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16-6953
Phase 2 and 3, Corinthian Park
Cheltenham, GL51 6UP

Flood Risk Assessment & Surface Water Management Plan

Hinton Properties Plc

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Date:	21/09/2018
Reference:	16-6953-FRA

Issue 5

Contents

Figures

Tables

Executive Summary

This combined Flood Risk Assessment (FRA) and Surface Water Management Plan (SWMP) has been prepared in support of Hinton Properties proposed development of Phase 2 and 3 of their ongoing development site located at Corinthian Park, Grovefield Way, Cheltenham. GL51 6UP. The Phase 1 development consisted of the construction of a flagship BMW dealership approved under planning application number 14_00656-Ful. It is intended to follow the approach previously accepted by the Lead Local Flood Authority (LLFA) put forward by Transport Planning Associates (TPA) in their previous report reference number 1303-30/FRA/01/A dated June 2013 and 1402-01SWP/01 dated September 2015 (contained within Appendix B of this report for reference).

It should be noted that the latter report deals with the drainage of the new access road off Grovefield Way which serves both a Flagship BMW Dealership, comprising a car showroom, servicing building with a 3000m² footprint plus car parking and the main access to the future Phase 2 and 3 development sites beyond. The developed Phase 1 site provided approximately 1.65 ha of impermeable area, and the access road will provide approximately 0.374ha of impermeable area.

This FRA is carried out in accordance with BS 8533:2011 [1], National Planning Policy Framework (NPPF), Planning Practice Guidance (PPG), Environment Agency (EA) Advice for Development, and following the guidance in CIRIA C624, C697 & C753. Reference is also made to the now replaced Planning Policy Statement 25 (PPS 25) and Planning Policy Statement 25 Practice Guide, which provided comprehensive tools for assessing and mitigating flood risk.

The proposed development site is a low risk (Zone 1) for fluvial or pluvial flooding; as shown on the EA's Risk of flood mapping.

The surface water drainage arising from the impermeable areas associated with Phase 2 development and its parking areas and access road is circa 1.825ha in area. Its proposed that these flows will discharge on an attenuated basis, to an existing Highway balancing pond system located along the northern boundary of the site which was constructed as part of the Phase 1 works via the existing gravity drainage system.

The surface water discharges associated with the Phase 2 development, will be contained on the site via a porous paving system together with cellular storage structures, subject to a restricted discharge of 8.4 l/s being accommodated within the existing Highway balancing pond arrangements located along the northern boundary of the development. The proposed outflow from the balancing pond will remain set at 10.2/s as per the agreed Phase 1 works**.** (with a further separate attenuation-based drainage system being provided to service the remainder of the Phase 3 site, subject to later detail design).

It is considered that this development will not increase the risk of flooding in the wider catchment as the surface water generated from the site will be contained within the proposed drainage systems and released on a controlled basis, and any exceedance from a potential culvert blockage and pond overtopping continues along its current flow path without change.

Any foul discharge from the new buildings and associated infrastructure will be connected to an existing private foul drain which crosses the Phase 2 development site, which will require a localised diversion. before out falling to an adopted 225mm diameter foul sewer located within the south west corner of the site, at STW Manhole reference 4400 which then discharges to public system located within North Road West.

Site Location:	The parcel of land as identified on the Site Location Plan (Appendix A) is located approximately 2 kilometres west of Cheltenham town centre, approached by Grovefield Way, a major access road which joins the A40 approximately 800m north from the site. The existing site is located within the business sector of Cheltenham and is surrounded by either agricultural land or business buildings. There are no main rivers running through or in the immediate vicinity of the site, although there is an unnamed ordinary watercourse which runs along the northern boundary of the site before being culverted where it crosses beneath the A40. The potential blockage of this culvert has been considered within this report. But it should be noted the culvert is in the ownership of Highways England.
Size and Current Land Use:	The Phase 2 commercial scheme area consists of approximately 2.45 hectares of green fields. The Phase 2 site has a level difference of up to 5m from approximately 40m AOD on the south-east boundary, to approximately 35m AOD in the south-west corner of the development site. The Phase 3 commercial scheme area consists of approximately 1.67 hectares of green fields. The Phase 3 site has a level difference of up to 2m from approximately 34.00m AOD on the south-east boundary, to approximately 32.0m AOD in the south-west corner of the development site. The existing 1250mm diameter ditch course outfall beneath the A40 has a recorded invert level of 31.21m AOD.

Proposed Development:	Proposed development of an, Aldi Store, Day Nursery and three new high specification office buildings and associated car parking / access road infrastructure. The following Phase 3 development will most likely consist of a further two number office buildings and associated infrastructure, the schematic for Phase 3 is indicative of the future proposals but may be subject to change
EA Flood Zone Classification:	Flood Risk Zone 1 – EA classification of less than 1 in 1000-year probability of flooding from rivers or seas in any given year.
Lead Local Flood Authority & SFRA:	Gloucestershire County Council (GCC) - Strategic Flood Risk Assessment Level 1, and Gloucestershire SuDS Design and Maintenance Guide.
Fluvial Flood Risk:	None
Tidal Flood Risk:	None
Surface Water Pluvial Flood Risk:	Low risk - small area recorded to be vulnerable to 1 in 1000-year event to a depth not exceeding 300mm, this is related to a local low spot which is to be removed during the Phase 2 development works. The overtopping of the pond provided to serve the development under the approved BMW phase 1 FRA and drainage strategy has been considered as well as culvert blockage for the 1250mm diameter culvert beneath the A40.
Artificial Sources	None
Sewers	None
Groundwater Flood Risk:	None
Historical Flooding:	None
Flood Risk Vulnerability Classification:	More vulnerable (applicable to the Phase 2 Day Nursery building only) – Less vulnerable to the remainder of phase 2 and 3 development.
Sequential and Exception Test:	Not Required

1. Introduction

This FRA is for the parcel of land as identified on the Site Location Plan (Appendix A). The site is located approximately 2 kilometres west of Cheltenham town centre, accessed by Grovefield Way, a major access road which joins the A40 approximately 800m north from the site. The existing site is located within the business sector of Cheltenham and is surrounded by either agricultural land or business buildings.

There are no main rivers running through or in the immediate vicinity of the site, although there is an unnamed ordinary watercourse which runs along the northern boundary of the site before being culverted where it crosses beneath the A40 within a 1250mm diameter pipe in the control of Highways England.

The Phase 2 scheme area consists of approximately 2.45 hectares of green fields and is bounded by tree lined hedgerows. The site has a level difference of up to 5m from approximately 40mAOD on the south-east boundary, to approximately 35mAOD in the north-west corner of the development site. The site also falls circa 3.0m across its width from south to north.

The Phase 3 scheme area consists of approximately 1.67 hectares of green fields. The site has a level difference of up to 2m from approximately 34mAOD on the south-east boundary, to approximately 32mAOD in the north-west corner of the development site.

The FRA is carried out in accordance with BS 8533:2011[1], National Planning Policy Framework (NPPF)[5], Planning Practice Guidance (PPG)[9] the guidance in CIRIA C624[2], C697[3] & C753[4]. Reference is also made to the now replaced Planning Policy Statement 25 (PPS 25) and Planning Policy Statement 25 Practice Guide, which provide comprehensive tools for assessing and mitigating flood risk[7,8]

Complete Design Partnership Ltd. has been instructed by Hinton Properties Plc, to produce the FRA and SWMP to support an ongoing planning application which is to be made to Cheltenham Borough Council.

The proposed development site is located within Flood Zone 1 on the EA Risk of Flooding from Rivers and Sea Flood map.

1.1 Reference Data

The following documents form part of this assessment (Table 1):

Document	Prepared by:	Reference/No.
Site Location Plan	Design Development Partnership	178-70
Proposed Block Plan	Design Development Partnership	178-96-Rev F
Flood Mapping / Data	Environment Agency and GOV	Web site
Local Flood Risk Management Strategy	Gloucestershire County Council (LLFA)	Flood Risk Management (Strategic Infrastructure)
Strategic Flood Risk	Halcrow on behalf of Cheltenham Borough Council (CBC)	Level 2 SFRA - 2013 Level 1 SFRA - 2007
SWMP – Drainage Strategy	Complete Design Partnership Ltd	16-6953-100 - Rev P5
Site Investigation Report	Structural Soils Ltd	July 2008 report no. 729381R2

Table 1: Reference Data

Existing site levels are shown upon the topographical survey. A copy of the drawing is included within Appendix A. For information, the site has a level difference of up to 8.0m from approximately 40mAOD on the south-east boundary, to approximately 32.0mAOD in the north-west corner of the development site.

The site is covered by Cheltenham Borough Council (CBC) Level 1 and later level 2 (2013) Strategic Flood Risk Assessment.

1.2 Climate change

Research by the Environment Agency (EA) shows that the probability of occurrence of severe flooding will increase. PPG sets out recommendations for contingency allowances for climate change. Table 2 summarises the relevant surface water increases that should be considered for an increase in peak rainfall intensity for developments with a design life horizon up to 2115:

Parameter	Total potential change anticipated for 2010-2039	Total potential change anticipated for 2040-2069	Total potential change anticipated for 2070-2115
Peak rainfall intensity	10%	20%	40%

Table 2: PPG Table 2 contingency allowances for climate change

The design life of the development is assumed to be around 100 years. Therefore, a climate change allowance of 40% on rainfall should be included in the design for the development. (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances)

2. Background to the site

2.1 General

The parcel of land as identified on the Site Location Plan (Appendix A) is located approximately 2 kilometres west of Cheltenham town centre, approached by Grovefield Way, a major access road which joins the A40 approximately 800m north from the site. The existing site is located within the business sector of Cheltenham and is surrounded by either agricultural land or business buildings. There are no main rivers running through or in the immediate vicinity of the site, although there is an unnamed ordinary watercourse which runs along the northern boundary of the site before being culverted where it crosses beneath the A40.

The Phase 2 scheme area consists of approximately 2.46 hectares and the Phase 3 site a further 1.67 hectares. The British Geological Survey and Environment Agency Maps have been studied to identify the site's Geological and Hydrogeological properties. The following figures show the information shown within them.

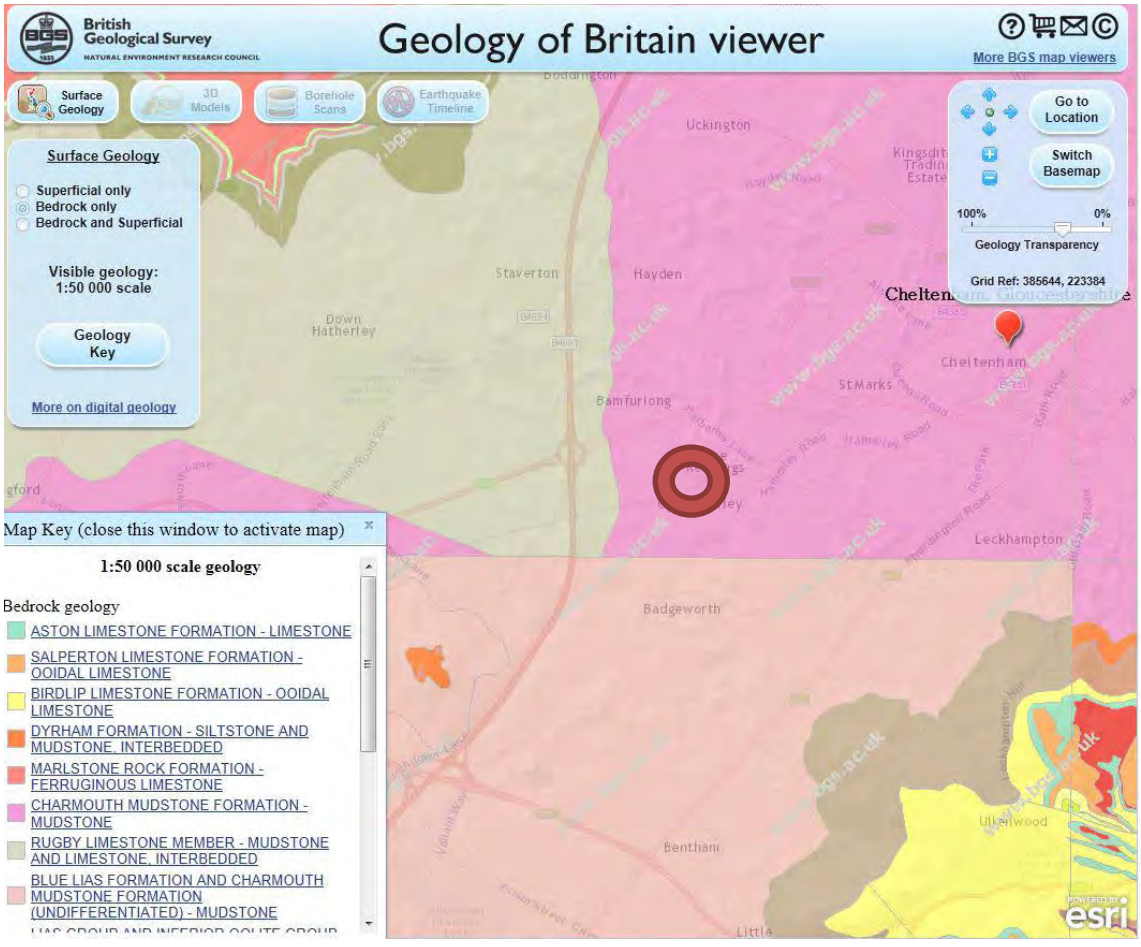


Figure 1: British Geological Survey Data – Bedrock Map

As can be seen in Figure 1a the British Geological Survey 'Bedrock Map', the site is underlain by the Charmouth Mudstone formation classification of bedrock material, a sedimentary bedrock formed approximately 190 to 202 million years ago, in the Jurassic Period, where the local environment was previously dominated by shallow seas. There is no evidence of superficial deposits located within this area.

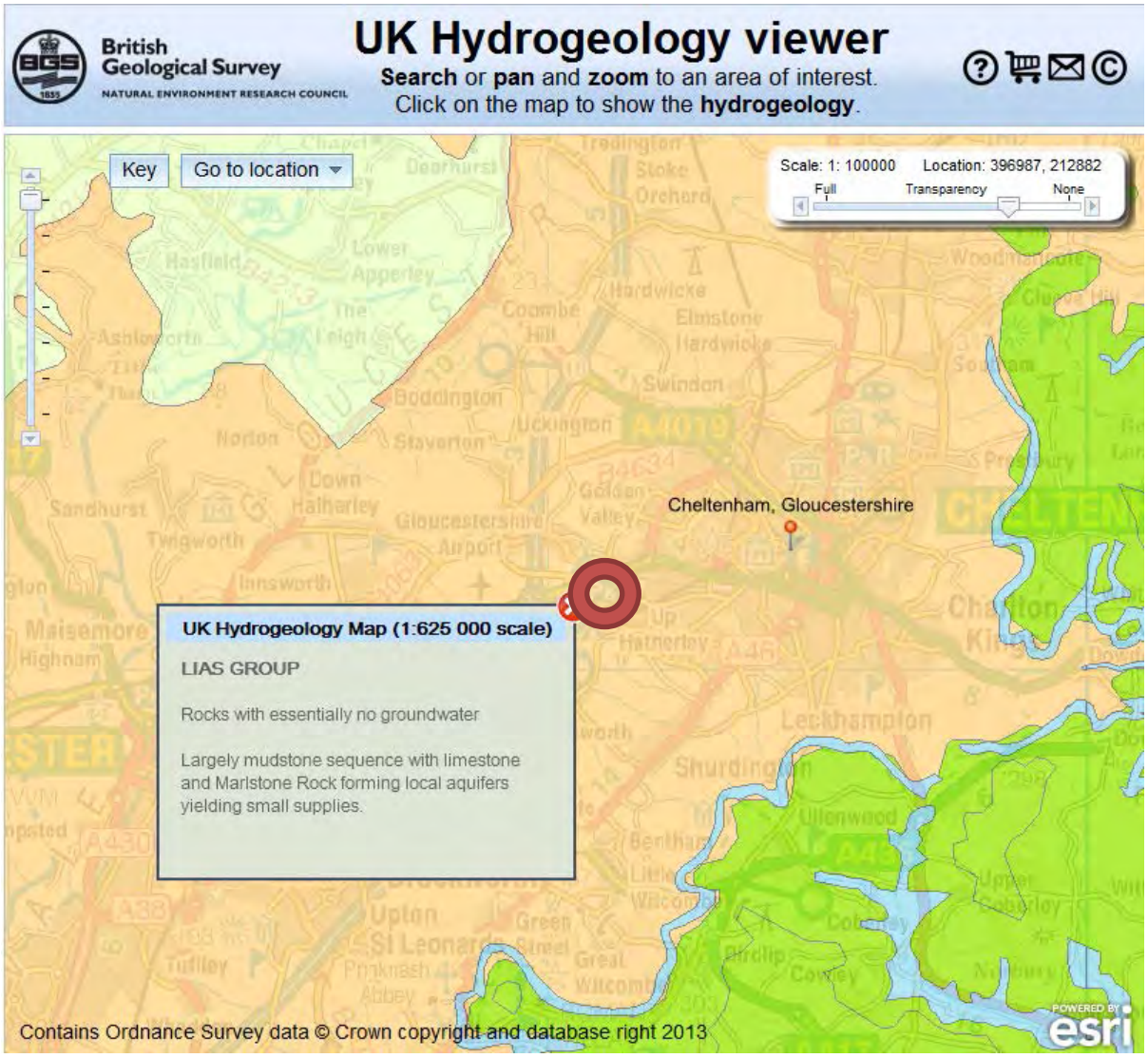


Figure 2: British Geological Survey Data – UK Hydrogeology Map

Figure 1b the British Geological Survey Data 'UK Hydrogeology Map' shows the potential for the ground to hold water. The area surrounding the development in Cheltenham is over the Lias group of bedrock material where the ground essentially has no groundwater. As shown on the map some local intrusions of Limestone provide localised aquifers with low yielding capacity.

Further to the map information in figures 1a and 1b above, an assessment of the site's infiltration properties is required to identify the site specific hydrological properties and storage capabilities.

Although the map information provided in Figures 1a and 1b shows the ground to have little or no infiltration properties.

A 'Site Investigation Report' carried out by Structural Soils Ltd in July 2008, covering the Phase 1 development provided information on three infiltration tests carried out across random locations on site. The results showed no measurable infiltration for the duration of the tests, which were carried out in accordance with BRE365 (see Appendix B containing previous TPA Phase 1 and highway FRA Data) therefore, we conclude that the use of soakaways would not be practical to use within this development site.

2.2 Strategic Flood Risk Assessment (SFRA)

The CBC level 1 SFRA and later level 2 SFRA denote that the site is partially at risk of surface water flooding during a 1 in 1000-year event, this is thought to be due to a localised, low lying area located along the southern boundary of the Phase 2 site. This small area is shown to flood to a depth of less than 300mm during the 1000-year event, it is thought that this is the result of a local low spot that will be removed during the Phase 2 developments proposed earthworks remodelling.

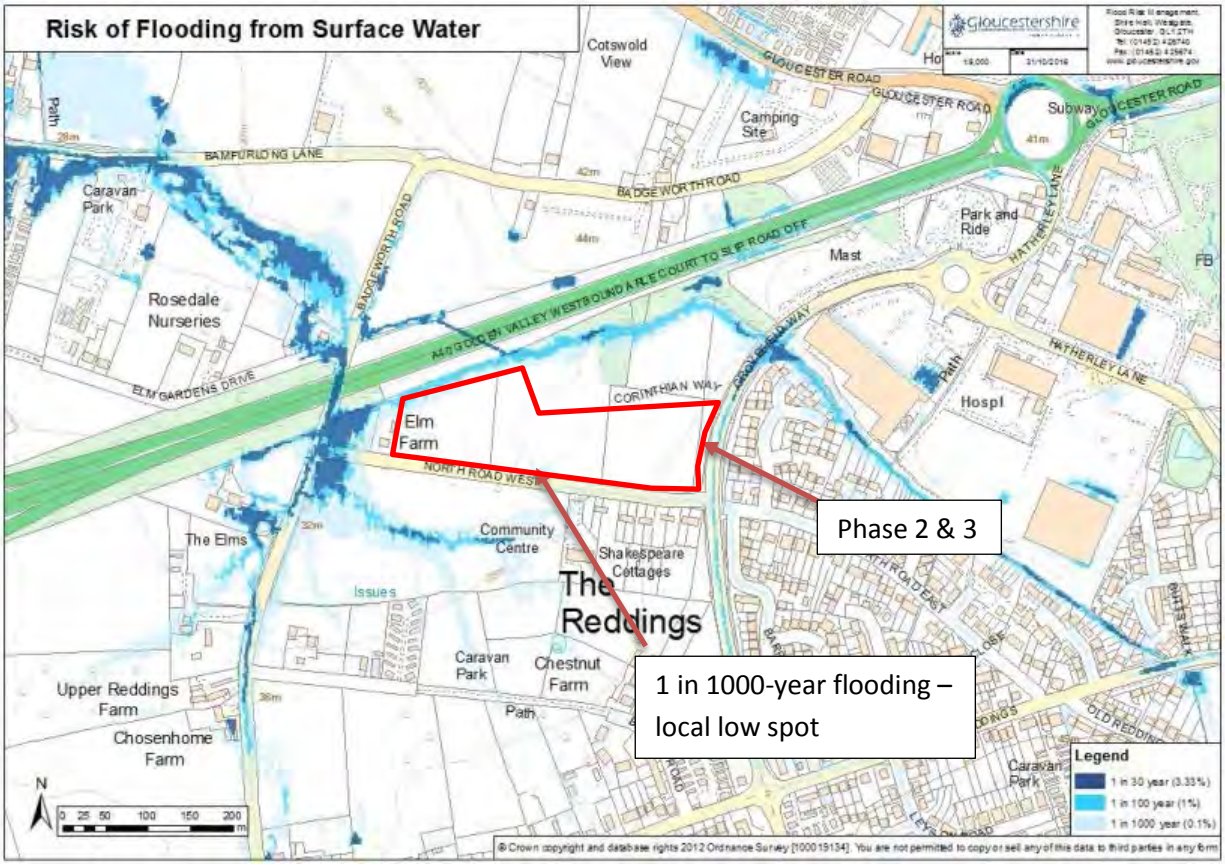


Figure 3: Flood mapping received from GCC/LLFA

Following the submission of this FRA in support of the planning application we have received further comment from Mr David Graham of the LLFA expressing potential concern over potential fluvial flooding located along the sites northern phase 3 boundary between the A40 and existing BMW dealership, a copy of the new 1 in 100-year flood mapping provided by the LLFA is shown below

Figure 4: Flood mapping received from GCC / LLFA dated July 2018

It should be noted that the LLFA's supplied flood mapping would appear to be somewhat out of date in terms of the alignment of the ditch course has been re-aligned under the permitted phase 1 BMW dealership works and the secondary balancing pond is not shown.

Subsequent correspondence with both the LLFA and EA has yet to provide any available modelling data or predicted flood levels upon which this mapping is based.

Therefore, in an attempt to replicate the provided mapping we have considered both a potential blockage of the existing 1250mm culvert in the control of highways England along with the potential overtopping of the secondary balancing pond has been considered and the following flood exceedance contour added to the drainage strategy drawing

- Contour level 32.46m this represents the current flood extent if the 1250mm culvert were to be fully blocked, if this contour represents the current soffit level of the culvert in a 100% blockage situation
- Contour level 32.79m which represents the secondary balancing ponds minimum overtopping level, which would be possible in the event of the existing 1250mm diameter culvert becoming blocked

We acknowledge that these contours will have a nominal effect upon the planned phase 3 works as currently planned and the treatment of this situation will need to be investigated and further developed with the LLFA and Local Planning Authority during the phase 3 development works, and note that this may require detailed modelling of the existing watercourse and culvert to be undertaken to assess the issue in greater detail, as such our client would welcome the provision of a suitable planning condition covering these future works.

2.2.1 Fluvial flooding

The proposed development site is located in Flood Zone 1 at low risk of fluvial flooding from rivers and sea. Figure 3 shows the site in relation to the EA Flood Map for planning;

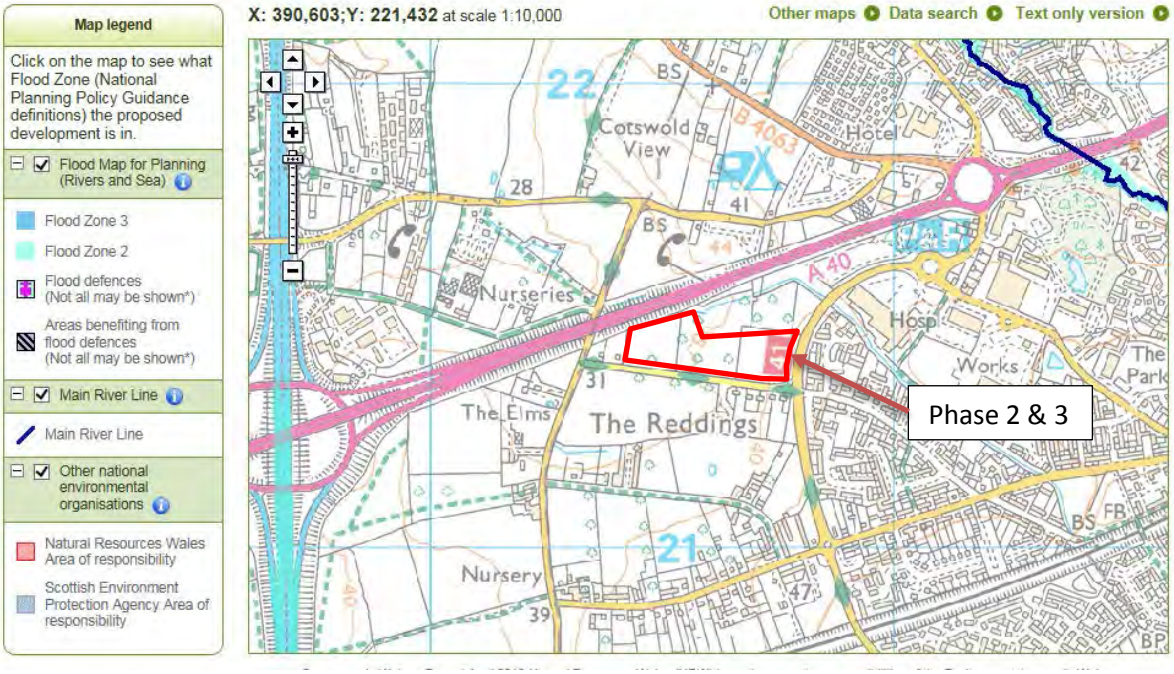


Figure 5: EA website mapping.

2.2.2 Historical flooding

Historical flooding incidents within the area are: -

- Cheltenham Borough – July 1967 & summer 2007.
- Cotswold District – March 1947, July 1968, August 1977, Sept 1992, Oct 1993, April 1998, Dec 2000, Summer 2007, Jan 2008.
- Forest of Dean – March 1947, July 1968, Dec 1981, Dec 2000, summer 2007.
- Gloucester City – Jan 1939, March 1947, July 1968, Dec 1981, Jan 1990, Dec 2000, Summer 2007.
- Stroud – Jan 1939, March 1947, Dec 1965, July 1968, Dec 1981, Jan 1990, Dec 2000, Summer 2007.
- Tewkesbury Borough – Jan 1939, March 1947, July 1968, Dec 1981, 1985, Jan 1990, April 1998, Dec 2000, Summer 2007.

Cheltenham is mentioned in the historic flooding part of the CBC report as having over 600 properties being flooded by the summer 2007 floods. Cheltenham suffered from Fluvial (River Chelt, Wymans Brook, Hatherley Brook, Mill Stream), surface runoff and exceedance from highway drains and public sewers. The areas mainly affected were Charlton Kings (70 properties), River Chelt (230 properties), Hatherley (100 properties), Prestbury (70 properties) and Whaddon (250 properties).

Although there were several areas severely affected by flooding as mentioned above, the population densities within these areas were not high enough to make it to the Environment Agency's Flood Risk Areas.

Historic flood map information provided to us identified two areas close to the development site as suffering flooding during the July 1968 floods, one approximately 50m north-west of the site on the opposite side of the A40, the other approximately 100m southwest of the site on the Reddings. The historic flood map also shows areas along Hatherley Brook which suffered flooding during the summer 2007 floods, the nearest being approximately 200m east of the site next to the roundabout junction with the A40.

The information found within this report identified that although the development site itself was not subject to flooding historically and is not predicted to suffer flooding in the future, consideration will need to be made towards both Hatherley Brook and the Reddings, two areas which have historically suffered flooding.

The asset location plans provided by Severn Trent Water show a surface water sewer within Grovefield Way to the east and a foul water sewer to the south within North Road West.

STWL were not able to provide any recorded evidence of flooding from public sewers that would have opportunity to cause a flood risk to the future development sites.

The STWL mapping information is provided within Appendix D.

2.2.3 Surface water (Pluvial) flooding

The EA Surface Water Flood Map shows Phase 2 to be recorded at a very low to low risk of surface water flooding, and Phase 3 at a Low to medium risk, this is thought to relate to the capacity and potential blockage of the existing 1250mm diameter Highways England culvert located beneath the A40 and its associated flow path.

It should be noted that no historic record for any such blockage event at this location can be found, as we note that Highways England are required to check and appraise the condition of the culvert as part of their ongoing asset maintenance plan, and as part of its highway structure condition survey inspection programme as the culvert is greater than 900mm in diameter and qualifies as a highway structure, which are subject to regular maintenance and inspection.

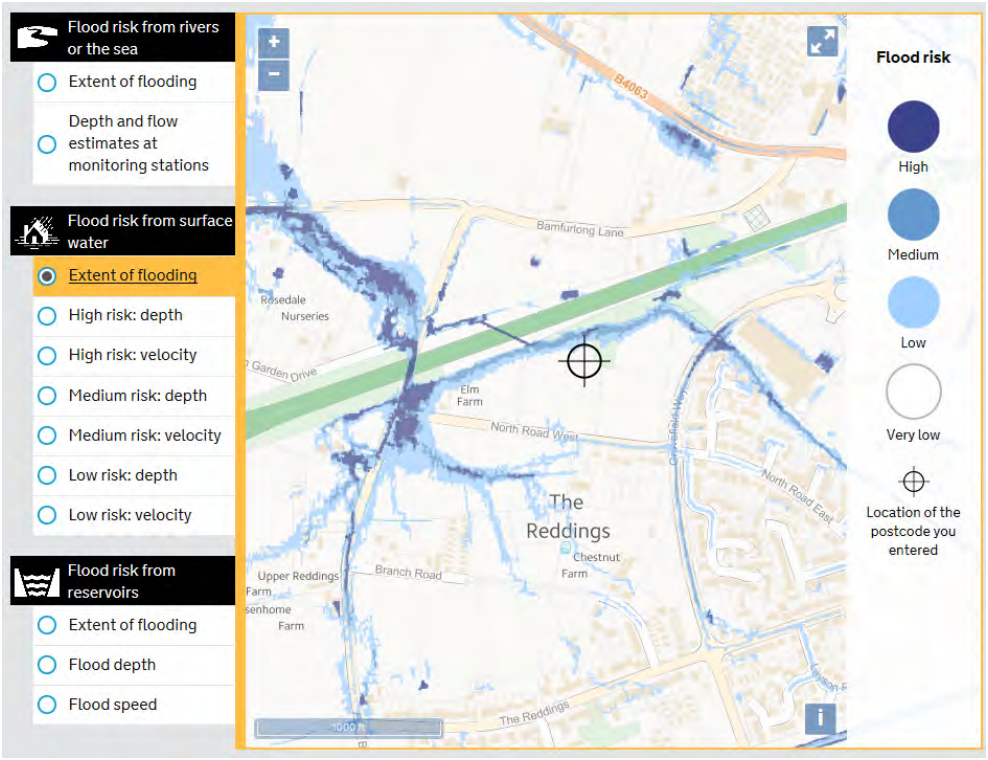


Figure 6: EA Surface Water flood mapping.

2.3 Ground conditions & ground water

The ground conditions indicated by BGS data and previous site investigation works would indicate that the use of infiltration-based SuDS systems is not practicable within the proposed development, which was confirmed during the 2008 site investigation works undertaken by Structural Soils.

2.4 Existing drainage

The Asset Location maps, provided by Severn Trent Water, show the location of a public Foul Water sewer within North Road West which runs along the southern boundary of the site. And a surface water system running in a northerly direction along the length of Grovefield Way to the eastern boundary of the site.

The BMW dealership constructed within the phase 1 works has the benefit of two number balancing ponds, the larger pond serves the Phase 1 development and the secondary pond was provided to drain the site access road before discharging to the existing ditch course and culvert system located below the adjacent A40. It should be noted that these works were consented and agreed under the previous planning application covering the BMW site.

Foul Water sewers from the development can connect to the existing public Foul Water Sewer under a Section 104/106 agreement with Severn Trent Water, via new connections to an existing private foul water drain which crosses the Phase 2 site, this drain was provided during the construction of the Phase 1 works and it was intended for the Phase 2 and 3 works to be connected to this drain, which currently remains un-adopted, and will be subject to a local diversion.

2.5 Existing impermeable area

The existing Phase 2 site is effectively greenfield, except for a small area (0.347ha) access road previously constructed to serve the remainder of the development during the construction of the adjacent Phase 1 BMW dealership project, which has the benefit of its own secondary "Highway" balancing pond facility, prior to discharging via a 100mm diameter throttle pipe to the adjacent watercourse and A40 culvert system.

2.6 Sequential Test

The majority of the proposed development is classified as "less vulnerable" and is located in Flood Zone 1. It therefore meets the compatibility requirements set out in PPG Table 3 (Figure 2); however the Day nursery is classified as "More Vulnerable" this being the higher classification to which the Phase 2 development will need to be tested against.

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	×	×	×

Key: ✓ Development is appropriate.
× Development should not be permitted.

Table 3: Flood risk vulnerability and flood zone compatibility

It is considered that the proposals satisfy the requirements of the sequential test and is therefore appropriate for the proposed location.

3. Proposed Development

The majority of the proposed Phase 2 and 3 development is classified in PPG Table 3 as “Less Vulnerable” and is located in Flood Zone 1; however the Day nursery is classified as “More Vulnerable” this being the higher classification to which the development will need to be tested against.

3.1 Description

The proposed Phase 2 and 3 developments are shown on the Architect’s drawings (located within Appendix A), comprising of a proposed access road (partially constructed within the Phase 1 works), , Aldi store, Nursery and three new office buildings with their associated parking areas and public realm / landscaping areas.

The proposed Phase 3 development is shown on the Architect’s drawings (located within Appendix A), comprising of a proposed access road, two new office buildings with their associated parking areas and public realm / landscaping areas. Note: the later Phase 3 development is currently shown indicatively upon these drawings and has been used to calculate the overall site discharge from the remaining Phase 3 development area.

Access to the site is via the existing access road arrangement.

3.2 Impermeable area

The proposed impermeable area contributing to the new network has been measured from the revised Architect’s layout (car park, access road and buildings) totalling an area of circa 18,253m² or (1.82ha) or 74.2% of the gross Phase 2 site area.

The proposed impermeable area contributing to the new network has been measured from the Architect’s layout (car park, access road and buildings) totalling an area of circa 11050m² or (1.67ha) or circa 66% of the gross Phase 3 site area.

3.3 Proposed levels

Proposed levels for the external areas and finished floor level are to tie into external levels with the new access road provided to serve the existing BMW site and paved areas around the site, whilst the proposed levels will be adjusted to minimise the need for material removal.

3.4 Proposed drainage

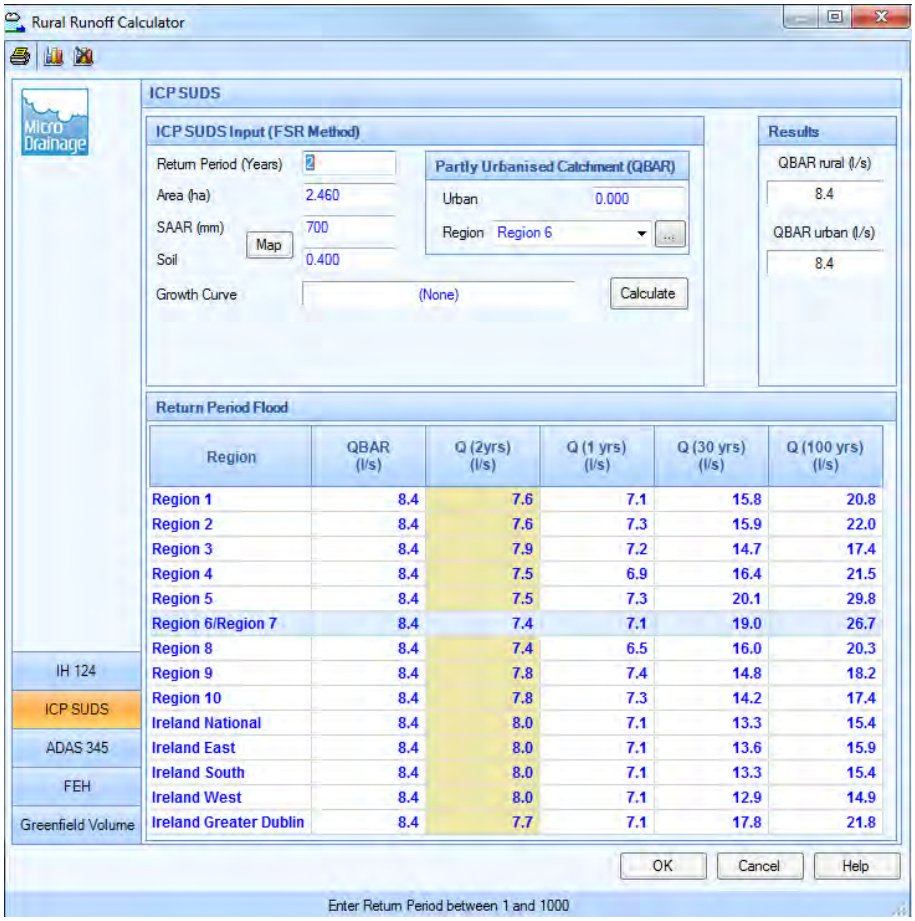
It is envisaged that the drainage arising from roofs shall enter into a combination of porous paving and piped attenuation systems.

Permeable paved areas and cellular attenuation structures to be located within the parking areas of each Phase which will attenuate flows generated by the parking court itself as well as from the hard-surfaced circulation areas and roofs, for storm events up to and including the 1 in 100+40% CC year storm event.

The access road will use a piped traditional drainage network. The drains will be sized to accommodate the 1 in 100+40% CC year storm event before entering a second highway balancing pond (previously constructed to serve the access road only) located adjacent the northern boundary, which is currently limited to a discharge rate of 1.8l/s.

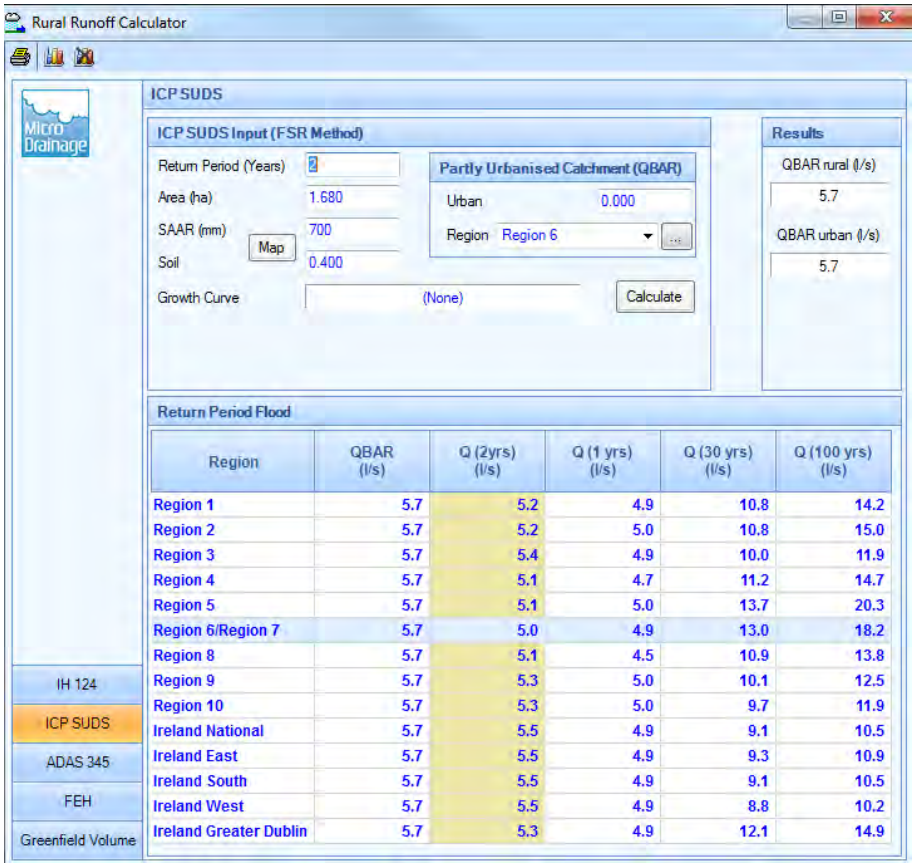
All of the proposed Phase 2 and following Phase 3 drainage systems will discharge into the ditch running along the northern boundary via a balancing pond and flow control chamber, which will be designed to limit discharge to Greenfield runoff rate of Qbar 8.4l/s for Phase 2 and Qbar of 5.7l/s for Phase 3, whilst the original flow control for the highway system regulated to 1.8l/s will be removed and replaced with a new unit set to limit flows to 10.2l/s @1.1m head (this represents the allowable discharge from Phase 2 at 8.4l/s and the Phase 1 highway area at 1.8l/s combined).

These figures are based on the same calculation data as used within the previously approved TPA FRA covering the Phase 1 site. The Qbar calculations are given below:



Region	QBAR (l/s)	Q (2yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
Region 1	8.4	7.6	7.1	15.8	20.8
Region 2	8.4	7.6	7.3	15.9	22.0
Region 3	8.4	7.9	7.2	14.7	17.4
Region 4	8.4	7.5	6.9	16.4	21.5
Region 5	8.4	7.5	7.3	20.1	29.8
Region 6/Region 7	8.4	7.4	7.1	19.0	26.7
Region 8	8.4	7.4	6.5	16.0	20.3
Region 9	8.4	7.8	7.4	14.8	18.2
Region 10	8.4	7.8	7.3	14.2	17.4
Ireland National	8.4	8.0	7.1	13.3	15.4
Ireland East	8.4	8.0	7.1	13.6	15.9
Ireland South	8.4	8.0	7.1	13.3	15.4
Ireland West	8.4	8.0	7.1	12.9	14.9
Ireland Greater Dublin	8.4	7.7	7.1	17.8	21.8

Table 4: Phase 2 Qbar Flow Calculations



Region	QBAR (l/s)	Q (2yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
Region 1	5.7	5.2	4.9	10.8	14.2
Region 2	5.7	5.2	5.0	10.8	15.0
Region 3	5.7	5.4	4.9	10.0	11.9
Region 4	5.7	5.1	4.7	11.2	14.7
Region 5	5.7	5.1	5.0	13.7	20.3
Region 6/Region 7	5.7	5.0	4.9	13.0	18.2
Region 8	5.7	5.1	4.5	10.9	13.8
Region 9	5.7	5.3	5.0	10.1	12.5
Region 10	5.7	5.3	5.0	9.7	11.9
Ireland National	5.7	5.5	4.9	9.1	10.5
Ireland East	5.7	5.5	4.9	9.3	10.9
Ireland South	5.7	5.5	4.9	9.1	10.5
Ireland West	5.7	5.5	4.9	8.8	10.2
Ireland Greater Dublin	5.7	5.3	4.9	12.1	14.9

Table 5: Phase 3 Qbar Flow Calculations

A Windes Quick Storage Estimate showed that for the 1 in 100-year return period plus 40% Climate change storm, and assuming there are no infiltration properties through the ground (based upon hydrology map information from the British Geological Survey website and historic soakage testing carried out in 2008 for Phase 1), a volume of circa 2000m³ of attenuation would be need to be included for within the onsite surface water management proposals for the Phase 2 area.

It is proposed that the Phase 2 parking areas be constructed using a permeable paving system to accommodate runoff from itself as well as from the hard-surfaced circulation roads and adjacent roof areas. Based on an area of 4890m² being provided with an approximately 400mm deep depth of filter material below and allowing for a 30% void ratio, a total of 586m³ volume of attenuation can be provided.

The remaining attenuation requirement of 1414m³ shall be accommodated by the provision of cellular storage structures located within the curtilage of the Phase 2 carparking and public realm areas, with the discharge rate controlled via suitable flow control devices. The exact layout and volume of the attenuation tanks will be confirmed during the detail design of the project. (For detailed Windes calculations refer to Appendix C).

The existing highway drainage and associated highway balancing pond will be able to cope with the additional 8.4l/s base flow, (refer to Appendix C for Windes simulation calculations) the results of this additional volume are that the existing highway balancing pond does not need to be extended physically to accommodate the additional flow arising from Phase 2, assuming Phase 3 provides a

separate controlled outfall to the existing watercourse; however the existing flow control device will need to be replaced and upsized to accommodate the revised highway and Phase 2 outflow of 10.2l/s.

With regard to the future Phase 3 area a Windes Quick Storage Estimate showed that for the 1 in 100-year return period plus 40% Climate change storm, assuming there are no infiltration properties through the ground (based upon hydrology map information from the British Geological Survey website and historic soakage testing carried out in 2008 for Phase 1), a volume of circa 454-650m³ of attenuation would need to be included for within the onsite surface water management proposals for the Phase 3 area.

It is proposed that the Phase 3 parking areas be constructed using a permeable paving system to accommodate runoff from itself as well as from the hard-surfaced circulation roads and adjacent roof areas. Based on an area of 4225m² being provided with approximately 400mm depth of filter material below and allowing for a 30% void ratio, a total of 507m³ volume of attenuation can be provided.

The remaining attenuation requirement of circa 100m³ shall be accommodated by the provision of cellular storage structures located within the curtilage of the Phase 3 car parking and public realm areas, with the discharge rate of 5.7l/s controlled via a suitable flow control device. The exact layout and volume of the attenuation tanks will be confirmed during the detail design of the project. (For detailed Windes calculations refer to Appendix C).

The site has the capacity to manage the storage requirements of the 1 in 100-year + 40% climate change event, and we note the requirement that surface water management plans should account for exceedances where, for example, storm events exceed the 1 in 100-year return period, any such exceedance routing would be quantified and plotted as part of the detail design works, our client is happy to accept a planning condition to this effect.

Foul drainage will also be served by new connections to the existing private drain which crosses the Phase 2 site, this drain will require a local diversion, before out falling to the public sewer system via existing manhole reference 4400 located in the western corner of the site to the boundary of Elm Farm.

It is believed this private foul drain is capable of dealing with the foul flows arising from the remainder of the development, and that this capacity was provided for within the original Phase 1 design, noting that this drain will require a local diversion.

4. Surface Water Management Plan

4.1 SuDS storm water management and storage volume

It is envisaged that the drainage from roofs shall enter into a combination of porous paving and piped attenuation systems. Permeable paved areas linked to cellular attenuation structures which are to be located within the parking courts will attenuate flows generated by the development, for storm events up to and including the 1 in 100 + 40% CC year storm event.

Highways will use an existing piped system sized to accommodate the 1 in 100 + 40% CC year storm event before entering an existing Highway balancing pond located adjacent the northern boundary, limited to a revised discharge rate of 10.2l/s. (For detailed Windes calculations refer to Appendix C).

All of the proposed Phase 2 and 3 drainage systems will discharge into the minor watercourse running along the northern boundary via a Flow Control Chambers, which will be designed to limit the total Phase 2 and 3 discharges to a Greenfield runoff rate of 14.1l/s. (i.e. 8.4l/s from Phase 2 and 5.7l/s from Phase 3).

The proposed foul water drainage will be designed to connect to the existing private drainage system crossing the Phase 2 site, this system then discharges to the public sewer located to the south west of the site at manhole reference 4400, which is located within the Phase 3 site at the junction of Elm Farm and North Road West.

4.2 Pollution Prevention

Class 2 Oil/ petrol interceptors will be used in the Pollution Prevention train as detailed in the EA guideline PPG3, prior to discharging to the balancing pond and existing watercourse.

5. Flood Risk Assessment

The following sources of flooding have been considered for the site:

- Fluvial flooding from streams, springs, sewers and culverts
- Pluvial/surface water flooding
- Groundwater flooding
- Tidal Flooding

5.1 Risk of fluvial flooding, and flooding from reservoirs, canals and other artificial sources to the proposed development

The proposed development site is located primarily in Flood Zone 1 at low risk of flooding from rivers and sea.

5.2 Risk of pluvial flooding to the proposed development

The EA Surface Water Flood Map shows a very small area of the Phase 2 works located along the southern boundary line to be at low risk of surface water flooding. This small area is shown to flood to a depth of less than 300mm during the 1000-year event, it is thought that this is the result of a local low spot that will be removed during the Phase 2 developments proposed earthworks remodelling.

The phase 3 works are shown to be at a low to medium risk of flooding which is thought o be related to the potential blockage of the existing 1250mm culvert below the adjacent A40.

We have indicated upon our drainage strategy an indicative contour line showing the extent of a potential 100% culvert blockage, and a secondary line indicating the possible extent of the overtopping of the existing secondary “Highway” balancing pond. It should be noted that these contours have a nominal effect upon the proposed phase 3 works and further modelling works may be required prior to a detailed planning permission covering the phase 3 works is submitted.

5.3 Risk of groundwater flooding to the proposed development

No historic groundwater flooding was found to be recorded and ground water is expected to be 5m below the existing ground level. Based on this information it is considered that the risk of flooding from this source is low.

5.4 Risk of tidal flooding to the proposed development

The proposed development site lies in an area shown on the EA indicative flood map as Flood Zone 1 at low risk of tidal flooding.

5.5 Effect of development on wider catchment

The development will generate an increase over the existing discharge volumes received to the wider catchment, following the provision of suitable storage and attenuation volumes it is considered a low risk of surface water flooding in the wider catchment, and an overall betterment in terms of water quality can be expected.

5.6 Mitigation of residual flood risk

There is no residual flood risk to be mitigated for the proposed Phase 2 development, and the proposed phase 3 works will need to be development, with a view to maintaining the areas of overland flow / exceedance routing associated with the potential blockage of the A40 culvert and overtopping of the existing balancing pond system.

6. Conclusions and Recommendations

The Flood Risk Assessment identifies that the proposed phase 2 and 3 development site is located within Flood Zone 1 therefore posing a low risk of flooding. The flooding problem areas near to the site should benefit from the on-site attenuation provided by the SWMP.

The asset location plans provided by Severn Trent Water show a surface water sewer located within Grovefield Way and a foul water sewer located within North Road West. There is no recorded evidence of public sewers flooding in the area of the site that would cause a flood risk to the development site.

The topography of the development site shows overland flows directing towards the northwest boundary. Which is in line with the flood mapping provided by the EA and LLFA. By using permeable paving linked to traditional attenuation systems, the proposed developments peak runoff volumes are effectively reduced to that of the calculated greenfield runoff rates.

By using SuDS features such as permeable paving, cellular storage structures and the existing highway balancing pond to attenuate flows up to the 1 in 100 year + 40%CC storm event, thereby actively creating betterment to the existing downstream areas.

The Surface Water Management Plan identifies that although the impermeable area will be increased on site from that of the existing greenfield scenario, using a combination of SuDS systems for attenuation as well as water cleansing, runoff from the site is not increased and its water quality will be improved.

Pollution control measures in the form of Class 2 petrol interceptors will be provided in accordance with recommendations of PPG3.

Foul Water from the site will be discharged (via an existing private drain, which requires diverting) into public foul water sewers off site under agreement with the adopting water authority, Severn Trent Water.

The impermeable area will increase post development; however the adoption of SUDS and the provision of on-site storage capacity will not increase the risk of flooding in the wider catchment.

The drainage strategy proposed for the future phase 3 works will provide mitigation against the potential for off-site flooding relating to the existing overland flow paths associated with a culvert blockage and possible overtopping of the existing secondary “highway” balancing pond.

In order to continually discharge into the adjacent water course when it is in flood and out of bank as shown in the 1 in 100-year event the proposed phase two and three drainage schemes will be designed and simulated with a submerged outfall, the surcharge level will need to be agreed with the LLFA during the detail design

7. References

1. BS 8533:2011 Assessing and Managing flood risk in development – Code of practice.
2. CIRIA C624 development and flood risk guidance for the construction industry. CIRIA. London 2004.
3. CIRIA C697 The SuDS Manual. London 2007.
4. CIRIA C753 The SuDS Manual. London 2015
5. National Planning Policy Framework 2012. Department for Communities and Local Government. March 2012.
6. Planning Policy Statement 25: development and Flood Risk, Communities and Local Government, TSO, March 2010.
7. Planning Policy Statement 25: Development and Flood Risk Practice Guide, Communities and Local Government, TSO, December 2009.
8. Planning Practice Guidance. Department for Communities and Local Government. March 2014
9. PPG3 Pollution Prevention Guidelines. Environment Agency. 2006.

Appendix A: Supporting drawings

Drawing	Prepared by:	No.
Site Location Plan	Design Development Partnership	178-70
Site Block Plan	Design Development Partnership	178-96-Rev F
Drainage Strategy	Complete Design Partnership Ltd	16-6953-100 - Rev P5

All drawings and specification to be read in conjunction with Structural Engineer and other consultants drawings; all discrepancies should be reported to the architect.

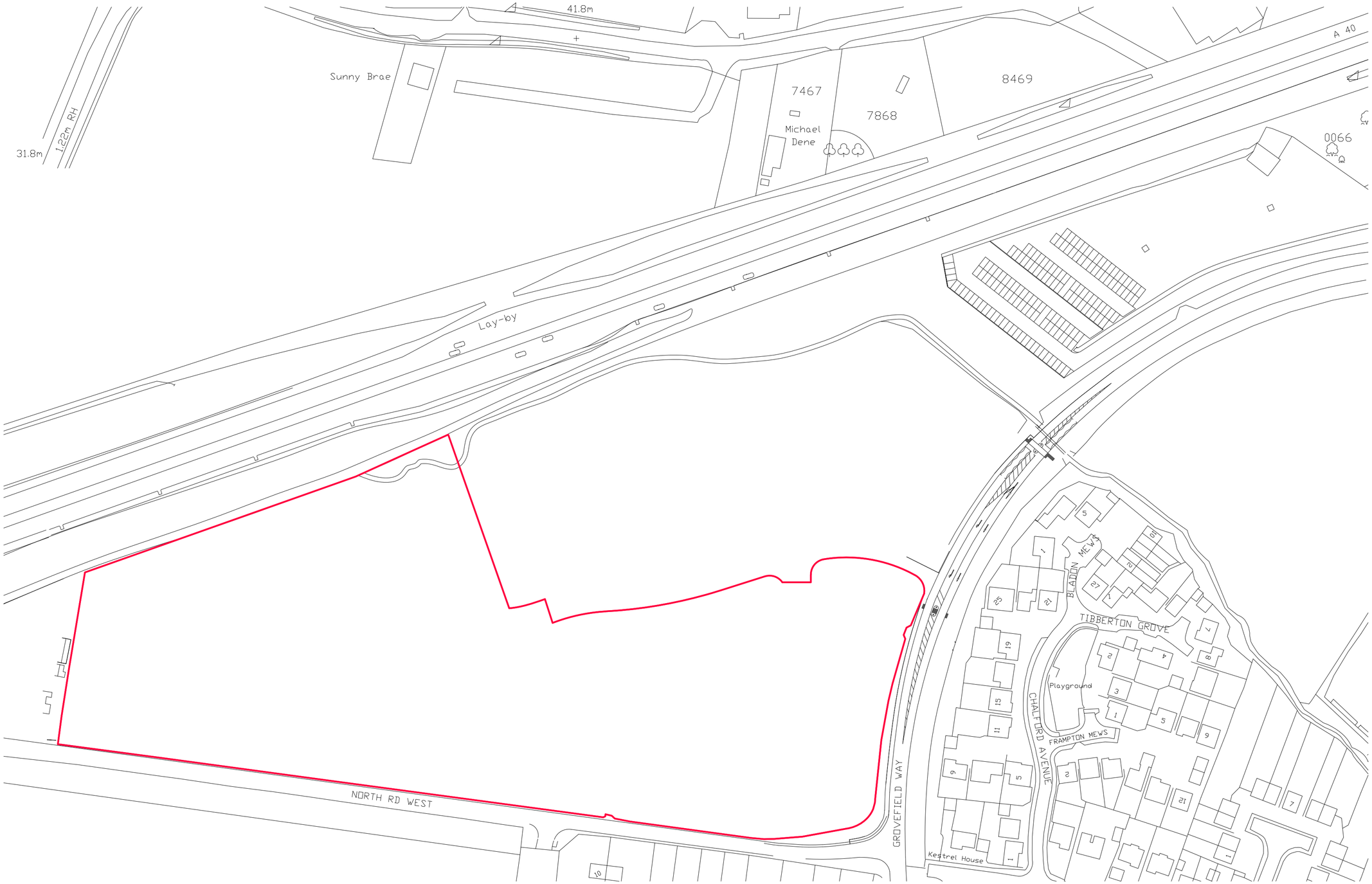
Figured dimensions only are to be taken from this drawing

☐ Preliminary ☐ Comment ☒ Planning

☐ Tender ☐ Construction ☐ Record

☐ Legal

REVISIONS			
REV	DATE	DESCRIPTION	CHECKED BY



5m 10m 20m 30m 40m 50m

CLIENT HINTON GROUP

PROJECT Phase 2
Corinthian Park
Grovefield Way
Cheltenham

TITLE Location Plan

SCALE @ A2 1:1250 DATE 24-11-16

DRAWING 178-70 REV

DRAWN BY R.D CHECKED BY D.W

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All drawings and specification to be read in conjunction with Structural Engineer and other consultants drawings; all discrepancies should be reported to the architect.

Figured dimensions only are to be taken from this drawing

☐ Preliminary ☐ Comment ☒ Planning

☐ Tender ☐ Construction ☐ Record

☐ Legal

REVISIONS			
REV	DATE	DESCRIPTION	CHECKED BY
A	03/08/17	- SCHEDULE OF ACCOMMODATION ADDED - EXISTING VEGETATION IDENTIFIED	
B	22/09/17	- KERB LINE AMENDED ADJACENT TO COSTA	
C	30/07/18	- LEVELS REMOVED	
D	12/09/18	- COSTA COFFEE REPLACED WITH OFFICE - CAR PARK LAYOUT AMENDED - OFFICES 1 AND 2 AMENDED TO SUIT OCCUPIER REQUIREMENTS	
E	13/09/18	- INDICATIVE PLANTING SHOWN (REFER TO DETAILED PLANS)	
F	20/09/18	- SITE WIDE AMENDMENTS MADE IN ACCORDANCE WITH HARD LANDSCAPING PROPOSALS	

SCHEDULE OF ACCOMMODATION		
UNIT	APPLICATION SITE	GROSS INTERNAL AREA (SQM)
Office 5	Detailed application	869
Aldi	Detailed application	1742
Happy Days Nursery	Detailed application	502
Office 1	Detailed application	2279
Office 2	Detailed application	2755
Office 3	Outline application	5451
Office 4	Outline application	2279

CLIENT HINTON GROUP

PROJECT Phase 2
Corinthian Park
Grovefield Way
Cheltenham

TITLE Proposed Block Plan

SCALE @ A0 1:500 DATE 21-06-17

DRAWING 178 - 96 REV F

DRAWN BY LW CHECKED BY DW

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Notes: DO NOT SCALE DRAWING

Dimensions provided are indicative only, and should be confirmed and read in conjunction with the Architect's construction drawings at such times as they are available, and/or from site measurement.
All setting out to be in accordance with the Architect's drawings, any ambiguities to be raised prior to construction.

RESIDUAL RISK REGISTER

No.	Description of Hazard	Control Measures	Action By
-	Standard construction	-	-

Notes:

1. All dimensions in metres unless stated otherwise.
2. This drawing has been prepared for the exclusive use of the commissioning party and unless agreed in writing by Complete Design Partnership Ltd no other party may use or rely on its contents. No liability is accepted by CDP Limited for any use of this drawing other than for the purpose for which it was originally prepared.
3. It should be noted that this drawing may include data provided by third parties. No liability is accepted by CDP Limited as to the accuracy of this data.
4. Levels in m AOD.

Drainage Notes:

Proposed site area: 2.46 ha

Existing impermeable area: 0ha (Greenfield)

Proposed impermeable area: 1.82 ha (74.2% of whole site)

1. Drawing should be read with accompanying Windes calculations
2. The proposed storm water drainage strategy is based on the Flood Risk Assessment completed by CDP in August 2017. All storage will outfall by gravity to the existing ditch course
3. The design has been carried out to ensure that no surface flooding occurs from the sewer network during a 30 year storm event, as per the statutory undertakers requirements. Due to the use of balancing ponds, the additional flows during a 1:100 year (+40%) storm event are also held within the network with no surface water flooding.
4. The proposed landscaping scheme and tree locations are to be coordinated with the location of the sewer, and cellular storage areas.

Drainage Key

- New Foul Water Gravity Sewer
- Proposed Storm Drainage
- Existing Storm Drainage
- Existing Foul Drain
- Drain to be Diverted
- Cellular Storage Structure
- Porous paving car parking areas (Phase 2 / 3)
- Excendance flow route (Phase 2 / 3)

PRELIMINARY

Rev	By	Details	Date
P5	MJB	Revised to include office 5	21.09.18.18
P4	MJB	Culvert and Pond exceedance contours added	27.07.18
P3	MSK	Amended Layout inserted and drainage amended to suit	26.03.18
P2	AM	Amended Layout inserted and drainage amended to suit	31.07.17
P1	MB	Preliminary Issue	29.11.16

(P=Preliminary, T=Tender, C=Construction, R=Record)

Client:
Hinton Properties Plc

Project:
Corinthian Park
Cheltenham - Phase 2

Drawing Title:
Drainage Strategy Layout

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Date:	Nov '16
Scale:	1:500 @ A1
Drawn:	MB
Chkd:	JB

Drawing No. 16-6953-100

Issue Rev. P 5

Appendix B: TPA Phase 1 and Highway Works FRA & Drainage Strategy

Transport Planning Associates

A Planning Application by

COTSWOLD BMW GROUP

In respect of

Flagship Dealership with Car Showroom and Servicing, GROVEFIELD WAY, CHELTENHAM

Site Specific Flood Risk Assessment and Surface Water Management Plan

June 2013

DOCUMENT SIGNATURE AND REVIEW SHEET

Project Details

Project Title:	Flagship Dealership with Car Showroom and Servicing, GROVEFIELD WAY, CHELTENHAM		
Project No.:	1303-30	**Report No.:**	1303-30/FRA/01/A
Client:	COTSWOLD BMW GROUP		

	Prepared By:	Checked By:	Approved for issue
Name	ALEX HALFORD	PHIL PARKER	CRAIG RAWLINSON
Signature	[redacted]	[redacted]	[redacted]
Date	[redacted]	JUNE 2013	

Document Review

Revision	Date	Description	Checked By
A	25.06.13	Amended to suit Rainwater Harvesting requirements.	CMR

Issued by:

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CONTENTS PAGE

LIST OF APPENDICES

1 EXECUTIVE SUMMARY

INTRODUCTION

1.1 Transport Planning Associates have been appointed to provide a combined Site Specific Flood Risk Assessment (FRA) and Surface Water Management Plan (SWMP) for Cotswold BMW Group's land off Grovefield Way, Cheltenham.

1.2 The purpose of this FRA and SWMP is to identify the historical, current and future flood risks of the development as well as to identify the developer's strategy to reduce the impact of the development upon the neighbouring surface watercourses.

1.3 This Flood Risk Assessment has been carried out in accordance with the National Planning Policy Framework (NPPF), March 2012 and Planning Policy Statement 25 annexes D and E, which although have now been replaced by the NPPF, are still best practice methods to proving the appropriateness of a site's proposals with regards to its location and its susceptibility to flooding. The Surface Water Management Plan has been carried out in accordance with PPS25 Annex F and Ciria document C697 'The SuDS Manual'.

METHOD STATEMENT

Flood Risk Assessment

1.4 To ascertain the potential flood risks to the development site a desktop study has been undertaken gathering information from the British Geological Survey 'Bedrock Map', the Environment Agency 'Flood Maps', and historical and current regional information from the 'Strategic Flood Risk Assessment for local development framework – Level 1' – produced by Halcrow, on behalf of Cheltenham Borough Council, dated September 2008, the 'Preliminary Flood Risk Assessment' – produced by Gloucestershire County Council, dated November 2011 (see Appendix D).

1.5 Early correspondence with the Environment Agency's (EA) Riversmeet House, Tewkesbury, Gloucestershire office, helped to determine the local areas main points for concern. Local knowledge of the area provided valuable information on the EA's concerns for the site which will be addressed within the report.

1.6 Information found within these resources was then used to ascertain the development site's risk of flooding through following the guidance provided within the PPS 25, Annexes D and E. The annexes provide categorisation methods to ascertain the risk of flooding to the development site, its potential to increase flooding to the immediate and broader areas, the proposed land use's appropriateness to the flood zone and the mitigating requirements of the flood risk assessment to prove its appropriateness for development.

Surface Water Management Plan

1.7 Planning Policy Statement 25, Annex F outlines the requirements of the Surface Water Management Plan to satisfy the development's requirements to reduce the risk of flooding to the immediate and surrounding areas.

1.8 As the development site is more than 1 hectare the Environment Agency will be consulted at the planning stage of the development and as such will require proof that the proposed development will not increase the existing Greenfield surface water run-off discharge rate or volume. The Interim Code of Practice for Sustainable Drainage Systems (ICPSuDS) (for developments less than 50ha) method of calculating Qbar was used to calculate the Greenfield run-off rate.

1.9 The SWMP will acknowledge the sources of flooding discovered in the FRA, provide guidance to the developer on how to manage surface water run-off and provide evidence that proves that the developed site's surface water run-off will be managed on-site, using appropriate SuDS, to at least mimic existing Greenfield run-off flows.

2 EXISTING SITE CONDITIONS

SITE DESCRIPTION

2.1 The parcel of land as identified on the site location plan (Appendix A.1) is located approximately 2 kilometres west of Cheltenham town centre, approached by Grovefield Way, a major access road which joins the A40 approximately 800m north from the site. The existing site is located within the business sector of Cheltenham and is surrounded by either agricultural land or business buildings. There are no main rivers running through or in the immediate vicinity of the site, although there is an unnamed ordinary watercourse which runs along the northern boundary of the site before being culverted where it crosses beneath the A40.

2.2 The commercial scheme area consists of approximately 2.35 hectares of green fields and is bounded by tree lined hedgerows. The site has a level difference of up to 6m from approximately 38.5mAOD on the south-east boundary, to approximately 32.5mAOD in the north-west corner of the development site.

2.3 The British Geological Survey and Environment Agency Maps have been studied to identify the site's Geological and Hydrogeological properties. The following figures show the information shown within them.

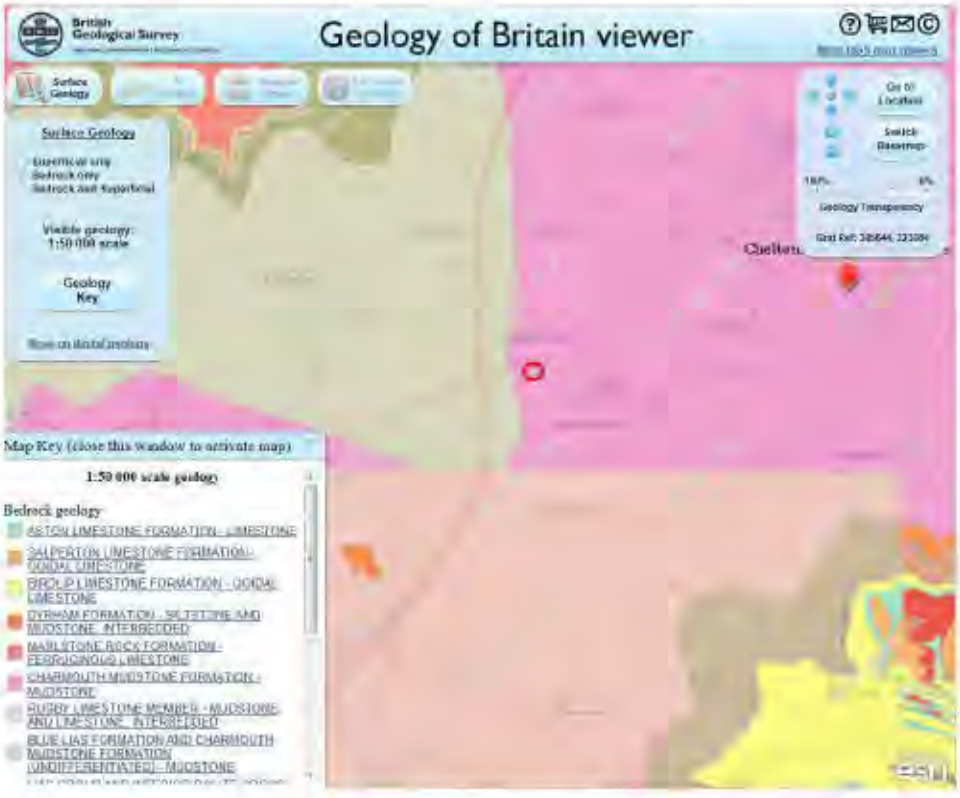

Figure 1a British Geological Survey Data – Bedrock Map

2.4 As can be seen in Figure 1a the British Geological Survey 'Bedrock Map', the site is underlain by the Charmouth Mudstone formation classification of bedrock material, a sedimentary bedrock formed approximately 190 to 202 million years ago in the Jurassic Period, where the local environment was previously dominated by shallow seas. There is no evidence of superficial deposits located within this area.

Figure 1b British Geological Survey Data – UK Hydrogeology Map

2.5 Figure 1b the British Geological Survey Data 'UK Hydrogeology Map' shows the potential for the ground to hold water. The area surrounding the development in Cheltenham is over the Lias group of bedrock material where the ground essentially has no groundwater. As shown on the map some local intrusions of Limestone provide localised aquifers with low yielding capacity.

2.6 Further to the map information in figures 1a and 1b above, an assessment of the site's infiltration properties is required to identify the site specific hydrological properties and storage capabilities. Although the map information provided in Figures 1a and 1b shows the ground to have little or no infiltration properties, site based trial pits with infiltration testing will provide more accurate ground properties which would not necessarily be shown on the maps.

2.7 A 'Site Investigation Report' carried out by Structural Soils Ltd in July 2008, provided information on three infiltration tests carried out across random locations on site. The results showed no soakage for the duration of the tests which were carried out in

accordance with BRE365 (see Appendix G). Soakaways would not be practical to use on this site.

SURFACE WATER RUN-OFF ANALYSIS

2.8 The development site is classified as being Greenfield with the site being solely covered in vegetation. The Surface Water run-off for the site is accepted at the Greenfield run-off rate, in accordance with PPS25, Annex F – Managing Surface Water.

2.9 Windes and the ICP-SUDS was used to calculate the Greenfield Run-off rate for the onsite development, (IH124 would be used if the development site is greater than 50 ha in area). The site area, amounts to approximately **2.35 ha** and based on Flood Studies Report (FSR) Figure I.2.4, gives a $QBAR_{rural}$ (average annual flood) rate of **8 l/s** (see Appendix C.1). The proposed development must not generate more runoff than this if it is proposed to discharge to a natural watercourse.

2.10 The developed site will provide 1.65 ha of impermeable area, made up of 0.761ha from roof area, 0.142 ha from driveways, 0.037 ha from footpaths and .0668 ha from driveways and parking bays.

2.11 Since the implementation of the Flood and Water Management Act, April 2010, new developments have to recognise exceedance in design. Appendix A.5 shows the overland flood route for the site based on existing site levels. The arrows shown on the plan indicate the direction of run-off flow through the site. Additional arrows outside the site are also shown indicating how run-off from the site affects neighbouring landowners.

3 FLOOD RISK ASSESSMENT - CONSULTATION AND POLICY GUIDANCE

CONSULTATION

3.1 As part of the research into the Flood Risk Assessment for this development, the Environment Agency (EA) and Severn Trent Water were consulted.

3.2 The response from looking at the EA flood maps confirms that the development site falls within Flood Zone 1. As the site is greater than 1 ha, Annex's D and E of PPS25 should still be adhered to within the planning application and that a Site Specific Flood Risk Assessment with incorporated Surface Water Management Plan should be submitted with the planning application.

3.3 The EA 'Flood Map' (see Appendix E) helped to ascertain the Flood Zone for the site with reference to the site's proximity to potential flood sources. The flood map for the area covering Grovefield Way showed the site as being within Flood Zone 1 where there is a less than 0.1% or 1 in 1000 probability of flooding in any one year. The nearest area for concern is approximately 750m south of site along Ham Brook an ordinary watercourse and tributary of the River Severn that runs through Gloucester approximately 7.69km west from the site.

3.4 Early correspondence with the EA confirmed the site is situated on Lias Formation Clays. The aquifer designation of the bedrock material was designated as being Unproductive, whereby the material's capacity for the storage of groundwater is too low to recognise.

3.5 The groundwater vulnerability designation for the site is Minor whereby the potential for groundwater to pose a flood risk to the site is low.

3.6 The EA confirmed that the site is not located over a groundwater source protection zone, whereby the site's location is far enough away from a source of drinking water to be deemed to have no impact.

3.7 The EA confirmed that the site is located in an area where surface water is vulnerable to Nitrates. Sites within these zones must comply with the Nitrate Pollution Prevention Regulations 2008, which are about to be amended during 2013. The impact of Nitrates upon the surface water strategy will require water cleansing facilities within the SuDS.

3.8 Asset Location searches were also carried out as part of this assessment with Severn Trent Water and their response was received in May 2013. The Asset Location maps show the location of a public Foul Water sewer within North Road West which runs along the southern boundary of the site. The map information provided shows a public surface water sewer running in a northerly direction along the length of Grovefield Way to the eastern

boundary of the site (see Appendix B for Asset location maps provided by Severn Trent Water).

POLICY GUIDANCE

3.9 The Flood Risk Assessment has considered National Policy and Local planning strategies in order to understand the wider implications of the development upon its surrounding area.

3.10 NATIONAL POLICY - 'NATIONAL PLANNING POLICY FRAMEWORK' (NPPF), MARCH 2012.

3.11 The NPPF takes over from where PPS25 left off, although looks further into more community driven priorities. Its main driver is sustainability making developments concentrate on how the proposals impact upon the community in which it resides. It incorporates a number of key objectives including providing quality homes, improving quality of life and meeting the challenge of climate change, flooding and coastal change.

3.12 Where the NPPF relates to Flooding and Flood Risk it states:-

100. 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. Local Plans should be supported by Strategic Flood Risk Assessment and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as lead local flood authorities and internal drainage boards. Local Plans should apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change, by:

- *Applying the Sequential Test;*
- *If necessary, applying the Exception Test;*
- *Safeguarding land from development that is required for current and future flood management;*
- *Using opportunities offered by new development to reduce the causes and impacts of flooding; and*
- *Where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking*

101. The aim of the Sequential Test is to steer new 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.

102. *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 account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

Both elements of the test will have to be passed for development to be allocated or permitted.

Table 1 Flood Zones Categorization (PPS25 Table D.1)

Zone 1 Low Probability **Definition** This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%). **Appropriate uses** All uses of land are appropriate **FRA requirements** For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA. This need only be brief unless the factors above or local considerations require particular attention. See Annex E for minimum requirements. **Policy aims** In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of development, and the appropriate application of sustainable drainage techniques.
Zone 2 Medium Probability **Definition** This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5 -0.1%) in any year. **Appropriate uses** The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in table D.2 are appropriate in this zone. Subject to the Sequential Test being applied, the highly vulnerable uses in table D.2 are only appropriate in this zone if the Exception Test is passed. **FRA requirements** All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

Zone 3a High Probability

Definition

This zone comprises 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.

Appropriate uses

The water-compatible and less vulnerable uses of land in Table D.2 are appropriate in this zone.

The highly vulnerable uses in table D.2 should not be permitted in this zone.

The more vulnerable and essential infrastructure uses in table D.2 should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.

FRA requirements

All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should see opportunities to:

i. reduce the overall level of flood risk in the area through the layout and form of development and appropriate application of sustainable drainage techniques;

ii. relocate existing development to land in zones with a lower probability of flooding; and

ii. create space for flooding to occur be restoring functional flood plain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Zone 3b The Functional Flood Plain

Definition

This zone comprises land where water has to flow or be stored in times of flood.

Local planning authorities should identify in their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.

Appropriate uses

Only the water-compatible uses and the essential infrastructure listed in table D.2 that has to be there should be permitted in this zone. It should be designed and constructed to:

- remain operational and safe for user in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows; and
- not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception Test.

FRA requirements

All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should seek opportunities to:

i. reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques; and

ii. relocate existing development to land with a lower probability of flooding.

Table 2 Flood Risk Vulnerability Classification (PPS25 Table D.2)

Essential Infrastructure	Essential transport infrastructure (including mass excavation routes) which has to cross the area at risk. Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. Wind turbines.
Highly Vulnerable	Police stations, Ambulance stations and Fire station and Command centres and telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent. (where there is a risk demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').
More Vulnerable	Hospitals. Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. Buildings used for: dwelling houses; student's 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.**
Less Vulnerable	Police, ambulance and fire stations which are ***not*** required to be operational during flooding. Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non-residential institutions not included in 'more vulnerable'; and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except landfill and hazardous waste facilities). Mineral working and processing (except for sand and gravel working). Water treatment works which do ***not*** need to remain operational during times of flood. Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).

Water-compatible Development	Flood control infrastructure. Water transmission infrastructure and pumping stations. Sewage transmission infrastructure and pumping stations. Sand and gravel workings. Dock, marinas and wharves. Navigation facilities. MOD defence installations. Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. Water-based recreation (excluding sleeping accommodation). Lifeguard and coastguard stations. Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. Essential ancillary sleeping or residential accommodation for staff required by uses in this category, **subject to a specific warning and evacuation plan.**

Table 3 Flood Risk Vulnerability and Flood Zone 'Compatibility' (PPS25 Table D.3)

Flood Risk Vulnerability classification (see Table D2)		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (see Table D.1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b	Exception Test required	✓	×	×	×

3.13 This development site is within Flood Zone 1 (Table 1), the proposed commercial land use is categorised as being 'Less Vulnerable' from effects of flooding (Table 2). Table 3 indicates that a 'Less Vulnerable' categorised site, such as proposed for this site, is an appropriate land use for a Flood Zone 1 and an Exception Test is not required.

NATIONAL POLICY – 'PLANNING POLICY STATEMENT 25, DEVELOPMENT AND FLOOD RISK' (PPS 25), MARCH 2010.

3.14 PPS 25, although now replaced by the NPPF, is still a useful guide to proving the appropriateness of a site's proposals with regards to its location and its susceptibility to flooding.

3.15 The policies outlined in PPS25 are designed to make regional and local planning authorities re-consider land uses in their strategic development plans, concentrating on the suitability of land uses within flood zones and give clear guidance on their responsibilities. Planning applications for individual developments will therefore have to consider the suitability of the proposed land use in the flood zone prior to the planning application.

3.16 Annex D of PPS25, refers to the 'Sequential Test', a tool used to gauge the suitability of a proposed development within a flood zone, with guidance being made to steer new development towards flood zone 1. Table D.1 outlines the categorisation of the different flood zones with flood zone 1 having the lowest probability and flood zone 3b having the highest with suitability being a Functional Floodplain. Table D.2 classifies the vulnerability of land uses from flooding. Table D.3 then matches the compatibilities of the site's vulnerability with the flood zone and then sees if an 'Exception Test' is required.

3.17 Annex E of PPS25, refers to 'The Assessment of Flood Risk', outlining the necessity of all developments to produce a Flood Risk Assessment that clearly proves that the proposed development has identified the sources of flood risk and mitigating measures that are required to reduce the risk of flooding to the users of the development in the future. Paragraph E.9 states:

- Planning applications for development proposals of 1 hectare or greater in Flood Zone 1 and all proposals for new development located in Flood Zones 2 and 3 (see Table D.1, Annex D) should be accompanied by a FRA. This should identify and assess the risks of all forms of flooding to and from the development and demonstrate how these flood risks will be managed, taking climate change into account. For major developments in Flood Zone 1, the FRA should identify opportunities to reduce the probability and consequences of flooding. A FRA will also be required where the proposed development or change of use to a more vulnerable class may be subject to other sources of flooding (see Annex C) or where the Environment Agency, Internal Drainage Board and/or other bodies have indicated that there may be drainage problems.

3.18 Annex F of PPS25, refers to 'Managing Surface Water', outlining the need to implement a strategy for dealing with surface water runoff as part of the Flood Risk Assessment. This annex refers to the effect of the development upon the surrounding area with a need to reduce its permeability. The annex also introduces the need for a sustainable urban drainage systems to be incorporated where possible on site to manage surface water in a manner which is easy to maintain and which provides benefit to the area. Reference to the Local Planning Authority's need to promote the use of SuDS is also made.

REGIONAL STRATEGY

'PRELIMINARY FLOOD RISK ASSESSMENT' (PFRA) – GLOUCESTERSHIRE COUNTY COUNCIL – NOVEMBER 2011

3.19 The PFRA was prepared by Gloucestershire County Council to fulfil their requirements as the Lead Local Flood Authority (LLFA) under the Flood Risk Regulations. The purpose of the PFRA was to assess past and future floods with significant harmful consequences and identify the areas of most significant flood risk in the catchment. The PFRA aimed to assess past flood incidents, identify the potential for future flooding and identify the area's most susceptible to significant flooding to aid the production of a flood mitigation strategy.

3.20 Gloucestershire identifies its catchment as being predominantly rural in setting whose population is mainly centred on Gloucester, Cheltenham, Stroud and Cirencester. The River Severn is the main Catchment River in the county although some of the southern Cotswold district feeds the River Thames and the western side of the Forrest of Dean feeds the River Wye.

3.21 Historical flooding incidents within the area are:-

- Cheltenham Borough – July 1967 & summer 2007.
- Cotswold District – March 1947, July 1968, August 1977, Sept 1992, Oct 1993, April 1998, Dec 2000, Summer 2007, Jan 2008.
- Forest of Dean – March 1947, July 1968, Dec 1981, Dec 2000, summer 2007.
- Gloucester City – Jan 1939, March 1947, July 1968, Dec 1981, Jan 1990, Dec 2000, Summer 2007.
- Stroud – Jan 1939, March 1947, Dec 1965, July 1968, Dec 1981, Jan 1990, Dec 2000, Summer 2007.
- Tewkesbury Borough – Jan 1939, March 1947, July 1968, Dec 1981, 1985, Jan 1990, April 1998, Dec 2000, Summer 2007.

3.22 The PFRA identified that the floods of the summer of 2007 were created by a dry spring followed by prolonged periods of intense rainfall which led to surface water overloading sewers and high river levels bursting their banks.

3.23 Cheltenham is mentioned in the historic flooding part of the report as having over 600 properties being flooded by the summer 2007 floods. Cheltenham suffered from Fluvial (River Chelt, Wymans Brook, Hatherley Brook, Mill Stream), surface runoff and exceedance from highway drains and public sewers. The areas mainly affected were

Charlton Kings (70 properties), River Chelt (230 properties), Hatherley (100 properties), Prestbury (70 properties) and Whaddon (250 properties).

3.24 Although there were several areas severely affected by flooding as mentioned above, the population densities within these areas weren't high enough to make it to the Environment Agency's Flood Risk Areas.

LOCAL STRATEGY

'STRATEGIC FLOOD RISK ASSESSMENT FOR LOCAL DEVELOPMENT FRAMEWORK – LEVEL 1' – PRODUCED BY HALCROW, ON BEHALF OF CHELTENHAM BOROUGH COUNCIL, DATED SEPTEMBER 2008.

3.25 The purpose of the level 1 SFRA was to assess and map all forms of flood risk from groundwater to river sources taking into account future climate change to allow councils to use as an evidence base for locating future development.

3.26 The SFRA breaks down the Borough into Flood Risk Zones in accordance with PPS25 'Development and Flood Risk', this information helps to set out the Borough's spatial strategy for development.

3.27 Historic flood map information provided within the report identified two areas close to the development site as suffering flooding during the July 1968 floods, one approximately 50m north-west of the site on the opposite side of the A40, the other approximately 100m south-west of the site on the Reddings. The historic flood map also shows areas along Hatherley Brook which suffered flooding during the summer 2007 floods, the nearest being approximately 200m east of the site next to the roundabout junction with the A40.

3.28 The information found within this report identified that although the development site itself was not subject to flooding historically and is not predicted to suffer flooding in the future, consideration will need to be made towards both Hatherley Brook and the Reddings, two areas which have historically suffered flooding.

4 SURFACE WATER MANAGEMENT PLAN (SWMP)

4.1 Currently the development land is made up of approximately 2.35 ha of green fields on the outskirts of Cheltenham, adjacent to the A40. The site has no evidence of built structures, is bound to the north and east with hedgerows with the south and west boundaries being unbound, forming part of the overall larger site for future development. It is proposed to provide a new access road off Grovefield Way, a Flagship Dealership with car showroom and servicing building with a 3000m² footprint and car parking. The developed site will provide approximately 1.65 ha of impermeable area.

4.2 The introduction of Schedule 3 of the Flood and Water Management Act, 2010, when it arrives, intends to put the onus of flood risk and the management of surface water onto the Lead Local Flood Authority. The implementation of the National SuDS Standards in October 2013 will provide the SuDS Approving Body (already set up within local councils) with implementable standards which they will use to assess suitability of development proposals.

4.3 Paragraph 3.8 confirms that the Asset Location maps, provided by Severn Trent Water, show the location of a public Foul Water sewer within North Road West which runs along the southern boundary of the site. The map information provided shows a public surface or combined water sewer running in a northerly direction along the length of Grovefield Way to the eastern boundary of the site. Foul Water sewers from the development can connect to the existing public Foul Water Sewer under a Section 104 agreement with Severn Trent Water, (see Appendix B for details of the asset location maps).

4.4 PPS 25 Annex F paragraph F8 says, 'Regional planning bodies and local authorities should promote the use of SuDS for the management of run-off. Local Planning Authorities (LPAs) should ensure that their policies and decisions on applications support and complement Building Regulations on sustainable rainwater drainage. These give priority to the use of infiltration drainage systems over first watercourses and then sewers.'

4.5 PPS25 Annex F paragraph F10 says, 'The surface water drainage arrangements for any development site should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect.'

4.6 It is proposed that the presence of a suitable Aquifer is unlikely beneath the site and based on this the SWMP recommends the use SuDS for attenuation purposes only in a manner which actively reduces the discharge rate of the surface water runoff from site and provides water cleansing.

4.7 To achieve this, the drainage strategy recommends the use of the following:-

- Domestic drainage from roofs shall enter into a rainwater harvesting system that will provide grey water to the premises for use within its toilets and vehicle wash facilities, the tank will be required to store up to 50m³ based upon the demand loadings calculated for the peak water usage of the premises. The remaining volume of runoff for up to and including the 1 in 100 year event will overflow from the storage tank into extra depth of filter material provided by the permeable paved car park.

- Permeable Paved attenuation structures within western parking court will attenuate flows generated by the parking court itself as well as from the hard surfaced driveway areas, for storm events up to and including the 1 in 100 year storm event as indicated in Appendix A.4.

- Highways will use a combination of a piped drainage network and lined filtration trenches to attenuate carriageway and footway run-off from the site. The filter drains will be sized to accommodate the 1 in 100 year storm event before entering a piped drain.

- All drainage systems will discharge into the minor watercourse running along the northern boundary via a Flow Control Chamber, which will be designed to limit discharge to Greenfield runoff rates.

4.8 The implementation of Sustainable Drainage Systems will both attenuate and cleanse the run-off from the site improving the quality before entering the watercourse.

4.9 The Storage Estimates provided in Appendix C.2 show that for the 1 in 100 year return period, and assuming there is no infiltration properties through the ground (based upon hydrology map information from the British Geological Survey website and historic soakage testing carried out in 2008 as shown in Appendix G), between **916m³** of **1303m³** attenuation will need to be provided by the onsite surface water management system.

4.10 It is proposed that the western parking court uses permeable paving to accommodate runoff from itself as well as from the hard surfaced drives. Based an area of 5385m² and approximately 260mm depth of filter material and allowing for a 30% void ratio, a total of **417m³** volume of attenuation can be provided (see Appendix C.3).

4.11 It is proposed that impermeable areas provided by the new business premises will enter into a rainwater harvesting system. The runoff volumes generated by these areas for storm events up to and including the 1 in 100 year return period (+30 climate change allowance) will be required to be attenuated within a two phased storage system. Storage calculations have been provided for these areas estimated at a volume of **482m³**. It is proposed that **50m³** is re-used within grey water services within the building and the remaining **432m³** will overflow into extra granular material storage beneath the permeable paving within the western car park. Based upon a car park area of 5385m² and a void ratio of 30%, an additional 267mm depth of filter material is required beneath the permeable paved car park (see Appendix C.4 for permeable car park design calculations, which include additional