Water Lane, Exeter

Outline Surface Water & Foul Drainage Strategy

On behalf of **Cilldara Group (Exeter) Ltd**

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For and on behalf of Stantec UK Limited				

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Executive Summary

This Outline Surface Water & Foul Drainage Strategy (SWFDS) has been prepared by Stantec UK Ltd to accompany an outline planning application for a proposed development at Water Lane, Exeter. In accordance with the fundamental objectives of the National Planning Policy Framework (NPPF), the SWFDS demonstrates that:

(i) The development is safe;

(ii) The development does not increase flood risk; and,

(iii) The development does not detrimentally affect third parties.

Rainfall will be intercepted by either a green roof / podium deck, blue roof, pervious paving or bioretention system. Some rainfall falling on conventional roofing will be directed to a green roof / podium deck or blue roof. Where it is not possible to manage runoff at roof level, it will be managed by a geocellular crate system underground these features prior to discharge from the site via the conveyance network. Rainfall falling on the hardstanding and public open space will drain via pervious paving and bioretention systems prior to discharging off site via the conveyance network.

The Outline SWFDs demonstrates there will be an approximate 31% reduction in peak discharge rates from the development in the 1 in 100 year storm (plus 45% allowance for climate change) event when compared to the existing condition.

For most instances on site, water quality shall be adequately managed. For roof areas served by blue roofs or geocellular crates, additional treatment is required. The same is also applicable to hardstanding areas that do not drain via pervious paving or bioretention areas.

A new foul sewer system will be constructed which will connect into the existing public foul sewer network. Removal of connections to combined sewers will be made where feasible to do so. It is likely that much of the assumed private foul drainage will need to be removed and replaced to accommodate the proposed development layout.

Correspondence with SWW has indicated that there are no known capacity issues within the site regarding existing foul drainage infrastructure and the quantum of proposed development. As such, they have not specified a point of connection for the development. Point(s) of connection will be determined at the next stage of design when more information is available.

As a foul drainage connection can be made within the site boundary, it is likely that the proposed foul drainage will be delivered as part of a S104 application and will be subject to technical approval by SWW.

In summary, the Outline SWFDS demonstrates that the proposed development is in accordance with the requirements of national and local planning policy.

1 Introduction

1.1 Scope of Report

1.1.1 This Outline Surface Water & Foul Drainage Strategy (SWFDS) has been prepared by Stantec UK Ltd ('Stantec') on behalf of our client, Cilldara Group (Exeter) Ltd, to support an outline planning application for a mixed-use development at Water Lane, Exeter. It should be read in conjunction with the Flood Risk Assessment (FRA) also produced by Stantec in support of this application.

1.1.2 The Site has been identified as a regeneration area in Exeter City Council's (ECC's) adopted Core Strategy (2012) under Policy CP3 for mixed-use development. The Site also forms part of an allocation in the Exeter Local Plan First Review 1995-2011 and the Local Plan First Review – Saved Policies under Policy KP6 for the development of a mix of tourist, leisure, housing, employment and specialist retailing uses proposed at Water Lane.

1.1.3 This report is based on the available information for the site as detailed and prepared in accordance with the planning policy requirements set out in **Section 1.3**.

1.2 Existing Site and Proposed Development

1.2.1 The proposed development at Water Lane is located approximately 1.25km to the south of Exeter City Centre. Water Lane runs along the eastern boundary of the site, Tan Lane forms the north-western boundary of the site, and the South Devon Mainline Railway runs along the south-west boundary of the site.

1.2.2 The site lies within the administrative boundary of ECC.

1.2.3 The proposal is for the regeneration of the site to provide residential dwellings, student accommodation, retail, education, commercial and hotel uses – see further details in **Section 3**.

1.3 Sources of Information & Policies

1.3.1 The Outline SWFDS has been prepared based on the following sources of information and policies:

- **National Planning Policy Framework (NPPF)**, updated in July 2021;
- **Planning Policy Guidance (PPG)**, updated in August 2022 and including the latest climate change allowances updated in May 2022;
- Devon County Council's (DCC) **Preliminary Flood Risk Assessment (PFRA)**, dated 2011 and its **Addendum**, dated 2017;
- DCC **Surface Water Management Plan (SWMP) Phase 1 Strategic Assessment**, dated 2012;
- DCC **Local Flood Risk Management Strategy 2021-2027 (LFRMS)**, dated January 2021;
- DCC **Sustainable Drainage Systems – Guidance for Devon**
- ECC **Level 1 Strategic Flood Risk Assessment (SFRA)**, dated February 2008;
- ECC **SFRA Level 2**, dated May 2014;

- ECC **Core Strategy**, adopted 2012;
- **The Exeter Plan Outline Draft Consultation**, dated September 2022;
- Water UK **Sewerage Sector Guidance Appendix C Design and Construction Guiance (DCG)**, updated June 2022;
- **CIRIA C753 'The SuDS Manual'**, dated 2015;
- DEFRA **Sustainable Drainage Systems – Non-statutory technical standards for sustainable drainage systems**, dated March 2015;
- LASOO **Non-statutory Technical Standards for Sustainable Drainage – Practice Guidance**;
- **Topographic survey** of the site (Drawing reference C21105_SX) undertaken by Lewis Brown Chartered Surveyors in May 2021 (see **Appendix B**);
- **Development proposals** by Nash Partnership (see **Appendix C**);
- **Landscape proposals** by Greenhalgh Landscape Architects;
- **Existing public sewerage asset records** provided by South West Water (SWW) (see **Appendix B**);
- Polypipe **Podium Deck** datasheets and standard details;
- Polypipe **Permavoids** datasheets and standard details.

1.4 Caveats and Exclusions

1.4.1 This FRA has been prepared in accordance with the NPPF, the associated PPG and local policy. The proposals for the surface water management strategy are based on the requirements of the EA and DCC in its role as Lead Local Flood Authority (LLFA). The conclusions are based on data available at the time of the study and on the subsequent assessment that has been undertaken in relation to the development proposals as outlined in **Section 1.2**.

1.4.2 Activities during the construction phase may have an impact on the existing and future flood risk. Thus, an assessment of the risks and appropriate mitigation measures should be identified and managed by the contractor.

1.4.3 The Construction (Design and Management) Regulations (CDM Regulations) will apply to any future development of this site which involves "construction" work, as defined by the CDM Regulations. As such it is the responsibility of the proposed developer (ultimate client) to fulfil its duties under the CDM Regulations.

1.4.4 It should be noted that the insurance market applies its own tests to properties in terms of determining premiums and the insurability of properties for flood risk. Those undertaking development in areas which may be at risk of flooding are advised to contact their insurers or the Association of British Insurers (ABI) to seek further guidance prior to commencing development. Stantec does not warrant that the advice in this report will guarantee the availability of flood insurance either now or in the future.

2 Site Setting

2.1 Site Description

2.1.1 The proposed development at Water Lane is located approximately 1.25km to the south of Exeter City Centre. Water Lane runs along the eastern boundary of the site, Tan Lane forms the north-western boundary of the site, and the South Devon Mainline Railway runs along the south-west boundary of the site (see **Figure 2.1**).

2.1.2 The site of the proposed development at Water Lane is currently brownfield, with industrial facilities, large areas of hard standing / car parking, and with a vegetated border along the railway line by the south-western boundary. Riverside Valley Park, a large greenspace managed by Devon Wildlife Trust, lies immediately south-east of the site.

2.1.3 The River Exe is located approximately 300m to the east of the site and flows from north to south. The River Exe is a 'Main River' and it is the primary source of flooding to the Water Lane site. The Exeter Ship Canal runs parallel to the River Exe, but is located closer to the site, bordering the south-eastern boundary. The Canal is linked to the River Exe by lock gates that are located approximately 200m east of the site, adjacent to Exeter Quay. It is understood that the Exeter Ship Canal is managed by ECC. The Alphin Brook is a tributary of the River Exe and is located approximately 500m south of the site, flowing west to east towards the River Exe.

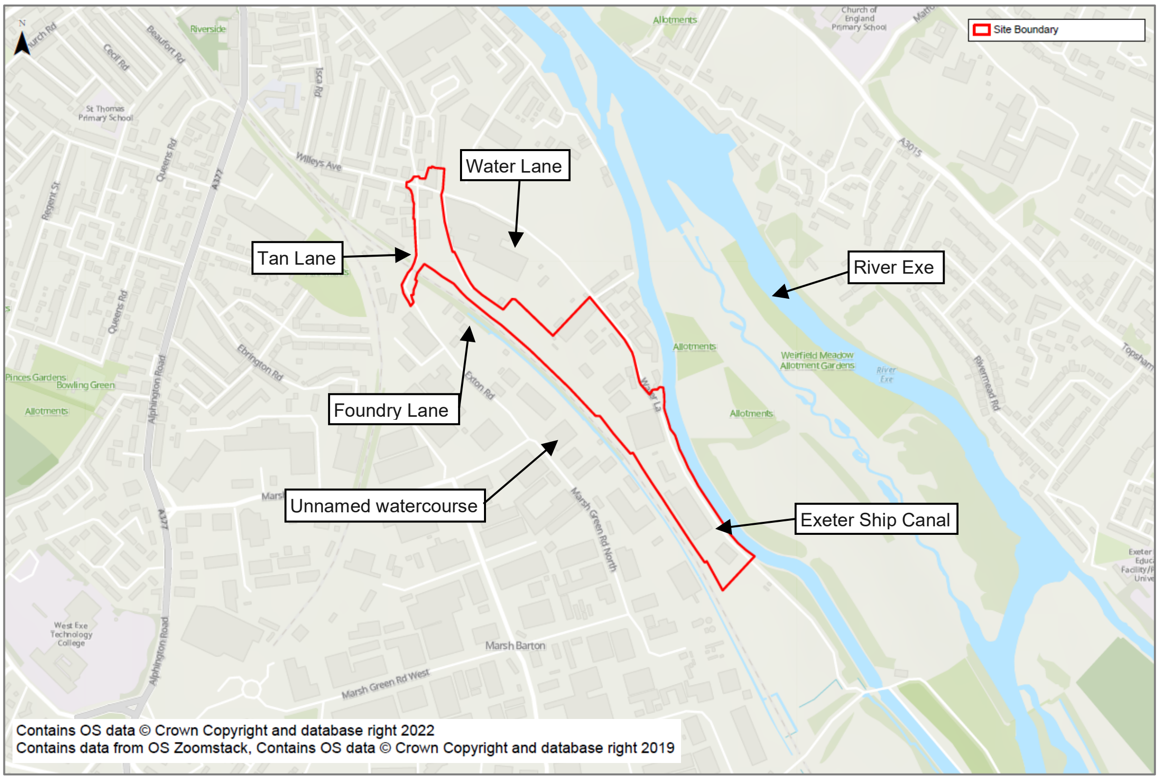

Figure 2.1 - Site Location Plan (not to scale)

2.2 Topography

2.2.1 EA LIDAR data, as provided in **Appendix A**, shows that the site levels fall towards the railway and from north to south across the site. Levels in the north of the site are approximately 7.4mAOD falling to 5.0mAOD in the south of the site. The South Devon Mainline Railway forms a topographic barrier along the south-west boundary of the site and an area of locally higher ground. The elevation of the railway line falls from approximately 10.9mAOD to 7.0mAOD in the south. Within the site boundary and concept masterplan there is an area of high ground alongside the railway, known as Foundry Lane, where the ground levels vary between approximately 8.5mAOD to 9mAOD.

2.2.2 A topographic survey of the site was undertaken by Lewis Brown Chartered Surveyors in May 2021, which shows the site levels are well represented by the LIDAR data. This is provided in **Appendix B**.

2.3 Hydrological Setting

2.3.1 The **Exeter Canal** is located adjacent to the Site and is not designated as a Main River.

2.3.2 The **River Exe** is located approximately 265 m east of the Site. The River Exe is designated as an EA Main River.

2.3.3 The **Alphin Brook**, an EA Main River, is a tributary of the River Exe and is located approximately 500m south of the site, flowing west to east towards the River Exe.

2.3.4 The Exeter Quayside is located approximately 450m to the north comprising a key retail and leisure area for Exeter.

2.4 Existing Drainage Arrangements

2.4.1 It is understood that the majority of the Site drains to the existing SWW public surface water and/or combined sewers. It is not clear where these systems eventually discharge, but the local topography and proximity to the River Exe indicate that this is the likely receptor for surface water discharge. It may be that in some instances these existing surface water sewers discharge into the Exeter Ship Canal, which is closer, however this itself eventually discharges into the River Exe near Powderham.

2.4.2 The Site is within SWWs wastewater service area. The nearest wastewater treatment facility is located approximately 2.8km south-east of the Site.

2.4.3 Asset mapping obtained from SWW indicates the presence of existing public surface water sewers within the Site, although their extent is limited. Therefore, it is assumed much of the Site is drained via private drainage systems prior to entering the public networks. The mapping indicates that the existing public surface water sewers remain separate from the combined network beyond the Site's boundary. However, the extent of this mapping does not confirm an eventual connection further downstream.

2.4.4 The mapping also indicates that there is a separate foul network, however this appears to serve the more recent developments at Cotfield Street and Gabriels Wharf rather than the existing industrial buildings. These appear to be served by the existing public combined network on the Site. The foul network remains separate from the combined network upon leaving the Site underneath the adjacent railway, but then connects approximately 100m south-west of the Site's boundary.

2.5 Geology and Hydrogeology

2.5.1 The British Geological Survey (BGS) Geology of Britain Viewer suggests that the site lies on superficial deposits of Alluvium comprising clay, silt, sand and gravel and is underlain by bedrock of the Alphington Breccia formation which is a sedimentary rock.

2.5.2 The site does not lie within an EA Groundwater Source Protection Zone or a 'Drinking Water Safeguard Zone' for surface water. The site lies within an area of Groundwater Vulnerability designated 'Medium'.

3 Proposed Development and Sequential Test

3.1 Proposed Development

3.1.1 The Proposed Development will be progressed through an outline planning application and will include a maximum of up to 980 dwellings, 290 student rooms and up to 40,000 m^2 commercial and non-residential uses as part of a mixed-use development incorporating other uses such as education, retail, community, cultural, leisure and hotel uses. The Proposed Development will also include a mobility hub, shared parking, and energy centre.

3.1.2 This FRA accompanies an outline planning application for:

> *"Demolition of existing buildings and structures and mixed-use development for residential dwellings (Class C3) including flexible live/work accommodation, co-living accommodation (sui-generis), student housing (sui-generis, Commercial; Business and Service Uses (Class E), Education Uses, Cultural and Community Uses (Classes F1 and F2) and associated infrastructure, including renewable energy installations, vehicular access and servicing, pedestrian and cycle routes, mobility hub, car cycle and motor cycle parking, alteration of ground levels, drainage and public open space, landscaping and public realm works, with all matters reserved for future consideration, with the exception of access".*

3.1.3 For the purpose of the EIA, four scenarios have been proposed dependent on land use. The scenario that will represent the worst case assessment has been selected. The four scenarios allow for flexibility for areas to come forward as a combination of either Residential (C3), Student (Suis Generis), and Commercial & Non- Residential (C1, E & F) as shown in **Table 3.1**.

3.1.4 Residential dwellings include allowance for 2 residents per dwelling, and student beds include allowance for 1 resident per unit.

Proposed Use Class	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Residential (Class C3)	920 dwellings	900 dwellings	980 dwellings	950 dwellings
Student (Suis Generis)	250 student beds	290 student beds	250 student beds	290 student beds
Commercial & Non-Residential (Use Classes C1, E & F)	40,000 m^2	40,000 m^2	36,000 m^2	36,000 m^2

Table 3.1 - Maximum Proposed Land Uses

3.1.5 Scenario 3 has therefore been selected as the worst case scenario in terms of flood risk as it is the scenario that accounts for the maximum number of people within the proposed development.

3.1.6 Details of the proposals by Nash Partnership are included in **Appendix C**, while an extract of proposed building layout and uses is shown in **Figure 3.1.**

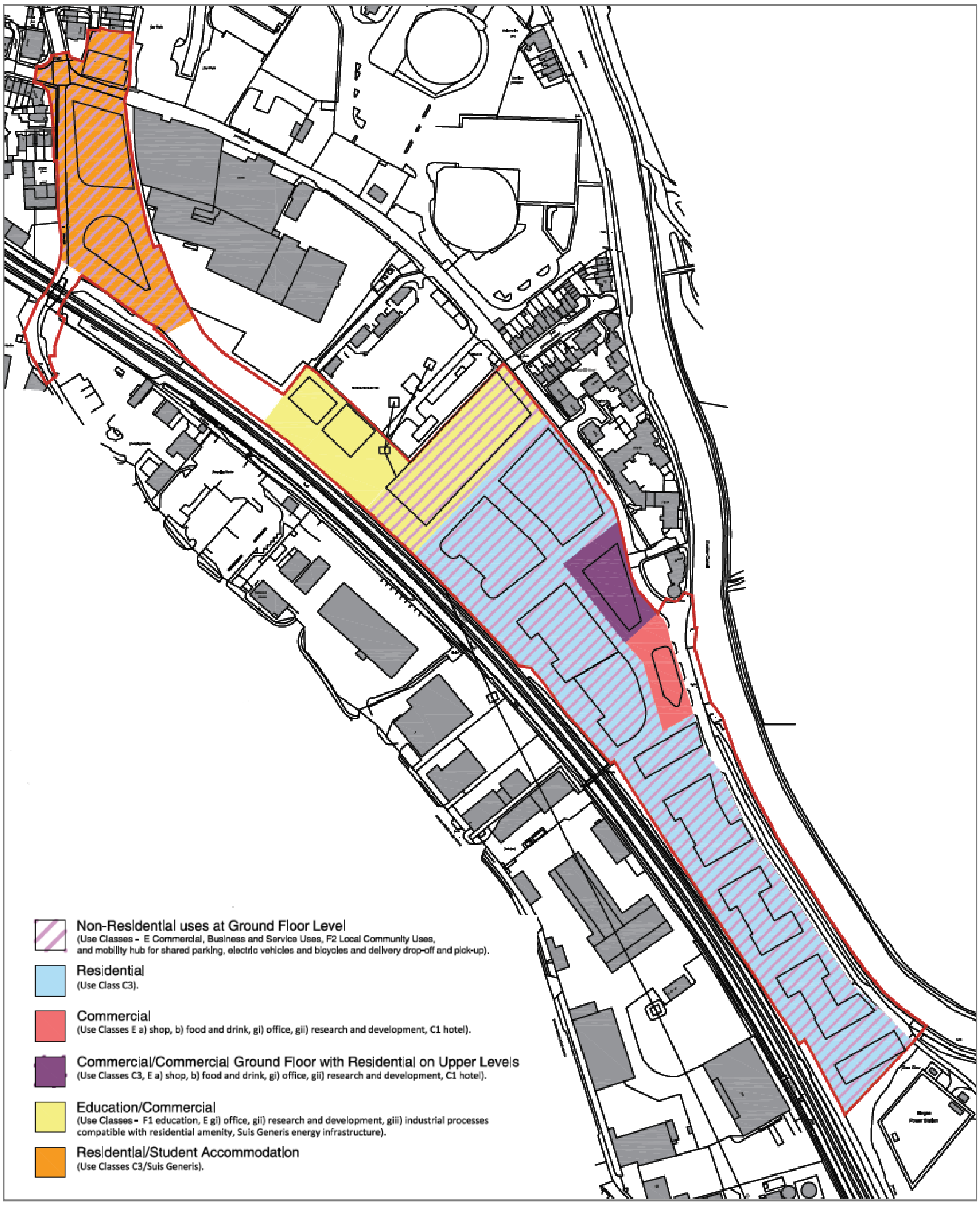

Figure 3.1 - Extract of Proposed Parameter Plan with Disposition of Uses

3.1.7 The proposed Outline SWFDS is based on a design life for the development of 100 years, and the climate change allowances discussed in **Section 4.2** are also based on this assumption.

4 Surface Water Drainage Parameters

4.1 Principles of Sustainable Drainage

4.1.1 A key requirement for the proposed development is to seek that flood risk downstream is not increased. The potential is associated with additional runoff generated by the introduction of roofs and hard-paved surfaces as part of the development. These surfaces replace natural ground where water can percolate into soil pores and to a greater or lesser extent infiltrate into the underlying rock. Additionally, natural ground is more uneven, promoting localised ponding while vegetation intercepts rainfall by collecting water. Lastly, natural ground is generally more resistant flow, reducing the velocity of overland flow and the time that it takes to leave the site.

4.1.2 The replacement of natural surfaces has two principal effects on the land's response to rainfall:

- An increase in the rate of runoff.
- An increase in the volume of runoff.

Both of these impacts have the potential to increase the flood risk downstream. The rate of runoff is normally of principal concern as it can impact on the peak flow rate in the receiving watercourse or drainage network. Increasing the volume of runoff can also increase flood risk in particular situations.

4.1.3 The NPPF recognises that flood risk and other environmental damage can be managed by minimising changes in the volume and rate of surface water runoff from development sites and recommended that priority is given to the use of Sustainable Drainage Systems (SuDS) in new development.

4.2 Climate Change – Peak Rainfall Intensity

4.2.1 The anticipated changes in peak rainfall intensity in small catchments (less than 5km^2) in the East Devon Management Catchment are summarised in **Table 4.1**.

East Devon Management Catchment	Total potential change anticipated (2070s epoch – i.e. 2061 to 2125)	
	Central	Upper End
3.3% (1 in 30-year) rainfall	25%	40%
1% (1 in 100-year) rainfall	30%	45%

Table 4.1 - Peak Rainfall Intensity Climate Change Allowances

4.2.2 Allowances are included for two future time frames, labelled 2050s and 2070s. The 2070s timeframe should be used for developments with a lifetime between 2061 and 2125, which includes all residential developments which have an assumed design life of 100 years.

4.2.3 The range of allowances is based on percentiles, which describes the proportion of possible scenarios that fall below an allowance level. The 50th percentile is the point at which half of the possible scenarios for peak rainfall intensities fall below and half above it. The Central allowance is based on the 50th percentile and the Upper End allowance is based on the 95th percentile. Residential developments should applied the Upper End allowance.

4.2.4 Therefore, a 45% climate change allowance will be assessed within the surface water drainage strategy discussed in **Section 5**.

4.3 Point of Surface Water Discharge

4.3.1 The aim of Sustainable Drainage should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practical:

i. Into the ground (infiltration);

ii. To a surface water body;

iii. To a surface water sewer, highway drain or another drainage system;

iv. To a combined sewer.

4.3.2 The hierarchy is considered in order below.

Discharge into the Ground (Infiltration)

4.3.3 The preferred method for disposal of surface water from the new development is via infiltration drainage.

4.3.4 Based on the geological information available (see **Section 2.5**), infiltration potential on site is considered to be too low to permit discharge of surface water to the ground.

4.3.5 An 'Interpretive Desk Study Report' into ground conditions on site was produced by G & J Geoenvironmental Consultants Ltd in December 2022. This stated that there is potential for significant contamination to be present on site, associated with the past and current industrial uses on site. Leaching of contaminants has been identified as a potential pathway for contamination to negatively impact receptors such as the River Exe and groundwater, albeit their risk has been identified as low to medium.

4.3.6 Given the potential significant contamination on site, disposal of surface water via infiltration is unlikely to be suitable without increasing the risk of contaminant mobilisation. As such, the option to infiltrate surface water runoff to the ground is not proposed as part of the Outline SWFDS.

4.3.7 It should be noted that the potential contamination on site does not prohibit proposed landscaped areas from naturally draining to the ground via infiltration i.e. source control of rainfall at those locations, but that it would not be suitable for a to direct a wider sub-catchment area to a location where infiltration would be permitted.

Discharge to a Surface Water Body

4.3.8 In areas where infiltration is not possible, the next preference in the hierarchy is to discharge to a surface water body (watercourse, lake, ditch etc.).

4.3.9 The nearest available surface water body is the Exeter Canal (see **Section 2.3**) on the site's eastern boundary, however given the existing drainage arrangements on site it is unlikely that surface water runoff from the site currently drains to the canal. Therefore, any proposed discharge would be an increase in rates and volumes entering the canal, potentially increasing flood risk regardless of the degree of attenuation provided. Furthermore, construction of one or more new outfalls to the canal would require significant engineering works to the bank to facilitate, potentially being an uneconomical and infrastructure intensive option.

4.3.10 The next closest water body is the River Exe, however the Exeter Canal blocks the site from being able to access the River. In addition, a connection to the River Exe would require third party land to construct any conveyance and therefore is not within this application's ability to secure. The same is true for the Alphin Brook.

4.3.11 Given the presence of an existing drainage system on site (see **Section 2.4**) and the obstacles to disposing of surface water runoff to a surface water body, this option has been discounted and is not proposed as part of this Outline SWFDS.

Discharge to a Surface Water Sewer, Highway Drain or Another Drainage System

4.3.12 In the instance that discharge to the nearby surface water bodies is not permitted, the next preference would be to discharge to an existing surface water sewer, highway drain or another drainage system.

4.3.13 Asset mapping received from SWW (**Appendix B**) indicates there are a number of existing public surface water sewers within the site. These likely already serve the existing uses on site, augmented by a network of private drains.

4.3.14 Therefore, surface water discharges into the existing public surface water sewer network is the preferred point of surface water discharge in this Outline SWFDS.

4.4 Discharge Rate Control

4.4.1 DCC Sustainable Drainage Systems – Guidance for Devon states the following:

"For developments on brownfield sites, peak flow control must still match the greenfield runoff rate. However, if this is robustly demonstrated as being unfeasible, the applicant must work backwards to achieve a betterment with a surface water runoff rate as close to the greenfield conditions as possible."

4.4.2 Existing brownfield and greenfield runoff rates have been calculated using the Modified Rational Method and FEH post-2008 Statistical Method respectively, utilising FEH22 rainfall data and point descriptors extracted from the FEH online web-service. These are indicated in **Table 4.2** below (values rounded to one decimal place). Copies of these calculations can be found in **Appendix D**.

Return Period	Pre-development Brownfield Runoff Rate (l/s/ha)	Pre-development Greenfield Runoff Rate (l/s/ha)
1 in 1 year	-	2.6
QBAR (1 in 2.3 year)	5.5	3.4
1 in 30 year	13.4	6.7
1 in 100 year	16.6	8.2
1 in 100 year plus 45% climate change allowance	24.1 (estimated)	11.9 (estimated)

Table 4.2 - Pre-Development Brownfield and Greenfield Runoff Rates

4.4.3 Based on an approximate site area of 6.4ha, the pre-development brownfield and greenfield runoff rates for the site are calculated to be 106.5 l/s and 52.6 l/s respectively for the 1 in 100 year storm event.

4.4.4 **Table 4.2** includes an estimated 1 in 100 year plus climate change allowance runoff rate by increasing the calculated present day 1 in 100 year rate by 45%. This has been estimated to demonstrate that the proposed post development peak discharge rate represents a betterment compared with a "do nothing" (i.e. existing undeveloped site) scenario).

4.4.5 In order to mitigate against the likely effects of climate change over the lifetime of development, the post-development discharge rate for the 1 in 100 year storm (plus 45% additional allowance) will be limited to match the pre-development present day greenfield runoff rate for the 1 in 100 year storm, or as close as feasible to do so, for the whole site.

4.4.6 See **Section 5** for the Outline SWFDS concept and proposed discharge rates.

4.5 Discharge Volume Control

4.5.1 Increasing impermeable areas (roads, houses etc) combined with reducing runoff rates and taking into account climate change over the lifetime of the development, introduces the need to attenuate (store and slowly release) the additional surface water runoff.

4.5.2 DCC Sustainable Drainage Systems – Guidance for Devon states the following:

"For developments on brownfield sites, the volume of surface water runoff discharged off-site must still match the greenfield runoff volume. However, if this is robustly demonstrated as unfeasible, the applicant must work backwards to achieve a betterment, with a surface water runoff volume as close to the greenfield conditions as possible."

4.5.3 By limiting peak discharge rates from the proposed development, an additional storage volume i.e. Long-Term Storage (LTS), may be required on site. This LTS is to manage the additional volume arising on site as a result of its increased impermeability following development when compared to its current greenfield state.

4.5.4 There are normally two accepted options for dealing with this volume where infiltration is not an option. They are as follows:

i. The additional volume is stored and discharged at rates limited to 2 l/s/ha after the storm event subsides. This volume is the LTS.

ii. All runoff from the development is limited to the mean annual peak flow rate (QBAR) for all return periods up to the design event.

4.5.5 The required LTS volume has been calculated using the method stated in CIRIA C753 Equation 24.11:

$$LTS = RD \times A \times 10 \left[(0.8 - SPR) \frac{PIMP_2}{100} + (SPR - 0.8) \frac{PIMP_1}{100} \right]$$

Where:

LTS	=	Long Term Storage
RD	=	Rainfall depth for the 1 in 100 year, 6 hour storm event
A	=	Area of the site (ha)
SPR	=	SPR index for the SOIL or HOST class, this specifies the proportion of runoff from pervious surfaces
PIMP2	=	Percentage impermeability of the proposed site
PIMP1	=	Percentage impermeability of the previously developed site

4.5.6 By reviewing aerial imagery, the site is currently completely developed i.e. 100% impermeable. However, there are likely to be cracks in hard surfaces and other losses due to evaporation. Therefore, the pre-development impermeability of the site has been assumed to be 95%.

4.5.7 The landscape proposals by Greenhalgh Landscape Architects indicate that the post-development site will be approximately 90% impermeable, due to increases in landscaped areas that can drain naturally (refer to paragraph 4.2.7). This value ignores other surface types proposed e.g. SuDS, green roofs etc. as these will contribute runoff to the Outline SWFDS.

4.5.8 Based on these values, CIRIA C753 Equation 24.11 indicates that there is no need to provide LTS. This is because the impermeability of the site will be reduced following its development, so there will inherently be a reduction in volumes discharged from the site. A copy of this calculation of LTS can be found in **Appendix D**.

4.5.9 See **Section 5** for the Outline SWFDS concept and proposed discharge volumes.

5 Managing Surface Water

5.1 Overview

5.1.1 Based on the existing site information and the design parameters (outlined in **Section 4**), a concept surface water drainage strategy has been developed to demonstrate how surface water could be managed for the proposed development.

5.1.2 The surface water drainage strategy has been developed to a level suitable for an outline planning application, using best practice SuDS techniques in accordance with the NPPF. Guidance on suitable techniques and methods has been obtained from the LLFA and CIRIA C753 amongst other sources.

5.1.3 Final volumes and SuDS techniques will be refined in future more detailed design stages.

5.2 Surface Water Drainage Concept

5.2.1 The overall philosophy of SuDS is to replicate, as closely as possible, the natural drainage process of a site prior to development to mitigate the adverse effects of urban storm water runoff on the environment. SuDS provide the ability to manage surface water discharge rates and volumes but also improve water quality, ecology and amenity within the development.

5.2.2 These aims are achieved by utilising a "management train", which simply consists of three elements:

i. Source control.

ii. Conveyance.

iii. Site Control.

5.2.3 Each of these elements and how they can be implemented within the surface water drainage strategy concept are described in the following sections. A surface water drainage concept plan has been produced to illustrate how the various forms of SuDS discussed could be integrated within the development at a level of detail suitable for an Outline Application. This can be found in **Appendix D**.

Source Control

5.2.4 Source control is an overarching term for SuDS techniques that manage rainfall at source e.g. green roofs or permeable paving. It is the most effective method of improving surface water quality and intercepting rainfall within the development, which can help to reduce attenuation storage volumes (subject to more detailed design). Improving surface water quality within the drainage system can also help to provide better amenity value and biodiversity enhancement further downstream and help to realise the multiple benefits SuDS can provide.

5.2.5 At this outline stage, the following SuDS techniques have been proposed as source control measures within the development proposals:

- Green roofs / podium decks;
- Pervious pavements;
- Tree pits (Bioretention system);
- Rain gardens (Bioretention system).

5.2.6 For the purpose of this Outline SWFDS, no storage volume or reduction in discharge rates resulting from the implementation of pervious pavements has been calculated. This is to provide a robust, 'worst-case' assessment of surface water management on site. Through the design and implementation of source control measures at the next design stage, when more accurate site information will be available, it is expected that further reductions in discharge rates will be achieved.

Green Roofs / Podium Decks

5.2.7 Green roofs and podium decks can replace traditional roof structures but provide either areas that mimic an undeveloped site or a usable amenity space above ground level for people to use, resembling a landscaped area. Green roofs are by nature vegetated whilst podium decks often include significant areas of vegetation. These vegetated areas at roof level intercept rainfall at source, they can help to reduce the volume and frequency of runoff whilst providing a highly effective means of water quality treatment. They can also provide a means of site control (see below).

5.2.8 Where green roofs are proposed, it has been assumed that these will be extensive (shallow growing medium). They will be underlain by a geocellular system which provide rainfall storage as well as potentially passive irrigation.

5.2.9 The same is true of podium decks, except the areas of vegetation will not be as widespread, allowing space for harder landscaping to permit access for recreation. It may be possible for these harder areas to be constructed as pervious pavements as well.

5.2.10 The function of these systems as source control features would be enhanced by adopting semi-intensive or intensive green roof structures for their vegetated areas. However, these require deeper growing mediums and therefore have a greater structural load. The choice of green roof type will be confirmed at the next stage of design.

5.2.11 The use of green roofs and podium decks for site control is discussed below.

5.2.12 Potential areas of green roofs and podium decks are shown in WTL-STN-DG-XX-DR-C-SK0003-P01 and WTL-STN-DG-XX-DR-C-SK0004-P01 in **Appendix D**.

Pervious Pavements

5.2.13 Pervious pavements can replace traditional hard surfaces, whilst allowing rainfall to infiltrate through its surface into the underlying structural layers. From this point, the water be discharged at a controlled rate. By intercepting rainfall at source, they can help to reduce the volume and frequency of runoff whilst providing a highly effective means of water quality treatment. There are two types of pervious pavements; porous pavements (infiltrate water across their entire surface material) and permeable pavements (surface is formed of impermeable material but laid with void spaces through which the water and infiltrate to the underlying structural layers).

5.2.14 It is recommended that pervious pavements are utilised where possible, but specific locations will need to be agreed with the pavement's adopting authority e.g. the local highway authority or private management company, regarding suitable locations. However, as a starting point, all proposed hardstanding areas which will remain private i.e. not adopted, and do not require vehicular movements should be considered eligible to be pervious pavement.

5.2.15 Potential areas of pervious pavement are shown in WTL-STN-DG-XX-DR-C-SK0003-P01 and WTL-STN-DG-XX-DR-C-SK0004-P01 in **Appendix D**.

Bioretention Systems

5.2.16 Bioretention systems reduce runoff rates and volumes whilst treating runoff water quality through the use of engineered soils and vegetation. These are commonly referred to as rain gardens but can take a variety of forms, including tree pits. Their flexibility means they can be used in a variety of development landscapes, adapting to fit within the overall development form.

5.2.17 Bioretention systems are generally used to manage and treat runoff for frequent rainfall events close to source. Runoff collected by the system temporarily ponds on the surface before filtering through the vegetation and underlying soils, where the majority of treatment occurs. On this site, the filtered runoff will then be collected by an underdrain system.

5.2.18 Potential areas of bioretention systems are shown in WTL-STN-DG-XX-DR-C-SK0003-P01 and WTL-STN-DG-XX-DR-C-SK0004-P01 in **Appendix D**.

Conveyance

5.2.19 Conveyance is the means which surface water is transported from source control features to site control features. Traditionally, this is done by pipes underneath highways, however SuDS measures offer alternative options which can contribute to managing runoff on site, providing water quality and treatment and contribute to the landscape and biodiversity objectives within the development.

5.2.20 At this outline stage, it has been assumed that underdrains serving potential areas of pervious pavement and bioretention areas would be utilised as conveyance measures. This would be in addition to any pipework required between areas of SuDS.

5.2.21 The conveyance network will be subject to further design and network modelling at the next stage of design.

Site Control

5.2.22 Site control provides the strategic means of managing the discharge rates and volumes within the development, although this function is augmented by the presence of upstream source control and conveyance SuDS features.

5.2.23 At this outline stage, the following SuDS techniques are proposed as site control measures within the development proposals:

- Green roofs / podium decks;
- Blue roofs;
- Geocellular crates.

5.2.24 For the purpose of this Outline SWFDS, storage volumes and peak discharge rate restrictions for the 1 in 100 year storm (plus 45% climate change allowance) event have been calculated for the proposed site control features. This is to provide a robust, 'worst-case' assessment of attenuation storage on site to demonstrated viability. It is expected that at the next stage of design, peak flow rate design for a range of storm events will be proposed.

Green Roofs / Podium Decks

5.2.25 As discussed previously, green roofs and podium decks can replace traditional roof structures but providing either areas that mimic an undeveloped site or a usable amenity space above ground level for people to use, resembling a landscaped area. They can also provide a means of site control by providing a storage layer underneath their growing medium.

5.2.26 As part of this Outline SWFDS, it is proposed that a geocellular crate system is included underneath either green roofs or podium decks of buildings, where possible, to provide site control.

5.2.27 Potential areas of green roofs and podium decks are shown in WTL-STN-DG-XX-DR-C-SK0003-P01 and WTL-STN-DG-XX-DR-C-SK0004-P01 in **Appendix D**.

Blue Roofs

5.2.28 Blue roofs are much the same as green roofs or podium deck, with the exception of not being vegetated structures. As such, they have a reduced biodiversity and amenity value. Where appropriate roof spaces are not overlooked by adjacent buildings and/or do not require access for recreation, blue roofs have been proposed. The aim of this is to reduced the structural demands of the building the blue roof sits on by having a reduced load from removal of vegetation and a growing medium.

5.2.29 It has been assumed that closed blue roof systems are utilised i.e. a permeable roof surface is underlain by a geocellular crate system, rather than an open system which is essentially an open tank on the roof. This is to prevent blockage of the system and therefore allow for greater restriction of peak discharge rates. As such, if desired at a future design stage, it is possible to convert the proposed blue roofs into green roofs as they will operate in the same manner.

5.2.30 Potential areas of blue roofs are shown in WTL-STN-DG-XX-DR-C-SK0003-P01 and WTL-STN-DG-XX-DR-C-SK0004-P01 in **Appendix D**.

Geocellular Crates

5.2.31 Geocellular crates systems are cuboid plastic, concrete, plastic/steel or plastic/concrete structures underground that provide additional storage capacity.

5.2.32 Potential areas of geocellular crates are shown in WTL-STN-DG-XX-DR-C-SK0003-P01 and WTL-STN-DG-XX-DR-C-SK0004-P01 in **Appendix D**.

5.3 Proposed Outline Surface Water Drainage Strategy

Site Overview

5.3.1 Based on the surface water drainage concept and identified SuDS measures, a proposed Outline SWFDS has been developed whereby the various measures and components are demonstrating their inter-relation and performance standard. This is demonstrated in WTL-STN-DG-XX-DR-C-SK0003-P01 and WTL-STN-DG-XX-DR-C-SK0004-P01 in **Appendix D**.

5.3.2 Generally, rainfall will be intercepted by either a green roof / podium deck, blue roof, pervious paving or bioretention system. Some rainfall falling on conventional roofing will be directed to a green roof / podium deck or blue roof. Where it is not possible to manage runoff at roof level, it will be managed by a geocellular crate system underground these features will then attenuate surface water prior to discharge from the site via the conveyance network

5.3.3 Rainfall falling on the hardstanding and public open space will drain via pervious paving and bioretention systems prior to discharging off site via the conveyance network.

5.3.4 The intention is to restrict peak discharges from attenuation features as far as reasonably practicable to reduce the overall peak discharge from the site. To provide a conservative estimate of attenuation and discharge rates, at this stage is has been assumed that there will be no reduction in peak discharge rates or volumes from hardstanding, public open space pervious paving or bioretention systems. However, in reality both pervious paving and bioretention systems will reduce peak discharge rates further.

5.3.5 **Table 5.1** and **Table 5.2** compare pre- and post-development peak discharge rates for the 1 in 100 year storm (plus 45% allowance for climate change in the post-development scenario) event.

Pre-Development			
Land Use	Area (ha)	Runoff Rate	
		(l/s/ha)	(l/s)
Existing Development / Hardstanding	**6.4**	16.6	**106.5**

Table 5.1 - Pre-Development 1 in 100 year Discharge Rate

Post-Development			
Land Use	Area (ha)	Runoff Rate	
		(l/s/ha)	(l/s)
Hardstanding / Roofs (incl. potential pervious paving and bioretention systems)	3.3	16.6	54.9
Soft Landscaping	0.6	8.2	4.9
Attenuated Roof Areas	2.5	varies	13.7
	6.4		**73.5**

Table 5.2 - Proposed Post-Development 1 in 100 year (plus 45% allowance for climate change) Discharge Rate

5.3.6 This demonstrates that even when ignoring the potential benefits of including pervious paving and bioretention systems, there will be an approximate 31% reduction in peak discharge rates from the development in the 1 in 100 year storm (plus 45% allowance for climate change) event.

5.3.7 To restrict peak discharges to match the equivalent greenfield runoff rate for the site of 52.6 l/s, this would require a 51% reduction from the present-day brownfield runoff rate in the 1 in 100 year storm. Through inclusion of pervious paving and bioretention systems in a network model at the next stage of design, it may be possible to achieve this reduction.

5.3.8 However, the Outline SWFDS as currently modelled demonstrates a significant betterment in peak flows.

Site Control Features

5.3.9 InfoDrainage software has been used to model the proposed site control features for the 1 in 100 year storm event (plus 45% allowance for climate change). **Table 5.3** summarises the results of this modelling. Please refer to WTL-STN-DG-XX-DR-C-SK0003-P01 and WTL-STN-DG-XX-DR-C-SK0004-P01 in **Appendix D** for building and model reference locations.

5.3.10 In order to model the proposed geocellular crates, calculations within InfoDrainage were based on the technical specifications for Polypipe's Polystorm Lite system. Each of these crates are 1.0m long by 0.5m wide by 0.4m deep and have a void ratio of 95%. The minimum cover depth required over these crates will vary depending on the surfacing and vehicular loading above them, both of which will be confirmed as part of the next design stage where more information will be available. If another geocellular crate system is proposed, the attenuation storage calculations will need to be revised to accommodate the differing specification.

5.3.11 For the proposed podium deck and blue roof storage, calculations within InfoDrainage were based on the technical specifications for Polypipe's Permavoid 150 system. Each of these crates are 0.708m long by 0.354m wide by 0.150m deep and have a void ratio of 92%. The minimum cover depth required over these crates will vary depending on the surfacing and loading above them, both of which will be confirmed as part of the next design stage where more information will be available. If another podium deck or blue roof storage system is proposed, the attenuation storage calculations will need to be revised to accommodate the differing specification.

5.3.12 In two instances, the InfoDrainage model has used Hydro-brakes. It should be noted that *'Hydro-brake'* is a trademark product manufactured exclusively by Hydro International Ltd. Due to the differing characteristics of outfall controls, should detailed design specify a different manufacturer or type of outfall then calculations will have to be reviewed.

5.3.13 Typically orifice diameters should be limited to no smaller than 50mm. However, it is proposed that less than 50mm will be allowable within the surface water drainage strategy due to closed nature of these systems and therefore a reduced likelihood of blockage. Nonetheless, orifice diameters have been limited to minimum of 20mm for buildability and maintenance reasons.

Building Ref.	Area (ha)	Attenuation Type	InfoDrainage SuDS Ref	Peak Discharge Rate (l/s)	Flow Control Device	Peak Flow Restriction Standard	Number of Units deep
A1	0.095	Geocellular Crates	GC-A1	0.8	Hydro-Brake – 50mm diameter orifice	Greenfield 100 year	1
B1	0.142	Podium Deck	PD-B1	1.1	Orifice – 29mm diameter	Greenfield 100 year	3
C1	0.136	Podium Deck	PD-C1	1.1	Orifice – 28mm diameter	Greenfield 100 year	3
C2	0.167	Podium Deck	PD-C2	1.3	Orifice – 31mm diameter	Greenfield 100 year	3
D1	0.072	Geocellular Crates	GC-D1/E1	0.4	Hydro-Brake – 36mm diameter orifice	Greenfield QBAR	1
E1	0.047						
E2	0.236	Podium Deck	PD-E2	0.8	Orifice – 24mm diameter	Greenfield QBAR	3
F1	0.103	Blue Roof	BR-F1	0.4	Orifice – 20mm diameter	Greenfield QBAR	2
F2	0.150	Podium Deck	PD-F2	0.5	Orifice – 20mm diameter	Greenfield QBAR	3
G1	0.254	Podium Deck	PD-G1	2.1	Orifice – 39mm diameter	Greenfield 100 year	3
G2	0.239	Podium Deck	PD-G2	0.8	Orifice – 24mm diameter	Greenfield QBAR	3
H1a	0.287	Blue Roof	BR-H1a	0.9	Orifice – 29mm diameter	Greenfield QBAR	2
H1b	0.101	Blue Roof	BR-H1b	0.3	Orifice – 20mm diameter	Greenfield QBAR	1
H2	0.063	Blue Roof	BR-H2	0.3	Orifice – 20mm diameter	Greenfield 10 year	1
Energy Centre	0.052	Blue Roof	BR-EC	0.3	Orifice – 20mm diameter	Greenfield 10 year	1
K1	0.181	Podium Deck	PD-K1	1.4	Orifice – 30mm diameter	Greenfield 100 year	4
L1	0.097	Podium Deck	PD-L1	0.8	Orifice – 26mm diameter	Greenfield 100 year	2
M1	0.048	Blue Roof	BR-M1	0.4	Orifice – 20mm diameter	Greenfield 100 year	2

Table 5.3 - Summary of InfoDrainage Results

5.3.14 InfoDrainage model outputs can be found in in **Appendix D.**

5.4 Water Quality

5.4.1 The drainage system will be designed to comply with the requirements of the SuDS Management Train as laid out in CIRIA C753.

5.4.2 The final strategy for water quality will be confirmed as part of the detailed design however, at this stage of the assessment, an appropriate SuDS treatment train has been incorporated into the design prior to discharge to the public surface water sewer. This consists of green roofs (which will be applicable to podium decks), blue roofs, pervious paving, bioretention systems and geocellular crates which will contribute to the pollution control of the site.

5.4.3 In accordance with Table 26.2 of the SuDS Manual, the proposed development will have the pollution hazard indices as shown in **Table 5.4**.

5.4.4 It should be noted that green roofs and podium decks are not listed as a land use for pollution hazard indices. For the purpose of this assessment, these will be assumed to have the same pollution loading as ‘roofs’. However, due to their vegetated nature, whether fully or partially, this is considered as a conservative approach.

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Roofs	Very Low	0.2	0.2	0.05
Pedestrian/cycle areas, low traffic routes, car parking, driveways	Low	0.5	0.4	0.4
Main site vehicular access points and routes	Medium	0.7	0.6	0.7

Table 5.4 - Summary of Pollution Indices

5.4.5 **Table 5.5** presents the mitigation indices provided by each SuDS method proposed or recommended as part of the drainage strategy.

5.4.6 It should be noted that green roofs and podium decks are not listed as a SuDS component for mitigation indices. For the purpose of this assessment, these will be assumed to have the same mitigation as ‘filter strips’.

5.4.7 Blue roofs and geocellular crates do not provide any water quality treatment benefit.

SuDS Measure	TSS	Metals	Hydrocarbons
Green roofs / podium decks i.e. filter strips	0.4	0.4	0.5
Geocellular crates	0	0	0
Blue roofs	0	0	0

SuDS Measure	TSS	Metals	Hydrocarbons
Permeable Paving	0.7	0.6	0.7
Bioretention system	0.8	0.8	0.8

Table 5.5 - SuDS Mitigation Indices

5.4.8 Through applying the equation set out in section 26.7.1 of the SuDS Manual:

Total SuDS mitigation index = mitigation index + 0.5(mitigation index)

5.4.9 Each Land Use was evaluated against the SuDS measure proposed, as summarised in **Table 5.6.**

Management Train Scenario	Land Use	SuDS Component	Resultant Indices		
			TSS	Metals	Hydro carbons
1	Roofs	Green roofs / podium decks i.e. filter strips	0.4 *sufficient*	0.4 *sufficient*	0.5 *sufficient*
2	Roofs	Geocellular crates	0 *insufficient*	0 *insufficient*	0 *insufficient*
3	Roofs	Blue roofs	0 *insufficient*	0 *insufficient*	0 *insufficient*
4	Pedestrian/cycle areas, low traffic routes, car parking, driveways	Permeable Paving	0.7 *sufficient*	0.6 *sufficient*	0.7 *sufficient*
5	Pedestrian/cycle areas, low traffic routes, car parking, driveways	Bioretention system	0.8 *sufficient*	0.8 *sufficient*	0.8 *sufficient*
6	Main site vehicular access points and routes	Permeable Paving	0.7 *sufficient*	0.6 *sufficient*	0.7 *sufficient*
7	Main site vehicular access points and routes	Bioretention system	0.8 *sufficient*	0.8 *sufficient*	0.8 *sufficient*

Table 5.6 - Water Quality Performance Evaluation

5.4.10 As shown in the above tables, the combined SuDS mitigation indices are higher than the pollution indices for most instances, therefore the water quality shall be adequately managed.

5.4.11 For roof areas served by blue roofs or geocellular crates, additional treatment is required. This could be achieved by converting blue roofs to green roofs or draining via pervious paving or bioretention systems downstream of the blue roof or geocellular crate. Another alternative would be to include proprietary treatment devices within those management trains, however their mitigation is subject to the specific device used.

5.4.12 The use or proprietary treatment devices is also applicable to hardstanding areas that do not drain via pervious paving or bioretention areas. These areas could also receive a degree of treatment through the inclusion of trapped gullies and sumps within the drainage network.

5.4.13 Therefore, it is recommended that at the next stage of design when more information will be available, water quality treatment of these area and the method for doing so should be confirmed.

6 Residual Risk

6.1 Exceedance and Overland Flows

6.1.1 The risk associated with a potential blockage for the main drainage system onsite is considered to be small. Routine inspection and maintenance procedures as described in **Section 7** of this report will minimise the risk of the accumulation of detritus and debris as well as ensuring that the drainage systems continue to operate efficiently. However, the residual risk of these events needs to be managed. The principles of dealing with these is set out below.

6.1.2 In the event of a rare storm (beyond the design condition), the capacity of the drainage network could be temporarily exceeded, and drainage inlets could be bypassed creating overland flow. To minimise and manage the impact of these events at source the SuDS features for the scheme will be designed with controlled overflows.

6.1.3 The detailed masterplan will need to consider the overland flow paths required to manage these events and the flows from the overflow of SuDS features. Where possible, the masterplan should divert the flows from critical infrastructure.

6.1.4 In certain circumstances it may be necessary to utilise road corridors to deliver this function. This, however, should not be considered the preferred option and should still facilitate safe access and egress as well as taking reasonable steps to protect property.

6.1.5 All buildings should be provided with internal threshold levels raised above surrounding ground levels and designated flow paths created around the buildings to the lower lying levels. Localised grading may be required to achieve level access criteria. Exceedance flows would then naturally be directed around the buildings to lower ground.

6.1.6 An overland flow assessment should be carried out at detailed design stage once all construction information is available so that any hotspots can be identified and managed.

6.2 SuDS Health and Safety

6.2.1 Due to the inherent requirement of SuDS features to retain water during normal operation open SuDS features pose a potential risk to the general public. As part of the detailed design process Health and Safety considerations need to inform the proposals and implement adequate protection for the public and enable safe means of egress from open features, while not compromising the proposed amenity uses.

7 Operation and Maintenance

7.1 Operation and Maintenance

7.1.1 To ensure the ongoing performance of the SuDS scheme, the proposed drainage will require regular maintenance over its lifetime. Typically, the maintenance of a SuDS network involves removing litter/debris in the system and general landscaping/grass cutting.

7.1.2 Final designs of the SuDS, outfalls, inlets and strategic drainage network must be designed with a regard for future maintenance. All areas should be easily accessible and safe for operatives without compromising the overall attenuation and landscape requirements.

7.1.3 The following tables outline key operation and maintenance requirements for green roofs (which will be applicable to podium decks and blue roofs), pervious paving, bioretention systems and geocellular crates, as set out in CIRIA C753. Following further detailed design of the proposed surface water drainage system, these requirements should be refined for individual, named SuDS components, taking account of site-specific factors.

Maintenance Schedule	Required Action	Typical Frequency
Regular inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	
	Inspect underside of roof for evidence of leakage	
Regular maintenance	Remove debris and litter to prevent clogging of inlet drainage an interference with plant growth	Six monthly and annually or as required
	During establishment, replace dead plants as required	Monthly (usually responsibility of manufacturer)
	Post establishment, replace dead plans as required (where >5% coverage)	Annually (in autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation, including weeds	
	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	
Remedial Actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
	If drain inlet has settled, cracked or moved, investigated and repair as appropriate	

Table 7.1 - Green Roof, Podium Deck and Blue Roof Recommended Outline Operation & Maintenance Requirements

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

Table 7.2 - Pervious Pavement Recommended Outline Operation & Maintenance Requirements

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut the grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plant	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for >48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly

Maintenance Schedule	Required Action	Frequency
Occasional maintenance	Reseed areas of poor vegetation growth; alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% of the swale treatment area
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Table 7.3 - Bioretention System Recommended Outline Operation & Maintenance Requirements

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

Table 7.4 - Geocellular Crates Recommended Outline Operation & Maintenance Requirements

7.2 Design Standard

7.2.1 All proposed drains and sewers shall be designed in accordance with Building Regulations – Approved Document H, the Design Manual for Roads and Bridges and the Design and Construction Guidance (DCG), sometimes referred to as Sewers for Adoption 8 as appropriate.

7.3 Adoption and Management

7.3.1 Where possible, the surface water drainage strategy has been designed to maximise the number of features that are acceptable for adoption by SWW as the local sewerage company. Based on the criteria set out in the DCG, bioretention systems and geocellular crates are all acceptable SuDS features.

7.3.2 However, permeable paving, green roofs / podium decks and blue roofs are not as they form a fundamental part of the highway or building structure respectively. These features would need to be adopted/maintained privately.

8 Managing Foul Drainage

8.1 Proposed Foul Drainage Strategy

8.1.1 The site is within the area managed by SSW for foul drainage. Asset mapping received from Southern Water (see **Appendix B**) indicates that there existing public foul and combined sewers within the site. It is assumed that the site currently benefits from existing private foul drainage infrastructure within the proposed site boundary to make connection with these sewers.

8.1.2 It is well understood that removal of flows from combined sewers has a catchment-wide pollution benefit by reducing the frequency and volume of Combined Sewer Overflows (CSOs). As such, to manage and drain foul flows from the proposed development, a new foul sewer system will be constructed which will connect into the existing public foul sewer network. Removal of connections to combined sewers will be made where feasible to do so. It is likely that much of the assumed private foul drainage will need to be removed and replaced to accommodate the proposed development layout.

8.1.3 A proposed foul drainage strategy layout will be developed at the next stage of design when more information, such as proposed site levels will be available to design the new system.

8.2 Point of Connection

8.2.1 Correspondence with SWW has indicated that there are no known capacity issues within the site regarding existing foul drainage infrastructure and the quantum of proposed development. As such, they have not specified a point of connection for the development. Point(s) of connection will be determined at the next stage of design when more information is available.

8.3 Delivery of Foul Drainage

8.3.1 Under S106 of the Water Industry Act, the development has a right to connect to a public sewer, provided that the connection is to a sewer with “reasonable” capacity. In this instance, “reasonable” is defined as a sewer diameter equal to or greater than that of the new sewer. As such, the proposed foul drainage will seek to maintain pipe diameters no greater than the existing public sewers on site, to avoid unnecessary upgrade works.

8.3.2 As a foul drainage connection can be made within the site boundary, it is likely that the proposed foul drainage will be delivered as part of a S104 application and will be subject to technical approval by SWW.

8.3.3 Where possible, site levels should be such that the need for foul sewage pumping station is not required.

8.3.4 Details of correspondence with Southern Water on this matter can be found in **Appendix B**.

9 Conclusions

9.1.1 This Outline SWFDS has been prepared by Stantec to accompany a planning application for the proposed mixed use development at Water Lane, Exeter.

Surface Water Drainage

9.1.2 Generally, rainfall will be intercepted by either a green roof / podium deck, blue roof, pervious paving or bioretention system. Some rainfall falling on conventional roofing will be directed to a green roof / podium deck or blue roof. Where it is not possible to manage runoff at roof level, it will be managed by a geocellular crate system underground these features will then attenuate surface water prior to discharge from the site via the conveyance network

9.1.3 Rainfall falling on the hardstanding and public open space will drain via pervious paving and bioretention systems prior to discharging off site via the conveyance network.

9.1.4 The intention is to restrict peak discharges from attenuation features as far as reasonably practicable to reduce the overall peak discharge from the site. At this stage is has been assumed that there will be no reduction in peak discharge rates or volumes from hardstanding, public open space pervious paving or bioretention systems. However, in reality both pervious paving and bioretention systems will reduce peak discharge rates further.

9.1.5 This demonstrates there will be an approximate 31% reduction in peak discharge rates from the development in the 1 in 100 year storm (plus 45% allowance for climate change) event when compared to the existing condition.

9.1.6 For most instances on site, water quality shall be adequately managed. For roof areas served by blue roofs or geocellular crates, additional treatment is required. The same is also applicable to hardstanding areas that do not drain via pervious paving or bioretention areas.

Foul Drainage

9.1.7 A new foul sewer system will be constructed which will connect into the existing public foul sewer network. Removal of connections to combined sewers will be made where feasible to do so. It is likely that much of the assumed private foul drainage will need to be removed and replaced to accommodate the proposed development layout.

9.1.8 A proposed foul drainage strategy layout will be developed at the next stage of design when more information, such as proposed site levels will be available to design the new system.

9.1.9 Correspondence with SWW has indicated that there are no known capacity issues within the site regarding existing foul drainage infrastructure and the quantum of proposed development. As such, they have not specified a point of connection for the development. Point(s) of connection will be determined at the next stage of design when more information is available.

9.1.10 As a foul drainage connection can be made within the site boundary, it is likely that the proposed foul drainage will be delivered as part of a S104 application and will be subject to technical approval by SWW.