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**EUTOPIA  
HOMES**

# **FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY REPORT**



**Exmouth Junction, Exeter**

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**AECOM**

April 2019

## Quality information

Prepared by



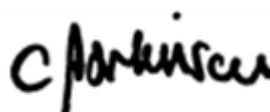
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# 1. Executive Summary

AECOM Limited has been commissioned by Eutopia Homes (Exeter) Ltd to prepare a site-specific Flood Risk Assessment (FRA) at Exmouth Junction, Exeter, EX4 7AE (the Site).

This FRA has been prepared to the requirements of the National Planning Policy Framework, 2018 (NPPF). The proposed development lies within Flood Zone 1 on the Environment Agency (EA) Flood Map (less than 1 in 1000 annual probability of river or sea flooding in any year). The proposed development is classified as 'More Vulnerable' in accordance with NPPF and is therefore compatible with Flood Zone 1.

The risk of flooding to the Site from fluvial, pluvial, groundwater, reservoirs and sewer sources is considered to be low.

The Development will not increase the risk of flooding off site. Surface water runoff from the proposed development will be captured by a new drainage system that will accommodate the 1 in 30 year rainfall event without above ground flooding. Runoff generated for design storm events greater than the 1 in 30 years event and up to and including the 1 in 100 year + 40% climate change events will be managed within the site.

The new drainage system will restrict all runoff from the site into the receiving watercourses to the greenfield runoff rates for all return periods up to and including the 1 in 100 year plus 40% climate change event, using complex flow control devices. Attenuation storage will be provided in various forms including rain gardens, swales, detention basins, permeable paving and geo-cellular storage.

When considered within the context of National, Regional and local planning policy in respect of development and flood risk, the assessment concludes that the proposed development remains safe; does not increase flood risk elsewhere and fulfils the Government's wider criteria for sustainable development.

On this basis, it is concluded that flood risk considerations do not constitute a barrier to the granting of planning consent for the development.

## 2. Introduction

AECOM Limited has been commissioned by Eutopia Homes (Exeter) Ltd to prepare a site-specific Flood Risk Assessment (FRA) relating to the proposed redevelopment of land at Exmouth Junction, off Prince Charles Road, EX4 7AE, Exeter (the Site).

This report sets out the results of a FRA required by the Local Authority in support of the outline planning application of this development. The assessment has been carried out in accordance with the guidance set out in National Planning Policy Framework (NPPF).

The Site is located at Exmouth Junction, Exeter, EX4 7AE (Figure 1).

The Site will be developed to provide 400 residential units, 65 homes with care (Class C2) and associated open space, car parking, landscaping and associated works.

Government policy with respect to development and flood risk of areas in England is contained within the Ministry of Housing, Communities and Local Government document National Planning Policy Framework (NPPF) and its accompanying Planning Practice Guidance published in 2014 (updated in 2018). This site-specific FRA has been prepared in accordance with those documents and in consultation with the Environment Agency (EA), South West Water, Exeter Council, Devon County Council.

This assessment also provides a surface water drainage strategy for the Site to establish constraints, design requirements and promote the use of Sustainable Drainage Systems (SuDS), as applicable.

### 2.1 Summary of Requirements of NPPF

The NPPF requires the FRA to consider all potential forms of flooding, including river, sea, estuary, land drainage, groundwater, surface water run-off, flooding from sewer systems, flooding from reservoirs and canals, etc. and should consider the impact of flooding on both the development and offsite parties and land. Appendix A contains further information on NPPF requirements.

#### 2.1.1 Flood Risk and Vulnerability

Flood risk takes account of both the probability and the consequences of flooding (i.e. vulnerability of the development etc.). Flood frequency is usually interpreted in terms of the return period e.g. 1 in 50 and 1 in 100-year event etc. In betting terms, there is a 50/1 (2%) chance of one or more 1 in 50-year floods occurring in a given year. Similarly, there is a 100/1 (1%) chance of one or more 1 in 100-year floods occurring in a given year.

Vulnerability classifications, as defined in the NPPF Technical Guidance document, are Essential Infrastructure, Highly Vulnerable, More Vulnerable, Less Vulnerable and Water Compatible Development.

Appendix A contains a detailed description of which types of development fall into each vulnerability classification.

#### 2.1.2 Flood Zones

There are four classifications for flood zones, as defined in the NPPF:

- Zone 1: Low probability (less than 1 in 1000 annual probability of river or sea flooding in any year);
- Zone 2: Medium probability (between 1 in 100 and 1 in 1000 annual probability of river flooding or between 1 in 200 and 1 in 1000 annual probability of sea flooding in any year);
- Zone 3a: High probability (1 in 100 or greater annual probability of river flooding in any year or 1 in 200 or greater annual probability of sea flooding in any given year);
- Zone 3b: High probability (functional flood plain. Essentially the 1 in 20 or greater annual probability of flooding in any given year).

#### 2.1.3 The Sequential Test and Exception Test

The Sequential Test is a risk-based test that should be applied at all stages of development and aims to steer new development to areas with the lowest probability of flooding (Zone 1). This is applied by the Local Authority by means of a Strategic Flood Risk Assessment (SFRA).

Furthermore, large sites partially affected by Flood Zones 2 and 3 should be developed sequentially, placing the most vulnerable land uses in the areas with lowest risk of flooding. Further details of the Sequential Test are provided in Appendix A.

The SFRA may require the Exception Test to be applied to certain forms of new development. The test considers the vulnerability of the new development to flood risk and, to be passed, must demonstrate:

- There are sustainability benefits that outweigh flood risk.
- It is on previously developed land or there are no other reasonably developable sites.
- The new development is safe without increasing flood risk elsewhere.

Further details of the Exception Test are provided in Appendix A.

#### 2.1.4 Climate Change

The NPPF makes it a planning requirement to account for climate change in a proposed development's design. The recommended allowances have been updated with new advice published by the Environment Agency on 19th February 2016 and amended on 12th April 2016. Making allowances for climate change helps to minimise vulnerability and provide resilience to flooding and coastal change in the future. The climate change allowances are predictions of anticipated change for:

- Peak river flow by river basin district;
- Peak rainfall intensity;
- Sea level rise;
- Offshore wind speed and extreme wave height.

They are each based on climate change projections and different scenarios of CO<sub>2</sub> emissions to the atmosphere. There are different allowances for different epochs or periods of time over the next century. Further information is included in Appendix B including the latest allowances.

#### 2.1.5 Sustainable Drainage

The key planning objectives in the NPPF are to appraise, manage and where possible, reduce flood risk. The NPPF (and covered by Part H of the Building Regulations (DTLR, 2002)), directs developers toward the use of SuDS wherever possible.

## 2.2 Local Policy Requirements

There is a number of local policies and evidence that support the implementation of SuDS, flood risk management and green infrastructure in Exeter.

The latest Planning Policy adopted by Devon County Council (DCC) is taken into consideration pertaining surface water drainage and flood prevention.

### 2.2.1 Devon Local Flood Risk Management Strategy 2014-2020

The high-level strategic document outlines the responsibilities of the Risk Management Authorities in Devon and how they are work in partnership to coordinate local flood risk management. This covers everything from engaging with communities and preparing for floods, responding to flood events, collaborating on flood risk studies and investing in flood improvements. The Strategy recommends that all new developments should have an effective and robust surface water drainage management system, designed in accordance with the most recent SuDS principles, with the aim of reducing on-site flood risk, whilst also avoiding increasing flood risk elsewhere.

### 2.2.2 Sustainable Drainage Systems: Guidance for Devon – Version 1.6 (January 2017)

DCC is a statutory consultee for all major planning applications in Devon. DCC guidance requirements are quoted below:

#### 6. Technical Requirements for SuDS in Devon

*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, providing robust evidence of the calculations undertaken.*

#### 6.4 Managing Volume Control

*For developments on greenfield sites, the volume of surface water runoff discharged off-site in the 1 in 100 year, 6 hour rainfall event, must never exceed the greenfield runoff volume for the same event.*

*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, providing robust evidence of the calculations undertaken.*

*Where infiltration is not used to dispose of surface water from a development site, long term storage must be provided to store the additional volume of surface water runoff generated by the increase in impermeable area, which is in addition to the attenuation storage required to address the greenfield runoff rates. The incorporation of long-term storage into surface water drainage management systems will ensure that each SuDS component is appropriately sized, and must discharge at a rate not exceeding 2 litres/second/hectare.*

#### 6.6 Managing Flood Risk within the Development

*Consideration must be given to surface water exceedance routes to ensure that life and property are not put at risk in the event of a surface water drainage management system failing, or during storms in excess of the design standard of such systems.*

*Consequently, unless an area is designed to hold or convey water, flooding within a development site should not occur:*

- *On any part of the development for a 1 in 30 year rainfall event;*
- *In any part of a building or any utility plant susceptible to water for a 1 in 100 year rainfall event.*

*Where surface water drainage management systems are designed to flood above the 1 in 30 year rainfall event, the depth of any standing water along access and egress routes must be demonstrated as being safe. Overland flows must also be managed by unobstructed exceedance routes which minimise the risk to life and property.*

*Dividing developments sites into sub-catchments to manage surface water runoff in smaller systems closer to the source of rainfall, in accordance with the SuDS Management Train, will ensure that the surface water drainage management system is more resilient to failure.*

#### SuDS Principles

*Approaches to managing surface water which take account of water quantity, water quality, public amenity and biodiversity issues are collectively referred to as Sustainable Drainage Systems (SuDS).*

*Conventional drainage systems employ underground pipe networks which prevent localised flooding by conveying water away as quickly as possible; they are only effective at managing water quantity (flows and volumes). SuDS are able to manage surface water flows and volumes in open features on the ground surface, whilst also providing benefits to water quality, public amenity and biodiversity. These systems are more sustainable than conventional drainage methods because they:*

- *Manage runoff volumes and flow rates, reducing the impact of urbanisation on flooding;*
- *Protect or enhance water quality;*
- *Are sympathetic to the environmental setting and the needs of the local community;*
- *Provide a habitat for wildlife in urban watercourses.*

### 2.2.3 Preliminary Flood Risk Assessment (PFRA)

The Devon PFRA (2011) was prepared to assist Devon County Council (DCC) with meeting their duties to manage local flood risk and deliver the requirements of the Flood Risk Regulation (2009). The report provides a high-level overview of flood risk from local flood sources including surface water, ground water, ordinary watercourses and canals.

According to historical data, fluvial and tidal sources cause the majority of flood incidents within Exeter. There are also localised surface water and sewer incidents. However, no flood incidents have been identified near the site.

### 2.2.4 Exeter Strategic Flood Risk Assessment (SFRA)

Exeter City Council (ECC) completed a Level 1 SFRA in 2008 in accordance with national planning guidance. This document provides an overview of flood risk with ECC boundaries. It aims to provide general guidance to planning officers, developers and other interested parties about areas where potential flood risk is an issue.

Exeter's Level SFRA 1 identified areas where more detailed work was required. The areas for further study were:

1. The Seabrook watercourse – within the Newcourt Strategic Allocation
2. The Pinbrook watercourse – within the Monkerton and Hill Barton Strategic Allocation
3. Haven Banks Area – within the Water Lane Regeneration Area

A Level 2 SFRA was completed in 2014. This document includes specific assessments in areas of higher flood risk and provides links to other sources of flood risk modelling (new sources of which will emerge over time). The ECC Level 2 SFRA refers to two watercourse catchments that encroach the proposed development Site:

1. Longbrook-Larkbeare watercourse catchment is a completely culverted watercourse running, to the west of the site.
2. Northbrook watercourse catchment is an extensive ordinary watercourse system running to the east of the site with a predominantly deep-set channel and a number of culverted sections.

According to the historical flood map for Exeter City, there have been no incidents within the boundary of the proposed development Site.

### 2.2.5 Exeter Surface Water Management Plan (SWMP)

The Surface Water Management Plan (SWMP) identifies SuDS strategy as a key catchment-wide action for Exeter. SuDS for new developments and retro-fitting for existing developments has been identified as a key measure in managing the surface water flood risk. The Flood Maps from the Surface Water Management Plan are included in Appendix B.

According to the published SWMP Mapping on the ECC SWMP, the proposed development Site is not at risk of flooding.

## 2.3 Objectives

The objectives of the Flood Risk Assessment are to:

- Identify potential forms of flooding including rivers, watercourses, surface water flooding, groundwater flooding, flooding from sewer systems and other forms of flooding;
- Establish the risk of flooding;
- Determine the effects of the development on flooding elsewhere either through displacement of floodwaters or increased runoff;
- Suggest appropriate flood mitigation measures, including a strategy for disposal of surface water run-off following the principles of SuDS.

## 2.4 Scope of Work

In preparing the Flood Risk Assessment AECOM has:

- Collected and reviewed publicly available information including:

- Environment Agency Flood Map for Planning;
  - Environment Agency Flood Risk from Surface Water mapping;
  - Environment Agency Flood Risk from Reservoirs;
  - Devon County Council Surface Water Management Plan;
  - Exeter City Council Strategic Flood Risk Assessment;
  - British Geological Survey and Soils Mapping; and,
  - Sustainable Drainage Systems – Guidance for Devon.
- Assessed all existing flood risks to the site as required under the National Planning Policy Framework and associated Planning Practice Guidance;
  - Reviewed site layout and information provided by the Client to identify potential flood risk constraints in context with the proposed development;
  - Calculated current surface water run-off rates and volumes from the site;
  - Calculated proposed surface water run-off rates and volumes from the site;
  - Calculated surface water attenuation storage volume and long-term storage volume as a result of the proposed development;
  - Provided supporting greenfield and storage calculations using Micro Drainage Source Control module;
  - Identified a surface water drainage strategy identifying compliance with the SuDS hierarchy and discharge from the site;
  - Identified proposed flood mitigation measures;
  - Provided plans of the proposed surface water management system in relation to the proposed development;
  - Provided a draft Flood Risk Assessment report for one set of consolidated comments from the Client;
  - Provided final Flood Risk Assessment for planning submission incorporating comments on draft report.

## 2.5 Stakeholders

The various parties and information sources, and their responsibilities, are:

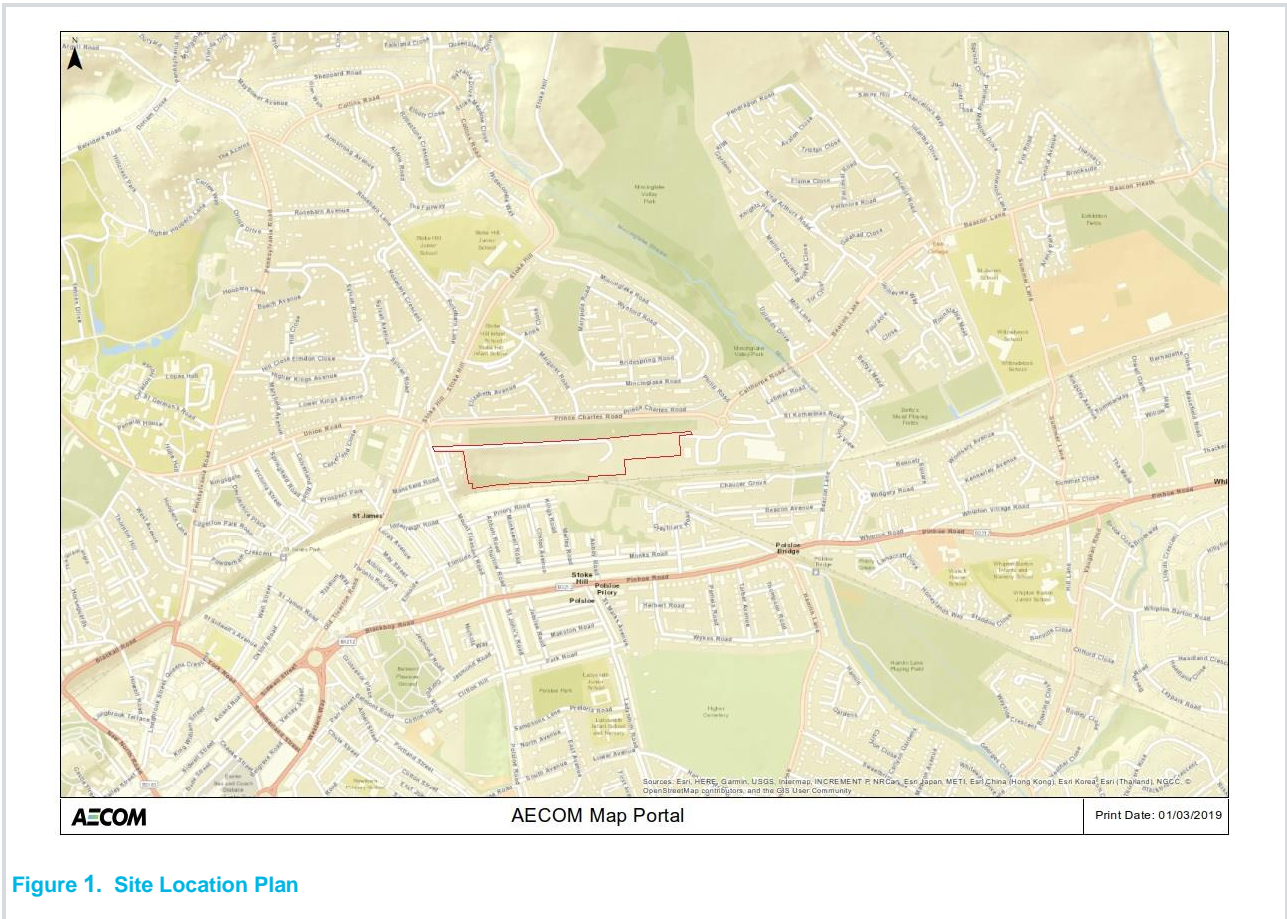
- Eutopia Homes (Exeter) Ltd – The Client;
- Exeter City Council:
  - Preliminary Flood Risk Assessment
  - Exeter Strategic Flood Risk Assessment (SFRA)
  - Exeter Surface Water Management Plan (SWMP)
  - Sustainable Drainage – Guide to Design, Adoption and Maintenance
  - LLFA guidance.
- Devon County Council
  - Sustainable Drainage Systems: Guidance for Devon – Version 1.6 (January 2017);
  - Devon Local Flood Risk Management Strategy 2014-2020.
- Environment Agency:
  - Flood maps.
- South West Water:
  - Asset plans.

### 3. Supporting Information

As part of this flood risk assessment, contact was made with the parties identified in Section 2.5. Information from these parties and other sources to support the flood risk assessment is documented within this section.

#### 3.1 Location and Site Description

The site is located within the city of Exeter, Devon, to the south of Prince Charles Road. The nearest postcode is EX4 7AE and an approximate grid reference at the centre of the site is 293438, 093741. A site location plan is shown as follow in the Figure 1.



The site includes a land parcel that consists in a roughly rectangular area of 5.95 hectares (ha) elongated in an east-west orientation. The main site access is from Mount Pleasant Road.

The site is previously developed (brownfield) and has had a number of previous uses including a rail depot. The estimated impermeable area of the site is approximately 3.77 hectares (equivalent to 64% of the total site area).

Based on the observations of the Site walkover survey, which took place on the 16<sup>th</sup> January 2019, the current Site is mostly impermeable.

## 3.2 Surrounding Area

The Site is in an area primarily comprising residential and commercial use. Land uses within 200m of the Site boundary determined from online mapping imagery are summarised in Table 1 below:

**Table 1. Surrounding Land Use**

Direction	Description
North:	Bounded by Prince Charles Road and public allotments.
East:	Bounded by a Morrison supermarket.
South:	Bounded by the railway line.
West:	Bounded by residential housing.

## 3.3 Site Topography

The topography of the site falls from west to east at an approximate gradient of 1 in 190. The lowest site elevation is approximately 46mAOD in the north-eastern corner. The highest elevation is approximately 61.00mAOD along the top of the slope on the northern boundary, in the far north-western corner of the site. The site sits at a lower elevation than Prince Charles Road and the allotments to the north and, therefore, the northern site boundary is characterised by a steep slope. Elevations at the top of the embankment range between 61.00mAOD at the western end and 50.00mAOD at the eastern end. The remaining rail sidings within the site along the southern boundary sit an approximate elevation of 46.70mAOD.

## 3.4 Watercourses

The nearest named watercourse is Mincinglake Stream which flows in a southerly direction to the east of the site. It is understood that Mincinglake Stream is an Ordinary watercourse, and is therefore, the responsibility of the Lead Local Flood Authority who is Devon County Council. It flows in culvert under the railway lines to the east of the site.

The Exeter City Council Strategic Flood Risk Assessment (SFRA) refers to two watercourse catchments that are located in the vicinity or encroach the proposed development Site:

- Longbrook-Larkbeare watercourse catchment is a completely culverted watercourse running to the west of the site. The Larkbeare catchment is located in the vicinity of the site immediately to the west. The SFRA states (on page 5) that the watercourses are the responsibility of South West Water, and any flooding from the watercourse is as a result of overloaded urban drainage. This is due to much of the former watercourses now has a public sewer status.
- Northbrook watercourse catchment is an extensive ordinary watercourse system running to the east of the site with a predominantly deep-set channel and a number of culverted sections. The Northbrook watercourse catchment incorporates the Mincinglake Stream and encroaches into the site for the entire extent of the site.

The River Exe is located approximately 2km to the west of the site in the centre of Exeter. There are no other local watercourses or surface water features near the site.

## 3.5 Ground Conditions

Due to the nature of the site and its previous uses, it is anticipated that there will be some made ground across the site. The depth and nature of this has not been investigated through intrusive works. The BGS, however, describe the made ground as “ballast, ash and hardcore”.

### 3.5.1 Published Geology

The British Geological Survey records the bedrock geology as the Whipton Formation from the Permian Period comprising of ‘Reddish-brown silty, clay, sand and weakly cemented sandstone, with some clayey silt, mudstone and breccia units.’

No superficial deposits are recorded on site according to the published mapping.

The Soilscales website (Cranfield Soil and Agrifood Institute) records the soils across the site as freely draining, slightly acid, loamy soils.

The BGS does not indicate any available borehole logs within the site boundary. The nearest available borehole SX99SW1 located within 100m outside the site boundary shows made ground recorded as covering the surrounded area and consisting of ashes and bricks for a depth between 0-3m. No groundwater is recorded.

### 3.5.2 Hydrogeology

The “bedrock sandstone” is recorded on the Environment Agency’s website as a Secondary A. Secondary-A Aquifers are described by the EA as “permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers”. These are generally aquifers formerly classified as minor aquifers.

The Site is not within a Source Protection Zone (SPZ) designated by the EA for the protection of potable water supply.

## 3.6 Proposed Development

The Site will be developed to provide 400 residential dwellings (Use Class C3), a 65 units care facility (Use Class C2), and associated access, open spaces, and landscaping. The proposed Development Site Plan is shown in Appendix C.

## 3.7 Vulnerability

The proposed development site is classified as ‘More Vulnerable’ in accordance with NPPF Technical Guidance document, Table 2 (Appendix A). The proposed development is therefore compatible with Flood Zones 1, 2 and 3a. The development is not compatible however within Flood Zone 3b. Refer to NPPF Technical Guidance document, Table 3 (Appendix A).

## 3.8 Flood Maps

The Flood Map for Planning (Rivers and Sea) from the GOV.UK website (see Figure 2 below) shows that the entirety of the site is situated in Flood Zone 1, which is defined as: Land having a less than 1 in 1,000 annual probability of river or sea flooding.

The nearest extent of Flood Zones 2 and 3 originate from Mincinglake Stream, approximately 300m to the west of the proposed Site.



Figure 2. GOV.UK Flood Map For Planning

The GOV.UK online Flood Risk from Surface Water map (see Figure 3) indicates areas which could experience surface water flooding during extreme events. The map indicates that most of the site is considered as being at a ‘Very Low’ risk of surface water flooding. This is defined as having less than a 1 in 1000 (0.1%) annual probability of flooding.

However, the surface water flood map also indicates that there are isolated areas of ‘Medium/High’ flood risk (between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability), ‘Medium’ flood risk (between 1 in 30 (3.3%) and 1 in 100 (1%) annual probability) and ‘High’ flood risk (greater than 1 in 30 (3.3%) annual probability) on the site.



Figure 3. GOV.UK Risk of Flooding from Surface Water Map

The GOV.UK online Risk of Flooding from Reservoirs map (see Figure 4 below) indicates that the site is not at risk of flooding from Reservoirs.

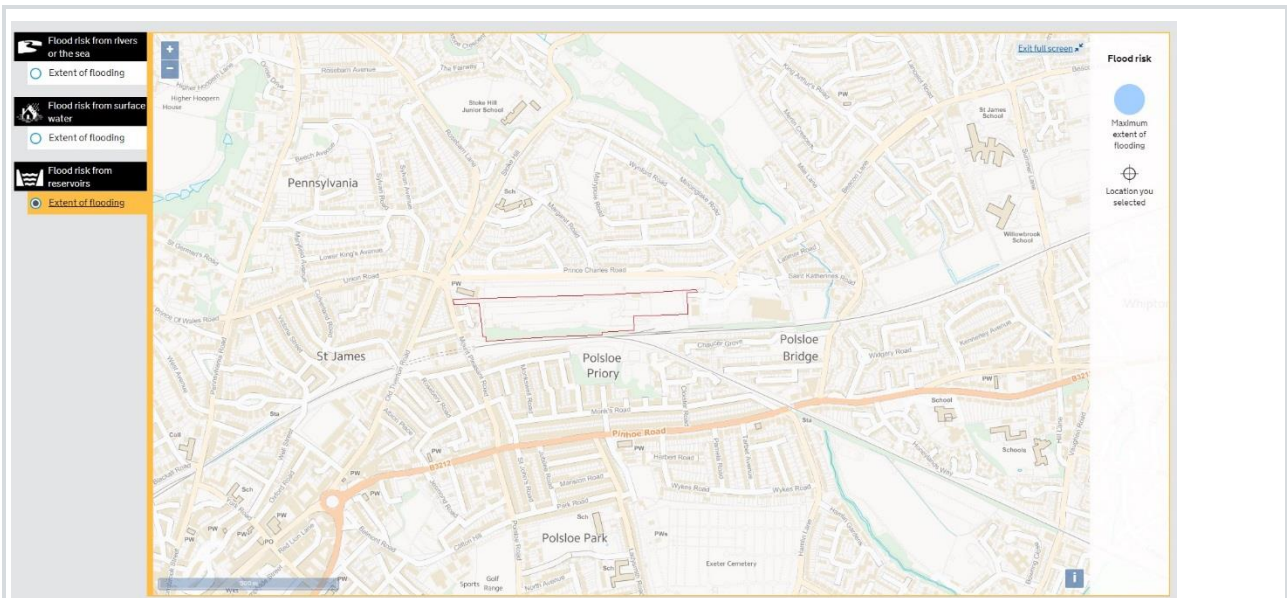


Figure 4. GOV.UK Risk of Flooding from Reservoirs Map

### 3.9 Strategic Flood Risk Assessment

As discussed in section 2.2.4, the historical flood map for Exeter City, does not contain any flooding incidents within the boundary of the proposed development Site.

### 3.10 Surface Water Management Plan

The Surface Water Management Plan (SWMP) for Exeter was released in 2014. The proposed Site is just inside the study area, however the SWMP confirms the site is not in a Critical Drainage Area (CDA).

### 3.11 Consultation with South West Water

South Waste Water (SWW) has been consulted on the proposed Site through a Pre-Development assessment report to evaluate the potential impacts of Site on the existing foul and surface water network. Within the report SWW have identified a foul and a surface water point of connection and a discharge rate for the site. Further discussion on foul water can be found in Section 6.

## 4. Assessment of Flood Risk

In accordance with the NPPF, flood risk must be assessed for all sources of flooding and development of the site should be carried out in such a way as to mitigate any potential flood risk to both the site and third parties and their property. This section identifies all possible sources of flooding and provides appropriate methods to mitigate flood risk.

### 4.1 The Sequential Test

The site is located on land that is wholly within Flood Zone 1 and therefore meets the requirements of the Sequential Test.

### 4.2 The Exception Test

The proposed development is classed as “More Vulnerable” and is therefore considered appropriate within Flood Zone 1. Application of the Exception Test is not required.

### 4.3 Sources of Potential Flooding

Flood risk from the following sources has been considered.

#### 4.3.1 Tidal Flooding

There are no sources of tidal flooding within the vicinity of the site.

#### 4.3.2 Fluvial Flooding

The nearest watercourse (Mincinglake Stream) does not flood within the site boundary according to the GOV.UK Flood Map for planning.

#### 4.3.3 Pluvial Flooding

'Pluvial' flooding is that which results from rainfall generated overland flow before the runoff enters any watercourse, drain or sewer. It is more often linked to high intensity rainfall events (typically in excess of 30mm per hour). However, it can also result from lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or has low permeability. This results in overland flow and ponding in depressions in the topography. In urban areas 'pluvial' flows are likely to follow the routes of highways and other surface connectivity to low spots where flooding can occur. In some cases, it can deviate from this route into adjacent developments via dropped kerbs (either for access to driveways or disability access).

The SWMP Flood Map indicates that the site is not at risk of flooding. However according to the GOV.UK Risk of Flooding from Surface Water Map, there are localised pockets of surface water flooding within the site (with a flood depth below 300mm), along Prince Charles Road to the north, at the junction with Calthorpe Road and Prince Charles Road (with a flood depth between 300-900mm and over 900mm) to the east of the site and along the railway to the south-east corner.

#### 4.3.4 Groundwater Flooding

Groundwater flooding is caused by the emergence of water from sub-surface permeable strata. Fluctuations in the groundwater table can cause flooding should the table rise above the existing ground level. Groundwater flooding events tend to have long durations, lasting days or weeks.

The BGS does not indicate any available borehole logs within the site boundary. Review of available borehole logs from neighbouring sites found on the BGS Geology of Britain Viewer did not identify groundwater in the proximity of the proposed Site.

Historic borehole logs in proximity to the site either did not encounter groundwater or groundwater was experienced at 2m below ground level. The risk of flooding from this source is therefore considered to be low.

#### 4.3.5 Flooding from Drains, Sewers and Water Mains

The existing public sewerage infrastructure in the vicinity of the site is as described in Section 5.

Due to the fact that the Exeter City Council Level 1 and 2 Strategic Flood Risk Assessments (SFRA) do not show that the site has flooded historically, the risk of flooding from drains, sewers and water mains is considered to be minimal.

### 4.3.6 Canals, Reservoirs and Other Artificial Sources

According to the Environment Agency Mapping, Exeter canal does not pose any risk to the proposed site.

### 4.3.7 Risk form Existing Culvert Blockage

Section 4.1.27 of the Flood Risk Assessment 9913 Report produced by Wardell Armstrong in 2013 states that:

*“It is understood that an existing culvert (watercourse/sewer) is present under the site at a depth of 7 – 8m running west to east, which also passes under the Morrisons supermarket site, to the east of the proposed development.*

*Anecdotal evidence from the recent survey work carried out for the adjacent Morrisons supermarket established that the culvert is generally in a good condition. The potential risk from this culvert becoming blocked or collapsing is, therefore, considered to be negligible due to its established condition and depth.*

*There may be, however, sections along the culvert route where depths may be shallower that could be at risk from flooding. In the event of the culvert surcharging at these locations, flows would escape from manholes and gullies located at the lowest parts of the site and flow overland in an easterly direction, into the Morrisons supermarket car park and be stored above ground.*

*There is no history of flooding from this culverted source. It is considered, therefore, that the risk of flooding to the site from the culvert is low.*

*It is understood that the culvert will be traced during detailed design stages to confirm its exact location within the development site.”*

An extract from this FRA is provided in Appendix F. Based on the above, it is considered that there is a low risk of flooding due to a blockage of the culvert.

## 5. Surface Water Runoff Management

### 5.1 Existing Drainage Arrangements

Public sewer records have been obtained from South West Water (SWW) and attached in Appendix E. These show that there are no public sewers (both for foul and surface) within the site boundary.

The nearest public surface water sewer (375mm diameter) is located to the north of the site within the allotments, and to the south of Prince Charles Road, which is east of the existing roundabout. It is understood that this sewer flows in an easterly direction and discharges to Mincinglake Stream to the east of the site.

There is also a 225mm diameter surface water sewer that runs along Mount Pleasant Road to the west of the proposed Site.

Public combined sewers are present in Mount Pleasant Road to the west of the site, and to the south of the railway line. Separate foul and surface water sewers serve the residential area to the north of Prince Charles Road.

The topographical survey shows a number of manholes within the site. It is assumed that foul water flows from the site are discharged to the public sewerage system.

It is understood that an existing culvert (watercourse/sewer) is present under the site at a depth of 7 – 8m running west to east, which also passes under the Morrisons supermarket site, to the east of the proposed development.

SWW have advised that surface water connection can be made into the 900mm diameter public sewerage network at manhole 9804 to the east of the site in Prince Charles Road in the vicinity of the existing roundabout.

### 5.2 Existing Culvert Passing through Network Rail Land

As stated in the sections 2.4.5 and 2.4.6 of the Flood Risk Assessment 9913 Report produced by Wardell Armstrong in 2013:

*“A survey of the culvert undertaken as part of the recent redevelopment of the Morrisons supermarket site found the culvert to be in generally good condition (see Appendix 3 for correspondence). It is assumed that this culvert may well have been linked with the former railway sidings, however, as the culvert is reasonably substantial in size (1500mm x 850mm) it is unlikely that the culvert had been constructed to serve the immediate site only and, therefore, it is deduced that the culvert may have formed part of a former ordinary watercourse. It is assumed, therefore, that surface water runoff from the site currently drains to this culvert, or runs off into landscaped areas around the perimeter of the site and soaks away.*

*Consultation with Network Rail Structures & Network Rail Liability Management Team, Exeter City Council Estates Team & Exeter City Council Drainage Team, Devon County Council Lead Local Flood Authority & Devon Heritage Centre and South West Water via both electronic and verbal means has established that these organisations have no records for the culvert. In lieu of any further records, it is currently assumed that the culvert will become the responsibility of individual landowners in the form of riparian ownership as the culvert crosses their land.”*

As stated in the section 2.4.4 of the same Report:

*“It is understood that a culvert is present under the site at a depth of 7 – 8m metres. This culvert runs in a west to east direction and also lies under the Morrisons supermarket, adjacent to the east of the site, before discharging to the Mincinglake Stream located to the east. The culvert is understood to be a 1500mm x 850mm egg-shaped brick-built structure.*

*A survey of the culvert undertaken as part of the recent redevelopment of the Morrisons supermarket site found the culvert to be in generally good condition (see Appendix 3 for correspondence). It is assumed that this culvert may well have been linked with the former railway sidings, however, as the culvert is reasonably substantial in size (1500mm x 850mm) it is unlikely that the culvert had been constructed to serve the immediate site only and, therefore, it is deduced that the culvert may have formed part of a former ordinary watercourse. It is assumed, therefore, that surface water runoff from the site currently drains to this culvert or runs off into landscaped areas around the perimeter of the site and soaks away.*

*Consultation with Network Rail Structures & Network Rail Liability Management Team, Exeter City Council Estates Team & Exeter City Council Drainage Team, Devon County Council Lead Local Flood Authority & Devon Heritage*

Centre and South West Water via both electronic and verbal means has established that these organisations have no records for the culvert. In lieu of any further records, it is currently assumed that the culvert will become the responsibility of individual landowners in the form of riparian ownership as the culvert crosses their land (see Appendix 4 for correspondence).

*It is recommended that further surveys during detail design stages be undertaken on the culvert to establish alignment, route and level in order to allow Network Rail and/or future land owners to understand the constraint with regards to any potential impacts on development proposals”.*

As recommended in the FRA, it is recommended that this culvert be located prior to detailed design to inform the final point of discharge as well as the masterplan.

## 5.3 Proposed Surface Water Drainage Strategy

The development site is currently brownfield covering 5.95ha with approximately 4ha of impermeable surfacing. Under the current development proposals, the impermeable area of the site will be reduced to approximately 3.77ha and, therefore, the overall rate and volume of surface water runoff from the site during a 1 in 100 year storm event will be reduced.

South West Water Public Sewer Records do not indicate any positive surface water drainage from the site. However, the topographical and services survey indicates that surface water runoff from the site currently drains to the existing culvert known to be located within the site.

The proposed surface water drainage strategy is to construct a new drainage system which will collect runoff from the site and discharge it into the existing 1500x750mm surface water culvert via a new outfall.

The site has been split into two catchments as shown on AECOM drawing ref. 60594954-ACM-EX-XX-RP-CE-00001 in Appendix C. Each catchment will have its own drainage system which will be tailored to the features it is draining (see Section 5.3.5 for further detail on each catchment).

### 5.3.1 Contributing Areas

For the purpose of this assessment, based on the current masterplan (refer to Appendix C) approximately 64% of the proposed Site has been assumed to contribute to surface area runoff.

### 5.3.2 Climate Change

The typical design life for this type of development is 100 years. The updated guidance on climate change allowances (see Appendix B) published by the Environment Agency states that for developments that will last until 2070 to 2115, climate change is expected to result in a 20-40% increase in rainfall intensity.

In accordance with the “Sustainable Drainage Systems: Guidance for Devon – v 1.6” released in January 2017 by Exeter City Council (ECC), it should be noted that ECC consider 40% to be an acceptable allowance for climate change, and that for all development (greenfield and brownfield) the peak surface water runoff rate for the 1 in 1 year rainfall event, up to and including the 1 in 100 year rainfall event, must never exceed the peak greenfield runoff rate for the same event. This will ensure that the surface water runoff rate from developed areas matches greenfield conditions.

The scheme will therefore consider management of surface water runoff up to and including the 1 in 100 year annual probability event with a 40% increase in rainfall intensity as an allowance for climate change.

### 5.3.3 Points of Discharge

The proposed drainage strategy proposes that new drainage networks will discharge into the existing 1500x750mm surface water culvert which runs through the eastern side off the Site.

The allowable discharge rate for the site has been based on Sustainable Drainage Systems: Guidance for Devon – v 1.6 released in January 2017 by Exeter City Council (ECC), which sets out the policy concerning the target run-off from brownfield developments, and states the following:

*“For developments on brownfield sites, peak flow control must still match the greenfield runoff rate. For developments on greenfield sites, the peak surface water runoff rate for the 1 in 1 year rainfall event, up to and*

*including the 1 in 100 year rainfall event, must never exceed the peak greenfield runoff rate for the same event. This will ensure that the surface water runoff rate from developed areas matches greenfield conditions.”*

The calculations of the greenfield runoff rate have been carried out using the ICP SUDS method in hydraulic modelling software XP Solutions Microdrainage (Source Control), with site parameters as noted below:

Average Annual Rainfall (SAAR) = 900 mm

Soil Index = 0.300

FSR Region = 8

An assessment of the existing greenfield run-off from the development Site has been completed to determine the permitted rate of discharges for a range of return periods up to the 100 year event as shown in Table 3 below (see Appendix D for calculations).

**Table 2. Greenfield Runoff rates**

Return period	Rate	Rate (whole site=5.912ha)
1 year	1.22 l/s/ha	7.2 l/s
30 year	2.97 l/s/ha	17.6 l/s
100 year	3.77 l/s/ha	22.3 l/s
Q <sub>BAR</sub>	1.56 l/s/ha	9.2 l/s

Source: MicroDrainage calculations (see Appendix D)

The proposed design will ensure that flows from the Site do not exceed the 1 in 100 year greenfield rate which is **3.77 l/s/ha or 22.3 l/s for the whole site**. The detailed description of the surface water management strategy for each catchment is described in the section 5.3.5.

It is proposed that the outlet for the system (related to the two catchments) is designed to **restrict flows to the 1 in 100 greenfield rate for all storm events up to and including the 1 in 100 year plus 40% climate change allowance** giving a total runoff rate of 22.1 l/s.

The current drainage design assumes discharge into the existing culvert on site. If, through detailed design and discussions with the adopting authorities, this is not accepted then SWW have confirmed a point of connection into their existing network located off site (see correspondence in Appendix E). However, connecting into SWW sewer will require the installation of a SW Pumping Station.

### 5.3.4 Storage Volume Estimation

An assessment of the flow rates and associated attenuation volumes has been carried out for each of the catchments in accordance with the methodology described above. The results of the analysis are indicated within the following sections.

XP Solutions MicroDrainage software has been used to calculate the required storage volume per contributing hectare for each catchment for the 1 in 30 year and 1 in 100 year + 40% climate change allowance event as shown in the Table 4. MicroDrainage (Quick Storage Estimate calculations) are also attached in Appendix D.

### 5.3.5 Details of Proposed Surface Water Management

The proposed development includes changing the drainage regime of the site.

In accordance with SuDS design principles the possibility of discharging the proposed surface runoff to soakaway or infiltration systems was first considered. However, given the former use of this Site as a railway depot and the potential presence of contamination in the soils, there is the potential for pollution of the underlying Secondary A Aquifer from the use of infiltration drainage. As a result, infiltration has not been considered further.

The proposed surface water runoff rate from the Site will be restricted to the greenfield runoff rate. This will be achieved by appropriate attenuation and a complex control devise for surface water within the development site such as rain gardens, swales, detention basins, permeable paving within car parking areas and a geo-cellular storage tank within the proposed green space.

The layout plan for the proposed surface water drainage strategy to serve the scheme is provided in Appendix C.

The site has been split into two catchments (1 and 2) as shown on the AECOM drawing 60571132-ACM-EX-XX-DR-CE-00000 in Appendix C and a detailed description of the surface water management strategy for each catchment is as follows:

#### 5.3.5.1 Catchment 1

Catchment 1 is the western area of the proposed development; it has an area of 4.01 hectares (ha) and levels fall south to north and west to east. According to the current Site development masterplan, it will contain one block of residential building (Block A with 66 units) and four blocks of residential town houses (with 104 units). Hard paved areas will be permeable paving. The proposed surface drainage for Catchment 1 is detailed on AECOM drawing reference 60571132-ACM-EX-XX-DR-CE-00001 included in Appendix C.

The drainage strategy for catchment 1 has been developed to provide sufficient storage to contain runoff for all the return period events up to and including 1 in 100 year + 40% climate change.

Runoff from the building/towns houses roofs and their hardstanding areas will be managed for the 1 in 30 year return period events throughout the proposed upsized surface water drainage network and underground geo-cellular attenuation tank to be located in the green space to the east of the Catchment 1.

Any flows in excess of the design standard will be conveyed and distributed throughout the site in various SuDs features such us cascade rain gardens along the southern site boundary (at the lowest topographical levels) and stored on site by means of a depressed attenuation area located in the proposed green space.

An assessment of the approximate volumes of storage is provided within Table 4 (further calculations are attached in the Appendix D).

In order to contain this runoff for the 1 in 30 year return period events and in addition to the proposed pipe network, a storage tank has been sized to provide approximately 1000m<sup>3</sup> of storage below ground to be located in the area highlighted on AECOM drawing reference 60571132-SHT-20-0000-C-0100 in Appendix C.

#### 5.3.5.2 Catchment 2

Catchment 2 is east of the whole proposed development; it has an area of 1.9 hectares (ha) and falls from south to north and from west to east. According to the current development masterplan, it contains three blocks of residential buildings (Block B with 177 units, Block C with 53 units, and Block D with 65 units), access roads, permeable paving (along the proposed car parking areas), car parking within the buildings and trees.

The drainage strategy for catchment 2 has been developed to provide sufficient storage to contain runoff for all the return period events up to and including 1 in 100 year + 40% climate change within the whole its area.

Runoff from the three building roofs and their surrounding hardstanding areas for the 1 in 30 year return period events will be contained throughout the proposed surface water network system. The assessment of the associated volumes is provided within Table 4 (further calculations are attached in the Appendix D)

Any flows in exceeds of this will be conveyed and distributed throughout the site in various SuDS features such us the proposed depressed attenuation areas as highlighted on AECOM drawing 60571132-ACM-EX-XX-DR-CE-00001, rain gardens in front the proposed residential Block D, within permeable paving within the car parking areas and an attenuation basin located to the east-north corner of the catchment.

In order to attenuate this exceeded runoff, the proposed SuDS features as described below has been sized to provide approximately 350m<sup>3</sup> of storage above ground to be located in the area highlighted as "C" as shown on AECOM drawing 60571132-ACM-EX-XX-DR-CE-00001 in the Appendix C.

The use of a complex flow control chamber has been assumed to ensure that the allowable greenfield discharge rate is not exceeded both in the 1 in 30 year (17.6 l/s) and in the 1 in 100year +40% cc (22.3 l/s) storm events.

Surface water will be then drained by gravity to existing 1500x750mm culvert surface water sewer system at manhole

Further details of the proposed surface drainage system are shown on AECOM drawing ref “60571132-ACM-EX-XX-DR-CE-00001” in Appendix C.

**Table 3. Storage Volume Calculation**

Catchment	Site Area (ha)	Impermeable Area (ha)	Q <sub>30</sub> (l/s)	Q <sub>100</sub> (l/s)	Q <sub>100</sub> -Q <sub>30</sub> Attenuation storage volume (m <sup>3</sup> )*
1	4.01	2.56	11.91	15.1	927.5
2	1.9	1.21	5.67	7.2	327
<b>Total</b>	<b>1.56</b>	<b>3.77</b>	<b>17.6</b>	<b>22.3</b>	<b>1255</b>

\*Source: MicroDrainage calculations - Quick Storage Estimate

### 5.3.6 Sustainable Drainage Systems (SuDS)

Conveyance and storage facilities will as far as practicable be provided in the form of recognised SuDS features in accordance with the CIRIA C753 – The SuDS Manual. The following SuDS features have therefore been considered:

#### 5.3.6.1 Infiltration Techniques

In accordance with SuDS design principles the possibility of discharging the proposed surface runoff to soakaway or infiltration systems was first considered. However, given the former site use as a railway depot, it is possible that there is contamination present which could leach out and pollute the Secondary A Aquifer.

#### 5.3.6.2 Green Roofs and Rainwater Harvesting

It is understood that the form and layout of the proposed development does not lend itself to the use of green roofs or rainwater harvesting hence their use has not been considered.

#### 5.3.6.3 Permeable Paving

Permeable paving has been proposed for all parking spaces within the car parking areas. Attenuation storage will be provided in the stone layer below the permeable paving and the infiltration of surface water runoff through the pavement layers will also provide a form of treatment for the surface water.

#### 5.3.6.4 Bioretention

Bioretention areas are proposed at regular intervals throughout the development to provide attenuation storage and treatment for highway runoff. The bioretention areas will also provide improved water quality, amenity and biodiversity benefit.

#### 5.3.6.5 Attenuation tanks

An underground geo-cellular storage tank is proposed to attenuate the runoff from the building roofs and their surrounding hardstanding areas within catchment 1.

### 5.3.7 Water Quality

The main risk to water quality on the site is likely to occur in the car parking area and internal road on the site. According to the CIRIA C753 (2015) – The SuDS Manual (Table 26.2) a site such as this with residential roofs and residential car parks with low traffic road' has a respectively a “very low” and ‘low’ pollution hazard level. Therefore, the current land use would have the following pollution hazard indices as shown in the Table 4 below.

**Table 4. Pollution hazard indices**

SuDS Manual Land Use Equivalent	Pollution Hazard Level	Pollution Hazard Indices		
		Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Driveways, residential car parks, low traffic roads etc.	Low	0.5	0.4	0.4
<b>Total Pollution Hazard Index</b>		<b>0.7</b>	<b>0.6</b>	<b>0.45</b>

Source: CIRIA C753 (2015) – The SuDS Manual

In accordance with the CIRIA C753 – The SuDS Manual the permeable paving will provide the following SuDS mitigation indices as shown in the Table 5 as follows:

**Table 5. SuDS Mitigation Index**

Type of SuDS component	Mitigation indices		
	TSS	Metals	Hydrocarbons
Filter drain	0.4	0.4	0.4
Bioretention system	0.8	0.8	0.8
Permeable paving	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6

Source: CIRIA C753 (2015) – The SuDS Manual

The total mitigation index exceeds the total pollution hazard index for all the pollutant types. The proposed SuDS treatment train will therefore provide adequate treatment of diffuse urban pollutants.

The current design intent would be for private access roads associated with low traffic volume access and parking to be constructed using permeable pavements which will provide a reduction in peak flow rates and capture of hydrocarbons at source.

The intention is that adoptable roads will be drained using bioretention systems to provide interception and treatment of low flow events. An overflow arrangement will be provided to ensure that more significant storm events that exceed the capacity of the system are captured by the drainage system.

The use of rain gardens may be considered to provide additional treatment and attenuation at source.

### 5.3.8 Maintenance and Management of SuDS

The proposed SuDS features will require maintenance including litter and debris removal, sediment removal, vegetation maintenance and remediation to any damaged structures. The maintenance requirements will be the responsibility of a private maintenance company. Tables 6 to 8 provide a summary of the maintenance requirements for permeable paving, and the geo-cellular storage respectively.

**Table 6 – Operation and maintenance requirements of permeable paving, in accordance with CIRIA C753 - The SuDS Manual**

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 surfaces 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 glyphosate 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 raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to Significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in First six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

**Table 7 – Operation and maintenance requirements for bio-retention systems, in accordance with CIRIA C753 - The SuDS Manual**

Maintenance Schedule	Required Action	Typical Frequency
Regular inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain.	Annually
	Assess plants for disease infection, poor growth invasive species etc and replace as necessary	Quarterly
	Inspect inlets, outlets and overflows for blockages, and clear if required	Quarterly
Regular maintenance	Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants, to maintain planting density	As required
	Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to biannually
Occasional maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required

	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial actions	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required but likely to be > 20 years

**Table 8 – Operation and maintenance requirements of underground geo-cellular tanks, in accordance with CIRIA C753 - The SuDS Manual**

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove 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

## 6. Foul Water Drainage Strategy

### 6.1 Public Sewers

The Sewer records obtained From South West Water (SWW) indicate that there are public sewers in the surrounding roads. The general locations of these are described in Section 5.1 of this report. A copy of the SWW Sewer records is included within Appendix E.

### 6.2 Proposed Site Dry Weather Flow Discharge Rate

The proposed foul water drainage strategy is to construct a new drainage system which will collect foul water generated by the proposed Site to convey it into the proposed Foul Water Pumping Station before to discharge to the existing combined water sewer network via a foul water main.

The proposed development will contain 400 homes and a care facility, with landscaping and access. Further details of calculations are attached in the Appendix E.

The Drainage strategy has identified the volume of foul water that will be generated by the proposed site development.

The utility demand estimations estimate the flow water discharge rates for the whole site on the domestic design flow (Section B5.1 Sewer for Adoption 7th Edition) and are shown in Table 9 as follows:

**Table 9. Foul Water Discharge Rate Estimate**

Total Number of units	Occupancy (person/dwelling)	Discharge (l/person/day)	DWF (l/s)*	Peak Discharge (l/s)**
465	2.3	200	1.5	16.5

*Note: Foul Flows Based on Potable water Demand Comparison over 24h/ day. \*95% Potable Water Demand l/s - \*\* Assume 24h days and 6 x DWF + 10% for residential*

A pre-planning enquiry was submitted in January to SWW for the flow associated within the site to discharge the proposed Site into the existing sewerage infrastructure into a proposed point of connection (PoC). Further details of the pre-planning enquiry are attached in the Appendix E.

South West Water have confirmed that there is existing capacity in the existing 300mm public sewerage network and the nearest foul point of connection would be at manhole 9810 in Prince Charles Road as stated in the SWW response attached in Appendix E.

For the purpose of this foul drainage strategy, the foul flow from the whole catchment will be collected within the site in a separate drainage system and drained via gravity through a foul sewer network into the wet well of the proposed Foul Water (FW) Pumping Station (PS) located in the vicinity of the existing water tower to the northern side of the site.

A gravity drainage network, with sewers sized for peak flows and to achieve self-cleansing velocities, will be used to convey foul water to this pumping station. The proposed site layout includes an area allowance for a foul water pumping station to be constructed following detailed design. The foul water will be pumped to the public point connection (manhole 9810) via a proposed 350m long rising main.

Details of the proposed foul drainage systems are show on AECOM drawing “60571132-ACM-EX-XX-DR-CE-00001” in Appendix C.

## 7. Flood Risk Management and Mitigation Measures

### 7.1 Surface Water Runoff Exceedance Flows

The effective management of surface water within the proposed development will ensure that any flood risk from the existing drainage within the site and flood risk from overland flows within the site are effectively mitigated. It will also ensure that the flood risk from surface water outside the site is not increased by the development.

The surface water management strategy will include reducing flow from the site down to greenfield runoff rates, providing attenuation to manage the flows and utilising SuDS components such as permeable paving and bio-retention areas to increase bio-diversity and water quality.

The system has been designed so that no flooding will occur for the 1 in 30 year storm event, however, for the 1 in 100 year event surface flooding water flooding may be present, but this will be managed within the site constraints to ensure that no surface water to discharged off the site.

The mitigation against this is that in this instance runoff will be directed away from buildings and managed on site to avoid flooding third party land. The general topography of the site means that following a major storm event runoff will eventually flow towards River Rea once water levels within the river have rescinded.

### 7.2 Maintenance of the drainage system

The proposed surface water runoff management features will require maintenance. Maintenance requirements of any SuDS features should be clearly identified and reflected in the detailed design. Drainage features common to site users will be maintained by the site Management Company/s and designed in accordance with best practice and the local authority requirement as appropriate.

## 8. Conclusions

This Flood Risk Assessment has demonstrated that the proposed Site is at low risk of flooding from all sources. Furthermore, the development will not increase the flood risk from these potential sources either to the site, or neighbouring sites.

The assessment may be summarised as follows:

- The development site is considered “More Vulnerable” and therefore is appropriate in Flood Zone 1 in accordance with the NPPF.
- The site will not increase the risk of flooding off site. All surface water runoff from the proposed contributing areas within the site will be captured by new drainage networks that can accommodate flows up to and including the 1 in 100 + 40% climate change event within the whole site through the use of SuDS features, underground geo-cellular storage unit and permeable paving.
- It is proposed that the new surface drainage systems will discharge into the existing 1500x750mm surface culvert located to the east of the site. An outlet from the new drainage system will be designed to restrict the flow rates to 22.1 l/s for all design storm events up to and including the 1 in 100 year plus a 40% allowance climate change
- An assessment of SuDS options available to the site has confirmed that rain gardens, swales, detention basins, permeable paving and a geo-cellular storage unit will be suitable. An assessment of the use of SuDS to treat surface water against potential pollution within the car park area has been made which shows that the proposed treatment train provides adequate treatment of diffuse urban pollutants. A maintenance plan for all SuDS features has also been provided.
- Infiltration drainage techniques do not appear to be feasible given the former use of this Site as a railway depot.
- Foul water discharge from the site is proposed to discharge into the existing South West Water (SSW) networks. These connections will be made via a proposed pumped foul water main in combination with the proposed FW pumping station to be built on site.
- The residual flood risks have been identified and suitable mitigation proposed in order to reduce these to acceptable levels.
- This Flood Risk Assessment has concluded that the flood risk to the existing site is acceptable in relation to the proposed scheme, and furthermore that the proposed scheme will not increase flood risk to other sites.

In light of the above, it can be concluded that there are no flood risk, surface or foul water drainage grounds on which to refuse this application.

## Appendices

## Appendix A - Extract from Technical Guidance to the NPPF

# Appendix B - Climate Change Allowances

## Appendix C - Masterplan, Topographical Survey and Drainage Strategies

C.1 Masterplan

C.2 Topographical Survey

C.3 Catchments Plan layout:

- 60571132-ACM-EX-XX-DR-CE-00000

C.4 Proposed Surface and Foul Drainage Strategy:

- 60571132-ACM-EX-XX-DR-CE-00001

## **Appendix D - Greenfield Runoff Rates and storage volume estimation**

D.1 Greenfield runoff rates

D.2 Storage volume estimation

## **Appendix E – South West Water Pre-Development Assessment**

- E.1 South West Water Asset Records
- E.2 Pre-development enquiries
- E.3 South West Water Correspondence

## **Appendix F - Extracts from the Flood Risk Assessment 9913 Report produced by Wardell Armstrong**



