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

DOCUMENT NUMBER: C3429-R1-REV-D

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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 following this application. 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.

Four 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
- Flood storage compensation has been provided, as shown on drawing number C3429-04, in Appendix C
- 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, we have used a 43% allowance for climate change, as per the response from the Environment Agency's. The results of this are provided in Appendix B.

This will address the increasing flood risk and remove the current safety to life issue.

The proposed dwelling will be raised up to the modelled flood level of 39.200m AOD, with the 43% allowance for climate change, plus 300mm.

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

1.3 Geology of The Area

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

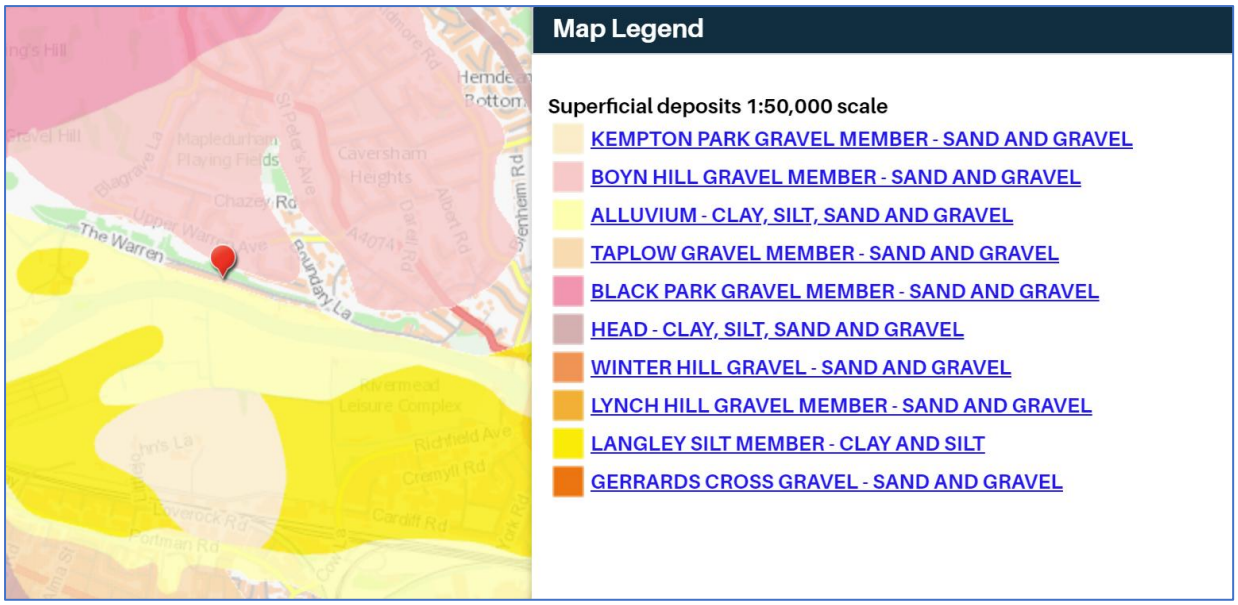


Figure 2 - Superficial Deposits at the site. (Source: British Geological Survey website (contains British Geological Survey materials © NERC2025).

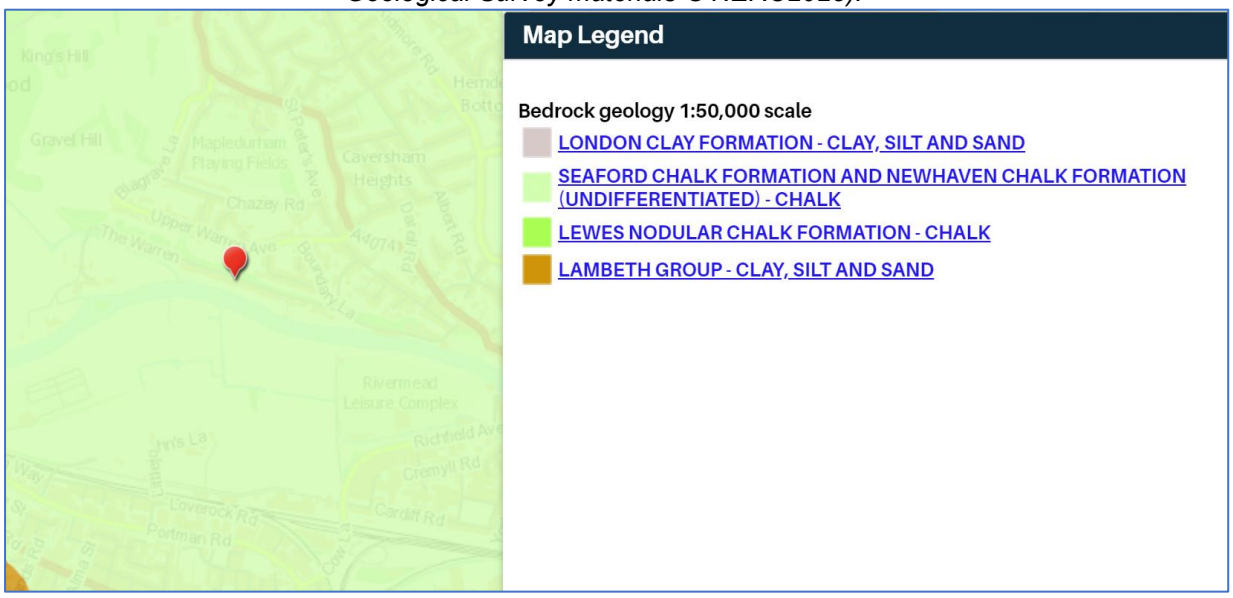


Figure 3 - Bedrock at the site. (Source: British Geological Society Website (contains British Geological Survey materials © NERC2025).

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 developments 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, November 2024.

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.

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 43% climate change event of 39.200mAOD. Therefore, the client has proposed the finished floor level of the proposed replacement dwelling to be raised 300mm above this flood level, to 39.500mAOD. Whilst stairs are provided, these will be slatted and not obstruct and flood flow routes.

A planning application for a permitted development for the existing house extensions has been approved, and therefore flood storage compensation has been provided by removing existing buildings at the site, including these extensions, as shown on drawing number C3429-04, in Appendix A. By removal of these buildings, and not including the mesh stairs, there is an overall gain of 6.59m^3. Excavation of the proposed floodplain compensation scheme will be completed prior to the construction of development to ensure floodplain capacity is maintained.

The fabric of the building will be safe, as well as there will be no risk of flooding to the proposed dwelling and no risk to life due to a safe access route provided.

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, the walls, brick plinths and slatted stairs, below the 1 in 100 year plus 43% climate change flood level will be formed of flood resistant material. There will be no issues with access and egress to the building during an extreme flooding event, as

the client has proposed a mesh bridge to the front of the site, where the ground levels are approximately 39.000mAOD, and therefore nominal flooding.

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.

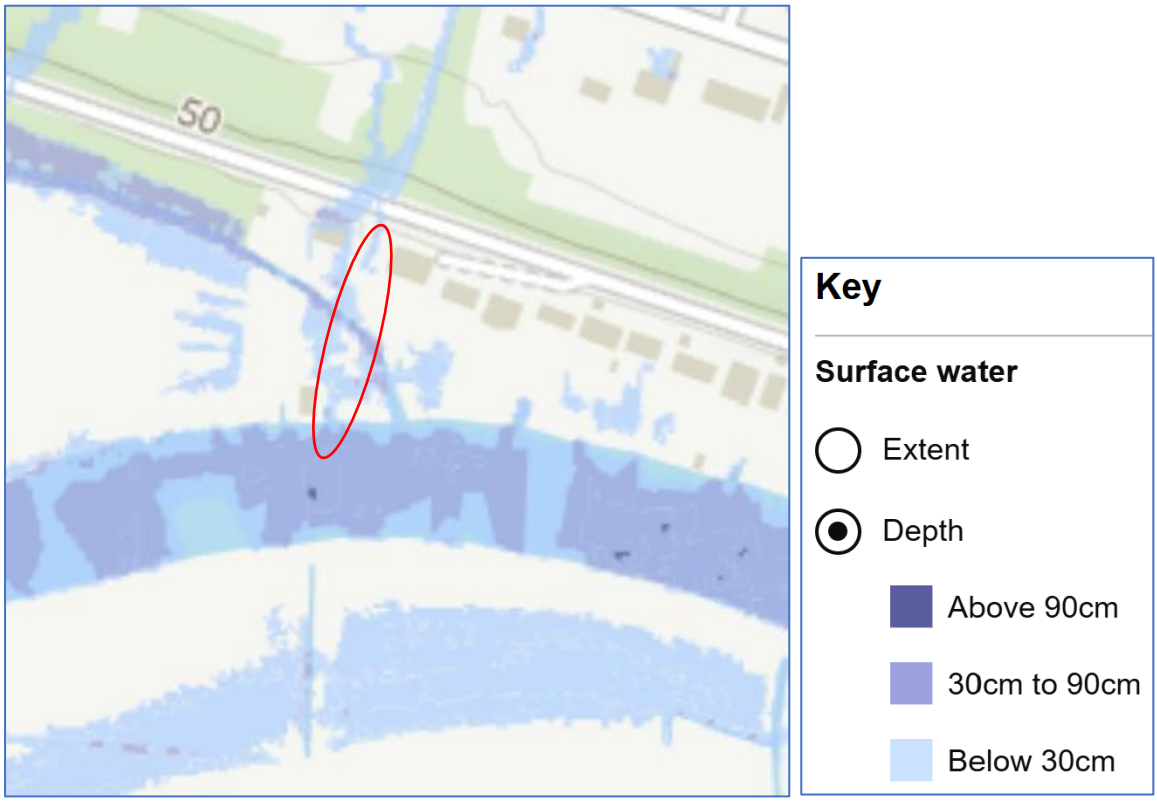


Figure 5 – Environment Agency Surface Water Flood Map for the proposed development.

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 overleaf, 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.

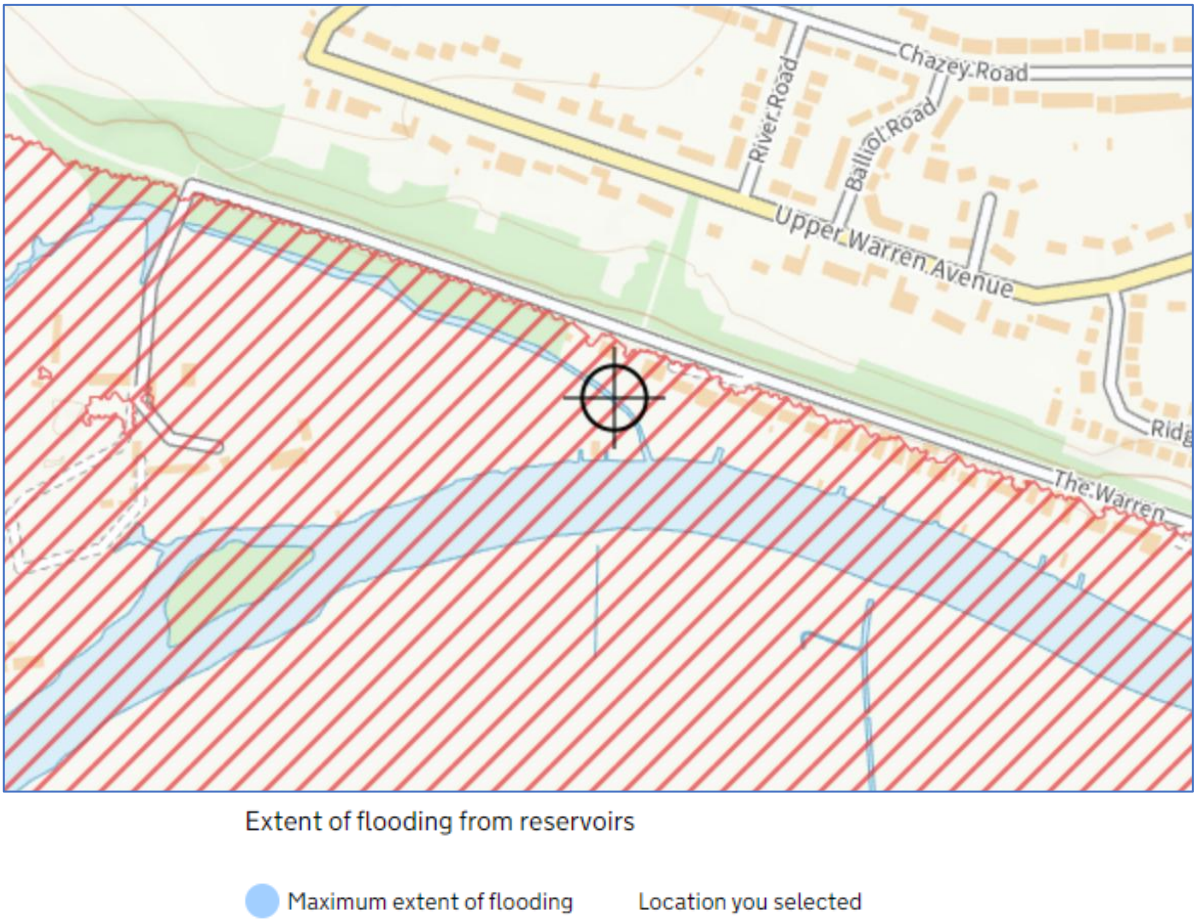


Figure 6 – Environment Agency Flood Map from reservoirs for the proposed development

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 43% event, and the building will be raised on plinths to allow flood water to flow through, including the stairs which will be slatted, therefore there is no obstruction to flood flow routes and flood storage compensation has been provided in addition to this by the removal of existing buildings.

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. However, the client has also proposed a mesh bridge which means the occupants can safely access and egress the site if required.

4.2. Mitigation Measures

The ground floor and the first floor of the building are not at risk of flooding, therefore no mitigation or resilience measures will be required.

4.3. Safe Access and Egress

As discussed, access and egress to the site will be feasible during an extreme fluvial event via a mesh bridge. To further ensure safety, the flood action plan overleaf will be placed visibly in the house for all household members to reference.

FLOOD ACTION PLAN

The house has been designed, built and equipped to keep its occupants safe throughout any flooding event over the next 100 years. Therefore it isn't anticipated that the house will need to be evacuated.

Below is the guidance for ensuring all occupants remain safe

When selling the house

- *Ensure the new owners are aware of the risk of flooding*
- *Provide a copy of this action plan to the new owners*

Annually

- *Ensure all full time residents are signed up to receive Environment Agency's flood warnings on their phone*
- *Review how the situation has changed in the last 12 months and consider if the emergency food and medical supplies should be updated*
- *Review the emergency food and medical supplies, replacing anything with a best-by date of less than 12 months*
- *Check the state of the walkway and complete any repairs*

When water is forecast to breech the banks

- *Assume the household will need to be self-sufficient for 30 days*
- *Procure any final items that the household feel would be useful to have*

- *While it remains safe to do so, relocate any garden and outbuilding items that would require moving or protecting in a severe flood situation.*
- *Verify the walkway is fully ready to be used*

When water is predicted to remain above the river bank and below the level of the mesh walkway

- *Monitor daily flood levels*
- *Monitor weather reports*
- *Consider the situation and decide if some or all member of the household should relocate*

When water rises above the mesh walkway

- *Remain in the house unless there is urgent reasons to do something else or the emergency services advise differently*
- *Should there be a need to exit the property, select someone who is fit and healthy. Exit the house via the walkway. Keep a hand on the rail at all times.*
- *Should anyone need to visit the property, provide a detailed explanation of where the raised wire walkway is and how to traverse it safely*

However, the occupants would be advised to sign up to the Environment Agency's flood warnings 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, where they can use this safe access and egress route via the proposed mesh bridge.

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. RESPONSE TO ENVIRONMENT AGENCY'S COMMENTS REPORT

The following objections were provided by the Environment Agency, therefore we have listed them below with an explanation of how we have addressed these objections in this report.

- **Calculate an appropriate allowance for climate change using those advised in 'Flood risk assessments: climate change allowances'**

We have used the 1 in 100 year plus 43% climate change allowance, as requested by the Environment Agency, as provided in Appendix B.

- **demonstrate that any loss of floodplain storage within the 1% AEP plus an appropriate allowance for climate change can be directly compensated for to prevent an increase in flood risk elsewhere.**

Drawing number C3429-04 in Appendix A, shows the flood storage compensation provided by removal of the existing buildings, including the permitted development extension, which provides a net gain of 6.59m^3.

- **demonstrate that finished floor levels are set above the 1% AEP plus climate change flood level to reduce the risk of flooding to people and property.**

This has been demonstrated in this report, and the ground floor finished floor level is set 300mm above the 1 in 100 plus 43% climate change event

6. SUSTAINABLE URBAN DRAINAGE SYSTEMS

The total site area is 2226m^2, and the impermeable areas of the site prior to development are 582m^2. Following the development at this site, the proposed impervious space will be 340m^2. This will show an improvement of 242m^2. The proposal is therefore a 41.58% 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.

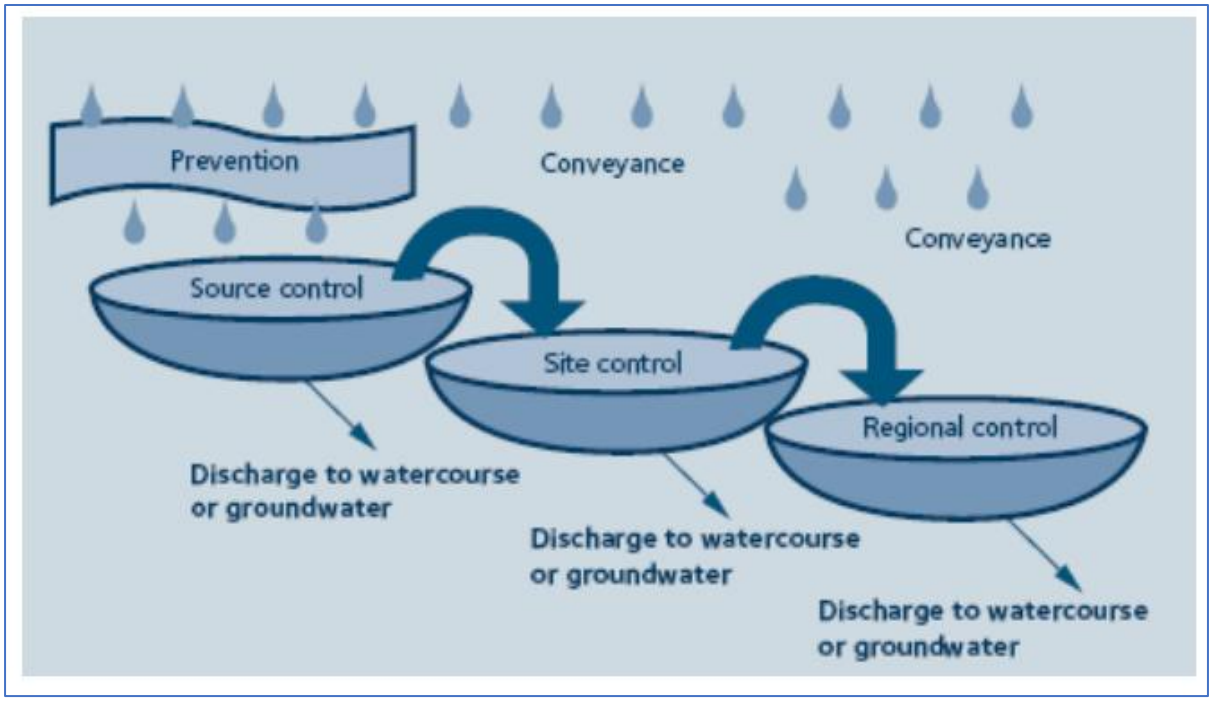


Figure 7 – SuDS Management Train

7. 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. The roof is 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 a 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, 11.6m^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.

8. 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	Two wall mounted rainwater harvesting tanks will be provided at the new building.	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 surfacing 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 Roofs,	The roof is 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 an underground tank.	No

	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 the homeowner 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

Policy and guidance wording for new homes is being used to assess this application. This is a rebuild with differences to a new build that results in the application being tested against some criteria which drive decisions counter to the pledge of the EA to go the extra mile for people and places. This report is produced in a way that allows the Planners to make their decisions in the interest of the big picture. In particular, the permitted development is shown on the as-is drawings, but the whole under house void is treated as non-floodable. With the confusion around what represents non-standard for void calculations under paragraph 49 of the Planning Practice Guidance, we believe this is the most appropriate way to assess what is being proposed in this rebuild application.

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 they are aware that the existing dwelling is at a risk of fluvial flooding, and therefore they have 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 of 43% in line with the requirements of the Environment Agency. 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 plinths, up to 300mm above the modelled flood level for the 1 in 100 year plus 43% climate change event, 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. We have also provided appropriate flood storage compensation via the removal of existing buildings. This results in an approximate 6.59m^3 gain in flood storage.

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. Whilst there will never be risk to life, the proposed dwelling includes a raised escape walkway for safe exit to higher ground at all times. Something that cannot be said about the existing dwelling, which is currently lethal during fluvial flooding as starkly observed during the January 2024 floods.

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.

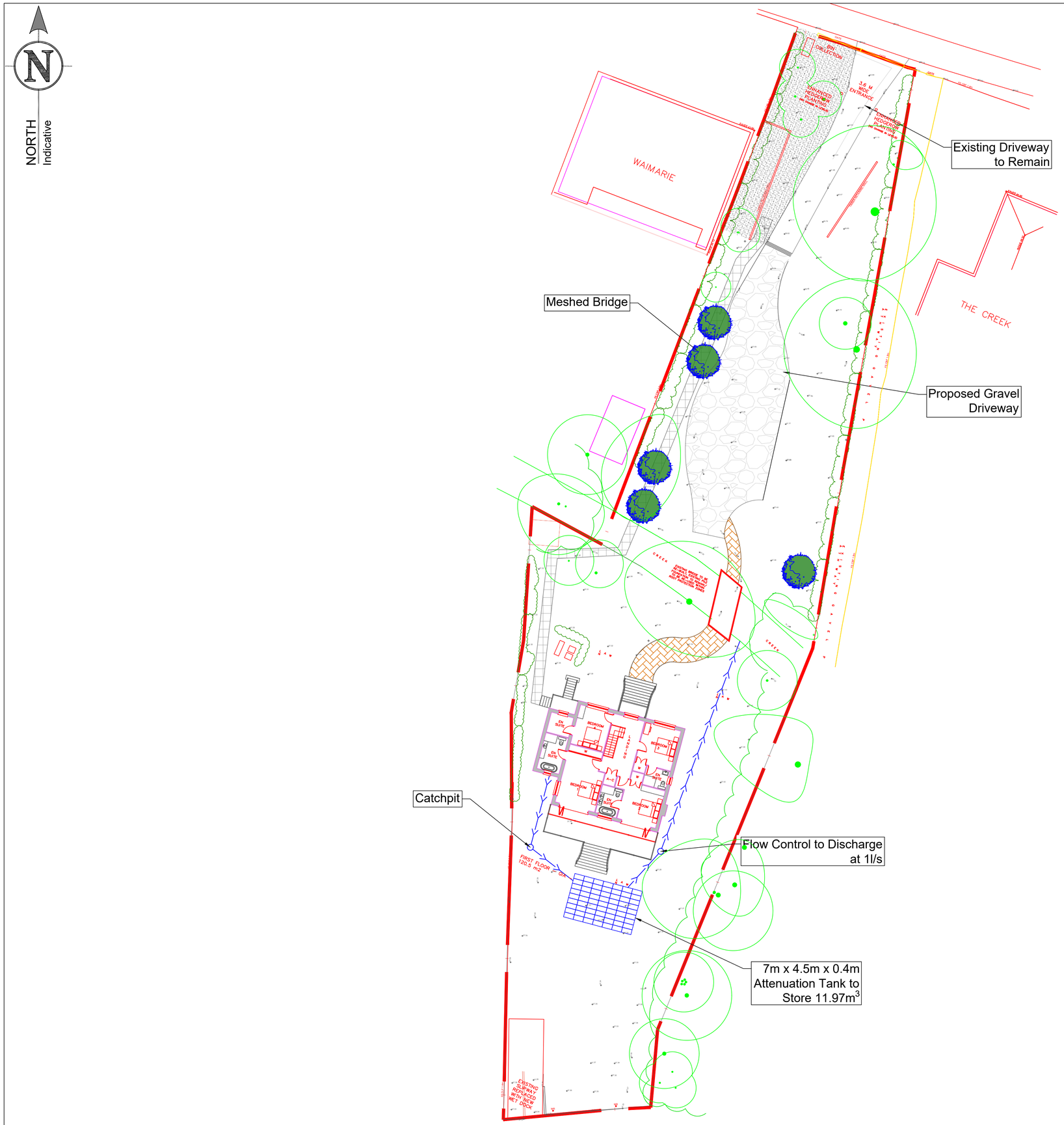
A suitable Sustainable Urban Drainage systems solution has been proposed which follows the SuDS hierarchy and represents a 98 % reduction in surface water run off for the 1 in 100-year storm event.

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 flood plain 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). For these reasons, in our professional opinion, this provides meaningful environmental gains and from a SuDS perspective there is no reason not to allow it to proceed.

APPENDIX A – DRAWINGS



DRAWING TO BE PRINTED IN COLOUR.

KEY:

Proposed Permeable Paving

Proposed Site Boundary

Surface Water UPVC Pipes

NOT FOR CONSTRUCTION

IMPORTANT

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REV	DATE	DRAWN	DESCRIPTION	CHECK	APPR.
E	06-03-25	M.HAM	Updated Layout.	S.L	S.L
D	27-11-24	M.HAM	Updated Garage Roof	S.L	S.L
C	15-11-24	M.HAM	Updated Mesh Bridge.	S.L	S.L
B	12-11-24	M.HAM	Added Foundations.	S.L	S.L
A	08-11-24	M.HAM	For Information.	S.L	S.L

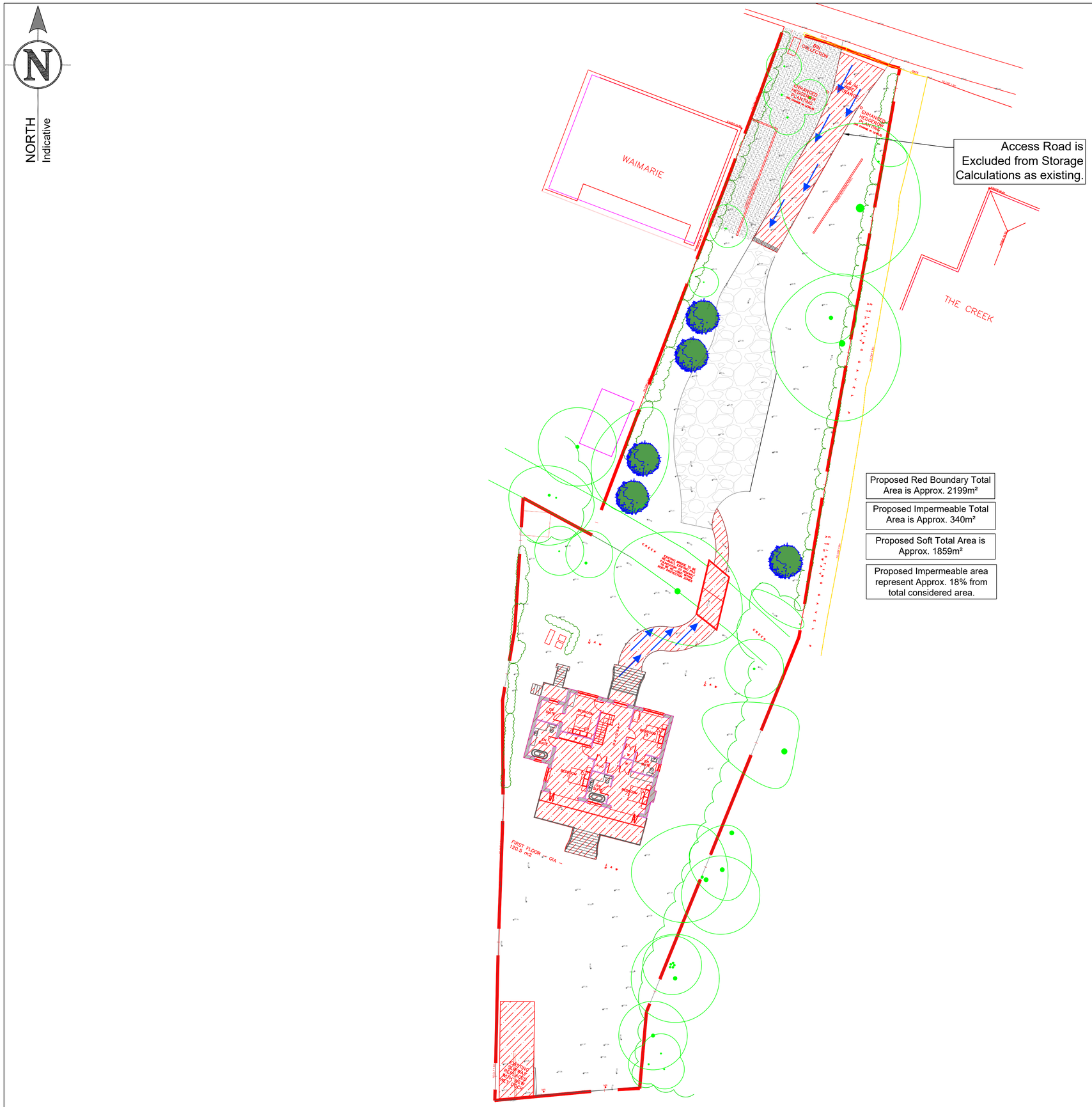
Warren Creek, The Warren, Caversham, RG4 7TQ

SuDS Layout & Location Plan

Mr Rob Arnold

Nimbus ENGINEERING CONSULTANTS

S.L	06-03-25	S.L	06-03-25
M.HAM	1:200	C3429-03	E
08-11-24	A1		



DRAWING TO BE PRINTED IN COLOUR.

KEY:

- Proposed Roof & Hardstanding Areas
- Proposed Site Boundary
- Exceedance Route Arrow

NOT FOR CONSTRUCTION

IMPORTANT

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REV	DATE	DRAWN	DESCRIPTION	CHECK	APPR.
D	05-03-25	M.HAM	Updated Drawing.	S.L	S.L
C	27-11-24	M.HAM	Updated Garage Roof.	S.L	S.L
B	15-11-24	M.HAM	Updated Mesh Bridge.	S.L	S.L
A	06-11-24	M.HAM	For Information.	S.L	S.L

Warren Creek, The Warren, Caversham, RG4 7TQ

Post-Development Impermeable Areas & Exceedance Routes Plan

Mr Rob Arnold

Nimbus
ENGINEERING CONSULTANTS

S.L	05-03-25	S.L	05-03-25
M.HAM	1:200	C3429-02	D
06-11-24	A1		

DRAWING TO BE PRINTED IN COLOUR.

KEY:

- Existing Roof Area
- Existing Hardstanding Area
- Proposed Site Boundary
- Exceedance Route Arrow

NOT FOR CONSTRUCTION

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REV	DATE	DRAWN	DESCRIPTION	CHECK	APPR.
B	05-03-25	M.HAM	Updated Layout.	S.L	S.L
A	06-11-24	M.HAM	For Information.	S.L	S.L

Warren Creek, The Warren, Caversham, RG4 7TQ

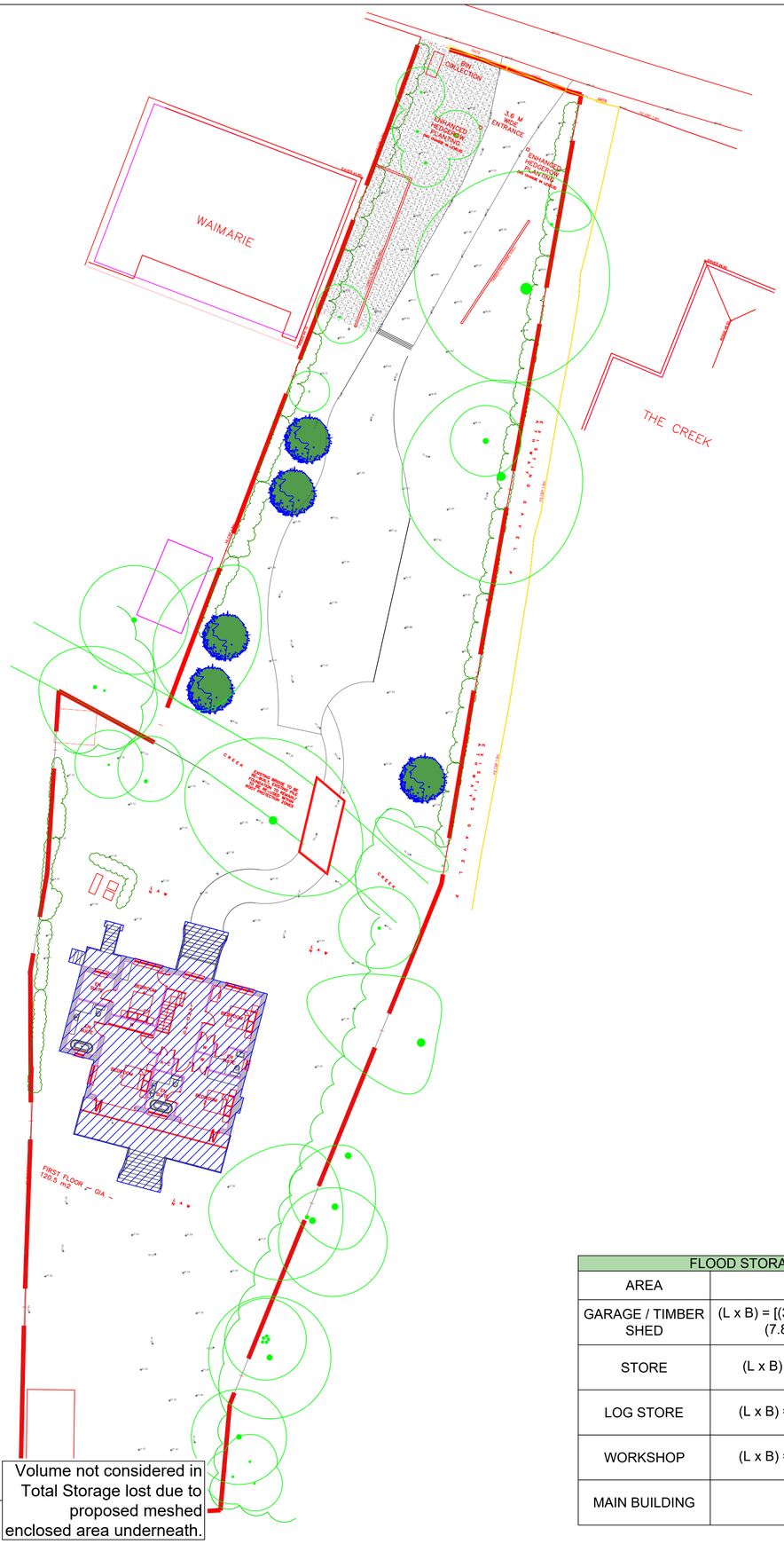
Pre-Development Impermeable Areas & Exceedance Routes Plan

Mr Rob Arnold

Nimbus
ENGINEERING CONSULTANTS

S.L	05-03-25	S.L	05-03-25
M.HAM	1:200	C3429-01	B
06-11-24	A1		

NORTH
Indicative



Volume not considered in Total Storage lost due to proposed meshed enclosed area underneath.

TOTAL FLOOD STORAGE GAINED/LOST	
TOTAL FLOOD STORAGE LOST BY DEVELOPMENT PROPOSALS	TOTAL FLOOD STORAGE GAINED BY REMOVING EXISTING BUILDINGS
$262.42m^3$	$290.24m^3$

FLOOD STORAGE LOST BY STAIRS		
SET OF STAIRS	SURFACE AREA	FLOOD STORAGE VOLUME DISPLACED
MAIN	(L x B) = (2.88 x 3.55) = $10.22m^2$	(10.22 x 1.78 x 0.5) = $9.10m^3$
LHS 1	(L x B) = (2.00 x 1.04) = $2.08m^2$	(2.08 x 1.74 x 0.5) = $1.81m^3$
LHS 2	(L x B) = (1.10 x 1.03) = $1.13m^2$	(1.13 x 1.74 x 0.5) = $0.98m^3$
REAR	(L x B) = (2.88 x 2.54) = $7.32m^2$	(7.32 x 1.79 x 0.5) = $6.55m^3$

FLOOD STORAGE LOST BY MAIN HOUSE & TERRACE		
AREA	SURFACE AREA	FLOOD STORAGE VOLUME DISPLACED
HOUSE	$137.07m^2$	(137.07 x 1.78) = $243.98m^3$
TERRACE	(L x B) = [(11.21 x 2.85) + (1.45 x 2.64)] = $36.04m^2$	(36.04 x 1.79) = $64.51m^3$

FLOOD STORAGE GAINED BY REMOVING BUILDINGS		
AREA	SURFACE AREA	FLOOD STORAGE VOLUME DISPLACED
GARAGE / TIMBER SHED	(L x B) = [(3.32 x 4.89) + (3.32 x 2.73) + (7.89 x 1.39)] = $36.27m^2$	(36.27 x 1.70) = $61.66m^3$
STORE	(L x B) = (2.97 x 2.50) = $7.43m^2$	(7.43 x 1.81) = $13.45m^3$
LOG STORE	(L x B) = (4.23 x 3.04) = $12.86m^2$	(12.86 x 1.78) = $22.89m^3$
WORKSHOP	(L x B) = (3.04 x 4.27) = $12.98m^2$	(12.98 x 1.78) = $23.10m^3$
MAIN BUILDING	$96.65m^2$	(96.65 x 1.75) = $169.14m^3$

DRAWING TO BE PRINTED IN COLOUR.

KEY:

Flood Storage Area Lost

Proposed Site Boundary

NOT FOR CONSTRUCTION

IMPORTANT

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REV	DATE	DRAWN	DESCRIPTION	CHECK	APPR.
D	06-03-24	M.HAM	Updated Layout & Calculations.	S.L	S.L
C	27-11-24	M.HAM	Updated Garage Roof.	S.L	S.L
B	15-11-24	M.HAM	Updated Mesh Bridge.	S.L	S.L
A	12-11-24	M.HAM	For Information.	S.L	S.L

Warren Creek, The Warren, Caversham, RG4 7TQ

Flood Storage Areas Lost & Gained on Proposed Plan

Mr Rob Arnold

Nimbus
ENGINEERING CONSULTANTS

S.L	06-03-24	S.L	06-03-24
M.HAM	1:200	C3429-04	D
12-11-24	A1		

APPENDIX B – MODELLED FLOOD LEVELS FROM THE ENVIRONMENT AGENCY

Product 4 (Detailed Flood Risk) for Warren Creek, The Warren, Caversham, RG4 7TQ
Our Ref: THM382851

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:

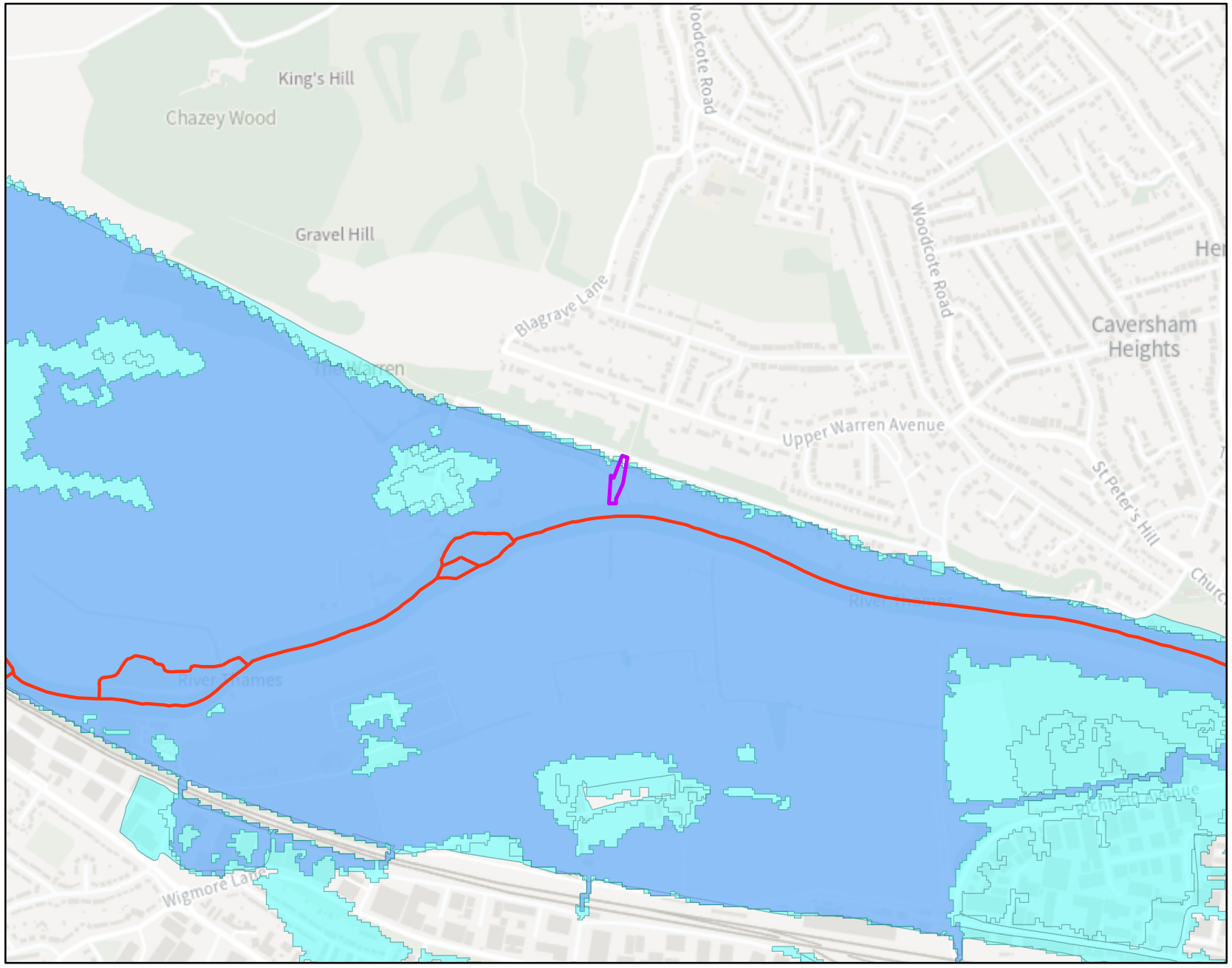
https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities

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, RG4 7TQ
Created on 01/11/2024 REF: THM382851



Environment Agency

Kilometres

0 0.3 0.6

Legend

- Statutory Main Rivers
- Warren Creek, RG4 7TQ
- 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.

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Defence information

THM382851

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.

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Model information

THM382851

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.

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Modelled in-channel flood flows and levels

THM382851

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 (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
061_00_2019_36.081	Thames (Pangbourne to Sonning) 2019	468724	174709	37.91	38.30	38.41	38.72	39.08	39.21	39.60	39.31
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
061_00_2019_36.049	Thames (Pangbourne to Sonning) 2019	470374	174855	37.51	37.93	38.06	38.39	38.77	38.91	39.32	39.01
061_00_2019_36.048	Thames (Pangbourne to Sonning) 2019	470717	174807	37.41	37.82	37.93	38.25	38.60	38.72	39.09	38.82

				Flood Flows (m3/s)							
Node label	Model	Easting	Northing	20% AEP	5% AEP	3.3% AEP	1% AEP	1% AEP (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
061_00_2019_36.081	Thames (Pangbourne to Sonning) 2019	468724	174709	203.08	227.56	229.32	232.83	234.46	234.05	236.24	233.90
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
061_00_2019_36.049	Thames (Pangbourne to Sonning) 2019	470374	174855	219.39	276.36	292.50	345.85	407.37	424.95	466.60	436.80
061_00_2019_36.048	Thames (Pangbourne to Sonning) 2019	470717	174807	222.43	285.38	303.75	363.98	434.94	459.98	534.66	478.79

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

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Modelled floodplain flood levels

THM382851

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 (+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	469203	175283	No data	No data	No data	38.56	39.02	39.16	39.55	39.26
Flood Point 2	Thames (Pangbourne to Sonning) 2019	469575	175113	37.65	38.09	38.22	38.59	39.00	39.13	39.52	39.23
Flood Point 3	Thames (Pangbourne to Sonning) 2019	469494	175172	No data	38.09	38.22	38.59	38.99	39.13	39.52	39.23
Flood Point 4	Thames (Pangbourne to Sonning) 2019	470503	174886	No data	No data	No data	No data	38.74	38.88	39.26	38.97

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

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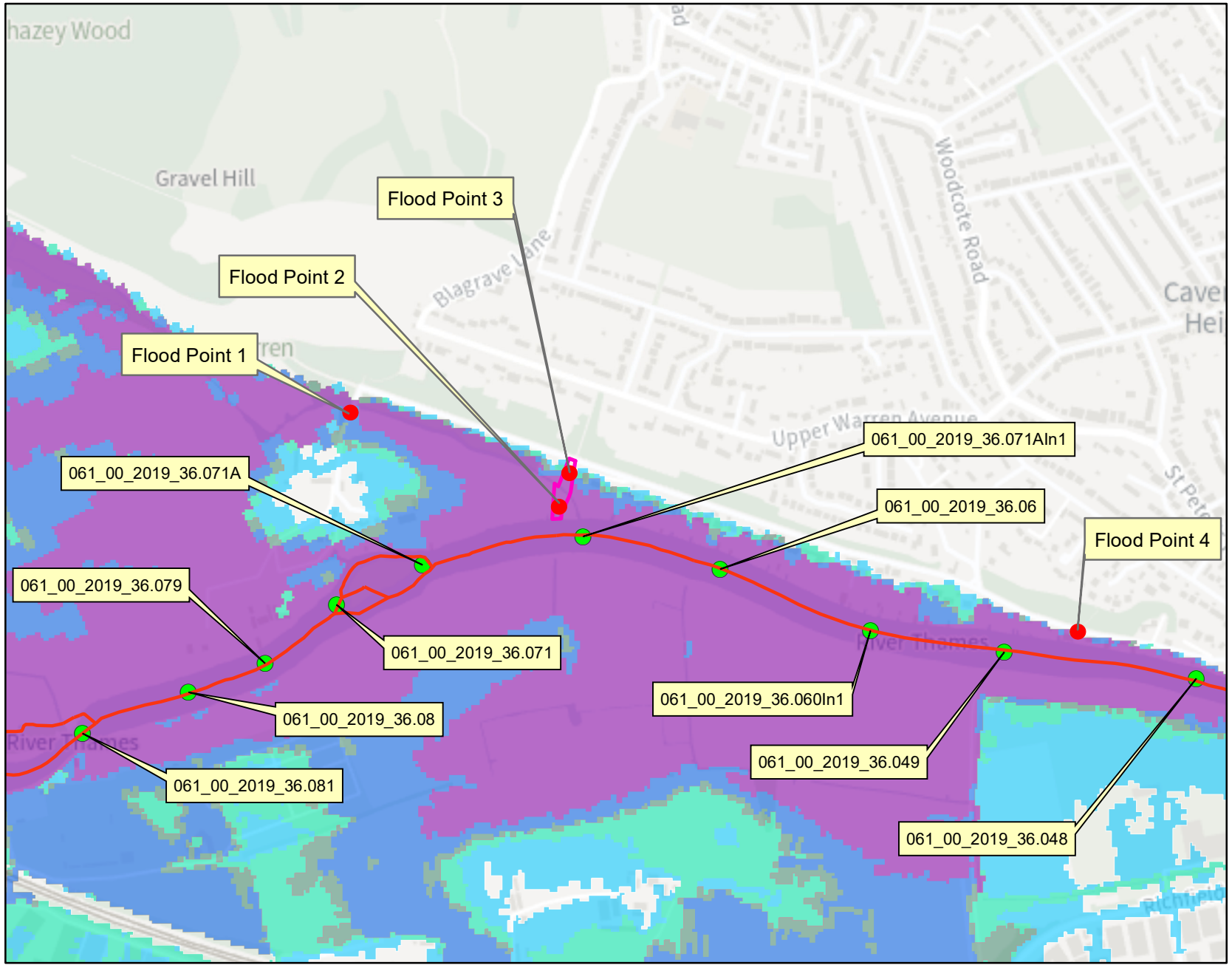
Detailed FRA Map on Warren Creek, RG4 7TQ
Created on 01/11/2024 REF: THM382851



Environment Agency

Kilometres

0 0.25 0.5

Legend

- Statutory Main Rivers
- Warren Creek, RG4 7TQ
- Model Nodes
- 20% AEP Flood Outline
- 5% AEP Flood Outline
- 3.3% AEP Flood Outline
- 1% AEP Flood Outline
- 0.1% AEP Flood Outline

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.

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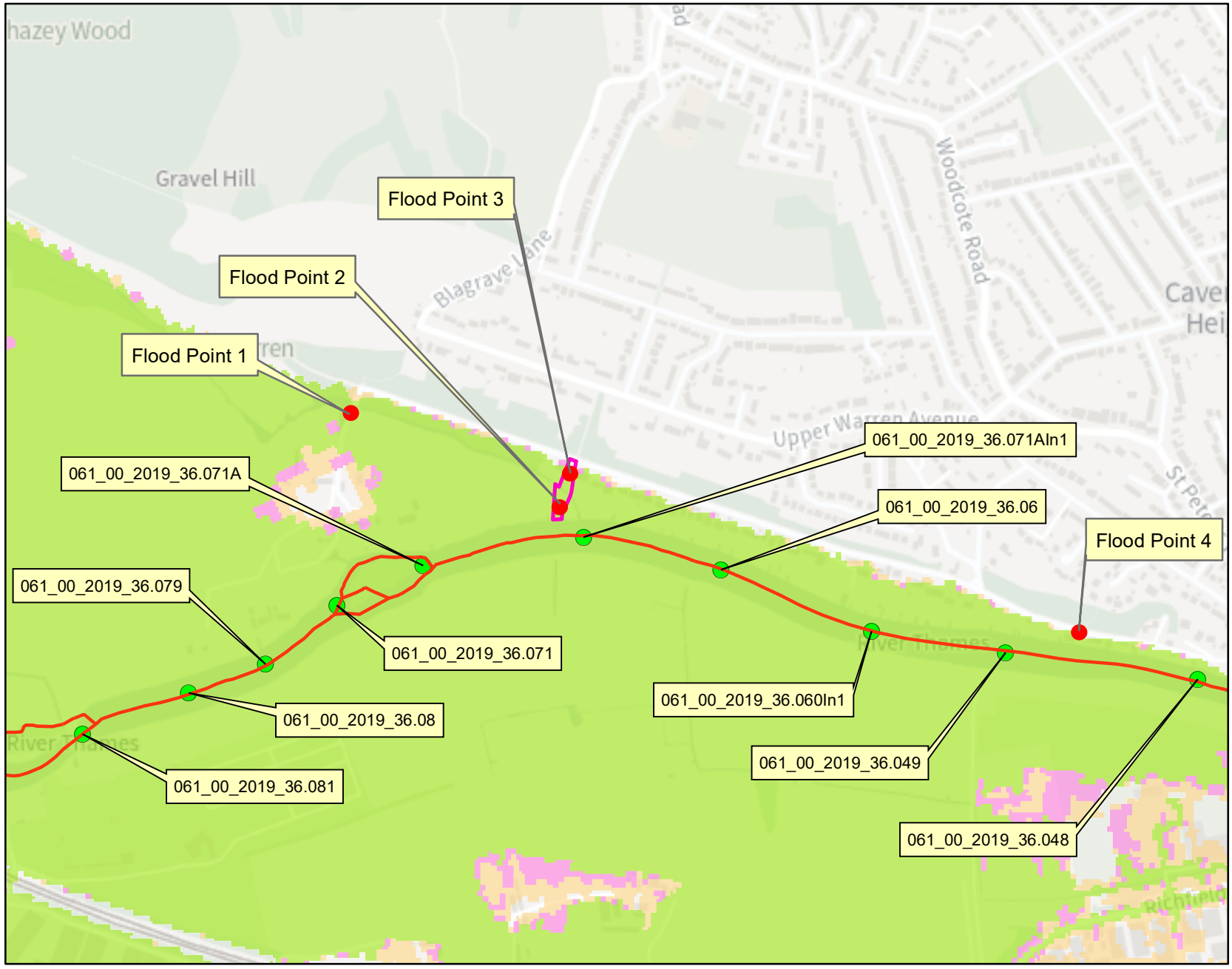
Detailed FRA Map on Warren Creek, RG4 7TQ
Created on 01/11/2024 REF: THM382851



Environment Agency

Kilometres

0 0.25 0.5

Legend

- Statutory Main Rivers
- Warren Creek, RG4 7TQ
- 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

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.

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Historic flood data

THM382851

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)
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)
EA0120144097369	Winter 2013/2014	23/11/2013	28/02/2014	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.

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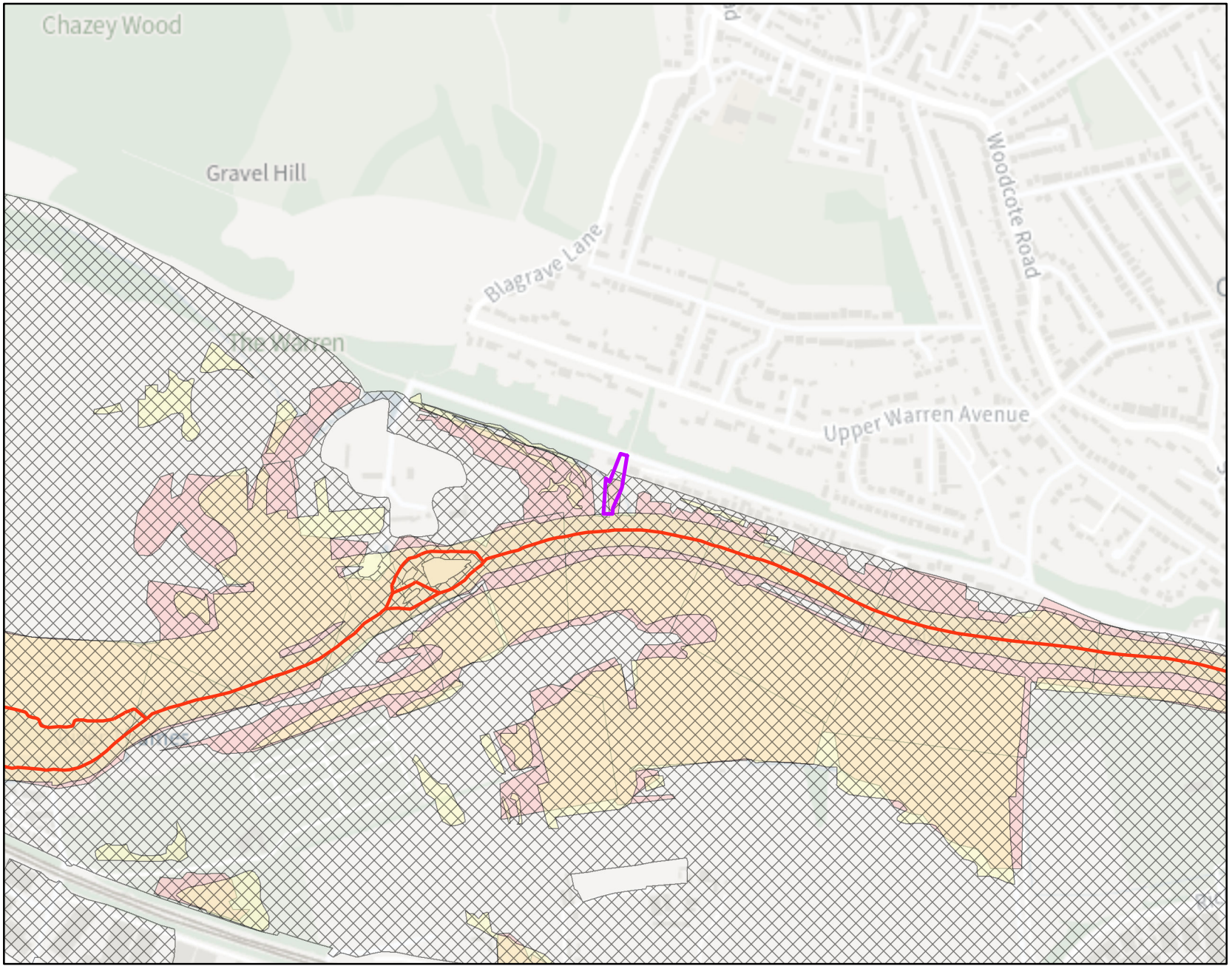
Historic Flood Map centred on Warren Creek, RG4 7TQ
Created on 01/11/2024 REF: THM382851



Environment Agency

Kilometres

0 0.25 0.5

Legend

Statutory Main Rivers

Warren Creek, RG4 7TQ

year

1947

1977

2000

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.

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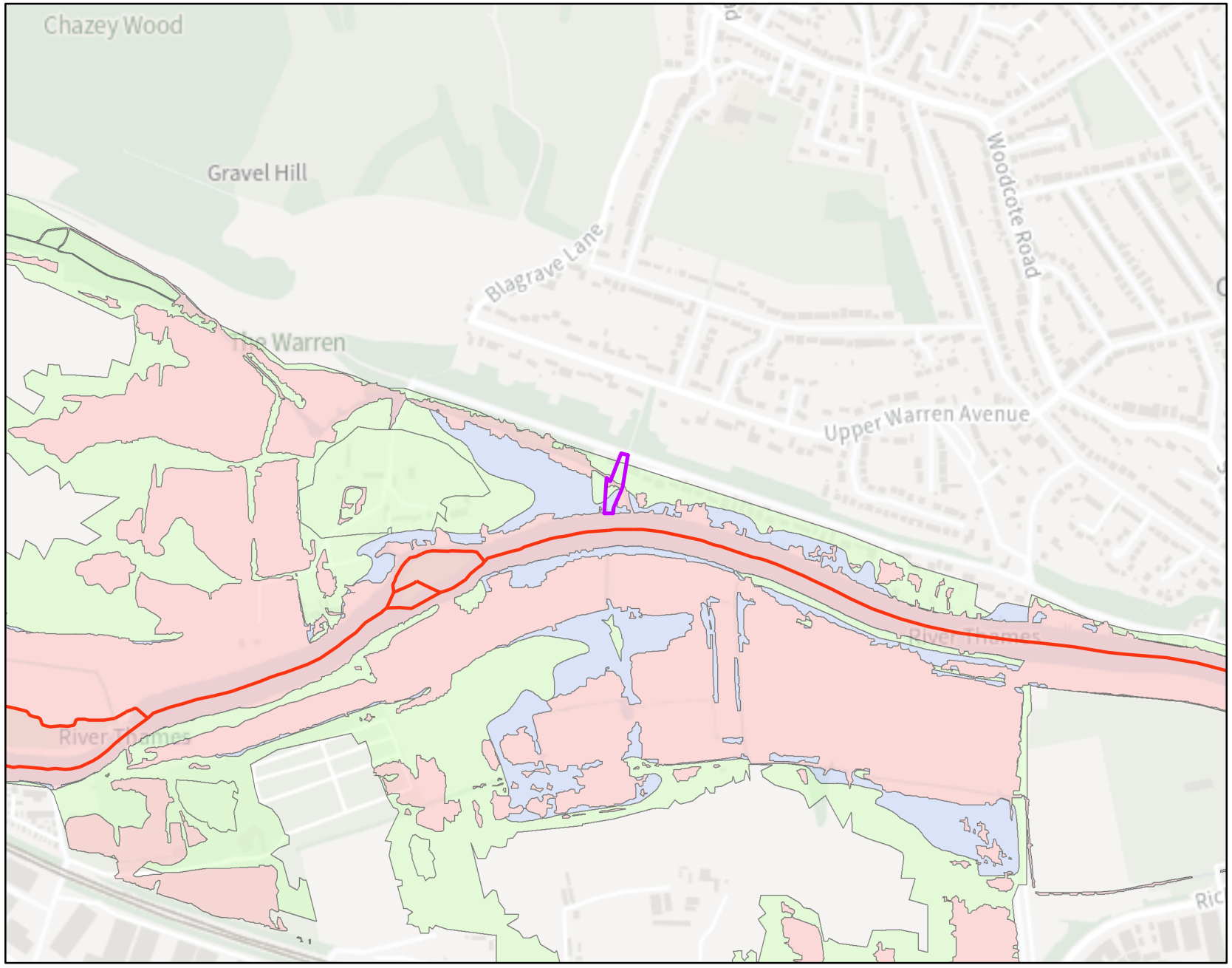
Historic Flood Map centred on Warren Creek, RG4 7TQ
Created on 01/11/2024 REF: THM382851



Environment Agency

Kilometres

0 0.25 0.5

Legend

Statutory Main Rivers

Warren Creek, RG4 7TQ

year

2002/3

2007

2014

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.

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Hazard Mapping

THM382851

Hazard Mapping methodology:

To calculate flood hazard with the debris factor we have used the supplementary note to Flood Risk to People Methodology (see below).
The following calculation is used:

HR = d x (v+0.5) + DF

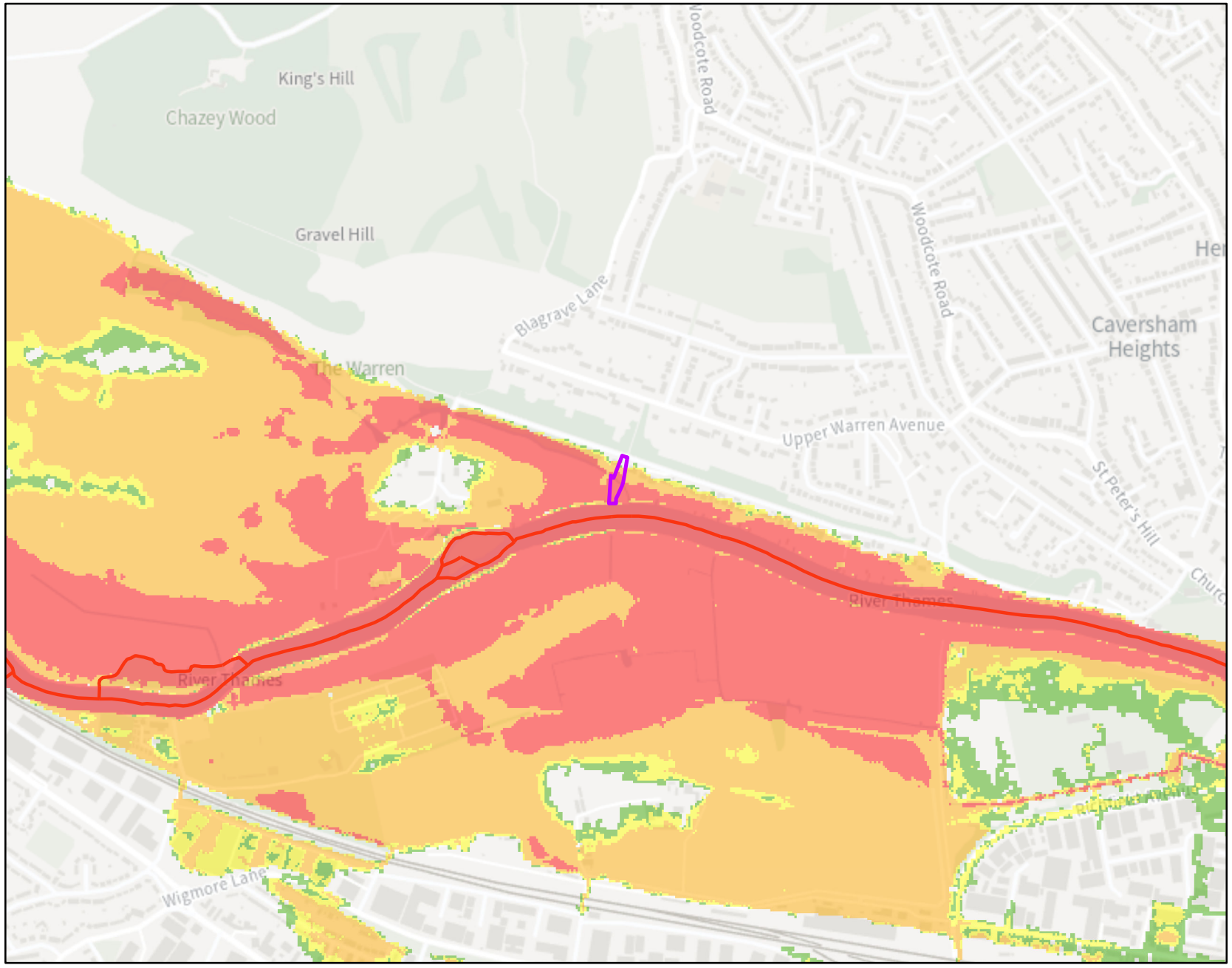
Where HR = flood hazard rating
d = depth of flooding (m)
v = velocity of floodwaters (m/sec)
DF = debris factor calculated (0, 0.5, 1 depending on probability that debris will lead to a hazard)

The resultant hazard rating is then classified according to:

Flood Hazard	Colour	Hazard to People Classification	
Less than 0.75		Very low hazard	- Caution
0.75 to 1.25		Danger for some	- includes children, the elderly and the infirm
1.25 to 2.0		Danger for most	- includes the general public
More than 2.0		Danger for all	- includes the emergency services

REF: HR Wallingford and Environment Agency (May 2008) Supplementary note of flood hazard ratings and thresholds for development planning and control purpose – Clarification of the Table 113.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1

Hazard Map (for the 1%+25% climate change scenario) centred on Warren Creek, RG4 7TQ Created on 01/11/2024 REF: THM382851



Environment Agency

Kilometres

0 0.3 0.6

Legend

- Statutory Main Rivers
- Warren Creek, RG4 7TQ
- Very low hazard – Caution
- Danger for some – includes children, the elderly and the infirm
- Danger for most – includes the general public
- Danger for all – includes the emergency services

For hazard and debris factor we used HR Wallingford and Environment Agency (May 2008) supplementary note on flood hazard ratings and thresholds for development planning and control purpose. The following calculation is used:

HR = d x (v+0.5) + DF

HR = flood hazard rating
d = depth of flooding (m)
v = velocity of floodwaters (m/sec)
DF = debris factor calculated (0, 0.5, 1 depending on probability that debris will lead to a hazard)

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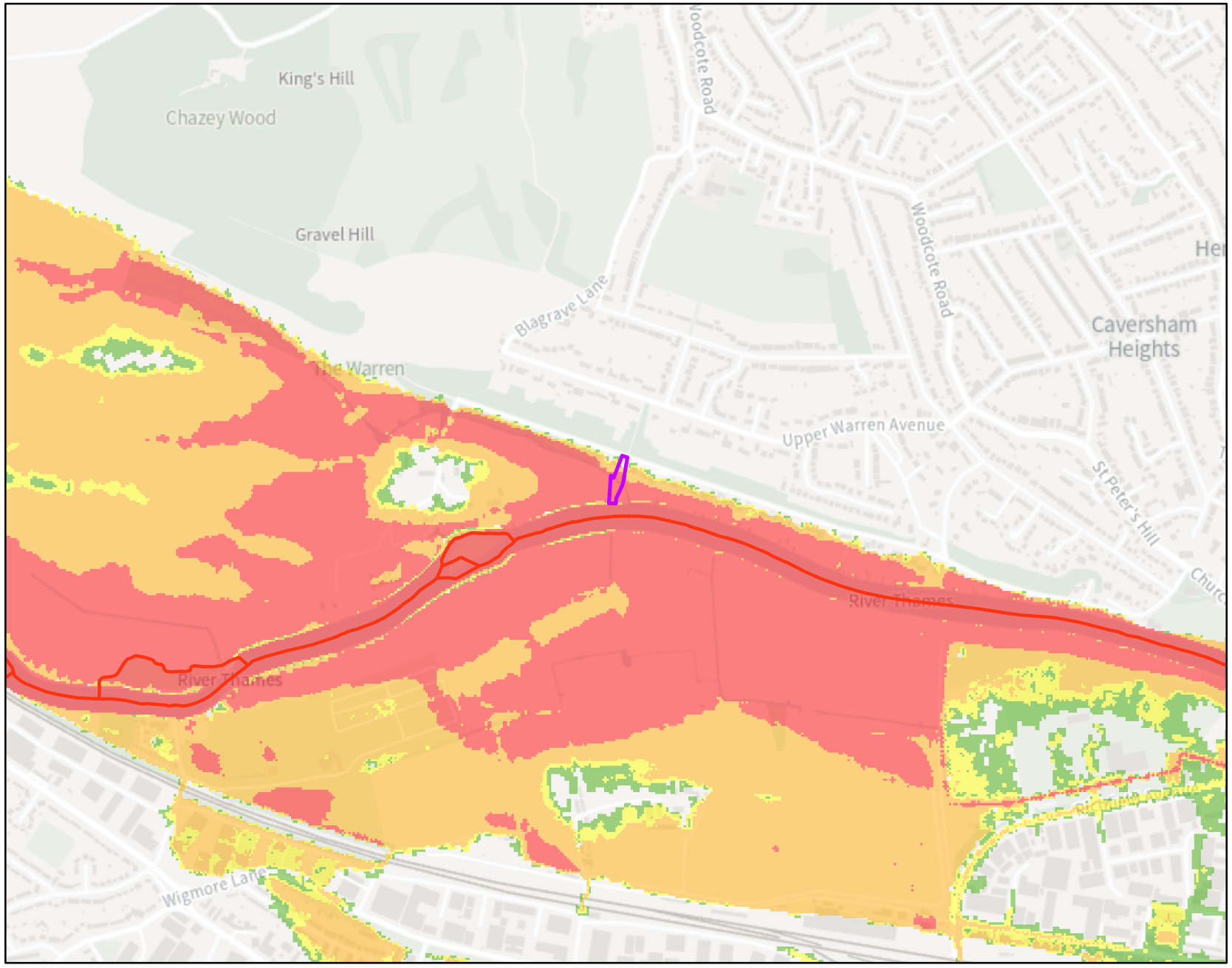
Hazard Map (for the 1%+35% climate change scenario) centred on Warren Creek, RG4 7TQ
Created on 01/11/2024 REF: THM382851



Environment Agency

Kilometres

0 0.3 0.6

Legend

- Statutory Main Rivers
- Warren Creek, RG4 7TQ
- Very low hazard – Caution
- Danger for some – includes children, the elderly and the infirm
- Danger for most – includes the general public
- Danger for all – includes the emergency services

For hazard and debris factor we used HR Wallingford and Environment Agency (May 2008) supplementary note on flood hazard ratings and thresholds for development planning and control purpose. The following calculation is used:

HR = d x (v+0.5) + DF

HR = flood hazard rating
d = depth of flooding (m)
v = velocity of floodwaters (m/sec)
DF = debris factor calculated (0, 0.5, 1 depending on probability that debris will lead to a hazard)

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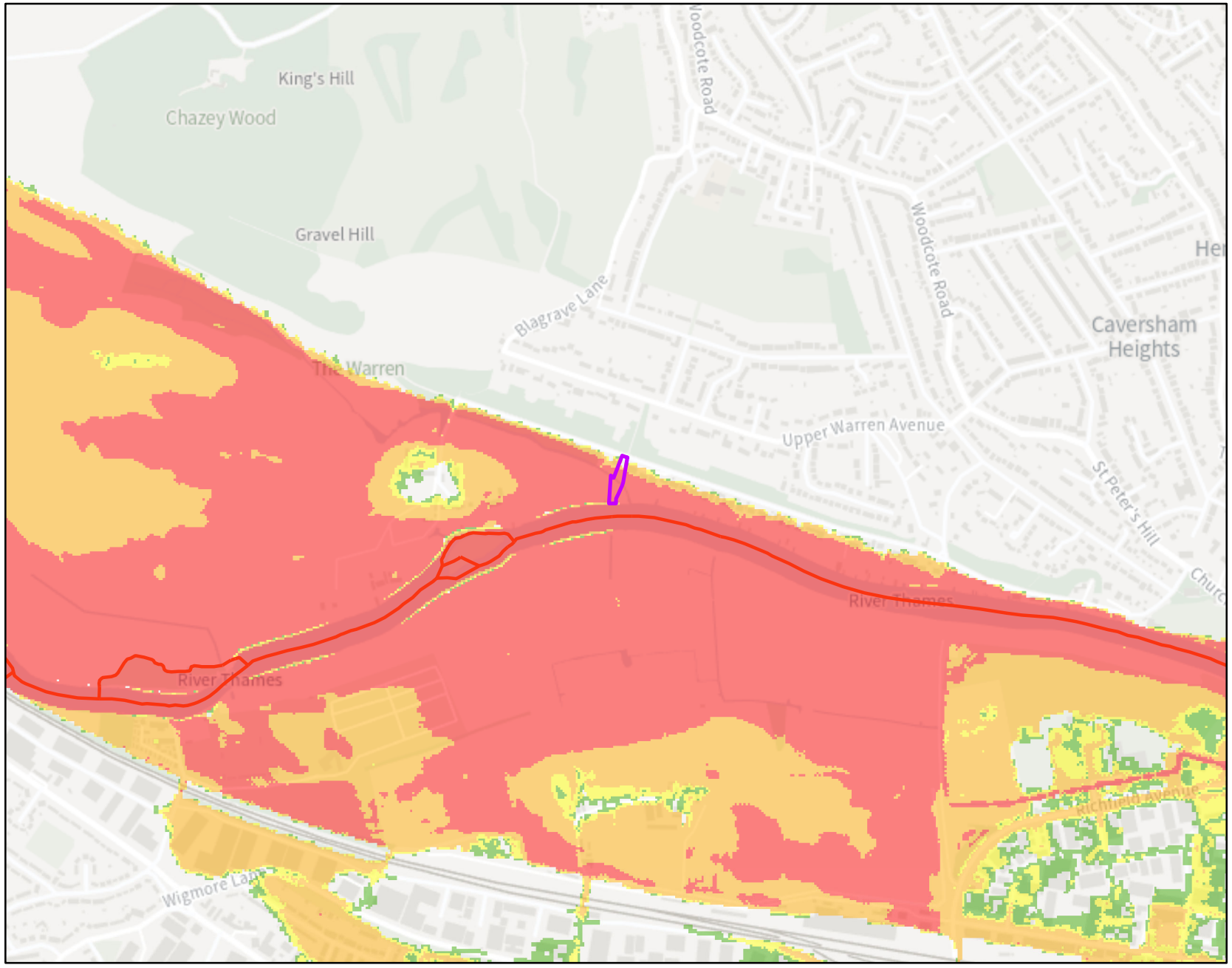
Hazard Map (for the 1%+70% climate change scenario) centred on Warren Creek, RG4 7TQ Created on 01/11/2024 REF: THM382851



Environment Agency

Kilometres

0 0.3 0.6

Legend

- Statutory Main Rivers
- Warren Creek, RG4 7TQ
- Very low hazard – Caution
- Danger for some – includes children, the elderly and the infirm
- Danger for most – includes the general public
- Danger for all – includes the emergency services

For hazard and debris factor we used HR Wallingford and Environment Agency (May 2008) supplementary note on flood hazard ratings and thresholds for development planning and control purpose. The following calculation is used:

HR = d x (v+0.5) + DF

HR = flood hazard rating
d = depth of flooding (m)
v = velocity of floodwaters (m/sec)
DF = debris factor calculated (0, 0.5, 1 depending on probability that debris will lead to a hazard)

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APPENDIX C – SURFACE WATER RUNOFF CALCULATIONS

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. C3429 Sheet no. 1 Date 06/03/25
	Project: Warren Creek, The Warren, Caversham, RG4 7TQ		By: MH Checked: Reviewed:
	Title: Hydrograph Storage Calcs - 1l/s		

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 = 275 m²
Total area = 275 m²
Total runoff = 17.6 m³

Pervious area = 0 m²
Equiv area = 275 m² (Tot. area x % runoff).
Discharge rate = 1.000 l/s

Storage (m³) = 11.6 m³ (Sum of all balance quantities)

Total rainfall depth = 64.0 mm

Calculations :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
0.020	20.0	6.4	0.035	0.072	0.000	0.000
0.040	20.0	6.4	0.035	0.072	0.000	0.000
0.060	21.0	6.7	0.037	0.072	0.000	0.000
0.080	21.0	6.7	0.037	0.072	0.000	0.000
0.100	22.0	7.0	0.039	0.072	0.000	0.000
0.120	23.0	7.4	0.040	0.072	0.000	0.000
0.140	24.0	7.7	0.042	0.072	0.000	0.000
0.160	26.0	8.3	0.046	0.072	0.000	0.000
0.180	27.0	8.6	0.048	0.072	0.000	0.000
0.200	29.0	9.3	0.051	0.072	0.000	0.000
0.220	31.0	9.9	0.055	0.072	0.000	0.000
0.240	32.0	10.2	0.056	0.072	0.000	0.000
0.260	33.0	10.6	0.058	0.072	0.000	0.000
0.280	34.0	10.9	0.060	0.072	0.000	0.000
0.300	36.0	11.5	0.063	0.072	0.000	0.000
0.320	38.0	12.2	0.067	0.072	0.000	0.000
0.340	39.0	12.5	0.069	0.072	0.000	0.000
0.360	40.0	12.8	0.070	0.072	0.000	0.000
0.380	42.0	13.4	0.074	0.072	0.002	0.002
0.400	45.0	14.4	0.079	0.072	0.007	0.009
0.420	49.0	15.7	0.086	0.072	0.014	0.023
0.440	53.0	17.0	0.093	0.072	0.021	0.045
0.460	57.0	18.2	0.100	0.072	0.028	0.073
0.480	62.0	19.8	0.109	0.072	0.037	0.110
0.500	66.0	21.1	0.116	0.072	0.044	0.154
0.520	71.0	22.7	0.125	0.072	0.053	0.207
0.540	77.0	24.6	0.136	0.072	0.064	0.271
0.560	84.0	26.9	0.148	0.072	0.076	0.347
0.580	91.0	29.1	0.160	0.072	0.088	0.435
0.600	98.0	31.4	0.173	0.072	0.101	0.535
0.620	105.0	33.6	0.185	0.072	0.113	0.648
0.640	114.0	36.5	0.201	0.072	0.129	0.777
0.660	125.0	40.0	0.220	0.072	0.148	0.925

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Job No. C3429			
Sheet no. 2			
Date 06/03/25			
MasterDrain SW	Project: Warren Creek, The Warren, Caversham, RG4 7TQ	By: MH	Checked / Reviewed
	Title: Hydrograph Storage Calcs - 1l/s		

Calculations (cont.) :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
0.820	204.0	65.3	0.359	0.072	0.287	2.725
0.840	212.0	67.8	0.373	0.072	0.301	3.026
0.860	219.0	70.1	0.385	0.072	0.313	3.340
0.880	226.0	72.3	0.398	0.072	0.326	3.666
0.900	233.0	74.6	0.410	0.072	0.338	4.004
0.920	239.0	76.5	0.421	0.072	0.349	4.352
0.940	244.0	78.1	0.429	0.072	0.357	4.710
0.960	248.0	79.4	0.437	0.072	0.365	5.074
0.980	249.0	79.7	0.438	0.072	0.366	5.441
1.000	250.0	80.0	0.440	0.072	0.368	5.809
1.020	250.0	80.0	0.440	0.072	0.368	6.177
1.040	249.0	79.7	0.438	0.072	0.366	6.543
1.060	248.0	79.4	0.437	0.072	0.365	6.908
1.080	244.0	78.1	0.429	0.072	0.357	7.265
1.100	239.0	76.5	0.421	0.072	0.349	7.614
1.120	233.0	74.6	0.410	0.072	0.338	7.952
1.140	226.0	72.3	0.398	0.072	0.326	8.278
1.160	219.0	70.1	0.385	0.072	0.313	8.591
1.180	212.0	67.8	0.373	0.072	0.301	8.892
1.200	204.0	65.3	0.359	0.072	0.287	9.180
1.220	194.0	62.1	0.341	0.072	0.269	9.449
1.240	183.0	58.6	0.322	0.072	0.250	9.699
1.260	173.0	55.4	0.305	0.072	0.233	9.932
1.280	164.0	52.5	0.289	0.072	0.217	10.148
1.300	154.0	49.3	0.271	0.072	0.199	10.347
1.320	143.0	45.8	0.252	0.072	0.180	10.527
1.340	135.0	43.2	0.238	0.072	0.166	10.693
1.360	125.0	40.0	0.220	0.072	0.148	10.841
1.380	114.0	36.5	0.201	0.072	0.129	10.969
1.400	105.0	33.6	0.185	0.072	0.113	11.082
1.420	98.0	31.4	0.173	0.072	0.101	11.183
1.440	91.0	29.1	0.160	0.072	0.088	11.271
1.460	84.0	26.9	0.148	0.072	0.076	11.347
1.480	77.0	24.6	0.136	0.072	0.064	11.410
1.500	71.0	22.7	0.125	0.072	0.053	11.463
1.520	66.0	21.1	0.116	0.072	0.044	11.507
1.540	62.0	19.8	0.109	0.072	0.037	11.545
1.560	57.0	18.2	0.100	0.072	0.028	11.573
1.580	53.0	17.0	0.093	0.072	0.021	11.594
1.600	49.0	15.7	0.086	0.072	0.014	11.608
1.620	45.0	14.4	0.079	0.072	0.007	11.616
1.640	42.0	13.4	0.074	0.072	0.002	11.618
1.660	40.0	12.8	0.070	0.072	0.000	11.616
1.680	39.0	12.5	0.069	0.072	0.000	11.613
1.700	38.0	12.2	0.067	0.072	0.000	11.608
1.720	36.0	11.5	0.063	0.072	0.000	11.599
1.740	34.0	10.9	0.060	0.072	0.000	11.587
1.760	33.0	10.6	0.058	0.072	0.000	11.573
1.780	32.0	10.2	0.056	0.072	0.000	11.557
1.800	31.0	9.9	0.055	0.072	0.000	11.540
1.820	29.0	9.3	0.051	0.072	0.000	11.519
1.840	27.0	8.6	0.048	0.072	0.000	11.494
1.860	26.0	8.3	0.046	0.072	0.000	11.468
1.880	24.0	7.7	0.042	0.072	0.000	11.438
1.900	23.0	7.4	0.040	0.072	0.000	11.407
1.920	22.0	7.0	0.039	0.072	0.000	11.374
1.940	21.0	6.7	0.037	0.072	0.000	11.339
1.960	21.0	6.7	0.037	0.072	0.000	11.303
1.980	20.0	6.4	0.035	0.072	0.000	11.267
2.000	20.0	6.4	0.035	0.072	0.000	11.230

Storage volume (m^3) = 11.6 m^3 (Sum of all balance quantities)

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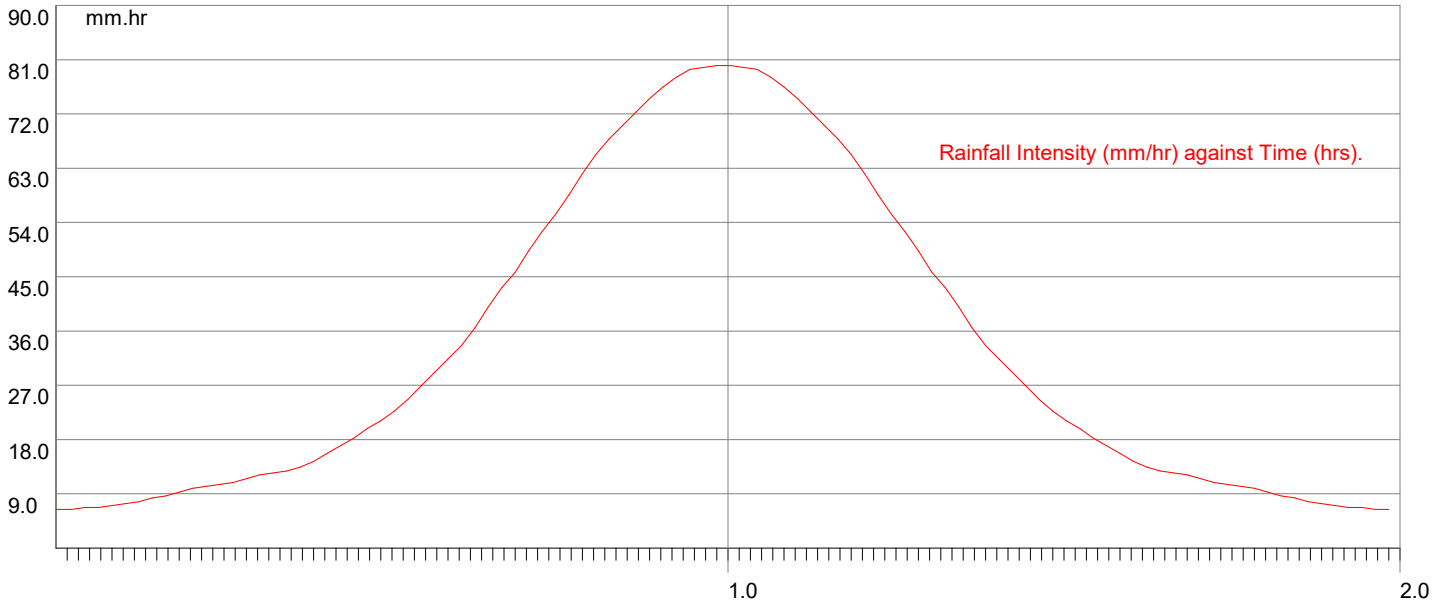
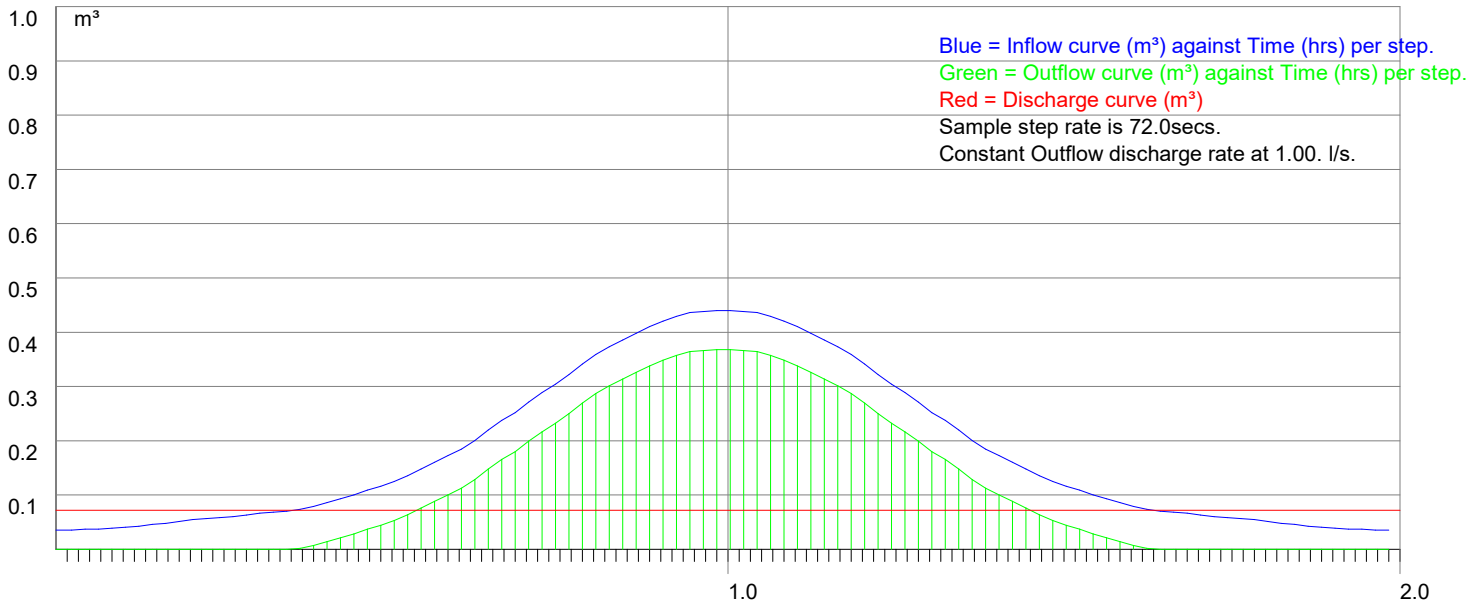
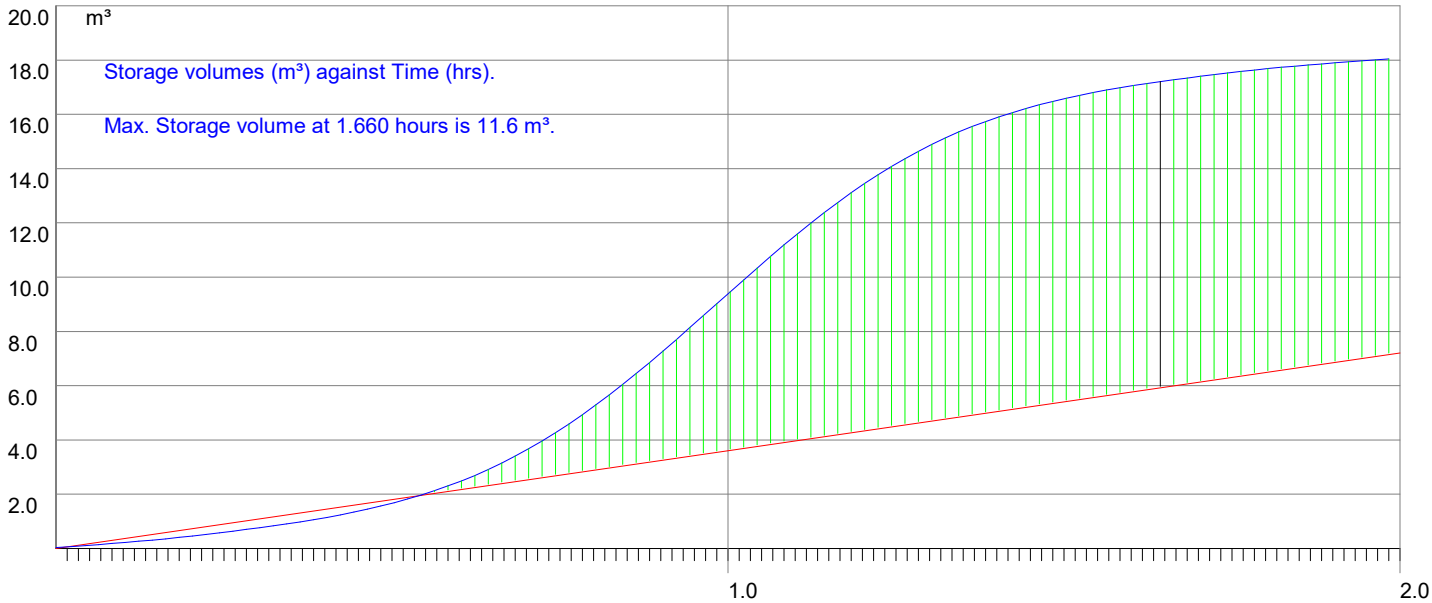
		Sheet no. **3**	
		Date **06/03/25**	
MasterDrain SW	Project **Warren Creek, The Warren, Caversham, RG4 7TQ**	By **MH**	Checked / Reviewed
	Title **Hydrograph Storage Calcs - 1l/s**		







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MasterDrain SW

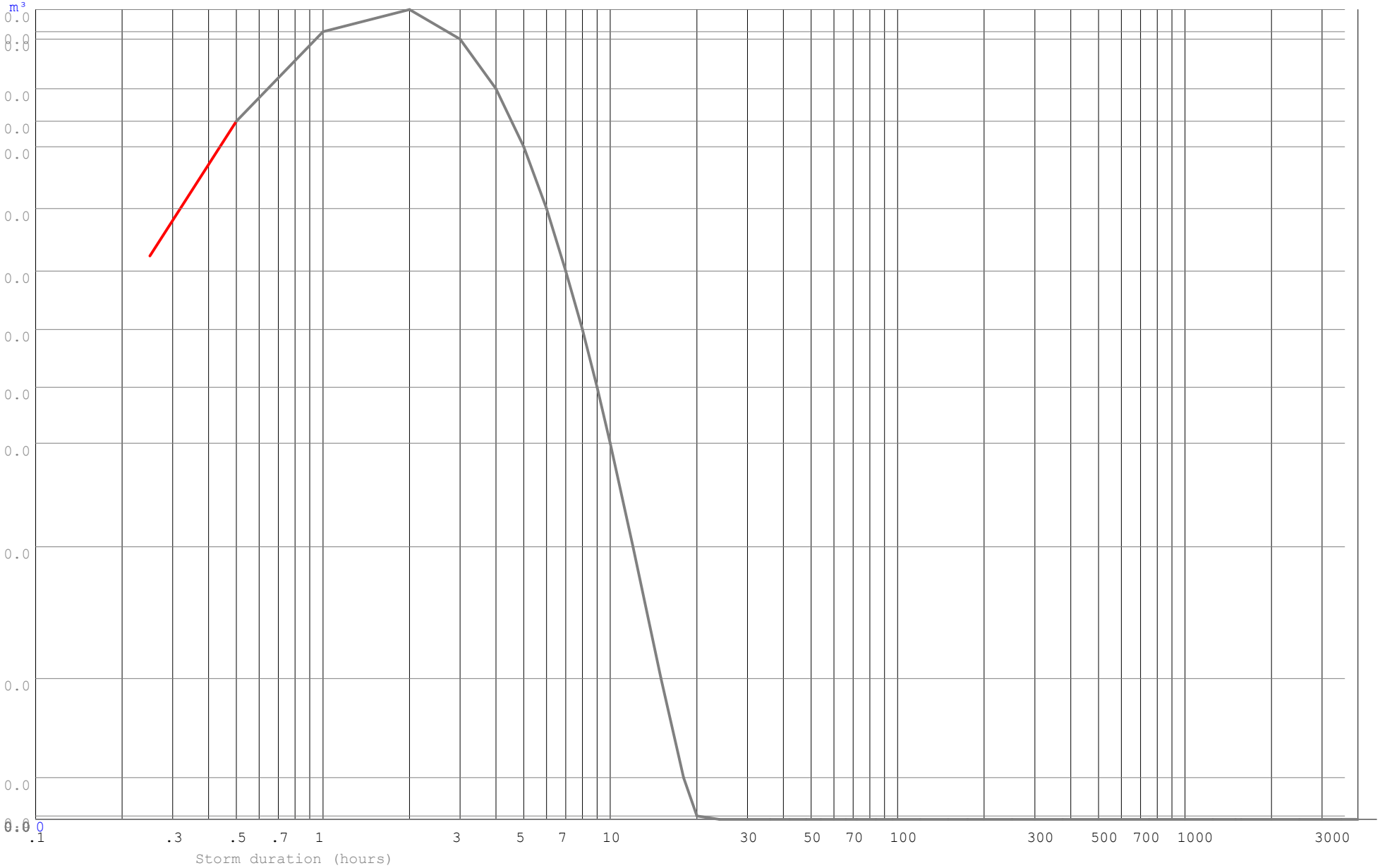
Job No. C3429			
Sheet no. 4			
Date 06/03/25			
Project Warren Creek, The Warren, Caversham, RG4 7TQ	By MH	Checked	Reviewed
Title Hydrograph Storage Calcs - 1l/s			

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	8.08	0.25	127.47	0.2	
0.5	10.01	0.50	83.83	0.3	
1	11.30	1.00	52.63	0.6	
2	11.62	2.00	32.00	1.2	Peak found
3	11.20	---	23.64	1.8	
4	10.48	---	18.98	2.4	
5	9.65	---	15.95	3.0	
6	8.76	---	13.82	3.6	
7	7.87	---	12.21	4.2	
8	7.03	---	11.00	4.8	
9	6.20	---	10.02	5.4	
10	5.40	---	9.22	6.0	
12	3.91	---	7.98	7.2	
15	2.02	---	6.69	9.0	
18	0.60	---	5.78	10.8	
20	0.05	---	5.32	12.0	
24	0.00	---	4.60	14.4	
30	0.00	---	3.84	18.0	
36	0.00	---	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	

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. C3429		
			Sheet no. 5		
			Date 06/03/25		
	Project Warren Creek, The Warren, Caversham, RG4 7TQ		By MH	Checked	Reviewed
	Title Hydrograph Storage Calcs - 1l/s				

Sequential storage volume at specific storm durations.



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.

Hydrological Data:-

FSR Hydrology:-

Location	= READING	Grid reference	= SU7272
M5-60 (mm)	= 18	r	= 0.40
Soil runoff	= 0.30	SAAR (mm/yr)	= 650
WRAP	= 2	Area = England & Wales	
Hydrological area = 7		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 = 0.002199 Km² - 0.22 Ha - 2199 m² % Urbanisation = 29.00%

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

$Q_{BAR(rural)}$ = 0.367 (l/s)

$Q_{BAR(urban)}$ = 0.719 (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.

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Job No. C3429			
Sheet no. 2			
Date 06/03/25			
Project Warren Creek, The Warren, Caversham, RG4 7TQ	By MH	Checked	Reviewed
Title IoH 124 (Qbar(urban))Runoff calcs			

MasterDrain
HY 10.01
Calculated data:-

Mean Annual Peak Flow $Q_{BAR(urban)}$ = 0.72 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	0.611	2.779	100yr	0.002	2.264	10.297
2yr	0.001	0.633	2.877	100yr+20%	0.003	2.717	12.357
5yr	0.001	0.920	4.184	100yr+30%	0.003	2.944	13.387
10yr	0.001	1.165	5.296	200yr	0.003	2.660	12.095
30yr	0.002	1.603	7.290	200yr + 30%	0.003	3.458	15.724
50yr	0.002	1.883	8.565	500yr	0.003	3.228	14.678
				1000yr	0.004	3.709	16.868

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).

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. C3429 Sheet no. 1 Date 06/03/25	
MasterDrain HY 10.01	Project: Warren Creek, The Warren, Caversham, RG4 7TQ	By: MH	Checked / Reviewed
	Title: Pre & Post SW Calcs prior to SuDS mitigation		

Data:-

Hydrology (FSR):-

Location = READING		WRAP	= 2
Long reference	= 472172	Grid reference	= SU7272
M5-60 (mm)	= 18	SAAR (mm/yr)	= 650
r	= 0.40	Soil	=0.30
Hyd. area	= 7	Hyd. zone	= 5
Hydrograph	= Winter	Area = England & Wales	

Site values used in design:-

Total site area	= 0.2199 ha	Climate change factor	= 45%
Pre-dev area drained	= 0.0630 ha	Post-dev area drained	= 0.0340 ha
Imperm runoff factor	= 100%	Perm runoff factor	= 20%

Pre-development

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

Post-development

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

Calculations:-

Revised Post-dev Imperm. area = 0.034 ha
Equiv. Post-dev Imperm. area = 0.034 ha
Equiv. Post-dev Perm. area = 0.037 ha
Total Pre-dev equiv. area ha = 0.094 ha
Total Post-dev equiv. area ha = 0.071 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	18.4	11.8	7.6	4.7	2.9	2.1	1.8	1.5	18.4	N/A	18.4	1
30	44.6	29.0	18.1	11.0	6.5	4.8	3.8	3.2	44.6	N/A	44.6	30
100	57.6	37.9	23.8	14.5	8.6	6.2	5.0	4.2	57.6	N/A	57.6	100

Post-dev peakflow runoff (l/s)

R.P.	15	30	60	120	240	360	480	600	Max	CCF	Final	R.P.
1	13.9	8.9	5.7	3.6	2.2	1.6	1.3	1.1	13.9	45	20.1	1
30	33.6	21.9	13.7	8.3	4.9	3.6	2.9	2.4	33.6	45	48.7	30
100	43.5	28.6	17.9	10.9	6.5	4.7	3.7	3.1	43.5	45	63.0	100

100 year 6 hour (x Climate Change Factor) storm gives:-
Pre-dev runoff volume m^3 = 54.0m^3
Post-dev rainfall volume = 59.0m^3
Post-dev volume m^3 (excess above SUDS) = 59.0m^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 = 59.0m^3
Post-dev 5mm imperm volume = 1.7 m^3
Post-dev 5mm perm volume = 9.3 m^3

$Q_{BAR(rural)}$ = 0.367 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.

Data summary.

Use the data below for the SUR1 form

Site areas:-

Total site area =	0.2199 ha ;2199.0 m²	[3A]
Pre-development impermeable area =	0.0630 ha	[3B]
Pre-development permeable area =	0.1569 ha	
Post-development impermeable area =	0.0340 ha	[3C]
Post-development permeable area =	0.1859 ha	

Peak runoff:-

Pre-development 1 year storm (15min) =	18.4 l/s	[6A]
Pre-development 100 year storm (15min) =	57.6 l/s	[6C]
Post-development 1 year storm (15min) =	13.9 l/s	[6B]
Post-development 100 year storm (15min)=	43.45 l/s	[6D]

Greenfield runoff:-

$Q_{BAR(rural)}$ = 0.367 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]= 78.2m³
Post-development 100 yr/6hr storm (add. volume with no SUDS) [12B]= 59.0m³
Post-development 100 yr/6hr storm (add. volume with SUDS) = 59.0m³
Post-development add. predicted volume (No SUDS) [12C] = -19.2m³

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

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