



STATION WORKS, RADCLIFE



PAUL COOK DEVELOPMENTS Ltd FLOOD RISK ASSESSMENT REPORT

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Document Verification

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Executive Summary

Site Setting	The site comprises approximately 0.56 hectares of brownfield land. It is located off Bury Road in Radcliffe, at National Grid reference 378940 , 407689 located centrally.
Flood Risk	The EA fluvial and tidal flood map shows that the site and its surroundings is partially contained within an area designated as Flood Zone 1 with areas of Flood Zone 2 present.
Consultations	Consultation has previously been undertaken by LK Group dated October 2022, their previous correspondence has been used to inform this report.
SUDS, Surface Water Management & Preliminary Drainage Strategy	Surface water flows generated by the development's hard surfaces will be attenuated into the wider system. According to the SUDS hierarchy consideration has been given to sustainable methods such as infiltration/soakaways. Based on available information infiltration is not expected to be viable. The runoff generated by the development will be attenuated within the site
Controlled Water Pollution	The underlying ground/groundwater beneath the site should be protected from pollution. This will be aided by carrying out the recommendations within this report and by using best practice construction techniques.



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1. Introduction

Westlakes Environmental, as a part of Westlakes Engineering Limited, have been appointed by Jenkins Design Group on Behalf of Paul Cook Developments Ltd to prepare a Flood Risk Assessment (FRA) for a 0.56 hectare brownfield site, located at Bury Road, Radcliffe.

This report presents the findings of the FRA, which has been carried out in accordance with the National Planning Policy Framework (NPPF), Technical Guidance to the NPPF and Planning Practice Guidance. Other documents consulted have included Environment Agency (EA) FRA Guidance Note 1, the local Strategic Flood Risk Assessments Level 1 and 2 (SFRA)

This FRA aims to identify and assess the risks of all forms of flooding to and from the site and demonstrate how these flood risks will be managed, taking climate change into account. The FRA also considers the management of surface water run-off and outlines the proposed drainage strategy.

The proposed development should not increase the risk of flooding elsewhere and this FRA has therefore been prepared to demonstrate that this has been achieved. Consideration has also been given to BREEAM accreditation, including the requirements of Pol 03, the risk of pollution to controlled waters and the site conditions prior to, during and after development

It is the assumption wherever possible that ground levels post-development will remain as close to existing as is practical. If this or other key assumptions change then the conclusions within this report may need to be reassessed to check that they are still applicable.

This report is based on information obtained from the site topographical survey and drainage record plans. It has also been informed by correspondence with the EA, Local Authorities (Bury Council) and the local public water utility company (United Utilities).

2. Site Setting

2.1. Site Description

The site is located to the east of Bury Road approximately 3.7km to the south of Bury Centre, at National Grid reference 378940, 407689.

The site's most recent use is from Kestral Forwarding Ltd as a warehouse depot however the site had been previously cleared following a serious fire in 2012.

2.2. Proposed Future Use

The site is intended to be developed for residential purposes to deliver a total of 30 new dwellings.

The proposed site layout is shown on the Architect's Proposed Layout in Appendix A.

2.3. Site Levels

From the topographical survey, it can be seen that the site is sloping from the north towards the southeast from 70.48 metres above ordnance datum (AOD) in the north to 69.25m in the south.

Proposed finished floor level should be set at a minimum of 69.6m, as concluded in the previous FRA.

The topographical survey is shown in Appendix B

2.4. Underlying Ground

A phase 1 desk study report has previously been completed by The Land Consultancy Limited in order to gain an understanding of the expected site and ground conditions, including a review of historical land use and the site's relationship with the surrounding land.

The Groundsure report which informs the Stage 1 Ground investigation desk study indicates superficial deposits of Devensian Glaciofluvial Sheet Deposits – sand and gravel. The 2012 BGS superficial deposit thickness map suggests that the drift is likely to be in the order of 1- 5m thick.

Further details refer to The Land Consultancy Limited report reference 096 SFK (TLC1204) rep NM JDS 110822 and historic BGS borehole logs that can be found in Appendix C.

2.5. Hydrology

The River Irwell lies approximately 450m to the south of the proposed site however a stream thought to be a tributary of the River Irwell runs along the North East section of the proposed development site.

The Withins Reservoir is located 1km to the north-west.

3. Flood Risk

The vulnerability of the site to flooding from rivers, sea and other sources has been considered, along with the potential to increase flooding elsewhere through the addition of impermeable areas and the effect on surface water run-off. Typical sources of flooding include fluvial, tidal, surface water, groundwater, sewers, and anthropogenic sources; these are considered below. The local SFRA has also been consulted.

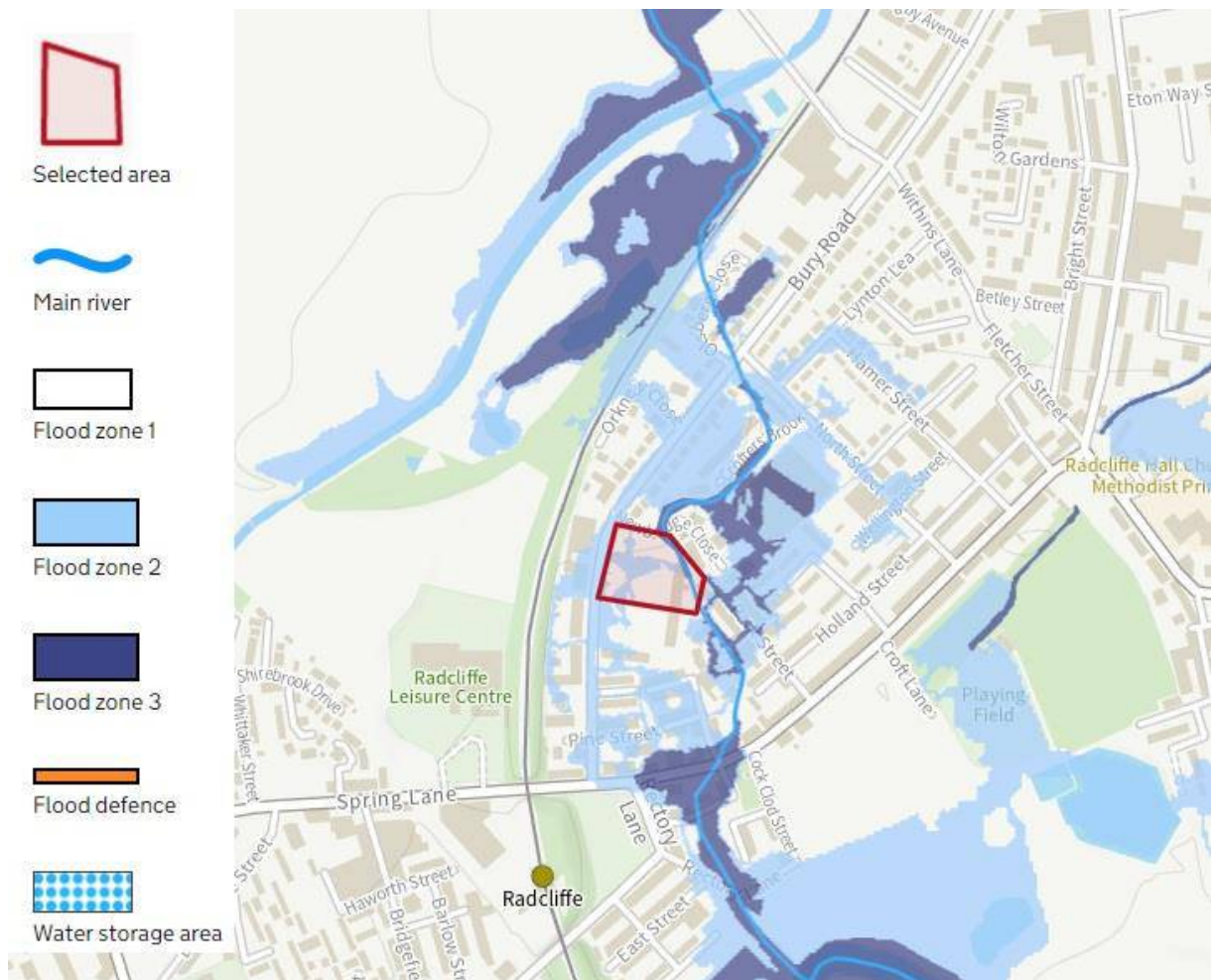
3.1. Flood Zones

3.1.1. Fluvial/Tidal

Flood maps are produced by the EA for the whole of the UK to highlight areas at particular risk of flooding by categorising them into different Zones according to the likelihood of flooding. These maps are based on a broad assessment of areas using digital mapping techniques and extracts from the EA flood maps for the site and its surroundings are included in the figures below.

The EA fluvial and tidal flood map in figure 1, below, shows that the site and its surroundings are partially contained within an area designated by the EA as Flood Zone 1 (unshaded areas) and areas of Flood Zone 2 (light blue shaded areas).

Figure 1 – Rivers and Sea



Zone 1 areas are defined in NPPF Table 1 as “land assessed as having a less than 1 in 1000 annual probability of river or sea flooding (<0.1%)”. With Zone 2 areas described as between 0.1% – 1% chance of flooding from rivers in any year (between 1:1000 and 1:100 chance) or between 0.1% – 0.5% chance of flooding from the sea in any year (between 1:1000 and 1:200 chance)

The compatibility of different end uses with the various Flood Zones is shown in NPPF Table 3 (see Figure 2 below).

Figure 2 – NPPF Table 3

Table 3: Flood risk vulnerability and flood zone ‘compatibility’

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

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

Notes to table 3:

This table does not show:

- the application of the Sequential Test which guides development to Flood Zone 1 first, then Zone 2, and then Zone 3;
- flood risk assessment requirements; or
- the policy aims for each flood zone.

The site is proposed to be used for residential use which falls within the ‘more vulnerable’ classification within Table 2. All uses, including residential, are deemed appropriate in Flood Zone 1 and Flood Zone 2.

The NPPF also includes a Sequential Test, the aim of which is to locate areas of development in areas at lowest risk from flooding. However, as the entirety of the site is located within either Flood Zone 1 or 2 a sequential and exceptions test is not necessary.

3.1.2. Surface Water

The EA’s surface water flood map shown in Figure 3 indicates the surface water flooding risk at the site as very low.

External of the proposed site boundary the existing watercourse is identified as having a high risk of surface water flooding to a maximum depth of between 300mm to 900mm. As the water level is approximately 1.5 - 2m lower than the existing site the risk associated with the watercourse is considered low.

Figure 3 – Environment Agency Flood Map – Surface Water



Management of surface water is being considered as part of the development proposals and a preliminary drainage strategy is outlined within Section 5 of this FRA report.

3.1.3. Groundwater

The current Phase 1 desk study indicates that the BGS records state that the site is at risk from groundwater flooding at the surface however as no boreholes records are currently available for the site the current depth of groundwater will need to be established through the production of a Phase 2 report.

Figure 5 – Environmental Agency Flood Map – Flood Risk from Reservoirs

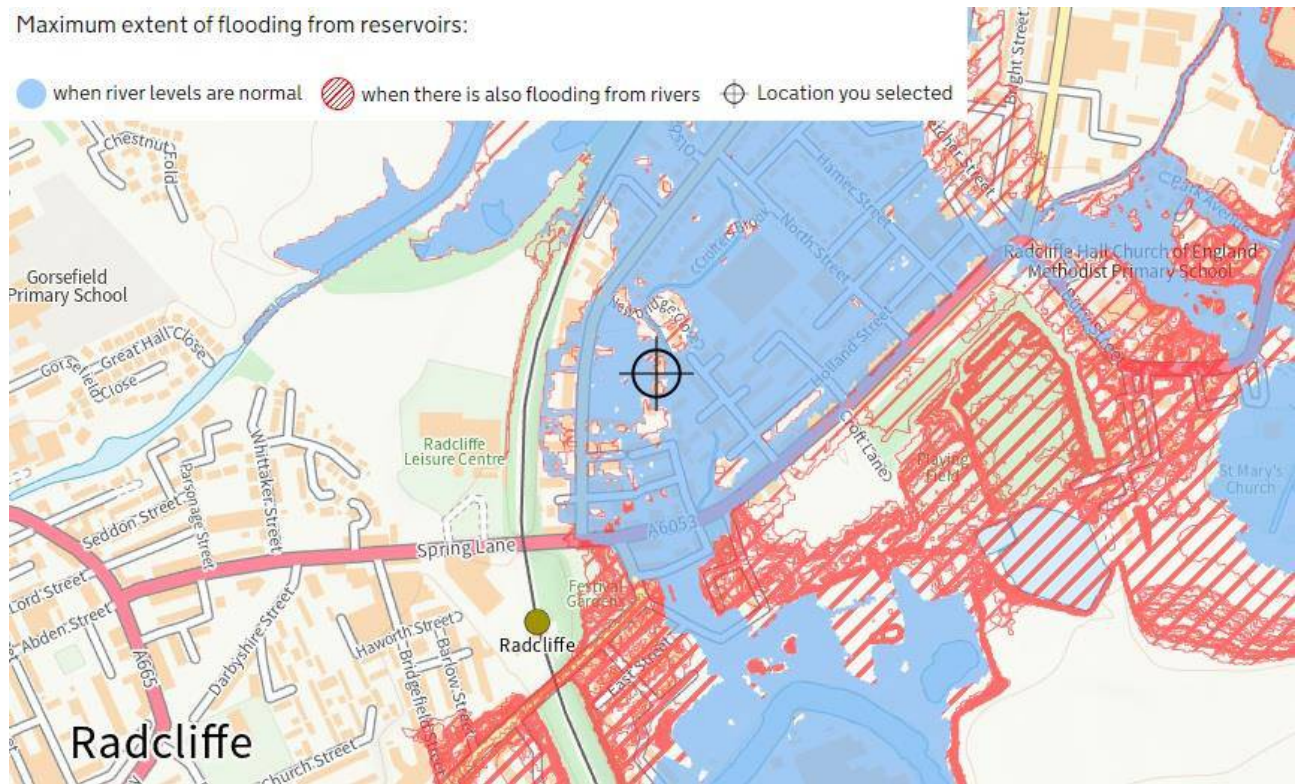


Figure 6 - Reservoir Name

Reservoirs

There is a risk of flooding from reservoirs in this area

Flooding from reservoirs is extremely unlikely. An area is considered at risk if peoples' lives could be threatened in the event of a dam or reservoir failure.

[View a map of the risk of flooding from reservoirs](#)

▼ Reservoirs that could affect this area

Withins (grid reference SD7850008700)

Owner: Withins Reservoir Limited

Lead Local Flood Authority: Bury

Comments: If you have questions about local emergency plans for this reservoir you should contact the named Local Authority

Although the consequences of such a reservoir failure would be significant following a dam breach or over topping, it should be emphasized that the dam is anticipated to be regularly monitored and inspected under the criteria listed within the Reservoir Act 1975 and the British Dam Society Reservoir Safety Guidance as such the probability of a breach occurring is unlikely.



3.2. Correspondence

Previous correspondence is shown in Appendix E.

4. Surface Water

In accordance with the NPPF and SFRA, consideration should be given to natural water flows at the site. The development should not adversely affect flow or increase flood risk elsewhere, including increasing run-off rates. The disposal of surface water should be dealt with in a sustainable way and climate change should also be accounted for. The site drainage strategy is discussed in Section 5.

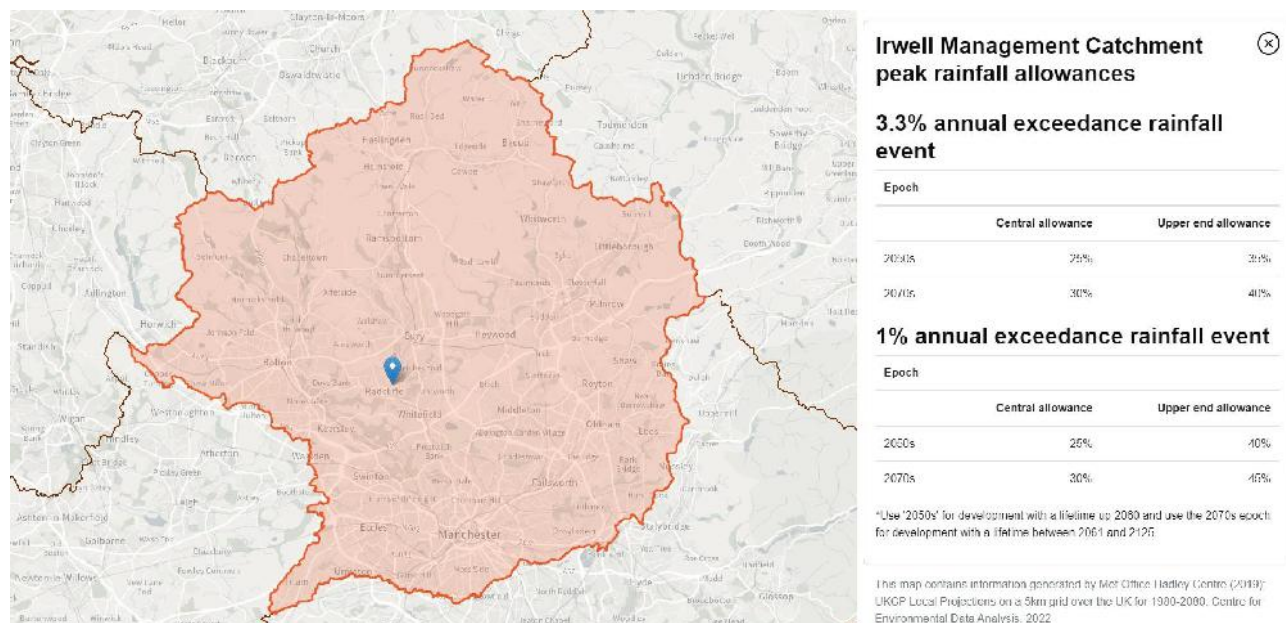
4.1. Previous Situation and Development Proposals

The sites most recent use is from Kestral Forwarding Ltd as a warehouse depot however the site had been previously cleared following a serious fire in 2012.

Climate Change

There is evidence to suggest that the climate is changing with sea levels predicted to continue to rise along with more frequent short-duration, high-intensity rainfall and more frequent periods of long-duration rainfall. The NPPF recommends that the effects of climate change be accounted for in FRA, with consideration of the EA flood maps and local authority SFRA. A 45% increase for the 100 year storm is therefore allowed for within the new surface water drainage design to take account of climate change. Climate change may also lead to variations in groundwater level. This will also be considered in the drainage design.

Figure 7 – Peak Climate Change Allowances

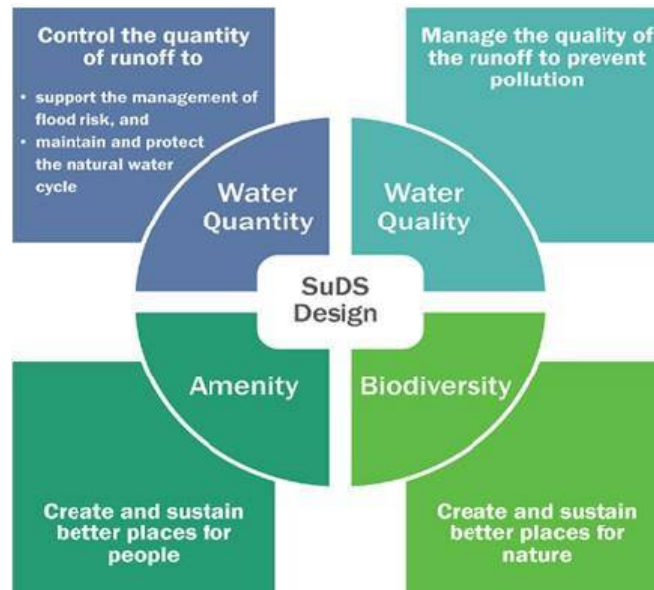


4.2. Sustainable Drainage Systems (SUDS)

SUDS are a desirable way to manage surface water disposal within new developments and SUDS methods for surface water drainage management are discussed further within the SUDS Manual.

In following the standard hierarchy of drainage solutions, consideration should firstly be given to the discharge of surface water runoff by sustainable methods such as infiltration. Initial findings contained within the phase 1 desk top study indicate that infiltration may be a possibility however the potential for groundwater flooding will need to be assessed once further information has been gathered.

The types of benefits that can be achieved by SUDS will be dependent on the site, but fit broadly into four categories: water quantity, water quality, amenity and biodiversity. These are also referred to as the four pillars of SuDS design (Figure 8) with a design objective.

Figure 8 - Four Pillars of SuDS

The proposed development will address the above 4 pillars of SuDS design criteria with the inclusion of a range of sustainable features through a comprehensive treatment train.

- **Water Quantity:** the quantity of run-off from the site will be significantly reduced, as set out in more detail in the Drainage Strategy in Section 5, whilst taking account of likely increases in future rainfall due to climate change.
- **Water Quality:** the quality of run-off from the site will be improved by the inclusion of a significant treatment permeable construction build-up for the carpark area, bio-retention areas, and cellular attenuation tank.

All flows will be collated within the site prior to discharge into the adopted network.

- **Biodiversity** will be addressed by the introduction of vegetation areas around the site, as well as by the inclusion of a significant planting regime creating a better environment for nature to thrive. With the inclusion of bio-retention areas, planting regimes can be created with the purpose of providing sanctuary for wild bees, butterflies and other wildlife species.
- **Amenity** is provided through the proposed treatment train, which presents the opportunity to create visually attractive areas within the proposed site which have the ability to connect people to water. Such features have been shown to improve the well-being of people that live within the proposed development.

5. Drainage Strategy

5.1. Existing Drainage Arrangements

A 300mm diameter combined sewer is located within Bury Road to the west of the proposed site increasing to 375mm diameter as it heads south, further afield a 225mm diameter combined sewer has also been identified within Schofield Street located to the south of the proposed site.

The response from United Utilities states the following:

Given that there is a more sustainable method of draining the site to the watercourse located to the east, it is assumed that a connection to the public sewer is not required".

5.2. Surface Water Drainage Strategy

In following the standard hierarchy of drainage solutions, consideration should firstly be given to the discharge of surface water runoff by sustainable methods such as infiltration.

Following assessment of all currently available information it would suggest infiltration could be a possibility for the proposed development, although the presence of groundwater should be considered once further information has been received and site permeability tests concluded,

The current site is understood to be 100% impermeable with the flows from the previous structure discharging via an existing connection to the United Utilities adopted network.

Although the existing site currently benefits from a connection to the adopted drainage network within the surrounding network offsite, given the Position of the River Irwell tributary it is considered the most suitable point of discharge, with options for reducing rate of discharge via attenuation on site.

In order to define the existing flows originating from the current site, a 2-pipe network has been formed following the guidance contained within Microdrainage modelling software to represent the pre-development impermeable area and simulating the 1 in 100-year storm 360minute duration with results shown below in figure 7.

Figure 7 – Brownfield Run Off Calculation – 2 Pipe Method

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria									
Areal Reduction Factor		1.000	Additional Flow - % of Total Flow		0.000				
Hot Start (mins)		0	MADD Factor * 10m ³ /ha Storage		2.000				
Hot Start Level (mm)		0	Inlet Coefficient		0.800				
Manhole Headloss Coeff (Global)		0.500	Flow per Person per Day (l/per/day)		0.000				
Poul Sewage per hectare (l/s)		0.000							
Number of Input Hydrographs		0	Number of Storage Structures		0				
Number of Online Controls		0	Number of Time/Area Diagrams		0				
Number of Offline Controls		0	Number of Real Time Controls		0				
Synthetic Rainfall Details									
Rainfall Model		PSR		Ratio R 0.357					
Region		England and Wales		Cv (Summer)		0.750			
M5-60 (mm)		18.000		Cv (Winter)		0.840			
Margin for Flood Risk Warning (mm)		300.0		DVD Status		OFF			
Analysis Timestep		Pine		Inertia Status		OFF			
DTS Status		ON							
Profile(s)		Summer and Winter							
Duration(s) (mins)		15, 30, 60, 120, 240, 360							
Return Period(s) (years)		1, 30, 100							
Climate Change (%)		0, 0, 0							
Water Level									
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)
1.000	1	15 Winter	100	+0%	30/15 Summer	100/15 Summer			69.756
1.001	2	15 Winter	100	+0%					68.067
Surcharged Flooded									
PN	US/MH Name	Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.956	6.246	1.56			145.7	FLOOD	3
1.001	2	-0.066	0.000	0.97			145.7	OK	

Therefore, the Brownfield run off rate for the critical storm has been calculated as 145.7 l/s.

In order to provide a significant betterment over the existing discharge rate currently experienced from the existing site a reduction in flow of 96.6% will be applied to the proposed development

The identified Brownfield rate reduced by 96.6% presents a development flow of 5.0 l/s, based on the identified flow the maximum level of storage required for the proposed site is noted as 171m³.



In conclusion, it is proposed that all surface water flows arising from the proposed development will be collected by a network of pipes before discharging to the onsite attenuation features designed as a mixture of permeable surfaces, offline bioretention areas and traditional cellular storage, Microdrainage outputs are shown in Appendix G.

The proposed flows emerging from the site attenuation will be restricted by a hydrobrake or similar control device prior to discharging to the existing watercourse as shown on the indicative drainage drawing reference WL_2226_001 shown in appendix F.

5.3. Foul Flows

Following consultation with United Utilities it has been confirmed that fall foul flows will be able to communicate with the existing combined system within Bury road, confirmation is provided within Appendix E.

6. Minimising the Risk to Controlled Water Pollution

Consideration has also been given to the risk of watercourse pollution as a result of the proposed development. Guidance in 'The SUDS Manual' has also been taken into account.

The potential to minimise watercourse and aquifer pollution during the life of the development is discussed below. Consideration has been given to controlled water pollution pre, post and during construction.

6.1. During Construction

Site development would entail general construction works to construct buildings and associated infrastructure.

During site works, earthworks and transportation, efforts should be made to minimise dust generation, keeping vehicle movement to a minimum.

Disposal of waste/spoil should be undertaken in an appropriate manner in accordance with the reduce-reuse-recycle waste management philosophy. Any surplus materials should be taken to an appropriate licensed waste disposal facility by a registered waste carrier. There will be excavation for foundations, and the contractors will need to be vigilant and inspect the arisings for contaminants.

Safe and appropriate working practices should be adopted during construction, which will help to minimise the potential for 'pollution' of controlled waters.

6.2. Post-Development Situation

It is proposed to dispose of surface water from impermeable areas into the surrounding sewers at an attenuated rate.

Precautions should be taken to manage future use of water and control run-off.

Drainage systems should be regularly maintained to ensure that they remain fit for purpose. Consideration should be given to the Operation & Maintenance of all proposed surface water features.

Future on-site activities are considered to represent a very low level of risk to controlled waters, as the site will be used as a residential development.

The EA provides Pollution Prevention Guidance notes, where further guidance can be obtained if required.

6.3. Summary

The underlying ground/groundwater beneath the site should be protected from pollution. This will be aided by carrying out the recommendations within this report and by using best practice construction techniques.

A development of residential buildings is proposed, which poses minimise potential contamination risks.

Overall, the influence of the development on controlled waters has been considered. Potential historic risks to controlled waters appear to be very low. Residual risks from development are thought to be low provided that best practice procedures are followed.

7. Conclusions

1. The site is partially contained within in EA Flood Zone 1 with additional areas of Flood Zone 2. Reference to NPPF Table 3 shows that an Exception Test is not required as residential end-use is deemed appropriate in both zones.
2. The site is considered to be at low overall risk of flooding. EA mapping indicates that surface water flooding does occur along the river Irwell tributary and this potential risk has been considered as part of the preliminary site surface water drainage strategy.
3. The risk of flooding elsewhere should not be increased as a result of the development.
4. The nearest surface water feature is located along the north-eastern boundary of the site noted as a tributary of the River Irwell.
5. A maximum permissible discharge rate of 5.0 l/s for the 1 in 100-year storm event will be used as the basis of the proposed design.
6. Attenuation will be provided on the site to ensure that the maximum run off rate of 5.0 l/s is not exceeded during a 1 in 100-year storm event, inclusive of a 96.6% allowance for climate change. The approximate level of storage required for the site will be traditional storage structure.
7. The proposed drainage will be designed with sufficient capacity not to flood during both 1 in 30-year storm event and 1 in 100 year plus climate change storm event (+45%) within the site. The risk of off-site flooding would not increase as a result of the development and safe access and egress will be maintained.
8. Infiltration testing to BRE 365 guidance should be completed as part of any further investigation across the site.
9. Foul flows are proposed to be taken to the public combined network operated by United Utilities.
10. The potential for pollution of controlled waters is considered to be low provided best practice procedures are following during development. Drainage systems should be maintained to ensure that they do not become blocked and unable to discharge.

References

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