drawing has been produced for printing onto A3 size paper,

0m 0.5m 1m 2m 4m 8m

REV	COMMENTS	DATE

SHAUN·TANNER
ARCHITECTURE & PLANNING
www.stlarchitecture.co.uk studio@stlarchitecture.co.uk 0118 989 0808

CLIENT Mr R. Arnold
PROJECT Warren Creek, The Warren
Caversham, Reading, RG4 7TQ
DRAWING Proposed Roof Plan

STATUS Planning DATE May 2023
SCALE 1:100 DRAWN ST CHECKED NO 3863/223 REV A

THIS DRAWING MUST NOT BE SCALED UNLESS ISSUED FOR PLANNING PURPOSES. ALL DIMENSIONS ARE TO BE VERIFIED PRIOR TO SETTING OUT, COMMENCING WORK, OR PRODUCTION OF FABRICATION DRAWINGS. REPORT ANY DISCREPANCIES TO THE SUPERVISING OFFICER IMMEDIATELY. ©

1:100 scale Bar
This Drawing has been produced for printing onto A3 size paper,

0m 0.5m 1m 2m 4m 8m

REV	COMMENTS	DATE

MATERIALS:

NATURAL SLATE ROOF

FACING BRICKWORK

PAINTED TIMBER JOINERY



FRONT (NORTH) ELEVATION - FACING ROAD



SIDE (EAST) ELEVATION

SHAUN·TANNER
ARCHITECTURE & PLANNING
www.stlarchitecture.co.uk studio@stlarchitecture.co.uk 0118 989 0808

CLIENT Mr R. Arnold
PROJECT Warren Creek, The Warren
Caversham, Reading, RG4 7TQ
DRAWING Proposed Elevations

STATUS Planning DATE Apr 2021
SCALE 1:100 DRAWN ST CHECKED NO 3863/224 REV F

THIS DRAWING MUST NOT BE SCALED UNLESS ISSUED FOR PLANNING PURPOSES. ALL DIMENSIONS ARE TO BE VERIFIED PRIOR TO SETTING OUT, COMMENCING WORK, OR PRODUCTION OF FABRICATION DRAWINGS. REPORT ANY DISCREPANCIES TO THE SUPERVISING OFFICER IMMEDIATELY. ©

MATERIALS:

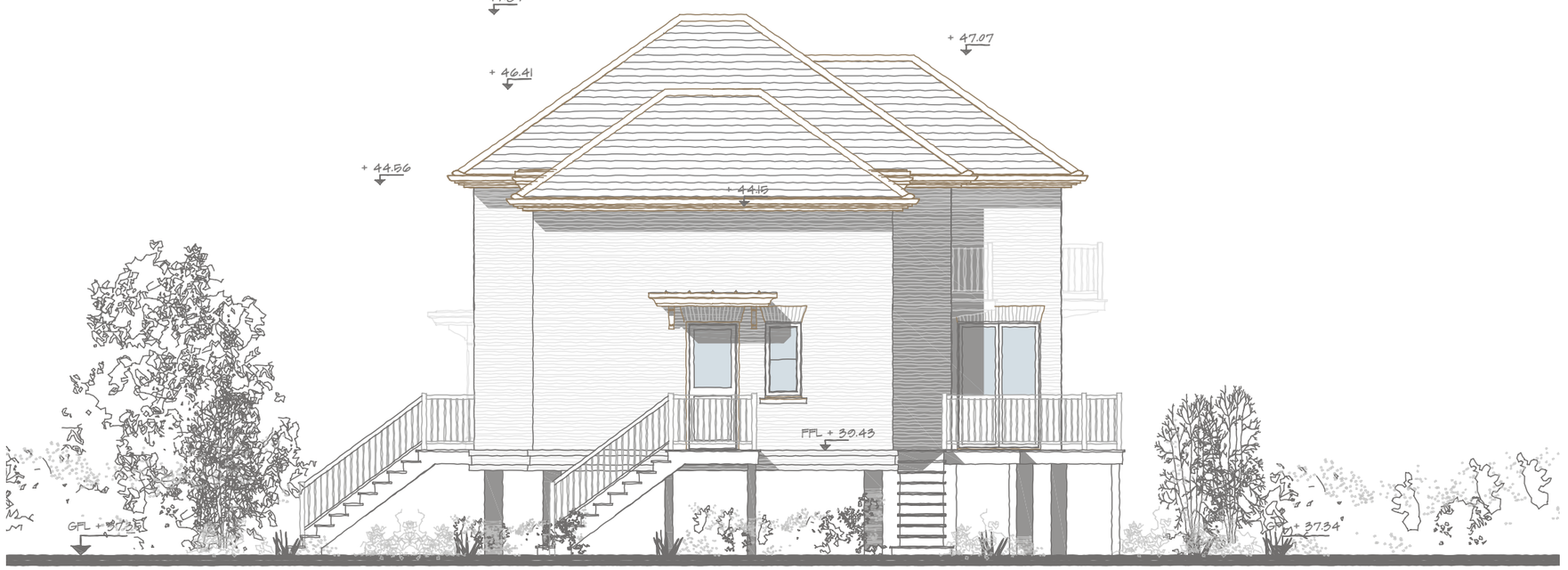
NATURAL SLATE ROOF

FACING BRICKWORK

PAINTED TIMBER JOINERY



REAR (SOUTH) ELEVATION - FACING RIVER



SIDE (WEST) ELEVATION

REV	COMMENTS	DATE

SHAUN·TANNER
ARCHITECTURE & PLANNING
www.stlarchitecture.co.uk studio@stlarchitecture.co.uk 0118 989 0808

CLIENT Mr R. Arnold

PROJECT Warren Creek, The Warren
Caversham, Reading, RG4 7TQ

DRAWING Proposed Elevations

STATUS Planning DATE Apr 2021

SCALE 1:100 DRAWN ST CHECKED NO 3863/225 REV F

THIS DRAWING MUST NOT BE SCALED UNLESS ISSUED FOR PLANNING PURPOSES. ALL DIMENSIONS ARE TO BE VERIFIED PRIOR TO SETTING OUT, COMMENCING WORK, OR PRODUCTION OF FABRICATION DRAWINGS. REPORT ANY DISCREPANCIES TO THE SUPERVISING OFFICER IMMEDIATELY. ©

EXISTING GAVEL PATHWAY

FE CBF 1.8m

GAVEL DRIVE

NO CHANGES TO EXISTING SITE LEVELS

AREA OF NEW BRICKWORK : 3.2 M2

TIMBER SHED

CREEK

BRIDGE

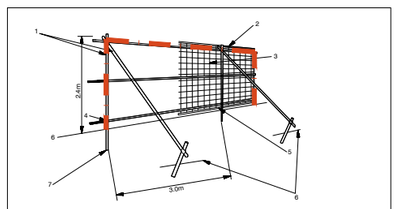
LAWN

AREA OF NEW STILTS :

SLIPWAY

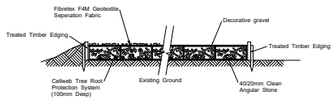
Tree Protection Fencing

Provide tubular scaffold framed fencing where shown, being 2.4m in height and faced with with weldmesh. All in accordance with BS 5837: 2012.



1. Standard scaffold poles
2. Uprights to be driven into the ground
3. Weldmesh wired to the uprights and horizontals
4. Standard clamps
5. Wire twisted and secured on inside face of fencing to avoid easy dismantling
6. Ground level
7. Approximately 0.6m driven into the ground

Appendix 1 - Protective Barrier



Cellweb Section - Tree Root Protection c/w Gravel Surface

Appendix 2 - Typical details of no-dig construction

Existing Hedge

Proposed Native Hedge

Proposed Trees

Existing trees/hedges retained

Extent of Gravel Driveway / Pathway

1:200 scale Bar
This Drawing has been produced for printing onto A3 size paper,

0m 1m 2m 4m 8m 16m

REV	COMMENTS	DATE
C	TREES ADDED	16/05/24
B	SUBSTRUCTURE CHANGED TO STILTS	14/04/24

SHAUN•TANNER ARCHITECTURE & PLANNING
www.stlarchitecture.co.uk studio@stlarchitecture.co.uk 0118 989 0808

CLIENT Mr R. Arnold
PROJECT Warren Creek, The Warren
Caversham, Reading, RG4 7TQ
DRAWING Walls above extg grnd supporting raised ground floor slab

STATUS Planning DATE May 2023
SCALE 1:200 DRAWN ST CHECKED NO 3863/226 REV C

THIS DRAWING MUST NOT BE SCALED UNLESS ISSUED FOR PLANNING PURPOSES. ALL DIMENSIONS ARE TO BE VERIFIED PRIOR TO SETTING OUT, COMMENCING WORK, OR PRODUCTION OF FABRICATION DRAWINGS. REPORT ANY DISCREPANCIES TO THE SUPERVISING OFFICER IMMEDIATELY. ©



Tree Protection Fence
Refer to Arboricultural Report and Tree Protection Plan by **Duckworths Arboriculture**

COLOUR KEY/SPECS

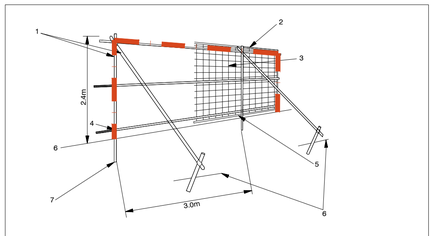
NEW NATIVE SCRUB PLANTING	NEW WILDFLOWER MEADOW
Planting of desirable species only including: • Dog Rose (15%) • Dogwood (10%) • Blackthorn (20%) • Hawthorn (20%) • Hazel (10%) • Holly (10%) • Guelder Rose (15%) Planting should take place between November and March.The planting pattern should include a mix of species planted close together, with some areas left open to create natural openings. Wood chip/mulch should be placed around each newly planted scrub to prevent weed competition and improve water retention. Upon planting the area will be left for 1 year to allow the new plants to be established before any management is started.	• EM2 - Standard General Purpose Meadow Mixture - mix of wildflower and grass species - beneficial to invertebrates, birds and bats. Seed mix includes cowslip (species specifically mentioned in the Reading Biodiversity Action Plan). • A rate of 4g/m^2 should be used. To cover the combined 176m^2 area of planting proposed in this plan, 0.7kg of seed mix is needed • The following is advised by Emorsgate Seeds: Sowing: Seed is best sown in the autumn or spring but can be sown at other times of the year if there is sufficient warmth and moisture. The seed must be surface sown and can be applied by machine or broadcast by hand. Management: Most sown meadow wildflower and grass species are perennial; they will be slow to germinate and grow and will not usually flower in their first growing season. There will often be a flush of annual weeds from the soil in the first growing season which may grow up and obscure the meadow seedlings beneath. This annual weed growth is easily controlled by topping or mowing. Mow newly sown meadows regularly throughout the first year of establishment to a height of 40-60mm, removing cuttings if dense. In the second and subsequent years EM2 sowings can be managed in a number of ways which, in association with soil fertility, will determine the character of the grassland. The best results are usually obtained by traditional meadow management based around a main summer hay cut in combination with autumn and possibly spring mowing or grazing.

NOTES
Root protection areas (RPA's), enclosed by default temporary protective fencing, as detailed below and to be agreed with the local planning Authority (LPA), shall:

1. Be protected throughout the development process, as specified and detailed in BS 5837:2012 Section 6.2, Fig 2
2. Be erected prior to any construction, demolition or excavation works and remain in place for the duration of the project.
3. Preclude any delivery of site accommodation and or materials and or plant machinery.
4. Preclude all construction related activity, with the sole exception of specified arboricultural works and any other works carried out under supervision that has been agreed by all parties, and:
5. Preclude the storage of all development related materials and substances including fuel, oils, additives, cement and or any other deleterious substances.
6. Any incursions into RPA's must be by prior arrangement, following consultation with the LPA.

Tree Protection Fencing

Provide tubular scaffold framed fencing where shown, being 2.4m in height and faced with with weldmesh. All in accordance with BS 5837: 2012.



1. Standard scaffold poles
2. Uprights to be driven into the ground
3. Weldmesh wired to the uprights and horizontals
4. Standard clamps
5. Wire twisted and secured on inside face of fencing to avoid easy dismantling
6. Ground level
7. Approximately 0.6m driven into the ground

Appendix 1 - Protective Barrier



2FN Schwegler Bat Box



Schwegler 2H Robin Box



1FF Schwegler Bat Box



Schwegler 1SP Sparrow Terrace

FIGURE 1. - Proposed Native Hedge Specification

Bare rooted plant mix hedge species to be 1.2m high planted staggered rows 45cm CTRS using:
Hawthorn (crataegus Monogyna) 90/120cm 2L pots;
Blackthorn (prunus Spinosa) 90/120cm 2L pots;
Hazel (corylus Avellana) 90/120cm 2L pots;
Field maple (sacer Campestre) 90/120cm 2L pots;
Wild cherry (prunus Avium) 90/120cm 2L pots.

Proposed Native Hedge

Proposed Trees

Existing trees/hedges retained

REV	COMMENTS	DATE
E	TREES ADDED	16/05/24
D	NEW TREES ADDED	14-05-24

SHAUN•TANNER ARCHITECTURE & PLANNING
www.stlarchitecture.co.uk studio@stlarchitecture.co.uk 0118 989 0808

CLIENT Mr R. Arnold
PROJECT Warren Creek, The Warren
Caversham, Reading, RG4 7TQ
DRAWING Proposed Landscape and Biodiversity / Tree Protection Site Plan

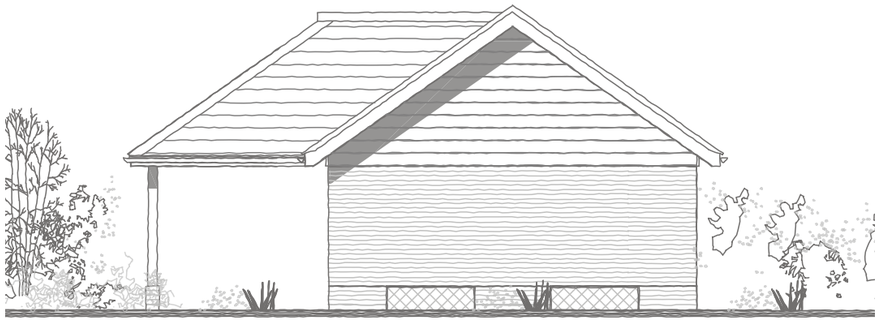
STATUS planning DATE May 2023
SCALE 1:200 DRAWN ST CHECKED NO 3863/227 REV E

1:200 scale Bar
This Drawing has been produced for printing onto A1 size paper,
If printing on A3 please use the scale below for reference.
0m 2m 4m 8m 16m

THIS DRAWING MUST NOT BE SCALED UNLESS ISSUED FOR PLANNING PURPOSES. ALL DIMENSIONS ARE TO BE VERIFIED PRIOR TO SETTING OUT, COMMENCING WORK, OR PRODUCTION OF FABRICATION DRAWINGS. REPORT ANY DISCREPANCIES TO THE SUPERVISING OFFICER IMMEDIATELY. ©

1:100 scale Bar
This Drawing has been produced for printing onto A3 size paper,

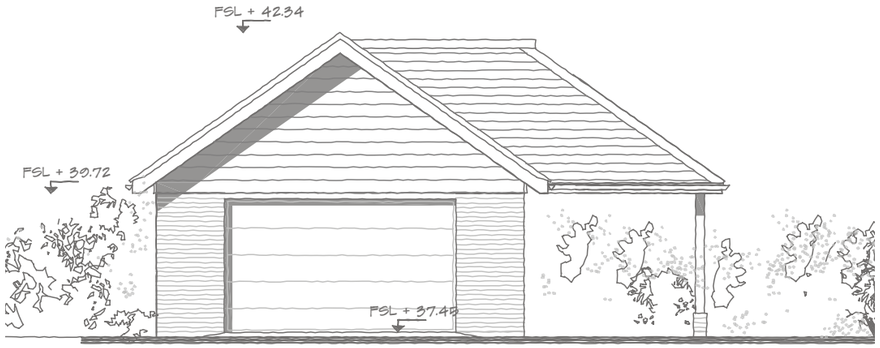
0m 0.5m 1m 2m 4m 8m



REAR ELEVATION



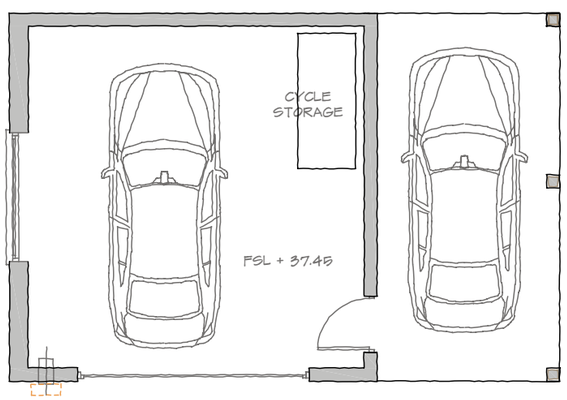
SIDE ELEVATION



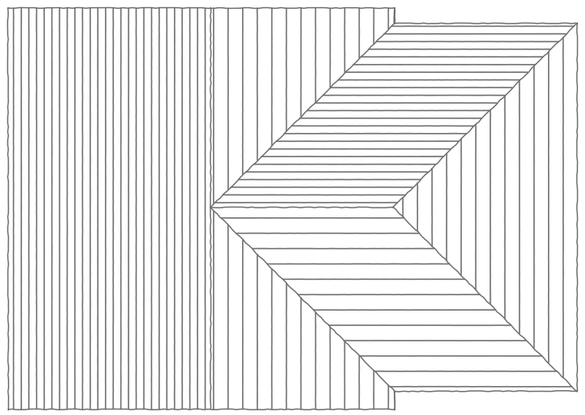
FRONT ELEVATION



SIDE ELEVATION



ELECTRIC CHARGING POINT



ROOF PLAN

REV	COMMENTS	DATE
B	SIZE ALTERED INTERNALY , ECP AND CYCLE STORAGE ADDED	22/04/24

SHAUN·TANNER
ARCHITECTURE & PLANNING
www.stlarchitecture.co.uk studio@stlarchitecture.co.uk 0118 989 0808

CLIENT Mr R. Arnold
PROJECT Warren Creek, The Warren
Caversham, Reading, RG4 7TQ
DRAWING Proposed Garage / Car Port

STATUS Planning DATE Apr 2021
SCALE 1:100 DRAWN ST CHECKED NO 3863/228 REV B

THIS DRAWING MUST NOT BE SCALED UNLESS ISSUED FOR PLANNING PURPOSES. ALL DIMENSIONS ARE TO BE VERIFIED PRIOR TO SETTING OUT, COMMENCING WORK, OR PRODUCTION OF FABRICATION DRAWINGS. REPORT ANY DISCREPANCIES TO THE SUPERVISING OFFICER IMMEDIATELY. ©



KEY

- ROOF AREAS
- PERMEABLE SURFACING
- DECKING AREAS
- EXCEEDANCE ROUTE
- SITE BOUNDARY
- SW PIPE
- SW CHAMBER

REV	DATE	DRAWN	DESCRIPTION	CHECK	APPR.
A	12-06-24	E.D	For Information	SL	SL

PROJECT:
Warren Creek

TITLE:
SuDS Layout and Location Plan

CLIENT:
Mr Rob Arnold

Nimbus
ENGINEERING CONSULTANTS
www.nimbusengineering.co.uk
info@nimbusengineering.co.uk

CHECKED BY:	DATE:	APPROVED BY:	DATE:
S.L	12-06-24	S.L	12-06-24
DRN BY:	SCALE:	DRAWING NUMBER:	REV:
E.D	N.T.S	C3007-01	A
DATE:	SIZE:		
12-06-24	A1		

APPENDIX B – MODELLED FLOOD LEVELS FROM THE ENVIRONMENT AGENCY

Product 4 (Detailed Flood Risk) for Warren Creek, The Warren, Caversham, Reading, RG4 7TQ
Our Ref: THM311206

Product 4 is designed for developers where Flood Risk Standing Advice FRA (Flood Risk Assessment) Guidance Note 3 Applies. This is:

i) "all applications in Flood Zone 3, other than non-domestic extensions less than 250 sq metres; and all domestic extensions", and
ii) "all applications with a site area greater than 1 ha" in Flood Zone 2.

Product 4 includes the following information:

Ordnance Survey 1:25k colour raster base mapping;
Flood Zone 2 and Flood Zone 3;
Relevant model node locations and unique identifiers (for cross referencing to the water levels, depths and flows table);
Model extents showing *defended* scenarios;
FRA site boundary (where a suitable GIS layer is supplied);
Flood defence locations (where available/relevant) and unique identifiers; (supplied separately)
Flood Map flood storage areas (where available/relevant);
Historic flood events outlines (where available/relevant, not the Historic Flood Map) and unique identifiers;

Statutory (Sealed) Main River (where available within map extents);

A table showing:

i) Model node X/Y coordinate locations, unique identifiers, and levels and flows for *defended* scenarios.
ii) Flood defence locations unique identifiers and attributes; (supplied seperately)
iii) Historic flood events outlines unique identifiers and attributes; and
iv) Local flood history data (where available/relevant).

Please note:

If you will be carrying out computer modelling as part of your Flood Risk Assessment, please request our guidance which sets out the requirements and best practice for computer river modelling.

This information is based on that currently available as of the date of this letter. You may feel it is appropriate to contact our office at regular intervals, to check whether any amendments/ improvements have been made. Should you re-contact us after a period of time, please quote the above reference in order to help us deal with your query.

This information is provided subject to the enclosed notice which you should read.

This letter is not a Flood Risk Assessment. The information supplied can be used to form part of your Flood Risk Assessment. Further advice and guidance regarding Flood Risk Assessments can be found on our website at:

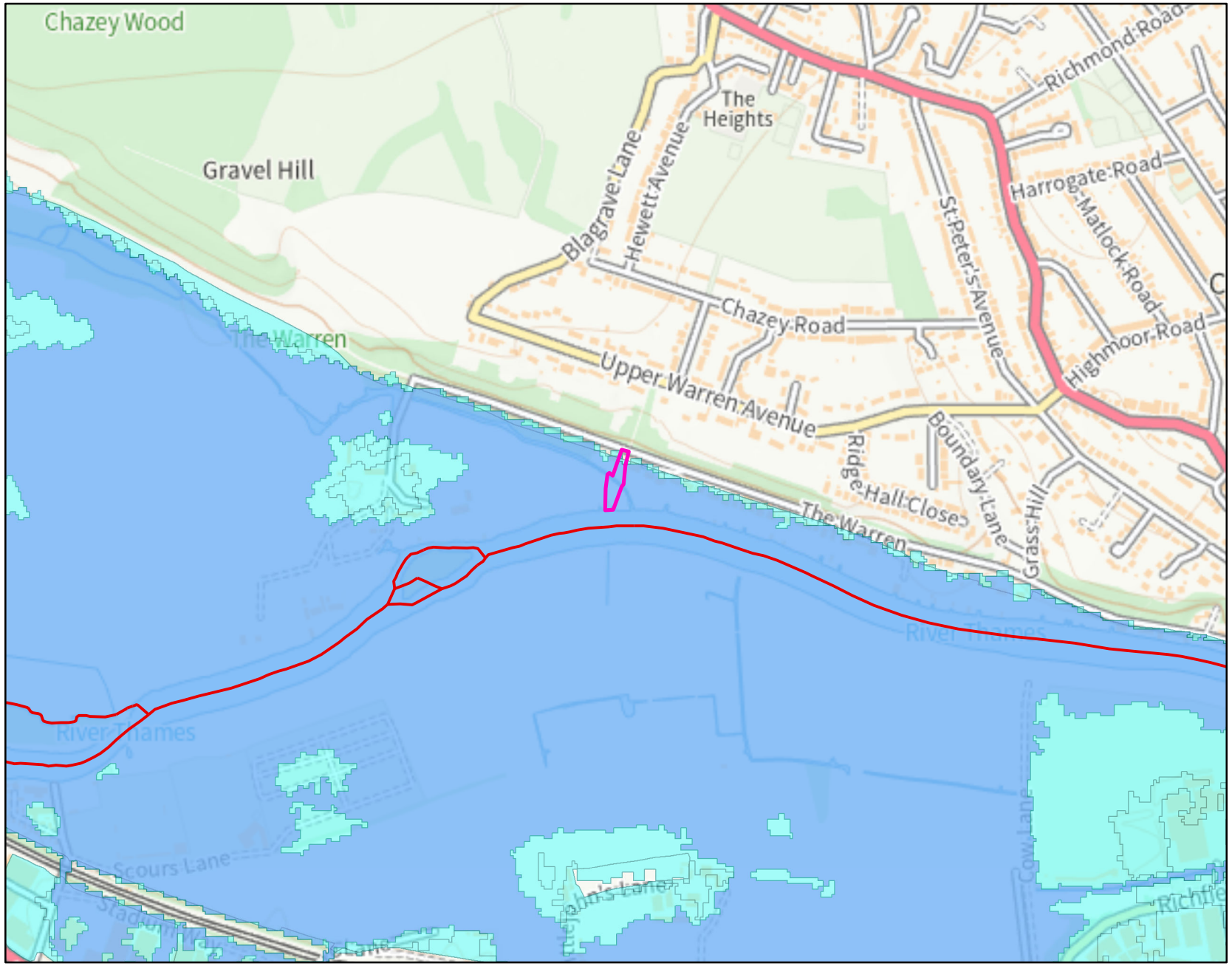
https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities

If you would like advice from us regarding your development proposals you can complete our pre application enquiry form which can be found at:

https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion

Red Kite House, Howbery Park, Wallingford, Oxon OX10 8BD
Customer services line: 08708 506 506
Email: enquiries_THM@environment-agency.gov.uk

Flood Map for Planning centred on Warren Creek, The Warren, Caversham, Reading, RG4 7TQ
Created on 06/06/23 REF: THM311206



Environment Agency

Kilometres

0 0.25 0.5

Legend

- Site Boundary
- Main River
- Flood Map - Flood defences
- Flood Map - Flood Storage Areas
- Flooding from rivers or sea (FZ3)
- Extent of extreme flood (FZ2)

Flooding from rivers or sea without defences (Flood Zone 3) shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

The Extent of an extreme flood (Flood Zone 2) shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

© Environment Agency copyright and / or database rights 2023. All rights reserved. © Crown Copyright and database right. All rights reserved. Environment Agency, 100024198, 2023.
Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Defence information

THM311206

Defence Location:	No defences on Main River
Description:	This location is not currently protected by any formal defences and we do not currently have any flood alleviation works planned for the area. However we continue to maintain certain watercourses and the schedule of these can be found on our internet pages.

© Environment Agency 2021

Model information

THM311206

Model:	Thames (Pangbourne to Sonning) 2019
Description:	The information provided is taken from the Reading and Caversham Flood Alleviation Scheme: Baseline Modelling Report - Final undertaken by Jacobs, dated 07 May 2021. The study was carried out using 1D-2D modelling software (Flood Modeller Pro-TUFLOW). This model study was undertaken as part of the technical studies stage for developing scheme options for the Reading and Caversham Flood Alleviation Scheme: in February 2022 it was announced that this scheme will not go ahead, however the modelling is still viable and can be used internally and externally to inform flood risk. The whole model covers 28 km of the River Thames from Whitchurch Lock to Henley-on-Thames, however the Environment Agency are only using this model up to Sonning: downstream of this location, please refer to the Thames (Sonning to Hurley) 2019 model. Model design runs: 1 in 2 / 50% AEP; 1 in 5 / 20% AEP; 1 in 10 / 10% AEP; 1 in 20 / 5% AEP; 1 in 30 / 3.3% AEP; 1 in 50 / 2% AEP; 1 in 75 / 1.33% AEP; 1 in 100 / 1% AEP; 1 in 100+25% / 1% AEP with 25% climate change; 1 in 100+35% / 1% AEP with 35% climate change; 1 in 100+70% / 1% AEP with 70% climate change; 1 in 200 / 0.5% AEP; and 1 in 1000 / 0.1% AEP. Mapped outputs: 1 in 2 / 50% AEP; 1 in 5 / 20% AEP; 1 in 10 / 10% AEP; 1 in 20 / 5% AEP; 1 in 30 / 3.3% AEP; 1 in 50 / 2% AEP; 1 in 75 / 1.33% AEP; 1 in 100 / 1% AEP; 1 in 100+25% / 1% AEP with 25% climate change; 1 in 100+35% / 1% AEP with 35% climate change; 1 in 100+70% / 1% AEP with 70% climate change; 1 in 200 / 0.5% AEP; and 1 in 1000 / 0.1% AEP.

© Environment Agency 2020

Modelled in-channel flood flows and levels

THM311206

The modelled flood levels and flows for the closest most appropriate model node points for your site that are within the river channel are provided below:

				Flood Levels (mAOD)										
Node label	Model	Easting	Northing	20% AEP	5% AEP	3.3% AEP	1% AEP	1% AEP (+10% increase in flows)	1% AEP (+15% increase in flows)	1% AEP (+20% increase in flows)	1% AEP (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
061_00_2019_36.08	Thames (Pangbourne to Sonning) 2019	468914	174783	37.90	38.30	38.40	38.71				39.07	39.20	39.59	39.30
061_00_2019_36.079	Thames (Pangbourne to Sonning) 2019	469052	174835	37.85	38.26	38.36	38.68				39.05	39.18	39.57	39.28
061_00_2019_36.071	Thames (Pangbourne to Sonning) 2019	469179	174939	37.75	38.17	38.29	38.62				39.01	39.14	39.54	39.24
061_00_2019_36.071A	Thames (Pangbourne to Sonning) 2019	469333	175011	37.70	38.12	38.24	38.59				38.99	39.12	39.52	39.23
061_00_2019_36.071AIn1	Thames (Pangbourne to Sonning) 2019	469620	175062	37.67	38.10	38.22	38.57				38.96	39.10	39.51	39.20
061_00_2019_36.06	Thames (Pangbourne to Sonning) 2019	469865	175003	37.61	38.06	38.18	38.54				38.94	39.07	39.47	39.18
061_00_2019_36.060In1	Thames (Pangbourne to Sonning) 2019	470134	174893	37.56	38.01	38.13	38.50				38.90	39.04	39.45	39.15

				Flood Flows (m3/s)										
Node label	Model	Easting	Northing	20% AEP	5% AEP	3.3% AEP	1% AEP	1% AEP (+10% increase in flows)	1% AEP (+15% increase in flows)	1% AEP (+20% increase in flows)	1% AEP (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
061_00_2019_36.08	Thames (Pangbourne to Sonning) 2019	468914	174783	213.57	252.68	259.98	273.61				278.75	278.96	293.00	279.10
061_00_2019_36.079	Thames (Pangbourne to Sonning) 2019	469052	174835	215.25	249.22	256.63	265.50				270.33	271.77	287.68	273.86
061_00_2019_36.071	Thames (Pangbourne to Sonning) 2019	469179	174939	216.29	244.76	250.22	256.85				259.38	260.96	274.54	262.47
061_00_2019_36.071A	Thames (Pangbourne to Sonning) 2019	469333	175011	215.58	247.73	251.61	255.34				255.67	257.34	271.12	258.93
061_00_2019_36.071AIn1	Thames (Pangbourne to Sonning) 2019	469620	175062	212.81	245.64	248.93	257.61				268.77	273.16	293.24	276.92
061_00_2019_36.06	Thames (Pangbourne to Sonning) 2019	469865	175003	212.75	238.54	243.06	259.79				276.95	283.36	308.80	288.66
061_00_2019_36.060In1	Thames (Pangbourne to Sonning) 2019	470134	174893	213.23	240.40	245.72	263.08				278.85	284.68	308.69	289.59

Note:

Due to changes in guidance on the allowances for climate change, the percentage increase in river flows above should no longer to be used for development design purposes. The data included in this Product can be used for interpolation of levels as part of an intermediate level assessment.

For further advice on the new allowances please visit
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

© Environment Agency 2021

Modelled floodplain flood levels

THM311206

The modelled flood levels for the closest most appropriate model grid cells for your site are provided below:

				flood levels (mAOD)										
2D grid cell reference	Model	Easting	Northing	20% AEP	5% AEP	3.3 AEP	1% AEP	1% AEP (+10% increase in flows)	1% AEP (+15% increase in flows)	1% AEP (+20% increase in flows)	1% AEP (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
Flood Point 1	Thames (Pangbourne to Sonning) 2019	469576	175109	37.65	38.09	38.22	38.59				39.00	39.13	39.52	39,23
Flood Point 2	Thames (Pangbourne to Sonning) 2019	469593	175163	37.65	38.09	38.22	38.59				38.99	39.13	39.52	39.23
Flood Point 3	Thames (Pangbourne to Sonning) 2019	469484	175144	37.67	38.10	38.22	38.60				39.00	39.14	39.53	39.24
Flood Point 4	Thames (Pangbourne to Sonning) 2019	469662	175126	37.65	38.08	38.21	38.59				38.99	39.13	39.51	39.22
Flood Point 5	Thames (Pangbourne to Sonning) 2019	469546	174978	37.66	38.09	38.22	38.59				39.00	39.13	39.52	39.23

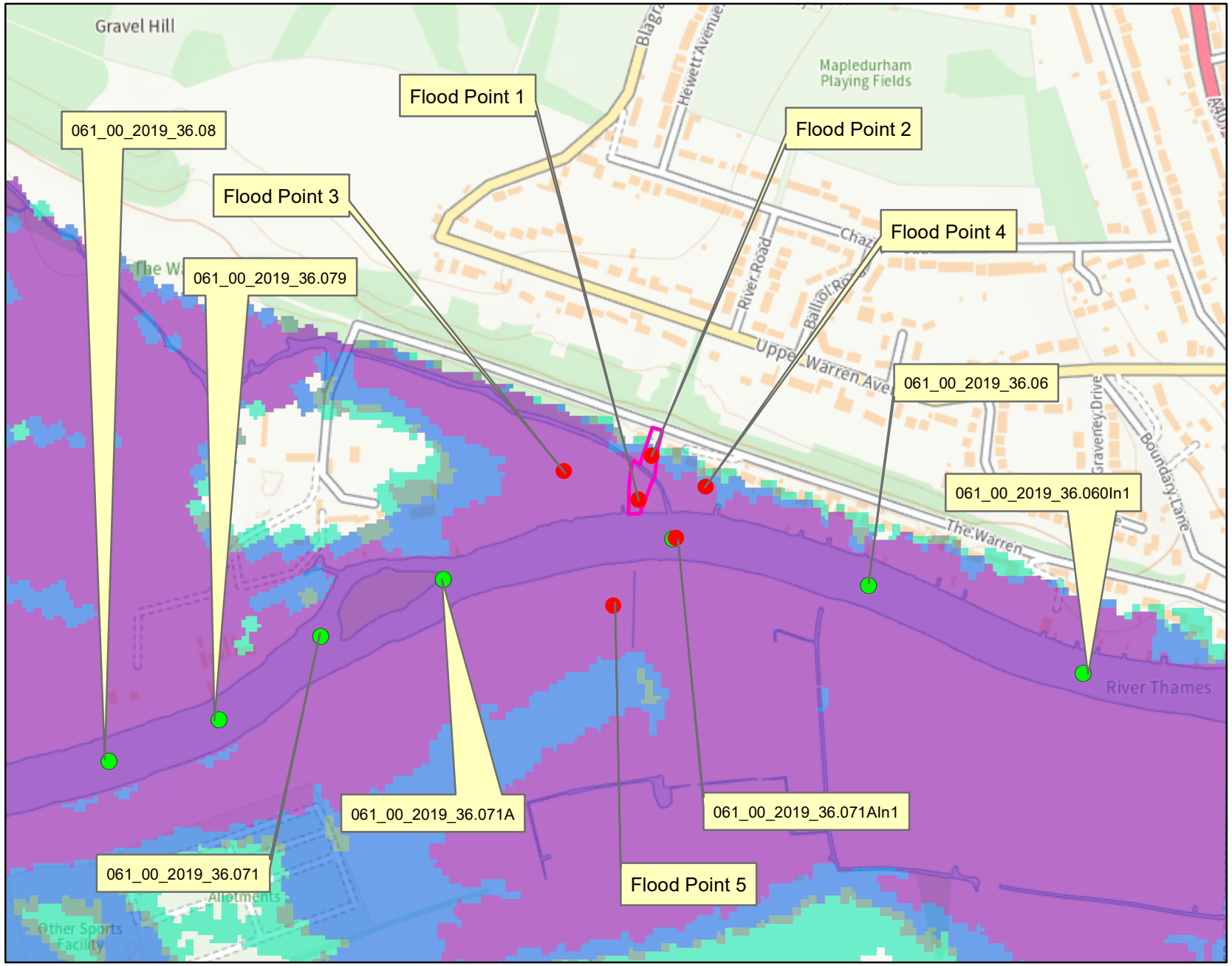
This flood model has represented the floodplain as a grid.
The flood water levels have been calculated for each grid cell.

Note:
Due to changes in guidance on the allowances for climate change, the percentage increase in river flows above should no longer to be used for development design purposes. The data included in this Product can be used for interpolation of levels as part of an intermediate level assessment.

For further advice on the new allowances please visit
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

© Environment Agency 2021

Detailed FRA Map #1 centred on Warren Creek, The Warren, Caversham, Reading, RG4 7TQ
Created on 06/06/23 REF: THM311206



Environment Agency

Kilometres

0 0.15 0.3

Legend

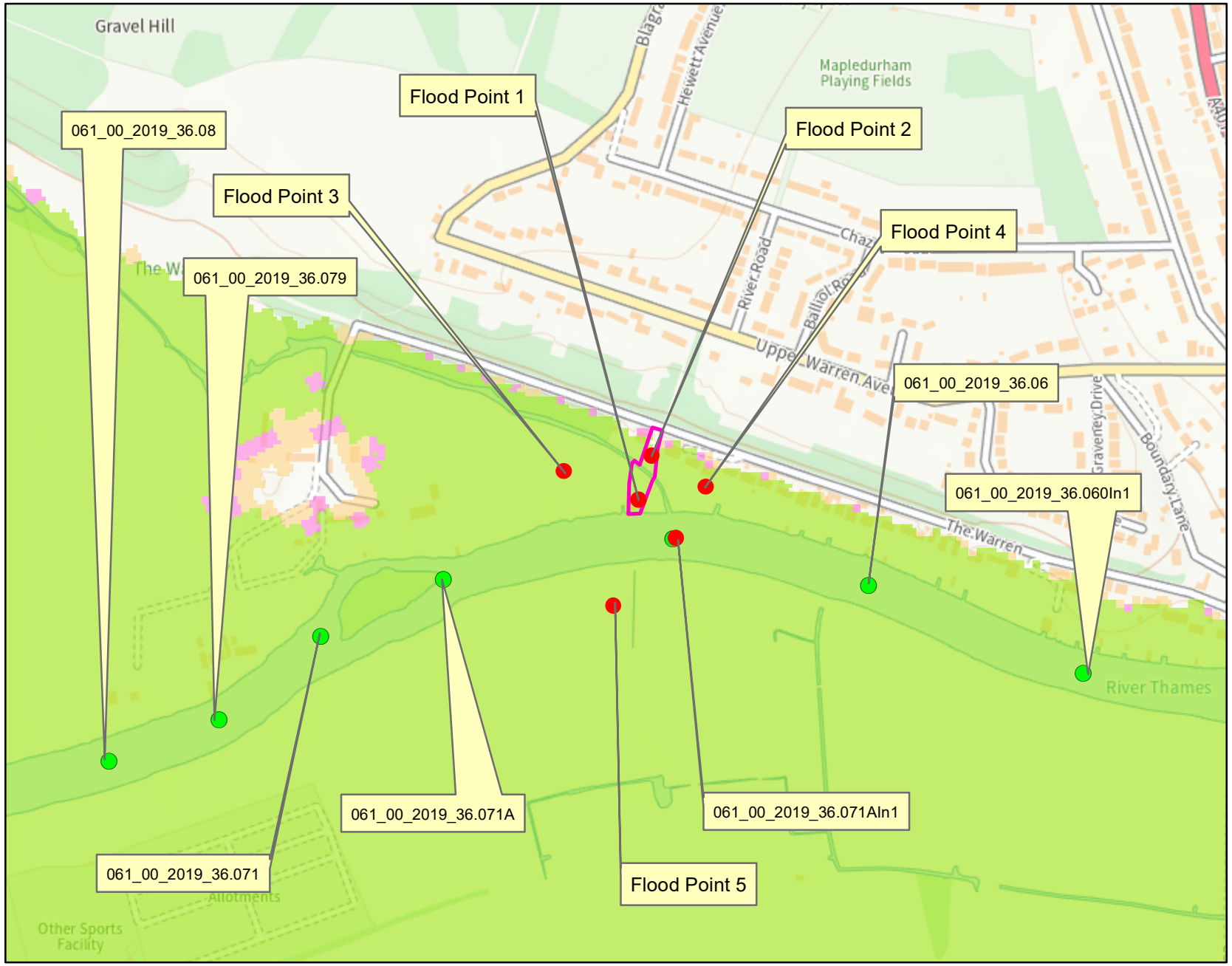
- Site Boundary
- Model Nodes
- 20% AEP Flood Outline
- 5% AEP Flood Outline
- 3.3% AEP Flood Outline
- 1% AEP Flood Outline
- Floodplain Node

AEP = Annual Exceedance Probability
The probability of a flood of a particular magnitude, or greater, occuring in any given year

Where available climate change extents have been calculated with an additional flow added to an AEP event. An example of how this is written is 1%+20% AEP.

© Environment Agency copyright and / or database rights 2023. All rights reserved. © Crown Copyright and database right. All rights reserved. Environment Agency, 100024198, 2023.
Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Detailed FRA Map #2 centred on Warren Creek, The Warren, Caversham, Reading, RG4 7TQ
Created on 06/06/23 REF: THM311206



Environment Agency

Kilometres

0 0.15 0.3

Legend

- Site Boundary
- Model Nodes
- 1%+25% CC AEP Flood Outline
- 1%+35% CC AEP Flood Outline
- 1%+70% CC AEP Flood Outline
- 0.1% AEP Flood Outline
- Floodplain Node

AEP = Annual Exceedance Probability
The probability of a flood of a particular magnitude, or greater, occuring in any given year

Where available climate change extents have been calculated with an additional flow added to an AEP event. An example of how this is written is 1%+20% AEP.

© Environment Agency copyright and / or database rights 2023. All rights reserved. © Crown Copyright and database right. All rights reserved. Environment Agency, 100024198, 2023.
Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Historic flood data

THM311206

Our records show that the area of your site has been affected by flooding.
Information on the floods that have affected your site is provided in the table below:

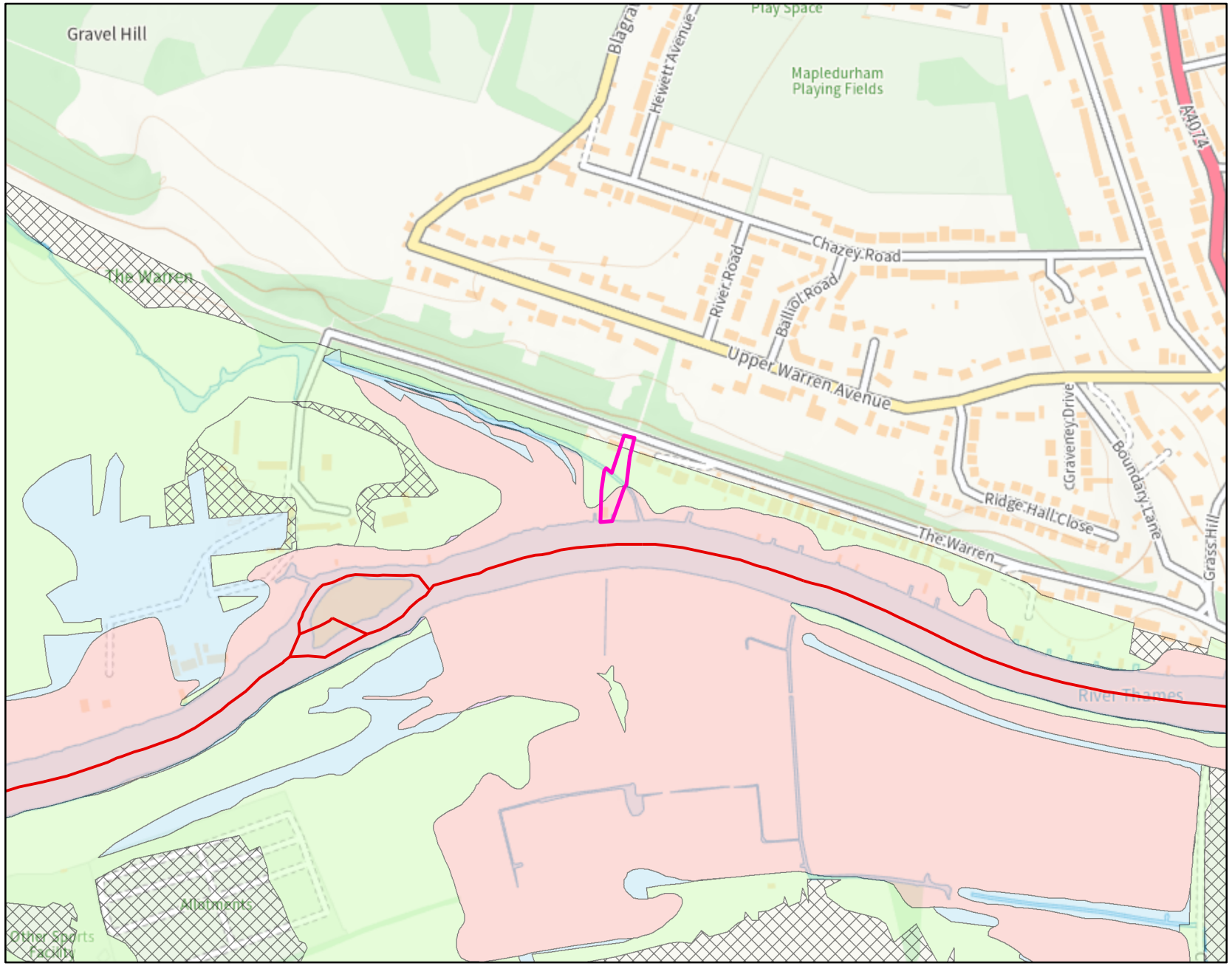
Flood Event Code	Flood Event Name	Start Date	End Date	Source of Flooding	Cause of Flooding
EA0619470300103	06MarchSpring1947	01/01/1947	12/12/1947	main river	channel capacity exceeded (no raised defences)
EA0619770800316	06AugustSummer1977	01/01/1977	12/12/1977	other	local drainage/surface water
EA0620001200982	06DecemberWinter2000	01/01/2000	12/12/2000	main river	channel capacity exceeded (no raised defences)
EA0620030101899	06JanuaryNewYear2003	23/12/2002	12/01/2003	main river	channel capacity exceeded (no raised defences)
ea061231504	Reading_Fluvial Water	19/07/2007	29/07/2007	main river	channel capacity exceeded (no raised defences)

Please note the Environment Agency maps flooding to land not individual properties. Floodplain extents are an indication of the geographical extent of a historic flood. They do not provide information regarding levels of individual properties, nor do they imply that a property has flooded internally.

Start and End Dates shown above may represent a wider range where the exact dates are not available.

© Environment Agency 2021

Historic Flood Map centred on Warren Creek, The Warren, Caversham, Reading, RG4 7TQ
Created on 06/06/23 REF: THM311206



Environment Agency

Kilometres

0 0.15 0.3

Legend

Site Boundary

Main River

Year

1947

1977

2000

2002/3

2007

Flooding from rivers or sea without defences (Flood Zone 3) shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

The Extent of an extreme flood (Flood Zone 2) shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

© Environment Agency copyright and / or database rights 2023. All rights reserved. © Crown Copyright and database right. All rights reserved. Environment Agency, 100024198, 2023.
Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

APPENDIX C – SURFACE WATER RUNOFF CALCULATIONS

Nimbus Engineering Consultants Ltd
www.nimbusengineering.co.uk

Kemp House,
152 City Road,
London, EC1V 2NX
Mob:0772 339 3155
email: info@nimbusengineering.co.uk

Job No.	C3007
Sheet no.	1
Date	17/08/23
By	SL
Checked	
Reviewed	

MasterDrain
HY 10.01

Project: Warren Creek, The Warren, Caversham, RG4 7TQ

Title: Pre & post SW calculations prior to SuDS mitigation

Data:-

Hydrology (FSR):-
Location = READING
Long reference = 472172
M5-60 (mm) = 18
r = 0.40
Hyd. area = 7
Hydrograph = Winter

WRAP = 2
Grid reference = SU7272
SAAR (mm/yr) = 650
Soil =0.30
Hyd. zone = 5
Area = England & Wales

Site values used in design:-

Total site area = 0.2236 ha
Pre-dev area drained = 0.0591 ha
Imperm runoff factor = 100%

Climate change factor = 45%
Post-dev area drained = 0.0447 ha
Perm runoff factor = 20%

Pre-development
Area to soakaways = 0.0000 ha
Perv. area to SUDS = 0.0000 ha

Area to other SUDS = 0.0000 ha
Pre-dev flow to drain = 0.00 l/s

Post-development
Area to soakaways = 0.0000 ha
Perv. area to SUDS = 0.0000 ha

Area to other SUDS = 0.0000 ha
Post-dev flow to drain = 0.00 l/s

Calculations:-

Revised Post-dev Imperm. area = 0.045 ha
Equiv. Post-dev Imperm. area = 0.045 ha
Equiv. Post-dev Perm. area = 0.036 ha
Total Pre-dev equiv. area ha = 0.092 ha
Total Post-dev equiv. area ha = 0.080 ha
100 yr 6 hour mean intensity = 9.53mm/hr

Results:-

Pre-dev peakflow runoff (l/s) (m^3/s)

R.P.	15	30	60	120	240	360	480	600	Max	CCF	Final	R.P.
1	18.0	11.5	7.4	4.6	2.8	2.1	1.7	1.5	18.0	N/A	18.0	1
30	43.4	28.3	17.7	10.7	6.4	4.7	3.7	3.1	43.4	N/A	43.4	30
100	56.2	36.9	23.2	14.1	8.4	6.1	4.8	4.1	56.2	N/A	56.2	100

Post-dev peakflow runoff (l/s)

R.P.	15	30	60	120	240	360	480	600	Max	CCF	Final	R.P.
1	15.7	10.1	6.4	4.0	2.5	1.8	1.5	1.3	15.7	45	22.8	1
30	38.0	24.8	15.5	9.4	5.6	4.1	3.3	2.7	38.0	45	55.1	30
100	49.1	32.3	20.3	12.3	7.3	5.3	4.2	3.6	49.1	45	71.2	100

100 year 6 hour (x Climate Change Factor) storm gives:-
Pre-dev runoff volume m^3 = 52.6m^3
Post-dev rainfall volume = 66.7m^3
Post-dev volume m^3 (excess above SUDS) = 66.7m^3
100 yr 6 hour mean intensity = 9.53mm/hr
Pre-dev volume to drain at 0 l/s = 0.0 m^3
Post-dev volume to drain at 0 l/s = 0.0 m^3
Post-dev storage volume = 66.7m^3
Post-dev 5mm imperm volume = 2.2 m^3
Post-dev 5mm perm volume = 8.9 m^3

$Q_{BAR(rural)}$ = 0.374 l/s or 1.671 l/s/ha or 0.000 cumecs - from IoH 124.

The rainfall rates are calculated using the location specific values above in accordance with the Wallingford procedure.

Nimbus Engineering Consultants Ltd
www.nimbusengineering.co.uk

Kemp House,
152 City Road,
London, EC1V 2NX
Mob:0772 339 3155
email: info@nimbusengineering.co.uk

MasterDrain
HY 10.01

Job No. C3007			
Sheet no. 2			
Date 17/08/23			
Project Warren Creek, The Warren, Caversham, RG4 7TQ	By SL	Checked	Reviewed
Title Pre & post SW calculations prior to SuDS mitigation			

Data summary.

Use the data below for the SUR1 form

Site areas:-

Total site area =	0.2236 ha ;2236.0 m²	[3A]
Pre-development impermeable area =	0.0591 ha	[3B]
Pre-development permeable area =	0.1645 ha	
Post-development impermeable area =	0.0447 ha	[3C]
Post-development permeable area =	0.1789 ha	

Peak runoff:-

Pre-development 1 year storm (15min) =	18.0 l/s	[6A]
Pre-development 100 year storm (15min) =	56.2 l/s	[6C]
Post-development 1 year storm (15min) =	15.7 l/s	[6B]
Post-development 100 year storm (15min)=	49.13 l/s	[6D]

Greenfield runoff:-

$Q_{BAR(rural)}$ = 0.374 l/s or 1.671 l/s/ha or 0.000 cumecs - from IoH 124.

Climate change factor:-
CCF = 45%

Volumes:-

Pre-development 100 yr/6hr storm [12A]=	76.3m³
Post-development 100 yr/6hr storm (add. volume with no SUDS) [12B]=	66.7m³
Post-development 100 yr/6hr storm (add. volume with SUDS) =	66.7m³
Post-development add. predicted volume (No SUDS) [12C] =	-9.5m³

You may also require
Data relating to the infiltration test calculations (if applicable)
Evidence to show runoff reduction (if applicable)
Information on calculation methods (if applicable see next sheet)

Note
Numbers in square brackets relate to the
Nov. 2010 v1.1 / issued 11/02/10 copy of SUR1

Nimbus Engineering Consultants Ltd
www.nimbusengineering.co.uk

Kemp House,
152 City Road,
London, EC1V 2NX
Mob:0772 339 3155
email: info@nimbusengineering.co.uk

MasterDrain
HY 10.01

Job No.	C3007
Sheet no.	3
Date	17/08/23
Project	Warren Creek, The Warren, Caversham, RG4 7TQ
Title	Pre & post SW calculations prior to SuDS mitigation
By	SL
Checked	
Reviewed	

Definitions and methods

Hydrology

The hydrological constants are derived from the Wallingford maps. They are used to calculate location specific rainfall figures.

Site values and factors

Areas of the site should be entered in hectares (10000 m²). If the Pre-development site is a green field, this box is blank.
Climate Change Factor is initially set at 20% - this may be changed as required.
Greenfield runoff is calculated using the method described in IoH 124.
Runoff factors

The impermeable runoff factor is initially set at 98%
The permeable runoff factor is initially set at 20%

Note: the CCF and the runoff factors may be changed by the user to suit the development
The areas draining to soakaways and other SUDS are entered in the appropriate box (in hectares)

Calculations

The post-development area is reduced by subtracting the areas that drain to soakaways or other SUDS, to give a revised figure.
All areas are then multiplied by the appropriate runoff factor to give an equivalent area with 100% runoff.
These are then summated.
This gives a total pre-development equivalent area, and a similar figure for the post-development area.
The 'Post-dev volume to drain (no SUDS)' gives the total runoff to drain if no SUDS were used.

Results

The pre- and post-development areas are subjected to 1,30 and 100 year return period storms with a duration of 15 to 600 minutes.
The Revised Post-dev Imperm. area is the area (in ha) that is not going to SUDS x impervious runoff factor.
The runoff rates are calculated for the chosen hydrograph (Summer or Winter) as l/s. Figures in red indicate m³/s
The peak value is measured, multiplied by the CCF and the total maximum rate is shown.
The pre- and post-development volumes for a 100 year / 6 hour storm are calculated from the area under the hydrograph curve.
Post-dev volume (i.e. excess above SUDS) is that volume produced by the drained area that does not go to SUDS.
Qbar(rural) is calculated in accordance with the procedure laid down in IoH 124

Nimbus Engineering Consultants Ltd
www.nimbusengineering.co.uk

Kemp House,
152 City Road,
London, EC1V 2NX
Mob:0772 339 3155
email: info@nimbusengineering.co.uk

Job No.	C3007
Sheet no.	1
Date	17/08/23

MasterDrain
HY 10.01

Project	Warren Creek, The Warren, Caversham, RG4 7TQ	By	SL
Title	IoH 124 (Qbar(urban))Runoff calcs	Checked	
		Reviewed	

Hydrological Data:-

FSR Hydrology:-

Location = READING
M5-60 (mm) = 18
Soil runoff = 0.30
WRAP = 2
Hydrological area = 7

Grid reference = SU7272
r = 0.40
SAAR (mm/yr) = 650
Area = England & Wales
Hydrological zone = 5

Soil classification for WRAP type 2

i) Very permeable soils with shallow ground water;

ii) Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils; (fragipan - a natural subsurface horizon having a higher bulk density than the solum above. Seemingly cemented when dry but showing moderate to weak brittleness when moist. The layer is low in organic matter, mottled and slowly or very slowly permeable to water. It is found in profiles of either cultivated or virgin soils but not in calcareous material).

iii) Moderately permeable soils, some with slowly permeable subsoils.

Design data:-

Area = 0.002236 Km² - 0.224 Ha - 2236 m² % Urbanisation = 26.40%

Calculation method:-

Runoff is calculated from:-

$$Q_{BAR(urban);} = Q_{BAR(rural)} (1 + URBAN)^{2NC}[1 + URBAN\{(21/CIND) - 0.3\}]$$

where:-

NC varies with the value of SAAR:-
for 500<SAAR<1100 mm then NC = 0.92 - 0.00024SAAR
for 1100<SAAR<3000 mm then NC = 0.74 - 0.000082SAAR

CIND = 102.4SOIL + 0.28(CWI - 125) CWI = Catchment Wetness Index

so

CIND =14.757 CWI =67.989 NC =0.764

For areas less than 50Ha, a modified calculation which multiplies the 50Ha runoff value by the ratio of the site area to 50Ha is used
Reducing factor used for these calculations is 0.004

$Q_{BAR(rural)}$ = 0.374 (l/s)

$Q_{BAR(urban)}$ = 0.693 (l/s)

$Q_{BAR(urban)}$ is then multiplied by a growth factor - GC(T) - for different storm return periods derived from EA publication W5-074/A.

Nimbus Engineering Consultants Ltd
www.nimbusengineering.co.uk

Kemp House,
152 City Road,
London, EC1V 2NX
Mob:0772 339 3155
email: info@nimbusengineering.co.uk

Job No.	C3007
Sheet no.	2
Date	17/08/23
Project	Warren Creek, The Warren, Caversham, RG4 7TQ
Title	IoH 124 (Qbar(urban))Runoff calcs
By	SL
Checked	
Reviewed	

MasterDrain
HY 10.01
Calculated data:-

Mean Annual Peak Flow $Q_{BAR(urban)}$ = 0.69 l/s

Values for $Q_{BAR(urban)}$

Ret. per.	m³/hr	l/s	l/s/ha	Ret. per.	m³/hr	l/s	l/s/ha
1yr	0.001	0.589	2.634	100yr	0.002	2.183	9.762
2yr	0.001	0.610	2.727	100yr+20%	0.003	2.620	11.715
5yr	0.001	0.887	3.967	100yr+30%	0.003	2.838	12.691
10yr	0.001	1.123	5.021	200yr	0.003	2.564	11.467
30yr	0.002	1.546	6.911	200yr + 30%	0.003	3.334	14.907
50yr	0.002	1.816	8.120	500yr	0.003	3.112	13.915
				1000yr	0.004	3.576	15.991

Growth factors -

1yr	2yr	5yr	10yr	30yr	50yr	100yr	200yr	500yr	1000yr
0.85	0.88	1.28	1.62	2.23	2.62	3.15	3.70	4.49	5.16

The above is based on the Institute of Hydrology Report 124 to which you are referred for further details (see Sect 7). Note that the 200 year growth curve was taken from W5-074/A.

For WRAP type 1 soils, CIND can become negative for lower values of SAAR. In this case the CIND value is multiplied by -1 to return a positive value (CIND is very small at this point).

MasterDrain
SW

Nimbus Engineering Consultants Ltd www.nimbusengineering.co.uk	Kemp House, 152 City Road, London, EC1V 2NX Mob:0772 339 3155 email: info@nimbusengineering.co.uk	Job No. C3007 Sheet no. 1 Date 12/06/24	
Project Warren Creek, The Warren, Caversham, RG4 7TQ		By SL	Checked / Reviewed
Title Hydrograph storage calcs with 1 l/s discharge			

Data:-

Location = READING
M5-60 (mm) = 18
Soil index = 0.30
Return period = 100
UCWI = 0.0

Grid reference = SU7272
r = 0.40
SAAR (mm/yr) = 650
WRAP = 2
Climate change = 45%

i) Very permeable soils with shallow ground water;
ii) Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils; The layer is low in organic matter, mottled and (fragipan - a natural subsurface horizon having a higher bulk density than the solum above. Seemingly cemented when dry but showing moderate to weak brittleness when moist. Slowly or very slowly permeable to water. It is found in profiles of either cultivated or virgin soils but not in calcareous material).
iii) Moderately permeable soils, some with slowly permeable subsoils.

Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Available MH storage = 0.0 m³

Percentage runoff = 100.0% (manual setting)

Imperv. area = 447 m²
Total area = 447 m²
Total runoff = 31.7 m³
Storage (m³) = 22.4 m³ (Sum of all balance quantities)
Total rainfall depth = 70.9 mm

Pervious area = 0 m²
Equiv area = 447 m² (Tot. area x % runoff).
Discharge rate = 1.000 l/s

Calculations :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
0.030	20.0	4.7	0.063	0.108	0.000	0.000
0.060	20.0	4.7	0.063	0.108	0.000	0.000
0.090	21.0	5.0	0.067	0.108	0.000	0.000
0.120	21.0	5.0	0.067	0.108	0.000	0.000
0.150	22.0	5.2	0.070	0.108	0.000	0.000
0.180	23.0	5.4	0.073	0.108	0.000	0.000
0.210	24.0	5.7	0.076	0.108	0.000	0.000
0.240	26.0	6.1	0.082	0.108	0.000	0.000
0.270	27.0	6.4	0.086	0.108	0.000	0.000
0.300	29.0	6.9	0.092	0.108	0.000	0.000
0.330	31.0	7.3	0.098	0.108	0.000	0.000
0.360	32.0	7.6	0.101	0.108	0.000	0.000
0.390	33.0	7.8	0.105	0.108	0.000	0.000
0.420	34.0	8.0	0.108	0.108	0.000	0.000
0.450	36.0	8.5	0.114	0.108	0.006	0.006
0.480	38.0	9.0	0.120	0.108	0.012	0.019
0.510	39.0	9.2	0.124	0.108	0.016	0.034
0.540	40.0	9.5	0.127	0.108	0.019	0.053
0.570	42.0	9.9	0.133	0.108	0.025	0.078
0.600	45.0	10.6	0.143	0.108	0.035	0.113
0.630	49.0	11.6	0.155	0.108	0.047	0.160
0.660	53.0	12.5	0.168	0.108	0.060	0.220
0.690	57.0	13.5	0.181	0.108	0.073	0.293
0.720	62.0	14.7	0.197	0.108	0.089	0.382
0.750	66.0	15.6	0.209	0.108	0.101	0.483
0.780	71.0	16.8	0.225	0.108	0.117	0.600
0.810	77.0	18.2	0.244	0.108	0.136	0.736
0.840	84.0	19.9	0.266	0.108	0.158	0.895
0.870	91.0	21.5	0.289	0.108	0.181	1.075
0.900	98.0	23.2	0.311	0.108	0.203	1.278
0.930	105.0	24.8	0.333	0.108	0.225	1.503
0.960	114.0	27.0	0.361	0.108	0.253	1.756
0.990	125.0	29.6	0.396	0.108	0.288	2.044
1.020	135.0	31.9	0.428	0.108	0.320	2.365
1.050	143.0	33.8	0.453	0.108	0.345	2.710
1.080	154.0	36.4	0.488	0.108	0.380	3.090
1.110	164.0	38.8	0.520	0.108	0.412	3.502
1.140	173.0	40.9	0.549	0.108	0.441	3.943
1.170	183.0	43.3	0.580	0.108	0.472	4.415
1.200	194.0	45.9	0.615	0.108	0.507	4.922

Nimbus Engineering Consultants Ltd
www.nimbusengineering.co.uk

Kemp House,
152 City Road,
London, EC1V 2NX
Mob:0772 339 3155
email: info@nimbusengineering.co.uk

MasterDrain SW

Job No.	C3007
Sheet no.	2
Date	12/06/24
Project	Warren Creek, The Warren, Caversham, RG4 7TQ
Title	Hydrograph storage calcs with 1 l/s discharge
By	SL
Checked	
Reviewed	

Calculations (cont.) :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
1.230	204.0	48.2	0.647	0.108	0.539	5.461
1.260	212.0	50.1	0.672	0.108	0.564	6.025
1.290	219.0	51.8	0.694	0.108	0.586	6.611
1.320	226.0	53.4	0.717	0.108	0.609	7.220
1.350	233.0	55.1	0.739	0.108	0.631	7.851
1.380	239.0	56.5	0.758	0.108	0.650	8.500
1.410	244.0	57.7	0.774	0.108	0.666	9.166
1.440	248.0	58.6	0.786	0.108	0.678	9.844
1.470	249.0	58.9	0.789	0.108	0.681	10.526
1.500	250.0	59.1	0.793	0.108	0.685	11.211
1.530	250.0	59.1	0.793	0.108	0.685	11.895
1.560	249.0	58.9	0.789	0.108	0.681	12.577
1.590	248.0	58.6	0.786	0.108	0.678	13.255
1.620	244.0	57.7	0.774	0.108	0.666	13.921
1.650	239.0	56.5	0.758	0.108	0.650	14.570
1.680	233.0	55.1	0.739	0.108	0.631	15.201
1.710	226.0	53.4	0.717	0.108	0.609	15.810
1.740	219.0	51.8	0.694	0.108	0.586	16.396
1.770	212.0	50.1	0.672	0.108	0.564	16.960
1.800	204.0	48.2	0.647	0.108	0.539	17.499
1.830	194.0	45.9	0.615	0.108	0.507	18.006
1.860	183.0	43.3	0.580	0.108	0.472	18.479
1.890	173.0	40.9	0.549	0.108	0.441	18.919
1.920	164.0	38.8	0.520	0.108	0.412	19.331
1.950	154.0	36.4	0.488	0.108	0.380	19.711
1.980	143.0	33.8	0.453	0.108	0.345	20.057
2.010	135.0	31.9	0.428	0.108	0.320	20.377
2.040	125.0	29.6	0.396	0.108	0.288	20.665
2.070	114.0	27.0	0.361	0.108	0.253	20.919
2.100	105.0	24.8	0.333	0.108	0.225	21.143
2.130	98.0	23.2	0.311	0.108	0.203	21.346
2.160	91.0	21.5	0.289	0.108	0.181	21.527
2.190	84.0	19.9	0.266	0.108	0.158	21.685
2.220	77.0	18.2	0.244	0.108	0.136	21.821
2.250	71.0	16.8	0.225	0.108	0.117	21.938
2.280	66.0	15.6	0.209	0.108	0.101	22.040
2.310	62.0	14.7	0.197	0.108	0.089	22.128
2.340	57.0	13.5	0.181	0.108	0.073	22.201
2.370	53.0	12.5	0.168	0.108	0.060	22.261
2.400	49.0	11.6	0.155	0.108	0.047	22.308
2.430	45.0	10.6	0.143	0.108	0.035	22.343
2.460	42.0	9.9	0.133	0.108	0.025	22.368
2.490	40.0	9.5	0.127	0.108	0.019	22.387
2.520	39.0	9.2	0.124	0.108	0.016	22.403
2.550	38.0	9.0	0.120	0.108	0.012	22.415
2.580	36.0	8.5	0.114	0.108	0.006	22.421
2.610	34.0	8.0	0.108	0.108	0.000	22.421
2.640	33.0	7.8	0.105	0.108	0.000	22.418
2.670	32.0	7.6	0.101	0.108	0.000	22.411
2.700	31.0	7.3	0.098	0.108	0.000	22.401
2.730	29.0	6.9	0.092	0.108	0.000	22.385
2.760	27.0	6.4	0.086	0.108	0.000	22.363
2.790	26.0	6.1	0.082	0.108	0.000	22.337
2.820	24.0	5.7	0.076	0.108	0.000	22.305
2.850	23.0	5.4	0.073	0.108	0.000	22.270
2.880	22.0	5.2	0.070	0.108	0.000	22.232
2.910	21.0	5.0	0.067	0.108	0.000	22.191
2.940	21.0	5.0	0.067	0.108	0.000	22.149
2.970	20.0	4.7	0.063	0.108	0.000	22.105
3.000	20.0	4.7	0.063	0.108	0.000	22.060

Storage volume (m^3) = 22.4 m^3 (Sum of all balance quantities)

Nimbus Engineering Consultants Ltd
www.nimbusengineering.co.uk

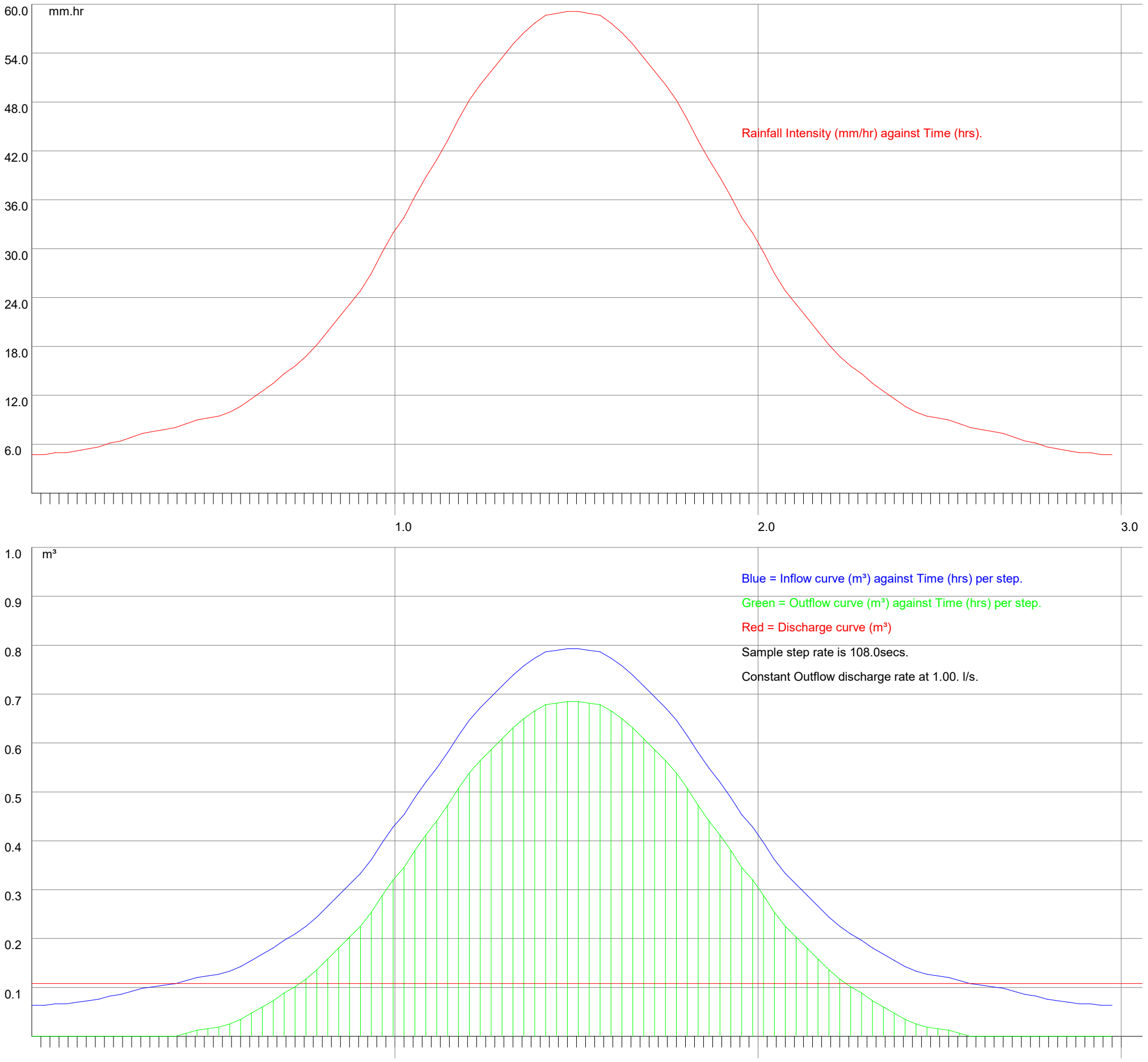
Kemp House,
152 City Road,
London, EC1V 2NX
Mob:0772 339 3155
email: info@nimbusengineering.co.uk

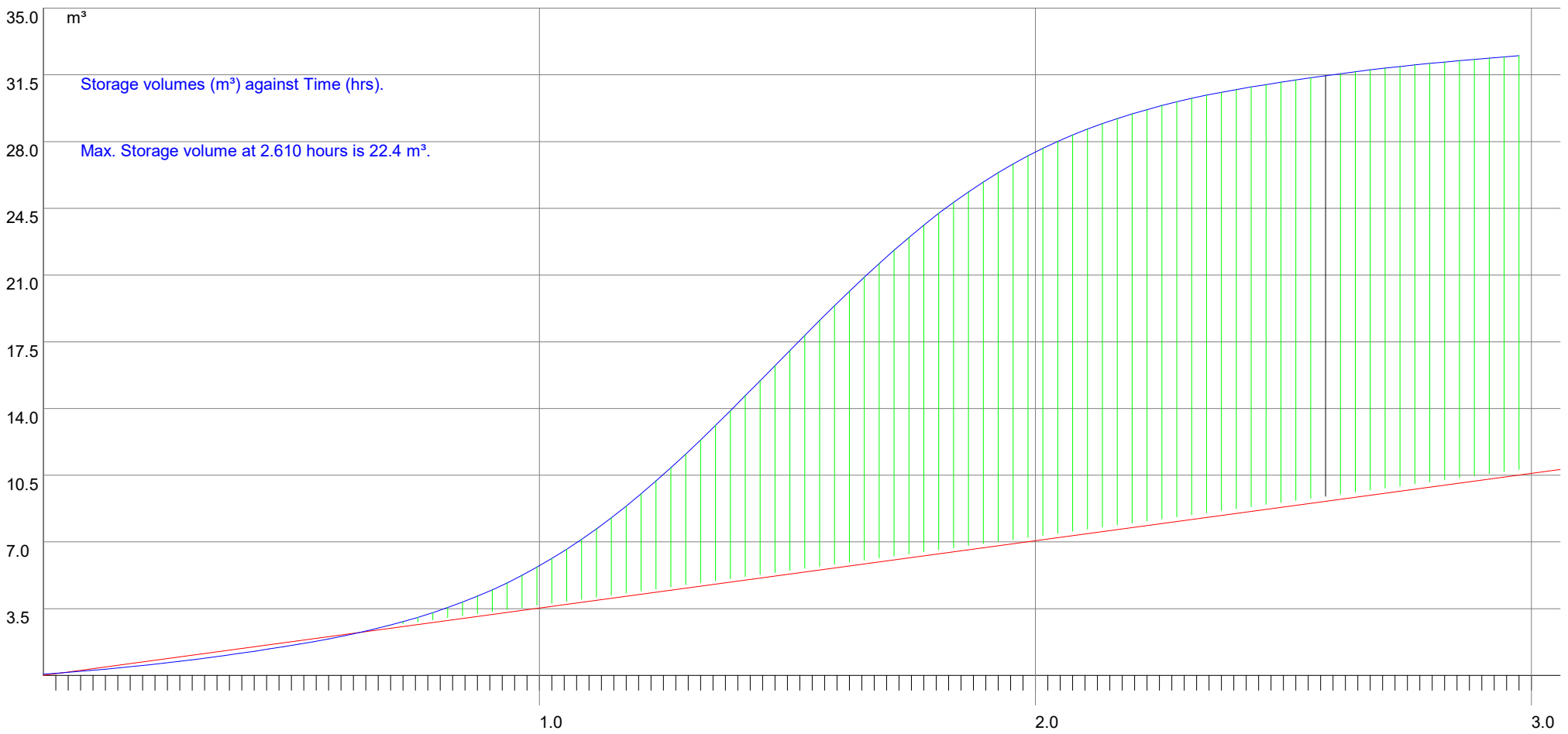
MasterDrain SW

Job No.	C3007
Sheet no.	3
Date	12/06/24
By	SL
Checked	
Reviewed	

Project: **Warren Creek, The Warren, Caversham, RG4 7TQ**

Title: **Hydrograph storage calcs with 1 l/s discharge**





Nimbus Engineering Consultants Ltd
www.nimbusengineering.co.uk

Kemp House,
152 City Road,
London, EC1V 2NX
Mob:0772 339 3155
email: info@nimbusengineering.co.uk

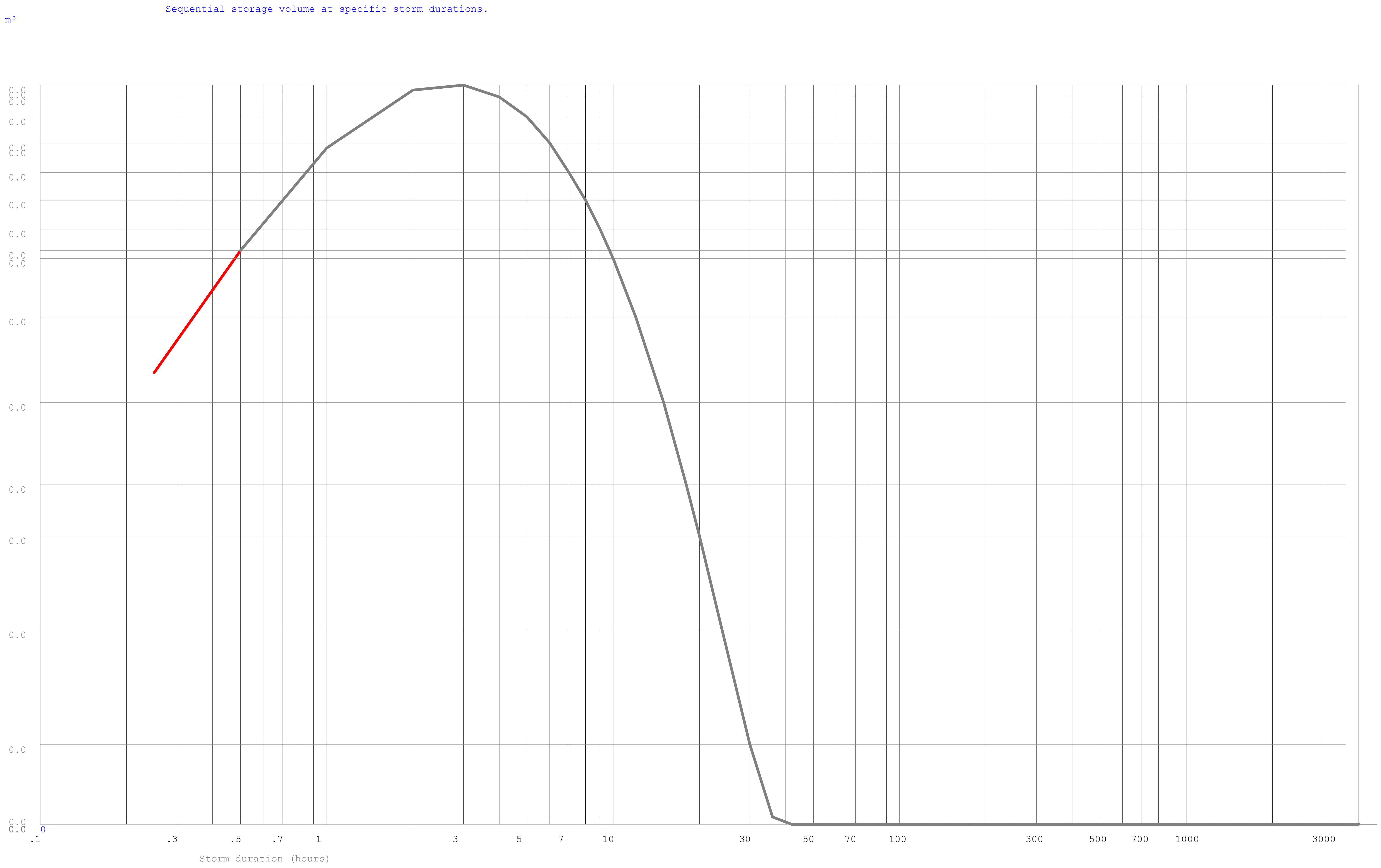
MasterDrain SW

Job No.	C3007
Sheet no.	4
Date	12/06/24
Project	Warren Creek, The Warren, Caversham, RG4 7TQ
Title	Hydrograph storage calcs with 1 l/s discharge
By	SL
Checked	
Reviewed	

Maximum storage volumes for varying duration storms.

Storm length (hrs)	Max. Vol (m^3)	Max. Vol time	Mean intens (mm/hr)	Step time. (mins)	Peak found
0.25	13.70	0.25	127.47	0.2	
0.5	17.40	0.50	83.83	0.3	
1	20.51	1.00	52.63	0.6	
2	22.27	2.00	32.00	1.2	
3	22.42	3.00	23.64	1.8	Peak found
4	22.06	---	18.98	2.4	
5	21.46	---	15.95	3.0	
6	20.67	---	13.82	3.6	
7	19.77	---	12.21	4.2	
8	18.93	---	11.00	4.8	
9	18.06	---	10.02	5.4	
10	17.16	---	9.22	6.0	
12	15.38	---	7.98	7.2	
15	12.80	---	6.69	9.0	
18	10.30	---	5.78	10.8	
20	8.75	---	5.32	12.0	
24	5.90	---	4.60	14.4	
30	2.42	---	3.84	18.0	
36	0.22	---	3.32	21.6	
42	0.00	---	2.93	25.2	
48	0.00	---	2.63	28.8	
54	0.00	---	2.40	32.4	
60	0.00	---	2.20	36.0	
66	0.00	---	2.04	39.6	
72	0.00	---	1.90	43.2	
84	0.00	---	1.67	50.4	
96	0.00	---	1.50	57.6	
120	0.00	---	1.25	72.0	
150	0.00	---	1.04	90.0	
175	0.00	---	0.92	105.0	
200	0.00	---	0.82	120.0	
250	0.00	---	0.69	150.0	
300	0.00	---	0.59	180.0	
375	0.00	---	0.49	225.0	
500	0.00	---	0.39	300.0	
750	0.00	---	0.28	450.0	
1000	0.00	---	0.22	600.0	
1250	0.00	---	0.18	750.0	
1500	0.00	---	0.16	900.0	
1570	0.00	---	0.15	942.0	
2000	0.00	---	0.13	1200.0	
2500	0.00	---	0.11	1500.0	
3000	0.00	---	0.09	1800.0	
3500	0.00	---	0.08	2100.0	
4000	0.00	---	0.07	2400.0	

Kemp House,
152 City Road,
London, EC1V 2NX
Mob:0772 339 3155
email: info@nimbusengineering.co.uk



MasterDrain SW

Nimbus Engineering Consultants Ltd
www.nimbusengineering.co.uk

Kemp House,
152 City Road,
London, EC1V 2NX
Mob:0772 339 3155
email: info@nimbusengineering.co.uk

Job No. C3007			
Sheet no. 6			
Date 12/06/24			
Project **Warren Creek, The Warren, Caversham, RG4 7TQ**	By SL	Checked	Reviewed
Title **Hydrograph storage calcs with 1 l/s discharge**			

Explanatory notes for Peak Flow Storage

1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
2) The balance is calculated from the inflow minus the outflow.
3) The storage volume is the maximum value of the balance curve.
4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
5) References to 'storm duration' relate only to the hydrograph method (qv).
6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

1) The user has the choice of Summer or Winter curves
2) The mean intensity varies with the duration of the storm curve
3) There are always 120 steps in the calculation process, irrespective of storm duration.
4) The balance is calculated from the inflow minus the outflow.
5) The storage volume is the sum of the balance values for each step.
6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function.
Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.