Technical note

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Pirelli Site Redevelopment: Albion Gateway Mixed-use Development

Flood Risk and Drainage Statement: Phase 3

Client: St Modwen Developments Ltd

August 2016

Document history

Job number: 5121643			**Document ref: 5121643/TN/DS/001 Flood Risk and Drainage Statement: Phase 3**			
Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 1.0	For Planning	JD	OP	CB	MT	08/09/16
Rev 2.0	For Planning	OP	JD	CB	MT	09/09/16
Rev 3.0	For Planning	OP	JD	CB	MT	13/09/16
Rev 4.0	For Planning	JD	OP	CB	MT	21/10/16

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1. Background

The new commercial/industrial Albion Gateway development proposed for the southern side of Pirelli's factory site in Burton-upon-Trent lends itself to two outfall locations; the Stretton Brook to the north and the Horninglow Channel to the south. A development enquiry was submitted to Severn Trent Water and a response has been received stating that surface water proposals should be agreed with the Lead Local Flood Authority (Staffordshire County Council).

The original outline planning permission reference for the whole development site is P/2011/01130/JN/PO. This was subsequently amended via a S73 application modifying aspects of conditions, including around finished floor levels.

Phase 1 was granted a reserved matters approval by the Council under reference P/2014/01504 on 13 February 2015. Phase 2 was granted reserved matters approval by the Council under reference P/2015/00285 on 21 May 2015. Phase 1 and much of 2 have been constructed and a technical note relating to drainage has been produced previously, see Technical Note - Derby Road Drainage Discharge Rates - Phases 1 & 2, enclosed in Appendix G. Confirmation that the reconfigured part of Phase 2 still complies with the principles previously approved is included in Appendix H.

This technical note and planning submission relates to Phase 3 at Albion Gateway and provides a summary of the proposed drainage strategy. The drainage strategy for Phase 3 has been developed on the basis that the discharge point will be to the Horninglow Channel to the south. Phase 3 comprises a revision to the Phase 2 reserved matters consent and further development across parts of the site previously addressed by the original outline permission. The approach here is therefore to review and apply earlier agreed principles to the current proposals to ensure consistency with what has been previously been approved.

This note covers the drainage for the Horinglow Channel catchment while the reformatted part of Phase 2 is to be drained in a manner consistent with the details previously approved for that Phase, as indicated on the plan at Appendix F

1.1. Flood Risk Assessment

The original outline planning permission for the development site as a whole (East Staffordshire Borough Council Application Reference P/2011/01130/JN/PO) includes the following drainage condition (Condition 25):

> 25. *The development hereby approved shall only be carried out in accordance with the recommendations set out in Section 8.3 of the approved Flood Risk Assessment (prepared by Halcrow and dated 1st August 2011).*
>
> *Reason: As recommended by the Environment Agency to minimise the risk of flooding in accordance with the National Planning Policy Framework (in particular Section 10).*

Extensive works have been carried out for the site to ensure the development progresses in accordance with the approved FRA[1], including but not limited to: a Technical Note[2] addressing the conditions for finished floor levels; as above, a Technical Note[3] addressing the discharge rates for Phase 1 and 2; and additional supporting strategy documents and drawings. The strategy for Phase 3 will be to design in accordance with

[1] Flood Risk Assessment, Document: PI/EPRB/21 Version 1.0, Pirelli Factory, Burton upon Trent. Report produced by Halcrow 01/08/11

[2] Technical Note – Proposal to amend Planning Condition 25, Albion Gateway. Report produced by Atkins 11/05/15.

[3] Technical Note - Pirelli Site Redevelopment: Albion Gateway Mixed-use Development, Drainage Discharge Rates: Phases 1 and 2. Report produced by Atkins 03/03/15.

the approved FRA whilst continuing to incorporate the principles agreed through the additional work done to date.

The following text is an extract from Section 8.3 ("Recommendations") of the FRA produced by Halcrow, with a response from Atkins in terms of how these recommendations continue to be met:

To provide additional safety to the development and to ensure any residual flood risk is mitigated for, it is recommended that the following measures are incorporated into the design, build and operation of the Pirelli development:

…

1. *Finished floor levels are set 46.11mAOD to the new development*

   Response: This recommendation has been addressed under a separate technical note produced by Atkins, 'Albion Gateway (Pirelli Redevelopment) – Finished Floor Levels, dated 11 March 2015. See Appendix A

2. *That a safe route of access and egress is provided for all three areas of the development*

   Response: This recommendation has been addressed under the technical note referenced above.

3. *That residents, hotel owners, pub landlords, company office managers and the Pirelli site manager are aware of the flood risks to the site, the flood warning service available and the emergency evacuation plan and advice on what to do the receipt of a severe flood warning.*

   Response: Information to be included in operation and maintenance manuals which will be shared with appropriate parties following completion.

4. *Flood resilient design and construction techniques be adopted during the detailed building design as set out in the guidance provided 'improving the Flood Performance of New Buildings: Flood Resilient Construction'*

   Response: This will be reviewed/addressed at detailed design. Building finished floor levels are to set a min 150mm above adjacent ground levels and proposed finishes to be graded away from buildings where possible to help alleviate the risk.

5. *Surface water runoff from the site is disposed of in a sustainable manner through the use of SuDS as recommended by PPS 25. A betterment of 30 % is also applied to the rate at which surface water runoff is discharged from the site to fully account for the effects of climate change.*

   Response: Addressed as part of this technical note.

2. Proposed Discharge Rate

Phase 3 is currently not in use and is deemed a greenfield site. The proposed restricted discharge rate will replicate the existing QBAR[4] rate (approximately the 1 in 2.3 year rainfall event). The Interim Code of Practice for Sustainable Drainage Systems[5] has been used to determine the existing QBAR rate, (see Micro Drainage calculation sheet included in Appendix B), as a result a QBAR flow rate of 8.8 l/s has been calculated.

The existing QBAR rate has then been used as the maximum proposed discharge rate for the site (up to including the 100 year event plus 20% for climate change). Therefore this will offer betterment over the current unrestricted greenfield run-off.

3. Proposed Drainage Strategy

3.1 Surface Water

This section should be ready in conjunction with Appendix F: the proposed drainage strategy drawing reference 5121643-ATK-DR-D-0807.

Surface water will typically drain via gullies or channel drains to a gravity fed pipe system which will flow to a proposed attenuation pond located to the south western part of the site adjacent to Horninglow channel.

The proposed discharge rate will be controlled via a flow control device downstream of the proposed attenuation pond as shown on drawing 5121643-ATK-DR-D-0807.

Due to the number of proposed car parking spaces an oil interceptor has been proposed immediately upstream of the attenuation pond.

The outfall for Phase 3 is into Horninglow channel, which ultimately discharges to the River Trent. On review of the topographical survey information and existing river modelling[6] provided by the Environment Agency (EA), it has been established the network should be designed with a free discharge and surcharged outfall condition. The closest node to the site outfall is SHOB01_059.2 and the water level used for the surcharged analysis is 45.24 mAOD, which is the level in the 100 year return period. A copy of the EA data is included in Appendix C.

Enclosed within Appendix D are the calculations and results for the proposed surface water system. The results of these calculations identify that the site is resilient to the 100 year event plus 20% (for climate change) on site with a simultaneous 1 in 100 year event river flow in the Horninglow channel. In this extreme event, there is 12m^3 of flooding reported at the pond node. To manage these flows the proposed ground in this area has been lowered to ensure that this water does not overflow towards a proposed building and is contained within the site boundary.

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[4] QBAR is defined as the mean annual flood flow from a rural catchment, approximately 2.3 year return period.

[5] Interim Code of Practice for Sustainable Drainage Systems. Produced by the National SuDS Working Group, July 2004.

[6] Data provided by the EA in a response to a Product 4 request, information provided in March 2015.

3.2 Foul Water

This section should be ready in conjunction with Appendix F: the proposed drainage strategy drawing reference 5121643-ATK-DR-D-0807.

The proposed foul water drainage strategy is to drain via gravity to an on plot private pumping station. From the pumping station there will be a proposed rising main that will run across the site, towards Derby Road, where it will follow the highway to an existing Severn Trent manhole SK25243901.

This point of connection has been approved in principle by Severn Trent Water and a requisition process is being progressed to allow the proposed connection to be formed as there is a small length of sewer that will be constructed through private land. A copy of initial preliminary desktop report is included in Appendix E.

The drainage proposals for the site have been designed in accordance with Sewers for Adoption 7th Edition and the FRA produced by Halcrow. Further detailed designs should also meet the requirements as set out in this document as well as industry standards and best practice.

4. Conclusion

This statement has addressed flood risk and drainage issues surrounding the Phase 3 “Albion Gateway” development of land adjacent to the Pirelli premises. Phase 3 is a reconfiguration of part of Phase 2, plus further development within an area previously addressed by an overarching outline planning permission. This statement explains how Phase 3 can be understood in the context of extensive technical work previously undertaken in support of the earlier phases of development on this site. The approach to flood risk and drainage for Phase 3 is a continuation of the principles already agreed for earlier phases, therefore Phase 3 can be delivered successfully from a flood risk and drainage perspective.

Technical note

Appendix A. Albion Gateway (Pirelli Redevelopment) – Finished Floor Levels

Technical note

Project:	Albion Gateway (Pirelli Redevelopment)	**To:**	Jason Tait (Planning Prospects)
Subject:	Finished Flood Levels	**From:**	Cathy Owens (Atkins)
Date:	11 Mar 2015	**cc:**	Mark Smith (Atkins); Keith Rainford (Atkins); Paul Birkenshaw (Atkins)

The Albion Gateway development proposed for the existing Pirelli site in Burton upon Trent has been granted planning permission subject to a number of conditions, including Planning Condition 25 which references Halcrow's FRA which in turn refers to finished floor levels required to mitigate against flood risk:

The development hereby approved shall only be carried out in accordance with the recommendations set out in Section 8.3 of the approved Flood Risk Assessment (prepared by Halcrow and dated 1st August 2011). Reason: As recommended by the Environment Agency to minimise the risk of flooding in accordance with the National Planning Policy Framework (in particular Section 10).

As a response to the 2008 Level 2 SFRA commissioned by East Staffordshire Borough Council (ESBC), Halcrow's site specific FRA stipulated that finished floor levels (FFLs) for the development should be set at 46.11m AOD to mitigate against flooding and protect the development from a breach occurrence of the existing flood defences.

Atkins has been commissioned by St Modwen Developments to demonstrate why a change should be made to the above condition such that the FFLS can be lower than 46.11m AOD. The proposal to provide lower FFLs (to what is stated in the approved FRA) has been put forward following a review of more recent flooding information made available from ESBC as detailed below.

Halcrow's original (approved) Flood Risk Assessment (FRA) for the Pirelli site was based on information provided in ESBC's Level 1 and Level 2 Strategic Flood Risk Assessments originally produced in 2008. Since then, East Staffordshire Borough Council have commissioned WSP to undertake an update to their Level 1 and Level 2 Strategic Flood Risk Assessments and have produced a report dated October 2013.

Table 13 of WSP's report (dated 2013) includes a summary of the overall flood risk to the Pirelli site in Burton upon Trent. An extract of this table is included in Table 1.

Access and egress during 1 in 100 year + Climate Change storm events	General summary comments
Site and surrounding area is not at risk. Safe access/egress via Princess Way.	Defended area. Small surface water risk and high susceptibility to groundwater flooding. Suitable for all types of development.

Table 1. Overall flood risk to the Pirelli site in Burton upon Trent

Table 14 of the same (WSP) report details the potential impacts of the new development on the flood risk to Burton upon Trent and finished floor level requirements. An extract of this table is included in Table 2.

Post development surface water run-off	Floodplain compensation	Finished floor levels
There is flood risk to the surrounding area and therefore surface water runoff should be limited to at most the existing brownfield runoff rates. The potential for limiting the outflow further should be considered to try to reduce the flood risk to the downstream properties.	None of the site is shown to be at risk of fluvial flooding and therefore floodplain compensation will not be required.	Finished floor levels do not need to be raised above the current ground level, other than the inclusion of a freeboard in accordance with Building Regulations.

Table 2. Potential impacts of the new development on the flood risk to Burton upon Trent and finished floor level requirements

Another reason for us proposing FFLs less than 46.11m AOD (in addition to following advice from ESBC as detailed in the above tables), is because we are looking to minimise the volume of imported fill and maintain a sustainable approach to the overall development which would not require the importation of large quantities of fill (requiring large numbers of vehicular traffic). In addition significant raising of site levels would have a material impact on the existing retained Pirelli factory site and operations.

Atkins, in advance of submitting these proposals formally to the Environment Agency, has had initial discussions with them and the overall view was supportive of the approach that is being taken.

The detailed design of the development will consider assessment of safe access and egress, flood depths, rate of onset of flood waters, Building Regulations and the associated information provided within WSP's report dated 29/10/2013 (SFRA Update).

Flood resilient design and the inclusion of sustainable drainage techniques will be incorporated into the design development.

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Appendix B. Rural run-off Calculation for existing greenfield area

ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 700 Urban 0.000
Area (ha) 2.000 Soil 0.450 Region Number Region 4

Results l/s

QBAR Rural 8.8
QBAR Urban 8.8

Q100 years 22.6

Q1 year 7.3
Q30 years 17.2
Q100 years 22.6

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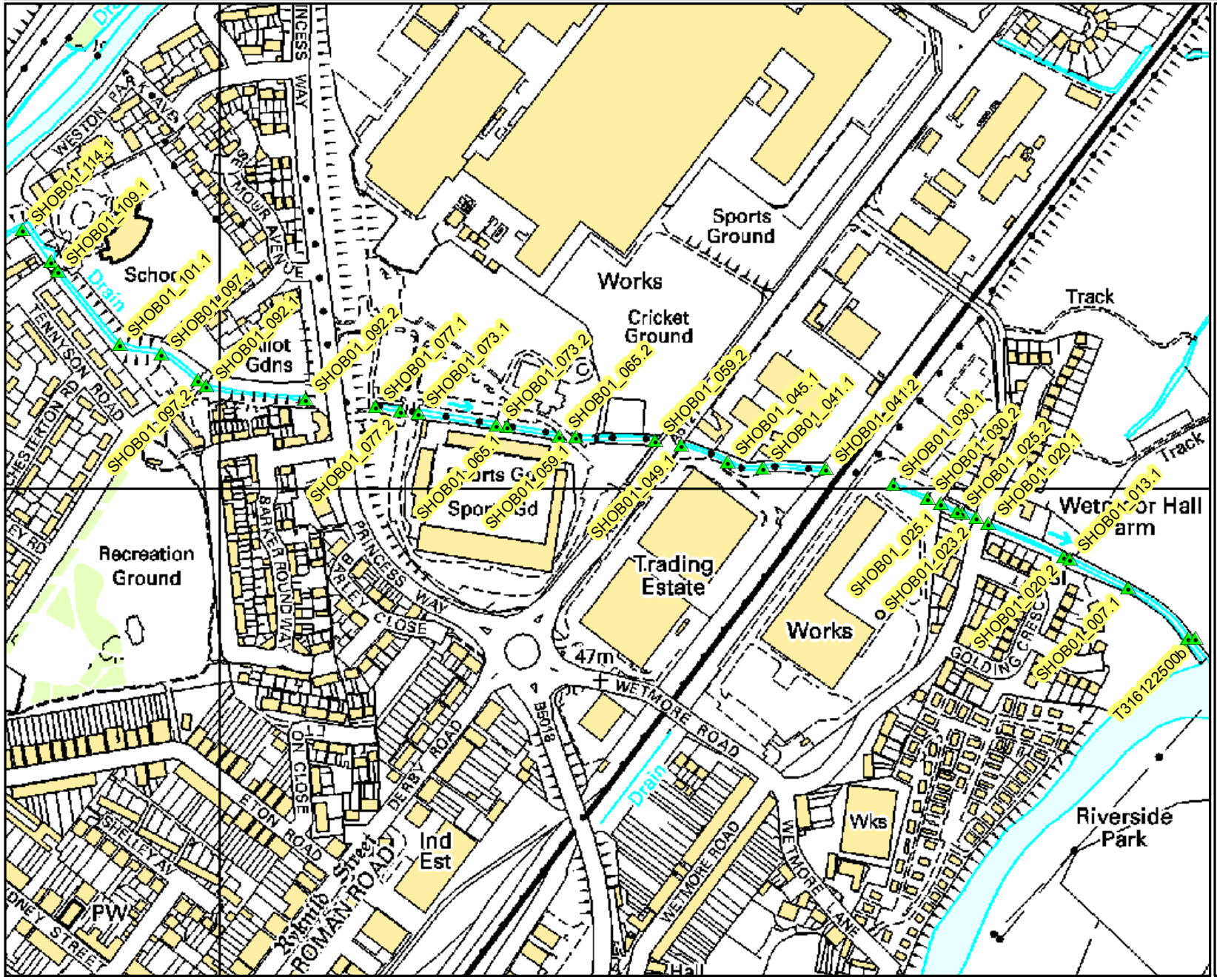
Appendix C. EA - Horninglow Channel Flood Data

Node point location map, Burton, Pirelli site area. Prepared 20 March 2015 Ref. SWWM-9647



Legend

▲ Selected node points

Scale 1:5000

Modelled levels

swwm-9647		**Return period (years),** levels (m AOD)									
SON ref.	**Node**	**02YR**	**05YR**	**10YR**	**20YR**	**50YR**	**75YR**	**100YR**	**1000YR**	**east**	**north**
Trent0484	SHOB01_020.2	43.91	44.27	44.50	44.72	45.02	45.11	45.19	45.92	425754	324939
Trent0485	SHOB01_013.1	43.91	44.26	44.50	44.71	45.01	45.10	45.19	45.95	425759	324937
Trent0486	SHOB01_007.1	43.91	44.26	44.49	44.71	45.01	45.10	45.19	46.08	425811	324911
Trent0487	T316122500a	43.92	44.28	44.50	44.72	45.02	45.11	45.19	45.88	425861	324859
Trent0488	SHOB01_007.2	43.92	44.28	44.50	44.72	45.02	45.11	45.19	45.88	425865	324866
Trent0490	T316122500b	43.92	44.28	44.50	44.72	45.02	45.11	45.19	45.88	425871	324866
Trent0498	SHOB01_020.1	43.92	44.27	44.51	44.72	45.02	45.11	45.19	45.91	425686	324968
Trent0499	SHOB01_023.2	43.92	44.28	44.52	44.73	45.03	45.12	45.19	45.92	425675	324973
Trent0500	SHOB01_023.1	43.92	44.28	44.52	44.73	45.03	45.12	45.19	45.92	425663	324978
Trent0501	SHOB01_025.2	43.93	44.29	44.52	44.74	45.04	45.13	45.20	45.93	425659	324979
Trent0502	SHOB01_025.1	43.93	44.29	44.52	44.74	45.04	45.13	45.20	45.93	425644	324986
Trent0503	SHOB01_030.2	43.93	44.30	44.53	44.75	45.05	45.14	45.20	45.93	425632	324991
Trent0504	SHOB01_030.1	43.94	44.30	44.54	44.75	45.05	45.14	45.20	45.93	425601	325003
Trent0505	SHOB01_041.2	43.94	44.31	44.55	44.76	45.06	45.15	45.21	45.94	425541	325017
Trent0506	SHOB01_041.1	43.94	44.31	44.55	44.76	45.06	45.15	45.21	45.94	425485	325019
Trent0507	SHOB01_045.1	43.95	44.31	44.55	44.76	45.06	45.15	45.21	45.94	425453	325023
Trent0508	SHOB01_049.1	43.95	44.31	44.55	44.76	45.06	45.15	45.21	45.94	425412	325038
Trent0509	SHOB01_059.2	43.97	44.37	44.63	44.82	45.14	45.21	45.24	45.94	425389	325043
Trent0510	SHOB01_059.1	43.98	44.38	44.64	44.83	45.14	45.21	45.24	45.94	425318	325046
Trent0511	SHOB01_065.2	43.98	44.38	44.64	44.83	45.14	45.21	45.24	45.94	425303	325047
Trent0512	SHOB01_065.1	43.99	44.38	44.64	44.83	45.14	45.22	45.24	45.94	425257	325055
Trent0513	SHOB01_073.2	43.99	44.39	44.65	44.83	45.15	45.22	45.25	45.94	425247	325056
Trent0520	SHOB01_114.1	44.04	44.44	44.70	44.87	45.19	45.28	45.30	45.95	424824	325231
Trent0521	SHOB01_114.2	44.04	44.43	44.70	44.87	45.19	45.28	45.30	45.95	424850	325202
Trent0522	SHOB01_109.1	44.04	44.43	44.69	44.86	45.18	45.26	45.29	45.95	424855	325193
Trent0523	SHOB01_101.1	44.03	44.42	44.68	44.86	45.18	45.26	45.28	45.95	424910	325128
Trent0524	SHOB01_097.1	44.03	44.42	44.68	44.86	45.18	45.26	45.28	45.95	424948	325119
Trent0525	SHOB01_097.2	44.02	44.42	44.68	44.86	45.18	45.26	45.28	45.95	424981	325096
Trent0526	SHOB01_092.1	44.02	44.41	44.67	44.85	45.17	45.24	45.27	45.95	424988	325091

Trent0527	SHOB01_092.2	44.01	44.40	44.67	44.85	45.17	45.24	45.27	45.95	425077	325080
Trent0528	SHOB01_077.1	44.00	44.40	44.66	44.84	45.15	45.23	45.25	45.94	425139	325073
Trent0529	SHOB01_077.2	44.00	44.39	44.65	44.84	45.15	45.23	45.25	45.94	425162	325069
Trent0530	SHOB01_073.1	44.00	44.39	44.65	44.83	45.15	45.22	45.25	45.94	425177	325067

Defences

swwm-9647		Crest levels m AOD				condition rating		Design Standard of protection
Asset ID	Length, m	down-stream	up-stream	Description	Date	overall	worst	
22998	268.65	45.70	45.70	Blue brick faced piled flood wall	2001	2	3	yrs 200
22875	107.69	45.48	45.85	Floodbank along Wetmore Lane.	1962	2	3	200
22876	219.21	46.61	46.60	Kwikform & gasworks blue brick floodwall	1962	2	2	200
24570	501.87	45.63	45.63	Waste water reclamation works FB.	1962	2	3	200
24571	13.81	45.75	45.75	Floodwall to builders yard.	2001	3	3	200
24572	94.08	46.09	46.04	Piled wall brick clad on dry side	2001	2	3	200
24573	95.67	45.98	45.95	Old station yard brickwork floodwall.	1962	2	2	200
24352	96.67	45.70	45.70	Blue brick clad reinforced concrete flood wall	2001	2	2	200
24353	24.23	45.75	45.75	Poured Concrete pile wall with blue brick facade	2001	2	2	200
24354	74.78	45.75	45.75	New concrete poured pile floodwall, with blue brick facade	2001	2	2	200
49333	34.77	45.58	45.45	Riverside Park Earth Embankment and floodwall.	1962	3	3	100
49334	73.18	45.71	45.71	Electrical estate / Wetmore Laneconcrete wall brick clad	2001	2	2	200
64290	119.44	45.63	45.63	Sewage works Earth embankment	2007	2	2	200
64135	373.62	45.67	45.67	Earth embankment on Wetmore farm housing development	2007	2	2	200
79378	387.53	45.63	45.63	Reclamation works (south) high ground/wall.	1962	3	3	200
79412	32.21	45.46	45.70	Floodbank upstream of Wetmore Lane.	2001	3	3	200
79413	144.35	45.90	45.90	High Ground - Wetmore Lane builders yard	1961	3	3	200
79414	72.41	45.31	45.57	Floodbank to builders yard.	2001	2	3	200
81263	282.80	45.83	45.70	Caravan Park Highground. Precast concrete on embankment	1962	2	3	200
81264	15.26	45.96	45.96	Masonry wall under bridge	2001	3	3	200

116048	748.13	45.78	45.83	Flood embankment adjacent to railway.	1962	3	3	200
129485	107.19	45.83	45.83	Riverside Park Earth Embankment	2007	3	3	200
178662	20.52	45.66	45.64	Wall		3	3	25

Defence Asset Condition Rating		
Grade	**Rating**	**Description**
1	Very Good	Cosmetic defects that will have no effect on performance
2	Good	Minor defects that will not reduce the overall performance of the assets
3	Fair	Defects that could reduce performance of assets
4	Poor	Defects that would significantly reduce the performance of the asset. Further investigation required
5	Very Poor	Severe defects resulting in complete performance failure

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Appendix D. Micro Drainage calculations. Free outfall

D.1. Free Outfall

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm - Free outfall

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.100	Minimum Backdrop Height (m)	0.000
Ratio R	0.400	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	100	Min Design Depth for Optimisation (m)	0.000
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Time Area Diagram for Storm - Free outfall

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.473	4-8	0.774	8-12	0.006

Total Area Contributing (ha) = 1.253

Total Pipe Volume (m³) = 89.047

Network Design Table for Storm - Free outfall

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S1.000	35.674	0.209	170.7	0.035	5.00	0.0	0.600	o	225	
S1.001	38.677	0.228	169.6	0.075	0.00	0.0	0.600	o	300	
S2.000	35.349	0.208	169.9	0.116	5.00	0.0	0.600	o	300	
S1.002	16.812	0.099	169.8	0.015	0.00	0.0	0.600	o	375	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	49.74	5.60	43.748	0.035	0.0	0.0	0.0	1.00	39.7	4.7
S1.001	47.67	6.13	43.464	0.110	0.0	0.0	0.0	1.20	85.1	14.2
S2.000	50.18	5.49	43.444	0.116	0.0	0.0	0.0	1.20	85.0	15.8
S1.002	46.94	6.33	43.161	0.241	0.0	0.0	0.0	1.39	153.2	30.6

Network Design Table for Storm - Free outfall

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S3.000	41.311	0.243	170.0	0.050	5.00	0.0	0.600	o	225	
S1.003	15.918	0.066	241.2	0.017	0.00	0.0	0.600	o	375	
S4.000	42.903	0.238	180.3	0.161	5.00	0.0	0.600	o	375	
S4.001	49.788	0.277	179.7	0.203	0.00	0.0	0.600	o	375	
S1.004	30.091	0.094	320.1	0.025	0.00	0.0	0.600	o	450	
S5.000	18.720	0.078	240.0	0.048	5.00	0.0	0.600	o	300	
S5.001	5.620	0.023	244.3	0.099	0.00	0.0	0.600	o	300	
S6.000	16.951	0.053	319.8	0.027	5.00	0.0	0.600	o	375	
S6.001	34.425	0.108	318.8	0.000	0.00	0.0	0.600	o	375	
S5.002	15.325	0.049	312.8	0.000	0.00	0.0	0.600	o	375	
S1.005	5.639	0.016	350.0	0.014	0.00	0.0	0.600	o	450	
S1.006	20.578	0.059	351.0	0.050	0.00	0.0	0.600	o	450	
S7.000	17.986	0.119	151.3	0.050	5.00	0.0	0.600	o	150	
S8.000	39.870	0.266	150.0	0.150	5.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S3.000	49.37	5.69	43.455	0.050	0.0	0.0	0.0	1.00	39.8	6.7
S1.003	46.14	6.56	43.062	0.308	0.0	0.0	0.0	1.16	128.4	38.5
S4.000	50.00	5.53	43.511	0.161	0.0	0.0	0.0	1.35	148.7	21.8
S4.001	47.61	6.15	43.273	0.364	0.0	0.0	0.0	1.35	148.9	46.9
S1.004	44.68	7.00	42.921	0.697	0.0	0.0	0.0	1.13	179.8	84.3
S5.000	50.94	5.31	43.127	0.048	0.0	0.0	0.0	1.01	71.4	6.6
S5.001	50.54	5.40	43.049	0.147	0.0	0.0	0.0	1.00	70.8	20.1
S6.000	51.06	5.28	43.112	0.027	0.0	0.0	0.0	1.01	111.3	3.7
S6.001	48.74	5.85	43.059	0.027	0.0	0.0	0.0	1.01	111.5	3.7
S5.002	47.79	6.10	42.951	0.174	0.0	0.0	0.0	1.02	112.6	22.5
S1.005	44.40	7.09	42.827	0.885	0.0	0.0	0.0	1.08	171.9	106.4
S1.006	43.43	7.41	42.811	0.935	0.0	0.0	0.0	1.08	171.7	110.0
S7.000	50.69	5.37	43.420	0.050	0.0	0.0	0.0	0.81	14.4	6.9
S8.000	49.63	5.62	43.500	0.150	0.0	0.0	0.0	1.07	42.4	20.2

Network Design Table for Storm - Free outfall

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S8.001	36.280	0.181	200.2	0.050	0.00	0.0	0.600	o	225	
S1.007	39.244	0.087	451.1	0.000	0.00	0.0	0.600	o	525	
S1.008	14.649	0.029	505.1	0.068	0.00	0.0	0.600	|_|	1050	
S1.009	7.300	0.018	405.6	0.000	0.00	0.0	0.600	o	450	
S1.010	9.307	0.023	404.6	0.000	0.00	0.0	0.600	o	450	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S8.001	47.12	6.28	43.234	0.200	0.0	0.0	0.0	0.92	36.6	25.5
S1.007	41.66	8.03	42.752	1.185	0.0	0.0	0.0	1.05	226.9	133.7
S1.008	41.14	8.23	42.665	1.253	0.0	0.0	0.0	1.25	394.5	139.6
S1.009	40.82	8.35	42.636	1.253	0.0	0.0	0.0	1.00	159.7	139.6
S1.010	40.43	8.50	42.618	1.253	0.0	0.0	0.0	1.00	159.8	139.6

Manhole Schedules for Storm - Free outfall

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	45.373	1.625	Open Manhole	1200	S1.000	43.748	225				
S2	45.164	1.700	Open Manhole	1200	S1.001	43.464	300	S1.000	43.539	225	
S3	45.300	1.856	Open Manhole	1200	S2.000	43.444	300				
S4	45.000	1.839	Open Manhole	1350	S1.002	43.161	375	S1.001	43.236	300	
								S2.000	43.236	300	
S5	45.080	1.625	Open Manhole	1200	S3.000	43.455	225				
S6	45.000	1.938	Open Manhole	1350	S1.003	43.062	375	S1.002	43.062	375	
								S3.000	43.212	225	
S7	45.286	1.775	Open Manhole	1500	S4.000	43.511	375				
S8	45.020	1.747	Open Manhole	1500	S4.001	43.273	375	S4.000	43.273	375	
S9	45.000	2.079	Open Manhole	1500	S1.004	42.921	450	S1.003	42.996	375	
								S4.001	42.996	375	
S10	44.827	1.700	Open Manhole	1200	S5.000	43.127	300				
S11	44.749	1.700	Open Manhole	1200	S5.001	43.049	300	S5.000	43.049	300	
S12	45.380	2.268	Open Manhole	1500	S6.000	43.112	375				
S13	45.100	2.041	Open Manhole	1500	S6.001	43.059	375	S6.000	43.059	375	
S14	44.726	1.775	Open Manhole	1500	S5.002	42.951	375	S5.001	43.026	300	
								S6.001	42.951	375	
S15	44.677	1.850	Open Manhole	1500	S1.005	42.827	450	S1.004	42.827	450	
								S5.002	42.902	375	
S17	44.659	1.848	Open Manhole	1500	S1.006	42.811	450	S1.005	42.811	450	
S21	44.920	1.500	Open Manhole	1200	S7.000	43.420	150				
S19	45.000	1.500	Open Manhole	1200	S8.000	43.500	225				
S20	44.940	1.706	Open Manhole	1200	S8.001	43.234	225	S8.000	43.234	225	
S18	44.950	2.198	Open Manhole	1500	S1.007	42.752	525	S1.006	42.752	450	
								S7.000	43.301	150	174
								S8.001	43.053	225	1
S22	44.900	2.235	Open Manhole	1500	S1.008	42.665	1050	S1.007	42.665	525	
S23	44.900	2.264	Open Manhole	1500	S1.009	42.636	450	S1.008	42.636	1050	
S24	44.900	2.282	Open Manhole	1500	S1.010	42.618	450	S1.009	42.618	450	
S25	44.643	2.048	Open Manhole	1350		OUTFALL		S1.010	42.595	450	

Area Summary for Storm - Free outfall

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.035	0.035	0.035
1.001	-	-	100	0.075	0.075	0.075
2.000	-	-	100	0.116	0.116	0.116
1.002	-	-	100	0.015	0.015	0.015
3.000	-	-	100	0.050	0.050	0.050
1.003	-	-	100	0.017	0.017	0.017
4.000	-	-	100	0.161	0.161	0.161
4.001	-	-	100	0.203	0.203	0.203
1.004	-	-	100	0.025	0.025	0.025
5.000	-	-	100	0.048	0.048	0.048
5.001	-	-	100	0.099	0.099	0.099
6.000	-	-	100	0.027	0.027	0.027
6.001	-	-	100	0.000	0.000	0.000
5.002	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.014	0.014	0.014
1.006	-	-	100	0.050	0.050	0.050
7.000	-	-	100	0.050	0.050	0.050
8.000	-	-	100	0.150	0.150	0.150
8.001	-	-	100	0.050	0.050	0.050
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.068	0.068	0.068
1.009	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.253	1.253	1.253

Surcharged Outfall Details for Storm - Free outfall

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.010	S25	44.643	42.595	0.000	1350	0

Datum (m) 0.000 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	0.000	12	0.000	23	0.000	34	0.000	45	0.000	56	0.000	67	0.000
2	0.000	13	0.000	24	0.000	35	0.000	46	0.000	57	0.000	68	0.000
3	0.000	14	0.000	25	0.000	36	0.000	47	0.000	58	0.000	69	0.000
4	0.000	15	0.000	26	0.000	37	0.000	48	0.000	59	0.000	70	0.000
5	0.000	16	0.000	27	0.000	38	0.000	49	0.000	60	0.000	71	0.000
6	0.000	17	0.000	28	0.000	39	0.000	50	0.000	61	0.000	72	0.000
7	0.000	18	0.000	29	0.000	40	0.000	51	0.000	62	0.000	73	0.000
8	0.000	19	0.000	30	0.000	41	0.000	52	0.000	63	0.000	74	0.000
9	0.000	20	0.000	31	0.000	42	0.000	53	0.000	64	0.000	75	0.000
10	0.000	21	0.000	32	0.000	43	0.000	54	0.000	65	0.000	76	0.000
11	0.000	22	0.000	33	0.000	44	0.000	55	0.000	66	0.000	77	0.000

Surcharged Outfall Details for Storm - Free outfall

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
20098	0.000	20107	0.000	20116	0.000	20125	0.000	20134	0.000	20143	0.000	20152	0.000
20099	0.000	20108	0.000	20117	0.000	20126	0.000	20135	0.000	20144	0.000	20153	0.000
20100	0.000	20109	0.000	20118	0.000	20127	0.000	20136	0.000	20145	0.000	20154	0.000
20101	0.000	20110	0.000	20119	0.000	20128	0.000	20137	0.000	20146	0.000	20155	0.000
20102	0.000	20111	0.000	20120	0.000	20129	0.000	20138	0.000	20147	0.000	20156	0.000
20103	0.000	20112	0.000	20121	0.000	20130	0.000	20139	0.000	20148	0.000	20157	0.000
20104	0.000	20113	0.000	20122	0.000	20131	0.000	20140	0.000	20149	0.000	20158	0.000
20105	0.000	20114	0.000	20123	0.000	20132	0.000	20141	0.000	20150	0.000	20159	0.000
20106	0.000	20115	0.000	20124	0.000	20133	0.000	20142	0.000	20151	0.000	20160	0.000

Simulation Criteria for Storm - Free outfall

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.100	Storm Duration (mins)	30
Ratio R	0.400		

Online Controls for Storm - Free outfall

Hydro-Brake Optimum® Manhole: S24, DS/PN: S1.010, Volume (m³): 5.0

Unit Reference	MD-SHE-0128-8800-1600-8800
Design Head (m)	1.600
Design Flow (l/s)	8.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	128
Invert Level (m)	42.618
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	8.7	Kick-Flo®	0.974	6.9
Flush-Flo™	0.468	8.7	Mean Flow over Head Range	-	7.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.6	1.200	7.6	3.000	11.7	7.000	17.6
0.200	7.7	1.400	8.2	3.500	12.6	7.500	18.2
0.300	8.4	1.600	8.7	4.000	13.5	8.000	18.8
0.400	8.6	1.800	9.2	4.500	14.2	8.500	19.3
0.500	8.7	2.000	9.7	5.000	15.0	9.000	19.8
0.600	8.6	2.200	10.1	5.500	15.7	9.500	20.4
0.800	8.1	2.400	10.6	6.000	16.3		
1.000	7.0	2.600	11.0	6.500	17.0		

Storage Structures for Storm - Free outfall

Tank or Pond Manhole: S24, DS/PN: S1.010

Invert Level (m) 42.618

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	370.0	1.000	660.0	1.001	826.0	1.800	1020.0

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.100	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	100	+20%	100/15 Summer				44.938
S1.001	S2	15 Winter	100	+20%	30/15 Winter				44.906
S2.000	S3	15 Winter	100	+20%	30/15 Winter				44.905
S1.002	S4	15 Winter	100	+20%	30/15 Summer				44.806
S3.000	S5	15 Winter	100	+20%	30/15 Winter				44.758
S1.003	S6	15 Winter	100	+20%	30/15 Summer				44.701
S4.000	S7	15 Winter	100	+20%	100/15 Summer				44.968
S4.001	S8	15 Winter	100	+20%	30/15 Winter				44.850
S1.004	S9	15 Winter	100	+20%	30/15 Summer				44.611
S5.000	S10	15 Winter	100	+20%	30/15 Summer				44.464
S5.001	S11	15 Winter	100	+20%	30/15 Summer				44.451
S6.000	S12	15 Winter	100	+20%	30/15 Summer				44.444
S6.001	S13	15 Winter	100	+20%	30/15 Summer				44.440
S5.002	S14	15 Winter	100	+20%	30/15 Summer				44.436
S1.005	S15	15 Winter	100	+20%	30/15 Summer				44.384
S1.006	S17	15 Winter	100	+20%	30/15 Summer				44.125
S7.000	S21	15 Winter	100	+20%	30/15 Summer				44.047
S8.000	S19	15 Winter	100	+20%	30/15 Summer	100/15 Summer			45.002
S8.001	S20	15 Winter	100	+20%	30/15 Summer				44.573
S1.007	S18	15 Winter	100	+20%	30/15 Summer				43.859

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.965	0.000	0.40		14.8	SURCHARGED	
S1.001	S2	1.142	0.000	0.58		45.5	FLOOD RISK	
S2.000	S3	1.161	0.000	0.62		48.2	SURCHARGED	
S1.002	S4	1.270	0.000	0.67		82.4	FLOOD RISK	
S3.000	S5	1.078	0.000	0.52		19.5	SURCHARGED	
S1.003	S6	1.264	0.000	0.98		101.7	FLOOD RISK	
S4.000	S7	1.082	0.000	0.48		64.9	SURCHARGED	
S4.001	S8	1.202	0.000	1.08		148.1	FLOOD RISK	
S1.004	S9	1.240	0.000	1.59		246.2	SURCHARGED	
S5.000	S10	1.037	0.000	0.29		17.8	SURCHARGED	
S5.001	S11	1.102	0.000	1.32		64.1	FLOOD RISK	
S6.000	S12	0.957	0.000	0.10		9.1	SURCHARGED	
S6.001	S13	1.006	0.000	0.15		15.1	SURCHARGED	
S5.002	S14	1.110	0.000	0.50		44.9	FLOOD RISK	
S1.005	S15	1.107	0.000	2.54		286.5	FLOOD RISK	
S1.006	S17	0.864	0.000	2.15		299.5	SURCHARGED	
S7.000	S21	0.477	0.000	1.75		23.6	SURCHARGED	
S8.000	S19	1.277	2.300	1.46		58.8	FLOOD	3
S8.001	S20	1.114	0.000	2.26		78.2	SURCHARGED	
S1.007	S18	0.582	0.000	1.93		381.0	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.008	S22	480 Winter	100	+20%					43.668
S1.009	S23	480 Winter	100	+20%	30/15 Summer				43.668
S1.010	S24	480 Winter	100	+20%	30/30 Winter				43.666

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.008	S22	-1.232	0.000	0.04		69.6	OK	
S1.009	S23	0.582	0.000	0.70		67.8	SURCHARGED	
S1.010	S24	0.598	0.000	0.09		8.7	SURCHARGED	

Technical note

D.2. Surcharged Outfall

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm - Surcharged outfall

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.100	Minimum Backdrop Height (m)	0.000
Ratio R	0.400	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	100	Min Design Depth for Optimisation (m)	0.000
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Time Area Diagram for Storm - Surcharged outfall

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.473	4-8	0.774	8-12	0.006

Total Area Contributing (ha) = 1.253

Total Pipe Volume (m³) = 89.049

Network Design Table for Storm - Surcharged outfall

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S1.000	35.674	0.209	170.7	0.035	5.00	0.0	0.600	o	225	
S1.001	38.677	0.228	169.6	0.075	0.00	0.0	0.600	o	300	
S2.000	35.349	0.208	169.9	0.116	5.00	0.0	0.600	o	300	
S1.002	16.812	0.099	169.8	0.015	0.00	0.0	0.600	o	375	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	49.74	5.60	43.748	0.035	0.0	0.0	0.0	1.00	39.7	4.7
S1.001	47.67	6.13	43.464	0.110	0.0	0.0	0.0	1.20	85.1	14.2
S2.000	50.18	5.49	43.444	0.116	0.0	0.0	0.0	1.20	85.0	15.8
S1.002	46.94	6.33	43.161	0.241	0.0	0.0	0.0	1.39	153.2	30.6

Network Design Table for Storm - Surcharged outfall

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S3.000	41.311	0.243	170.0	0.050	5.00	0.0	0.600	o	225	
S1.003	15.918	0.066	241.2	0.017	0.00	0.0	0.600	o	375	
S4.000	42.903	0.238	180.3	0.161	5.00	0.0	0.600	o	375	
S4.001	49.788	0.277	179.7	0.203	0.00	0.0	0.600	o	375	
S1.004	30.091	0.094	320.1	0.025	0.00	0.0	0.600	o	450	
S5.000	18.720	0.078	240.0	0.048	5.00	0.0	0.600	o	300	
S5.001	5.620	0.023	244.3	0.099	0.00	0.0	0.600	o	300	
S6.000	16.951	0.053	319.8	0.027	5.00	0.0	0.600	o	375	
S6.001	34.425	0.108	318.8	0.000	0.00	0.0	0.600	o	375	
S5.002	15.325	0.049	312.8	0.000	0.00	0.0	0.600	o	375	
S1.005	5.639	0.016	350.0	0.014	0.00	0.0	0.600	o	450	
S1.006	20.578	0.059	351.0	0.050	0.00	0.0	0.600	o	450	
S7.000	17.818	0.119	149.9	0.050	5.00	0.0	0.600	o	150	
S8.000	39.945	0.266	150.3	0.150	5.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S3.000	49.37	5.69	43.455	0.050	0.0	0.0	0.0	1.00	39.8	6.7
S1.003	46.14	6.56	43.062	0.308	0.0	0.0	0.0	1.16	128.4	38.5
S4.000	50.00	5.53	43.511	0.161	0.0	0.0	0.0	1.35	148.7	21.8
S4.001	47.61	6.15	43.273	0.364	0.0	0.0	0.0	1.35	148.9	46.9
S1.004	44.68	7.00	42.921	0.697	0.0	0.0	0.0	1.13	179.8	84.3
S5.000	50.94	5.31	43.127	0.048	0.0	0.0	0.0	1.01	71.4	6.6
S5.001	50.54	5.40	43.049	0.147	0.0	0.0	0.0	1.00	70.8	20.1
S6.000	51.06	5.28	43.112	0.027	0.0	0.0	0.0	1.01	111.3	3.7
S6.001	48.74	5.85	43.059	0.027	0.0	0.0	0.0	1.01	111.5	3.7
S5.002	47.79	6.10	42.951	0.174	0.0	0.0	0.0	1.02	112.6	22.5
S1.005	44.40	7.09	42.827	0.885	0.0	0.0	0.0	1.08	171.9	106.4
S1.006	43.43	7.41	42.811	0.935	0.0	0.0	0.0	1.08	171.7	110.0
S7.000	50.71	5.36	43.420	0.050	0.0	0.0	0.0	0.82	14.5	6.9
S8.000	49.62	5.63	43.500	0.150	0.0	0.0	0.0	1.06	42.3	20.2

Network Design Table for Storm - Surcharged outfall

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
S8.001	36.378	0.181	200.8	0.050	0.00	0.0	0.600	o	225	
S1.007	39.244	0.087	451.1	0.000	0.00	0.0	0.600	o	525	
S1.008	14.649	0.029	505.1	0.068	0.00	0.0	0.600	|_|	1050	
S1.009	7.287	0.018	404.8	0.000	0.00	0.0	0.600	o	450	
S1.010	9.307	0.023	404.7	0.000	0.00	0.0	0.600	o	450	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S8.001	47.11	6.29	43.234	0.200	0.0	0.0	0.0	0.92	36.5	25.5
S1.007	41.66	8.03	42.752	1.185	0.0	0.0	0.0	1.05	226.9	133.7
S1.008	41.14	8.23	42.665	1.253	0.0	0.0	0.0	1.25	394.5	139.6
S1.009	40.82	8.35	42.636	1.253	0.0	0.0	0.0	1.00	159.7	139.6
S1.010	40.43	8.50	42.618	1.253	0.0	0.0	0.0	1.00	159.7	139.6

Manhole Schedules for Storm - Surcharged outfall

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	45.373	1.625	Open Manhole	1200	S1.000	43.748	225				
S2	45.164	1.700	Open Manhole	1200	S1.001	43.464	300	S1.000	43.539	225	
S3	45.300	1.856	Open Manhole	1200	S2.000	43.444	300				
S4	45.000	1.839	Open Manhole	1350	S1.002	43.161	375	S1.001	43.236	300	
								S2.000	43.236	300	
S5	45.080	1.625	Open Manhole	1200	S3.000	43.455	225				
S6	45.000	1.938	Open Manhole	1350	S1.003	43.062	375	S1.002	43.062	375	
								S3.000	43.212	225	
S7	45.286	1.775	Open Manhole	1500	S4.000	43.511	375				
S8	45.020	1.747	Open Manhole	1500	S4.001	43.273	375	S4.000	43.273	375	
S9	45.000	2.079	Open Manhole	1500	S1.004	42.921	450	S1.003	42.996	375	
								S4.001	42.996	375	
S10	44.827	1.700	Open Manhole	1200	S5.000	43.127	300				
S11	44.749	1.700	Open Manhole	1200	S5.001	43.049	300	S5.000	43.049	300	
S12	45.380	2.268	Open Manhole	1500	S6.000	43.112	375				
S13	45.100	2.041	Open Manhole	1500	S6.001	43.059	375	S6.000	43.059	375	
S14	44.726	1.775	Open Manhole	1500	S5.002	42.951	375	S5.001	43.026	300	
								S6.001	42.951	375	
S15	44.677	1.850	Open Manhole	1500	S1.005	42.827	450	S1.004	42.827	450	
								S5.002	42.902	375	
S17	44.659	1.848	Open Manhole	1500	S1.006	42.811	450	S1.005	42.811	450	
S21	44.920	1.500	Open Manhole	1200	S7.000	43.420	150				
S19	45.000	1.500	Open Manhole	1200	S8.000	43.500	225				
S20	44.940	1.706	Open Manhole	1200	S8.001	43.234	225	S8.000	43.234	225	
S18	44.950	2.198	Open Manhole	1500	S1.007	42.752	525	S1.006	42.752	450	
								S7.000	43.301	150	174
								S8.001	43.053	225	1
S22	44.900	2.235	Open Manhole	1500	S1.008	42.665	1050	S1.007	42.665	525	
S23	44.900	2.264	Open Manhole	1500	S1.009	42.636	450	S1.008	42.636	1050	
S24	44.900	2.282	Open Manhole	1500	S1.010	42.618	450	S1.009	42.618	450	
S25	44.643	2.048	Open Manhole	1350		OUTFALL		S1.010	42.595	450	

Area Summary for Storm - Surcharged outfall

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.035	0.035	0.035
1.001	-	-	100	0.075	0.075	0.075
2.000	-	-	100	0.116	0.116	0.116
1.002	-	-	100	0.015	0.015	0.015
3.000	-	-	100	0.050	0.050	0.050
1.003	-	-	100	0.017	0.017	0.017
4.000	-	-	100	0.161	0.161	0.161
4.001	-	-	100	0.203	0.203	0.203
1.004	-	-	100	0.025	0.025	0.025
5.000	-	-	100	0.048	0.048	0.048
5.001	-	-	100	0.099	0.099	0.099
6.000	-	-	100	0.027	0.027	0.027
6.001	-	-	100	0.000	0.000	0.000
5.002	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.014	0.014	0.014
1.006	-	-	100	0.050	0.050	0.050
7.000	-	-	100	0.050	0.050	0.050
8.000	-	-	100	0.150	0.150	0.150
8.001	-	-	100	0.050	0.050	0.050
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.068	0.068	0.068
1.009	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.253	1.253	1.253

Surcharged Outfall Details for Storm - Surcharged outfall

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.010	S25	44.643	42.595	0.000	1350	0

Datum (m) 0.000 Offset (mins) 0

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1	45.240	12	45.240	23	45.240	34	45.240	45	45.240	56	45.240
2	45.240	13	45.240	24	45.240	35	45.240	46	45.240	57	45.240
3	45.240	14	45.240	25	45.240	36	45.240	47	45.240	58	45.240
4	45.240	15	45.240	26	45.240	37	45.240	48	45.240	59	45.240
5	45.240	16	45.240	27	45.240	38	45.240	49	45.240	60	45.240
6	45.240	17	45.240	28	45.240	39	45.240	50	45.240	61	45.240
7	45.240	18	45.240	29	45.240	40	45.240	51	45.240	62	45.240
8	45.240	19	45.240	30	45.240	41	45.240	52	45.240	63	45.240
9	45.240	20	45.240	31	45.240	42	45.240	53	45.240	64	45.240
10	45.240	21	45.240	32	45.240	43	45.240	54	45.240	65	45.240
11	45.240	22	45.240	33	45.240	44	45.240	55	45.240	66	45.240

Surcharged Outfall Details for Storm - Surcharged outfall

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
20035	45.240	20056	45.240	20077	45.240	20098	45.240	20119	45.240	20140	45.240
20036	45.240	20057	45.240	20078	45.240	20099	45.240	20120	45.240	20141	45.240
20037	45.240	20058	45.240	20079	45.240	20100	45.240	20121	45.240	20142	45.240
20038	45.240	20059	45.240	20080	45.240	20101	45.240	20122	45.240	20143	45.240
20039	45.240	20060	45.240	20081	45.240	20102	45.240	20123	45.240	20144	45.240
20040	45.240	20061	45.240	20082	45.240	20103	45.240	20124	45.240	20145	45.240
20041	45.240	20062	45.240	20083	45.240	20104	45.240	20125	45.240	20146	45.240
20042	45.240	20063	45.240	20084	45.240	20105	45.240	20126	45.240	20147	45.240
20043	45.240	20064	45.240	20085	45.240	20106	45.240	20127	45.240	20148	45.240
20044	45.240	20065	45.240	20086	45.240	20107	45.240	20128	45.240	20149	45.240
20045	45.240	20066	45.240	20087	45.240	20108	45.240	20129	45.240	20150	45.240
20046	45.240	20067	45.240	20088	45.240	20109	45.240	20130	45.240	20151	45.240
20047	45.240	20068	45.240	20089	45.240	20110	45.240	20131	45.240	20152	45.240
20048	45.240	20069	45.240	20090	45.240	20111	45.240	20132	45.240	20153	45.240
20049	45.240	20070	45.240	20091	45.240	20112	45.240	20133	45.240	20154	45.240
20050	45.240	20071	45.240	20092	45.240	20113	45.240	20134	45.240	20155	45.240
20051	45.240	20072	45.240	20093	45.240	20114	45.240	20135	45.240	20156	45.240
20052	45.240	20073	45.240	20094	45.240	20115	45.240	20136	45.240	20157	45.240
20053	45.240	20074	45.240	20095	45.240	20116	45.240	20137	45.240	20158	45.240
20054	45.240	20075	45.240	20096	45.240	20117	45.240	20138	45.240	20159	45.240
20055	45.240	20076	45.240	20097	45.240	20118	45.240	20139	45.240	20160	45.240

Simulation Criteria for Storm - Surcharged outfall

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.100	Storm Duration (mins)	30
Ratio R	0.400		

Online Controls for Storm - Surcharged outfall

Hydro-Brake Optimum® Manhole: S24, DS/PN: S1.010, Volume (m³): 5.0

Unit Reference	MD-SHE-0128-8800-1600-8800
Design Head (m)	1.600
Design Flow (l/s)	8.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	128
Invert Level (m)	42.618
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	8.7	Kick-Flo®	0.974	6.9
Flush-Flo™	0.468	8.7	Mean Flow over Head Range	-	7.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.6	1.200	7.6	3.000	11.7	7.000	17.6
0.200	7.7	1.400	8.2	3.500	12.6	7.500	18.2
0.300	8.4	1.600	8.7	4.000	13.5	8.000	18.8
0.400	8.6	1.800	9.2	4.500	14.2	8.500	19.3
0.500	8.7	2.000	9.7	5.000	15.0	9.000	19.8
0.600	8.6	2.200	10.1	5.500	15.7	9.500	20.4
0.800	8.1	2.400	10.6	6.000	16.3		
1.000	7.0	2.600	11.0	6.500	17.0		

Storage Structures for Storm - Surcharged outfall

Tank or Pond Manhole: S24, DS/PN: S1.010

Invert Level (m) 42.618

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	370.0	1.000	660.0	1.001	826.0	1.800	1020.0

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.100	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Winter	100	+20%	30/7200 Winter			
S1.001	S2	15 Winter	100	+20%	30/15 Winter			
S2.000	S3	15 Winter	100	+20%	30/15 Winter			
S1.002	S4	15 Winter	100	+20%	1/8640 Winter			
S3.000	S5	15 Winter	100	+20%	30/15 Winter			
S1.003	S6	15 Winter	100	+20%	1/5760 Winter			
S4.000	S7	15 Winter	100	+20%	30/4320 Winter			
S4.001	S8	15 Winter	100	+20%	30/15 Winter			
S1.004	S9	15 Winter	100	+20%	1/4320 Winter			
S5.000	S10	10080 Winter	100	+20%	1/5760 Winter			
S5.001	S11	10080 Winter	100	+20%	1/2880 Winter			
S6.000	S12	10080 Winter	100	+20%	1/7200 Winter			
S6.001	S13	10080 Winter	100	+20%	1/5760 Winter			
S5.002	S14	10080 Winter	100	+20%	1/2880 Winter			
S1.005	S15	10080 Winter	100	+20%	1/2160 Winter			
S1.006	S17	10080 Winter	100	+20%	1/2160 Winter			
S7.000	S21	10080 Winter	100	+20%	1/10080 Winter			
S8.000	S19	15 Winter	100	+20%	30/15 Summer	100/15 Summer		
S8.001	S20	15 Winter	100	+20%	1/5760 Winter			
S1.007	S18	10080 Winter	100	+20%	1/2160 Winter			

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	44.938	0.965	0.000	0.40		14.8	SURCHARGED	
S1.001	S2	44.906	1.142	0.000	0.58		45.6	FLOOD RISK	
S2.000	S3	44.905	1.161	0.000	0.62		48.2	SURCHARGED	
S1.002	S4	44.805	1.269	0.000	0.67		82.3	FLOOD RISK	
S3.000	S5	44.757	1.077	0.000	0.52		19.6	SURCHARGED	
S1.003	S6	44.700	1.263	0.000	0.98		101.7	SURCHARGED	
S4.000	S7	44.967	1.081	0.000	0.48		65.0	SURCHARGED	
S4.001	S8	44.850	1.202	0.000	1.08		148.1	FLOOD RISK	
S1.004	S9	44.611	1.240	0.000	1.59		246.2	SURCHARGED	
S5.000	S10	44.518	1.091	0.000	0.00		0.2	SURCHARGED	
S5.001	S11	44.518	1.169	0.000	0.01		0.7	FLOOD RISK	
S6.000	S12	44.518	1.031	0.000	0.00		0.1	SURCHARGED	
S6.001	S13	44.518	1.084	0.000	0.00		0.1	SURCHARGED	
S5.002	S14	44.518	1.192	0.000	0.01		0.8	FLOOD RISK	
S1.005	S15	44.518	1.241	0.000	0.04		4.1	FLOOD RISK	
S1.006	S17	44.518	1.257	0.000	0.03		4.3	FLOOD RISK	
S7.000	S21	44.518	0.948	0.000	0.02		0.2	SURCHARGED	
S8.000	S19	45.002	1.277	2.311	1.46		58.7	FLOOD	3
S8.001	S20	44.573	1.114	0.000	2.26		77.9	SURCHARGED	
S1.007	S18	44.518	1.241	0.000	0.03		5.5	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.008	S22	10080 Winter	100	+20%					44.518
S1.009	S23	10080 Winter	100	+20%	1/360 Winter				44.518
S1.010	S24	10080 Winter	100	+20%	1/360 Winter				44.518

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.008	S22	-0.382	0.000	0.01		13.3	OK	
S1.009	S23	1.432	0.000	0.06		5.7	SURCHARGED	
S1.010	S24	1.450	0.000	0.00		0.0	SURCHARGED	

Technical note

Appendix E. STW – Sewer Requisition – Preliminary Desktop Report

Preliminary Desktop Report

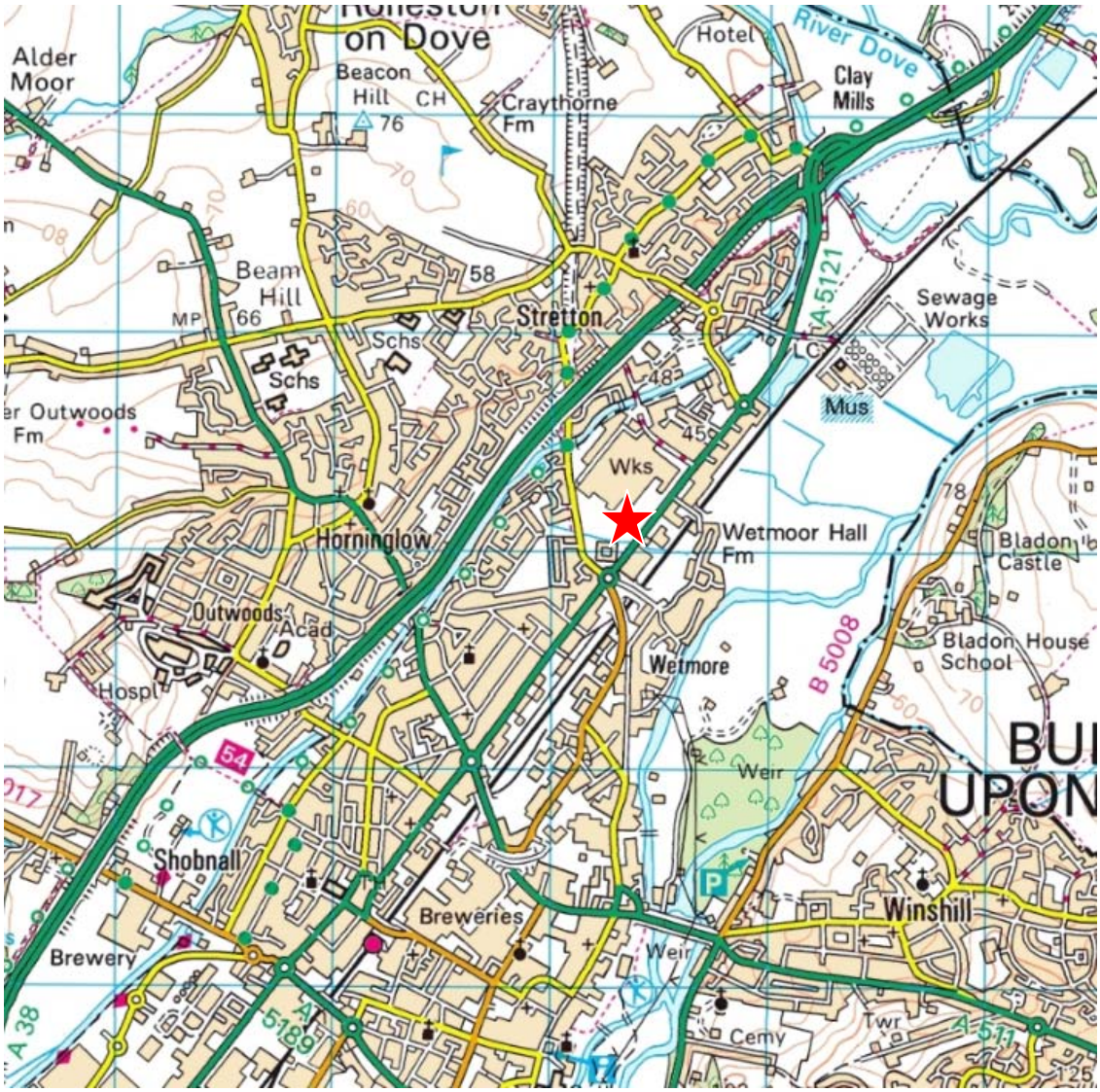
A6S/12844/04/01/05 / 8228853
Pirelli Works, Burton-on-Trent
Sewer Requisition

John Amos, Asset Creation, Severn Trent Water

5th August 2016

Requisition Enquiry by:	**St Modwen Developments Ltd**
Requisition Enquiry at :	Pirelli Works, Burton-on-Trent
Project number:	A6S/12844/04/01/05
Notification number:	8228853
Report prepared by:	Francis Rooney

1) Brief description of the site

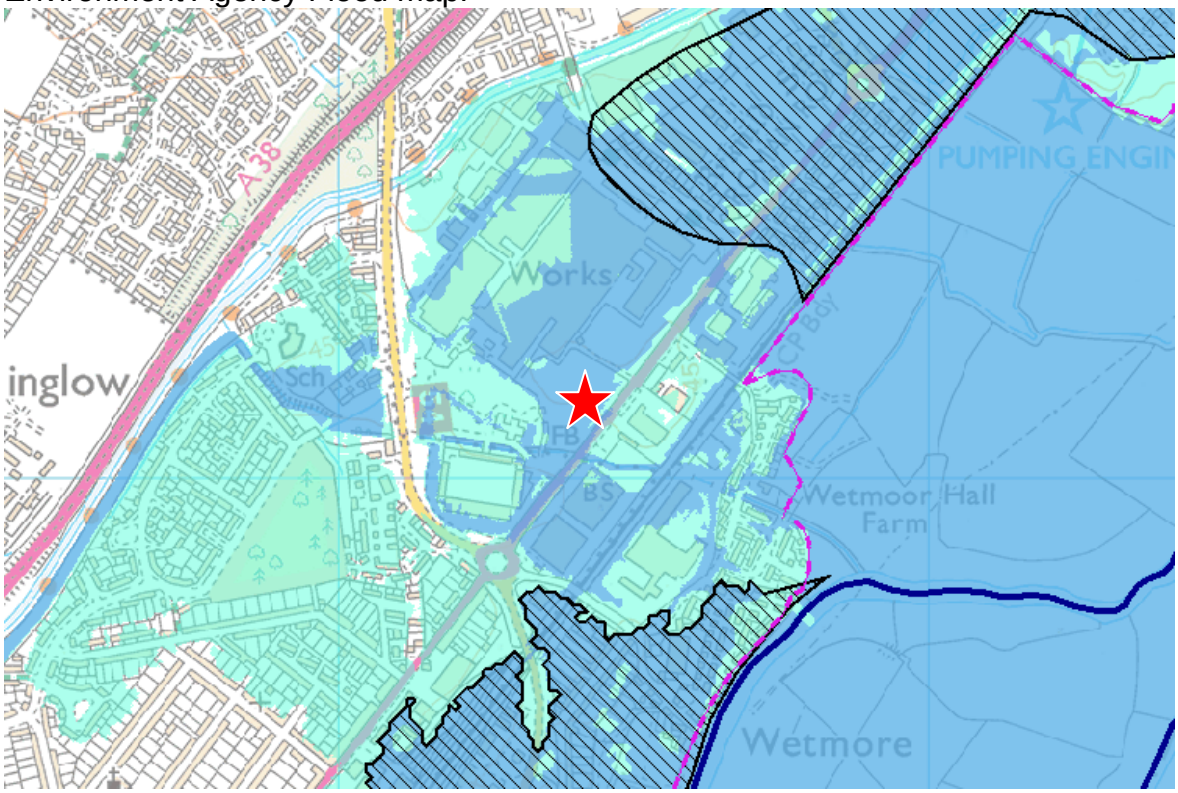


The proposed development site is located off Derby Road, Burton-on-Trent. The site is located in the north of Burton-on-Trent, approximately 2 miles from the City Centre.

The development site is currently a vacant greenfield site, with an empty site to north-east, the Pirelli Tyres works to the north-west, the Pirelli Stadium to the south-west and the A5121 Derby Road to the south-east. The site is approximately 2 ha with a generally flat topography.

The site boundary is shown on drawing number A6S12844-CC00005A in Appendix B.

The proposed development is in a designated flood zone as indicated on Environment Agency Flood map.



A MAGIC search was completed and returned no relevant results

2) Type of sewer requisition and flows to be catered for

The developer has submitted a Sewer Requisition application for a foul water sewer, in accordance with section 98 of the Water Industry Act (1991). The application states that outline planning consent been received for 3 commercial units. The Staffordshire County Council planning consent ref: is P/2011/01130/JN/PO.
The applicant has advised that the peak foul water discharge will be 2.7 litres / second.

3) Description of the existing sewerage system

According to STW sewer records, there is an existing public foul water sewer in the vicinity of the site.
A 150mm diameter foul water sewer is located approximately 50 metres south of the development site. The sewer is located in the carpark of the Pirelli Stadium. Asset Protection have approved discharge of foul water flows from the new development into this sewer.
The sewer is in the Claymills Sewage Treatment Works catchment.

4) Other possible development sites

A search of Glenigans data and Stroud District Council Planning Portal returned the following results in the vicinity of the development site.

MONTH_RECEIVED	HEADING	ADDRESS	APPLICATION_NU	X Ref	Y Ref
132015	11 Employment Units	Land Adjacent To Pirelli Facto,Derby Road,	P/2014/01504	425478	325483
172015	12 Employment Units	Phase 2, Ld Adjacent To Pirelli Factory,Der	P/2015/00285	425478	325483

5) Description of the sewer requisition

On the supplied ‘Phase 3 & 4 Proposed FW Rising Main Requisition Location’ (Drawing No. 5121643-ATK-DR-D-0506 Rev. P1) it is proposed a foul water pumping station is located within the development site and a pressurised foul water sewer would convey flows to a requisitioned foul sewer in Derby Road.

The nearest feasible point of connection to the STW system is a foul sewer located within the carpark of the Pirelli Stadium at manhole SK25243901 (Minimum depth of cover in accordance with STW Design Standards cannot be achieved at a closer point of connection at manhole SK25243903). According to STW Sewer Records the invert level of the manhole is 43.58 metres.

A 150mm dia foul sewer requisition could be laid from the verge in Derby Road at a gradient of 1 in 150, therefore providing required capacity and satisfy self-cleansing requirements as stated in Sewers for Adoption.

Topographical & Manhole surveys would be required to ascertain accurate gradient and levels of the proposed requisition routes.

The proposed requisition routes are detailed on drawing A6S/12844-CC00005A in Appendix B.

6) Cost of the sewer requisition works

	£000's			
Description	**Civils**	**M&E**	**Contract**	**Project**
12m of 150mm dia foul water sewer & 1 no. 1200 dia manhole	29		29	66
Contract total	**29**	**0**	**29**	
Feasibility			6	
Site Investigation / Surveys			3	
Design			2	
Support			1	
Land/Easements			3	
Traffic Management			1	
Compensation			1	
Project Management & Assurance			5	
Sub total (A)			**51**	
Contingencies (25%)			13	
Sub total (B)			**64**	
Overheads (4.34%)			3	
Project total			**66**	**66**

7) Programme

Formal design instruction to completion of detailed feasibility, design, return of tenders	12 Weeks
Tender validity period (lead-in period for New Connections to obtain monies from developer)	(max.) 12 Weeks
Receipt of balance payment to Contract Award (serving notices, negotiation of outfall easements etc)	10 Weeks
Contract award to project commissioning	6 Weeks

The above timescales are an estimate and **may** be affected by possible unavoidable delays as shown below or other unforeseen external factors.

8) Possible unavoidable delays and risks

1. Mitigation strategy for protected species. Habitat Survey - included in programme above (subject to time of year issues).
2. Land Entry Notices to be served (3 weeks – included in programme above).
3. Footpath Closure / Diversion required - TMA notices to be served for works in Derby Road (10 days – included in programme above).
4. Water Mains (South Staffs Water) – Underground Water Mains may cross requisition route, potential requirement for water mains diversion (not included in programme above)
5. Electric Cables (Western Power Distribution) – HV underground cables cross requisition route. Safe working methods in vicinity of underground cables to be utilised. Potential requirement for electric cable diversion (not included in estimate / programme above).
6. Gas Mains (National Grid) – MP / IP gas mains cross requisition route.
   Works approval to be obtained from National Grid.
   Potential requirement for gas main diversion (not included in estimate / programme above).
7. Telecommunication Cables (BT) – Telecommunication cables cross requisition route / Overhead apparatus in vicinity of requisition route. Potential requirement for apparatus diversion. (not included in estimate / programme above).

Appendix A - Photographs

Photo 1: Pirelli Stadium - Existing manhole SK25243901

Photo 2: Derby Road – Proposed requisition manhole location

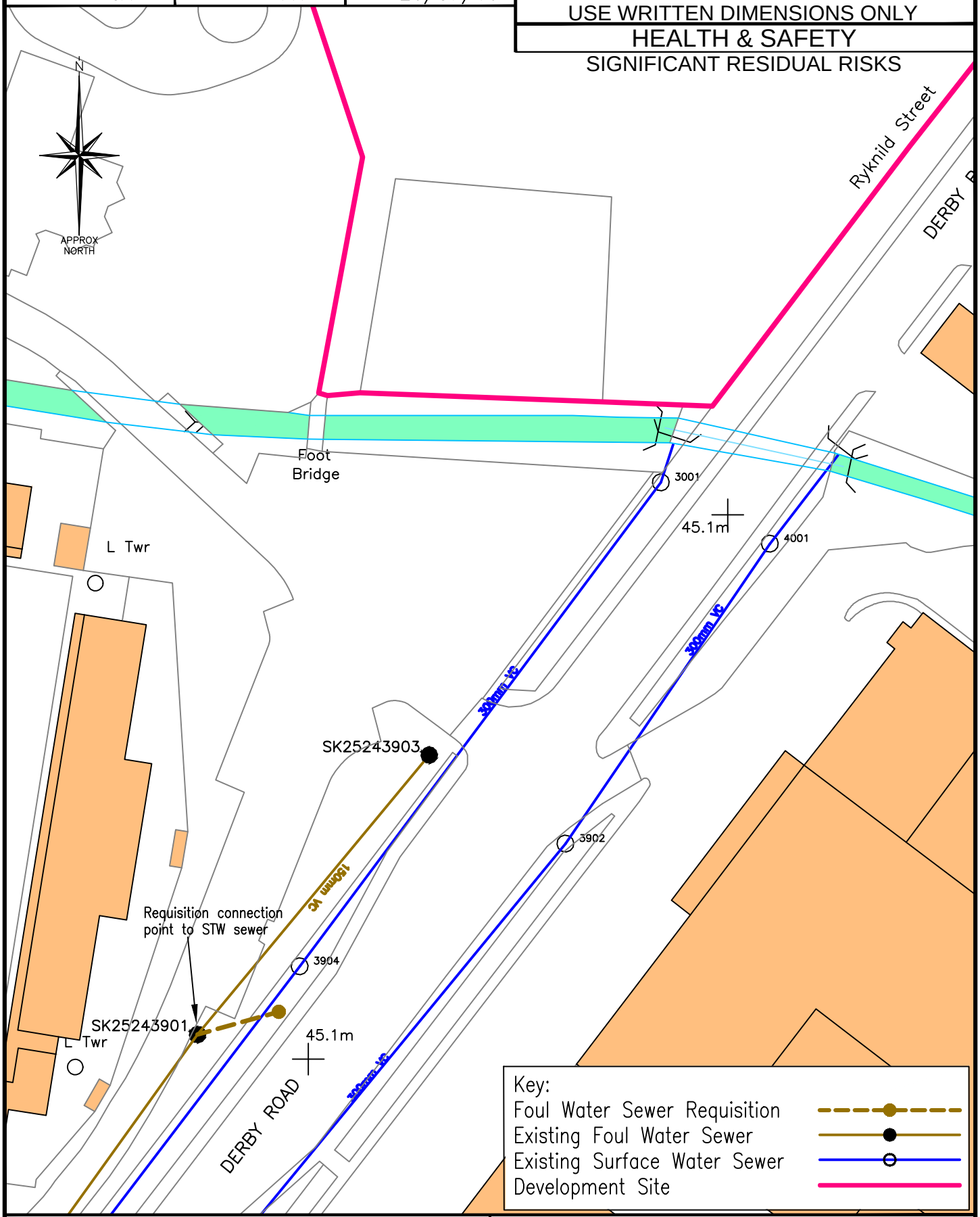
Photo 3: Derby Road – Bus Stop

Appendix B - Plan

ORIGINATOR	DRAWN	DATE
JA	FR	26/07/16

DO NOT SCALE
USE WRITTEN DIMENSIONS ONLY

HEALTH & SAFETY
SIGNIFICANT RESIDUAL RISKS



ISSUE STATUS: PRELIMINARY

SEVERN TRENT WATER

PROJECT TITLE
A6S/12844/04/01/05
WYRE MEADOWS, PERSHORE SEWER DIVERSION

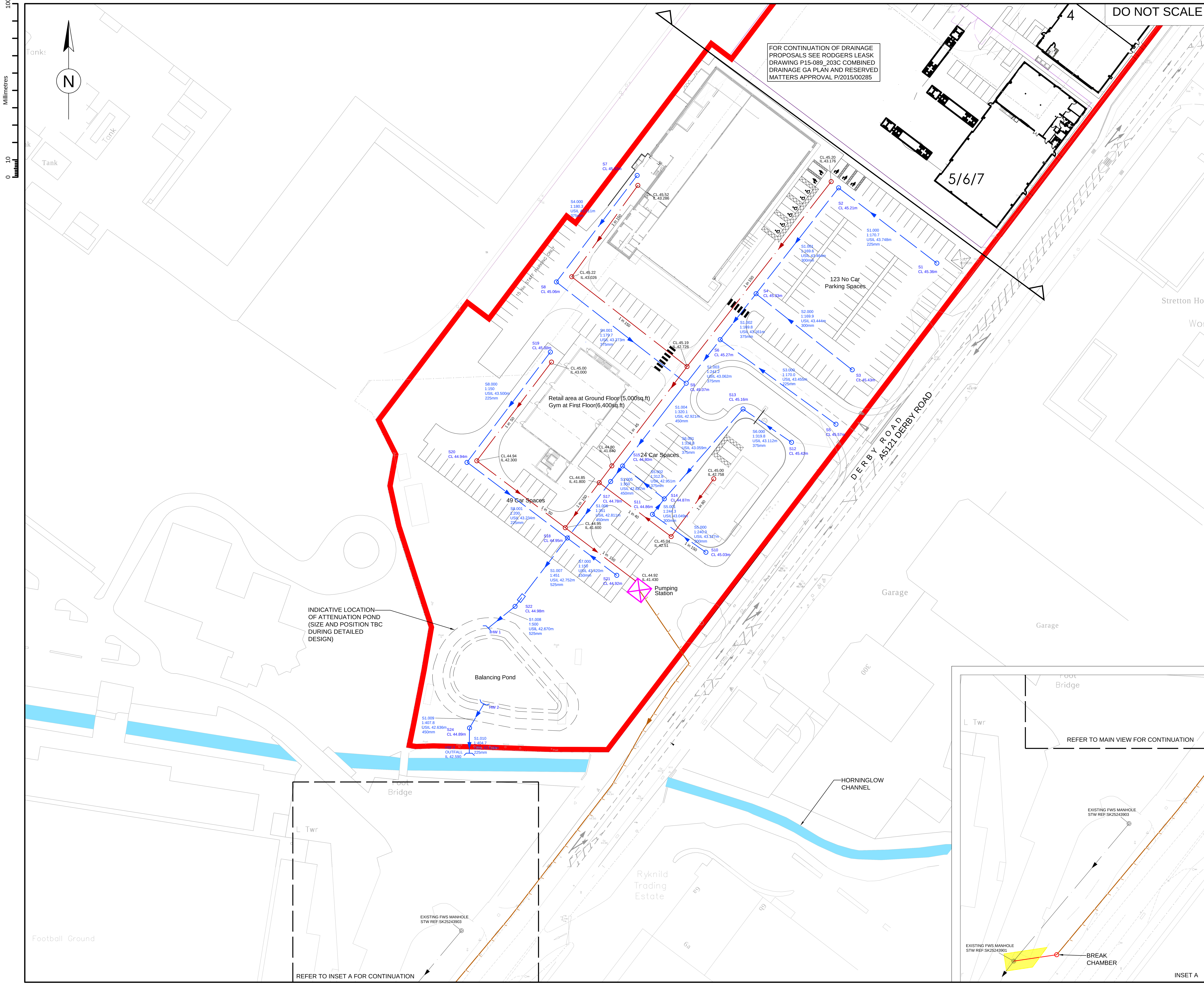
DRAWING TITLE
PRELIMINARY DESKTOP REPORT

SCALE	DRG NO	REV	ORIGINAL SHEET SIZE
1 : 750	A6S12844-CC00005	A	A4

FILENAME: S:\EPS\ENG\SECTION-WIDE DATA\E25\E31\TL1\REQUISITIONS AND DIVERSIONS\PDRS\2016 - 2017\A6S 12844 04 01 05 PIRELLI WORKS, DERBY ROAD

Technical note

Appendix F. Drainage Strategy Drawing



NOTES

1. TOPOGRAPHICAL SURVEY BY GREENHATCH LTD DRAWING REF: 9347C_OGL_REV0.
2. MASTERPLAN BY GLANCY NICHOLLS ARCHITECTS DRAWING REF: 16001-A-MP-ST-DR-A-0002i.

KEY

- PROPOSED STORM NETWORK
- PROPOSED FOUL NETWORK Ø150mm
- FOUL NETWORK TO BE CONSTRUCTED UNDER FOUL REQUISITION
- PROPOSED 5m WIDE SEWER EASEMENT
- EXISTING STW FOUL SEWER
- RISING MAIN
- HEADWALL
- PHASE 3 BOUNDARY
- OIL INTERCEPTOR
- INDICATIVE LOCATION OF FOUL PUMP STATION

Rev.	Date	Description	By	Chk'd	App'd
P8	30/11/16	FWS OUTFALL LOCATION UPDATED	JD	CB	MAS
P7	20/10/16	ADDITIONAL RETAIL UNITS AND GYM ADDED. DESIGN UPDATED ACCORDINGLY	JD	OP	CB
P6	28/09/16	POND SHAPE AMENDED TO AVOID UTILITY EASEMENTS, PUMP STATION MOVED TO SOUTHERN BOUNDARY AND FOOTPRINT REDUCED, MASTERPLAN UPDATED	OP	JD	CB
P5	13/09/16	PHASE 3 BOUNDARY EXTENDED NORTH AND REFERENCE TO RODGERS LEASK DESIGN AND PLANNING APPLICATION ADDED	OP	JD	CB
P4	09/09/16	NOTE ADDED TO POND	OP	JD	CB
P3	08/09/16	OIL INTERCEPTOR DOWNSTREAM OF MH S19 REMOVED, SECOND INTERCEPTOR MOVED TO BE UPSTREAM OF POND, DRAWING TITLE AMENDED	OP	JD	CB
P2	02/09/16	MASTERPLAN UPDATED TO REVISE POSITION OF POND AND REMOVAL OF PUB, SURFACE AND FOUL WATER DRAINAGE HAS BEEN REVISED TO REFLECT CHANGE	OP	JD	CB
P1	05/05/16	FOR COMMENT	NR	LGF	MAS

Drawing Status: FOR INFORMATION
Suitability: S2

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www.atkinsglobal.com

Client: ST.MODWEN

Project Title: PIRELLI REDEVELOPMENT BURTON

Drawing Title: PHASE 3 PROPOSED DRAINAGE

Scale	Designed	Drawn	Checked	Authorised
1:500	JD	JD	LGF	MT
Original Size: A1	Date: 20/02/16	Date: 20/02/16	Date: 03/05/16	Date: 05/05/16

Drawing Number: 5121643-ATK-DR-D-0807
Revision: P8

Drawing file: \\wsatkins.com\project\GBBMA\DE2\Drw80\5121643 Pirelli (MAS)\50. DRAWINGS\54.WORKING\Phase 3 & 4\5121643-ATK-DR-D-0807 - Phase 3 & 4 - Proposed Drainage.dwg

Technical note

Appendix G. Technical Note - Derby Road Drainage Discharge Rates - Phases 1 & 2

Technical note

Pirelli Site Redevelopment: Albion Gateway Mixed-use Development

Drainage Discharge Rates: Phases 1 & 2

Client: St Modwen

March 2015

Document history

Job number: 5121643			**Document ref: Drainage Discharge Rates: Phases 1 & 2**			
Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 1.0	For LLFA Approval	CO	PB	KMR	MS	03/03/15

Technical note

1. Background

The new commercial/industrial Albion Gateway development proposed for the southern side of Pirelli's factory site in Burton-upon-Trent lends itself to two outfall locations; the Stretton Brook to the north and the Horninglow Channel to the south. A development enquiry was submitted to Severn Trent Water and a response has been received stating that surface water proposals should be agreed with the Lead Local Flood Authority (Staffordshire County Council). The drainage strategy for Phases 1 & 2 is being developed on the basis that the discharge point will be to the nearest available outfall which is the existing culvert in Beech Avenue (the culverted Stretton Brook) to the north (which ultimately discharges to the River Trent).

The planning consent document for the development site (East Staffordshire Borough Council Application Reference P/2011/01130/JN/PO) includes the following drainage condition (Condition 25):

> 25. *The development hereby approved shall only be carried out in accordance with the recommendations set out in Section 8.3 of the approved Flood Risk Assessment (prepared by Halcrow and dated 1st August 2011).*
>
> *Reason: As recommended by the Environment Agency to minimise the risk of flooding in accordance with the National Planning Policy Framework (in particular Section 10).*

The following text is an extract from Section 8.3 ("Recommendations") of Halcrow's FRA which makes reference to surface water proposals:

> *To provide additional safety to the development and to ensure any residual flood risk is mitigated for, it is recommended that the following measures are incorporated into the design, build and operation of the Pirelli development:*
>
> *…*
>
> 5. *Surface water runoff from the site is disposed of in a sustainable manner through the use of SuDS as recommended by PPS 25. A betterment of 30 % is also applied to the rate at which surface water runoff is discharged from the site to fully account for the effects of climate change.*

2. Run-off Calculations

To address the recommendation in the approved FRA that a 30% betterment is applied to the existing rate of run-off, we consider that there are two options available:

1. Use a simple control structure to discharge the site at 30% betterment of the existing QBAR (i.e. 1 in 2.33-year) run-off rate across all return periods. (i.e. the allowable discharge rate would be the same for each return period which would provide a betterment of approximately 30% for all storm events with a return period of 1 in 2.333 year or less, and more than 30% betterment on higher return periods.)
2. Use a complex control structure to discharge the site at a 30% betterment of each of the existing run-off rates in the 1 in 1-year, 1 in 30-year and 1 in 100-year plus 20% Climate Change return periods. (i.e. the allowable discharge rate would be different for each return period.)

In the absence of level information for the proposed outfall (i.e. the culvert in Beech Avenue), the option of using a system with a complex control cannot be evaluated to give sufficient confidence in the results and as such, only Option 1 has been addressed in this technical note. Upon receipt of the level information, the potential advantages of designing the drainage network to utilise a complex control (i.e. Option 2) will be assessed.

Phases 1 and 2 are a mixture of existing permeable and impermeable areas. The discharge rate from each has been assessed to determine the maximum permitted discharge rate from the two phases.

2.1. Run-off rate from existing impermeable areas

The existing discharge rate for areas that are presently brownfield would usually be determined by the lower of either; the discharge rate calculated by an assessment of the existing site areas, or, the discharge rate presently leaving the site via existing drainage systems based on the diameter and gradient of the existing outfall pipes. In the absence of level and pipe size information for the proposed outfall (i.e. the culvert in Beech Avenue), the existing discharge rate from areas that are presently brownfield has been calculated by an assessment of catchment areas (rather than outfall pipe diameters and gradients).

The modified rational method has been used to calculate the QBAR flow rates (i.e. maximum flow rates for a 1 in 2.333 year return period) for the existing impermeable area. The time of concentration (for Phases 1 and 2) has been calculated (based on site area, length and slope) to be 15 minutes (0.25 hours). A rainfall event with a return period of 1 in 2.33 years and a duration equal to the time of concentration has an average intensity of 40 mm/hr which gives a maximum run-off flow rate of 153.1 l/s for the existing impermeable catchment area (in Phases 1 & 2) of 1.38 hectares.

2.2. Run-off rate from existing permeable (greenfield) areas

To determine the QBAR flow rate for the existing greenfield areas, the ICP SUDS method has been used (see Micro Drainage calculation sheet included in Appendix A).

2.3. Total existing run-off rate from Phases 1 & 2

	Area (ha)	QBAR (l/s)
Existing impermeable area (hardstanding)	1.378	153.1
Existing permeable area (greenfield)	0.355	1.6
Total:	1.733 ha	154.7 (153.1 + 1.6)
30% betterment on Total QBAR run-off rate:		**108.3** (70% of 154.7)

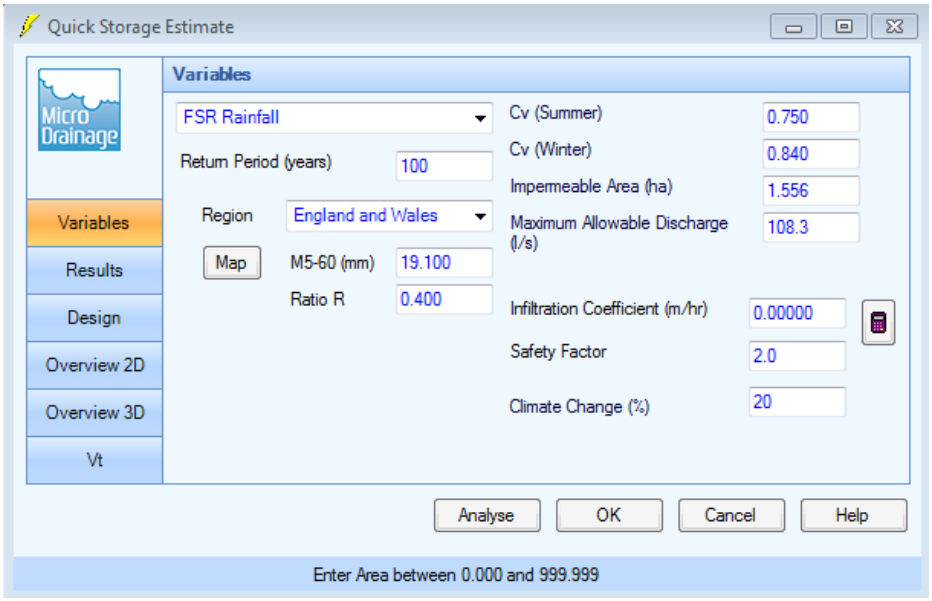
Table 1. QBAR Values and 30% Betterment

3. Quick Storage Estimates

The following calculations are based on impermeable areas taken from Glancy Nicholls' Masterplan reference 14022-A001 Rev B.

3.1. Phases 1 & 2 Combined

For a proposed impermeable area of 1.556 hectares and when restricting the discharge rate to a 30% betterment on the existing QBAR rate for the 1 in 100-year + 20% Climate Change event, the storage volume required, using the Quick Storage Estimate tool in Micro Drainage, is calculated to be between 287m^3 and 506m^3:



3.2. Phases 1 & 2 Separately

If Phases 1 & 2 are to have separate storage features and controls, their discharge rates, based on a pro-rata of the total area of each phase, would be as per Table 2.

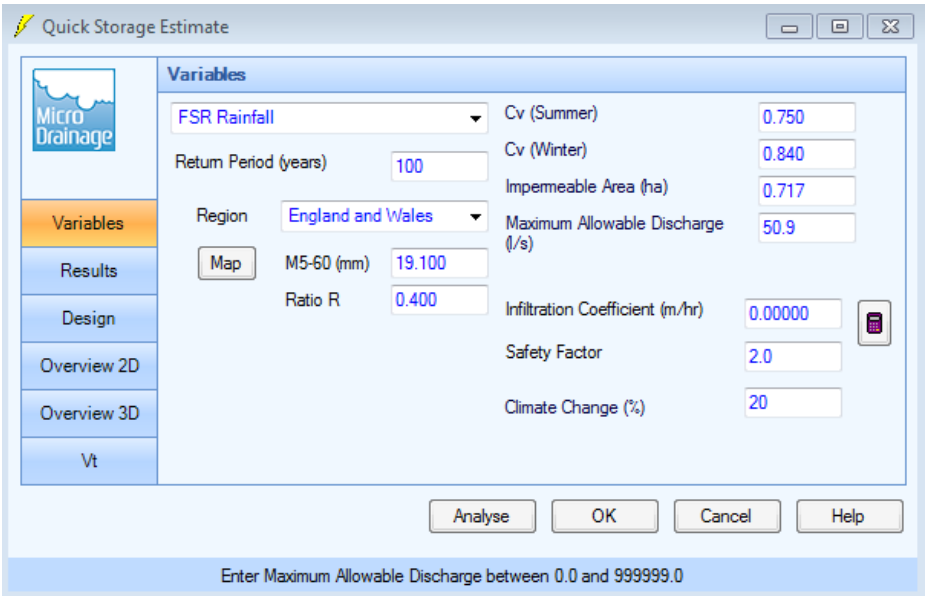
	Total Area of Phase		Allowable Discharge Rate based on Total Area of each Phase as a Percentage of Total Site Area
Phase 1	0.806 ha	47%	50.9 l/s
Phase 2	0.914 ha	53%	57.4 l/s

Table 2. Separate Discharge Rates for Phases 1 & 2

Technical note

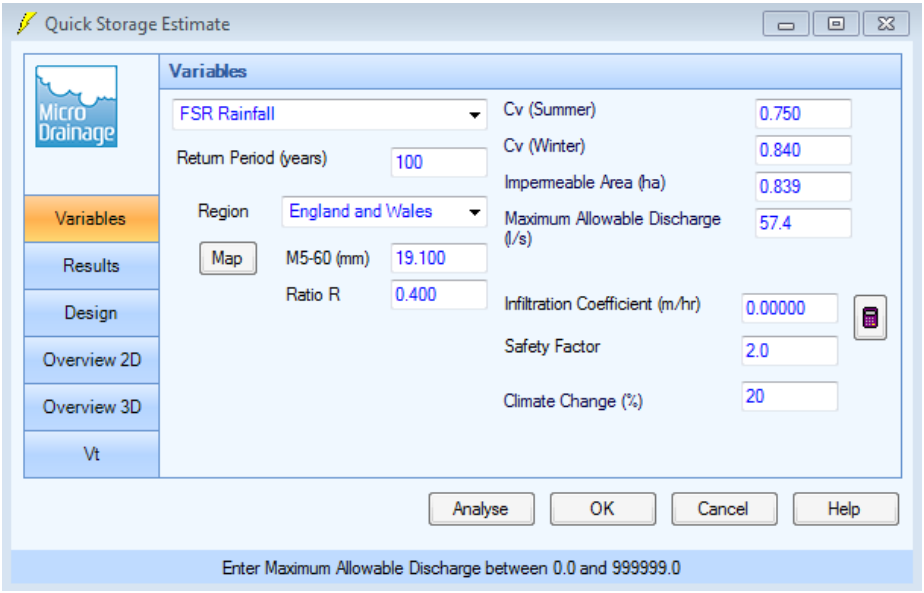
3.2.1. Phase 1

For a proposed impermeable area of 0.717 hectares, the storage volume required has been calculated using the Quick Storage Estimate tool in Micro Drainage, to be between 131m^3 and 231m^3:



3.2.2. Phase 2

For a proposed impermeable area of 0.839 hectares, the storage volume required has been calculated using the Quick Storage Estimate tool in Micro Drainage, to be between 156m^3 and 275m^3:



Technical note

Appendix A. Rural run-off Calculation for existing greenfield area

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	0.355	Urban	0.000
SAAR (mm)	700	Region Number	Region 4

Results l/s

QBAR Rural	1.6
QBAR Urban	1.6
Q100 years	4.0
Q1 year	1.3
Q30 years	3.1
Q100 years	4.0

Technical note

Appendix H. Rodgers Leask – Technical Note – Drainage Strategy

RODGERS LEASK
Consulting Civil & Structural Engineers

Technical Note

Project:	Albion Gateway Phase 3 - Burton
Subject:	Technical Note – drainage strategy
Date:	20.10.16
Prepared by:	B Daykin
Authorised by:	B Daykin

Phase 3 Drainage strategy

To accompany Rodgers Leask Drawing P16-145-203 and P15-089-203(1) and (2)

Surface Water:

The original phase 1 and 2 development area covered part of the current phase 3 application boundary with all of that surface water generated from this phase 1 and 2 area proposed to drain to the outfall, as previously agreed by Atkins, and as noted on drawings 203(1) and 203(2).

Post planning and part way through the detailed design of the phase 1/2 works the client made a request to “future proof” the phase 1/2 attenuation size so that if could accommodate the full extent of the possible phase 2 area (and now the phase 3 area).

This exercise was carried out by Rodgers Leask Ltd design team and then subsequently by the phase 1/2 contractors design team. The attenuation sized installed as part of that phase 1/2 contract has therefore been sized to cater for the area that is now termed Phase 3. All phase 1/2 outfall conditions remain as previously agreed.

Foul Water:

As with surface water the foul system originally designed to serve the phase 1 and 2 development area was “future proofed” to allow connection of the possible full extent of the phase 2 area, part of which is now noted as the phase 3 development.

Pipe sizing and the foul water pumping station have therefore been designed and installed to accommodate foul flows from the phase 3 area.

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