



J N P G R O U P
CONSULTING ENGINEERS

Flood Risk Assessment

Project: Land West of Arundel Road,
Angmering

Client: Redrow Homes

Reference: C86473-JNP-66-XX-RP-C-2002 P01

Date: December 2021

DOCUMENT CONTROL SHEET

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FOR AND ON BEHALF OF JNP GROUP

Date: December 2021

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1 INTRODUCTION

1.1 Terms of Reference

1.1.1 JNP Group has been commissioned by Redrow Homes to prepare a flood risk assessment for the proposed residential development to the west of Arundel Road in Angmering, West Sussex.

1.1.2 This report assesses flood risk at the development site from all potential sources and describes the measures adopted in the master planning process to manage such risks. It has been prepared in compliance with current policies and best practices.

1.2 Policy Framework and Key Stakeholders

1.2.1 The *National Planning Policy Framework* (NPPF) (February 2019) sets strict tests to protect people and property from flooding which all local planning authorities are expected to follow. Where these tests are not met, national policy is clear that new development should not be allowed.

1.2.2 In areas at risk of flooding or for sites of one hectare (ha) or more, developers must undertake a site-specific flood risk assessment to accompany applications for planning permission (or prior approval for certain types of permitted development).

1.2.3 In decision-taking, local planning authorities must ensure a sequential approach to site selection and master planning is followed so that development is, as far as reasonably possible, located where the risk of flooding (from all sources) is lowest, taking account of climate change and the vulnerability of future uses to flood risk.

1.2.4 Where development needs to be in locations where there is a risk of flooding, local planning authorities and developers must ensure development is appropriately flood resilient and resistant, safe for its users for the development's lifetime, and will not increase flood risk elsewhere.

1.2.5 The Environment Agency (EA) is a statutory consultee on applications where there is a risk of flooding from the sea or main rivers.

1.2.6 Lead local flood authorities (unitary authorities or county councils) are responsible for managing local flood risk from ordinary watercourses, surface water or groundwater, and for preparing local flood risk management strategies. Local planning authorities work with lead local flood authorities to ensure local planning policies are compatible with the local flood risk management strategy.

1.2.7 West Sussex County Council (WSCC) is the lead local flood authority (LLFA) and its strategy for managing local flood risk is set out in Local Flood Risk Management Strategy (2013) and 'Water. People. Places. A guide for master planning sustainable drainage into developments' (2013).

1.2.8 Arun District Council (ADC) is the local planning authority (LPA) and its policies on flood risk management are set out in Local Plan Local Plan 2011 – 2031.

1.2.9 Where relevant, local planning authorities and developers must also take advice from:

- Internal drainage boards; to identify the scope of their interests.
- Sewerage undertakers; to ensure they can assess the impact of new development on their assets and plan any required improvements. Southern Water (SW) is the local sewerage undertaker.
- Reservoir undertakers; to avoid an intensification of development within areas at risk from reservoir failure and ensure they can assess the cost implications of any reservoir safety improvements required due to change in land use downstream of their assets.
- Navigation authorities; in relation to developments adjacent to, or which discharge into, canals (especially where these are impounded above natural ground level).

1.3 Sources of Information

1.3.1 This flood risk assessment has been based on the following sources of information:

- Bespoke topographic survey undertaken by SubVision Surveys Ltd (Ref. SS-RED-001, February 2021);
- British Geological Survey's *Geoindex Tool*;
(<http://mapapps2.bgs.ac.uk/geoindex/home.html>)
- DEFRA / EA's aquifer and source protection data
(<https://magic.defra.gov.uk/MagicMap.aspx>)
- EA's Flood Map for Planning;
(<https://flood-map-for-planning.service.gov.uk/>)
- EA's Long Term Flood Risk Information;
(<https://flood-warning-information.service.gov.uk/long-term-flood-risk/map>)
- WSCC's Preliminary Flood Risk Assessment Volume II, Technical Report (2011)
- WSCC's Strategic Flood Risk Assessment Volume II, Technical Report (2010);
- Water. People. Places. A guide for master planning sustainable drainage into developments – LLFAs of the South East of England and AECOM, (2013);
- ADC's Strategic Flood Risk Assessment (2016);
- Land off Arundel Road, Angmering - Flood Risk Assessment & Outline Surface Water Drainage Strategy, 881292-R3(00)-FRA (2019).

2 DEVELOPMENT SITE

2.1 Location

2.1.1 The site is located off Arundel Road, in Angmering, West Sussex (Figure 2.1, Table 2.1).

Table 2.1: Site Location

OS X	OS Y	Area (ha)	Nearest Postcode
506554	105259	9.1	BN16 4DN

Figure 2.1: Site Location



2.1.2 The site is located to the north of Angmering, to the west of Arundel Road and approximately 200m south of the A27. The site comprises agricultural land and an existing small industrial park and caravan storage facility.

2.1.3 The surrounding land uses are summarised in the following table.

Table 2.2: Surrounding Land Use

Direction	Land Use
North	Steyne Woods
East	Nine new houses, Arundel Road, woods and arable land beyond.
South	Angmering Recreation Ground
West	Arable farmland

2.2 Topography

- 2.2.1 The available topographic information (Appendix A) shows that ground levels within the development site range between 23.0 m above Ordnance Datum (aOD) adjacent to Arundel Road in the north east and 11.0m aOD in the north west.

2.3 Hydrology

- 2.3.1 An unnamed watercourse is located c. 70m to the north of the site, flowing north east to west. From the Ordnance Survey map, this appears to rise from a spring just to the north of the A27, but the alignment is also an overland flow route to the north east of the spring.
- 2.3.2 The watercourse discharges into ponds (named Decoy ponds) to the north west of the site, which in turn flow into the Black Ditch and ultimately the River Arun.
- 2.3.3 A ditch is located along the western site boundary. The northern part of this falls towards the unnamed watercourse. The part of the ditch near the south western corner of the site is understood to connect to a ditch to the west via a culvert, with this ultimately discharging to downstream watercourses.

2.4 Geology

- 2.4.1 The geology of the site has been determined by reference to the 1:50,000 scale British Geological Survey (BGS) online Geoindex Tool
<http://mapapps2.bgs.ac.uk/geoindex/home.html>
- 2.4.2 No artificial or Made Ground is indicated to be present underlying the site. The superficial geology of the site to be is indicated to be Head deposits, which underlie all but the north east of the site and are described by the BGS as *“poorly sorted and poorly stratified, angular rock debris and/or clayey hillwash and soil creep”*.
- 2.4.3 The underlying geology is indicated to be the London Clay Formation, which is part of a syncline orientated north west to south east with the axis just to the north of the site. The outcrop of the underlying clays, silts and sands of the Lambeth Group is just off-site to the north.
- 2.4.4 There are no faults denoted within 500 m of the site.
- 2.4.5 JNP Group have consulted online borehole records held by the BGS. There are borehole records c. 500m to the west, albeit on the outcrop of the Lambeth group so slightly lower in the geological sequence. These boreholes are used for groundwater abstraction from the Chalk which underlies the Lambeth group. The borehole logs indicate 30m of Lambeth group above the Chalk indicating that there be at least this thickness beneath the site.
- 2.4.6 The RSK report includes the results of infiltration testing. This was undertaken in four trial pits excavated to between 1.8m and 2.5m bgl. The strata encountered was clays classified as head deposits or London Clay. The pits were dry. Infiltration did not occur in three pits and a very low rate of 6.7×10^{-7} m/s was determined from the testing the fourth pit.

- 2.4.7 EA Aquifer Maps indicate that the Head deposits are classified as a Secondary (Undifferentiated) Aquifer, the London Clay is not classified and the Lambeth group as a secondary A Aquifer.
- 2.4.8 The Environment Agency define a Principal Aquifer as:
- “These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.”*
- 2.4.9 The Environment Agency define a Secondary-A Aquifer as:
- “Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.”*
- 2.4.10 The site’s proximity to groundwater Source Protection Zones (SPZs) was determined by reference to the EA’s website. The site is not located within or close to a SPZ. Based on the available geological and hydrogeological information, infiltration drainage is deemed unfeasible at the development site.

3 PROPOSED DEVELOPMENT

- 3.1.1 The proposed development (Figure 3.1 and Appendix B) comprises approximately 160 residential properties with associated hard paved / impermeable surfaces (e.g. roofs, roads, driveways, parking areas, etc.), public open space and a SUDS basin. The impermeable area totals approximately 3.29ha.
- 3.1.2 Under [Table 2](#) of the *Flood Risk and Coastal Change Guidance* (March 2014), the proposed residential development is classified as more vulnerable.

Figure 3.1: Proposed Development



4 FLOOD RISK ASSESSMENT

4.1 Overview

- 4.1.1 All potential sources of flood risk at the development site have been assessed based on the information listed in Section 1.3 and are summarised in Table 4.1. The key sources of flood risk to the proposed development are further described in the ensuing sections.

Table 4.1: Potential Sources of Flood Risk

Source	Flood Risk
Coastal	No risk, site 10m + aOD
Fluvial	Site Flood Zone 1 – low risk. ADC SFRA indicates site will still be FZ1 when climate change is considered.
Surface Water	Very low risk predicted across site, small discrete areas at higher risk associated with ditch along western boundary. Increased surface water flood risk resulting from development will be mitigated by drainage strategy.
Groundwater	Site underlain by cohesive strata and GI determined groundwater at least 2.5m bgl. Low risk
Sewers	ADC SFRA indicates only two reported incidents in BN16 4 postcode. Pre-development private sewer system on site to septic tank in SW of developed area. System will be replaced during development. Low risk.
Infrastructure Failure	Very low risk

4.2 Climate Change

- 4.2.1 The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. This includes demonstrating how flood risk will be managed now and over the development's lifetime, taking climate change into account.
- 4.2.2 In accordance with the EA's guidance [Flood Risk Assessment: Climate Change Allowances](#) (July 2021), the proposed development with anticipated life span into the 2080's (2070 to 2115) must take account of the following allowances:
- Peak River Flows (Southern river basin district)
 - Central 25%
 - Peak Rainfall Intensity
 - Upper End 40%

4.3 Sequential and Exception Tests

- 4.3.1 The sequential, risk-based approach to the location of development is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. The aim is to keep development out of medium and high flood risk areas (Flood Zones 2 and 3) and other areas affected by other sources of flooding where possible.
- 4.3.2 Application of the sequential approach in the master planning process, in particular application of the *Sequential Test*, helps ensure that development can be safely and

sustainably delivered, and developers do not waste resources promoting proposals which are inappropriate on flood risk grounds.

4.3.3 The *Sequential Test* ensures that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The aim is to steer new development to Flood Zone 1 (areas with a low probability of sea or river flooding). Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of sea or river flooding), applying the *Exception Test* if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of sea or river flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the *Exception Test* if required.

4.3.4 [Table 2](#) of the *Flood Risk and Coastal Change Guidance* categorises different types of uses and development according to their vulnerability to flood risk. [Table 3](#) of the *Flood Risk and Coastal Change Guidance* (Table 4.2) maps these vulnerability classes against flood zones to indicate where development is appropriate and where it should not be permitted.

Table 42: Flood Risk Vulnerability and Flood Zone Compatibility

Flood Zone	Flood Risk Vulnerability				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test	✓	✓	✓
Zone 3a	Exception Test	✗	Exception Test	✓	✓
Zone 3b	Exception Test	✗	✗	✗	✓

Key:

✓ Development is appropriate

✗ Development should not be permitted

4.3.5 The site is located in Flood Zone 1 and at no significant risk of flooding from any potential source, thus following a sequential approach to steer development away from flood risk. The Exception Test is not required for less vulnerable development in Flood Zone 1.

5 CONCLUSIONS AND RECOMMENDATIONS

- 5.1.1 JNP Group has been commissioned by Redrow Homes to prepare a Flood Risk Assessment for the proposed residential development to the west of Arundel Road in Angmering, West Sussex.
- 5.1.2 The site comprises agricultural land and an existing small industrial park and caravan storage facility.
- 5.1.3 The site slopes from c. 23m aOD in the east to 11m aOD in the west.
- 5.1.4 The site is underlain by Head deposits underlain by the London Clay Formation.
- 5.1.5 The underlying strata are classified as a Secondary (Undifferentiated) Aquifer (Head deposits). The London Clay is not classified as an aquifer. The site is not in a groundwater source protection zone.
- 5.1.6 Based on the available geologic and hydrogeologic information, and the previous use of the site, infiltration drainage is deemed unfeasible at the development site.
- 5.1.7 An unnamed watercourse is located c. 70m to the north of the site, flowing north east to west. A ditch is located along the western site boundary. The northern part of this falls towards the unnamed watercourse. The part of the ditch near the south western corner of the site is understood to connect to a ditch to the west via a culvert, with this ultimately
- 5.1.8 The Flood Risk Assessment section of this report demonstrates that the risk of flooding from all sources (fluvial, tidal, surface water, groundwater, sewer and reservoir) is low.
- 5.1.9 In conclusion, the proposed development is not at risk of flooding and does not increase flood risk off-site.
- 5.1.10 This report is intended for the use of the developer of the site in support of their planning application for the site only.

6 LIMITATIONS

- 6.1.1 The information, conclusions and recommendations presented within this report are deemed to be current at the time of issue. No guarantee can be given to the status of this information other than at the time of issuing. Where necessary, the user shall confirm the status of any applicable assessments and consents.
- 6.1.2 This report has been commissioned by Redrow Homes. No third party may receive a copy of this report without first obtaining our permission in writing.
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APPENDIX A: TOPOGRAPHICAL INFORMATION



LOCAL SCALE FACTOR: 0.9997408

ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM GENERATED BY ACTIVE GP

NETWORK:-

NO ALLOWANCE HAS BEEN MADE FOR SUB SURFACE ACCESS TO MANHOLES OR CHAMBERS. ANY PIPE SIZES, DEPTHS OR BELOW GROUND DIMENSIONS ARE TAKEN FROM THE SURFACE AND THUS WILL ONLY BE APPROXIMATE. ANY FLOW TYPE

(FOUL WATER, SURFACE WATER OR COMBINED) ARE ASSUMED AND THEREFORE REQUIRE VERIFICATION.

ROAD MARKINGS DISPLAYED ARE SYMBOLIC. LENGTH, SPACING AND THICKNESS ETC. ARE ILLUSTRATIVE ONLY.

LEGEND

- | | |
|--|---------------------------|
| | SPOT LEVEL |
| | SURVEY STATION |
| | SAPLING |
| | BUSH/SHRUB |
| | TREE (INDICATIVE ONLY) |
| | HEDGE/AREA OF UNDERGROWTH |
| | CONTOUR |
| | GATE |
| | OVERHEAD CABLE |
| | EDGE |

ABBREVIATIONS

- [illegible]

STATION CO-ORDINATES

STATION	EASTING	NORTHING	LEVEL	DESCRIPTION
STN#1	506759.66	106265.18	16.81	Survey Nail
STN#2	506752.99	106300.44	16.11	Survey Nail
STN#3	506746.03	106355.64	20.37	Survey Nail
STN#4	506732.58	106343.92	22.85	Survey Nail
STN#5	506726.18	106565.13	17.13	Survey Nail
STN#6	506688.45	106294.28	19.92	Survey Nail
STN#51	506697.78	106289.31	16.16	Survey Nail
STN#56	506635.22	106271.80	16.42	Survey Nail

TREE SCHEDULE

No	DIAM.	SPREAD Ø	HEX-H
TE/1	0.50	10	8
TE/2	1.00	8	20
TE/3	0.60	8	20
TE/4	0.60	12	12
TE/5	0.70	8	20
TE/6	0.90	8	20
TE/7	0.90	8	20
TE/8	1.40	20	20
TE/9	0.50	12	12
TE/10	0.60	12	10
TE/11	0.15	8	8
TE/12	0.80	12	12
TE/13	0.30	6	6
TE/14	0.30	6	6
TE/15	0.60	10	10
TE/16	0.30	6	6
TE/17	0.40	6	8
TE/18	0.40	2	3
TE/19	0.80	8	8

TREE DIAMETER MEASURED APPROXIMATELY 1.5M ABOVE GROUND LEVEL. TREE SPREADS ARE SYMBOLIC ONLY AND ARE REPRESENTATIVE OF THE GENERALISED CANOPY SIZE. TREE BOLE MAY NOT SIT CENTRALLY TO THE CANOPY. TREE HEIGHT ESTIMATED FROM GROUND LEVEL.

PLOT LOCATIONS

Rev	Date	Revision notes	B
DO NOT SCALE			

Status	
--------	--

INFORMATION

Project

Arundel Road,
Angmering.

Title

TOPOGRAPHICAL SURVEY
AS OF 13.09.17
SHEET 1 OF 2



Drawn By	Publish Date	Scale(s)	Sheet Size
JH/JW	20.09.17	1:500	A0
Project no.	Drawing no.	Revision	
2017-084	Topo_01_2D	0	



THIS SURVEY IS ORIENTATED TO ORDINANCE SURVEY GRID NORTH. THE SURVEY TO A PLANE GRID. HORIZONTAL MEASUREMENTS TAKEN FROM THIS SURVEY WILL BE GROUND DISTANCES.

SITE CENTRE: E 509527.7403, N 105336.6085

SITE CENTRE: E 508527.7405, N 105338.60

ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM GENERATED BY ACTIVE CP NETWORK.

DRAINAGE

NO ALLOWANCE HAS BEEN MADE FOR SUB SURFACE ACCESS TO MANHOLES OR CHAMBERS. ANY PIPE SIZES, DEPTHS OR BELOW GROUND DIMENSIONS ARE TAKEN FROM THE SURFACE AND THUS WILL ONLY BE APPROXIMATE. ANY FLOW TYPE (FOLL WATER, SURFACE WATER OR COMBINED) ARE ASSUMED AND THEREFORE REQUIRE VERIFICATION.

ROAD MARKINGS:-
ROAD MARKINGS DISPLAYED ARE SYMBOLIC. LENGTH, SPACING AND THICKNESS ETC. ARE INDICATIVE ONLY.

LEGEND

30.29	SPOT LEVEL
	SURVEY STATION
	SAPLING
	BUSHES/SHRUB
	TREE (INDICATIVE)
	HEDGE/AREA OF FOREST
	CONTOUR
	GATE
	OVERHEAD CABLE LINE

ABBREVIATIONS

[illegible]

STATION CO-ORDINATES

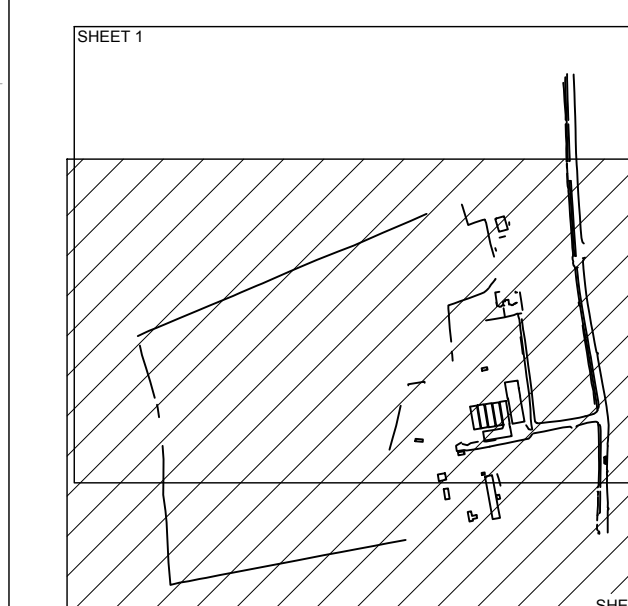
STATION	EASTING	NORTHING	LEVEL	DESCRIPTION
STN1	508759.66	106265.18	16.81	Survey Nail
STN2	508752.99	106306.44	18.11	Survey Nail
STN3	508746.03	106355.24	20.37	Survey Nail
STN4	508732.58	106463.92	22.85	Survey Nail
STN5	508726.16	106565.13	17.73	Survey Nail
STN6	508688.45	106284.28	17.92	Survey Nail
STN7	508697.78	106289.31	16.56	Survey Nail
STN8	508625.22	106271.80	16.42	Survey Nail

TREE SCHEDULE

No.	DIAM.	SPREAD Ø	HEIGHT
TE1/	0.50	10	6
TE2/	1.00	8	20
TE3/	0.60	8	12
TE4/	0.60	12	12
TE5/	0.70	5	12
TE6/	0.90	8	20
TE7/	0.90	8	20
TE8/	1.40	20	20
TE9/	0.50	12	12
TE10/	0.60	12	10
TE11/	0.15	8	8
TE12/	0.80	12	12
TE13/	0.30	6	6
TE14/	0.30	6	6
TE15/	0.60	10	10
TE16/	0.30	6	6
TE17/	0.40	6	8
TE18/	0.40	2	2
TE19/	0.80	5	8

TREE DIAMETER MEASURED APPROXIMATELY 1.5M ABOVE GROUND LEVEL. TREE SPREADS ARE SYMBOLIC ONLY AND ARE REPRESENTATIVE OF THE GENERALISED CANOPY SIZE. TREE BOLE MAY NOT SIT CENTRALLY TO THE CANOPY. TREE HEIGHT ESTIMATED FROM GROUND LEVEL.

PLOT LOCATIONS



*	*	*	
Rev	Date	Revision notes	B
DO NOT SCALE			

Status

INFORMATION

	Project

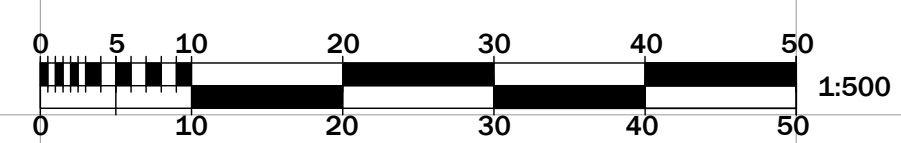
Arundel Road
Angmering.

[illegible]

TOPOGRAPHICAL SURVEY
AS OF 13.09.17
SHEET 2 OF 2



Drawn By	Publish Date	Scale(s)	Sheet Size
JH/JW	20.09.17	1:500	A0
Project no.	Drawing no.	Revision	
2017-084	Topo_02_2D	0	



APPENDIX B: PROPOSED DEVELOPMENT



Site Plan Legend	
Site Area X-XXXXa	
	Application Site Boundary Line
	Existing Trees/Hedgerow
	Proposed Trees
	Dwelling Reference
	Plot Number
	Allocated Parking
	Visitor Parking
	1.8m Brick Wall
	1.8m Timber Fence
	Shared Ownership
	Affordable Rent
	M4 / 2
	M4 / 3

Camp Site

Pond

William
Older
Hall

Nursery

Sports Court

TPO Reference
(TPO/A/2/19)

17.1m

Planning

REV. DATE	REVISIONS:	BY	REV. DATE	REVISIONS:	BY	STATUS:	CLIENT:	Redrow Homes Ltd.	PROJECT:	Arundel Road Angmering	 architecture planning masterplanning Broadside House, Farnham Business Park, Weydon Lane, Farnham, Surrey GU8 8DT. info@osrarchitects.com www.osrarchitects.com Tel: 01252 267878
A	22/11/23 Plots 1-3 updated. Affordable house types revised. Visitor parking updated.	RD					SCALE:	1:500 (A0 ORIGINAL)	DRAWING:	Proposed Site Layout	
							DRAWN:	RD/RDB	20232	P101	
							DATE:	Aug 2021		A	

APPENDIX C: GREENFIELD RUN-OFF RATES

JNP Group		Page 1
The Innovation Centre Queens Meadow Bus. Park Hartlepool TS25 5TG		
Date 20/08/2021 12:31 PM File	Designed by Muddasser.Ali Checked by	
Micro Drainage		Source Control 2020.1.3

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.400
Area (ha)	3.292	Urban	0.000
SAAR (mm)	749	Region Number	Region 7

Results l/s

QBAR Rural	12.1
QBAR Urban	12.1
Q1 year	10.3
Q1 year	10.3
Q30 years	27.5
Q100 years	38.7

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