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Flood Risk Assessment

Land off Oakhurst Rise, Charlton Kings
Cheltenham, Gloucestershire

Client:
William Morrison (Cheltenham) Ltd
3 Promenade
Cheltenham
Gloucestershire

C21505 – Land off Oakhurst Rise,
Charlton Kings / FRA
REVISION M
April 2020

APPENDICES

APPENDIX A: Topographical Site Survey by Midland Survey Ltd

APPENDIX B: Site Investigation Statement/Letter by Wilson Associates reference SW/4130 dated November 2016

APPENDIX C: Proposed Site Layout by Coombes Everitt Architecture Ltd

APPENDIX D: IH124 Drainage Calculation

MicroDrainage Attenuation Storage Volume Calculations/Results

APPENDIX E: Drainage Strategy by Simpson Associates LLP drawing references:
- C21505 – SK01C – Sheet 1 of 2
- C21505 – SK02C – Sheet 1 of 2

APPENDIX F: Pre-Development Enquiry Response Letter from Severn Trent Water reference 8245984 dated November 2016

Email confirmation for addition connection points to Andrew Uncles at Simpson Associates LLP from Belal Ali at Severn Trent Water

1. INTRODUCTION

1.1 This report has been prepared by Simpson Associates LLP on behalf of William Morrison (Cheltenham) Ltd in support of the *outline application for residential development of 43 dwellings – access, layout and scale not reserved for subsequent approval* at land off Oakhurst Rise, Charlton Kings in Cheltenham, Gloucestershire.

1.2 The report considers the flood risk associated with the development proposals which propose the construction of 43 residential properties with associated hard and soft landscaping and a new carriageway network.

1.3 The report follows advice contained in the Department for Communities and Local Government document "Technical Guidance to the National Planning Policy Framework (NPPF)", which provides guidance to planning authorities, developers, the public and Environment Agency (EA) on development and flood risk, as well as the "Joint Core Strategy Policy INF2: Flood Risk Management."

2. SITE LOCATION AND TOPOGRAPHY

2.1 The development site is located to the North of St Edward's Preparatory School, Cheltenham as shown in *Figure 1* below. A topographical survey has been undertaken by Midland Survey Limited, drawing references 32533/1, 32533/2 & 32533/3 dated August 2016. The survey drawings are included within *Appendix A* of this document.

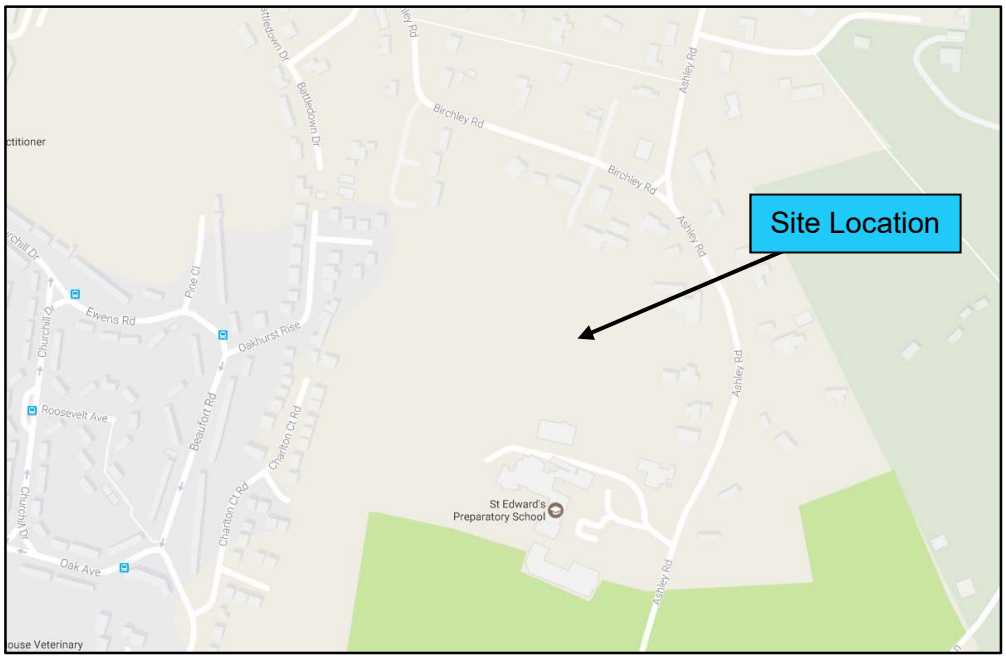


Figure 1: Site Location

2.2 The site co-ordinates are approximately X: 396507, Y: 221589, the site is located off Oakhurst Rise, Cheltenham and the nearest postcode is GL52 6NR.

2.3 The development site, as existing is approximately 41,684m^2 and currently comprises of soft landscaping made up of trees, shrubs, and grassed areas and typically falls in a South Westerly direction.

Figure 2: Site Topography

2.4 As shown on *Figure 2* above, the site has a perimeter of trees along the Western boundary which backs onto the rear of a row of residential properties. To the South, the site is bound by a small tree line connecting the site with St Edward's Preparatory School. A few residential properties bound the site to the East and North with various shrubs and fence lines and their respective boundaries.

3. EXISTING GROUND CONDITIONS

3.1 The existing ground conditions below are quoted from Wilson Associates letter to Simpson Associates outlining the assumed site conditions, reference SW/4130 dated 23rd November 2016. A copy of the letter is included within *Appendix B* for reference.

3.2 The letter indicates 'the site to be underlain by "bedrock" of the Lower Lias now called the Charmouth Mudstone Formation, typically comprising grey and khaki, plastic clays near-surface, which grade with depth to dark bluish-grey, fissured, shaly mudstones'.

3.3 The letter also reveals that Wilson Associates have undertaken numerous ground investigations within the Battledown area of Cheltenham and that one of the sites recorded ground conditions of 'firm to stiff grey and khaki-brown mottled orange becoming dark blue-grey clay; becoming thinly laminated with fine mudstone lithorelicts; grading to weak becoming moderately strong, shaly mudstone below approximately 3m depth with occasional gypsum crystals'.

3.4 It was noted that Wilson Associates had experience of the Charmouth Mudstone Formation (CMF) noting that it 'mostly classifies as unproductive strata (non-aquifer) due to low permeability. There are no recorded groundwater abstractors listed within EA records, and the site is not located within a groundwater Source Protection Zone (SPZ)'.

3.5 Wilson Associates stated that 'Based upon this Practice's experience of infiltration testing within the CMF, adoption of a conventional SUDs type drainage solution is highly unlikely to be feasible. The CMF is a largely impermeable unit, and whilst initial water uptake can vary from site to site, dependent upon degree of weathering and presence/distribution of fissures etc, such uptake is minimal and generally of little value'.

3.6 Therefore, from the statement provided by Wilson Associates, soakaway/infiltration structures will not be incorporated into the storm water drainage design due to poor infiltrating ground conditions.

4. PROPOSED SCHEME

4.1 The existing site is made up of soft landscaping with a variety of trees, shrubs and grassed areas. The proposed development will consist of 43 plots with associated hard and soft landscaping. A new carriageway linking all the properties will be constructed with a main entrance from Oakhurst Rise.

4.2 It is noted that the site area is approximately 41,684m^2 (4.168 ha) and as part of the development proposals, the impermeable roof and hard standing will be increased. Under the existing condition, the site is occupied by 41,684m^2 of permeable soft landscaping.

4.3 Under the proposed condition, the site impermeable roof, hard landscaping and carriageway access shall be increased to approximately 7,500m^2 which, will result in 34,184m^2 of permeable soft landscaping and planting.

4.4 Plans showing the layout of the proposed development are included in *Appendix C*.

5. SOURCE OF FLOODING

5.1 Planning authorities are responsible for the production of Strategic Flood Risk Assessments (SFRA's). These are studies that allow more detailed examination of the likely appropriateness of developing sites within a planning area in terms of flood risk. The following report commissioned by Cheltenham Borough Council (CBC) provides an assessment of the extent and nature of the risk of flooding in the local area:

Cheltenham Borough Council Strategic Flood Risk Assessment for Local Development Framework – Level 1, Volume 1 - FINAL – September 2008 by Halcrow Group Limited

5.2 The report, including relevant appendices, can be viewed by following the link below. The webpage also includes the relevant appendices:

https://www.cheltenham.gov.uk/downloads/46/planning_policy

5.3 The possible flood risk associated with sources of flooding considered within the above report has been reviewed under the headings below.

Fluvial / Tidal Flooding

5.4 The EA has derived flood maps, from which it is possible to initially identify whether development is located within an area that is at risk of fluvial or tidal flooding.

5.5 The maps, which are available on the EA's website, show the extent of the natural floodplain, if there were no flood defences or certain other manmade structures and channel improvements and categorise land as follows:

- Area that could be affected by flooding form rivers by a 1 in 100 year (1%) of greater flood or from sea by a 1 in 200 year (0.5%) or greater flood.
- Area that could be affected by flooding from rivers or the sea by a 1 in 1000 year (0.1%) or greater flood.

5.6 The maps are produced from a combination of national generalised computer models, detailed modelling and some historic flood event outlines, and are intended as a guide only.

5.7 A review of flood mapping is available with the combined use of the EA's website and the government website (Gov.uk) which indicates that the site lies outside of Flood Zone 2 and 3 as shown on *Figure 3* and *Figure 4* below.

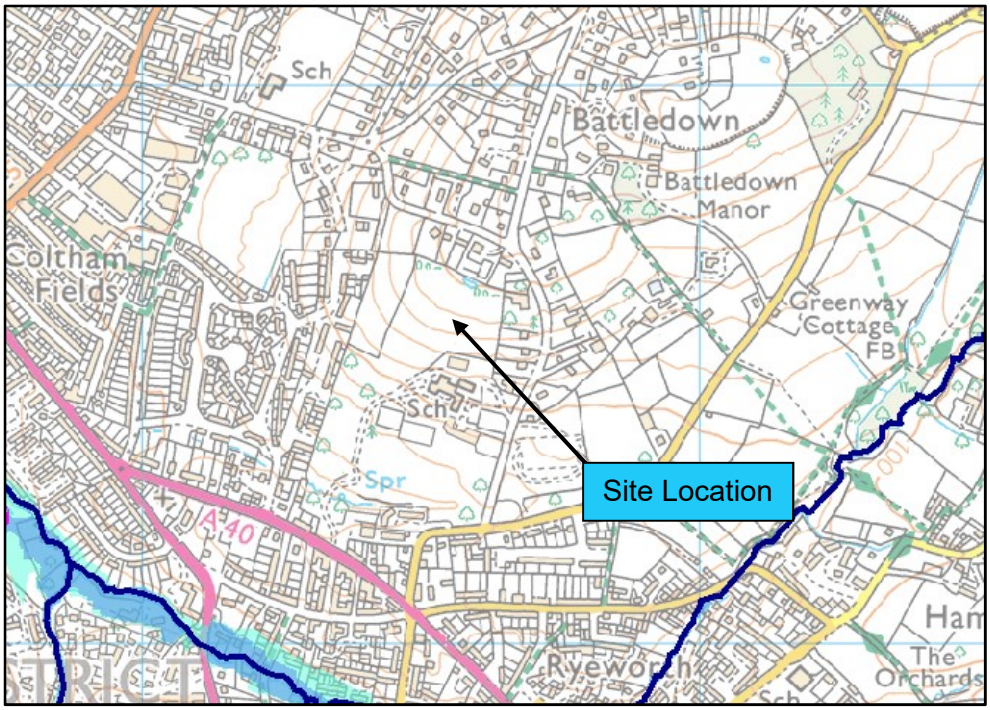


Figure 3: EA Flood Map for Planning Rivers and Sea (Extracted January 2017)

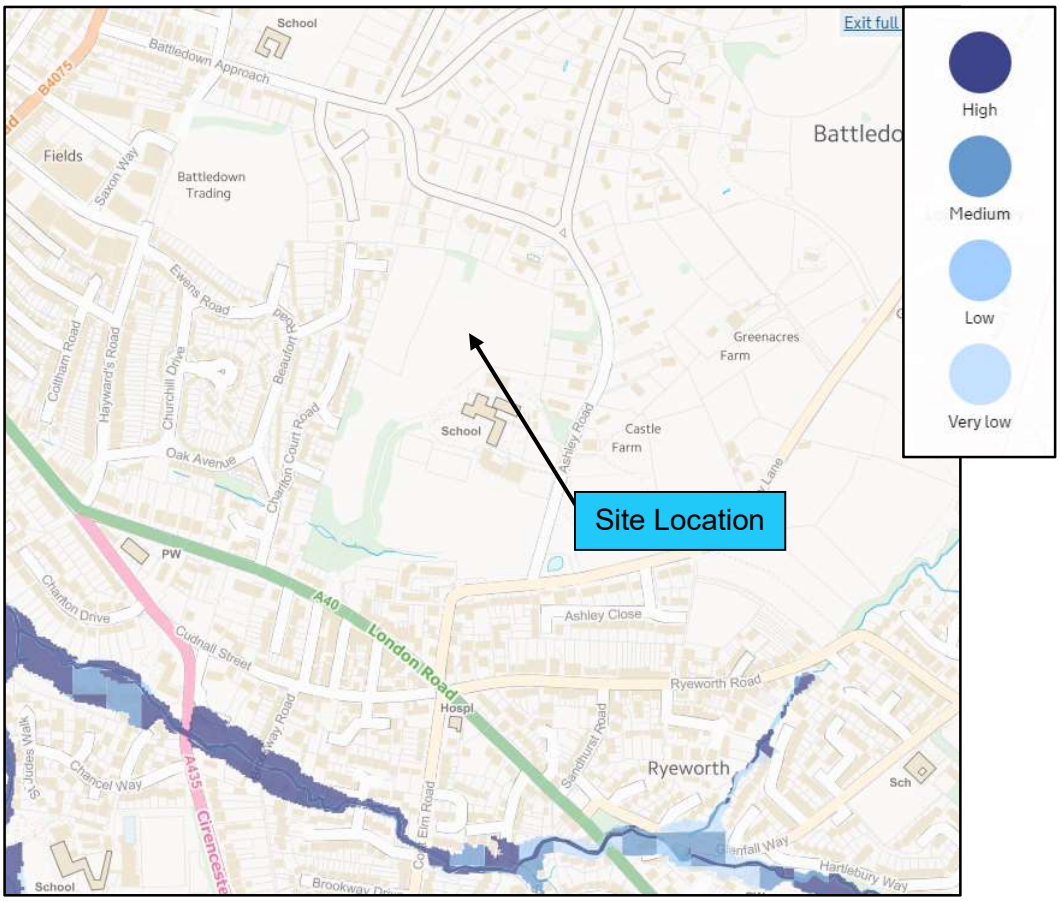


Figure 4: Gov.uk Flood Map of Fluvial/Tidal Flooding (Extracted January 2017)

5.8 The definitions of the Flood Zones extracted from the NPPF are described below:

- Flood Zone 1 – low probability
  This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

- Flood Zone 2 – medium probability
  This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.

- Flood Zone 3a – high probability
  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.

- Flood Zone 3b – the functional floodplain
  This zone comprises land where water has to flow or be stored in times of flood. Typically 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.

5.9 Both *Figures 3* and *4* show the site to be within Flood Zone 1, which the NPPF classifies as land having less than 1 in 1000 annual probability (<0.1%) of flooding from river or sea.

5.10 To the South of the site boundary is an existing river known as River Chelt. Due to the location of the site in relation to River Chelt and topographical levels increasing towards the site location, it is considered that the site is at low risk of fluvial flooding events.

Surface Water & Overland Flooding

5.11 Risk of Flooding from Surface Water map taken from the Gov.uk's website shows that the site lies within an area considered to be at no risk of surface water flooding as shown below in *Figure 5*. This may be due to the current greenfield site conditions of trees, shrubs and grass.

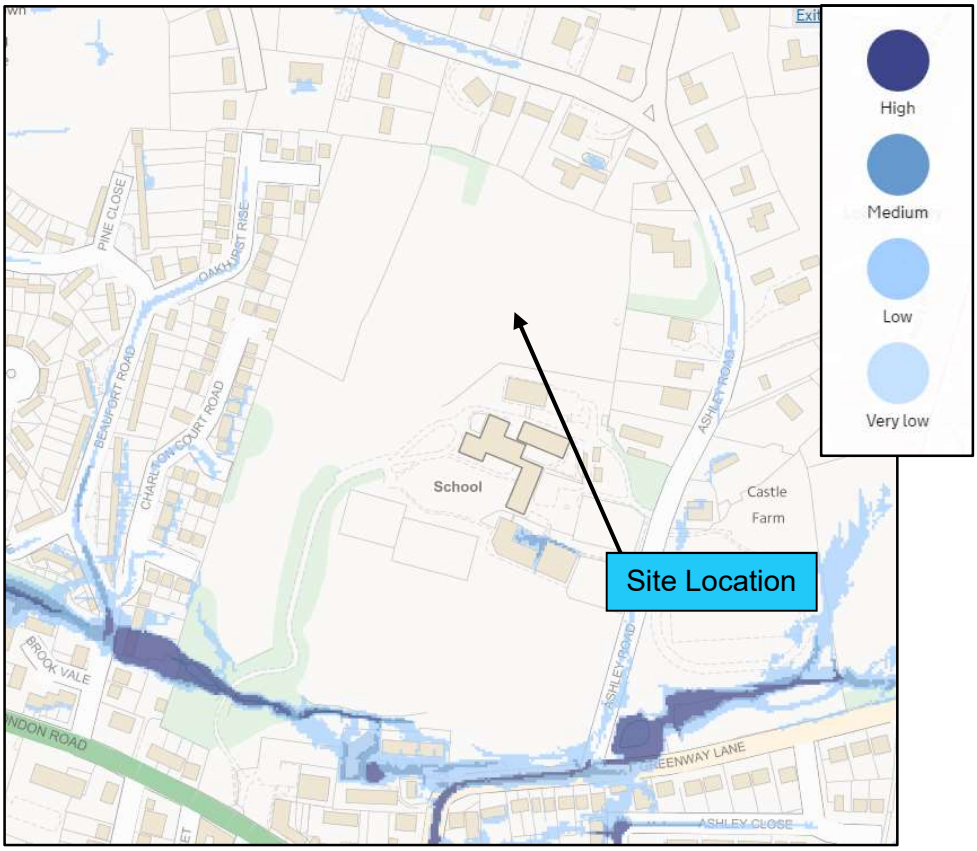


Figure 5: Gov.uk Flood Map of Surface Water Flooding (Extracted January 2017)

5.12 The site topographical survey shows that although the levels vary across the site, a fall typically towards the South West has been indicated. It is therefore assumed that risk of surface water flooding is low due to the steeply sloping site.

Flooding from Sewers

5.13 The SFRA includes information on past flooding incidents in the local area by inclusion of the DG5 register, this provides post codes of the affected areas. The exact locations of the affected properties are unknown.

5.14 The CBC has shown that 3 incidents of flooding from sewers have occurred in the vicinity of the site when looking at the postal area GL52 6. It is assumed that due to the low number of occurrences the site is at low risk of sewer flooding.

Flooding from Groundwater

5.15 The occurrence of groundwater flooding as an identifiable phenomenon has only been recognised in the last decade, primarily as a result of the extensive groundwater flooding throughout the UK during the winter of 2000/2001 which followed a period of exceptionally heavy rainfall. It is noted within the SFRA that during an eight-month period from September 2000, the rainfall in England and Wales reached 166% of the long term average with the highest rainfall coinciding with areas of Chalk outcrop.

5.16 Following the widespread flooding of 2000 and 2001, Defra commissioned a study of groundwater flooding throughout England. This research currently being carried out for Defra, identifies seven types of groundwater flooding event, as follows:

i) Rise of typically high groundwater levels to extreme levels in response to prolonged extreme rainfall;
ii) Rising groundwater levels in response to reduced groundwater abstraction in an urban area (termed groundwater rebound) or a mining area (termed minewater rebound);
iii) Subsidence of the ground surface below the current groundwater level;
iv) Rise of groundwater level in aquifers in hydraulic continuity with high inbank river levels or extreme tidal conditions;
v) Rise of groundwater levels due to leaking sewers, drains and water supply mains;
vi) Faulty borehole headworks or casings causing upward leakage of groundwater through confining layers driven by artesian heads;
vii) Increases in groundwater levels and changed flow paths due to artificial obstructions or pathways, and loss of natural storage and drainage paths.

5.17 Of these, (i), (iv) (v) and (vii) are the most likely to apply in the study area, although type (vi) may be possible, it is likely to be localised and the responsibility for actions to address any such occurrence may, in most cases, be readily identified.

5.18 The EA map shown below in *Figure 6* shows the risk of groundwater flooding. The map indicates that the site is not located within or near a Groundwater Source Protection Zone (SPZ's) which is defined as 2000 groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activity that might cause pollution in the area.

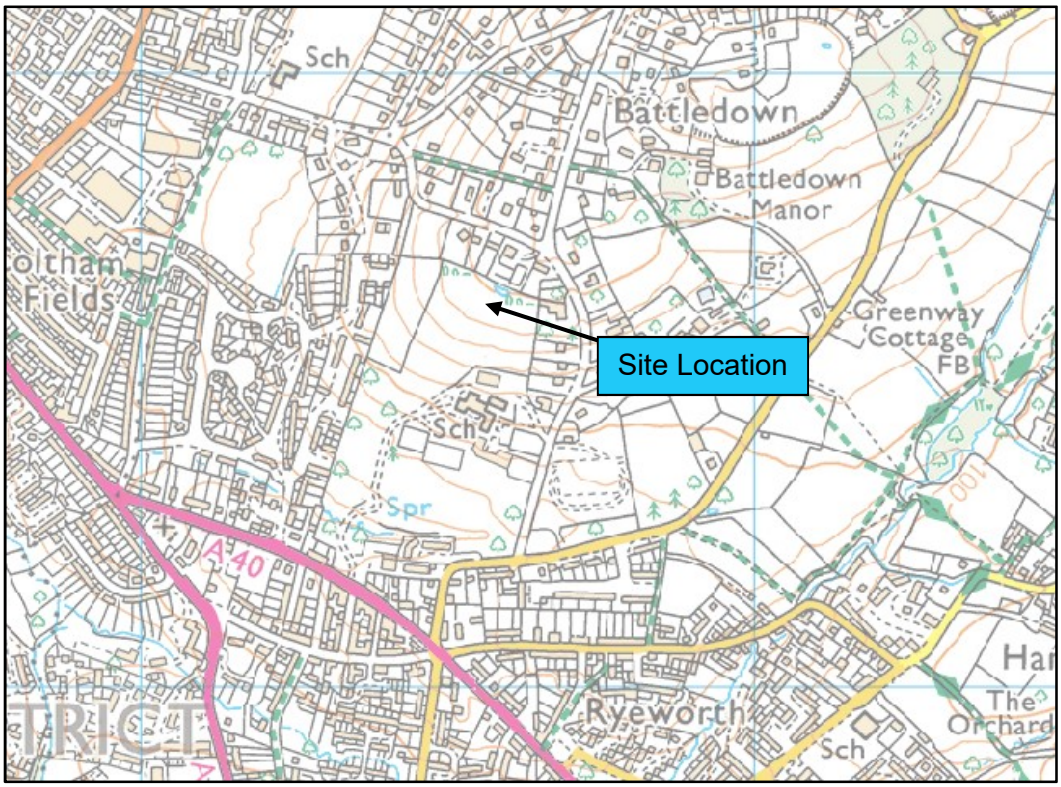


Figure 6: EA Groundwater Map (Extracted January 2017)

5.19 Groundwater Emergence Maps (GEMs), provisionally indicate areas vulnerable to groundwater emergence from consolidated aquifers have been produced to assess the geographical extent and severity of the groundwater flooding in 2000 and 2001. The SFRA has analysed the GEMs which indicate that the problem of groundwater flooding within England is largely confined to Chalk aquifers, particularly in the southeast of England. However, it should be noted that given the difficulty in distinguishing between groundwater flooding and fluvial flooding, such events may have occurred but not necessarily recorded as such in these areas.

5.20 The SFRA highlights that 'consultation with the Environment agency has indicated the GEMs do not cover the Cheltenham Borough Council area and there are no recorded incidents of groundwater flooding within the Council area'.

5.21 Based on the information available within the CBC Strategic Flood Risk Assessment, EA website mapping data and topographical survey information, it is considered that the risk from ground water flooding is low.

5.22 The geological information within Section 3 of this report when read in conjunction with the EA and SFRA would suggest that the risk of groundwater flooding potential for the site may be regarded as 'minimal'. This is however based on observations of the hydrogeological properties and historical records, and is not based on a formal risk assessment.

Flooding from Artificial Sources

5.23 The Gov.uk map shown in *Figure 7* shows the maximum extent of the potential flooded area from artificial sources. As shown, there is no indication of risk within the immediate vicinity of the proposed development site.

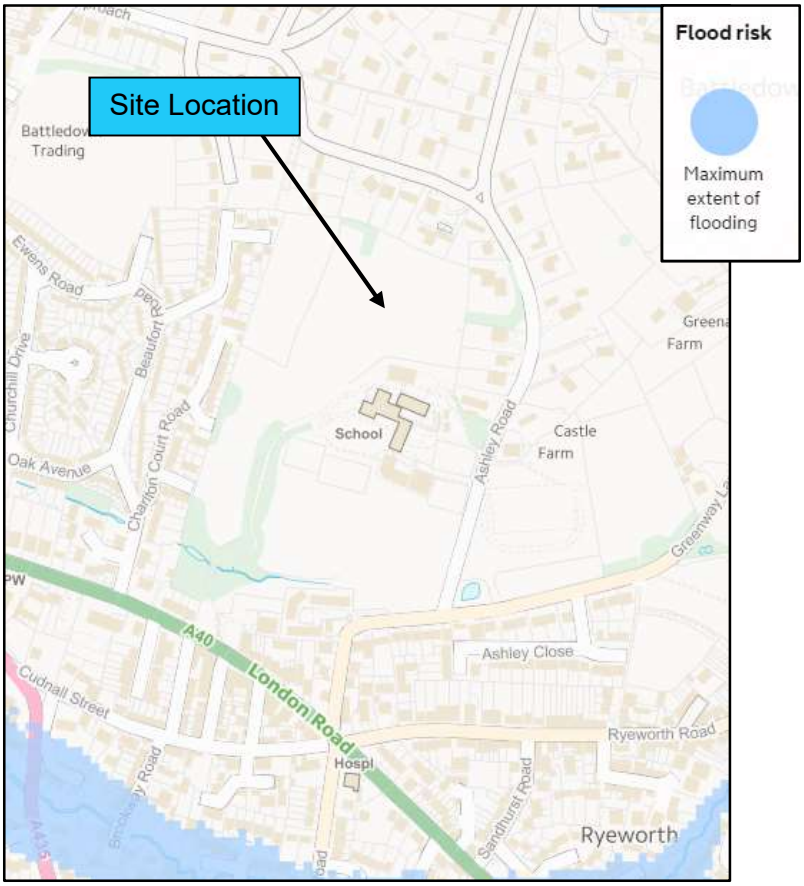


Figure 7: EA Flood Map for Flooding from Artificial Sources (Extracted January 2017)

5.24 The SFRA includes information on reservoirs within the overall study area as these typically lie immediately upstream of, or adjacent to, heavily populated areas. The rapid or uncontrolled discharge of waters such as reservoirs may have significant consequence on life and property although the risk of occurrence is considered to be low.

5.25 Dowdeswell Reservoir is located just outside of the extent of Cheltenham Borough and is noted in CBC SFRA to provide flood storage for the River Chelt forming part of the flood alleviation scheme for the river. Dowdeswell Reservoir is noted to be currently operated by the Environment Agency and forms part of their reservoir register.

5.26 Reservoirs with an impounded volume of greater than 25,000m Cu (measured above ground level) are governed by the Reservoirs Act 1975 and, registered within a list held by the Environment Agency. Each reservoir is generally designated a category (A/B/C/D) which describes the danger posed in the event of a dam breach. The definitions of these categories are given below:

i) Category A – a breach could endanger lives in a community
ii) Category B – a breach could endanger lives not in a community or result in extensive damage
iii) Category C – a breach would pose negligible risk to life and cause limited damage
iv) Category D – no loss of life can be foreseen as a result of a breach and very limited additional flood damage would be caused

5.27 The reservoir register for Cheltenham Borough Council is detailed in *Table 1* below:

Reservoir	Physical Status	Situation	NGR	Category	Year Built	Dam Type	Max Height	Capacity	Surface Area
The Reservoir– Cheltenham Racecourse	In Operation	Near Cheltenham	SO9597425033	Non-Impounding	Unknown	Unknown	Unknown	Unknown	Unknown
Cox's Meadow	In Operation	Cheltenham	SO9566021270	Non-Impounding	Unknown	Unknown	Unknown	Unknown	Unknown

Table 1: Reservoir Register for Cheltenham Borough Council taken from CBC SFRA

5.28 The EA mapping data, topographical location of the site and corresponding information gathered from the SFRA indicates that the site would not be regarded as at risk from flooding of artificial sources.

6. THE SEQUENTIAL AND EXCEPTION TEST

6.1 The National Planning Policy Framework (NPPF) encourages a sequential risk based approach to determine the suitability of land for development in flood risk areas. It advises local planning authorities to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.

6.2 In areas at risk of river flooding, the NPPF advises that preference be given to new development in Flood Zone 1. If there are no reasonably available sites in Flood Zone 1 the flood vulnerability of the development can be taken into account in locating development in Flood Zone 2 and then Flood Zone 3. Within each flood zone new development should be directed to sites at the lowest probability of flooding from all sources.

6.3 Detailed flood mapping included in the Level 1 SFRA confirms that the site lies outside of Flood Zone 2 as well as Flood Zone 3. The site is therefore deemed to fall within Flood Zone 1, where the annual probability of flooding from river or sea is less than 1 in 1000 in any given year (<0.1%). The National Planning Policy Framework (NPPF) advises that all land uses are appropriate in Flood Zone 1. Therefore, the proposed development is considered appropriate in terms of the sequential test.

7. MANAGING THE RISK OF FLUVIAL FLOODING

7.1 It has been established that the site is at low risk of flooding from all sources. Therefore, the primary flood risk is considered to be the management of surface water runoff.

7.2 A topographical survey of the site has identified a fall in level towards the South West of the site.

7.3 The impermeable area of the site as a result of the proposed development will be increased from 0m^2 to 7,500m^2. Therefore, the demands upon the existing sewer network off site will be increased.

7.4 A Sustainable Urban Drainage System (SUDs) management train is considered to mimic the natural catchment processes as closely as possible. This is intended to use drainage techniques in series to incrementally reduce pollution, flow rates and volumes. However, it is noted that not all sites will lend themselves to a management train or restrict available techniques due to site constraints.

7.5 The hierarchy of techniques that should be considered in developing management train are as follows;

- Prevention - Site design and maintenance to prevent runoff and pollution (eg sweeping to remove surface debris and rainwater reuse/harvesting).
- Source Control - Control of runoff at or very near to source (eg soakaways, alternative infiltration methods, green roofs, porous pavements).
- Site Control - Management of water in a local area (eg routing of roof/car park drainage to soakaway, infiltration or detention basin).
- Regional Control - Management of runoff from the site typically in a balancing pond or wetland.

7.6 The management train shown within *Figure 8* below shows the hierarchy of techniques and, it should be noted that systems appropriate to higher up the hierarchy are preferred to those further down such that prevention and source control should always be considered before site or regional controls. Water should be conveyed elsewhere only if it cannot be dealt with on site. Hence, wherever possible storm water should be managed in smaller, cost effective landscaped features located within small catchments rather than being conveyed to and managed within larger systems at the downstream end of the catchment.

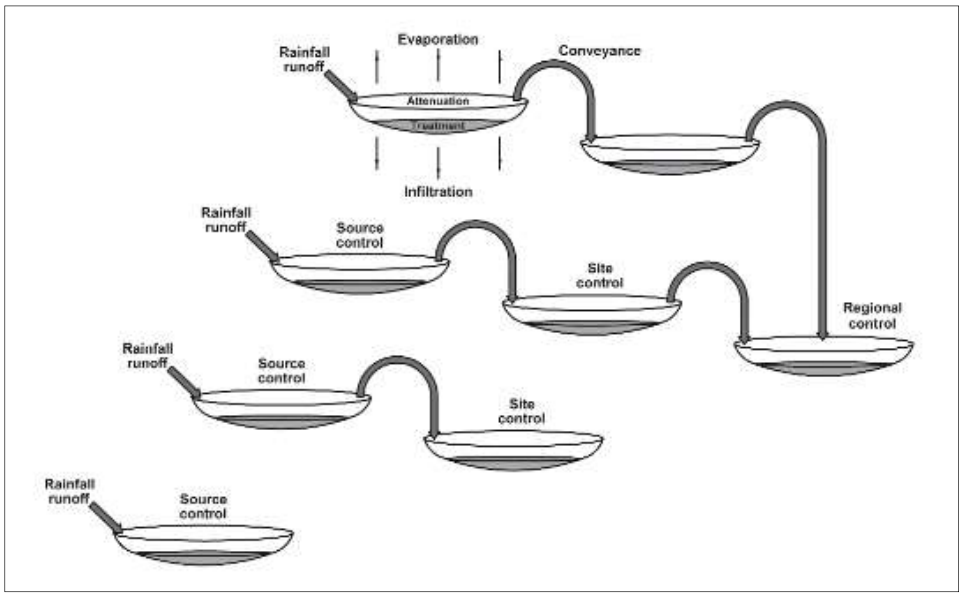


Figure 8: The SUDS Management Train

7.7 According to the SUDS management train methodology the preferred method of disposal is to ground in order to mimic natural drainage pathways. However, if this is not considered a viable option due to site constraints such as ground conditions providing poor infiltration and availability of suitable development space then techniques lower within the management train hierarchy must be considered.

7.8 Within *Figure 9* below is a summary of SUDS components which shall be considered as part of the development proposals. The techniques listed should not be considered exhaustive however, represents a broad selection of typical SUDS options as discussed within CIRIA publication C609 SUDS Techniques – hydraulic, structural and water quality advice.

Most Sustainable	*SUDS technique*	*Flood Reduction*	*Pollution Reduction*	*Landscape & Wildlife Benefit*
	Living roofs	✔	✔	✔
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✔	✔	✔
	Filter strips and swales	✔	✔	✔
	Infiltration devices - soakaways - infiltration trenches and basins	✔	✔	✔
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paviors	✔	✔	
Least Sustainable	**Tanked systems** - over-sized pipes/tanks - storms cells	✔		

Figure 9: The SUDs Management Train

7.9 The SUDs techniques identified within *Figure 9* are defined as per below;

- Preventative measures – *The first stage of the SUDS approach to prevent and/or reduce pollution and runoff quantities. This may include good*

housekeeping, to prevent spills and leaks, storage in water butts, rainwater harvesting systems, and alternative roofs (ie green and brown roofs).

- Green roofs – Vegetative roofs that reduce the volume and rate of runoff and remove pollution.
- Basins, ponds and wetland – Areas that may be utilised for surface runoff storage.
- Filter drains – Linear drains consisting of trenches filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water; they may also permit infiltration.
- Filter strips – Vegetative areas of gently sloping ground designed to drain water evenly off impermeable areas and to filter out silt and other particles.
- Swales – Shallow vegetated channels that conduct and retain water, and may also permit infiltration; the vegetation filters particulate matter.
- Bioretention areas – Vegetative areas designed to collect and treat water before discharge via piped system or infiltration to the ground.
- Infiltration devices – Sub-surface structures to promote the infiltration of surface water to ground. They can be trenches, basins or soakaways.
- Pervious surfaces – Surface that allow inflow of rainwater into the underlying construction or soil.
- Filters – Engineered sand filters designed to remove pollutants from runoff.
- Pipes and accessories – A series of conduits and their accessories normally laid underground that convey surface water to s a suitable location for treatment and/or disposal. (Although sustainable, these techniques should be considered where other SUDS techniques are not practical).

7.10 The following measures within Section 8.0 of this report are proposed to ensure that the development can be occupied and operated safely whilst forming a strategy for the management of surface water runoff. This will ensure that the development does not increase the risk of surface water flooding as a result.

8. STORM WATER DRAINAGE STRATEGY

8.1 Sections 5 and 6 of this report established that, the site is considered to be at low risk of flooding from all sources and located within Flood Zone 1. The National Planning Policy Framework (NPPF) advises that all land uses are appropriate in Flood Zone 1. Therefore, the proposed development is also considered appropriate in terms of the sequential test. The new development will have the potential to generate additional volumes of surface water runoff, which can increase the risk of surface water flooding both on site and elsewhere in the overall catchment

8.2 This section of this report considers a strategy for the management of surface water runoff to ensure the development does not increase the risk of surface water flooding.

8.3 As noted in section 3 of this document, infiltration drainage techniques for the disposal of surface water runoff from this area are not considered feasible due to the impermeable nature of soil. Therefore, discharge of runoff from the additional impermeable area to the existing storm sewer network off site shall be considered. Refer to 8.16 for further information regarding final outfall.

8.4 As part of the final design solution, the SUDS management train should be applied where practical. Various techniques will be considered fully during final below ground drainage

design however, a summary of the techniques considered is shown below within *Table 2*.

SUDS Technique	Site Benefit	Suitability for use on development area	To be considered at detailed design stage
Preventative measures - good housekeeping	Prevention of spills and leaks	The access and adjacent soft landscaped areas are to be maintained by a management company enabling 'good housekeeping measures' to be instigated	Yes
Preventative measures - storage in water butts	May reduce discharge volume and rates from the development. The harvested water is typically used for maintenance of soft landscaped areas	Rainwater downpipes may be connected to water butts where adjacent to soft landscaped areas	Suitable for use within garden areas of properties
Preventative measures - rainwater harvesting systems	May reduce discharge volume and rates from the development. The harvested water is typically used for grey water	Development will have typically a low grey water demand which reduces site benefit.	Not suitable due to low water demand for grey water
Green roofs	May reduce discharge volume and rates from the development. Removes pollution	Development incorporates a combination of steeply sloping roof lines and flat roofs to the proposed properties as per Architects site plan	Not suitable due to steeply sloping roof lines on Architects proposals
Basins, ponds and wetland	May reduce discharge volume and rates from the development. Removes pollution	These features typically require a large level area of soft landscaping which, may accommodate surface water storage.	Site is steeply sloping however, may be suitable subject to landscape proposals
Filter drains	May reduce discharge volume from the development by infiltration	As per section 3 of this report, infiltration techniques are not suitable on the site due to underlying ground conditions.	Not suitable
Filter strips	May reduce discharge volume and rates from the development by infiltration. Removes pollution	Feature requires gently sloping areas to discharge water. Infiltration techniques are not suitable on the site due to underlying ground conditions	Not suitable
Swales	May reduce discharge volume and rates from the development by infiltration. Removes pollution	These features typically require a large level area of soft landscaping which, may accommodate surface water storage.	Site is steeply sloping however, may be suitable subject to landscape proposals
Bioretention areas	May reduce discharge volume and rates from the development by infiltration. Removes pollution	As per section 3 of this report, infiltration techniques are not suitable on the site due to underlying ground conditions.	Not suitable
Infiltration devices	Discharge from the development by infiltration.	As per section 3 of this report, infiltration techniques are not suitable on the site due to underlying ground conditions.	Not suitable
Pervious surfaces	May reduce discharge volume and rates from the development by infiltration. Removes pollution	To fully utilise available storage within sub base, the paving shall be relatively level.	Driveways and areas of carriageway maybe suitable for filtration purposes only
Filters	Removes pollution	Filter chambers within drainage system may be considered	Installation of filter manholes to be considered during detailed design
Pipes and accessories	Controlled discharge rate from the development	Flow control and cellular storage is considered suitable	Yes

Table 2: Summary of SUDS techniques

8.5 As part of the detailed design stage and where practicable, attempts should be made for the proposed development to use water wisely due to the increasing pressure on water resources. It is therefore recommended that source control systems are installed. In addition, to improve the level of sustainability achieved, components such as dual flush toilets, aerated taps and shower units (if provided), solar water heaters can be installed to reduce water consumption.

8.6 As per *Table 2* above, permeable paving to hard landscaped areas and/or filters shall be used where practicable during detailed design stage to provide water quality improvements. An Aqua-Swirl will also be provided to add further betterment to the surface water runoff.

The CIRIA C753 SuDS Manual 2015 sets out requirements for delivering appropriate levels of treatment to surface water runoff using SuDS. *Table 3* below identifies the pollution hazard indices for the relevant uses on the site.

Use	Pollution Hazard Level	Pollution Hazard Index		
		TSS	Metals	TPH
Individual property driveways, residential car parks, low traffic roads.	Low	0.5	0.4	0.4

Table 3: Pollution Hazard Indices

The introduction of an Aqua-Swirl provides the required water quality treatment:

Pollution index	Pollution Mitigation Index		
	TSS	Metals	TPH
Aqua-Swirl	0.8	0.5	0.7

Table 4: Pollution Mitigation Indices

8.7 Ecological improvements have been proposed in the form of a pond to the South of the site which will allow storm water flows from the site part to pass through it and onto the flow control chamber via a below ground attenuation tank. The pond will be designed to allow water to be held within it but will not form part of the attenuation storage, this will be provided in the attenuation tank only.

8.8 It is considered that, by incorporating these SUDS features the opportunity is provided to reduce the overall discharge rate further by slowing the rate of concentration via the use of filtration. The volume of storm water discharge may also be reduced by allowing limited infiltration and evaporation within swales/pond or permeable paving.

8.9 The existing site area is taken as 41,684m^2 which consists of permeable soft landscaping. Under the proposed condition, approximately 7,500m^2 will be impermeable roof and hard landscaped areas with the remaining 34,184m^2 being permeable soft landscaping (consisting mainly of grassed areas with retained trees).

8.10 A Greenfield runoff rate (QBAR) has been calculated using the IH124 method of calculation, which is included in the Source Control design facility of the WINDES software package by Micro Drainage.

8.11 The calculation recommends that QBAR should be calculated using an area of 50 Ha in the formula which should then be adjusted by the ratio of the site area to 50 Ha. A QBAR figure of 170.1 l/s has been calculated for an area of 50 Ha, which is equivalent to a rate of 3.402 l/s/Ha. A copy of the IH124 design results are included in *Appendix D.*

The corresponding maximum permitted discharge rate from the existing site using this method for an area of 7,500m^2 (0.750 Ha) would be 2.55 L/s.

8.12 MicroDrainage software has been used to prepare an attenuation storage volume for the new impermeable catchment areas using the Source Control Module. An attenuation volume of approx. 625m^3 has been calculated based on the 1 in 100 year storm event plus 40% allowance for climate change. Using the space provided on site 625m^3 of storage volume could be provided in 250m^2 x 2.5m attenuation crates with a 95% void ratio and a 600mm distributor pipe in a 1.5m wide gravel strip. Further design results can be found within *Appendix D*.

8.13 A surface water drainage scheme has been prepared on this basis and is shown on the drainage strategy plan included in *Appendix E.*

8.14 In terms of surface water management, it is concluded that through the proposed surface water strategy the development can be occupied safely. It is noted that with the incorporation of a pond, permeable paving and a Hydrodynamic Vortex Separator (Aqua-Swirl by SDS Ltd), water quality improvements are provided. The attenuation is sized also to accommodate flows up to and including the 1 in 100 year return period event with 40% allowance for climate change.

8.15 Detailed network analysis and simulations will be undertaken of the proposed network with the use of Micro Drainage design software as part of the final below ground drainage design.

8.16 The final outfall for the storm water network is proposed as the construction of a new manhole on the line of the existing storm water sewer between Severn Trent Water (STW) manhole SO96212405 and SO96213403, located within Charlton Court Road. STW have confirmed that their system has capacity to take the new flows from the site. Copies of the correspondence with STW can be found in *Appendix F*.

8.17 Where the proposed drainage system is demonstrated to have sufficient capacity to serve the 1 in 100 year return period storm inclusive of climate change and, it is demonstrated that no flooding will occur due to the new connection, the scheme can be considered acceptable in terms of surface water drainage strategy.

9. FOUL WATER DRAINAGE STRATEGY

9.1 The existing Greenfield site currently comprises of no foul drainage features or networks.

9.2 STW have reviewed the location and type of the proposed development in relation to their sewers. Three suitable points of connection have been identified through a pre-development enquiry by STW. These suitable points of connection for foul water disposal include the existing sewer within Oakhurst Rise (STW MH SO96213604) to the North, Charlton Court Road (between STW MH SO96213403 and SO96212405) to the South

West and St Edward's Preparatory School (STW MH SO96214401) to the South. Correspondence between Simpson Associates and STW can be found in *Appendix F*.

9.3 Topographical information indicates that the site steeply slopes towards its Southern boundary. STW apparatus, manhole SO96213604, to the North located within Oakhurst Rise has a cover level of 102.20m and invert level of 99.85m, to achieve a connection into this manhole the foul flows within the site would have to be conveyed via gravity to the South of the site then pumped up to the North. Two gravity options to the South would therefore be preferred to eliminate the use of a pump.

9.4 STW existing manhole SO96214401 would be the preferred option for the foul water outfall connection as it is located just to the South of the site within St Edward's school grounds and would therefore minimise the works outside of the site boundary.

9.5 Should a connection not possible into manhole SO96214401, due to complications such as crossing third party land or buildability issues, then an alternative connection could be made under gravity to an existing 225mm diameter sewer located within Charlton Court Road to the South West of the development. A new manhole would be constructed on the line of the existing sewer with an assumed cover level of 89.05m and invert level of 87.00m which would tie into the expected levels within Charlton Court Road.

9.6 A peak discharge into for the proposed development has been calculated using 4000 litres per day per dwelling. The peak foul flows for the 43 units has been calculated as 1.99 L/s.

9.7 A drainage strategy plan has been developed on this basis and is included in *Appendix E*.

9.8 The final outfall for the foul water network is proposed as a new connection to an existing manhole located at the existing foul water sewer within St Edward's School to the south of the site. Severn Trent Water (STW) have initially confirmed that their system has capacity to take the new flows from the site, a further capacity check should be undertaken downstream of the proposed outfall connection during the detailed design stage once proposed flows have been finalised. As mentioned in 9.2 on the previous page, copies of the correspondence with STW can be found in *Appendix F*.

9.9 Where the proposed drainage network is demonstrated that no flooding will occur due to the new connections, the scheme can be considered acceptable in terms of foul water drainage strategy.

10. CONCLUSIONS

10.1 It has been established that the site is located in Flood Zone 1. Therefore, the level of fluvial flood risk is considered to be low.

10.2 The site is at low risk of surface water flooding but new developments can increase the volume and rate at which surface water runoff is discharged from the site when compared to the existing condition, which can cause an increase in flood risk both on the site and elsewhere within the catchment. Therefore, to mitigate against this risk the proposed development allows for a controlled discharge for the 1 in 100 year return period storm allowing for 40% climate change at the greenfield runoff rate.

10.3 A drainage strategy has subsequently been prepared for the development and, confirms that the surface water flows from the site will not be increased for all storm return periods up to and including the 1 in 100 year event with 40% allowance for climate change when compared to the existing site condition.

10.4 To provide a reduction in the proposed storm water site discharge rate, it will be necessary to provide attenuation. It is considered that a below ground attenuation tank will provide a suitable means of storing excess flows. Permeable paving, a pond and an Aqua-Swirl will also provide an additional benefit of water quality improvements.

10.5 The necessary flow controls shall be provided with the use of vortex flow control devices and sized appropriately to ensure that the proposed flows are not exceeded under the designed head.

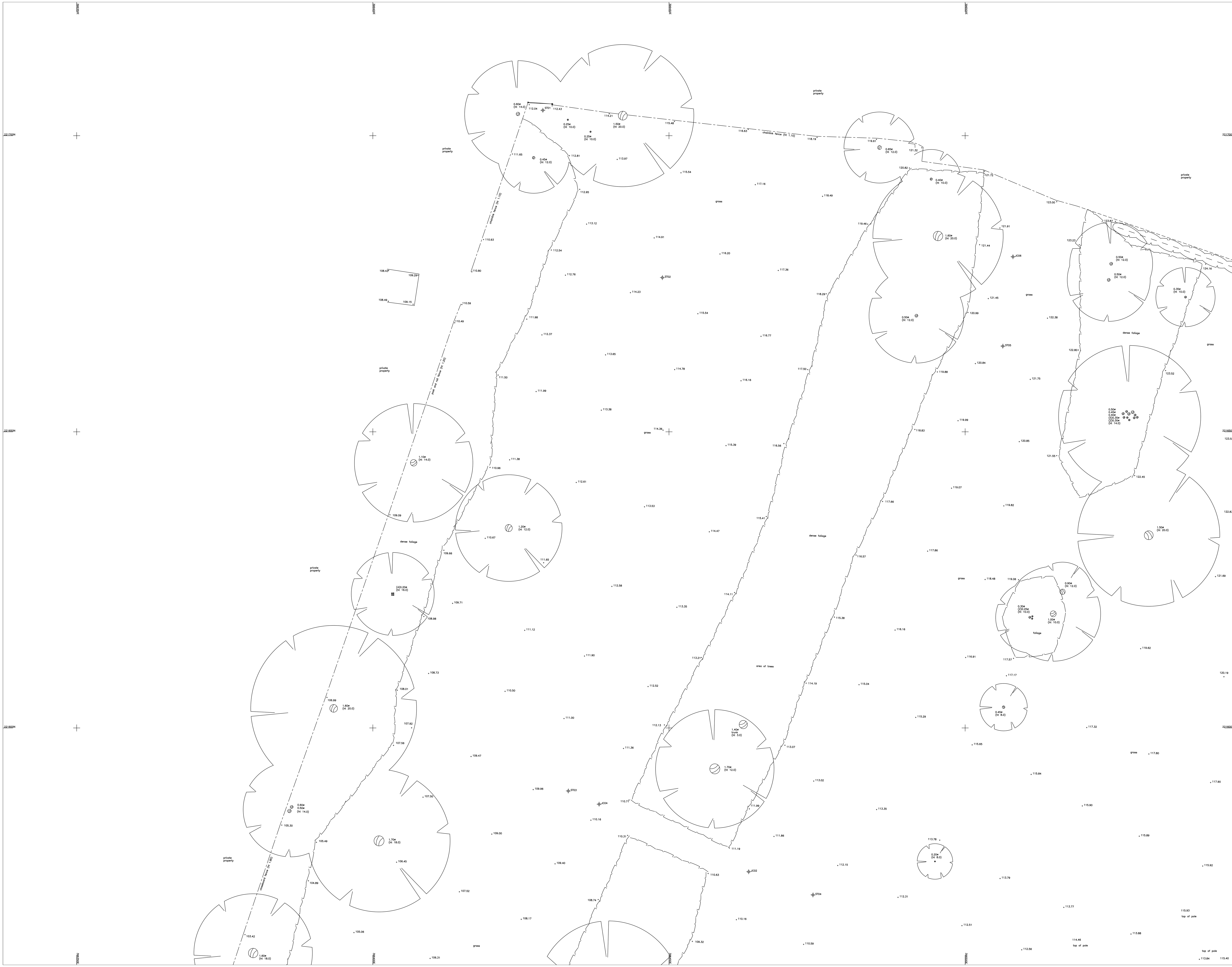
10.6 The existing foul water sewer to the South of the site located within the ground of St Edward's preparatory school is assumed suitable to accept the additional flows generated by the development and, are noted to have sufficient capacity to accommodate the flows derived from the development by Severn Trent Water.

10.7 Should the connection into the sewer within St Edward's school ground not be feasible, then an alternative outfall connection could be made into the existing 225mm diameter sewer to the South West of the site located within Charlton Court Road.

10.8 STW have approved in principle the connections/discharge rate for storm and foul water. Refer to *Appendix F* for correspondence with STW.

APPENDIX A

Topographical Site Survey by Midland Survey Ltd



NOTES

GENERAL NOTES :–

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GPS COORDINATES AND LEVELS SET AT ST01 (NO SCALE FACTOR APPLIED)

THIS DRAWING HAS BEEN PRODUCED WITH A PLOT SCALE ACCURACY OF 1:200

SERVICE COVERS INDICATED WHERE VISIBLE. PIPE INVERTS / DETAILS SURVEYED FROM SURFACE INSPECTION ONLY. GENERALLY DAMAGED COVERS AND COVERS WITHIN HIGHWAYS WILL NOT BE LIFTED

TREE SPECIES SHOULD BE CONFIRMED BY TREE SPECIALIST IF CRITICAL.

OVERHEAD CABLES ARE INDICATED USING REMOTE SURVEY METHODS AND ARE SUBJECT TO SEASONAL VARIATION, AND SHOULD BE TREATED AS APPROXIMATE.

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JC05	396606.132	221597.258	121.520
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SHEET LAYOUT :–

A0–SHEET 32533/1
A0–SHEET 32533/2
A0–SHEET 32533/3

UTILITY SURVEY KEY :–

HATCHED AREA
BOREHOLE
CPT
TRIAL PIT
HAND PIT
WINDOW SAMPLE

— N — N — ELECTRIC CABLE
— W — W — WATER PIPE
FOUL SEWER
STORM SEWER
COMBINED SEWER
— D — D — DUCTS
— TV — TV — CABLE TELEVISION
— COM — COM — DATA CABLE
— : — : — TELECOM CABLE
— G — G — GAS PIPE
— U — U — UNIDENTIFIED SERVICE
— – – — OTHER
— CCTV — CCTV — CCTV
— TL — TL — TRAFFIC LIGHT
— O — O — OFFSET FILL
— V — V — VENT
— F — F — FUEL PIPE
— GL — GL — GAUGE LINES
— P — P — PIPE
— AR — AR — ASSUMED ROUTE
— TFR — TFR — TAKEN FROM RECORDS

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UTILITY NOTES

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www.midlandsurvey.co.uk

Client WILLIAM MORRISON (CHELTENHAM) LTD

Project ST EDWARDS JUNIOR SCHOOL, CHARLTON KINGS, CHELTENHAM, GL52 6NR

Title TOPOGRAPHICAL SURVEY

Date AUGUST 2016
Scale 1:200@A0
Dwg No 32533 /1
Surveyor A.B/J.C
Checked J.S/P.G

Revisions
R2: NEW JOB NUMBER, JOB ORIGINALLY POSITIONED VIA BEST FIT TECHNIQUES, WHOLE JOB NOW MOVED AND ROTATED TO GPS COORDINATES. EXTRA DETAIL AND SOUTH FIELD ADDED AS REQUESTED, SEPTEMBER 2018

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SHEET LAYOUT :–

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Title TOPOGRAPHICAL SURVEY

Date AUGUST 2016

Scale 1:200@A0

Dwg No 32533/2

Surveyor A.B/J.C

Checked J.S/P.G

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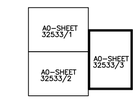

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Client	WILLIAM MORRISON (CHELTENHAM) LTD
Project	ST EDWARDS JUNIOR SCHOOL, CHARLTON KINGS, CHELTENHAM, GL52 6NR
Title	TOPOGRAPHICAL SURVEY
Date	AUGUST 2016
Scale	1:200@A0
Dwg No	32533 /3
Surveyor	A.B/J.C
Checked	J.S/P.G

Revisions

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TOPOGRAPHICAL (LAND) SURVEYORS / UTILITY SURVEYORS
BUILDING MEASUREMENT SURVEYORS / 3D LASER SCANNING

APPENDIX B

Site Investigation Statement/Letter by Wilson Associates reference SW/4130 dated November 2016

Wilson Associates
Consulting Engineering Geologists & Geo-Environmental Engineers

36 Brunswick Road Gloucester GL1 1JJ
Tel: 01452 422843
Email: info@wilsonac.co.uk
www.wilsonac.co.uk
Company No. 6133365

Simpson Associates
Elmbridge Court
Cheltenham Road East
Innsworth
Gloucester
GL3 1JZ

Our ref: SW/4130

23 November 2016

FAO: Mr Robert Wilson, Senior Engineer

Dear Robert,

RE: LAND TO THE NORTH OF ST EDWARDS SCHOOL, BATTLEDOWN, CHELTENHAM

It is proposed to develop the above site to comprise a residential led scheme, although a definitive layout is yet to be finalised / made available. To aid your development of a Flood Risk Assessment and Drainage Strategy for the site, it is understood that you require an understanding of the ground conditions and infiltration potential. This letter therefore summarises the mapped geology, hydrogeology and provides 'local knowledge' concerning the infiltration potential based upon the expected ground conditions, in advance of being able to derive site-specific data from intrusive investigation.

Geology

British Geological Survey mapping sheet SO92SE (1:10,000 scale, 1983) and online shows the site to be underlain by "bedrock" of the Lower Lias now called the Charmouth Mudstone Formation, typically comprising grey and khaki, plastic clays near-surface, which grade with depth to dark bluish-grey, fissured, shaly mudstones. There are no recorded superficial deposits across the site, and no mapped geological faulting or made ground.

There are no nearby, pertinent archive BGS borehole records, although this Practice has undertaken numerous ground investigations within the Battledown area of Cheltenham. One of these sites, located on Oakley Road some 475m to the north, verified the mapped ground conditions in recording *"firm to stiff grey and khaki-brown mottled orange becoming dark blue-grey clay; becoming thinly laminated with fine mudstone lithorelicts; grading to weak becoming moderately strong, shaly mudstone below approximately 3m depth with occasional gypsum crystals"*.

Hydrogeology

The EA website classifies the CMF as a 'Secondary Undifferentiated' aquifer, which means that the EA has not been able to characterise the formation due to the variable characteristics of the rock type. This Practice's experience of the CMF is that it mostly classifies as unproductive strata (non-aquifer) due to low permeability. There are no recorded groundwater abstractors listed within EA records, and the site is not located within a groundwater Source Protection Zone (SPZ).

Hydrology

The site contains a small pond coincident within the north-eastern site boundary, which appears to have been present since before first edition Ordnance Survey mapping (1886). On the basis that the site is entirely grass covered, rainwater infiltration is expected to be high, subject to natural permeability.

Infiltration Potential

Based upon this Practice's experience of infiltration testing within the CMF, adoption of a conventional SUDS type drainage solution is highly unlikely to be feasible. The CMF is a largely impermeable unit, and whilst initial water uptake can vary from site to site, dependent upon degree of weathering and presence/distribution of fissures etc, such uptake is minimal and generally of little value.

This Practice recently undertook falling head tests within boreholes at a property on Harp Hill (road) some 650m northeast of the site. That investigation recorded a 'normal' weathering profile of the CMF, within which infiltration testing was carried out between approximately 1.0m and 3.5m depth. Testing recorded nil infiltration, with the report concluding that the client *"may wish to consider the benefit of performing full-scale soakaway tests (in accordance with BRE 365 guidance) within machine-excavated trial pits in an attempt to achieve more favourable infiltration rates, although given the results to date and this Practice's experience of performing infiltration analysis within the CMF, such additional efforts are highly unlikely to result in a successful outcome"*.

On the basis of the foregoing it was recommended to the client that *"alternative drainage options be sought; in conjunction with alternative measures such as rainwater harvesting, porous paving/driveways and attenuation ponds, this may involve the transmission of storm water run-off to existing drainage networks and/or existing watercourse(s). In the case of the latter prior approval should be sought from the local regulatory authorities"*.

I trust that the above and attached suitably addresses your requirements, however should you have any queries or require further information, please do not hesitate to contact me. This report is subject to our standard terms and conditions.

Yours sincerely,

SIMON A WILKINSON BSc (Geol) FGS
SENIOR GEOLOGIST
for
WILSON ASSOCIATES (CONSULTING) LIMITED

APPENDIX C

Site Layout by Coombes Everitt Architecture Ltd

Land off Oakhurst Rise, Charlton Kings, Cheltenham

Accommodation Schedule

Ref	Type	Bedrooms	Bedspaces	No. Off	G.I.A sq/m	Total G.I.A sq/m
Pa	2.0	2	4	6	89.9	534.00
Fa	Flat	1	2	4	52.0	208.00
Hi	2.5	4	6	23	107.5	2472.50
Dy	2.0	3	5	3	108.5	325.5
Te	2.0	3	5	5	117.5	587.5
An	2.0	4	8	2	150.4	300.8
				43		4428.30

To be read in conjunction with site layout drawing

coombes : everitt architects limited
Unit No.1, The Old Dairy
Rushley Lane
Winchcombe
Gloucestershire
GL54 5JE

t: 01242 807727 f: 0845 5575833
e: info@ce-architects.co.uk
www.ce-architects.co.uk

- ☐ Preliminary
- ☐ Feasibility
- ☐ Planning
- ☐ Building Regulations
- ☐ Tender
- ☐ Construction issue
- ☐ As Built

RIBA Chartered Practice

Drawing title: Site Plan

Client: William Morrison (Cheltenham) Ltd & The Trustees of the Carmelite Charitable Trust

Drawn by: AH Checked: JE

Project No: 16.20.034

Project: Land off Oakhurst Rise, Charlton Kings, Cheltenham

Scale: 1:500 @ A1

Date: April 2020

Project / Drawing No: PL005

coombes : everitt architects

APPENDIX D

IH124 Drainage Calculation

MicroDrainage Attenuation Storage Volume Calculations/Results

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	50.000	Urban	0.000
SAAR (mm)	700	Region Number	Region 4

Results	**l/s**
QBAR Rural	170.1
QBAR Urban	170.1
Q100 years	437.2
Q1 year	141.2
Q2 years	152.5
Q5 years	209.2
Q10 years	253.5
Q20 years	302.4
Q25 years	319.5
Q30 years	333.3
Q50 years	374.6
Q100 years	437.2
Q200 years	513.7
Q250 years	539.3
Q1000 years	707.7

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

Half Drain Time : 2189 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	103.157	0.697	0.0	1.5	1.5	165.6	O K
30 min Summer	103.394	0.934	0.0	1.7	1.7	221.8	O K
60 min Summer	103.652	1.192	0.0	1.9	1.9	283.0	O K
120 min Summer	103.921	1.461	0.0	2.0	2.0	347.1	O K
180 min Summer	104.076	1.616	0.0	2.1	2.1	383.9	O K
240 min Summer	104.179	1.719	0.0	2.2	2.2	408.2	O K
360 min Summer	104.309	1.849	0.0	2.2	2.2	439.1	O K
480 min Summer	104.396	1.936	0.0	2.3	2.3	459.8	O K
600 min Summer	104.456	1.996	0.0	2.3	2.3	474.0	O K
720 min Summer	104.497	2.037	0.0	2.3	2.3	483.8	O K
960 min Summer	104.544	2.084	0.0	2.4	2.4	495.0	O K
1440 min Summer	104.557	2.097	0.0	2.4	2.4	498.0	O K
2160 min Summer	104.506	2.046	0.0	2.3	2.3	485.8	O K
2880 min Summer	104.440	1.980	0.0	2.3	2.3	470.4	O K
4320 min Summer	104.323	1.863	0.0	2.3	2.3	442.5	O K
5760 min Summer	104.223	1.763	0.0	2.2	2.2	418.8	O K
7200 min Summer	104.132	1.672	0.0	2.2	2.2	397.0	O K
8640 min Summer	104.044	1.584	0.0	2.1	2.1	376.3	O K
10080 min Summer	103.963	1.503	0.0	2.1	2.1	357.0	O K
15 min Winter	103.241	0.781	0.0	1.6	1.6	185.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	118.882	0.0	121.2	19
30 min Summer	79.966	0.0	127.8	34
60 min Summer	51.407	0.0	265.2	64
120 min Summer	31.968	0.0	281.1	124
180 min Summer	23.880	0.0	296.5	184
240 min Summer	19.289	0.0	307.6	244
360 min Summer	14.172	0.0	321.6	362
480 min Summer	11.393	0.0	331.1	482
600 min Summer	9.611	0.0	337.6	602
720 min Summer	8.359	0.0	342.2	722
960 min Summer	6.701	0.0	347.7	962
1440 min Summer	4.898	0.0	349.6	1440
2160 min Summer	3.572	0.0	631.4	1800
2880 min Summer	2.852	0.0	639.0	2188
4320 min Summer	2.073	0.0	623.4	2984
5760 min Summer	1.651	0.0	891.0	3808
7200 min Summer	1.382	0.0	933.4	4616
8640 min Summer	1.195	0.0	968.1	5448
10080 min Summer	1.058	0.0	976.2	6256
15 min Winter	118.882	0.0	121.9	19

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	103.507	1.047	0.0	1.8	1.8	248.7	O K
60 min Winter	103.797	1.337	0.0	2.0	2.0	317.6	O K
120 min Winter	104.102	1.642	0.0	2.1	2.1	390.1	O K
180 min Winter	104.279	1.819	0.0	2.2	2.2	432.0	O K
240 min Winter	104.397	1.937	0.0	2.3	2.3	460.1	O K
360 min Winter	104.548	2.088	0.0	2.4	2.4	496.0	O K
480 min Winter	104.652	2.192	0.0	2.4	2.4	520.7	O K
600 min Winter	104.725	2.265	0.0	2.5	2.5	538.1	Flood Risk
720 min Winter	104.778	2.318	0.0	2.5	2.5	550.6	Flood Risk
960 min Winter	104.844	2.384	0.0	2.5	2.5	566.3	Flood Risk
1440 min Winter	104.888	2.428	0.0	2.5	2.5	576.7	Flood Risk
2160 min Winter	104.850	2.390	0.0	2.5	2.5	567.6	Flood Risk
2880 min Winter	104.780	2.320	0.0	2.5	2.5	551.0	Flood Risk
4320 min Winter	104.629	2.169	0.0	2.4	2.4	515.1	O K
5760 min Winter	104.479	2.019	0.0	2.3	2.3	479.5	O K
7200 min Winter	104.344	1.884	0.0	2.3	2.3	447.5	O K
8640 min Winter	104.215	1.755	0.0	2.2	2.2	416.7	O K
10080 min Winter	104.095	1.635	0.0	2.1	2.1	388.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	79.966	0.0	134.7	34
60 min Winter	51.407	0.0	272.3	64
120 min Winter	31.968	0.0	297.2	122
180 min Winter	23.880	0.0	315.0	182
240 min Winter	19.289	0.0	326.6	240
360 min Winter	14.172	0.0	341.1	358
480 min Winter	11.393	0.0	350.8	476
600 min Winter	9.611	0.0	357.3	592
720 min Winter	8.359	0.0	361.8	708
960 min Winter	6.701	0.0	366.8	936
1440 min Winter	4.898	0.0	367.2	1384
2160 min Winter	3.572	0.0	674.5	2012
2880 min Winter	2.852	0.0	679.4	2280
4320 min Winter	2.073	0.0	661.5	3200
5760 min Winter	1.651	0.0	998.0	4144
7200 min Winter	1.382	0.0	1045.2	5040
8640 min Winter	1.195	0.0	1084.4	5880
10080 min Winter	1.058	0.0	1046.9	6760

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.200	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.750

Time (mins) From:	To:	Area (ha)
0	4	0.750

Model Details

Storage is Online Cover Level (m) 104.960

Cellular Storage Structure

Invert Level (m) 102.460 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	250.0	250.0	2.501	0.0	412.5
2.500	250.0	412.5			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0061-2500-2500-2500
Design Head (m)	2.500
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	61
Invert Level (m)	102.320
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.500	2.5	Kick-Flo®	0.543	1.3
Flush-Flo™	0.269	1.5	Mean Flow over Head Range	-	1.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.3	1.200	1.8	3.000	2.7	7.000	4.0
0.200	1.5	1.400	1.9	3.500	2.9	7.500	4.2
0.300	1.5	1.600	2.0	4.000	3.1	8.000	4.3
0.400	1.5	1.800	2.1	4.500	3.3	8.500	4.4
0.500	1.4	2.000	2.3	5.000	3.4	9.000	4.5
0.600	1.3	2.200	2.4	5.500	3.6	9.500	4.7
0.800	1.5	2.400	2.4	6.000	3.7		
1.000	1.6	2.600	2.5	6.500	3.9		

APPENDIX E

Drainage Strategy by Simpson Associates LLP
drawing references:
C21505:SK01C
C21505:SK02C

DO NOT SCALE

DRAINAGE LEGEND

- 150mm 1/100 — Surface water sewer
- 150mm 1/100 — Foul water sewer
- Perforated collector pipe.
- Surface water catchpit manhole
- Surface water manhole
- Foul water manhole
- Denotes extent of permeable block paving.
- Area of easement, min width of 2.5m either side of pipework
- Site boundary.
- SDS Aqua-swirl.

SURFACE WATER DESIGN NOTES 1

1. It is understood that ground conditions are unsuitable for infiltration drainage techniques. Therefore, it is proposed to drain surface water runoff via a traditional network of underground pipework to an existing Severn Trent Water sewer located in Charlton Court Road.
2. The sites greenfield runoff rate (QBAR) has been calculated as 2.5 litres / second using the IH124 method.
3. Prior to discharging surface water flows to the surface water sewer, flows will be restricted to the sites greenfield runoff rate (QBAR) using a Hydrobrake flow control device, with excess surface water flows stored and attenuated within a below ground geocellular tank, for all return periods up to and including the 1 in 100 year design event plus a 40 allowance for climate change.
4. Water quality improvements will be provided by the use of permeable block paving, a pond and a Hydrodynamic Vortex Separator 'Aquaswirl 'by SDS Limited.

C	DRAWING UPDATED TO SUIT LATEST SITE LAYOUT. SURFACE WATER DISCHARGE RATE DECREASED TO SUIT REDUCED IMPERMEABLE AREA.	JA	15.04.20
B	DRAWING UPDATED TO SUIT LATEST SITE LAYOUT. SURFACE WATER DISCHARGE RATE DECREASED TO SUIT REDUCED IMPERMEABLE AREA.	LJK	22.05.19
A	DRAWING UPDATED TO SUIT LATEST SITE LAYOUT.	EL	22.10.18
MK	REVISION	BY	DATE

DRAWING STATUS

PLANNING

DRAWING TITLE

DRAINAGE LAYOUT
SHEET 1 OF 2

PROJECT — Project Number C21505

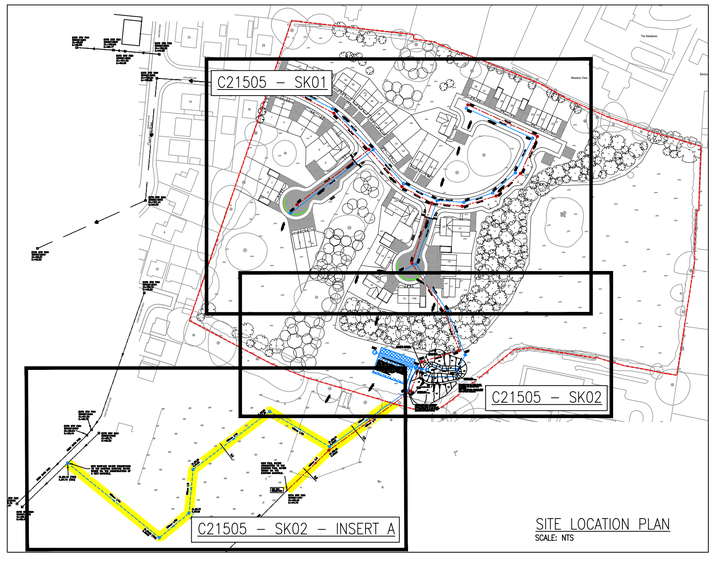
OAKHURST RISE
CHARLTON KINGS
CHELTENHAM

simpson
Unit B10
Elmbridge Court Business Park
Gloucester GL3 1JZ
T.01452 309 727
London, Henley-on Thames and Gloucester

Drawn	Ch'kd	Scales	Date
EL	AdC	1:250 @ A1	OCT 2018

Purpose of Issue
PLANNING

Drawing Number C21505 - SK01 — Revision C



SITE LOCATION PLAN
SCALE: NTS

A1

DO NOT SCALE

EXCEEDENCE FLOW PATH

CL.114.50
IL.112.91

18
17
16
15
14

300mm 1/143
150mm 1/147
300mm 1/18
150mm 1/19

CL.110.53
IL.108.12
CL.107.78

CL.106.41
IL.102.47

AQUA-SWIRL TREATMENT MANHOLE BY SDS LIMITED.

600mm FULLY PERFORATED DISTRIBUTOR PIPE

250m*2.5m DEEP ATTENUATION TANK WITH 600mm FULLY PERFORATED DISTRIBUTOR PIPE IN A 1.5m WIDE GRAVEL STORAGE TRENCH TO STORE AND ATTENUATE SURFACE WATER FLOWS FROM THE 1 IN 100 ALL STORM EVENTS UP TO AND INCLUDING THE 1 IN 100 YEAR EVENT PLUS A 40% ALLOWANCE FOR CLIMATE CHANGE.
MINIMUM COVER LEVEL 105.46m
TOP OF CRATES LEVEL 105.46m
BOTTOM OF CRATES 102.46m

CL.106.54
IL.106.59
CL.106.54
IL.106.71
CL.106.54
IL.106.45
CL.106.90
IL.102.46

AQUATIC BENCH
MAXIMUM DEPTH 0.2m

150mm 1/19
300mm 1/18
1/5
1/4
1/3
1/7
1/10

105.95
106.45
106.05
106.65
106.87

CL.106.95
IL.106.15
IL.106.65
BD.105.90

MAXIMUM WATER LEVEL
106.65

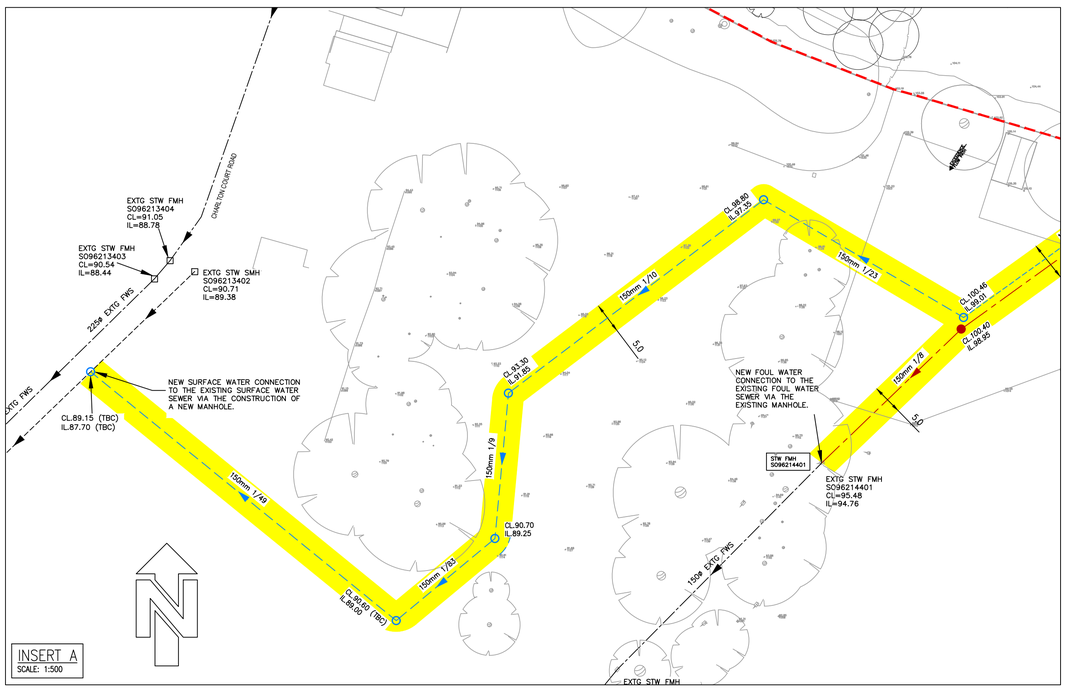
DEEPENED POOL
MAXIMUM DEPTH 0.6m

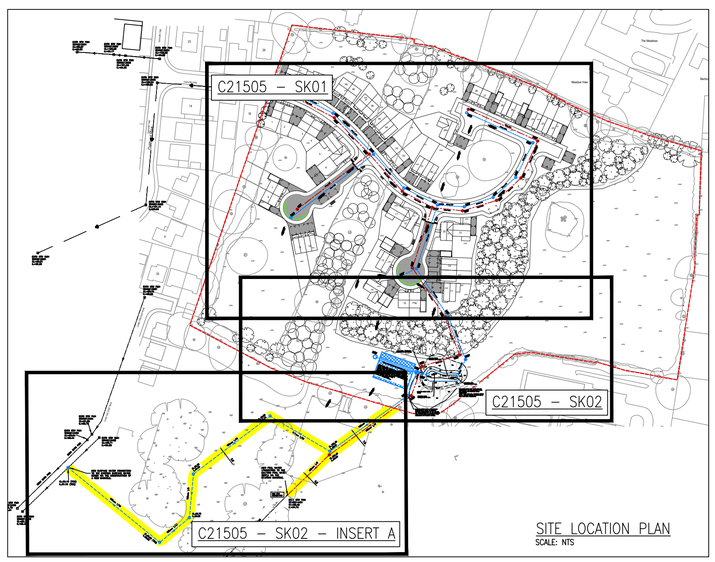
DEEPENED POOL
MAXIMUM DEPTH 0.7m

PERMANENT POND FOR WATER QUALITY IMPROVEMENT AND BIO-DIVERSITY ONLY. NOT UTILISED FOR SURFACE WATER ATTENUATION.
185m² AREA, WITH 2No. DEEPENED POOLS & 1No. AQUATIC BRIDGE. MAXIMUM DEPTH 0.7m WITH 0.3m FREEBOARD.

CL.106.90
IL.102.90
CL.106.50
IL.103.75

MANHOLE FITTED WITH A HYDROBRAKE FLOW CONTROL DEVICE TO RESTRICT SURFACE WATER FLOWS TO 2.5 L/S FOR ALL STORM EVENTS UP TO AND INCLUDING THE 1 IN 100 YEAR EVENT PLUS A 40% ALLOWANCE FOR CLIMATE CHANGE.





SITE LOCATION PLAN
SCALE: NTS

DRAINAGE LEGEND

- 150mm 1/100 — Surface water sewer
- 150mm 1/100 — Foul water sewer
- Perforated collector pipe.
- Surface water catchpit manhole
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- Area of easement, min width of 2.5m either side of pipework
- Site boundary.
- SDS Aqua-swirl.

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2. The sites greenfield runoff rate (QBAR) has been calculated as 2.5 litres / second using the IH124 method.
3. Prior to discharging surface water flows to the surface water sewer, flows will be restricted to the sites greenfield runoff rate (QBAR) using a Hydrobrake flow control device, with excess surface water flows stored and attenuated within a below ground geocellular tank, for all return periods up to and including the 1 in 100 year design event plus a 40 allowance for climate change.
4. Water quality improvements will be provided by the use of permeable block paving, a pond and a Hydrodynamic Vortex Separator 'Aquaswirl' by SDS Limited.

MK	REVISION	BY	DATE
C	DRAWING UPDATED TO SUIT LATEST SITE LAYOUT. SURFACE WATER DISCHARGE RATE DECREASED TO SUIT REDUCED IMPERMEABLE AREA.	JA	15.04.20
B	DRAWING UPDATED TO SUIT LATEST SITE LAYOUT. SURFACE WATER DISCHARGE RATE DECREASED TO SUIT REDUCED IMPERMEABLE AREA.	LJK	22.05.19
A	DRAWING UPDATED TO SUIT LATEST SITE LAYOUT.	EL	22.10.18

DRAWING STATUS

PLANNING

DRAWING TITLE

DRAINAGE LAYOUT
SHEET 2 OF 2

PROJECT — Project Number C21505

OAKHURST RISE
CHARLTON KINGS
CHELTENHAM

simpson
Unit B10
Elmbridge Court Business Park
Gloucester GL3 1JZ
T.01452 309 727
London, Henley-on Thames and Gloucester

Drawn	Ch'kd	Scales	Date
EL	AdC	1:250 @ A1	OCT 2018

Purpose of Issue
PLANNING

Drawing Number	Revision
C21505 - SK02	C

A1

APPENDIX F

Pre-Development Enquiry Response Letter from Severn Trent Water reference 8245984 dated November 2016

Email confirmation for addition connection points to Andrew Uncles at Simpson Associates LLP from Belal Ali at Severn Trent Water

Severn Trent Water Ltd
Regis Road
Wolverhampton
WV6 8RU

Tel: 01902 793871

www.stwater.co.uk
net.dev.west@severntrent.co.uk

Contact: Belal Ali

Your ref:
Our ref: 8245984

Simpson Associates
Unit B10
Elmbridge Court Business Park
Gloucester
GL3 1JZ

FAO Mr Andrew Uncles

28th November 2016

Dear Mr Uncles,

Proposed Redevelopment (100 dwellings) at Land adjacent to King Edwards Primary School, London Road, Cheltenham, GL52 6NR

I refer to your Development Enquiry Request in respect of the above site. Please find enclosed the sewer records that are included in the fee together with the Supplementary Guidance Notes (SGN) referred to below.

Public Sewers in Site – Required Protection

No public sewers cross through the development site.

Foul Water Drainage

Our records show foul sewers running along Oakhurst Rise, MH ref SO96213604. A gravity connection to these are possible subject to obtaining necessary consent.

I confirm that the foul flows (at 2 x DWF) from your proposed development of 100 dwellings should not have an adverse hydraulic impact on our network. A connection is therefore acceptable to the Company subject to formal S106 approval (see later).

SEVERN TRENT WATER

Severn Trent Water

Surface Water Drainage

Under the terms of Section H of the Building Regulations 2000, the disposal of surface water by means of soakaways should be considered as the primary method. If this is not practical and no watercourse is available as an alternative, the use of sewerage can be considered as a last resort. Our records show surface water sewers running along Oakhurst Rise (MH Ref SO96213601).

In addition, other sustainable drainage methods should also be explored before a discharge to the public sewerage system is considered.

If Soakaways are found to be unsuitable, satisfactory evidence will need to be submitted. The evidence should be either percolation test results or by the submission of a statement from the SI consultant (extract or a supplementary letter).

Subject to the above, Severn Trent Water expects all surface water from the development to be drained in a sustainable way to the nearest watercourse or land drainage channel, subject to the developer discussing all aspects of the developments surface water drainage with the Local Lead Flood Authority (LLFA). Any discharge rate to a watercourse or drainage ditch will be determined by the LLFA / EA.

Connections

For any new connections (including the re-use of existing connections) to the public sewerage system, the developer will need to submit a Section 106 application form. Our Developer Services department are responsible for handling all new connections enquiries and applications. To contact them for an application form and associated guidance notes please call 0800 7076600 or download from www.stwater.co.uk.

Please quote 8246070 in any future correspondence (including e-mails) with STW Limited. Please note that Developer Enquiry responses are only valid for 6 months from the date of this letter.

Yours sincerely

Belal Ali
Asset Protection Waste Water West
Wholesale Network Control and Asset Management

Luke Johnson

From: Ali, Belal <Belal.Ali@severntrent.co.uk>
Sent: 01 December 2016 11:04
To: Andrew Uncles
Subject: 8246070 - DEV ENQ (S) London Road,Cheltenham.

Hello Andrew,

Further to our conversation I can confirm connection to MH 3501 or MH4401 is acceptable for foul water. For surface water connection to MH 3404 is acceptable subject to agreement with Lead Local Flooding Authority.

Kind regards

Belal Ali

Evaluation Technician
Asset Protection (Wholesale Operations) East

☎ Direct : **07834420010**
✉ belal.ali@severntrent.co.uk

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