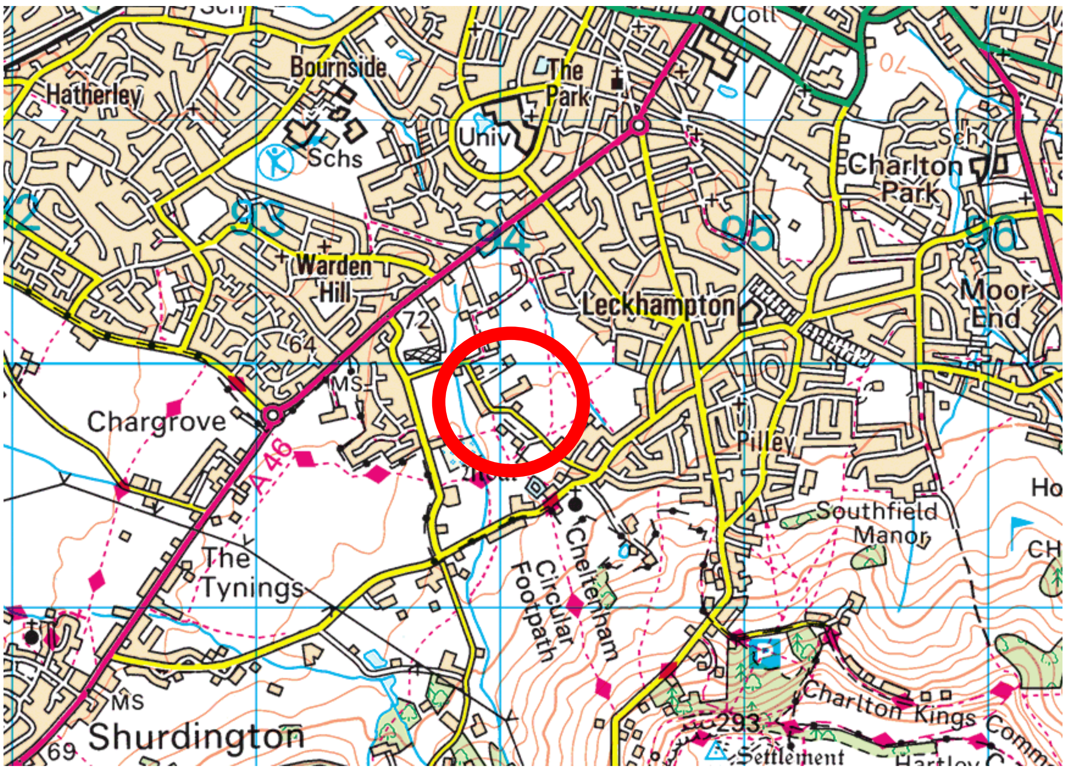
5. FLOOD RISK ASSESSMENT

5.1. Site Description

The site is located adjacent to Kidnappers Lane in Leckhampton, Cheltenham, approximately 2.5km south of Cheltenham Town centre. The site centred OS Grid Co-ordinates are E394050, N219850.



The development site is a former Plant Nursery and covers an area of approximately 1.4 hectares.

To the south of the Application Site is Kidnappers Lane, to the west and north fields, and to the east existing properties and fields.

The application site falls south and west towards the boundary ditches. Site levels vary from approximately 82.0mAOD in the south to 77.0mAOD in the north with an average gradient of 1 in 40.

5.2. Flood Zone

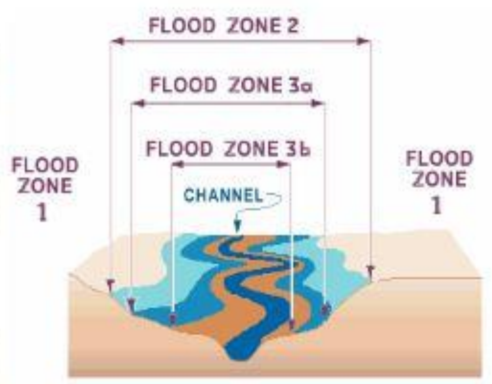
Table 1 of Planning Practice Guidance ‘Flood Risk and Coastal Change’ defines different flood zones according to the probability of river and sea flooding, ignoring the presence of any defences.

The flood zones are shown below:-

Zone 1: Low Probability
This zone comprises land assessed as having a less than 1 in 1000 annual probability of river flooding in any year (<0.1%).

Zone 2: Medium Probability
This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) in any year.

Zone 3a: High Probability
This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any year.



Zone 3b: The Functional Floodplain
This zone comprises land where water has to flow or be stored in times of flood. This Flood Zone comprises land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or at another probability to be agreed between the LPA and the Environment Agency.

As part of the L2SFRA assessment, a 1D-2D model has been developed for key watercourses within strategic allocation C17 at Leckhampton & Shurdington, namely the Hatherley Brook and Ham Brook. The L2SFRA shows flooding associated with the watercourses however the Kidnappers Lane site is entirely within Flood Zone 1 (low risk, less than 1:1,000 annual probability of flooding). Refer to flood maps contained in Appendix B. This has been confirmed by EA online mapping (see Section 5.4.1) and mapping provided by Cheltenham Borough Council’s Engineer, refer to CBC correspondence in Appendix E.

5.3. Flood Risk Vulnerability Classification

Flood risk vulnerability classifications are shown in Table 2 of the Planning Practice Guidance ‘Flood Risk & Coastal Change’.

The Proposed Development will comprise of residential development, open space, landscaping, parking and supporting infrastructure and utilities; and the creation of a new vehicular access from Kidnappers Lane.

In accordance with Table 2 the Proposed Development is classified as:
More Vulnerable – Dwellings.
Water Compatible – Amenity Open Space.

Flood Risk Vulnerability and Flood Zone ‘Compatibility’ is shown in Table 3 of the

Planning Practice Guidance 'Flood Risk & Coastal Change' below:-

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

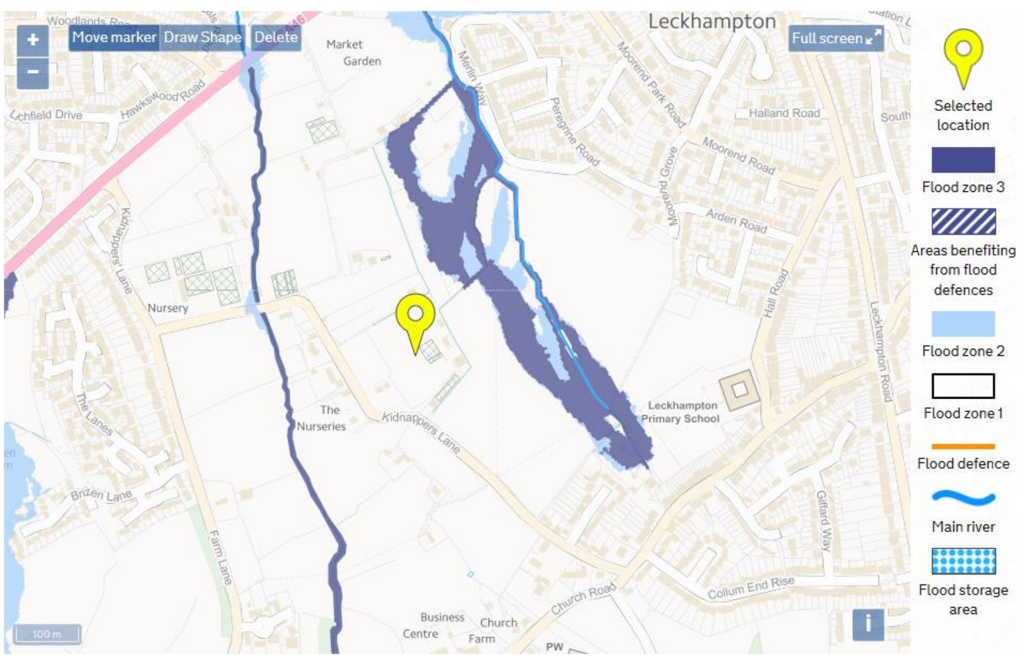
All types of development is appropriate in Flood Zone 1.

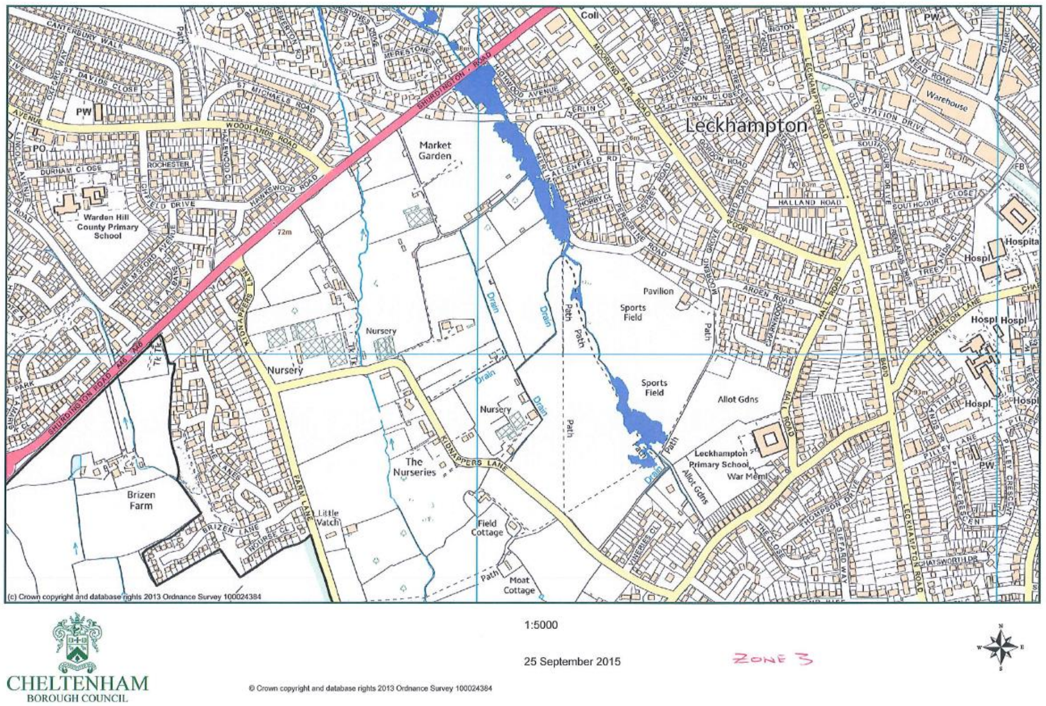
5.4. Flooding Hazards

5.4.1. Fluvial & Tidal Flooding

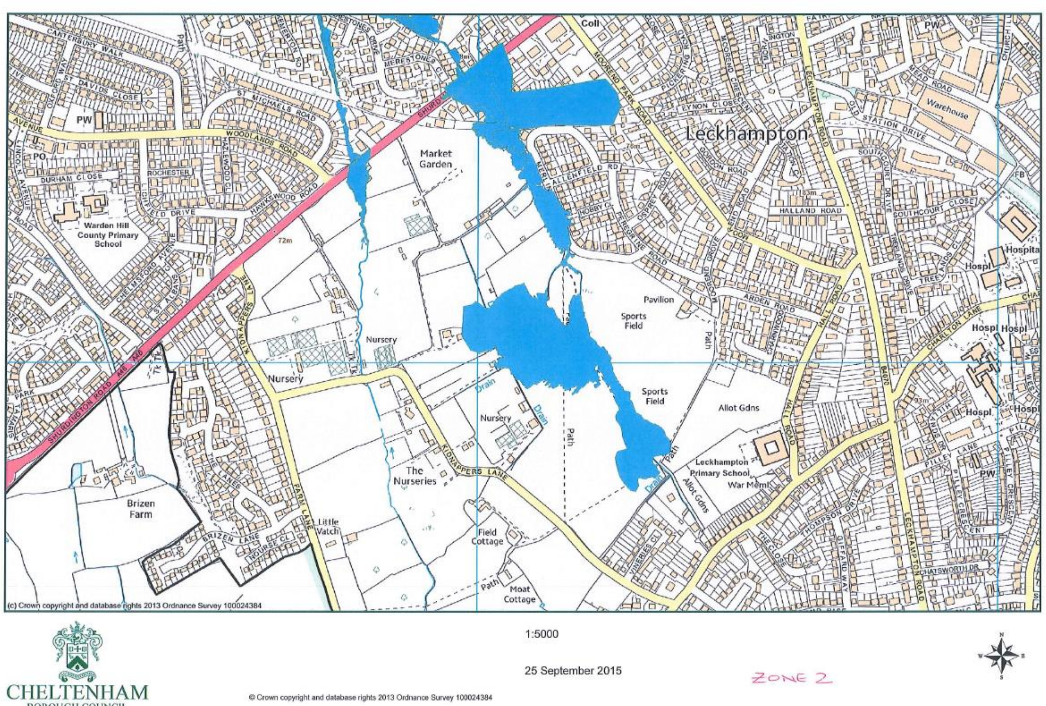
The nearest watercourses are the Hatherley Brook approximately 150m to the west and an unnamed watercourse approximately 150m to the east.

The L2SFRA mapping, CBC mapping and EA mapping below all show the site to be entirely within Flood Zone 1 (low risk, less than 1:1,000 annual probability of flooding).

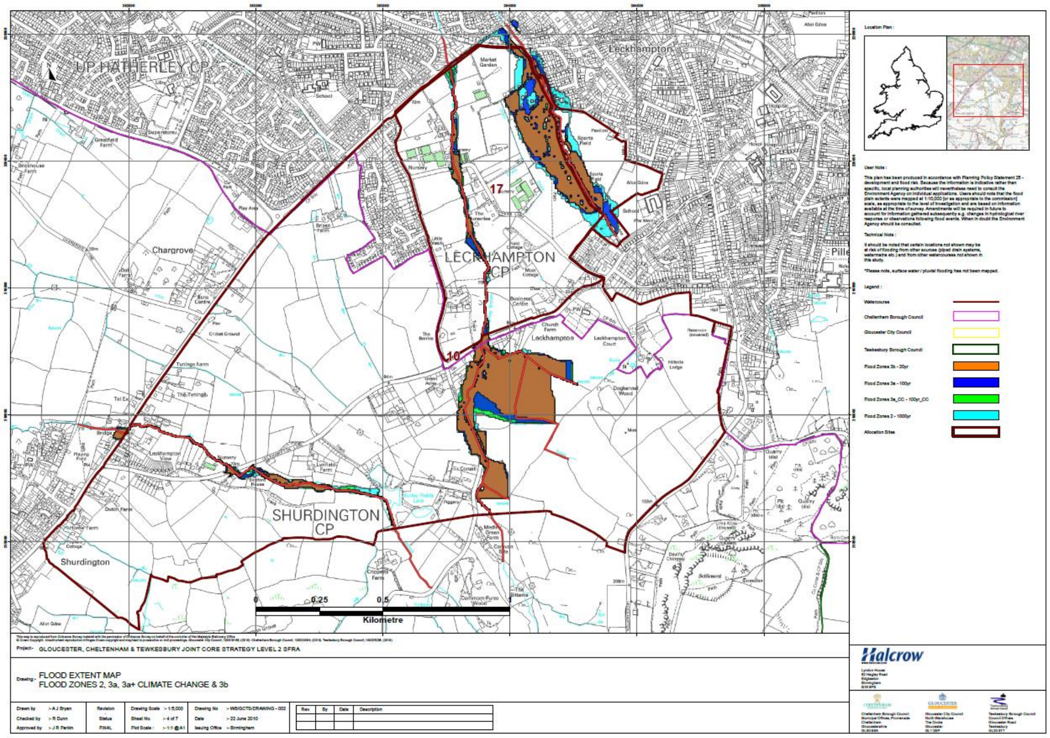




Cheltenham Borough Council Flood Map – Flood Zone 3



Cheltenham Borough Council Flood Map – Flood Zone 2



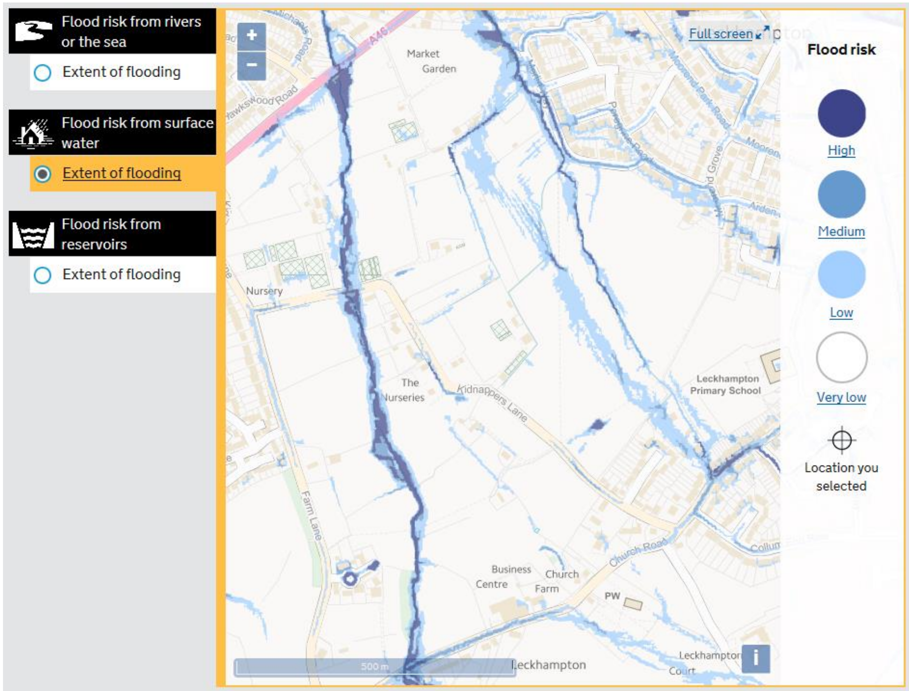
The CBC mapping shows potential flood risk adjacent to the northern boundary associated with the existing ditches and watercourse. Housing will be located away from this area and will be elevated to ensure that it is not at risk from flooding.

5.4.2. Flood Risk from Land (Surface Water Overland Flow)

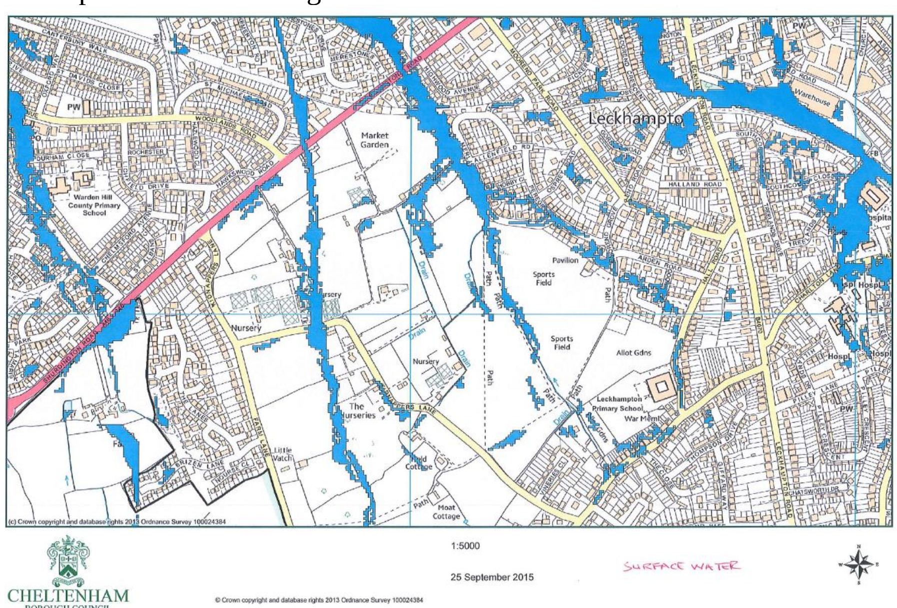
Intense periods of rainfall over a short duration can often lead to overland flow as rainwater is unable to infiltrate into the ground or enter drainage systems. It is made worse when soils are saturated so that they cannot accept any more water. Surface water run-off is currently collected by on site ditches and outfalls to the Hatherley Brook.

The EA surface water flood map below has been generated by simulating rainfall events over the site to determine where surface flows and collects based on Lidar survey information. The rainfall events chosen for modelling were the 1 in 30, 1 in 100 and 1 in 1000 year storm return periods. These events were modelled for the 1 hour, 3 hour and 6 hour storm durations.

High – Site area that has a chance of flooding of greater than 1 in 30 (3.3%) in every year
Medium - Site area that has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%) in every year
Low - Site area that has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%) in every year
Very Low – Site area that has a chance of flooding of less than 1 in 1000 (0.1%) in every year



EA Map – Risk of Flooding from Surface Water



CBC Map – Risk of Flooding fron Surface Water

The results of the modelling show that the site is generally located in a very low area of surface water flooding (flooding from rainfall) with a low risk of flooding from the ditches along the boundary. The proposed new development will be designed to ensure that existing overland flow pathways are maintained where required. Surface Water run-off from the proposed development will be collected and managed through the use of Sustainable Drainage System.

5.4.3. Groundwater Flooding

Groundwater flooding occurs when the sub-surface water levels in the ground rise above surface elevations, which is most likely to occur in low lying areas underlain by permeable rocks (aquifers).

The underlying soils are generally clay and are unlikely to allow the free passage of groundwater; the risk of flooding from groundwater is therefore considered to be low.

The existing site generally falls towards the north and the ditches along the boundaries. In the unlikely event that the ground water table rises above existing ground levels, the proposed development will be designed to ensure a flood route is maintained which will convey and channel groundwater away from site and towards the pond and ditches, mimicking the existing drainage regime for the site.

The SFRA states that there have been no reported occurrences of ground water flooding.

The risk of groundwater flooding is therefore considered to be negligible.

5.4.4. Flooding from Sewers

Sewer flooding occurs when sewers are overwhelmed by heavy rainfall or when they become blocked. The likelihood of flooding depends on the capacity of the local sewerage system.

Severn Trent Water records show that there are no sewers within or adjacent to the site. There are sewers approximately 350m to the west in Farm Lane, approximately 450m to the north in Woodlands Lane, approximately 250m to the east in Merlin Way, and approximately 250m to the south in Vineries Close. Refer to Severn Trent Water sewer records contained within Appendix G. The risk of flooding from these sewer is considered to be low.

The surface water run-off from the proposed development will be collected and managed through the use of Sustainable Drainage Syetem. This system will be designed to cater for the 1 in 100 year plus 30% climate change without flooding occuring. In the unlikly event that a sewer becomes blocked the proposed development will be designed to ensure flood routes are provided to convey and direct flows through the development without causing flood risk to existing or new properties.

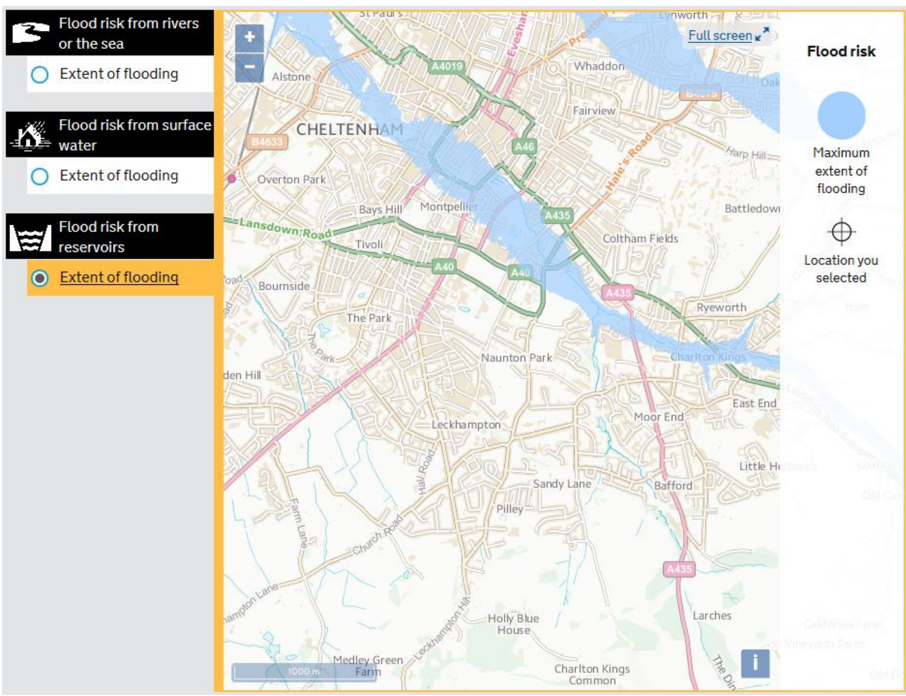
The risk of flooding from existing and proposed future sewers is therefore considered to be negligible.

5.4.5. **Artificial Sources**

Artificial sources of flooding include reservoirs, dams, canals and lakes upstream of the site.

The EA online mapping identifies the nearest potential risk as flooding from the EA's Dowdeswell Reservoir flooding the River Chelt approximately 2km to the northeast. Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency ensure that reservoirs are inspected regularly and essential safety work is carried out.

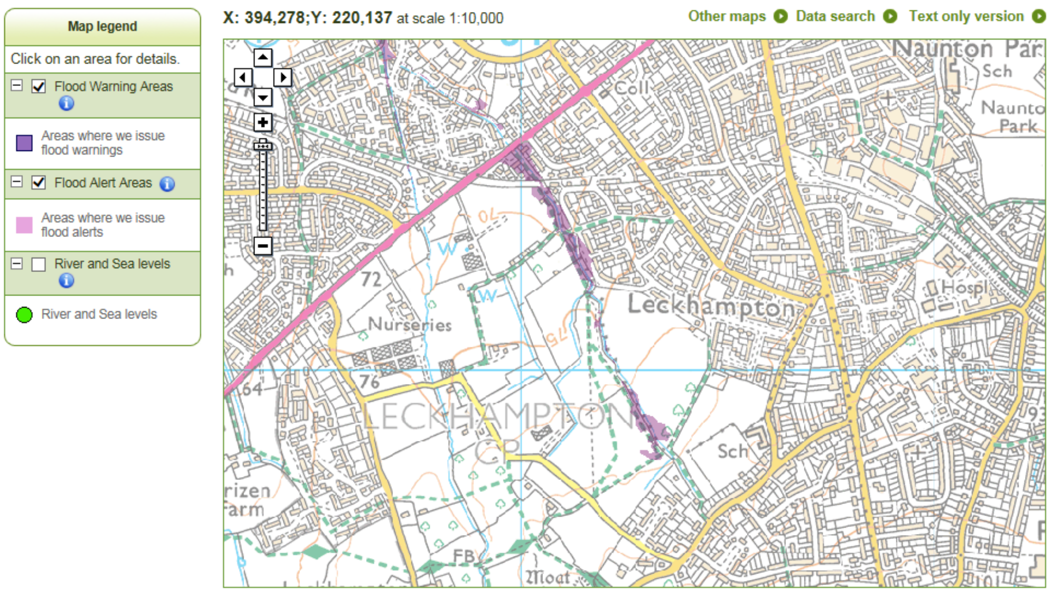
The EA map below shows the location of the nearest risk.



5.4.6. **Flood Warning & Flood Alert Areas**

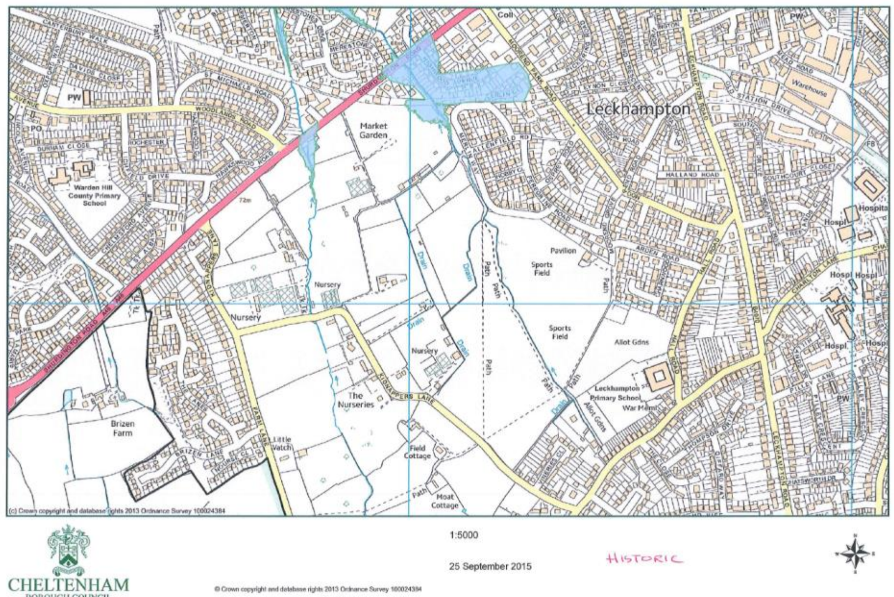
The EA map below shows details of Flood Warning and Flood Alert Areas. The floodplain adjacent the watercourse to the east of the site are shown as a Flood Alert Area; the Environment Agency issues flood alerts to homes and business in these areas when flooding is possible.

The map below shows that the proposed built development will be located outside of the flood warning and flood alert area.

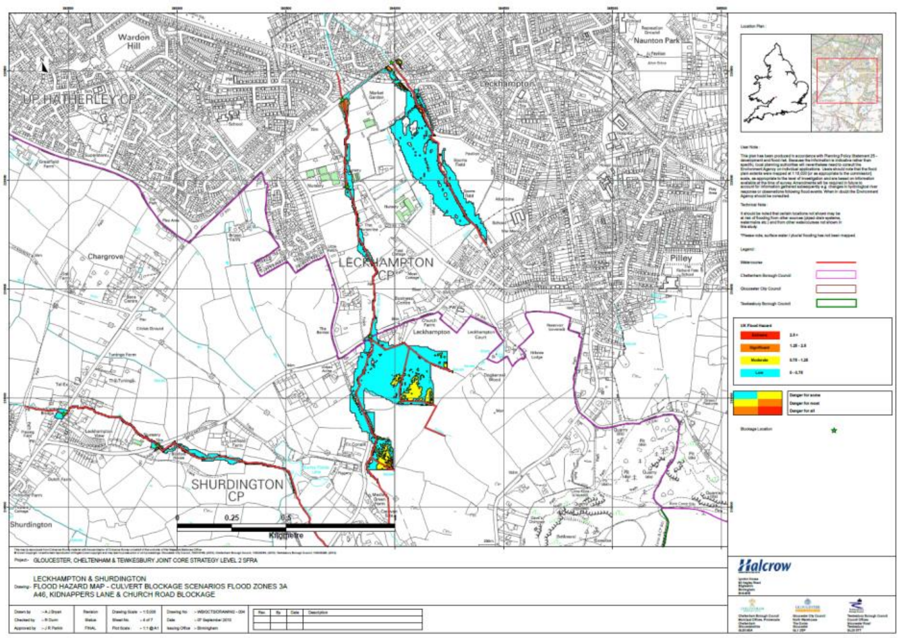


5.5. Historic Flooding

The nearest areas of recorded flooding are from the two watercourses to the north upstream of the A46 Shurdington Road (see Cheltenham BC mapping below). There are no recorded incidents of flooding in or adjacent to the site.



CBC Map – Historic Flooding



L2SFRA A46 Culvert Blockage Hazard Map

5.6. Sequential Test

Paragraph 101 of the NPPF states that:

The aim of the Sequential Test is to steer development to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. The Strategic Flood Risk Assessment will provide the basis for applying this test. A sequential approach should be used in areas known to be at risk from any form of flooding'.

The site is entirely in Flood Zone 1 and therefore is in accordance with the NPPF sequential approach to locate development in areas of lowest flood risk.

5.7. Exception Test

Paragraph 102 of the NPPF states that:

'If, following application of the Sequential Test, it is not possible, consistent with wider sustainability objectives, for the development to be located in zones with a lower probability of flooding, the Exception Test can be applied if appropriate. For the Exception Test to be passed:

It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared: and

a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking in to account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.'

The Flood Risk Vulnerability and Flood Zone 'Compatibility' Table 3 within Section 5.3 shows that the proposed development is appropriate and compatible.

5.8. Climate Change

The SuDS design will include a 40% allowance for the predicted increase in rainfall intensity over the lifetime of the residential development (100 year design life to 2115).

Peak rainfall intensity allowance

Increased rainfall affects river levels and land and urban drainage systems.

When to use the peak rainfall intensity allowance

Table 2 shows anticipated changes in extreme rainfall intensity in small and urban catchments.

For flood risk assessments and strategic flood risk assessments, assess both the central and upper end allowances to understand the range of impact.

Table 2 peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

Table 2 from Environment Agency guidance

5.9. Probability of Flood Risk

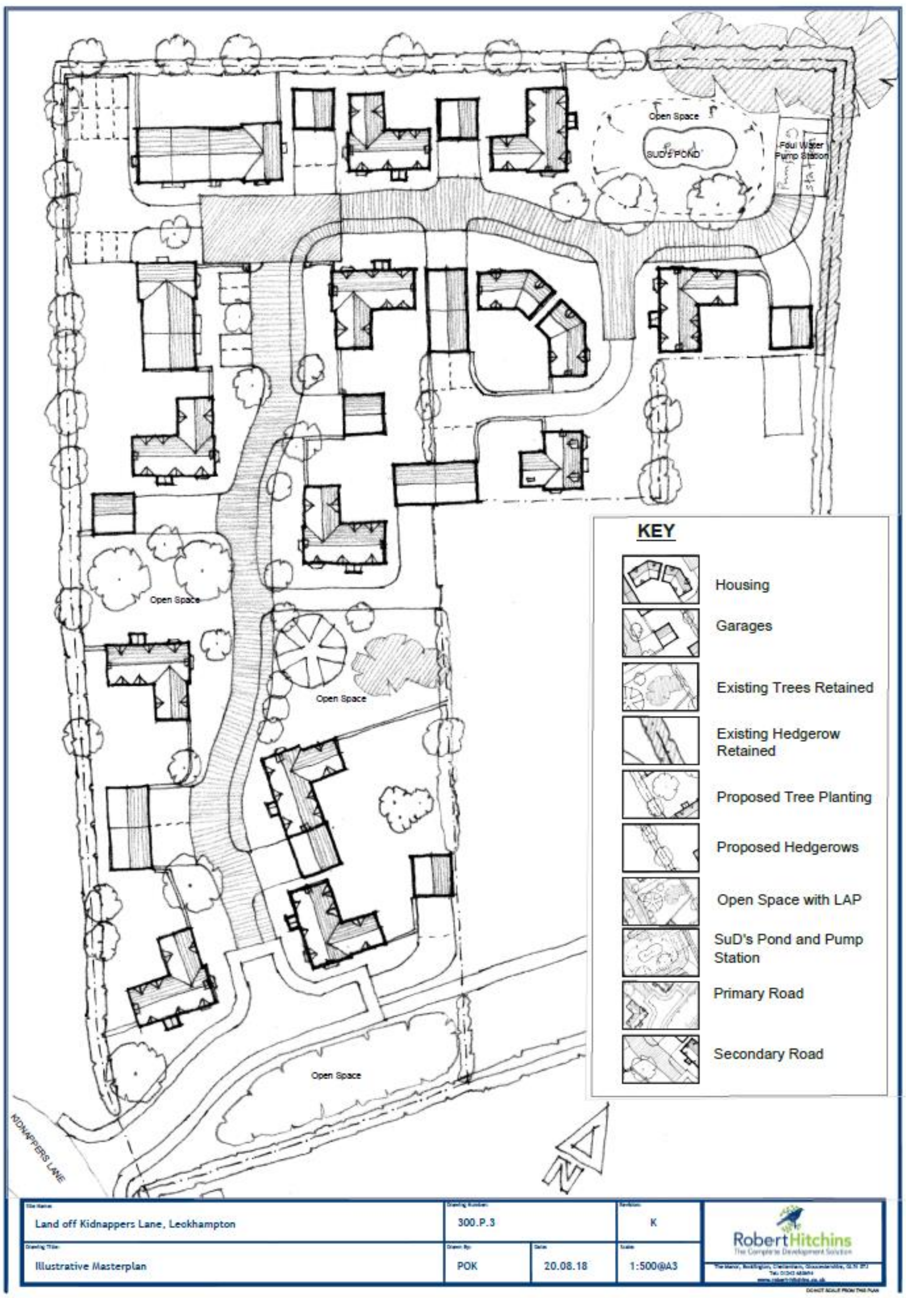
Flood mapping shows fluvial flood risk associated with the two watercourses to the east and west of the site and that the proposed development will be entirely within Flood Zone 1 having a low flood risk (less than 0.1%).

All flood hazards appropriate for this site have been evaluated within section 5.0. It has been concluded that the site is not at risk of flooding from any of the hazards identified and therefore the probability and consequences of flooding from all sources is considered to be negligible and the risk of flooding low.

6. DEVELOPMENT PROPOSALS

6.1. Development

The outline planning application is for a residential development comprising of up to 25 dwellings, associated infrastructure, open space, and landscaping, with creation of new vehicular access from Kidnappers Lane.



6.2. Foul Drainage Strategy

Severn Trent Water (STW) has been consulted on foul flows from the proposed development, refer to records and correspondence in Appendix G.

STW has advised that foul flows could connect to their existing 225mm foul sewer at the junction of Kidnappers Lane/Church Road to the south, to their 150mm sewer to the east in Farm Lane, or to their 300mm sewer to the west. To avoid crossing third party land the preferred point of connection is to the 225mm foul sewer at the junction of Kidnappers Lane/Church Road.

STW has confirmed that the flow from the development will not have a significant impact on their sewers (25 dwellings = 0.4l/s pumped @ 2 x Dry Weather Flow).

Due to levels it will be necessary to pump flows, a sewage pumping station will therefore be required as indicated in the northeast corner of the site.

All private foul drainage for the development will be designed in accordance with the Building Regulations Part H 2010.

It is intended to offer the foul sewers and pumping station to Severn Trent Water for adoption under a Section 104 Agreement in accordance with The Water Industries Act 1991. All details will be subject to technical approval at the detailed design stage as part of the S104 process.

6.3. Surface Water Drainage Strategy

A surface water drainage strategy has been developed that incorporates a Sustainable Drainage System and is shown on drawing No. 421-200 Drainage Strategy within Appendix F. The proposed SuDS will ensure that flood risk resulting from pluvial events (rainfall) will be managed on-site and that flood risk will not be increased elsewhere as a result of the development. The strategy is intended to provide guidance and to inform the detailed design; full details of the SuDS will be submitted as a reserved matters planning application or to discharge a planning condition attached to the outline permission.

The surface water drainage and SuDS will be designed in accordance with the following:

Building Regulations Part H: Drainage & Waste Disposal
Sewers for Adoption and the requirements of Severn Trent Water.
Ciria C753: The SuDS Manual.
BS8582: Code of Practice for Surface Water Management for Development Sites.
EA/Defra: Preliminary Rainfall Run-off Management for Developments
Other standards/guidance relevant at the time of detailed design

The hierarchy for the disposal of surface water is as follows (Part H of Building regulations):

Rainwater shall discharge to one of the following, listed in order of priority:
(a) an adequate soakaway, or some other adequate infiltration system; or, where that is not reasonably practicable,

(b) a watercourse; or, where that is not reasonably practicable,
(c) a sewer.

BGS records indicate that the solid geology for the site is Charmouth Mudstone Formation (CMF) which generally comprises of firm to stiff clay. The records show superficial deposits of Cheltenham Sands and gravels. Whilst it is considered that the bands of sand and gravel may be suitable for infiltration drainage, these superficial deposits are usually located in isolated areas and are generally located between layers of clay. The use of SuDS in the form of infiltration drainage to manage surface water run-off from this site is unlikely but will be confirmed by intrusive investigation and infiltration tests.

In order to manage the surface water run-off from the site, the surface water flows have been designed to drain to an attenuation pond in the northeast of the site with an outfall to an adjacent ditch. The pond has been designed as an online pond to provide storage and treatment to the surface water run-off from the proposed development prior to final outfall to the ditch.

To mitigate for the additional surface water run-off volume resulting from the proposed development, refer to section 6.4 of this report, the EA/Defra and Ciria guidance together with BS8582 and SuDS standards recommend that Extended Attenuation Storage is provided and that run-off is restricted to the existing 1:1 green-field rate for the 1:1 event and the Mean Annual Flood Flow (Qbar, 1:2.3 event) green-field rate for all events above the 1:1 and up to the 1:100 with allowance for climate change. This approach ensures that sufficient run-off is retained on site for extreme events to protect the receiving water course in times of flooding. Existing run-off rates for the 1:1 event and Qbar are however less than 5 l/s. The discharge for all events will therefore be restricted to 5 l/s which is considered to be the minimum flow that can be achieved without the risk of blockage to the flow control devices.

Micro-drainage has been used to simulate the proposed attenuation pond for the 1 in 1, 1 in 30, and the 1 in 100 +40% climate change events assuming an impermeable area of 0.56ha, 40%. The results of the simulation are contained within Appendix H and are summarised below:

Event	Discharge (l/s)	Volume (m3)	Depth (m)	Freeboard (m)
1	4.9	46	0.28	0.97
30	5.0	139	0.67	0.58
100 + 40%	5.0	300	1.13	0.12

The half drain time for the pond based on an attenuated volume of 300m3 is approximately 8 hours.

In order to restrict the surface water flows a suitable flow control device (E.g. Hydro-brake) will be used and all flows attenuated within the pond.

The proposed surface water sewers to serve the new development will be designed to meet the hydraulic design and construction requirements within “Sewers for Adoption”.

All private surface water drainage for the development will be designed in accordance with the Building Regulations Part H 2010.

It is intended to offer the surface water sewers to Severn Trent Water for adoption under a Section 104 Agreement in accordance with The Water Industries Act 1991. All details will be subject to technical approval at the detailed design stage as part of the S104 process.

6.4. Development Run-off Volume

Guidance recommends that the 100 year 6 hour event is used to compare existing and developed run-off volumes.

The developed run-off volumes have been calculated using the following formula (from Ciria C753 Section 24.10):

Volume = RD x A x 10 x [((PIMP/100)α0.8) + ((1-(PIMP/100))βSPR)]

RD = Rainfall depth (mm).
PIMP = Percentage impermeable area.
A = Total Catchment Area (ha).
SPR = Standard percentage run-off for soil type (as a fraction).
α = Proportion of impermeable draining to system at 80% (0.8) run-off (roofs, parking, roads, etc).
Can be increased to 100 % for more conservative assessment (will depend on materials, drainage...).
β = Proportion of pervious areas draining to system, 0-1.0 (landscaped area, etc).

PIMP = 40% (0.56ha Impermeable)

SPR (Soil Type 4) = 40% (0.40)
α = 1.0 (100% run-off from impermeable surfaces)
β = 0.5 (50% run-off from landscaped areas to drainage system)
RD = 100 year 6 hour rainfall (6 hours @ 9.808mm/hr, from Micro Drainage) = 58.85mm
Rainfall has been calculated using Micro Drainage with M5-60 = 18mm and Ratio r = 0.37 (from Wallingford Maps).

Total run-off from developed site (1.4 ha) =
10 x 58.85 x 1.4 x [((40/100)x1.0x0.8) + ((1-(40/100))x0.5x0.4)] = 363 m3
40% allowance for climate change = 145 m3

Developed 100 Year + 40% CC 6 Hour Run-off Volume = 508 m3.

Net Increase in Run-off Volume for 1:100 6 Hour = 178 m3

To mitigate for the increase in the volume of run-off extended attenuation will be provided and the discharge from the site will be restricted to 5 l/s for all events (refer to Section 6.3).

6.5. Water Quality

The proposed surface water run-off from the site mimics existing Greenfield conditions and discharges to the existing ditch on the northern boundary.

The Water Framework Directive (WFD) shows that the downstream receiving watercourse, the Hatherley Brook, is currently assessed as having a moderate status. The WFD objective for the Hatherley Brook is to achieve good status by 2027.

SuDS will be used to ensure that the proposed development will not result in deterioration in the status of the watercourses or compromise the WFD objectives.

The proposed development will include roads, hard standings, roofs and landscaped areas. Run-off from roofs is unlikely to contain significant pollution. Run-off from roads and hard standings will pick up fuel, oil, heavy metals, rubbish and other pollutants. Run-off from landscaped areas could include pesticides and fertilisers.

Higher concentration of pollutants occur in the early stages of a storm event known as the ‘first flush’ and is due to higher initial rainfall intensities, greater erosion potential and to greater solids and pollutants that have built up on urban surfaces during preceding dry weather. To remove pollution guidance recommends that the run-off from small frequent events and the initial run-off from larger and rarer events is captured and treated using SuDS.

The main techniques used to remove pollutants are filtration and detention. Improvements to storm water quality can be achieved by filtering the run-off (particularly for small frequent events) using a variety of media such as gravels (permeable paving and filter trenches), grass/vegetation (swales, basins and ponds). Storing run-off with controlled discharges allows sedimentation to take place which also contributes to water quality improvements.

During construction there is also an increased risk of pollution particularly from silt and sediment. Temporary pre-treatment might be needed prior to discharge to the main drainage system. Areas of permeable or porous construction will also need to be protected from silt during construction.

Ciria C753, Chapter 26 provides guidance on Water Quality Management: Design Methods. The SuDS pollution mitigation index should equal or exceed the pollution hazard index.

Tables 26.2 and 26.3 below provide details of the indices.

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

	Mitigation indices[1]		
Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

The table below summarizes the Indices for the proposed development. The mitigation index can be seen to exceed the pollution index for all hazards.

	Total Suspended Solids	Metals	Hydrocarbons
Pollution Index (Residential Roofs)	0.2	0.2	0.05
Pollution Index (Driveways, Residential Roads)	0.5	0.4	0.4
Mitigation Index (Pond)	0.7	0.7	0.5

The following techniques will also be used, where appropriate, to help remove pollution:

Trapped Gullies (Access Roads, Drives and Parking Areas) – Sedimentation.
Permeable/Porous Surfaces (Drives and Parking Areas) – Filtration through gravel bases.
Filter Trenches (Roofs, Drives & Parking Areas) – Filtration.

Ciria C753, Section 23.5 provides guidance on treatment design for ponds and suggests a treatment volume equivalent to 10-15mm of rain over the contributing area.

The pond permanent pool volume is approximately 40m3, the equivalent of 7mm of rain over the 0.56ha contributing area. Additional treatment will be provided in other forms of at source SuDS.

Suitable SuDS techniques are discussed in more detail in Section 6.6. Full details of the SuDS will be provided at detail design stage and will be submitted as part of a reserved matters planning application or to discharge any outline planning conditions relating to surface water drainage and SuDS.

6.6. SuDS Details

The SuDS identified below are considered to be the techniques and devices best suited to the proposed development. Additional SuDS as identified in Ciria C753 'The SuDS Manual' could be used to provide attenuation and improvements in water quality.

6.6.1. Water Butts

Water butts could be used for individual dwellings to collect water for reuse externally for irrigation. The provision of water butts will help reduce potable water consumption but will not provide significant attenuation, reduction in flows or treatment.

6.6.2. Permeable/Porous Surfaces

Permeable and porous surfaces could be used externally to help reduce run-off and remove urban pollutants. Any pollution will be filtered out by the granular construction and geotextile. Research has also shown that 5mm of rainfall will be retained within the granular construction and that run-off is only likely to take place for rainfall events where the rainfall depth exceeds this figure.

Construction of permeable and porous surfaces will be in accordance with supplier/manufacturer details. Adjacent impermeable surfaces will, where possible, be designed to shed water on to the permeable surfaces. Where practicable permeable/porous surfaces will be used for shared private driveways, private drives and private parking courts.

Due to the impermeable clay soils the permeable surfaces will need to be designed to discharge to the main sewer system via high level gullies or filter drain with details agreed with a Severn Trent Water.

Further guidance on pervious pavements is provided in Chapter 20 of Ciria C753 'The SuDS Manual'. Suitable types of permeable/porous surface include:

a. Permeable Clay & Concrete Block Paving;
b. Porous Asphalt;
c. Porous Bonded & Stabilised Gravels

6.6.3. **Filter Trenches**

Filter trenches could be used to convey flows, filter flows and provide subsurface storage. Because of the impermeable clay soils the filter trenches will need to be designed to discharge to the main sewer with details agreed with Severn Trent Water. Further guidance on trenches is provided in Chapter 16 of Ciria C753 'The SuDS Manual'.

6.6.4. **Storage Tanks, Large Pipes & Box Culverts**

Storage tanks, large pipes and box culverts could be provided under landscaped areas, roads, and hard standings to help attenuate flows; they would provide attenuation but not treatment. Depending on the final development layout there may be areas where it is not possible to use green SuDS and hard engineering solutions are necessary to attenuate flows. The tanks would be constructed in accordance with relevant standards and supplier / manufacturer details, and would include access chambers for inspection and maintenance. Further guidance on storage is provided in Chapter 21 of Ciria C753 'The SuDS Manual'.

6.6.5. **Attenuation Pond**

A pond will be used to provide storm water attenuation and treatment. Further guidance on ponds is provided in Chapter 23 of Ciria C753 'The SuDS Manual'. Refer also to section 7 of this report for further details.