

12 Drainage and Flood Risk

12.1 Introduction

12.1.1 This chapter assesses the effects of the proposed development on drainage and flood risk. In particular, it considers the potential effects of:

- Flood risk;
- Surface water quality (watercourses [rivers and canals]; reservoirs, lakes and ponds; and wetlands);
- Flood risk management; and
- Land drainage.

12.1.2 The chapter has been written by Tier Consult.

12.1.3 The study area used for this assessment includes both the Site and its nearby relevant hydrological features (extending at least to 1 km from the Site), including the catchments of local watercourses, surface water features and dependant habitats. It also includes hydrogeological features, including underlying geology, aquifers and nearby groundwater dependent features.

12.1.4 This chapter utilises the results of the site specific Flood Risk Assessment (FRA) prepared for the Proposed Development as a requirement of and in accordance with the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance. The FRA is included as Appendix 12.1.

12.1.1 This chapter is supported by the following reports produced by Tier:

- Flood Risk Assessment (Report Ref. T/18/2126/FRA dated ~~August~~ December 2020) that is presented in Appendix 12.1;
- Surface Water Drainage Strategy (Report Ref. 2126 Drainage Strategy 001 dated August 2020) that is presented in Appendix 12.2;
- Drainage Layout Drawings (Ref. 55-00, 55-01, 55-02, 55-03 and 55-04 dated August 2020) that is presented in Appendix 12.2;
- SuDS Maintenance Plan (Report Ref. 2126 SuDS 001 dated August 2020) that is presented in Appendix 12.2;
- Preliminary Risk Assessment (Report Ref. TE1163PRA dated July 2020) that is presented in Appendix 11.1; and,
- Preliminary Ground Investigation Report (Report Ref. TE1163PGIR dated ~~July 2020~~ December 2021) that is presented in Appendix 11.2.

12.1.2 The assessment covers the construction and operational phases of the Proposed Development and identifies aspects that have the potential to affect the existing baseline situation. The following issues have been considered:

- effects on surface water quality;
- changes to the natural drainage patterns;
- effects on base flows;
- effects on runoff rates and volumes;
- effects on erosion and sedimentation;
- effects on water resources (both private and public water supplies); and
- effects on flooding and impediments to flow.

12.1.3 Where likely effects are predicted, their significance has been assessed taking into account measures incorporated into the design to mitigate or reduce the significance of these effects. Additional mitigation measures are then outlined to reduce any outstanding significant effects with significance then assigned to any residual effects following the implementation of the additional mitigation measures.

12.2 Planning Policy Context

The Flood and Water Management Act 2010

12.2.1 The legislative framework for flood and coastal risk management is set out principally in The Flood and Water Management Act 2010. The legislation endorses the principle of an integrated approach to water and drainage management. The intentions of the Act are summarised below:

- Deliver improved security, service and sustainability for people and their communities;
- Clarify responsibilities for managing all sources of flood risk;
- Protect essential water supplies by enabling water companies to control more non-essential uses of water during droughts;
- Modernise the law for managing the safety of reservoirs;
- Encourage more sustainable forms of drainage in new developments through new arrangements for adoption and future operation of such features; and
- Make it easier to resolve misconnections to sewers.

Water Framework Directive

12.2.2 The Water Framework Directive 2000/60/EC is a European Union directive designed to improve and integrate the way water, from all sources, is managed throughout Europe. In the UK, much of the implementation work is undertaken by competent authorities such as the Environment Agency and Local Authorities. It came into force in December 2000 and was transposed into

UK law in 2003. Member States are required to achieve good chemical and ecological status for their inland and coastal waters by 2015.

Water Resources Act 1991

- 12.2.3 Under the Act, it is an offence to “cause or knowingly permit poisonous, noxious or polluting matter or any solid waste to enter controlled waters” unless it is covered by a consent to discharge issued by the Environment Agency. Failure to comply may result in a fine. This includes discharge to surface water drains.

National Planning Policy Framework

- 12.2.4 The National Planning Policy Framework (NPPF) aims to ensure that flood risk is taken into account by all relevant statutory bodies from regional to local authority planning departments to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of high risk. Where new development is, exceptionally necessary in high risk areas, the policy framework aims to make it safe, ensure that it will not increase flood risk elsewhere and, where possible, reduce overall flood risk in the local area.
- 12.2.5 Local Authorities should only consider development in flood risk areas as appropriate where it is informed by a Site-specific Flood Risk Assessment, based upon the Environment Agency’s Standing Advice on flood risk. The Assessment should identify and assess the risks of all forms of flooding to and from the development and demonstrate how flood risks will be managed so that the development remains safe throughout its lifetime, taking climate change into account.

Knowsley Local Plan Core Strategy

- 12.2.6 Policy CS24: Managing Flood Risk states that new development should preferably be located in areas of low probability of flooding. New development shall include flood mitigation measures, where necessary, to manage flood risk associated with or caused by the development. These should:
- a) Be designed to contribute to the biodiversity of the borough unless it can be demonstrated that this would not be technically feasible;
 - b) Incorporate a Sustainable Drainage System;
 - c) Be fully described in the planning application; and
 - d) Be funded by the developer, including long term maintenance.
- 12.2.7 The Policy also states that the drainage of new development shall be designed to reduce surface water run-off rates to those associated with a green-field site by treating it at its source. The chosen method of implementation should take account of site size, ground contamination or conditions, and potential damage to adjacent buildings or sites.

12.3 Approach

Assessment Methodology

- 12.3.1 The approach to the assessment considers the significance of the likely effects upon the hydrological characteristics of the Site.
- 12.3.2 The study area used for this assessment includes both the Site and its nearby relevant hydrological features (extending at least to 1 km from the Site), including the catchments of local watercourses, surface water features and dependant habitats. It also includes hydrogeological features, including underlying geology and aquifers.
- 12.3.3 There are a number of potential impacts that have to be considered that could have a direct or indirect effect on hydrology, flood risk, water quality and drainage. These impacts may be transitional, but also can be more permanent in nature. The primary concerns relate to potential impacts on controlled water receptors and flood risk.
- 12.3.4 The existing flood map in this location is based on coarse resolution JFLOW modelling, as such the flood outlines do not align to the watercourses in the area as agreed by both the Environment Agency and the Knowsley Metropolitan Borough Council SFRA. Therefore, a detailed 1D/2D linked hydraulic model of the Fox's Bank Brook has been developed to confirm the flood risk posed to the site and to inform the FRA. A river channel survey has been undertaken to inform the channel geometry of the hydraulic model.
- 12.3.5 Professional judgement is used to assess the findings in relation to each of these criteria to give an assessment of significance for each effect. This approach has been used to inform the assessment of predicted effects.

Knowsley Metropolitan Borough Council

- 12.3.6 Knowsley Metropolitan Borough Council as the Lead Local Flood Authority (LLFA) has made the following comments:

"Please take a look at our Strategic and Preliminary Flood Risk Assessments. They can be found on Knowsley Council's Lead Local Flood Authority website.

The Strategic Flood Risk Assessments provide an overview of flood risk in Knowsley. The SFRA Part 1 focuses on future development in the borough but does not focus upon individual properties or sites. The SFRA Part 2 provides more detailed information regarding the nature of flood risk at a number of sites allocated within the Local Plan. The Preliminary Flood Risk Assessment (PFRA) report was submitted to the Environment Agency and approved in October 2011. According to the guidelines set by the Environment Agency / DEFRA, Knowsley does not have a nationally significant flood risk.

Further information on sustainable drainage can be found in Knowsley MBC's 'Sustainable Drainage & Surface Water Management - Technical Guidance for Developers' document (v06) for your information.

Guidance on the production of Flood Risk Assessments can be found here: <https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications>

From the limited information provided: the LLFA considers the development site to be greenfield and will require the surface water discharge rate be restricted to greenfield (Q_{bar}) runoff rates, in accordance with our technical guidance and the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) or any subsequent replacement national standards.

The LLFA will require a comprehensive and detailed Flood Risk Assessment and Drainage Strategy, together with a corresponding detailed surface water drainage scheme to be submitted, together with hydraulic drainage calculations for a 1:2yr, 1:30yr and a 1:100yr plus an appropriate climate change allowance design storm event. (summer and winter storms, for all storm durations from 15mins to 10080mins). The drainage plan should be annotated with the pipe numbers from the calculations and show any attenuation, restricted discharge, exceedance storage and overland flow routes.

If the development is classified as Major Development under Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2015; the development must include Sustainable Urban Drainage Systems (SuDS) unless it can be demonstrated that it is inappropriate for the site.

With regards to historical flooding; I have checked our records, and we do not have any recorded incidents of historical flooding within the development area. However, this does not necessarily mean that no historical flooding has occurred, just that none were reported to Knowsley Council.

Any works on or near a main river may need an Environmental Permit for Flood Risk Activities from the Environment Agency (EA).

Any works on or near an ordinary watercourse will need Ordinary Watercourse Consent (OWC) from the Lead Local Flood Authority.

With regards to Surface Water, Groundwater, Coastal flooding; I have directed you towards our Strategic and Preliminary Flood Risk Assessments for this information.

We do not have any additional information or knowledge at this time.

Knowsley MBC do not have any modelling for the area and SuDS will not be adopted by the Local Authority.

As a general comment the LLFA requires a site wide flood risk assessment (FRA) report (for the whole of the Halsnead development and not just parcels of land in isolation) for all sources of flood risk, including recommendations for mitigation for any part of the area which is at flood risk from any source e.g. finished floor level minimum height etc.

In addition, the LLFA will require a surface water drainage strategy and layout encompassing and demonstrating an integrated drainage system (SuDS), which takes account of the site constraints, the masterplan and any pre-application discussions. The integrated site specific drainage strategy must ensure the individual requirements of each development parcel are taken into consideration and its layout is consistent with the masterplan, and demonstrates that the proposal does not prejudice other development parcels. See the information required section for a list of information that should be included.

It is recommended that the proposal seeks opportunities to reduce flood risk post-development through provision of flood storage betterment and/or improvement in flood flow conveyance.

The LLFA advise all opportunities are taken to ensure no negative impact on water quality. SuDS at source, alongside roads, verges, open areas, footpaths and near receptors can control flows and potentially improve water quality on receiving watercourses.

The FRA should include but not exhaustive:

- Desk and initial ground investigation and geotechnical survey (boreholes, trial pits) to establish variations in soil and geology conditions, position of groundwater table (winter/summer), constraints on infiltration and a recommendations for the use of infiltration method (e.g. soakaway, deep bore, blanket etc) and other SuDS features. Results should be supported with a map in geotechnical 'bands' e.g. infiltration band etc*
- Values for pre and post development impermeable area in hectares.*
- Information on existing drainage (hard engineering and natural drainage) on the site, including current discharge method(s) and any outfall locations.*
- Consideration of the possibility of runoff from existing neighbouring sites and, if so, recommendations for how this should be managed.*
- An assessment of how the integrated sustainable drainage system takes account of the natural site catchment, including all existing watercourses and*

water bodies such as Big Water, and ensures that any proposals do not impact upon the natural catchment, water quality (treatment train) and enjoyment of these features.

- Pre and post development peak surface water discharge rates and discharge volumes, in line with Defra's Technical Standards for SuDS and taking account of the 'upper end' climate change allowance. To be submitted in MicroDrainage format. Recommendation for the rate at which the development parcel should discharge surface water at, and what attenuation volume is required to achieve the proposed discharge rates.*
- Recommendations for surface water treatment trains for each discharge point, particularly for surface water bodies (watercourses, Big Water etc).*
- Comprehensive, drainage layout plans / drawings of pre- and post-development sustainable drainage recommended option.*
- Recommendations for surface water drainage during construction and phasing of the sustainable drainage system to ensure that no part of the development site is prejudiced. E.g. temporary drainage measures, pollution prevention, sediment capture, protection of existing/part built drainage systems.*
- Recommendation for in perpetuity maintenance of each part of the sustainable drainage system e.g. S104, S106, S38, Private (deeds)."*

12.3.7 The LLFA has advised that applications forming part of the Halsnead Garden Village will need to undertake FRAs that cover the whole of the Halsnead development rather than for different parcels in isolation. The advice received from the LLFA is shown above.

12.3.8 The surface water drainage regimes for the parcels of land north and south of the M62 are entirely separate, with their own access to watercourses for discharging surface water and being notably separated by the physical barrier of the M62.

12.3.9 The plots to the north of the M62, which are to be developed by a number of different developers, will need to collaborate on a site wide drainage strategy in order to effectively store and discharge surface water to a limited number of outfall points, such as Big Water. This is because some of the plots have no direct access to an outfall point and will therefore need to direct surface water through third party land.

12.3.10 On the southern side of the M62, there are only two distinct applicants, those being the applicant for this site, Tritax Symmetry, and Maro Developments, who control the land to the west of the site. The advantage of this approach is that the Tritax application covers the majority of the land south of the M62 and enables a site-wide drainage strategy to be developed by one applicant.

12.3.11 The Maro site has direct access to Fox's Bank Brook to discharge its own surface water, which will be subject to appropriate storage and greenfield discharge rates. Therefore, there is no potential for the Tritax proposals to isolate the Maro site and restrict its ability to deliver its own drainage system. As such, the two sites do not need to be part of the same surface water drainage system. Indeed, draining the Maro site through the proposed country park system

would be impractical given the distance to the ponds compared with the proximity to the watercourse and the need to pump water back upstream to make use of the proposed ponds in the country park.

12.3.12 It is also the case that all development parcels within the Halsnead Garden Village will be required to achieve greenfield runoff rates through the delivery of appropriate surface water storage systems, thus ensuring that the developments will not have any cumulative effect on the risk of flooding off-site.

12.3.13 In accordance with the above, the FRA and drainage strategy for the site take a proportionate approach based on an appreciation of the drainage and flood risk across the entire Garden Village area as well as the site-specific conditions. Accordingly, there are no cumulative effects on drainage and flood risk associated with the proposed development.

Environment Agency

12.3.14 The Environment Agency has made the following comments:

“Flood Zones 2&3 associated with Foxes Bank Brook through the old Cronton Colliery site do appear somewhat misaligned with the watercourse in certain places and probably stems from the first generation of national Flood Map modelling undertaken nearly 20-years ago. Because of the limited amount of local development pressures since that time and the fact that there aren’t any existing properties (houses) located within the flood outlines, the justification to carry out an updated (and more accurate) modelling study hasn’t existed.

Any future Flood Risk Assessment carried out in support of a planning application for development on the site should consider multiple data sources, including site-specific hydraulic modelling where the risk is considered necessary. The published surface water flood map quoted is again the product of a national modelling exercise and produced to provide an initial estimation of areas susceptible to surface water flood risk only.

Ideally surface water attenuation ponds should be located within Flood Zone 1 only, as attenuation ponds can’t fulfil their primary purpose of storing excess run-off from new development sites if already full of fluvial flood flows from adjacent watercourses or rivers.”

Significance Criteria

12.3.15 The assessment takes into account any mitigation measures to be applied in the implementation of the development proposals.

12.3.16 The significance of effects is determined by considering the magnitude of the effect against the sensitivity of the environmental feature. A matrix is used to combine magnitude and sensitivity to generate the overall significance of the effect, as illustrated in Table 12.1.

Table 12.1. Assessment Matrix.

Sensitivity of Receptor	Magnitude of Impact			
	Negligible	Low	Medium	High
Low	Negligible	Negligible	Minor	Moderate
Medium	Negligible	Minor	Minor	Moderate
High	Negligible	Moderate	Moderate	Major
Very High	Negligible	Moderate	Major	Major

12.3.17 The criteria for determining any effects associated with the proposal are summarised in Table 12.2.

Table 12.2. Description of Effects

Significance Criteria	Definition
Major Adverse	Considerable detrimental impact (by extent, duration or magnitude) of more than local significance or in breach of recognised acceptability/legislation/policy standards
Moderate Adverse	Limited detrimental impact (by extent, duration or magnitude) that may be considered significant
Minor Adverse	Slight, very short or highly localised detrimental impact
Negligible	No appreciable impact on the attribute, or the attribute of negligible importance
Minor Beneficial	Advantageous or positive impact to an environmental resource or receptor (e.g. improvement in water quality) of slight, very short or highly localised impact of no significance
Moderate Beneficial	Advantageous or positive impact to an environmental resource or receptor (e.g. improvement in water quality) of limited impact (by extent, duration or magnitude) that may be considered significant
Major Beneficial	Advantageous or positive impact to an environmental resource or receptor (e.g. improvement in water quality) of considerable impact (by extent, duration or magnitude) of more than local significance

Assumptions and Limitations

12.3.18 It has been assumed in the production of this ES that the Site is to be redeveloped (in accordance with the illustrative masterplan) into 4 No. industrial warehouses with associated

car parking areas, infrastructure, areas of soft landscaping and surface water attenuation ponds in the south-eastern area of the Site. In the event that the development proceeds with a layout different to that shown in the illustrative masterplan, a revised FRA model may be required and subject to environmental reassessment. This would be subject to a scoping exercise at the appropriate time to determine the consistency of the model with the revised design details.

12.3.19 The assessment in this Chapter is reliant on the data presented in the FRA for the scheme and comments from Knowsley Metropolitan Borough Council) as the LLFA and the Environment Agency. The Environment Agency's flood data can change over time. However, it is not considered that the above limitations would have a significant bearing on the outcome of this assessment.

12.4 Baseline Conditions

12.4.1 This section identifies the current drainage and flood risk conditions of the site and the study area.

12.4.2 The sources of information used in this desktop study are listed in Table 12.3.

Table 12.3. Data Sources

Topic	Sources of Information
Topography	• Ordnance Survey Maps • Site topographic survey
Geology	• BGS Bedrock and Superficial Geological Map • BGS online data
Hydrogeology	• Environment Agency online data • Relevant scientific literature
Hydrology	• Meteorological Office Historic Rainfall Data • Flood Estimation Handbook (FEH) • National Soil Resource Institute • Environment Agency Flood Risk Maps

Topography

12.4.3 Overall, the site slopes in a south westerly direction. Ground levels are highest in the north eastern corner of the site, approximately 40 to 47 metres Above Ordnance Datum (mAOD) decreasing to 18mAOD in the western corner adjacent to the M62 roundabout.

Hydrology / Existing Drainage

12.4.4 Fox's Bank Brook enters the site from the east, it appears to run around the southern boundary until just east of Park Villas, at which point it heads north before turning eastwards again. After approximately 400m it heads south westwards beneath the A5080 to meet with Chapel Brook, after which the watercourse is known as Ochre Brook. Environment Agency data on the status and route of the watercourse is inconsistent. There are also a number of other drains within the site that appear to connect to Fox's Bank Brook, and there a number of small ponds.

12.4.5 The hydrological setting of the site has been determined from the Groundsure report and is summarised below:

- There are no licensed surface water abstractions within 400m of the site.
- Ditton Brook, located approximately 450m to the southwest of the site, has been classified as 'poor' with regard to biological quality.

12.4.6 The site is currently drained through a network of ditches/open watercourses flowing in a general southwest direction, following the local gradient.

Rainfall

12.4.7 The Site is located within an area of moderate rainfall. The 1961-1990 Standard Average Annual Rainfall (SAAR) for the Site is 820 mm per annum. The UK national average is 832 mm per annum.

Ground Conditions

12.4.8 The superficial deposits at the site were found to comprise (see Appendix 11.1 and 11.2):

- Manufactured topsoil (blend of colliery spoil, paper mill crumb and sewage cake) underlain by colliery spoil in the southern and eastern areas of the site underlain by Till (Devensian – Diamicton); and,
- Topsoil underlain by Till (Devensian – Diamicton) in the northern area of the site.

12.4.9 The superficial deposits were anticipated to be underlain by the Pennine Middle Coal Measures Formation comprising sandstones, mudstones and coal seams across the majority of the site, with competent rockhead encountered at depths between 28.82m and 32.30m AOD.

12.4.10 The superficial deposits in the eastern area of the site were anticipated to be underlain by the Kinnerton Sandstone Formation. Competent rockhead of the Kinnerton Formation was encountered at 37.94m AOD.

12.4.11 A north-south trending normal fault is shown on available BGS maps.

12.4.12 During the intrusive investigation works, no olfactory or visual evidence of hydrocarbon or similar contamination was observed.

12.4.13 Localised shallow obstructions comprising concrete and brick were encountered.

12.4.14 It is anticipated that shallow perched groundwater bodies will be present within the superficial soils, notably the colliery spoil mounds within the southern and eastern areas.

Historic Mining

12.4.15 The Groundsure report and the Coal Authority records indicate that the 3 Foot Coal seam subcrops beneath the western area of the site, with a dip of approximately 12° towards the southwest. This area of the site has been classified by the Coal Authority as a 'development high risk area'. It is anticipated that historic unrecorded workings and mine entries, such as bell pits, may be associated with this coal seam.

12.4.16 There are 3 No. recorded mine shafts associated with the former Cronton Colliery located adjacent to the proposed development site. It is understood that these shafts were associated with workings of deeper coal seams greater than 100 metres below ground level (m bgl).

12.4.17 The records for No.2 shaft at Cronton Colliery records the presence of a 0.90m thick un-named coal seam at approximately 39m bgl. It is anticipated that this seam may be present at shallow depth in the northern area of the site.

Hydrogeology

12.4.18 The hydrogeological setting of the site has been determined from the Groundsure report and is summarised below:

- The majority of the superficial deposits are a Secondary (Undifferentiated) Aquifer, with a Secondary (A) Aquifer along the eastern site boundary;
- The bedrock beneath the majority of the site is a Secondary (A) Aquifer. The bedrock beneath the eastern area of the site is a Principal Aquifer; and
- The eastern area of the Site is located within a Source Protection Zone 3 – Total Catchment.

Surface Water Abstractions

12.4.19 The surface water abstractions located within 2 km of the site are shown in Table 12.4.

Table 12.4. Surface Water Abstractions

Distance (m)	Direction	NGR	Details	
450	SW	346600	Status: Historical	Annual Volume (m³): -
		389100	Licence No: 2569028018	Max Daily Volume (m³): -
			Details: Spray Irrigation - Direct	Application No: -

			Direct Source: "Surface, Non-Tidal - North West Region" Point: "OCHRE & DOG CLOG BRKS, TARBOCK HALL FARM, TARBOCK, PRESCOT" Data Type: Line Name: T H CRITCHLEY & SON	Original Start Date: 13/05/1976 Expiry Date: - Issue No: 100 Version Start Date: 01/04/1993 Version End Date:
450	SW	346600	Status: Historical	Annual Volume (m³): -
		389100	Licence No: 2569028018 Details: Spray Irrigation - Direct Direct Source: Surface, Non-Tidal - North West Region Point: OCHRE & DOG CLOG BRKS, TARBOCK HALL FARM, TARBOCK, PRESCOT Data Type: Line Name: T H CRITCHLEY & SON	Max Daily Volume (m³): - Application No: - Original Start Date: 13/05/1976 Expiry Date: - Issue No: 100 Version Start Date: 01/04/1993 Version End Date:
450	SW	346600	Status: Historical	Annual Volume (m³): 2098
		389100	Licence No: 2569028018 Details: Spray Irrigation - Direct Direct Source: Surface, Non-Tidal - North West Region Point: OCHRE AND DOG CLOG BROOKS	Max Daily Volume (m³): 636 Application No: - Original Start Date: 13/05/1976 Expiry Date: -

			TARBOCK HALL FARM PRESCOT Data Type: Line Name: T H CRITCHLEY & SON	Issue No: 100 Version Start Date: 01/04/1993 Version End Date:
943	SW	346400 388600	Status: Active Licence No: 2569028018 Details: Spray Irrigation - Direct Direct Source: Surface, Non-Tidal - North West Region Point: OCHRE AND DOG CLOG BROOKS TARBOCK HALL FARM PRESCOT Data Type: Line Name: BELPOOL DEVELOPMENTS LTD	Annual Volume (m³): 2098 Max Daily Volume (m³): 636 Application No: - Original Start Date: 13/05/1976 Expiry Date: - Issue No: 102 Version Start Date: 31/01/2011 Version End Date:

Potable Water Abstractions

12.4.20 The potable water abstractions located within 2 km of the site are shown in Table 12.5.

Table 12.5. Surface Water Abstractions

Distance (m)	Direction	NGR	Details
1035	NE	348550 390340	Status: Historical Licence No: 2569028021 Details: "Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public
			Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: - Original Start Date: 06/09/1994 Expiry Date: -

			Services" Direct Source: Ground Water - North West Region Point: "B/HOLE AT BLUNDELLS HILL GOLF CLUB, BLUNDELLS LANE, RAINHILL" Data Type: Point Name: BLUNDELLS HILL GOLF CLUB LTD	Issue No: 101 Version Start Date: Version End Date:
1035	NE	348550 390340	Status: Active Licence No: 2569028021 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Ground Water - North West Region Point: B/HOLE AT BLUNDELLS HILL GOLF CLUB, BLUNDELLS LANE, RAINHILL Data Type: Point Name: BLUNDELLS HILL GOLF CLUB LTD	Annual Volume (m³): 21966.9 Max Daily Volume (m³): 191.81 Original Application No: - Original Start Date: 06/09/1994 Expiry Date: - Issue No: 102 Version Start Date: Version End Date:

1330	S	347880	Status: Historical	Annual Volume (m³): 34000
		387926	Licence No: 2569028024	Max Daily Volume (m³): 108.97
			Details: Water Bottling	Original Application No: -
			Direct Source: Ground Water - North West	Original Start Date: 03/12/2002
			Region	Expiry Date: 31/03/2015
			Point: BOREHOLE AT ALDER LANE, CRONTON,	Issue No: 2
			WIDNES	Version Start Date:
			Data Type: Point	Version End Date:
			Name: MORPHET	
1330	S	347880	Status: Active	Annual Volume (m³): 34000
		387926	Licence No: 2569028024R01	Max Daily Volume (m³): 110
			Details: Water Bottling	Original Application No: -
			Direct Source: Ground Water - North West	Original Start Date: 01/04/2015
			Region	Expiry Date: 31/03/2028
			Point: BOREHOLE AT ALDER LANE, CRONTON,	Issue No: 1
			WIDNES	Version Start Date:
			Data Type: Point	Version End Date:
			Name: MORPHET	
1336	S	347880	Status: Historical	Annual Volume (m³): 34000
		387920	Licence No: 2569028024	Max Daily Volume (m³): 108.97
			Details: Water Bottling	Original Application No: -

			Direct Source: Ground Water - North West Region Point: BOREHOLE AT ALDER LANE, CRONTON, WIDNES Data Type: Point Name: MORPHET	Original Start Date: 03/12/2002 Expiry Date: 31/03/2015 Issue No: 2 Version Start Date: Version End Date:
1336	S	347880 387920	Status: Historical Licence No: 2569028024 Details: Water Bottling Direct Source: Ground Water - North West Region Point: "BOREHOLE AT ALDER LANE, CRONTON, WIDNES" Data Type: Point Name: C S MORPHET & SONS LTD	Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: - Original Start Date: 03/12/2002 Expiry Date: 31-Mar-15 Issue No: 1 Version Start Date: Version End Date:
1422	S	346700 387900	Status: Historical Licence No: 2569028011 Details: Potable Water Supply - Direct Direct Source: Ground Water - North West Region	Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: - Original Start Date: 23/03/1966 Expiry Date: - Issue No: 101

			Point: "B/HOLES (2) AT WATER LA PUMPING STATION, WHISTON, MERSEYSIDE" Data Type: Point Name: UNITED UTILITIES WATER PLC	Version Start Date: Version End Date:
1422	S	346700 387900	Status: Active Licence No: 2569028011 Details: Potable Water Supply - Direct Direct Source: Ground Water - North West Region Point: B/HOLES (2) AT WATER LA PUMPING STATION, WHISTON, MERSEYSIDE Data Type: Point Name: UNITED UTILITIES WATER LTD	Annual Volume (m³): 1.75e+006 Max Daily Volume (m³): 11400 Original Application No: - Original Start Date: 23/03/1966 Expiry Date: - Issue No: 101 Version Start Date: Version End Date:
1667	N	348100 391300	Status: Historical Licence No: 2569028008 Details: Potable Water Supply - Direct Direct Source: Ground Water - North West Region	Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: - Original Start Date: 16/03/1966 Expiry Date: - Issue No: 100

			Point: 2 WELLS + CONNECTING B/HOLES, CUMBER LA, WHISTON, MERSEYSIDE Data Type: Point Name: NORTH WEST WATER LTD	Version Start Date: Version End Date:
1846	SE	348200 387500	Status: Historical Licence No: 2569028009 Details: Potable Water Supply - Direct Direct Source: Ground Water - North West Region Point: "BOREHOLES (3) AT STOCKSWELL PUMPING STATION, WHISTON" Data Type: Point Name: UNITED UTILITIES WATER PLC	Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: - Original Start Date: 23/03/1966 Expiry Date: - Issue No: 101 Version Start Date: Version End Date:
1846	SE	348200 387500	Status: Active Licence No: 2569028009 Details: Potable Water Supply - Direct Direct Source: Ground Water - North West Region Point: BOREHOLES (3) AT STOCKSWELL	Annual Volume (m³): 3.36e+006 Max Daily Volume (m³): 10900 Original Application No: - Original Start Date: 23/03/1966 Expiry Date: - Issue No: 101

			PUMPING STATION, WHISTON	Version Start Date:
			Data Type: Point	Version End Date:
			Name: UNITED UTILITIES WATER LTD	

Groundwater Abstractions

12.4.21 The groundwater abstractions located within 2 km of the site are shown in Table 12.6.

Table 12.6. Groundwater Abstractions

Distance (m)	Direction	NGR	Details	
1035	NE	348550	Status: Historical	Annual Volume (m³): -
		390340	Licence No: 2569028021 Details: "Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services" Direct Source: Ground Water - North West Region Point: "B/HOLE AT BLUNDELLS HILL GOLF CLUB, BLUNDELLS LANE, RAINHILL" Data Type: Point Name: BLUNDELLS HILL GOLF CLUB LTD	Max Daily Volume (m³): - Original Application No: - Original Start Date: 06/09/1994 Expiry Date: - Issue No: 101 Version Start Date: 19/02/2001 Version End Date:
1035	NE	348550	Status: Historical	Annual Volume (m³): -
		390340	Licence No: 2569028021	Max Daily Volume (m³): -

			Details: Spray Irrigation - Direct Direct Source: Ground Water - North West Region Point: "B/HOLE AT BLUNDELLS HILL GOLF CLUB, BLUNDELLS LANE, RAINHILL" Data Type: Point Name: BLUNDELLS HILL GOLF CLUB LTD	Original Application No: - Original Start Date: 06/09/1994 Expiry Date: - Issue No: 101 Version Start Date: 19/02/2001 Version End Date:
1035	NE	348550 390340	Status: Active Licence No: 2569028021 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Ground Water - North West Region Point: B/HOLE AT BLUNDELLS HILL GOLF CLUB, BLUNDELLS LANE, RAINHILL Data Type: Point Name: BLUNDELLS HILL GOLF CLUB LTD	Annual Volume (m³): 21966.9 Max Daily Volume (m³): 191.81 Original Application No: - Original Start Date: 06/09/1994 Expiry Date: - Issue No: 102 Version Start Date: 11/02/2007 Version End Date:

1035	NE	348550	Status: Active	Annual Volume (m³): 21966.9
		390340	Licence No: 2569028021 Details: Spray Irrigation - Direct Direct Source: Ground Water - North West Region Point: B/HOLE AT BLUNDELLS HILL GOLF CLUB, BLUNDELLS LANE, RAINHILL Data Type: Point Name: BLUNDELLS HILL GOLF CLUB LTD	Max Daily Volume (m³): 191.81 Original Application No: - Original Start Date: 06/09/1994 Expiry Date: - Issue No: 102 Version Start Date: 11/02/2007 Version End Date:
1330	S	347880	Status: Historical	Annual Volume (m³): 34000
		387926	Licence No: 2569028024 Details: General Use Relating To Secondary Category (Medium Loss) Direct Source: Ground Water - North West Region Point: BOREHOLE AT ALDER LANE, CRONTON, WIDNES Data Type: Point Name: MORPHET	Max Daily Volume (m³): 108.97 Original Application No: - Original Start Date: 03/12/2002 Expiry Date: 31/03/2015 Issue No: 2 Version Start Date: 01/02/2007 Version End Date:
1330	S	347880	Status: Historical	Annual Volume (m³): 34000
		387926		

			Licence No: 2569028024 Details: Water Bottling Direct Source: Ground Water - North West Region Point: BOREHOLE AT ALDER LANE, CRONTON, WIDNES Data Type: Point Name: MORPHET	Max Daily Volume (m³): 108.97 Original Application No: - Original Start Date: 03/12/2002 Expiry Date: 31/03/2015 Issue No: 2 Version Start Date: 01/02/2007 Version End Date:
1330	S	347880 387926	Status: Active Licence No: 2569028024R01 Details: General Use Relating To Secondary Category (Medium Loss) Direct Source: Ground Water - North West Region Point: BOREHOLE AT ALDER LANE, CRONTON, WIDNES Data Type: Point Name: MORPHET	Annual Volume (m³): 34000 Max Daily Volume (m³): 110 Original Application No: - Original Start Date: 01/04/2015 Expiry Date: 31/03/2028 Issue No: 1 Version Start Date: 01/04/2015 Version End Date:
1330	S	347880 387926	Status: Active Licence No: 2569028024R01 Details: Water Bottling	Annual Volume (m³): 34000 Max Daily Volume (m³): 110

			Direct Source: Ground Water - North West Region Point: BOREHOLE AT ALDER LANE, CRONTON, WIDNES Data Type: Point Name: MORPHET	Original Application No: - Original Start Date: 01/04/2015 Expiry Date: 31/03/2028 Issue No: 1 Version Start Date: 01/04/2015 Version End Date:
1336	S	347880 387920	Status: Historical Licence No: 2569028024 Details: Water Bottling Direct Source: Ground Water - North West Region Point: BOREHOLE AT ALDER LANE, CRONTON, WIDNES Data Type: Point Name: MORPHET	Annual Volume (m³): 34000 Max Daily Volume (m³): 108.97 Original Application No: - Original Start Date: 03/12/2002 Expiry Date: 31/03/2015 Issue No: 2 Version Start Date: 01/02/2007 Version End Date:
1336	S	347880 387920	Status: Historical Licence No: 2569028024 Details: Water Bottling Direct Source: Ground Water - North West Region Point: "BOREHOLE AT ALDER LANE,	Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: - Original Start Date: 03/12/2002 Expiry Date: 31-Mar-15 Issue No: 1

			CRONTON, WIDNES" Data Type: Point Name: C S MORPHET & SONS LTD	Version Start Date: 03/12/2002 Version End Date:
1336	S	347880 387920	Status: Historical Licence No: 2569028024 Details: General Use Relating To Secondary Category (Medium Loss) Direct Source: Ground Water - North West Region Point: BOREHOLE AT ALDER LANE, CRONTON, WIDNES Data Type: Point Name: MORPHET	Annual Volume (m³): 34000 Max Daily Volume (m³): 108.97 Original Application No: - Original Start Date: 03/12/2002 Expiry Date: 31/03/2015 Issue No: 2 Version Start Date: 01/02/2007 Version End Date:
1336	S	347880 387920	Status: Historical Licence No: 2569028023 Details: General use relating to Secondary Category (Medium Loss) Direct Source: Ground Water - North West Region Point: BOREHOLE AT ALDER LANE, CRONTON,	Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: - Original Start Date: - Expiry Date: 31/03/2005 Issue No: 1 Version Start Date: 10/03/2000 Version End Date:

			WIDNES Data Type: Point Name: C S MORPHET & SONS LTD	
1336	S	347880 387920	Status: Historical Licence No: 2569028024 Details: General use relating to Secondary Category (Medium Loss) Direct Source: Ground Water - North West Region Point: "BOREHOLE AT ALDER LANE, CRONTON, WIDNES" Data Type: Point Name: C S MORPHET & SONS LTD	Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: - Original Start Date: 03/12/2002 Expiry Date: 31-Mar-15 Issue No: 1 Version Start Date: 03/12/2002 Version End Date:
1422	S	346700 387900	Status: Historical Licence No: 2569028011 Details: Potable Water Supply - Direct Direct Source: Ground Water - North West Region Point: "B/HOLES (2) AT WATER LA PUMPING	Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: - Original Start Date: 23/03/1966 Expiry Date: - Issue No: 101 Version Start Date: 01/09/2001 Version End Date:

			STATION, WHISTON, MERSEYSIDE"	
			Data Type: Point	
			Name: UNITED UTILITIES WATER PLC	
1422	S	346700	Status: Active	Annual Volume (m³): 1.75e+006
		387900	Licence No: 2569028011	Max Daily Volume (m³): 11400
			Details: Potable Water Supply - Direct	Original Application No: -
			Direct Source: Ground Water - North West	Original Start Date: 23/03/1966
			Region	Expiry Date: -
			Point: B/HOLES (2) AT WATER LA PUMPING	Issue No: 101
			STATION, WHISTON, MERSEYSIDE	Version Start Date: 01/09/2001
			Data Type: Point	Version End Date:
			Name: UNITED UTILITIES WATER LTD	
1667	N	348100	Status: Historical	Annual Volume (m³): -
		391300	Licence No: 2569028008	Max Daily Volume (m³): -
			Details: Potable Water Supply - Direct	Original Application No: -
			Direct Source: Ground Water - North West	Original Start Date: 16/03/1966
			Region	Expiry Date: -
			Point: 2 WELLS + CONNECTING B/HOLES,	Issue No: 100
				Version Start Date: 16/03/1966
				Version End Date:

			CUMBER LA, WHISTON, MERSEYSIDE Data Type: Point Name: NORTH WEST WATER LTD	
1765	N	348100 391400	Status: Historical Licence No: 2569028020 Details: Laundry Use Direct Source: Ground Water - North West Region Point: "BOREHOLE AT STONEY LANE, RAINHILL" Data Type: Point Name: THE SUNLIGHT SERVICES GROUP LTD	Annual Volume (m³): - Max Daily Volume (m³): - Original Application No: - Original Start Date: 01/06/1993 Expiry Date: - Issue No: 101 Version Start Date: 24/10/1996 Version End Date:
1765	N	348100 391400	Status: Active Licence No: 2569028020 Details: Laundry Use Direct Source: Ground Water - North West Region Point: BOREHOLE AT STONEY LANE, RAINHILL Data Type: Point Name: Berendsen UK Limited	Annual Volume (m³): 118182 Max Daily Volume (m³): 545.46 Original Application No: - Original Start Date: 01/06/1993 Expiry Date: - Issue No: 102 Version Start Date: 22/07/2013 Version End Date:

1846	SE	348200	Status: Historical	Annual Volume (m³): -
		387500	Licence No: 2569028009 Details: Potable Water Supply - Direct Direct Source: Ground Water - North West Region Point: "BOREHOLES (3) AT STOCKSWELL PUMPING STATION, WHISTON" Data Type: Point Name: UNITED UTILITIES WATER PLC	Max Daily Volume (m³): - Original Application No: - Original Start Date: 23/03/1966 Expiry Date: - Issue No: 101 Version Start Date: 01/09/2002 Version End Date:
1846	SE	348200	Status: Active	Annual Volume (m³): 3.36e+006
		387500	Licence No: 2569028009 Details: Potable Water Supply - Direct Direct Source: Ground Water - North West Region Point: BOREHOLES (3) AT STOCKSWELL PUMPING STATION, WHISTON Data Type: Point Name: UNITED UTILITIES WATER LTD	Max Daily Volume (m³): 10900 Original Application No: - Original Start Date: 23/03/1966 Expiry Date: - Issue No: 101 Version Start Date: 01/09/2002 Version End Date:

12.4.22

Flooding

- 12.4.23 An FRA (Appendix 12.1) has been carried out for the Proposed Development in accordance with guidance contained within the NPPF and associated Planning Practice Guidance. The FRA identifies and assesses the risks of all forms of flooding to and from the Proposed Development and demonstrates how these flood risks would be managed so that the Proposed Development remains safe throughout its lifetime, taking climate change into account.
- 12.4.24 The majority of the site is located within Flood Zone 1 and therefore has a 'low probability' of fluvial flooding, with less than a 1 in 1000 annual probability (<0.1%). However, a small proportion of the site, to the south east, is located within Flood Zone 2 and 3 and therefore has a 'medium to high' probability of fluvial flooding, with a greater than 1 in 1000 annual probability of river flooding (1% - 0.1%), to a 1 in 100 or greater annual probability of river flooding (>1%) in any year.
- 12.4.25 The Environment Agency has confirmed the following: *"Flood Zones 2 & 3 associated with Foxes Bank Brook through the old Cronton Colliery site do appear somewhat misaligned with the watercourse in certain places and probably stems from the first generation of national Flood Map modelling undertaken nearly 20-years ago. Because of the limited amount of local development pressures since that time and the fact that there aren't any existing properties (houses) located within the flood outlines, the justification to carry out an updated (and more accurate) modelling study hasn't existed."*
- 12.4.26 The Knowsley Metropolitan Borough Council SFRA states: *"A visual inspection indicates that they may not match the true nature of flooding in this location and as such are suspect. In addition, it is not possible to quantify the flood risk from the other watercourses / drains on site."*
- 12.4.27 The existing flood map in this location is based on coarse resolution JFLOW modelling, as such the flood outlines do not align to the watercourses in the area and does not match the true nature of flooding posed to the site as agreed by both the Environment Agency and the Knowsley Metropolitan Borough Council SFRA. Therefore, a detailed 1D/2D linked hydraulic model of the Fox's Bank Brook has been developed to confirm the flood risk posed to the site and to inform the FRA. A river channel survey has been undertaken to inform the channel geometry of the hydraulic model.
- 12.4.28 Fox's Bank Brook is a small watercourse in in scale, the channel is approximately 2m wide and approximately 0.50m in depth. The channel is approximately 3.00m below the existing ground levels of the site, a maximum 'normal' water level of between 25.40mAOD and 25.80mAOD has been recorded.
- 12.4.29 The likelihood of the Fox's Bank Brook rising over 3.00m and inundating the site is very minimal. The site has no history of flooding and has not flooded during the largest flood events. The water levels of the Fox's Bank Brook would have to rise from 25.80mAOD to 29.00AOD for the site to be inundated with floodwater, which is very unlikely.
- 12.4.30 The preliminary outputs from the detailed hydraulic model of the Fox's Bank Brook show that the majority of the site will not be inundated with floodwater for all events up to and including the 1 in 1000 year event. The actual flood risk posed to the site, compared to the Environment

Agency's Flood Zones, is much less the majority of flows will be contained within the channel of Fox's Bank Brook for all events up to and including the 1 in 1000 year event.

12.4.31 There is a small area of inundation to the south of the site, where ground levels are lower. However, the large area of the site, to the south east, which is shown to be located within the Environment Agency's Flood Zone 3 will not be inundated with floodwater during the 1 in 1000 year event and should be considered as being located within Flood Zone 1 (see Drawing T/18/2126/3). The area of the proposed country park and attenuation lagoons is not located within Flood Zones 2/3 and should be designated as Flood Zone 1.

12.4.32 The likelihood of a rapid river level rise and possible rapid inundation of areas posing a risk to life is considered to be minimal. The site is located within a low risk area where the onset of flooding is gradual as per Flood Risk Assessment Guidance for New Development Phase 2, R&D Technical Report FD2320/TR2. The speed of inundation and rate of floodwater rise would be low.

12.4.33 Any overbank flow would follow the contours of the surrounding area and would flow directly to the west rather than flowing towards the site.

12.4.34 The flood risk can also be considered to be limited due to the difference in elevations. The ground levels of the site are located a minimum of 3.00m above the normal water level of the Fox's Bank Brook. The flood risk would be confined to the river channel and areas immediately adjacent.

12.4.35 Given the scale and nature of the proposed development and the size and location of the fluvial flooding sources it has been concluded that fluvial flooding poses a low flood risk to the site therefore, the risk of fluvial flooding is considered to be not significant.

12.4.36 The FRA concludes that given the scale and nature of the proposed development and the size and location of the fluvial flooding sources it has been concluded that fluvial flooding poses a low flood risk to the site therefore, the risk of fluvial flooding is considered to be of low significance. A secondary flooding source has been identified which may pose a low risk to the site. This is:

- Surface Water (pluvial) Flooding

12.4.37 The risk of flooding from all sources is considered to be low or not significant. The flooding sources will only inundate the site to a relatively low water depth and water velocity, will only last a short period of time, in very extreme cases and will not have an impact on the whole of the proposed development site.

12.4.38 The proposed development is classified as 'less vulnerable', 'less vulnerable' uses are appropriate within Flood Zones 1, 2 and 3 after the completion of a satisfactory FRA. The proposed warehousing units will be located within Flood Zone 1 and the area of the proposed country park and attenuation lagoons is not located within Flood Zones 2/3 and should be designated as Flood Zone 1. Therefore, there will be no loss of floodplain storage capacity and the proposed development will have no impact on the movement of water.

- 12.4.39 There will be no detriment to the flood storage capacity of the site. The overall direction of the movement of water will be maintained within the developed site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed. The proposed development will have no impact on the movement of floodwater across the site. There will be no increase in the floodwater levels due to the proposed development. There will be no loss in flood storage capacity and no change in the on-site and off-site flood risk.
- 12.4.40 The flood risk at the site, will be further managed and mitigated by using a number of risk management techniques, and mitigation strategies to manage and reduce the overall flood risk at the site. The application is for a new, suitable flood-resilient design. The exposure of people and property will be reduced and minimised compared to existing site conditions. The chance of flooding each year is low each year. This takes into account the effect of any flood defences that may be located within the vicinity of the site as well property level protection measures.

Environmentally Sensitive Sites

- 12.4.41 The site is located within a nitrate sensitive area.
- 12.4.42 The only identified environmentally sensitive site in the vicinity of the proposed redevelopment is ancient woodland (The Old Wood) located adjacent to the western site boundary.

Recreation and Fisheries

- 12.4.43 There are designated fishery waterbodies and / or watercourses used for recreation within 2 km of the site with Halsnead Park to the north of the site.

Sensitive Receptors

- 12.4.44 Based on the baseline conditions presented above, Table 12.7 presents the sensitive receptors which have been considered in the following assessment, along with their sensitivity to change which is based on the general criteria outlined below.

Table 12.7 Sensitive Receptors

Receptor	Medium	Sensitivity	Description
Flood Risk (all sources including river, surface water, groundwater, etc.)	Construction workers	Medium	Flooding may impact upon construction workers, but their sensitivity is lowered as a result of their competency in their role as well as operating in teams and/or prescribed systems.

	Residents/users of the surrounding area	Medium	Residents/users of the surrounding areas generally have no awareness of flood risk and residents vulnerability is high given their presence overnight (via sleeping accommodation)
	Future site occupants (staff and public)	Medium	The vulnerability is reduced as all buildings are located within Flood Zone 1 and above the design flood level.
Watercourses	Water quantity/ quality/ supply	Medium	This would only be felt over short distance of the watercourses compared to the overall length of the watercourses. Water quality issues would also be diluted rapidly within the watercourses.

12.4.45 Users of the country park are not considered as a sensitive receptor as amenity open space and nature conservation areas are defined as water compatible development in the National Planning Practice Guidance.

12.5 Embedded Mitigation

Drainage Strategy

- 12.5.1 Increasing the area of impermeable surface has the potential to increase surface water runoff rates and volumes. An increase in impermeable area across the Site could result in increased rates and volume of runoff that would not otherwise occur. A Surface Water Drainage Strategy is proposed as part of the Proposed Development, details of which are contained in Appendix 12.2. It is proposed the surface water for the development will discharge into Fox's Bank Brook at Greenfield runoff rates for all events up to and including the 1 in 100 year (+40%) events.
- 12.5.2 The Surface Water Drainage Strategy ensures that a sustainable drainage solution can be achieved, which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the Site as well as providing water quality benefits.
- 12.5.3 There is limited space within the proposed site layout for the attenuation storage, the limited space has been maximised as much as possible.
- 12.5.4 As a consequence of limiting the rate of discharge from the site, at times of heavy rainfall the volume of water leaving the site will be significantly less than that draining from it. In order to prevent this water backing up in the system and causing flooding, linked attenuation lagoons will be incorporated into the country park to provide the necessary attenuation storage. The size of this attenuation storage has been calculated such that the overall proposed development has the capacity to accommodate the 100 year rainfall event including a 40% increase in rainfall intensity that is predicted to occur as a result of climate change.
- 12.5.5 The remainder of the site that is not formally drained, i.e. landscaped areas, will be permeable (grass). The majority of rainwater falling on these areas will soak into the ground. Surface water

runoff would be directed to the drainage system through drainage gullies located around the perimeter of the buildings and through contouring of the hardstanding areas.

- 12.5.6 These methods will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for this site. These preliminary considerations are based on the outline development scheme provided and hence the design purposes. The adoption of a Surface Water Drainage Strategy for the site represents an enhancement from the current conditions as the current surface water runoff from the site is uncontrolled, untreated, unmanaged and unmitigated. In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

12.6 Potential Effects

- 12.6.1 This section sets out the potential effects of the development on the basis of the assessment parameters plans and assumes the inclusion of embedded mitigation as set out in the preceding section.

Demolition and Construction

- 12.6.2 Potential effects that may arise during the construction phase of the Proposed Development are outlined below.

Impact on Flood Risk - Construction Workers

- 12.6.3 The surface water drainage regime may be altered during this stage, as a result of new groundworks. The rate of runoff may potentially be altered as a result of new ground levels. It is expected that if there is groundwater encountered, it is likely to be in limited shallow quantities. Therefore, ground works and excavations are unlikely to affect groundwater and associated potential flooding. Other potential sources of flooding (e.g. artificial and sewer) have also been investigated and no significant issues have been identified.
- 12.6.4 Parts of the Site have been identified as being at risk of flooding from fluvial flooding. Any alteration of ground levels or obstructions placed within areas considered to be at risk of flooding during construction therefore has the potential to increase flood risk to the Site and elsewhere. Additionally, on and off-site flood risk may increase due to increased runoff due to soil compaction on-site.
- 12.6.5 The sensitivity of construction workers to the risk of flooding is considered medium. This is due to their presence on Site only during working hours, their awareness and training.
- 12.6.6 The probability of this occurring is unlikely, the extent is likely to be short, on a temporary basis and is likely to be reversible. The magnitude of impact is medium and therefore, without mitigation the increase in flood risk during construction is considered to have a **minor adverse** effect.

Impact on Flood Risk - Residents/Users of the Surrounding Area

- 12.6.7 The residents of the surrounding area may sleep in the area and lack the knowledge and understanding of the activities undertaken at the Site during construction works. However, there are very few residential properties or other properties within close vicinity of the site that could be affected by flooding.
- 12.6.8 The rate of surface water runoff may be altered as a result of amended ground levels. Without the management of surface water runoff, there could be surface water flooding conveyed to the surrounding areas. A temporary increase in impermeable area across the Site could result in increased rates and volume of runoff that would not otherwise occur. However, any effect off Site would be mitigated by the distance therefore the sensitivity to the risk of flooding is considered medium.
- 12.6.9 The probability of this occurring is unlikely, the extent is likely to be short, on a temporary basis and is likely to be reversible. The magnitude of impact is low and therefore, without mitigation measures the increase in flood risk during construction is considered to have a **minor adverse** effect.

Watercourses – water quantity/quality/supply

- 12.6.10 The water environment and the flora and fauna that it supports may be adversely affected by excessive levels of fine sediment contained within surface water runoff originating from construction activities associated with the Proposed Development. Furthermore, the construction activities would involve the excavation and movement of soil / ground at the Site and therefore increase the potential for leaching of pollutants into surface water receptors.
- 12.6.11 Runoff laden with fine sediment is principally generated by rain falling onto land that has been cleared of any vegetation and the ground potentially compacted, preventing infiltration. Other potential sources of water containing high levels of fine sediment at the Site include runoff from material stockpiles, dewatering of excavations, mud on site and local access roads, and generated as part of the construction works themselves (e.g. vehicle washing).
- 12.6.12 Generally, excessive fine sediment in runoff is chemically inert and affects the water environment through smothering of riverbeds and plants, changing water quality (e.g. increased turbidity); consequently it can have physical impacts on aquatic organisms. However, at this Site, where much of the ground within the main Proposed Development area comprises manufactured topsoil, there is also the potential for fine sediments to impact the chemical status of water bodies.
- 12.6.13 Without mitigation in place the watercourses would be susceptible to sediment laden water affecting water quality. Suspended fine sediment has the potential effect fisheries and cause a measurable decrease in ecological and chemical quality on the nearby watercourses, although this would only be felt over short distance of the watercourses compared to the overall length of the watercourses. Suspended fine sediment would also be diluted rapidly within the watercourses.

12.6.14 A number of potentially polluting materials may be used during the construction phase. These include oils, diesels, fuels, hydraulic fluids, cement / concrete, heavy metals / metalloids, bentonite, solvent / paints and flocculants etc. The accidental spillage of these may result in the contamination of surface water or groundwater.

12.6.15 The sensitivity of the receiving watercourses is medium. The probability of this occurring is likely, the extent is likely to be short, on a temporary basis and is likely to be reversible. The magnitude of impact is medium and therefore, without mitigation measures the increase in flood risk during construction is considered to have a **minor adverse** effect.

Operational Development

12.6.16 Potential effects that may arise during the operational phase of the Proposed Development are outlined below.

Impact on Flood Risk - Future site occupants (staff and public)

12.6.17 The surface water drainage regime may be altered during this stage, as a result of new groundworks. The rate of runoff may potentially be altered as a result of new ground levels.

12.6.18 Parts of the Site have been identified as being at risk of flooding from fluvial flooding. Any alteration of ground levels or obstructions placed within areas considered to be at risk of flooding during operation therefore has the potential to increase flood risk to the Site and elsewhere. Additionally, on and off-site flood risk may increase due to increased runoff due to an increase in impermeable areas.

12.6.19 However, the majority of the site is located within Flood Zone 1, with the warehouse units being located within Flood Zone 1 and a Surface Water Drainage Strategy has been developed to manage the surface water runoff.

12.6.20 The sensitivity of occupants to the risk of flooding is considered low. This is due to their presence on Site only during working hours, their awareness and training.

12.6.21 The probability of this occurring is unlikely, the extent is likely to be short, on a temporary basis and is likely to be reversible. The magnitude of impact is medium and therefore, without mitigation the increase in flood risk during construction is considered to have a **negligible** effect.

Impact on Flood Risk - Residents/Users of the Surrounding Area

12.6.22 The residents of the surrounding area may sleep in the area and lack the knowledge and understanding of the activities undertaken at the Site during operation of the Site. However, there are few residential properties or other properties within close vicinity of the site.

12.6.23 The rate of surface water runoff may be altered as a result of amended ground levels. Without the management of surface water runoff, there could be surface water flooding conveyed to the surrounding areas. An increase in impermeable area across the Site could result in increased rates and volume of runoff that would not otherwise occur. However, any effect off the Site

would be mitigated by the distance therefore the sensitivity to the risk of flooding is considered medium.

12.6.24 The incorporated mitigation measures noted above include those appropriate for climate change predictions.

12.6.25 The probability of this occurring is unlikely, the extent is likely to be short, on a temporary basis and is likely to be reversible. The magnitude of impact is low and therefore, without mitigation measures the increase in flood risk during construction is considered to have a **negligible** effect.

Watercourses – water quantity/quality/supply

12.6.26 A number of potentially polluting materials may be used during the operation of the Proposed Development. These include oils and hydraulic fluids. The accidental spillage of these may result in the contamination of surface water and groundwater.

12.6.27 Other potential sources of pollution include oils and fuels from vehicles operating within the Site and also potential increases in suspended sediment loads from runoff from roads and hardstanding areas. The surface water drainage system will include petrol / oil interceptors and potentially proprietary treatment devices that would capture and retain sediment, oils and floatables from stormwater runoff.

12.6.28 Chemical spillages and suspended fine sediment have the potential effect fisheries and cause a measurable decrease in ecological and chemical quality on the nearby watercourses, although this would only be felt over short distance of the watercourses compared to the overall length of the watercourses. Chemical spillages and suspended fine sediment would be diluted rapidly within the watercourses.

12.6.29 The sensitivity of the receiving watercourses is medium. The probability of this occurring is likely, the extent is likely to be short, on a temporary basis and is likely to be reversible. The magnitude of impact is medium and therefore, without mitigation measures the increase in flood risk during construction is considered to have a **minor adverse** effect.

12.7 Mitigation

12.7.1 This section describes the measures which are proposed to mitigate any significant environmental effects. It is anticipated that the delivery of these measures will be secured by way of appropriate planning conditions or obligations.

Demolition and Construction

Flood Risk

12.7.2 The flood risk posed to the Site would be reduced by using the following mitigation measures:

- Flood Warning - The site will participate in the Environment Agency flood warning telephone service. The site will register contact details with the Environment Agency' Flood Warning Service (Floodline 0345 988 1188) in order to receive Flood Alerts.
- Flood Plan - A Flood Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed. Sensible precautions would include raising electrical items, irreplaceable items and sentimental items off the ground or where possible moving them to a higher floor, rolling up carpets and turning off utilities. In addition, consider what actions you would take should the property need to be evacuated including access and egress routes and preparing a flood kit in advance containing warm clothing, medication, a torch, food and wellingtons.
- Safe Access and Egress Routes - Safe access and egress routes, including emergency access can be maintained for vehicles and/or by foot can be maintained. The likelihood of a rapid river level rise and possible rapid inundation of urban areas posing a risk to life is considered to be minimal. The site is located within a low risk area where the onset of flooding is very gradual (many hours) as per Flood Risk Assessment Guidance for New Development Phase 2, R&D Technical Report FD2320/TR2. The speed of inundation and rate of floodwater rise would be low. Therefore, safe access and egress can be maintained in accordance with the NPPF and Environment Agency Guidance. People should make their way to areas outside of the flood zone. In the event of a Flood Warning, vital belongings, including waterproof clothing, necessary medication and essentials will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site. Facilities such as community centres, shops etc. are located within the vicinity of the site which may be used in the event of a flood event. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site.

Watercourses

12.7.3 The design and implementation of the construction works will be undertaken in accordance with ISO 14001 and industry and regulatory procedures. As such, it is envisaged that the following documents will be prepared and, where appropriate, agreed with the regulatory bodies:

- Construction Environmental Management Plan (CEMP);
- Site Drainage Plan;
- Incidence Response Plan (IRP);
- Environmental training for personnel;
- Record keeping; and,
- The identification, mitigation and remediation of contaminated land.

12.7.4 The management of runoff during construction would be included in the CEMP. In summary, withdrawn Pollution Prevention Guidance¹ (PPG), Environment Agency guidance² and CIRIA guidance³ states that the following methods of surface water management should be put in place during the construction phase to ensure pollution, sediment and erosion control.

12.7.5 Mitigation measures will be included within the CEMP, a Site Drainage Plan and as part of the Incident Response Plan. Mitigation will include:

- 8m working standoff from the watercourses/ditches to be retained (excluding works drainage works and the construction of the attenuation ponds);
- Bunds will be used to prevent run-off entering watercourses;
- Compounds will have hard surfacing to prevent infiltration;
- Areas of localised contamination identified during the ground investigation will be remediated/ removed as appropriate;
- A procedure will be put in place to manage previously unidentified contaminated ground that is encountered during the works; and,
- Any surplus soil arisings from levelling or excavation works that has visual or olfactory evidence of contamination will be stored in sheeted stockpiles placed on hardstanding or sheeting pending its removal or treatment.

12.7.6 There is potential for the introduction of contaminated materials to the ground or groundwater due to incorrect storage or spillages of construction materials/fuels. Design of operational pollution prevention measures will be included in the Construction Environmental Management Plan. Impacts due to incorrect storage and spillage will be mitigated by the following:

- Design of a Drainage Plan for the site;
- Compounds will comprise hardstanding;
- Environmental training for all personnel;
- Designated re-fuelling areas on hardstanding with interceptor drainage, bunds, plant nappies or similar;
- Spill kits will be readily available;
- Storage areas for materials will be identified; and,

¹ Pollution Prevention Guidelines PPG1: Understanding Your Environmental Responsibilities (July 2013).

Guidance for Pollution Prevention GPP2: Above ground oil storage tanks (January 2018).

Guidance for Pollution Prevention GPP5: Works and maintenance in or near water (January 2017).

Pollution Prevention Guidelines PPG6: Working at construction and demolition sites (March 2012).

Pollution Prevention Guidelines PPG7: The safe operation of refuelling facilities (July 2011).

Guidance for Pollution Prevention GPP8: Safe storage and disposal of used oils (July 2017).

Guidance for Pollution Prevention GPP13: Vehicle washing and cleaning (April 2017).

Guidance for Pollution Prevention GPP21: Incident Response Planning (July 2017).

Guidance for Pollution Prevention GPP22: Dealing with spills (October 2018).

Guidance for Pollution Prevention GPP23: Safe storage - drums and intermediate bulk containers (February 2019).

² Environment Agency Guidance 'Oil storage regulations for businesses' (2015).

Environment Agency Guidance 'Manage water on land: guidance for land managers' (2015).

³ CIRIA C502 Environmental Good Practice on Site.

CIRIA C532 Control of Water Pollution from Construction Sites.

CIRIA C753 The SuDS Manual.

- Deliveries will be planned in advance.

Excavated ground and exposed ground

- 12.7.7 To limit the volume of runoff reaching the exposed ground, runoff diversion or interception devices can be placed upstream. To help prevent pollution from entering a watercourse, silt fences, hay bales or stilling ponds can be placed downstream.
- 12.7.8 The extent of all excavations would be minimised as far as is reasonably practicable. During construction activities, surface water flows would be captured through a series of cut-off drains to prevent water entering excavations or eroding exposed surfaces. If dewatering of excavations is required, pumped discharges would be passed through a washout area, settlement/attenuation ponds and silt fences to capture sediments before release to a watercourse/ drain.

Stockpiles

- 12.7.9 Stockpiles will be located away from a watercourse or site drainage system to prevent leaching of contaminants. Protective coverings will help prevent runoff stripping a stockpile. Concrete should also be stored to prevent release into drains.
- 12.7.10 Topsoil / subsoil would be stored away from watercourses and on flat lying land (minimum 20m on flat land). Where this is not possible and it is to be stockpiled for longer than a two week period, the material would, as soon as possible either be covered with geotextile mats, seeded to promote vegetation growth, or drainage provided to a suitable settlement area.

Plant and wheel washing

- 12.7.11 Plant wheel washing will take place in designated locations. The area will be tanked and will not be allowed to discharge into a watercourse or infiltrate to groundwater. Some proprietary vehicle washing systems offer a recycling facility, which filter and settle solids, with effluent being pumped back into the system. The solid waste materials from this process need to be treated as contaminated waste due to the high hydrocarbon content.
- 12.7.12 Mud deposits would be controlled at entry and exits to the Site using wheel washing facilities and / or road sweepers operating during earthworks or other times as considered necessary.
- 12.7.13 Tools and plant would be washed out and cleaned in designated areas within the Site compound where runoff can be isolated for treatment before discharge to surface water drainage under appropriate consent and / or agreement with the Environment Agency and / or the LLFA, or otherwise removed from site for appropriate disposal at a licenced waste management facility.

Haul roads

- 12.7.14 Haul roads will be designed so that the length is kept to a minimum, but still serves its purpose. The gradient will be shallow to prevent increasing runoff velocity and, if possible, bunds and / or discrete ditches constructed to intercept the runoff. Haul roads will be sprayed regularly to

keep down dust. If any section of a haul road is hard surfaced, then it will be swept on a regular basis to prevent accumulation of dust and mud. Gullies will be covered when not in use before the final bituminous running surface is laid.

12.7.15 The movement of construction traffic (to / from and between main construction areas) would be controlled via defined tracks and hardstanding areas.

Oils and hydrocarbons

12.7.16 Simple measures can be taken to prevent oil and hydrocarbons becoming pollutants, such as:

- Maintenance of machinery and plant
- Drip trays
- Regular checking of machinery and plant for oil leaks
- Correct storage facilities
- Check for signs of wear and tear on tanks
- Care with specific procedures when refuelling
- Designated areas for refuelling
- Emergency spill kit located near refuelling area
- Regular emptying of bunds
- Tanks located in secure areas to stop vandalism

12.7.17 In accordance with the Environment Agency PPGs, all fuel tanks on-Site will have a bunded containment of a minimum of 110% fuel tank capacity. There would be no drainage point from the bunded catchment area and tamperproof taps / valves would be installed. All empty fuel containers or drums would be stored within a catchment area prior to their removal from the Site. Oil traps would be incorporated in pertinent drainage systems to prevent accidental spillage being discharged into the surface runoff. Furthermore, spill kits would be stored at refuelling areas in the event of accidental spillage.

12.7.18 Best practice measures would be undertaken when refuelling plant and machinery. Where fuelling of large machinery is required, drip trays and absorbent mats or pellets would be utilised. General maintenance would also be undertaken in a designated area and similar contamination prevention measures would be adopted.

12.7.19 All runoff from the Site would be intercepted and treated to remove sediment, oils and other substances prior to discharge. As construction of the Proposed Development progresses the drainage system would be progressively implemented and would also include pollution prevention control systems.

Watercourses / drainage channels

12.7.20 The gradient of any constructed drainage channels needs to be carefully considered. If the gradient is made too flat, then the channel is likely to silt up and reduce the flow capacity of the

channel and prevent sediment travelling downstream. Alternatively, if the gradient is made too steep, this can increase erosion of the ditch banks which would result in an increase in the quantity of sediments which migrate downstream.

12.7.21 The Fox's Bank Brook would be monitored throughout the construction period to identify any enhanced scouring of the catchment surface. If sediment from disturbed ground was found to be excessively mobilised through the minor channels network, this would be mitigated by temporary sediment control measures (e.g. geotextiles/straw bales).

Operational Development

Flood Risk

12.7.22 The flood risk posed to the Site would be reduced by using the following mitigation measures:

- Minimum Floor Level - There is no minimum finished floor level proposed as a result of flooding. However, the minimum finished floor level will be 29.50mAOD, which would be well above any flood levels. The ground levels of the site are located a minimum of 3.00m above the normal water level of the Fox's Bank Brook. Furthermore, it is recommended that generally all buildings are located above the highways by 150mm to enable the full capacity of any secondary flood conveyance to be utilised.
- Flood Resilience and Resistance - To make the buildings more resistant to seepage the following measures will be incorporated. Sealant will be used around external doors and windows. All external doors and windows will be constructed from durable materials and the walls of the buildings will be thick. To improve the buildings resilience to flooding the following measures will be incorporated. All electrics wiring, switches, sockets, socket outlets etc. to be located a minimum of 450mm above the finished floor levels.
- Flood Warning - The site will participate in the Environment Agency flood warning telephone service. The site will register contact details with the Environment Agency' Flood Warning Service (Floodline 0345 988 1188) in order to receive Flood Alerts.
- Flood Plan - A Flood Plan outlining the precautions and actions you should take when a flood event is anticipated to help reduce the impact and damage flooding may cause will be developed. Sensible precautions would include raising electrical items, irreplaceable items and sentimental items off the ground or where possible moving them to a higher floor, rolling up carpets and turning off utilities. In addition, consider what actions you would take should the property need to be evacuated including access and egress routes and preparing a flood kit in advance containing warm clothing, medication, a torch, food and wellingtons.
- Safe Access and Egress Routes - Safe access and egress routes, including emergency access can be maintained for vehicles and/or by foot can be maintained. The likelihood of a rapid river level rise and possible rapid inundation of urban areas posing a risk to life is considered to be minimal. The site is located within a low risk area where the onset of

flooding is very gradual (many hours) as per Flood Risk Assessment Guidance for New Development Phase 2, R&D Technical Report FD2320/TR2. The speed of inundation and rate of floodwater rise would be low. Therefore, safe access and egress can be maintained in accordance with the NPPF and Environment Agency Guidance. People should make their way to areas outside of the flood zone. In the event of a Flood Warning, vital belongings, including waterproof clothing, necessary medication and essentials will be collected. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site. Facilities such as community centres, shops etc. are located within the vicinity of the site which may be used in the event of a flood event. It should be ensured that all occupiers and visitors to the site are accounted for, and then exit the site.

12.7.23 Storage and handling of fuels and oils at the Site would comply with the Environment Agency PPGs, Environment Agency guidance and CIRIA guidance. Standard pollution prevention procedures to mitigate the risks to surface water quality would be implemented throughout operation of the Proposed Development. Examples of some of the measures that would be adopted at the Site are: bunded fuel storage; provision of spill kits etc.; and minimising the amount of exposed ground.

12.7.24 In accordance with the Environment Agency PPGs, all fuel tanks on-site shall have a bunded containment of a minimum of 110% fuel tank capacity. There would be no drainage point from the bunded catchment area and tamperproof taps / valves would be installed. All empty fuel containers or drums would be stored within a catchment area prior to their removal from the Site. Oil traps would be incorporated in pertinent drainage systems to prevent accidental spillage being discharged into the surface runoff. Furthermore, spill kits would be stored at refuelling areas in the event of accidental spillage.

12.7.25 Best practice measures would be undertaken when refuelling plant and machinery. Where fuelling of large machinery is required, drip trays and absorbent mats or pellets would be utilised. General maintenance would also be undertaken in a designated area and similar contamination prevention measures would be adopted.

12.8 Residual Effects

12.8.1 This section summarises the significance of the anticipated residual environmental effects, which are those that remain after all proposed mitigation measures are implemented.

Demolition and Construction

Impact on Flood Risk - Construction Workers

12.8.2 The implementation of the mitigation measures will result in a **negligible** effect and **no significant** residual effect.

Impact on Flood Risk - Residents/Users of the Surrounding Area

12.8.3 The implementation of the mitigation measures will result in a **negligible** effect and **no significant** residual effect.

Watercourses – water quantity/quality/supply

12.8.4 The implementation of the mitigation measures will result in a **negligible** effect and **no significant** residual effect.

Operational Phase

Impact on Flood Risk - Construction Workers

12.8.5 The implementation of the mitigation measures will result in a **negligible** effect and **no significant** residual effect.

Impact on Flood Risk - Residents/Users of the Surrounding Area

12.8.6 The implementation of the mitigation measures will result in a **negligible** effect and **no significant** residual effect.

Watercourses – water quantity/quality/supply

12.8.7 The implementation of the mitigation measures will result in a **negligible** effect and **no significant** residual effect.

12.8.8 The residual effects are summarised below in Table 12.8 below.

Table 12.8: Summary of Residual Effects

Potential Effect	Significance	Mitigation	Residual Effect
<i>Construction and Demolition</i>			
Impact on Flood Risk - Construction Workers	Minor Adverse	CEMP, Site Drainage Plan, IRP	Negligible
Impact on Flood Risk - Residents/Users of the Surrounding Area	Minor Adverse	CEMP, Site Drainage Plan, IRP	Negligible
Watercourses – water quantity/quality/supply	Minor Adverse	CEMP, Site Drainage Plan, IRP	Negligible
<i>Completed Development</i>			
Impact on Flood Risk - Future site occupants (staff and public)	Negligible	Finished Floor Levels, Surface Water Drainage Strategy	Negligible

Impact on Flood Risk - Residents/Users of the Surrounding Area	Negligible	Surface Water Drainage Strategy	Negligible
Watercourses – water quantity/quality/supply	Minor Adverse	Surface Water Drainage Strategy	Negligible

12.9 Summary

- 12.9.1 This impact assessment has considered the potential adverse impacts on the waterbodies at or near the Site from the Proposed Development. The principal risks during construction are considered to be the risk from excess fine sediment, hydrocarbons, chemicals polluting waterbodies and increase in surface water runoff volumes. This could be exacerbated by the extensive earthworks that would be required at the Site.
- 12.9.2 An FRA (Appendix 12.1) has been prepared to inform this Chapter of the ES the Proposed Development.
- 12.9.3 The existing flood map in this location is based on coarse resolution JFLOW modelling, as such the flood outlines do not align to the watercourses in the area and does not match the true nature of flooding posed to the site as agreed by both the Environment Agency and the Knowsley Metropolitan Borough Council SFRA. Therefore, a detailed 1D/2D linked hydraulic model of the Fox's Bank Brook has been developed to confirm the flood risk posed to the site and to inform the FRA. A river channel survey has been undertaken to inform the channel geometry of the hydraulic model.
- 12.9.4 A Surface Water Drainage Strategy is proposed as part of the Proposed Development, details of which are contained in Appendix 12.2.
- 12.9.5 The Surface Water Drainage Strategy ensures that a sustainable drainage solution can be achieved, which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the Site as well as providing water quality benefits.
- 12.9.6 There is limited space within the proposed site layout for the attenuation storage, the limited space has been maximised as much as possible. It is proposed the surface water for the development will discharge into Fox's Bank Brook at Greenfield runoff rates for all events up to and including the 1 in 100 year (+40%) events.
- 12.9.7 A range of pollution prevention and mitigation measures have been described that if implemented would adequately manage the flood risk and water quality/quantity during construction. The assessment concludes that the mitigation measures described would reduce the magnitude of impacts to a negligible level and would prevent significant adverse effects arising.
- 12.9.8 In terms of operational impacts, a series of mitigation measures are incorporated into the design to avoid potential adverse effects on flood risk and water quality/quantity. The assessment concludes that the mitigation measures described would reduce the magnitude of impacts to a negligible level and would prevent significant adverse effects arising.

12.9.9 The findings of this assessment have demonstrated that the development would not result in any significant residual adverse impacts on surface waters, groundwaters or flood risk.
