

**No 1 Reading,
29-35 Station Road,
Reading**
Surface Water Drainage Strategy

On behalf of
Station Road Dev Co. Ltd

Project: 43102/2002 | Rev: A | Date: October 2018



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For and on behalf of Peter Brett Associates LLP				

Revision	Date	Description	Prepared	Reviewed	Approved
A	24/10/2018	Development Description Updated	JPS	PJG	SM

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1 Introduction

- 1.1.1 Peter Brett Associates LLP now part of Stantec (PBA) has been commissioned by Station Road Dev Co. Ltd to prepare a Surface Water Drainage Strategy for the proposed development known as No.1 Reading, 29-35 Station Road, Reading.
- 1.1.2 This strategy has been prepared in accordance with relevant national, regional and local planning policy guidance as follows:
- National policy regarding flood risk as contained within National Planning Policy Framework (NPPF), dated July 2018, and the accompanying National Planning Practice Guidance (NPPG), dated November 2016 and updated July 2017.
 - The Ministerial Statement HCW161, dated 18th December 2014.
 - Non-statutory Technical Standards for Sustainable Drainage Systems, March 2015, Defra.
 - Flood Risk Assessments: Climate Change Allowances, 19th February 2016, Environment Agency.
 - Reading Borough Council Strategic Flood Risk Assessment (SFRA) (June 2017)

1.2 Flood Risk Assessment

- 1.2.1 The flood risk map for planning from the Environment Agency (EA) is given in **Appendix A**. This shows the site is located in Flood Zone 1.
- 1.2.2 Section 10 of the National Planning Policy Framework, clause 103, footnote 5 states:
- A site specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1: all proposals for new development (including minor development and change of use) in Flood Zone 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.***
- 1.2.3 There is therefore no need for a flood risk assessment to be carried out.

2 Site Information

2.1 Site Location and Plan

2.1.1 The site is located at 29-35 Station Road, Reading, RG1 1LG.



Figure 2.1: Site Location

2.1.2 The site currently contains a disused 6 story building and an access road to the west of the site which provides access to a number of properties. The site is bounded by Garrard Street on the North and Station Road on the East. To the south the site is bound by Brunel House and Garrard House is to the west of the access road.

2.1.3 The site is approximately 0.09ha in area, 100% of which is hardstanding.

2.2 Proposals

2.2.1 The development comprises of the demolition of existing building and erection of replacement mixed use building comprised of hotel (Class C1), office (Class B1a) and flexible ground floor retail use (Classes A1, A2, A3, A4 and A5 use), with associated servicing from Garrard Street.

2.2.2 Copies of the proposed site general arrangements are contained in **Appendix B**.

3 Existing Surface Water Regime

- 3.1.1 It is anticipated that the surface water from the existing site outfalls into the 100mm un-adopted surface sewer located in the access road in the west of the site. This sewer was detected during a GPR survey carried out for the site and is shown in **Figure 3.1**. The sewer flows west along the access road before crossing below Garrard House and flowing west along Garrard Street. It is assumed that this unadopted surface water sewer network discharges into the Thames Water 300mm surface water sewer at the junction between Garrard Street and Merchants Place.

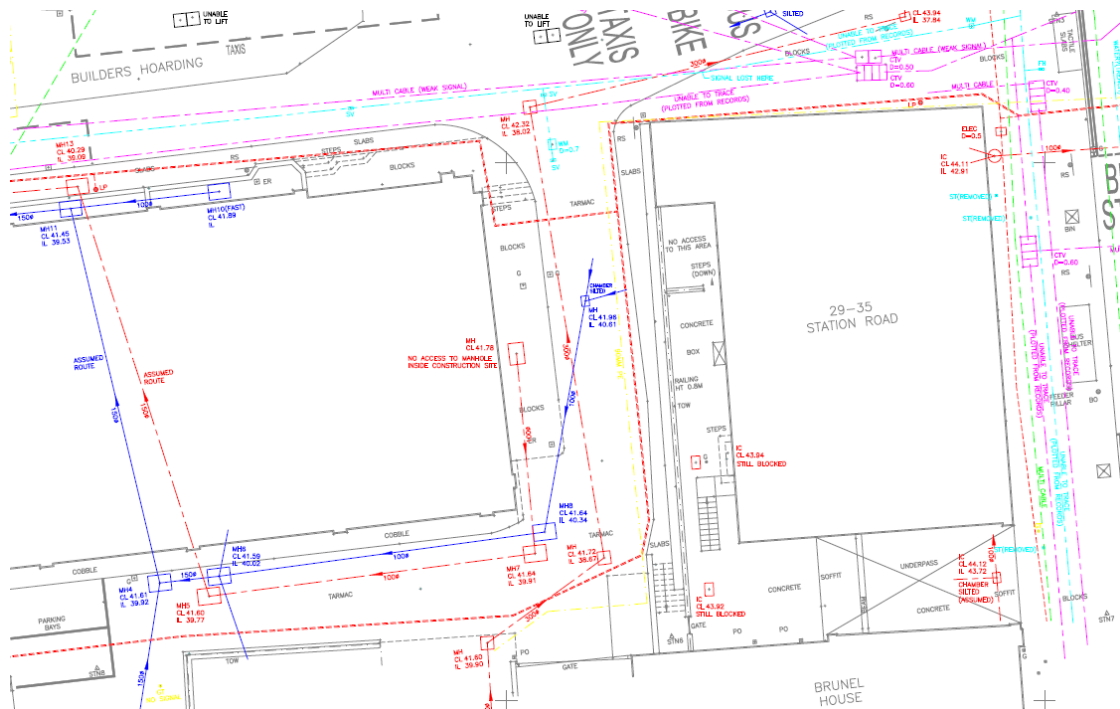


Figure 3.1: Existing Surface Water Sewer.

- 3.1.2 Further investigation is required to confirm that the site does discharge into the sewer.
- 3.1.3 The site is currently 100% impermeable and there is no existing attenuation storage provided on the site.
- 3.1.4 The site boundary includes 410m² of impermeable area on Garrard Street, the access road and surrounding footways that are to be resurfaced as part of the works, See **Appendix B** for drawings. It is assumed that the surface water run-off from this part of the development will continue to discharge as it currently does. Therefore the existing runoff and greenfield runoff rates for the site are based on 490m².
- 3.1.5 Based on the topographic survey of the site the existing surface water network has been modelled using MicroDrainage. The equivalent greenfield discharge rate from the site has been calculated using the Rainfall Runoff Management for Developments (Report SC030219, October 2013, Defra/EA)
- 3.1.6 A copy of the calculations is contained in **Appendix C. Table 3.1**, provides a summary of the discharge rates.

Return Period	Existing Brownfield Runoff Rate (l/s)	Equivalent Greenfield Discharge Rate (l/s)
1 in 1 year	6.4	1.21
1 in 30 year	12.9	3.29
1 in 100 year	15.9	4.56

Table 3.1: Brownfield and Greenfield Discharge Rates

4 Proposed Surface Water Drainage Strategy

4.1 Discharge Destination

- 4.1.1 In accordance with the discharge destination hierarchies of the Building Regulations H3 and the National Planning Practice Guidance an assessment of the suitability of the site to utilise infiltration drainage techniques has been undertaken.

See the Planning Practice Guidance

This states:

“Generally the aim should be discharge surface runoff as high up the following hierarchy of drainage options as reasonably practicable:

- 1. Into the ground (infiltration)*
- 2. To a surface water body;*
- 3. To a surface water sewer, highway drain or another drainage system;*
- 4. To a combined sewer.”*

- 4.1.2 A Phase One Environmental Assessment Report carried out by Subadra Consulting Ltd for the site references a Geo-Environmental Site investigation which found that infiltration to ground water through soakaway is not recommended for the development. The report recommends “that soak away systems not be adopted at the subject site based on the substantial depths of made ground encountered and the potential of chalk dissolution to occur if soak away systems were to be adopted within the formation, causing a reduction in stability.”
- 4.1.3 The majority of the development is covered by buildings and there is no space for infiltration features, therefore discharge by ground infiltration will not be possible.
- 4.1.4 There are no surface water bodies within the vicinity of the site, therefore it is proposed to continue to utilise the existing discharge point which is the 100mm unadopted surface water sewer located in the access road and maintain the sites existing drainage regime.

4.2 Peak Flow Control – Defra Technical Standard S3

S3. For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

- 4.2.1 As previously discussed (**Section 3**) the application site is currently developed. The existing peak discharge rates from the 490m² area of the site that is to be changed as part of the development are contained in **Table 3.1**.
- 4.2.2 This development will incorporate two Green/Blue roofs which will cover the entire lower roof and part of the upper roof of the development. These roofs are shown in **Figure 4.1**.

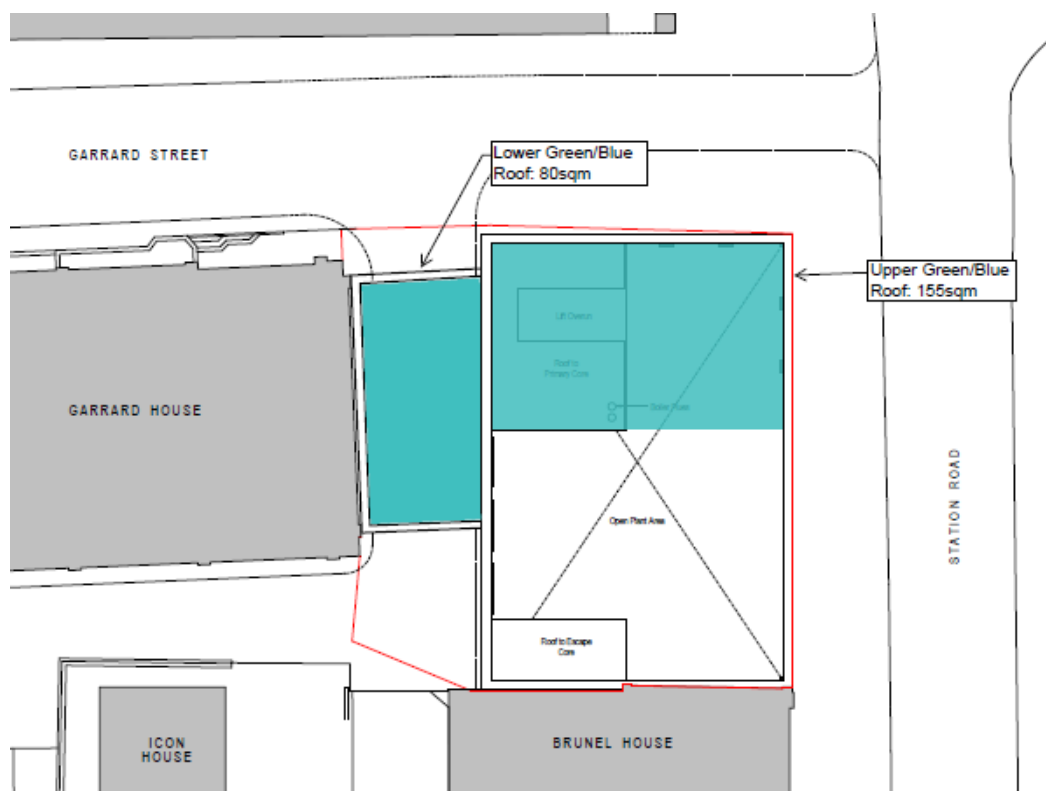


Figure 4.1: Locations of Green/Blue Roofs.

- 4.2.3 Green/Blue Roofs attenuate surface water on the roof of the building. The Green/Blue Roof has a Green Roof finish which rainwater filters through before entering surface water storage crates beneath the surface. Surface water is then attenuated in the storage crates by a flow control device that limits discharge into the rainwater down pipes. This reduces the peak surface water discharge rate from the development.
- 4.2.4 The EA's Flood Risk Assessments: Climate Change Allowances guidance which supports the NPPF provides contingency allowances for potential increases in sea level rise, peak river flow and rainfall intensity.
- 4.2.5 In accordance with this guidance, the potential for increased flood probability as the result of possible climate change has been taken into account in the consideration of mitigation measures over the lifetime of the development through a +20% allowance for increases in peak rainfall intensity (i.e. surface water drainage).

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper End	10%	20%	40%
Central	5%	10%	20%

Table 4.1: Flood Risk Assessments: Climate Change Allowances Table 2 Peak Rainfall Intensity Allowance in Small and Urban Catchments (use 1961 to 1991 baseline)

- 4.2.6 A sensitivity test for the 1 in 100 year +40% climate change event has been undertaken and shows no flooding across the site.
- 4.2.7 **Table 4.2** below confirms the proposed peak rates and the betterment provided.

Return Period	Existing Modified Rational Method	Proposed Peak Discharge	% Reduction in Discharge to TWUL Sewer
	l/s	l/s	
1 in 1 Year	6.4	2.9	55%
1 in 30 year	12.9	8.5	34%
1 in 100 year	15.9	10.3	35%
1 in 100 year + 20% allowance for climate change	-	11.8	26% reduction on 1 in 100 year

Table 4.2: Proposed Discharge Rates and Reduction on Existing

- 4.2.8 A copy of the greenfield discharge calculations for comparison are shown in **Table 3.1**.
- 4.2.9 In order to demonstrate that the proposed peak discharge rates are deliverable within the proposed development layout an outline proposed surface water drainage network has been modelled. A copy of the MicroDrainage calculations for the proposed development are contained within **Appendix D**.

4.3 Volume Control - Defra Technical Standard S6

S5. Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

- 4.3.1 The proposed brownfield development prevents the peak discharge volume from being reduced to that of greenfield, as the site is currently impermeable the run off volume will remain unchanged.

4.4 Flood Risk within the Development – Defra Technical Standards S7 to S9

S7. The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.

S8. The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement) or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.

- 4.4.1 The proposed outline surface water drainage network (**Section 4.2.2**) has been designed to demonstrate that the peak discharge rate can be achieved with no flooding in a 1 in 30 year rainfall event or a 1 in 100 year rainfall event with a +20% allowance for climate change.
- 4.4.2 A copy of the MicroDrainage calculations for the proposed development are contained within **Appendix D**.

S9. The design of the site must ensure that so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.

- 4.4.3 In the event of a rainfall event in excess of a 1 in 100 year + 40% climate change event surface water will be retained in the surface water network without flooding. An exceedance calculation for a 1 in 100 year + 40% climate change is contained in **Appendix E**.

4.5 SuDS Selection

- 4.5.1 The Ministerial Statement HCWS161, dated 18th December 2014 states that:

*'.....the Government's expectation is that sustainable drainage systems will be provided in new developments **wherever this is appropriate**.'*

- 4.5.2 The NPPG paragraph 051 describes SuDS as follows:

*'Sustainable drainage systems are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible. **They provide opportunities to:***

- *reduce the causes and impacts of flooding;*
- *remove pollutants from urban run-off at source;*
- *combine water management with green space with benefits for amenity, recreation and wildlife.'*

- 4.5.3 The current planning policy and guidance advises that SuDS in the form of open or near surface systems employing natural processes should be used where possible, not that they must be used. They can also provide opportunities to combine water management with amenity and wildlife, but only where appropriate.

- 4.5.4 For the No.1 Reading site it is considered that open surface SuDS and underground SuDS, such as cellular storage crates for infiltration or attenuation, are not appropriate due to the lack of space on the site. Therefore, Green/Blue Roofs are considered the most appropriate SuDS technique for the development.

4.6 Structural Integrity – Defra Technical Standards S10 & S11

S10. Components must be designed to ensure structural integrity of the drainage system and any adjacent structures or infrastructure under anticipated loading conditions over the design life of the development taking into account the requirement for reasonable levels of maintenance.

S11. The materials, including products, components, fittings or naturally occurring materials, which are specified by the designer must be of a suitable nature and quality for their intended use.

- 4.6.1 The components that make up any drainage network have different life expectancies which can be greatly affected by the effectiveness of their maintenance regime and upstream sediment capture/management.

- 4.6.2 The No.1 Reading drainage network comprises a piped network and inspection chambers. As with any drainage system, this network requires regular inspection and maintenance to ensure that the individual components continue to operate as designed, both in terms of hydraulic capacity and potential pollutant removal.
- 4.6.3 All the drainage channel sumps and catchpits will therefore be inspected and cleaned regularly by a private maintenance company.
- 4.6.4 The detail design of each of the individual components will be undertaken at the detailed design stage.
- 4.6.5 Further details regarding the maintenance of the proposed system are contained in **Section 5**.

5 Maintenance Strategy

- 5.1.1 This section sets out the inspection and maintenance requirements for long term management of the development's surface water drainage system.

5.2 Health, Safety and Welfare

- 5.2.1 All those responsible for maintenance should take appropriate health, safety and welfare precautions for all activities including lone working, if relevant, and risk assessments should always be undertaken. The site's infrastructure Health and Safety File should be consulted before carrying out any works either inside or outside of the development's boundary and information regarding the location of existing utilities passed on to operatives.
- 5.2.2 The requirements of the Health and Safety at Work Act 1974 and The Construction (Design and Management) Regulations 2015 should be adhered to and any residual risks identified in the Health and Safety File should be managed and information passed on to maintenance operatives through task specific risk assessments.

5.3 Operation and Maintenance

- 5.3.1 There are three types of maintenance activities associated with surface water drainage systems. The SuDS Manual, CIRIA C753, defines these as:
- Regular Maintenance – *'basic tasks undertaken on a frequent and predictable schedule' including vegetation management, litter and debris removal, and inspections.'*
 - Occasional Maintenance – *'tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example).'*
 - Remedial Maintenance – *'intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.'*
- 5.3.2 Specific maintenance needs should be monitored and maintenance schedules adjusted to suit the location and condition of the drainage feature in question.

Operation and Maintenance Activity		
	Piped Network / Inspection Chambers	Geocellular / Green / Blue Roof Deck Drain Storage
Regular Maintenance		
Inspection	■	■
Litter and debris removal	■	□
Occasional Maintenance		
Sediment management ¹	■	■
Remedial Maintenance		
Structure rehabilitation / repair	□	□
■ Will be required □ May be required ¹ Sediment should be collected and managed in pre-treatment systems, upstream of the main device.		

Table 5.1: Extract from The SuDS Manual Table 32.1: Typical key SuDS components operation and maintenance activities.

5.4 Piped Network / Inspection Chambers

- 5.4.1 Piped network components requires regular inspection and maintenance to ensure that the individual components continue to operate as designed, both in terms of hydraulic capacity and potential pollutant removal. All the gullies, inspection chambers and catchpits will therefore be inspected and cleaned regularly.

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any features that are not operating correctly. If required take remedial action	Monthly for three months, then six monthly
	Debris removal from catchment surface / gratings (where may cause risks to performance)	Monthly (and after large storms)
	Remove sediment from trapped sumps, manholes and catchpits.	Annually or as required
Remedial Maintenance	Repair / rehabilitation of gratings, inlets and outlets	As required
Monitoring	Inspect / check all gratings, trapped sumps, manholes and catchpits to ensure that they are in good condition and operating as designed	Annually and after large storm events
Structure Rehabilitation / Repair	Regular Maintenance and Monitoring to identify if repair and / or replacement of features or pipework is required.	As required

Table 5.2: Piped Network / Inspection Chambers operation and maintenance

5.5 Geocellular / Green / Blue Roof Deck Drain Storage

- 5.5.1 A Green/Blue Roof system comprises a deck drain laid across a waterproofed podium/roof slab. Direct rainfall landing on the podium/roof infiltrates through the landscape build-up and into the deck drain, which attenuates run-off prior to discharge via rainwater downpipes. This drainage system will in turn discharge into the external sewer network.

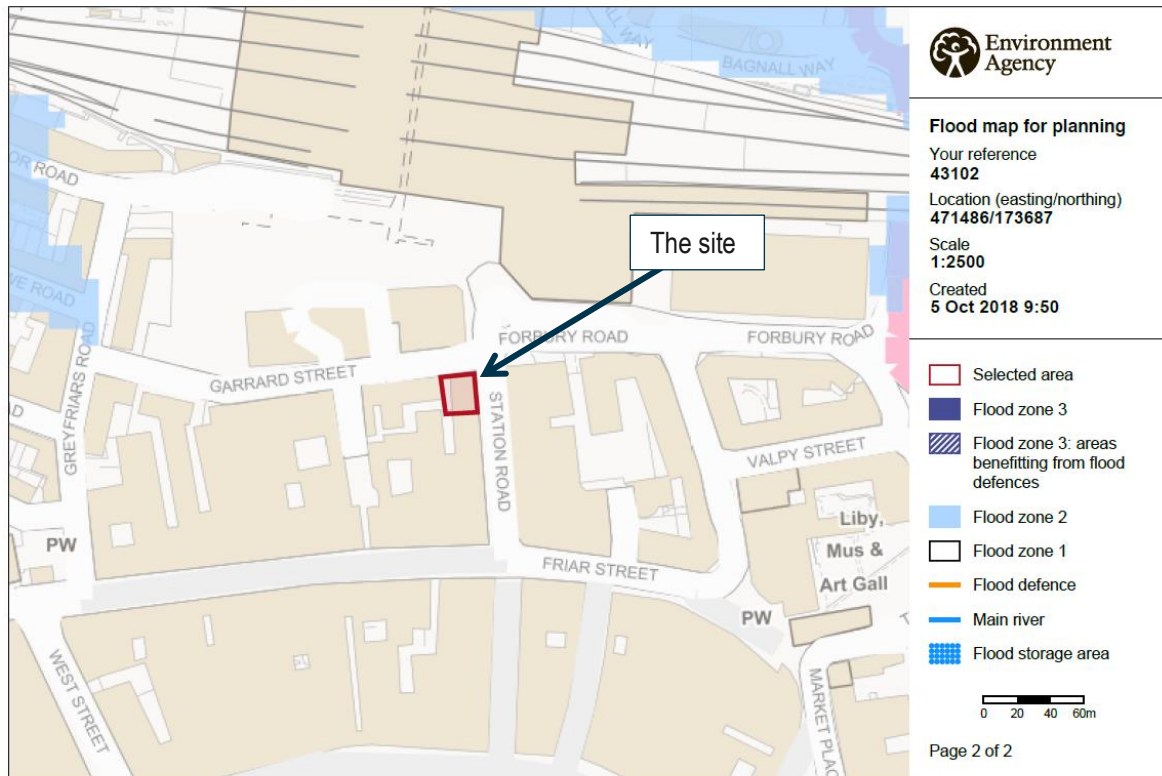
Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required take remedial action	Monthly for three months, then annually
	Remove debris from catchment surface (where may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary	Annually
	Remove sediment from pre-treatment structures and / or internal forebays	Annually, or as required
Remedial Maintenance	Repair / rehabilitate inlets, outlets, overflows and vents	As required
Monitoring	Inspect / check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

Table 5.3: The SuDS Manual Table 21.3: Operation and maintenance requirements for attenuation storage tanks

6 Summary

- 6.1.1 This Strategy has been developed in accordance with relevant national, regional and local planning policy guidance.
- 6.1.2 A Phase One Environmental Assessment Report carried out by Subadra Consulting Ltd for the site references a Geo-Environmental Site investigation which found that infiltration to ground water through soakaway is not recommended for the development. There are no surface water bodies in the vicinity of the site. As such the proposed surface water strategy mimics the existing drainage regime which is believed to be through outfall into the existing unadopted sewer sewer located in Station Road.
- 6.1.3 The proposed brownfield development prevents the peak discharge rate from being reduced to that of greenfield, however attenuation storage has been sized to limit the peak discharge rate during a 1 in 100 year annual probability event with a +20% allowance for climate change to 11.8 l/s which represents a significant reduction (26%) on the existing discharge to the surface water network.
- 6.1.4 The brownfield and proposed developments are made up of 100% impermeable area which prevents the peak discharge volume from being reduced to that of greenfield. Additionally, there is not enough space in the development to infiltrate to groundwater and therefore the run-off during a 100 year 6 hour storm event will be the same as the existing condition.
- 6.1.5 In accordance with Table 2 of the EA's Flood Risk Assessments: Climate Change Allowances guidance, an allowance of 20% climate change has been added to the peak rainfall intensities in the 1 in 100 year event to take account of the proposed developments 100 year life expectancy.
- 6.1.6 Surface water is contained without flooding during exceedance testing for a 1 in 100 year event with a +40% allowance for climate change.
- 6.1.7 It is considered that open surface SuDS are not appropriate due to the space available on the site. Therefore, a system which utilises Green/Blue Roofs is proposed. This will still follow the principles of the NPPG SuDS requirements by reducing flood risk and removal of pollutants / contaminants through the use of trapped gullies, oil interceptors and catchpits / silt traps.
- 6.1.8 A private maintenance contractor will be responsible for the long term maintenance of the proposed system and will undertake inspection and maintenance in accordance with this Strategy.
- 6.1.9 The inspection and maintenance requirements for long term management of the development's surface water drainage system is set out within **Section 5**.
- 6.1.10 As a result, the principles advocated by relevant national, regional and local planning policy guidance have been satisfactorily addressed.

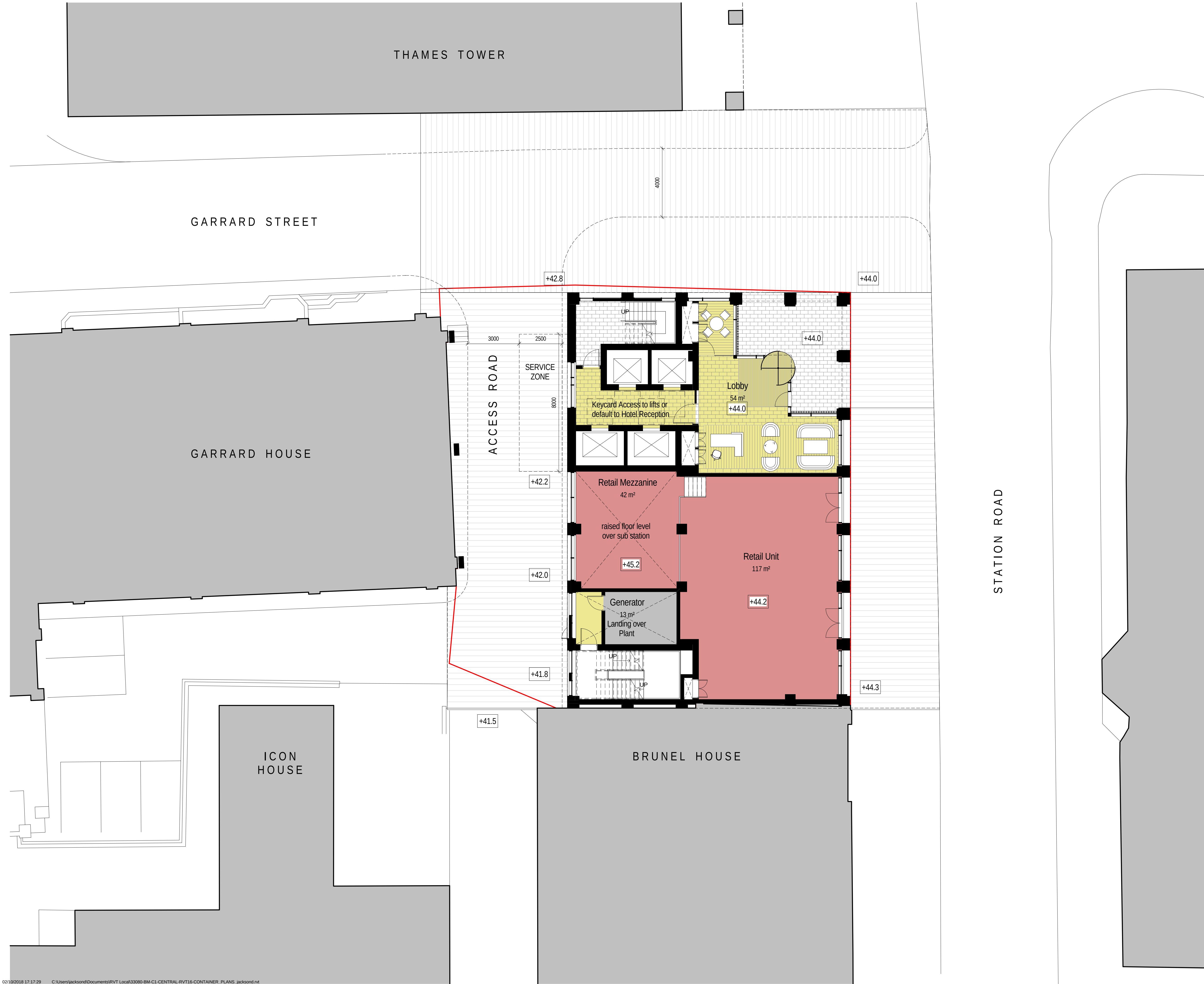
Appendix A Environment Agency Flood Risk Maps



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The site is shown as being in flood zone 1, less than 1 in 1000 annual probability of flooding.

Appendix B Broadway Malyan –General Arrangements

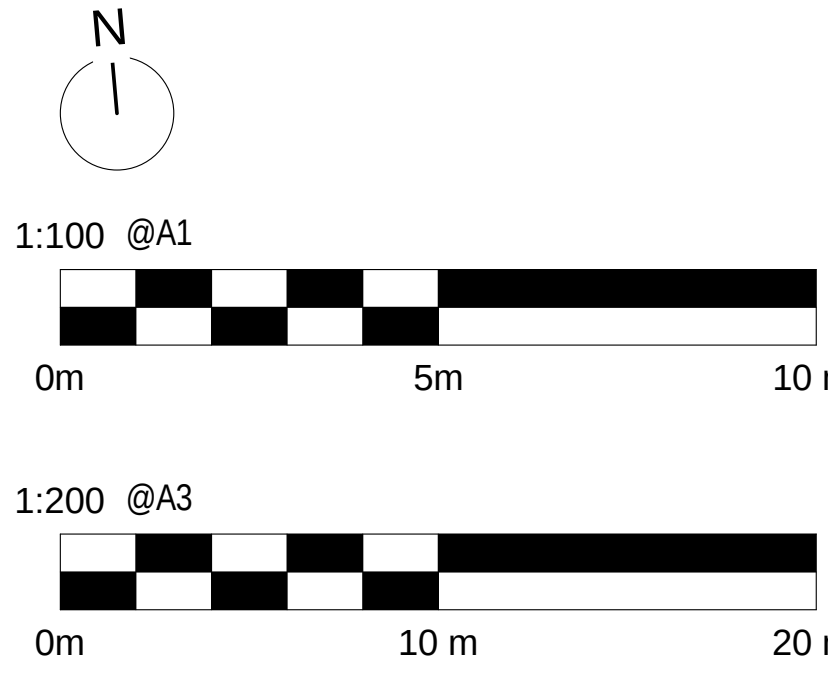


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F	01.10.18	General revisions to entrance and materials
E	18.09.18	General envelope and layout revisions
D	27.07.18	Update to 121m ACD
C	13.07.18	IMC Presentation
B	22.06.18	Core Update
A	14.06.18	IMCOP Brief Update
-	13.04.18	First Issue
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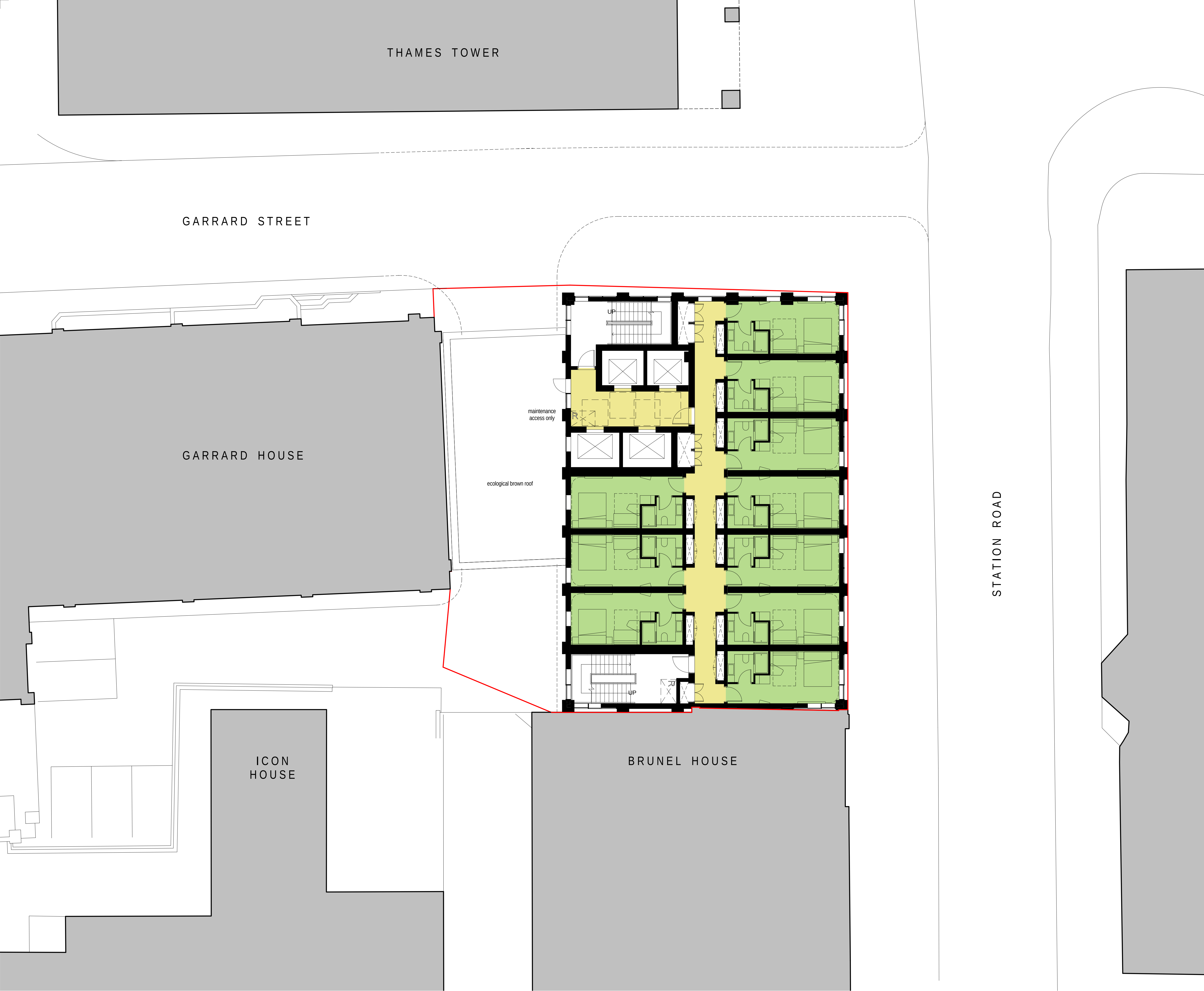
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Client
K2 Consultancy
Project
29-35 Station Road

Description
**Proposed Ground Floor (Hotel
Entrance and Retail)**

Status
PRELIMINARY
Scale
1:100@A1
Job Number
33080
Drawn By
MC
Drawing Number
A-03-001
Date
Jun '18
Revision
F

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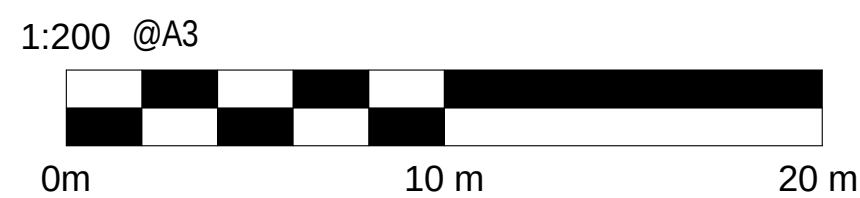
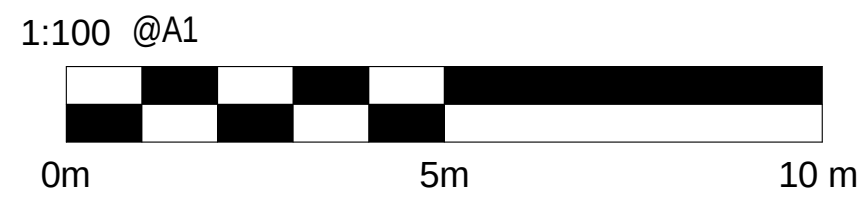
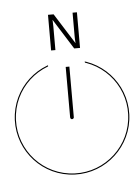


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A	01.10.18	General revisions to entrance and materials
-	18.09.18	First Issue
Revision	Date	Description

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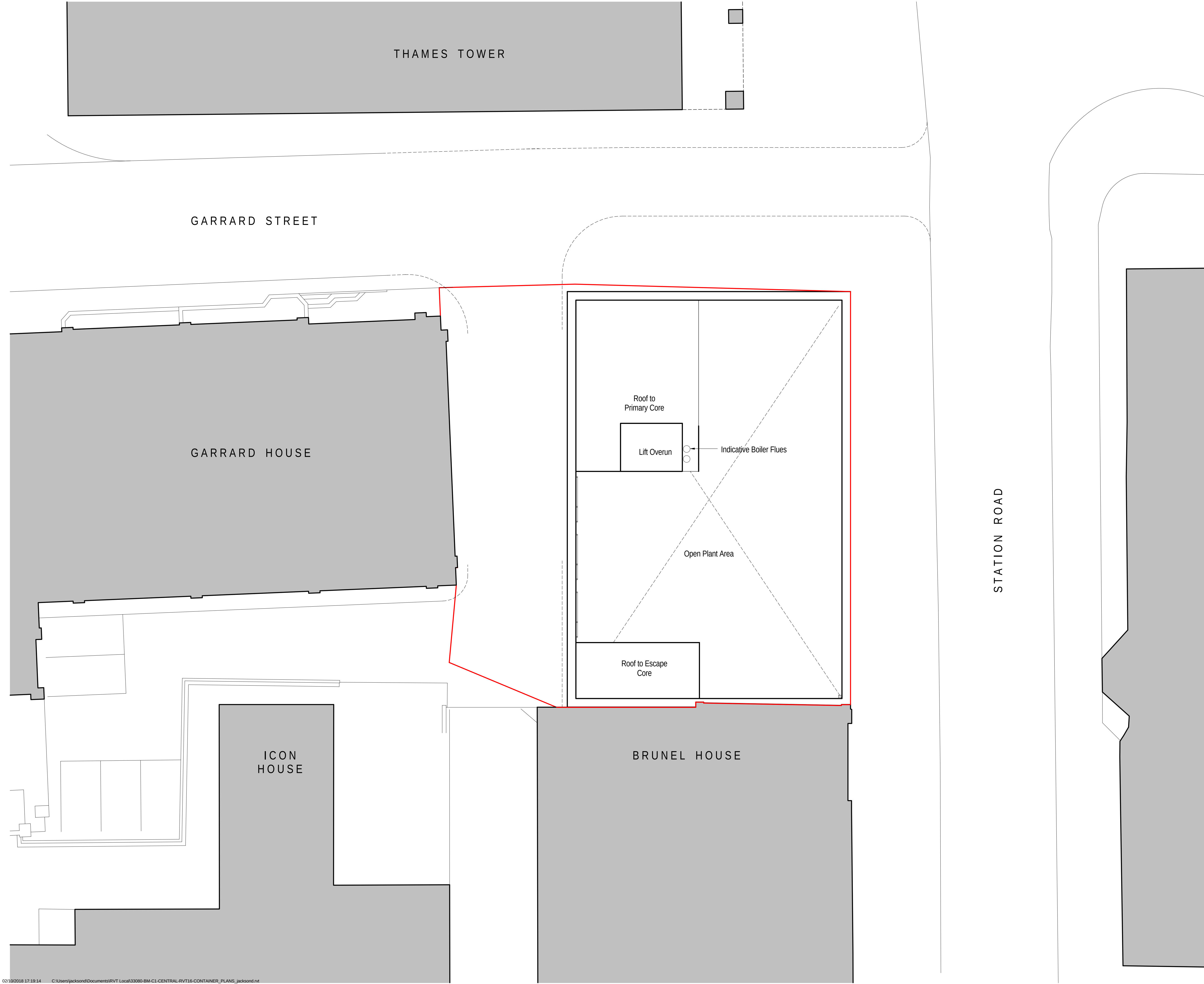
Project
29-35 Station Road

Description
Proposed 5th Floor (Hotel Rooms + Roof)

Status
PRELIMINARY

Scale	Drawn By	Date
1:100@A1	MC	Jun '18
Job Number	Drawing Number	Revision
33080	A-03-007	A

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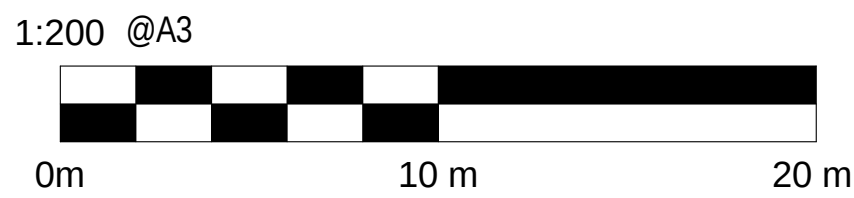
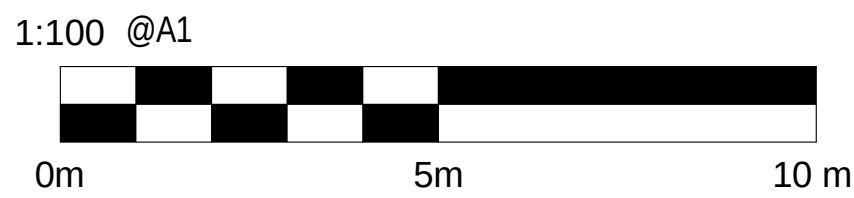
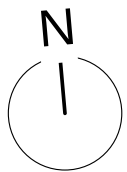


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C	13.07.18	IMC Presentation
B	22.06.18	Core Update
A	14.06.18	IMCOPR Brief Update
-	13.04.18	First Issue
Revision	Date	Description

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Client
K2 Consultancy

Project
29-35 Station Road

Description
Proposed Roof Layout

Status
Preliminary

Scale	Drawn By	Date
1:100@A1	MC	09/18/18
Job Number	Drawing Number	Revision
33080	A-03-011	F

Original size 100mm @ A1 Copyright Broadway Malyan Limited

Appendix C Existing Brownfield and Equivalent Greenfield Runoff Calculations

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.700	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	4.852	0.135	35.9	0.049	5.00	0.0	0.600	o	100	Pipe/Conduit	
S1.001	4.852	0.135	35.9	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	

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	50.00	5.06	40.610	0.049	0.0	0.0	0.0	1.29	10.1	6.6
S1.001	50.00	5.13	40.475	0.049	0.0	0.0	0.0	1.29	10.1	6.6

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	41.960	1.350	Open Manhole	1200	S1.000	40.610	100				
S2	41.800	1.325	Open Manhole	1200	S1.001	40.475	100	S1.000	40.475	100	
S	41.640	1.300	Open Manhole	0		OUTFALL		S1.001	40.340	100	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd	Diam	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	Sect	(mm)	Name	(m)	(m)	(m)	Connection	(mm)
S1.000	o	100	S1	41.960	40.610	1.250	Open Manhole	1200
S1.001	o	100	S2	41.800	40.475	1.225	Open Manhole	1200

Downstream Manhole

PN	Length	Slope	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	(m)	(1:X)	Name	(m)	(m)	(m)	Connection	(mm)
S1.000	4.852	35.9	S2	41.800	40.475	1.225	Open Manhole	1200
S1.001	4.852	35.9	S	41.640	40.340	1.200	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall	Outfall	C. Level	I. Level	Min	D,L	W
Pipe	Number	Name	(m)	I. Level	(mm)	(mm)
				(m)		

S1.001	S	41.640	40.340	0.000	0	0
--------	---	--------	--------	-------	---	---

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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 Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.700	Storm Duration (mins)	30
Ratio R	0.400		

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Caversham Bridge House Waterman Place Reading RG1 8DN	29-35 Station Road, Reading Existing Network	
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XP Solutions	Network 2017.1.2	

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 0

	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level
									(m)
S1.000	S1	15 Winter	1	+0%	30/15 Summer				40.674
S1.001	S2	15 Winter	1	+0%	30/15 Summer				40.539

	US/MH	Depth	Volume	Flow / Overflow	Pipe		Level
PN	Name	(m)	(m³)	Cap.	(l/s)	(l/s)	Status Exceeded
S1.000	S1	-0.036	0.000	0.71		6.3	OK
S1.001	S2	-0.036	0.000	0.72		6.4	OK

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 0

	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level
									(m)
S1.000	S1	15 Winter	30	+0%	30/15 Summer				41.031
S1.001	S2	15 Winter	30	+0%	30/15 Summer				40.728

	US/MH	Depth	Volume	Flow / Overflow	Pipe		Level
PN	Name	(m)	(m³)	Cap. (l/s)	Flow (l/s)	Status	Exceeded
S1.000	S1	0.321	0.000	1.48	13.1	SURCHARGED	
S1.001	S2	0.153	0.000	1.47	12.9	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 0

									Water
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)
S1.000	S1	15 Winter	100	+0%	30/15 Summer				41.319
S1.001	S2	15 Winter	100	+0%	30/15 Summer				40.875

		Surcharged Flooded			Pipe			
PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.609	0.000	1.83		16.2	SURCHARGED	
S1.001	S2	0.300	0.000	1.80		15.9	SURCHARGED	

	No1. Reading		JOB No:	43102/2001	SHEET:	1 of 1
	Surface Water Drainage Strategy		DATE:	28.09.2018	BY:	JPS
	Calculation of Greenfield Discharge Rate				CHECKED:	PJG

Calculation based on 'Rainfall runoff management for developments' - Report SC030219, October 2013, Defra / Environmental Agency

	Site	
R	6	Hydrological region (see Figure A1.1)
S	1	SOIL type from: http://www.uksuds.com/drainage-tools-members/surface-water-storage-tool.html
Catchment	<200 ha	
$A_{(site)}$	0.05 ha	Size of catchment (excluding large open parkland that is to remain)
SAAR or AAR	642 mm	SAAR value from: http://www.uksuds.com/drainage-tools-members/surface-water-storage-tool.html
SPR	0.1	For SOIL type 1 (0.1), type 2 (0.3), type 3 (0.37), type 4 (0.47), type 5 (0.53)
$A_{(50)}$	50 ha	Use 50ha for sites less than 50ha
$Q_{BAR(50)}$	7.59 l/s	Catchment mean annual peak flow for $A_{(50)}$ (50ha site)
Q_{BAR}	0.01 l/s	
$Q_{BAR(site)}/A_{(site)}$	1.00 l/s/ha	Mean annual peak flow per unit area (If less than 1 use 1 l/s/ha)
$Q_{throttle}$	5.00 l/s	Based on minimum limit of discharge - refer to Page xvi, para 17
$Q_{throttle}/A_{(site)}$	102.04 l/s/ha	
$Q_{throttle}/3.5A_{(site)}$	29.15 l/s/ha	
Q_{BAR}/A	29.15 l/s/ha	Use greater value of $Q_{BAR(site)}/A_{(site)}$ and $Q_{throttle}/A_{(site)}$
GC_1	0.85	Value taken from Line 10.1
GC_{30}	2.30	Value from: http://www.uksuds.com/drainage-tools-members/surface-water-storage-tool.html
GC_{100}	3.19	Value from: http://www.uksuds.com/drainage-tools-members/surface-water-storage-tool.html
Q_{1yr}	24.78 l/s/ha	
Q_{30yr}	67.06 l/s/ha	
Q_{100yr}	93.00 l/s/ha	
Total Q_{1yr}	1.21 l/s	
Total Q_{30yr}	3.29 l/s	
Total Q_{100yr}	4.56 l/s	

Appendix D MicroDrainage Results - Proposed Strategy

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.700	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	5.591	0.095	58.9	0.000	5.00	0.0	0.600	o	100	Pipe/Conduit	
S1.001	4.574	4.390	1.0	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S2.000	5.456	0.093	58.9	0.000	5.00	0.0	0.600	o	100	Pipe/Conduit	
S2.001	4.296	4.390	1.0	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.002	6.578	0.173	38.0	0.026	0.00	0.0	0.600	o	100	Pipe/Conduit	
S1.003	3.687	0.097	38.0	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	

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	50.00	5.09	45.095	0.000	0.0	0.0	0.0	1.01	7.9	0.0
S1.001	50.00	5.10	45.000	0.000	0.0	0.0	0.0	7.64	60.0	0.0
S2.000	50.00	5.09	45.093	0.000	0.0	0.0	0.0	1.01	7.9	0.0
S2.001	50.00	5.10	45.000	0.000	0.0	0.0	0.0	7.89	62.0	0.0
S1.002	50.00	5.19	40.610	0.026	0.0	0.0	0.0	1.25	9.9	3.5
S1.003	50.00	5.24	40.437	0.026	0.0	0.0	0.0	1.25	9.9	3.5

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	46.000	0.905	Open Manhole	1200	S1.000	45.095	100				
S2	46.000	1.000	Open Manhole	1200	S1.001	45.000	100	S1.000	45.000	100	
S3	46.000	0.907	Open Manhole	1200	S2.000	45.093	100				
S4	46.000	1.000	Open Manhole	1200	S2.001	45.000	100	S2.000	45.000	100	
S3	41.960	1.350	Open Manhole	1200	S1.002	40.610	100	S1.001	40.610	100	
								S2.001	40.610	100	
S4	41.750	1.313	Open Manhole	1200	S1.003	40.437	100	S1.002	40.437	100	
S	41.640	1.300	Open Manhole	0		OUTFALL		S1.003	40.340	100	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	100	S1	46.000	45.095	0.805	Open Manhole	1200
S1.001	o	100	S2	46.000	45.000	0.900	Open Manhole	1200
S2.000	o	100	S3	46.000	45.093	0.807	Open Manhole	1200
S2.001	o	100	S4	46.000	45.000	0.900	Open Manhole	1200
S1.002	o	100	S3	41.960	40.610	1.250	Open Manhole	1200
S1.003	o	100	S4	41.750	40.437	1.213	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	5.591	58.9	S2	46.000	45.000	0.900	Open Manhole	1200
S1.001	4.574	1.0	S3	41.960	40.610	1.250	Open Manhole	1200
S2.000	5.456	58.9	S4	46.000	45.000	0.900	Open Manhole	1200
S2.001	4.296	1.0	S3	41.960	40.610	1.250	Open Manhole	1200
S1.002	6.578	38.0	S4	41.750	40.437	1.213	Open Manhole	1200
S1.003	3.687	38.0	S	41.640	40.340	1.200	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
------------------------	-----------------	-----------------	-----------------	------------------------	-------------	-----------

S1.003	S	41.640	40.340	0.000	0	0
--------	---	--------	--------	-------	---	---

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	2
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

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Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.700	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm Orifice Manhole: S2, DS/PN: S1.001, Volume (m³): 1.2 Diameter (m) 0.007 Discharge Coefficient 0.600 Invert Level (m) 45.000 Orifice Manhole: S4, DS/PN: S2.001, Volume (m³): 1.2 Diameter (m) 0.007 Discharge Coefficient 0.600 Invert Level (m) 45.000		
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Storage Structures for Storm

Tank or Pond Manhole: S2, DS/PN: S1.001

Invert Level (m) 45.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	155.0	0.085	155.0	0.086	0.0

Tank or Pond Manhole: S4, DS/PN: S2.001

Invert Level (m) 45.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	80.0	0.085	80.0	0.086	0.0

Time Area Diagram for Green Roof at Pipe Number S1.001 (Storm)

Area (m³) 155 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)
0 4 0.002817	32 36 0.000569	64 68 0.000115	96 100 0.000023				
4 8 0.002306	36 40 0.000466	68 72 0.000094	100 104 0.000019				
8 12 0.001888	40 44 0.000381	72 76 0.000077	104 108 0.000016				
12 16 0.001546	44 48 0.000312	76 80 0.000063	108 112 0.000013				
16 20 0.001266	48 52 0.000256	80 84 0.000052	112 116 0.000010				
20 24 0.001036	52 56 0.000209	84 88 0.000042	116 120 0.000009				
24 28 0.000848	56 60 0.000171	88 92 0.000035					
28 32 0.000695	60 64 0.000140	92 96 0.000028					

Time Area Diagram for Green Roof at Pipe Number S2.001 (Storm)

Area (m³) 80 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)
0 4 0.001454	32 36 0.000294	64 68 0.000059	96 100 0.000012				
4 8 0.001190	36 40 0.000240	68 72 0.000049	100 104 0.000010				
8 12 0.000974	40 44 0.000197	72 76 0.000040	104 108 0.000008				
12 16 0.000798	44 48 0.000161	76 80 0.000033	108 112 0.000007				
16 20 0.000653	48 52 0.000132	80 84 0.000027	112 116 0.000005				
20 24 0.000535	52 56 0.000108	84 88 0.000022	116 120 0.000004				
24 28 0.000438	56 60 0.000088	88 92 0.000018					
28 32 0.000358	60 64 0.000072	92 96 0.000015					

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 2
 Number of Online Controls 2 Number of Time/Area Diagrams 2
 Number of Offline Controls 0 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) 18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 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	60 Winter	1	+0%					45.095
S1.001	S2	1440 Winter	1	+0%					45.017
S2.000	S3	60 Winter	1	+0%					45.093
S2.001	S4	1440 Winter	1	+0%					45.015
S1.002	S3	15 Winter	1	+0%	100/15 Summer				40.649
S1.003	S4	15 Winter	1	+0%	30/15 Summer				40.478

		<u>Surcharged</u>		<u>Flooded</u>		<u>Pipe</u>			
PN	US/MH Name	Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded	
S1.000	S1	-0.100	0.000	0.00		0.0	OK		
S1.001	S2	-0.083	0.000	0.00		0.0	OK		
S2.000	S3	-0.100	0.000	0.00		0.0	OK		
S2.001	S4	-0.086	0.000	0.00		0.0	OK		
S1.002	S3	-0.061	0.000	0.32		2.8	OK		
S1.003	S4	-0.059	0.000	0.35		2.9	OK		

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 2
 Number of Online Controls 2 Number of Time/Area Diagrams 2
 Number of Offline Controls 0 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) 18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 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	60 Winter	30	+0%					45.095
S1.001	S2	1440 Winter	30	+0%					45.041
S2.000	S3	60 Winter	30	+0%					45.093
S2.001	S4	1440 Winter	30	+0%					45.036
S1.002	S3	15 Winter	30	+0%	100/15 Summer				40.704
S1.003	S4	15 Summer	30	+0%	30/15 Summer				40.539

		Surcharged		Flooded	Pipe			
PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.100	0.000	0.00		0.0	OK	
S1.001	S2	-0.059	0.000	0.00		0.0	OK	
S2.000	S3	-0.100	0.000	0.00		0.0	OK	
S2.001	S4	-0.064	0.000	0.00		0.0	OK	
S1.002	S3	-0.006	0.000	0.97		8.6	OK	
S1.003	S4	0.002	0.000	1.03		8.5	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 2
 Number of Online Controls 2 Number of Time/Area Diagrams 2
 Number of Offline Controls 0 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) 18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 100
 Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	60 Winter	100	+0%					45.095
S1.001	S2	1440 Winter	100	+0%					45.054
S2.000	S3	60 Winter	100	+0%					45.093
S2.001	S4	1440 Winter	100	+0%					45.048
S1.002	S3	15 Winter	100	+0%	100/15 Summer				40.830
S1.003	S4	15 Winter	100	+0%	100/15 Summer				40.586

PN	US/MH Name	Surcharged		Flooded		Pipe		Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)			
S1.000	S1	-0.100	0.000	0.00		0.0		OK	
S1.001	S2	-0.046	0.000	0.00		0.0		OK	
S2.000	S3	-0.100	0.000	0.00		0.0		OK	
S2.001	S4	-0.052	0.000	0.00		0.0		OK	
S1.002	S3	0.120	0.000	1.17		10.4	SURCHARGED		
S1.003	S4	0.049	0.000	1.24		10.3	SURCHARGED		

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 2
 Number of Online Controls 2 Number of Time/Area Diagrams 2
 Number of Offline Controls 0 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) 18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	60 Winter	100	+20%					45.095
S1.001	S2	1440 Winter	100	+20%					45.066
S2.000	S3	60 Winter	100	+20%					45.093
S2.001	S4	1440 Winter	100	+20%					45.059
S1.002	S3	15 Winter	100	+20%	100/15 Summer				40.956
S1.003	S4	15 Winter	100	+20%	30/15 Summer				40.637

		Surcharged		Flooded	Pipe		Level	
PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Exceeded
S1.000	S1	-0.100	0.000	0.00		0.0	OK	
S1.001	S2	-0.034	0.000	0.00		0.0	OK	
S2.000	S3	-0.100	0.000	0.00		0.0	OK	
S2.001	S4	-0.041	0.000	0.00		0.0	OK	
S1.002	S3	0.246	0.000	1.36		12.1	SURCHARGED	
S1.003	S4	0.100	0.000	1.43		11.8	SURCHARGED	

Appendix E MicroDrainage Results – Exceedance Event

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 2
 Number of Online Controls 2 Number of Time/Area Diagrams 2
 Number of Offline Controls 0 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) 18.700 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 150.0 DVD Status OFF
 Analysis Timestep Fine Inertia Status OFF
 DTS Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 100
 Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	60 Winter	100	+40%					45.095
S1.001	S2	1440 Winter	100	+40%					45.078
S2.000	S3	60 Winter	100	+40%					45.093
S2.001	S4	1440 Winter	100	+40%					45.071
S1.002	S3	15 Winter	100	+40%	100/15 Summer				41.101
S1.003	S4	15 Winter	100	+40%	100/15 Summer				40.695

		Surcharged		Flooded	Pipe		Level	
PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Exceeded
S1.000	S1	-0.100	0.000	0.00		0.0	OK	
S1.001	S2	-0.022	0.000	0.00		0.0	OK	
S2.000	S3	-0.100	0.000	0.00		0.0	OK	
S2.001	S4	-0.030	0.000	0.00		0.0	OK	
S1.002	S3	0.391	0.000	1.54		13.7	SURCHARGED	
S1.003	S4	0.158	0.000	1.63		13.5	SURCHARGED	