Design Note

11 and 19 Osiers Road

GLA Response

Revision: 01
Date: 16/09/2019
Project reference: 4618 - GLA 4558 - 9
File path: P:\Projects\4618\Documents\Reports\FRA\GLA Response\4618-Design Note-WA-190916-Rev1.docx

1. Introduction

This design note has been produced to supplement the Flood Risk Assessment document reference 4618-FRA-jk-180726-jk-Rev2-RDCD, to provide additional information and clarification on items raised by the GLA during the Stage 1 consultation for the proposed development at 9, 11 and 19 Osiers Road, Wandsworth.

Within this report risks are expressed as an annual exceedance probability (AEP). This is the percentage probability that a given event could occur in any given year.

2. GLA Comments

Following the Stage 1 consultation the GLA made the following comments in an email dated 13th August 2019:

Information requested	Location Addressed
2. The surface water drainage strategy for the proposed development does not comply with the London Plan policy 5.13 (and draft policy SI.13), as it does not give appropriate regard to the drainage hierarchy, greenfield runoff rate and climate change. Further details on how SuDS measures at the top of the drainage hierarchy will be included in the development, and how greenfield runoff rate will be achieved should be provided. Additional attenuation storage volumes calculations, attenuation tank dimensions, and SuDS maintenance information should also be provided.	Section 3.3
3. The proposed development does not comply with the requirements of London Plan policy 5.15 (and draft New London Plan policy SI.15) as no water consumption target has been identified for the residential component of the development.	Section 3.8

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9. The calculations of Greenfield runoff rates adopts an urbanisation factor of 0.75, representing partially developed catchment. The Greenfield runoff rate is intended to represent a partially developed catchment (literally a 'green field') and the use of an urbanisation factor greater than zero is incorrect. The applicant should provide revised Greenfield runoff calculations using an urbanisation factor of zero.	Section 3.1
10. The surface water drainage strategy addresses the Drainage Hierarchy, and notes that rainwater harvesting and green roofs would be possible options, and that infiltration is not feasible due to the site geology. Attenuation tanks are proposed as the main SuDS measure, and these are the only measures that are shown on plans. Permeable paving is mentioned but does not appear on landscaping plans. Opportunities for green infrastructure-based SuDS public realm areas have not been considered. This approach does not satisfy the requirements of London Plan policy 5.13 (and draft London Plan SI.13).The applicant should provide more detailed plans including rainwater harvesting, green/blue roofs, permeable paving and green infrastructure-based SuDS such as tree pits and raingardens.	Section 3.4
11. The attenuation tank volume have been estimated using a simplified method, which gives an estimated attenuation requirement of 300m^3 for a design discharge rate of 2.3l/s in a 100 year event with 40% climate change allowance. Section 6.3 of the FRA suggests a range of potential design discharge rates, up to Q100. Where a design discharge rate greater than Q_{bar} is proposed, more detailed calculations should be provided to show resultant discharge rates in a range of design events up to the 100 year event with 40% climate change allowance.	Section 3.5
12. Section 6.2.1 and 6.3 of the FRA show a 30% climate change allowance for design. This is not consistent with the value adopted in section 6.2.4 or current government climate change allowance guidance for small catchment areas.	Section 3.2
13. No maintenance plan has been included in the drainage strategy. The applicant should include a maintenance plan showing the maintenance and inspection frequency, and maintenance activities for each SuDS measure proposed.	Section 3.6
14. No assessment of the exceedance flow paths has been provided. Additional information should be provided showing that exceedance flow paths, through the site are available in the case of attenuation system blockage or an extreme rainfall event.	Section 3.7
15. The surface water drainage strategy for the proposed development does not comply with London Plan policy 5.13 (a draft policy SI.13), as it does not give appropriate regard to the drainage hierarchy, Greenfield runoff rate and climate change. Further details on how SuDS measure at the top of the drainage hierarchy will be included in the development, and how Greenfield runoff rates will be achieved should be provided. Additional attenuation	Section 3.3

storage volumes calculation, attenuation tank dimensions, and SuDS maintenance information should also be provided.	

Following the initial submission of the report, reference 4618-LET-KJ-190815-Rev1, response from Reece Harris was received in an email dated 3rd September 2019. This response accepted all issues raised by GLA except from point 11 and 15 (partially addressed). To address these points a detailed design model was produced along with proposed schematic drawings which are presented in Appendix D & E respectively.

3. Proposed SuDS Drainage Details & Calculations

3. 1. Greenfield Runoff Rates

The FRA proposed a Greenfield runoff rate of 2.3 l/s based on a site area of 0.41ha and applying an urbanisation factor of 0.75. Following the GLA's comments on the Greenfield calculation this rate has been reviewed and revised to represent the greenfield runoff rate for the site excluding the urbanisation factor. The rates have been calculated using the WINDES Micro-Drainage software SUDS function which is based on the FSR method. The calculations for the rates are presented in Appendix D of this report. The table below summarises the Greenfield runoff rates for the 50%, 3.3% and 1% annual exceedance probabilities.

Greenfield Runoff Rates		
Annual Exceedance Probability (AEP)	**Greenfield Runoff Rate (l/s)**	
50% AEP	Q_{bar}	0.6
3.3% AEP	Q_{30}	1.4
1% AEP	Q_{100}	2.0

3. 2. Climate Change

The climate change allowance is now taken as 40% in line with upper estimate of the current government climate change allowances and the London Plan.

3. 3. Drainage Hierarchy

In accordance with policy SI.13 of the new Draft London plan which Is largely in keeping with policy 5.13 of the London plan, all new developments should utilise Sustainable Drainage Systems (SuDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1) *Rainwater use as a resource (for example rainwater harvesting and blue roofs for irrigation)*
2) *Rainwater infiltration to ground at or close to source*
3) *Rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)*
4) *Rainwater discharge direct to a watercourse (unless not appropriate)*
5) *Rainwater attenuation above ground (including blue roofs);*

6) *Rainwater attenuation below ground;*
7) *Controlled rainwater discharge to a surface water sewer or drain*
8) *Controlled rainwater discharge to a combined sewer*

The summary below provides site specific comments on how the drainage hierarchy has been followed:

1) *Rainwater use as a resource (for example rainwater harvesting and blue roofs for irrigation)*

Blue roofs are proposed at podium level as a source control SuDS feature, however, due to the high density nature of the development there is little permeable landscaped area that require irrigation. It is therefore not considered practical to harvest rainwater for the purposes of irrigation. Green and brown roofs provide a degree of storage within the substrate that will naturally be used to irrigate the roof.

2) *Rainwater infiltration to ground at or close to source*

The site investigation report indicates infiltration is not possible due to the underlying strata and groundwater level. Tanked permeable paving is proposed to the external ground level paved areas.

3) *Rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens).*

Green and Brown roofs are proposed at roof level and raised planters at ground level.

4) *Rainwater discharge direct to a watercourse (unless not appropriate)*

The route to the River Wandle crosses 3rd party land and is therefore not considered to be viable

7) Controlled rainwater discharge to a surface water sewer or drain

There are no known surface water sewers in the vicinity of the site.

8) Controlled rainwater discharge to a combined sewer

There are no known combined sewers in the vicinity of the site. Surface water will likely need to be discharged to the designated foul water sewer which is assumed to be combined as existing, subject to Thames Water approval.

3. 4. Proposed Sustainable drainage features

In line with the London Plan the SuDS selected for the proposed development should be appropriate for the development and for the location, on this basis the following SuDS features are proposed:

- Blue roofs
- Green/ Brown roofs
- Permeable paving
- Below ground attenuation tank

Blue roofs are proposed at podium level in areas that are not above residential units. It is proposed that blue roofs will be provided in the form attenuation crates between 85mm and 100mm deep and with 95% void ratio. Due to the depth of the attenuation feature the blue roof is assumed to only attenuate rainwater falling directly onto it and would not have the capacity to attenuate rainwater from roof level as well.

Green roofs are proposed at roof level as indicated on drawing T20P14 included in Appendix A and is represented on the Indicative SuDS Strategy drawing in Appendix E. The drawing highlights roof areas that are to be used for photovoltaic modules and green roofs, roof areas that are to be used for photovoltaic modules are not considered viable for green roofs as well.

The use of permeable block paving is proposed on external hard landscaped areas. Due to the lack of infiltration potential the paving would have to be 'Type C – No infiltration' construction. As noted in the drainage strategy, storage in permeable paving is assumed to be provided in the form of a 300mm subbase at 30% void ratio.

At this stage of the design detailed plans of SuDS measures and landscaping features cannot be provided as the design of the building is not at detailed design. However approximate areas and depths of proposed SuDS features and the benefits provided by them have been summarised.

The strategy for implementing and providing detailed design of green infrastructure based SuDS features has been agreed with the Architect, Landscape Architect and Client. However, large scale rainwater harvesting is not practicable for implementation for the project.

3. 5. Discharge rates

In line with the FRA and CIRIA guidance the peak discharge rate off site is proposed to match the Q_{100} discharge rate for the 1% AEP rainfall with a 40% allowance for climate change. The 3.3% AEP discharge rate should target the Q_{30} Greenfield rate and the 50% AEP discharge rate should target the Q_{bar} greenfield rate for the site.

CIRIA guidance notes that the implementation of 'long term storage' features such as green roofs, brown roofs and permeable paving reduces the volume of discharge off-site. A greater percentage of runoff is prevented from discharging in more frequent storm events due to the process of evapotranspiration and wetting of soil and aggregate, as well as temporary storage provided by the green roof and permeable paving subbase. In addition the SuDS features are a form of 'source control' SuDS which provide treatment to surface water runoff in line with the SuDS management train.

With consideration given to the above the 50% AEP discharge rate will be lower than the Q_{30} discharge rate due to the use of long term storage features, however the Q_{bar} discharge rate is considered unreasonable to achieve without introducing a risk of blockage. This is because the size of the flow control orifice will be smaller which in turn increases maintenance issues associated with them.

The 3.3% AEP will be restricted to the Q_{30} discharge rate and the 1% AEP restricted to the Q_{100} discharge rate through the implementation of a series of flow control, for example at podium level to attenuation flows from the blue roof as well as a complex flow control prior to discharging off site.

Appendix D provides detailed calculations on the discharge rates for Q_{bar}, Q_{30} and Q_{100} and the required volumes of storage required has been established. The detailed design has been based on providing the following volumes:

Attenuation Feature	Storage Volume Provided
Below ground attenuation tank	228m^3
Permeable Paving subbase	100m^3
Blue Roof	8m^3

The discharge modelled represents a 'Hydrobrake' devise with a discharge profile close to linear. By adopting such a profile the risk of blockage and the increased maintenance this results in is reduced.

The maximum discharge rates for various storms are given below:

Storm Event	Max Discharge (l/s)
100% AEP	1.2
3.33% AEP	1.5
1% AEP	1.9

It can be seen that the discharge rates for the high intensity low frequency storms are less than or equal to the greenfield run off rates noted in section 3.1.

The discharge rate for the lower intensity storms (50% of 100% AEP) will be slightly above the greenfield run-off. However, to restrict these storms to a run off of 0.6l/s would be impractical and increase flood risk on site.

3. 6. Maintenance Plan

A maintenance plan for each of the proposed SuDS techniques has been included in Appendix C.

3. 7. Exceedance Flows

An assessment of the exceedance flow paths based on the existing site levels demonstrates that the exceedance flows will be from the north eastern corner of the site to the southwestern towards the public highway. The topographical survey is included in Appendix B.

In the event of a system blockage or an extreme rainfall event the site levels and surface waters system should be designed to convey runoff away from the building and its users. The diagram below demonstrates the overland flow routes.

Due to the upper climate change limit being used for the drainage design exceedance flows are not expected to be significant. In addition most of the external landscaping will be permeable paving, so a flows generated by a blockage of the surface water system at a particular point in the system would likely drain back into the system at another point, without generating significant flows off site.

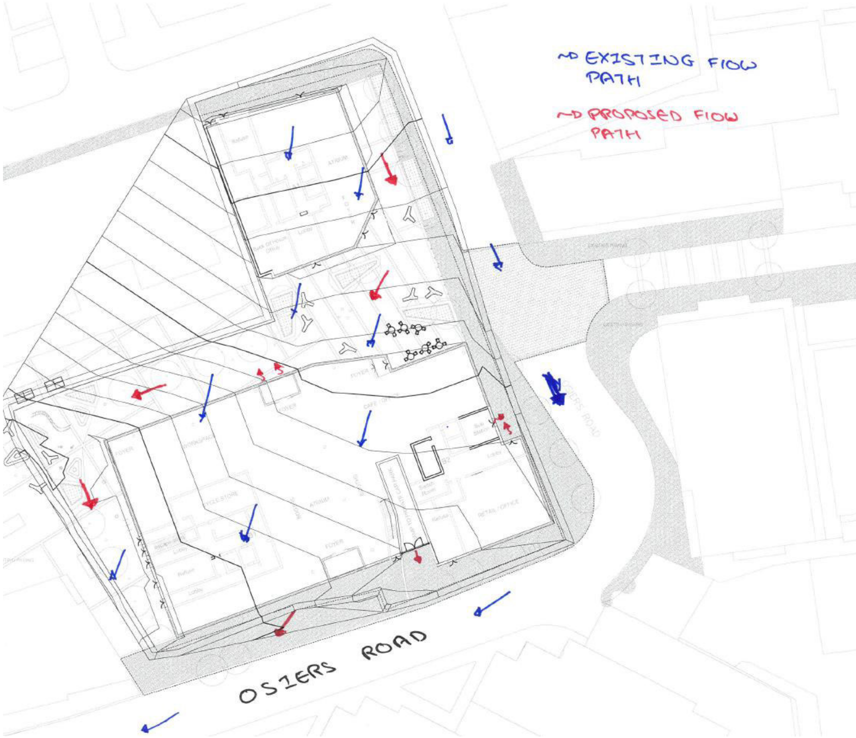

Figure 3.1 Exceedance flow paths

3. 8. Water Consumption Target

The residential component will be designed so that the mains water consumption would meet a target of 105 litres or less per person per day (excluding 5 litres per person per day for external water use). This target will be met by specifying fittings in accordance with the optional requirement' fitting approach as noted on table 2.2 in buildings regulations approved document G.

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4. Conclusion

It is intended that this design note demonstrates the sustainable drainage principles set out for the proposed development and addresses the GLA comments regarding the drainage proposals for the site.

Prepared by	Keval Joshi	William Alexander
Checked by	Kate Mackay	
Approved by	Andy Stanford	

Yours Sincerely,

William Alexander
Infrastructure Engineer

Appendix A – **Proposed Development Architectural Plans**

NOTES

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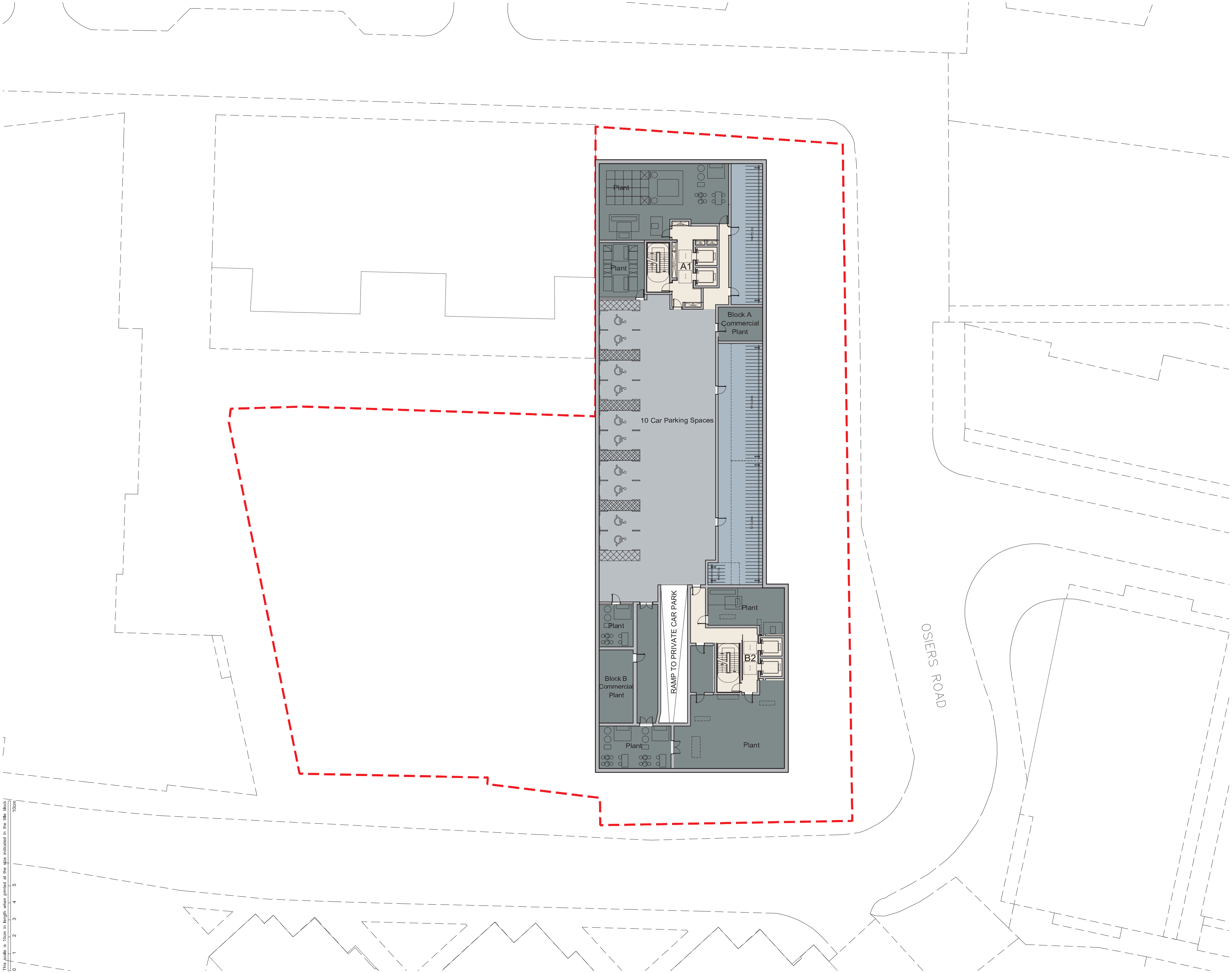
1 The Contractor must check and confirm all dimensions
2 All discrepancies must be reported and resolved by the Architect before works commence
3 This drawing is not to be scaled
4 All work and materials to be in accordance with current applicable Statutory Legislation and to comply with all relevant Codes of Practice and British Standards



Rev		Date
P1	Issued for Planning	17/07/18

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Client
Hollybrook Limited

Project
Osiers Road

Drawing
Basement Floor Plan

Scale	Date	Status	
1:200 (A1)	Mar 18	Planning	
Job Number	Drawing Number		Revision
5865	T20P-1		P1

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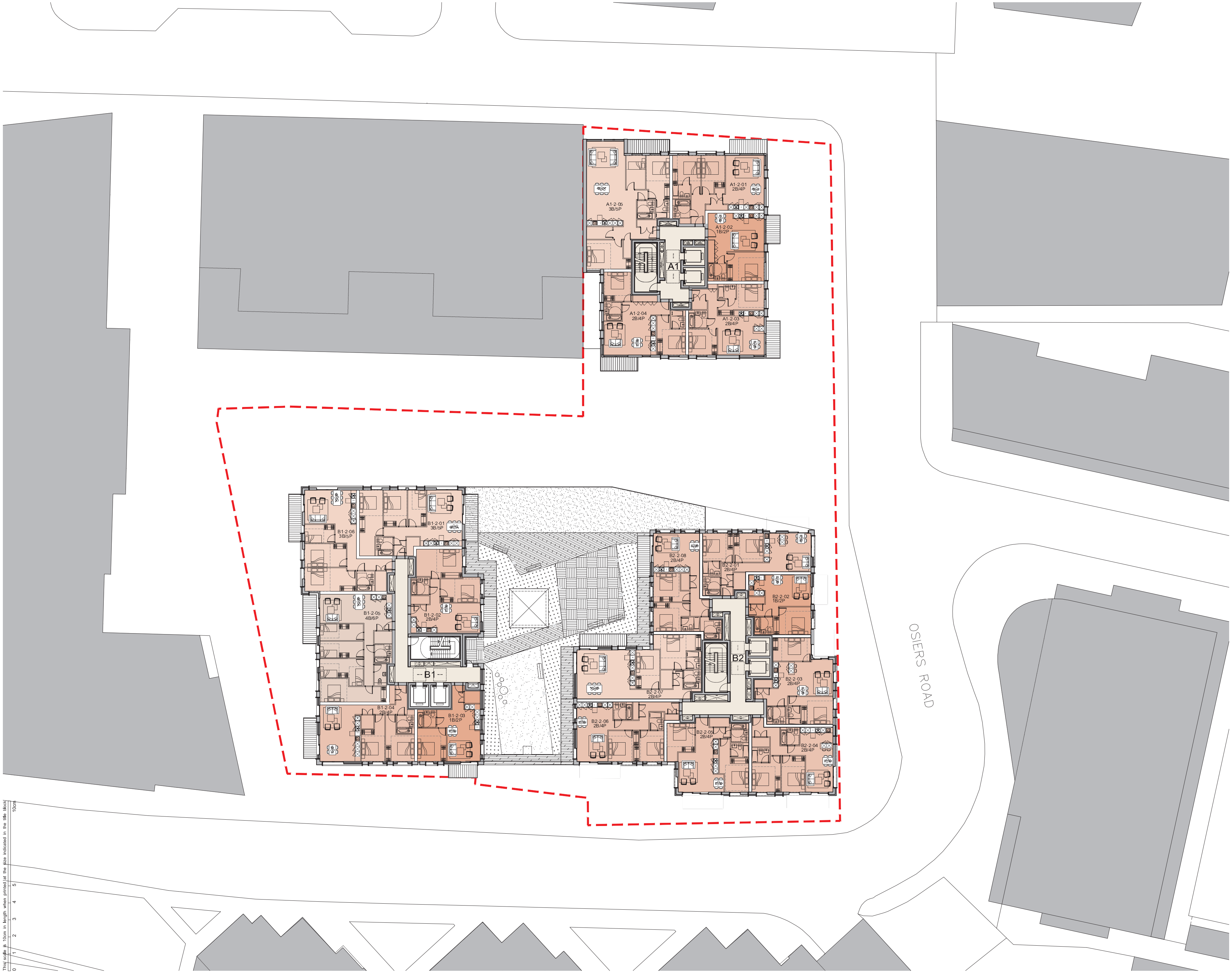

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P1	Issued for Planning	17/07/18

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Client
Hollybrook Limited

Project
Osiers Road

Drawing
Second Floor Plan

Scale	Date	Status	
1:200 (A1)	May 18	Planning	
Job Number	**Drawing Number**		**Revision**
5865	T20P02		P1

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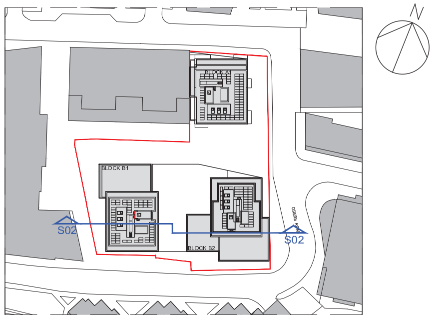
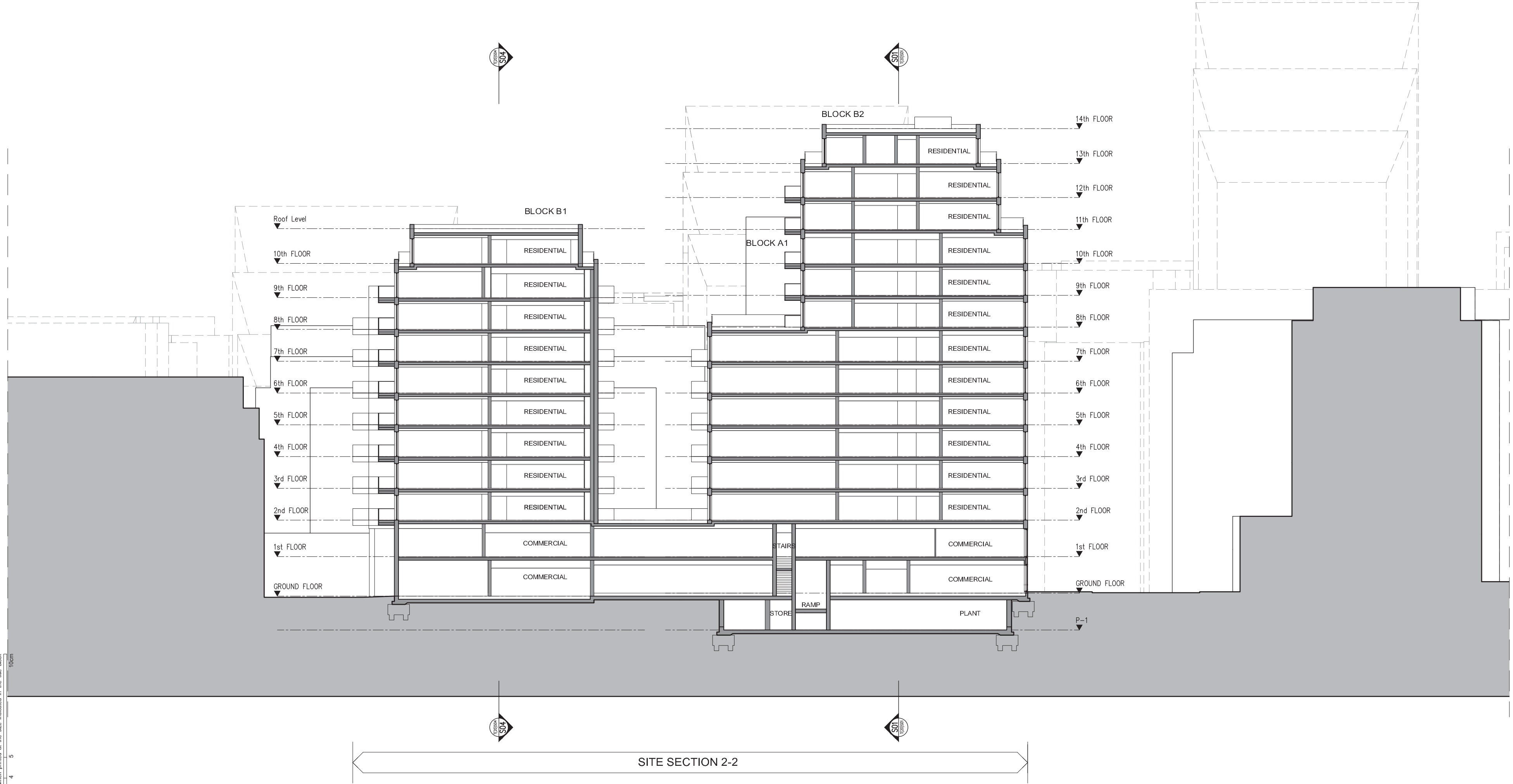


KEY PLAN



SITE SECTION 2-2

NOTES

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Rev		Date
P1	Issued for Planning	17/07/18

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Client
Hollybrook Limited

Project
Osiers Road

Drawing
Proposed Site Section S02

Scale 1:200 (A1) | Date June 18 | Status Planning

Job Number **5865** | Drawing Number **T20S02** | Revision **P1**

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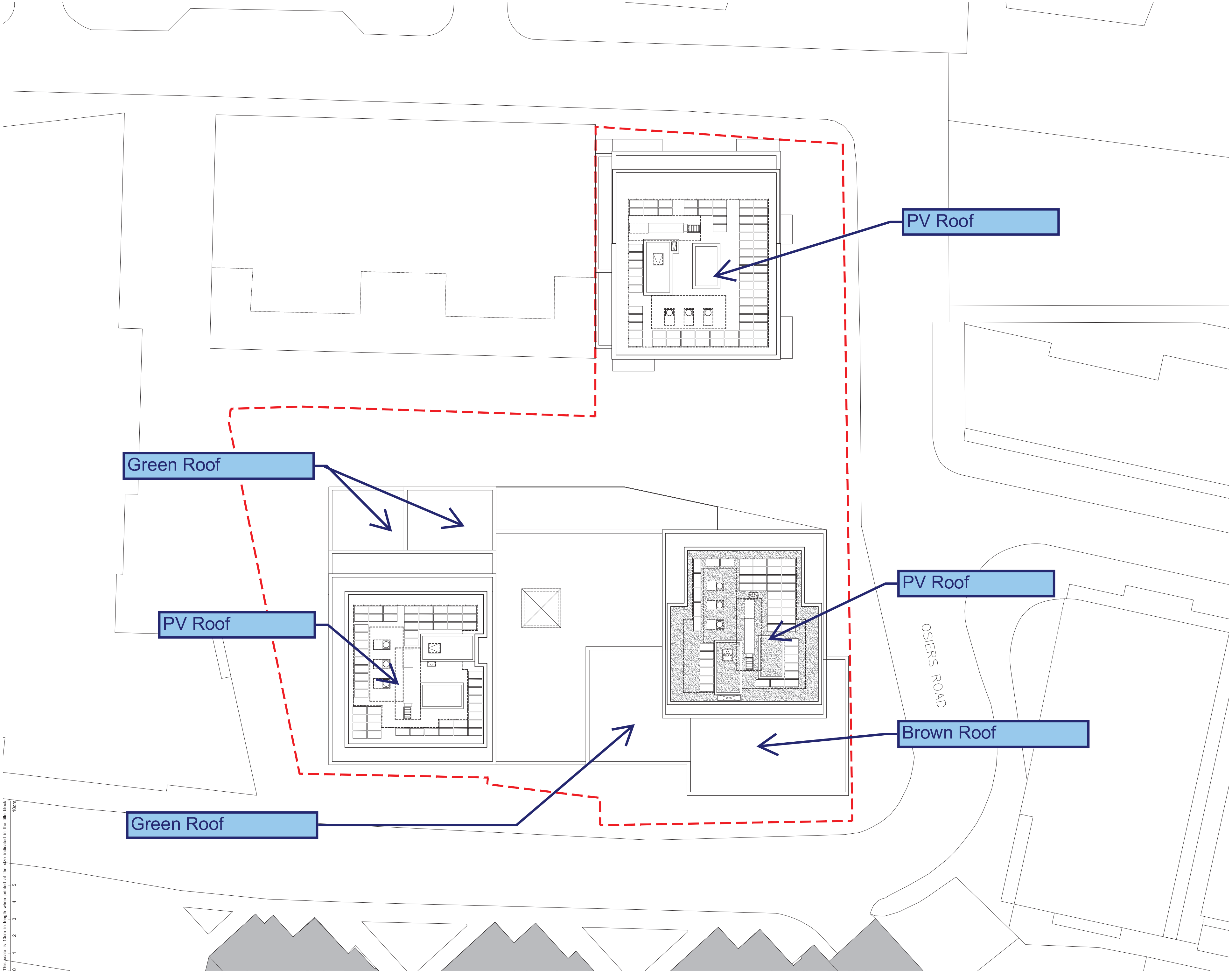
0 1 2 3 4 5 10cm



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1 The Contractor must check and confirm all dimensions
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Rev		Date
P4	Issued for Planning	30/01/19
P3	Issued for Planning	28/01/19
P2	Issued for Planning	19/07/18
P1	Issued for Planning	17/07/18

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Client
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Project
Osiers Road

Drawing
Roof Floor Plan

Scale	Date	Status
1:200 (A1)	May 18	Planning

Job Number	Drawing Number	Revision
5865	T20P14	P4

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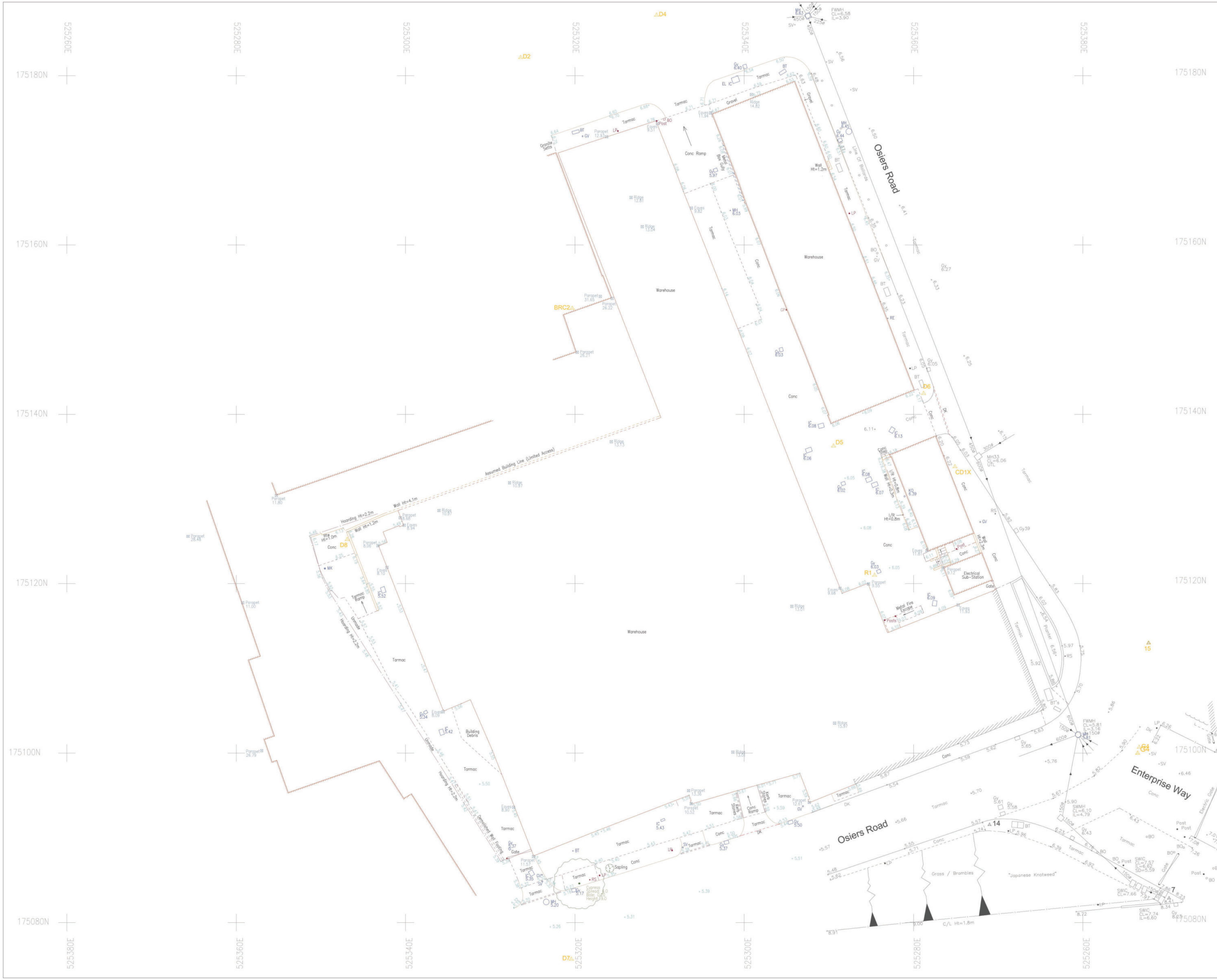
Appendix B – **Topographical Survey**



Notes:

Whilst every effort has been made to correctly identify species of trees on the site, we advise that an arborologist be consulted before any final decisions are made.

All information contained in this drawing (including digital data) should be checked and verified prior to any fabrication or construction.

Grid coordinates are based on an OS GNSS system.

INDICATIVE

Legend:

Coordinate Table

Stn	Easting	Northing	Level
BRC1	525391.465	175139.776	32.665
BRC2	525319.696	175152.524	29.724
CD1	525386.099	175143.453	50.006
CD1X	525364.892	175133.830	6.187
D2	525313.588	175182.160	6.985
D3	525342.693	175191.084	6.859
D4	525329.647	175187.156	6.922
D5	525350.548	175136.288	6.088
D6	525361.173	175142.479	6.170
D7	525319.584	175075.664	5.206
D8	525293.111	175125.232	6.285
G4	525386.642	175100.687	6.096
R1	525355.381	175121.018	7.713

Rev. Suffix	Date	Initial	Revision Details

Surveyor	DH	Verified By	DH	CAD Operator	TJH	Approved By	ARL	Date	07.09.15

Levelling GNSS Datum OSGB36

To an OS GNSS Datum

Client

JJL Residential

Location

Osiers Road Wandsworth

Drawing Title

Topographical Survey

Job No. 1506030

Old Job No.

Drawing Number JR/1506030

Revision Suffix

Scale 1:200m (A1)

Date September 2015

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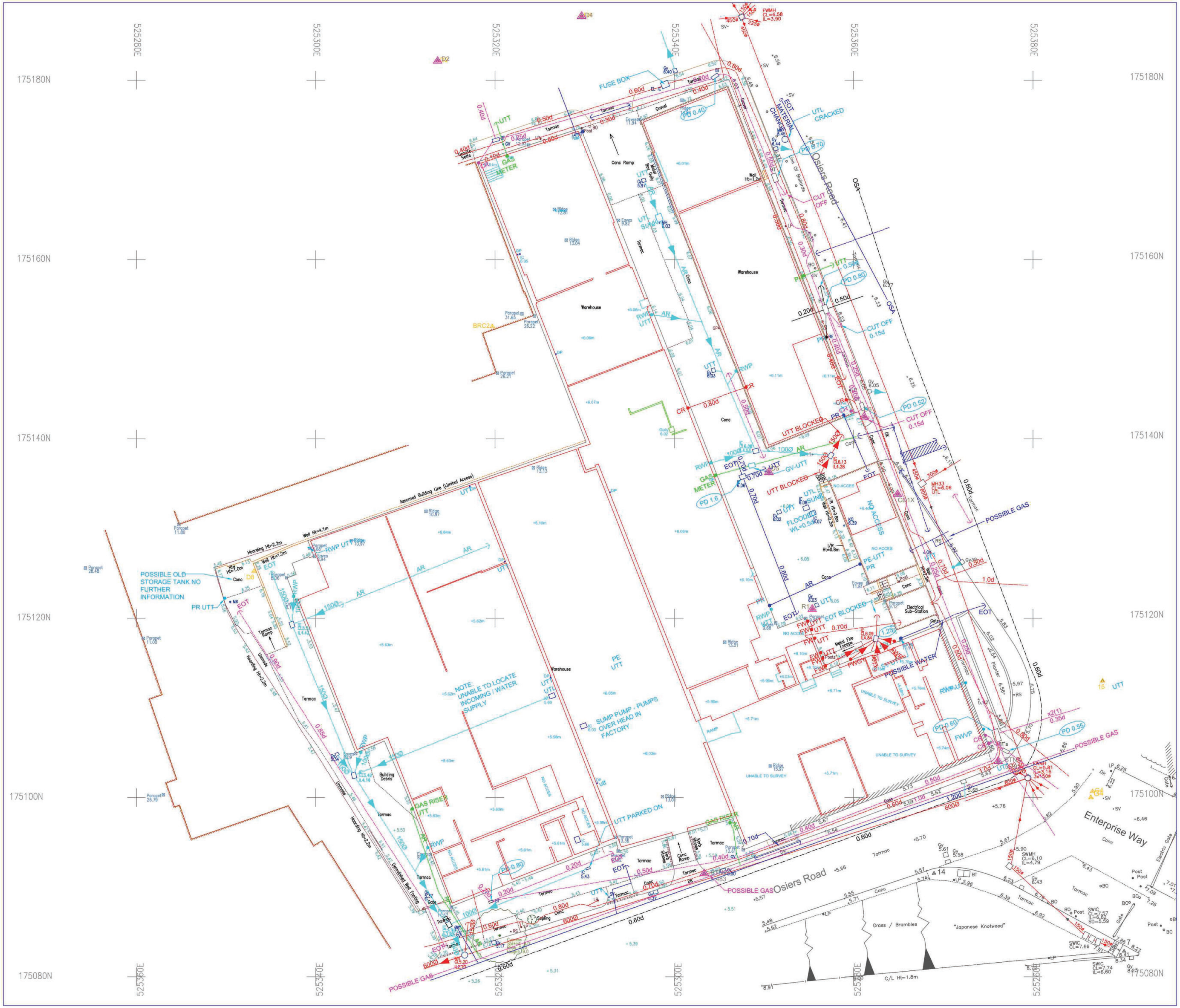

PROJECT NAME:	OSIERS ROAD
PROJECT ADDRESS:	9, 11 & 19 OSIERS ROAD LONDON WANDSWORTH SW18
DRAWING TITLE:	UNDERGROUND UTILITY SURVEY
CLIENT:	HOLLYBROOK HOMES

SCALE: 1:200	PAPER SIZE: A1	DATE: 20/06/2017
PROJECT NO: CS-3026		DRAWING NO: 01

SURVEYED	DRAWN	QA
LK	AS	PC

METERS 0 — 20

REV NO	DATE	DESCRIPTION	DRAWN	QA
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NOTES:
- SURVEY ORIENTATION IS IN RELATION TO EXISTING SITE NETWORK.
- SURVEY HEIGHTS ARE IN RELATION TO EXISTING SITE CONTROL NETWORK.
- ALL HEIGHTS SHOWN ARE IN METERS.

LEGEND:

KEY

CCTV / CABLE TELEVISION	TRAFFIC LIGHTS
COMBINED DRAINAGE	UNIDENTIFIED
COMMUNICATIONS CABLE	VAPOUR RECOVERY
COMPRESSED AIR	VENT PIPE
DUCTING	WATER PIPE
EARTH CABLE	O.S BENCH MARK
ELECTRIC CABLE	SURVEY CONTROL STATION
END OF TRACE	
FOUL DRAINAGE	
FUEL PIPE	
GAS PIPE	
GAUGE LINE	
HEATING	
OFFSET FILL PIPE	
PUMPING MAIN	
RADAR AREA ANOMALY	
RADAR UTILITY TRACE	
SURFACE DRAINAGE	
SURVEY BOUNDARY	
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Appendix C – SuDS Maintenance Schedule

WALSH

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Osiers Road,

Sustainable Drainage Operation and Maintenance Schedule

Component	Task	Frequency	Responsibility
Green Roofs	Inspect Vegetation-Free Zones	Annual once established	Site Maintenance Contractor/Specialist Maintenance Contractor
	Remove Debris	Annual once established	
	Deadhead	As needed	
	Check Irrigation/Moisture Levels	To Manufacturer's guidance	
	Fertilising	As needed only	
Blue roofs and associated ancillaries. (This is TBC following appointment of manufacturer)	Inspections of flow control outlets	1 Month	Site Maintenance Contractor/ Specialist Maintenance Contractor
	Inspections of rainwater inlet chambers	1 Month	
	Inspection of hard standing surfaces	8-10 Weeks	
	Removal of silt from chambers	As required	
	Record of inspections/maintenance undertaken to be kept	As required	
Inspection and Control Chambers	Inspect surface structures removing obstructions and silt as necessary. Check there is no physical damage.	3 Months	Site Maintenance Contractor
	Remove cover and inspect ensuring water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt.	1 Year	Site Maintenance Contractor
Inlets and Outlets to SUDS features	Inspect, remove silt and debris	3 months	Site Maintenance Contractor
Geocellular Attenuation Tank	Maintenance to be carried out as necessary	As needed	Specialist Maintenance Contractor

Appendix D – **MicroDrainage Calculations**

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	0.410	Urban	0.000
SAAR (mm)	600	Region Number	Region 6

Results	**l/s**
QBAR Rural	0.6
QBAR Urban	0.6
Q100 years	2.0
Q1 year	0.5
Q30 years	1.4
Q100 years	2.0

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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)	100	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.428	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

« - Indicates pipe capacity < flow

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
1.000	28.479	0.673	42.3	0.034	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	13.234	0.132	100.3	0.092	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	13.234	0.132	100.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	3.337	0.033	101.1	0.054	4.00	0.0	0.600	o	100	Pipe/Conduit	
2.001	4.751	5.062	0.9	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	
1.003	14.386	0.096	149.9	0.084	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	14.386	0.096	149.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	7.407	0.049	151.2	0.024	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	23.431	0.156	150.2	0.041	0.00	0.0	0.600	o	225	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)
1.000	50.00	4.31	4.800	0.034	0.0	0.0	0.0	1.55	27.4	4.6
1.001	50.00	4.47	4.052	0.126	0.0	0.0	0.0	1.31	51.9	17.1
1.002	50.00	4.64	3.920	0.126	0.0	0.0	0.0	1.31	51.9	17.1
2.000	50.00	4.07	9.008	0.054	0.0	0.0	0.0	0.76	6.0«	7.3
2.001	50.00	4.08	8.975	0.054	0.0	0.0	0.0	8.05	63.3	7.3
1.003	50.00	4.87	3.788	0.264	0.0	0.0	0.0	1.07	42.4	35.8
1.004	50.00	5.09	3.692	0.264	0.0	0.0	0.0	1.07	42.4	35.8
1.005	50.00	5.21	3.596	0.288	0.0	0.0	0.0	1.06	42.2	39.0
1.006	50.00	5.58	3.547	0.329	0.0	0.0	0.0	1.06	42.3«	44.6

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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
3.000	8.707	0.087	100.1	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	8.707	0.087	100.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.002	17.413	0.174	100.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.007	4.707	0.047	100.1	0.054	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.008	5.638	0.056	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.009	3.814	0.488	7.8	0.000	0.00	0.0	0.600	o	150	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)
3.000	50.00	4.14	3.739	0.000	0.0	0.0	0.0	1.00	17.7	0.0
3.001	50.00	4.29	3.652	0.000	0.0	0.0	0.0	1.00	17.7	0.0
3.002	50.00	4.58	3.565	0.000	0.0	0.0	0.0	1.00	17.7	0.0
1.007	50.00	5.66	3.391	0.383	0.0	0.0	0.0	1.00	17.7«	51.9
1.008	50.00	5.75	3.344	0.383	0.0	0.0	0.0	1.00	17.8«	51.9
1.009	50.00	5.77	3.288	0.383	0.0	0.0	0.0	3.63	64.1	51.9

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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)
1	6.300	1.500	Open Manhole	1200	1.000	4.800	150				
2	6.150	2.098	Open Manhole	1200	1.001	4.052	225	1.000	4.127	150	
3	6.050	2.130	Open Manhole	1200	1.002	3.920	225	1.001	3.920	225	
3	9.110	0.102	Junction		2.000	9.008	100				
3	9.110	0.135	Junction	0	2.001	8.975	100	2.000	8.975	100	
3	5.950	2.162	Open Manhole	1200	1.003	3.788	225	1.002	3.788	225	
								2.001	3.913	100	
5	5.750	2.058	Open Manhole	1200	1.004	3.692	225	1.003	3.692	225	
4	5.550	1.954	Open Manhole	1200	1.005	3.596	225	1.004	3.596	225	
5	5.530	1.983	Open Manhole	1200	1.006	3.547	225	1.005	3.547	225	
6	6.200	2.461	Open Manhole		3.000	3.739	150				
11	6.020	2.368	Junction		3.001	3.652	150	3.000	3.652	150	
8	5.840	2.275	Junction	0	3.002	3.565	150	3.001	3.565	150	
6	5.480	2.089	Open Manhole	1200	1.007	3.391	150	1.006	3.391	225	
								3.002	3.391	150	
7	5.400	2.056	Open Manhole	1200	1.008	3.344	150	1.007	3.344	150	
8	5.350	2.062	Open Manhole	1200	1.009	3.288	150	1.008	3.288	150	
	5.260	2.460	Open Manhole	1800		OUTFALL		1.009	2.800	150	

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.009	0.009	0.009
	User	-	100	0.026	0.026	0.034
1.001	User	-	100	0.031	0.031	0.031
	User	-	100	0.061	0.061	0.092
1.002	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.054	0.054	0.054
2.001	-	-	100	0.000	0.000	0.000
1.003	User	-	100	0.030	0.030	0.030
	User	-	100	0.026	0.026	0.056
	User	-	100	0.029	0.029	0.084
1.004	-	-	100	0.000	0.000	0.000
1.005	User	-	100	0.024	0.024	0.024
1.006	User	-	100	0.006	0.006	0.006
	User	-	100	0.035	0.035	0.041
3.000	-	-	100	0.000	0.000	0.000
3.001	-	-	100	0.000	0.000	0.000
3.002	-	-	100	0.000	0.000	0.000
1.007	User	-	100	0.012	0.012	0.012
	User	-	100	0.013	0.013	0.024
	User	-	100	0.030	0.030	0.054
1.008	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.383	0.383	0.383

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)
1.009		5.260	2.800	0.000	1800	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
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 Storage Structures	10
Number of Online Controls	2	Number of Time/Area Diagrams	0
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)	20.000	Storm Duration (mins)	30
Ratio R	0.428		

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Online Controls for Storm

Orifice Manhole: 3, DS/PN: 2.001, Volume (m³): 0.0

Diameter (m) 0.038 Discharge Coefficient 0.600 Invert Level (m) 8.975

Hydro-Brake® Optimum Manhole: 6, DS/PN: 1.007, Volume (m³): 3.5

Unit Reference	MD-SCU-0037-2000-1850-2000
Design Head (m)	1.850
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	37
Invert Level (m)	3.391
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.850	2.0
Flush-Flo™	0.056	0.4
Kick-Flo®	0.056	0.4
Mean Flow over Head Range	-	1.4

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	0.5	1.200	1.6	3.000	2.5	7.000	3.7
0.200	0.7	1.400	1.8	3.500	2.7	7.500	3.8
0.300	0.9	1.600	1.9	4.000	2.9	8.000	4.0
0.400	1.0	1.800	2.0	4.500	3.0	8.500	4.1
0.500	1.1	2.000	2.1	5.000	3.2	9.000	4.2
0.600	1.2	2.200	2.2	5.500	3.3	9.500	4.3
0.800	1.4	2.400	2.3	6.000	3.5		
1.000	1.5	2.600	2.3	6.500	3.6		

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Storage Structures for Storm

Porous Car Park Manhole: 1, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	22.0
Max Percolation (l/s)	30.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.750	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: 2, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	22.6
Max Percolation (l/s)	62.8	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.600	Cap Volume Depth (m)	0.300

Cellular Storage Manhole: 3, DS/PN: 1.002

Invert Level (m)	3.920	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	75.5	0.0	0.801	0.0	0.0
0.800	75.5	0.0			

Porous Car Park Manhole: 3, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	17.0
Membrane Percolation (mm/hr)	1000	Length (m)	5.0
Max Percolation (l/s)	23.6	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	9.008	Cap Volume Depth (m)	0.100

Porous Car Park Manhole: 3, DS/PN: 1.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	33.5
Max Percolation (l/s)	93.1	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.400	Cap Volume Depth (m)	0.300

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Cellular Storage Manhole: 5, DS/PN: 1.004

Invert Level (m) 3.692 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	100.0	0.0	0.801	0.0	0.0
0.800	100.0	0.0			

Porous Car Park Manhole: 4, DS/PN: 1.005

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	23.5
Max Percolation (l/s)	65.3	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.000	Cap Volume Depth (m)	0.300

Cellular Storage Manhole: 11, DS/PN: 3.001

Invert Level (m) 3.652 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	49.0	0.0	1.201	0.0	0.0
1.200	49.0	0.0			

Cellular Storage Manhole: 8, DS/PN: 3.002

Invert Level (m) 3.565 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	51.0	0.0	0.801	0.0	0.0
0.800	51.0	0.0			

Porous Car Park Manhole: 6, DS/PN: 1.007

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	7.0
Membrane Percolation (mm/hr)	1000	Length (m)	25.0
Max Percolation (l/s)	48.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.930	Cap Volume Depth (m)	0.300

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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 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 Storage Structures	10
Number of Online Controls	2	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	0.426
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia 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 (%)	40, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+40%	100/15 Summer				5.069
1.001	2	960 Winter	100	+40%	30/15 Summer				4.976
1.002	3	960 Winter	100	+40%	30/15 Winter				4.975
2.000	3	30 Winter	30	+40%					9.108
2.001	3	60 Winter	30	+40%					9.075
1.003	3	960 Winter	100	+40%	30/15 Summer				4.974
1.004	5	960 Winter	100	+40%	1/240 Winter				4.972
1.005	4	960 Winter	100	+40%	1/30 Winter				4.969
1.006	5	960 Winter	100	+40%	1/15 Summer				4.967
3.000	6	960 Winter	100	+40%	1/120 Winter				4.963
3.001	11	960 Winter	100	+40%	1/60 Summer				4.853
3.002	8	960 Summer	100	+40%	1/15 Summer				4.366
1.007	6	960 Winter	100	+40%	1/15 Summer				4.964
1.008	7	960 Winter	100	+40%					3.379
1.009	8	960 Winter	100	+40%					3.308

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.119	0.000	0.83		21.8	SURCHARGED	
1.001	2	0.699	0.000	0.10		4.7	SURCHARGED	
1.002	3	0.830	0.000	0.06		2.8	SURCHARGED	
2.000	3	0.000	0.000	0.44		2.2	FLOOD RISK*	
2.001	3	0.000	0.000	0.03		2.0	FLOOD RISK*	
1.003	3	0.961	0.000	0.15		5.7	SURCHARGED	
1.004	5	1.055	0.000	0.07		2.6	SURCHARGED	
1.005	4	1.148	0.000	0.08		2.6	SURCHARGED	
1.006	5	1.195	0.000	0.10		3.8	SURCHARGED	
3.000	6	1.074	0.000	0.01		0.2	SURCHARGED	
3.001	11	1.051	0.000	0.07		1.3	SURCHARGED*	
3.002	8	0.651	0.000	0.06		1.1	SURCHARGED*	
1.007	6	1.423	0.000	0.14		1.9	SURCHARGED	
1.008	7	-0.115	0.000	0.13		1.9	OK	
1.009	8	-0.130	0.000	0.04		1.9	OK	

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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 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 Storage Structures 10
Number of Online Controls 2 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 0.426
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status ON
Inertia 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 (%) 40, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	1	+40%	100/15 Summer				4.854
1.001	2	15 Winter	1	+40%	30/15 Summer				4.166
1.002	3	30 Winter	1	+40%	30/15 Winter				4.001
2.000	3	120 Winter	1	+40%					9.076
2.001	3	120 Winter	1	+40%					9.073
1.003	3	480 Winter	1	+40%	30/15 Summer				3.975
1.004	5	480 Winter	1	+40%	1/240 Winter				3.973
1.005	4	960 Winter	1	+40%	1/30 Winter				3.974
1.006	5	960 Winter	1	+40%	1/15 Summer				3.974
3.000	6	480 Winter	1	+40%	1/120 Winter				3.966
3.001	11	480 Winter	1	+40%	1/60 Summer				3.966
3.002	8	480 Winter	1	+40%	1/15 Summer				3.966
1.007	6	480 Winter	1	+40%	1/15 Summer				3.973
1.008	7	480 Winter	1	+40%					3.372
1.009	8	480 Winter	1	+40%					3.304

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.096	0.000	0.28		7.3	OK	
1.001	2	-0.111	0.000	0.51		22.8	OK	
1.002	3	-0.144	0.000	0.28		12.7	OK	
2.000	3	-0.032	0.000	0.23		1.2	FLOOD RISK*	
2.001	3	-0.002	0.000	0.01		0.8	FLOOD RISK*	
1.003	3	-0.038	0.000	0.15		5.5	OK	
1.004	5	0.056	0.000	0.09		3.2	SURCHARGED	
1.005	4	0.153	0.000	0.08		2.4	SURCHARGED	
1.006	5	0.202	0.000	0.08		3.0	SURCHARGED	
3.000	6	0.077	0.000	0.00		0.0	SURCHARGED	
3.001	11	0.164	0.000	0.02		0.3	SURCHARGED*	
3.002	8	0.251	0.000	0.05		0.9	SURCHARGED*	
1.007	6	0.432	0.000	0.09		1.2	SURCHARGED	
1.008	7	-0.122	0.000	0.08		1.2	OK	
1.009	8	-0.134	0.000	0.03		1.2	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 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 Storage Structures	10
Number of Online Controls	2	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	0.426
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia 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 (%)	40, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	30	+40%	100/15 Summer				4.891
1.001	2	15 Summer	30	+40%	30/15 Summer				4.424
1.002	3	960 Winter	30	+40%	30/15 Winter				4.405
2.000	3	30 Winter	30	+40%					9.108
2.001	3	60 Winter	30	+40%					9.075
1.003	3	960 Winter	30	+40%	30/15 Summer				4.405
1.004	5	960 Winter	30	+40%	1/240 Winter				4.403
1.005	4	960 Winter	30	+40%	1/30 Winter				4.406
1.006	5	960 Winter	30	+40%	1/15 Summer				4.407
3.000	6	960 Winter	30	+40%	1/120 Winter				4.394
3.001	11	960 Winter	30	+40%	1/60 Summer				4.394
3.002	8	960 Winter	30	+40%	1/15 Summer				4.366
1.007	6	960 Winter	30	+40%	1/15 Summer				4.407
1.008	7	960 Winter	30	+40%					3.376
1.009	8	960 Winter	30	+40%					3.306

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.059	0.000	0.68		17.9	OK	
1.001	2	0.147	0.000	1.47		66.0	SURCHARGED	
1.002	3	0.260	0.000	0.06		2.8	SURCHARGED	
2.000	3	0.000	0.000	0.44		2.2	FLOOD RISK*	
2.001	3	0.000	0.000	0.03		2.0	FLOOD RISK*	
1.003	3	0.392	0.000	0.14		5.3	SURCHARGED	
1.004	5	0.486	0.000	0.06		2.2	SURCHARGED	
1.005	4	0.585	0.000	0.08		2.6	SURCHARGED	
1.006	5	0.635	0.000	0.09		3.4	SURCHARGED	
3.000	6	0.505	0.000	0.00		0.0	SURCHARGED	
3.001	11	0.592	0.000	0.03		0.5	SURCHARGED*	
3.002	8	0.651	0.000	0.05		0.8	SURCHARGED*	
1.007	6	0.866	0.000	0.11		1.5	SURCHARGED	
1.008	7	-0.118	0.000	0.10		1.5	OK	
1.009	8	-0.132	0.000	0.03		1.5	OK	

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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 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 Storage Structures	10
Number of Online Controls	2	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	0.426
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia 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 (%)	40, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+40%	100/15 Summer				5.069
1.001	2	960 Winter	100	+40%	30/15 Summer				4.976
1.002	3	960 Winter	100	+40%	30/15 Winter				4.975
2.000	3	60 Winter	100	+40%					9.108
2.001	3	60 Winter	100	+40%					9.075
1.003	3	960 Winter	100	+40%	30/15 Summer				4.974
1.004	5	960 Winter	100	+40%	1/240 Winter				4.972
1.005	4	960 Winter	100	+40%	1/30 Winter				4.969
1.006	5	960 Winter	100	+40%	1/15 Summer				4.967
3.000	6	960 Winter	100	+40%	1/120 Winter				4.963
3.001	11	960 Winter	100	+40%	1/60 Summer				4.853
3.002	8	120 Winter	100	+40%	1/15 Summer				4.366
1.007	6	960 Winter	100	+40%	1/15 Summer				4.964
1.008	7	960 Winter	100	+40%					3.379
1.009	8	960 Winter	100	+40%					3.308

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.119	0.000	0.83		21.8	SURCHARGED	
1.001	2	0.699	0.000	0.10		4.7	SURCHARGED	
1.002	3	0.830	0.000	0.06		2.8	SURCHARGED	
2.000	3	0.000	0.000	0.57		2.9	FLOOD RISK*	
2.001	3	0.000	0.000	0.04		2.6	FLOOD RISK*	
1.003	3	0.961	0.000	0.15		5.7	SURCHARGED	
1.004	5	1.055	0.000	0.07		2.6	SURCHARGED	
1.005	4	1.148	0.000	0.08		2.6	SURCHARGED	
1.006	5	1.195	0.000	0.10		3.8	SURCHARGED	
3.000	6	1.074	0.000	0.01		0.2	SURCHARGED	
3.001	11	1.051	0.000	0.07		1.3	SURCHARGED*	
3.002	8	0.651	0.000	0.02		0.4	SURCHARGED*	
1.007	6	1.423	0.000	0.14		1.9	SURCHARGED	
1.008	7	-0.115	0.000	0.13		1.9	OK	
1.009	8	-0.130	0.000	0.04		1.9	OK	

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1 year Return Period Summary of Critical Results by Maximum Outflow (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 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 Storage Structures 10
Number of Online Controls 2 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 0.426
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status ON
Inertia 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 (%) 40, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	1	+40%	100/15 Summer				4.854
1.001	2	15 Winter	1	+40%	30/15 Summer				4.166
1.002	3	30 Winter	1	+40%	30/15 Winter				4.001
2.000	3	360 Summer	1	+40%					9.064
2.001	3	120 Winter	1	+40%					9.073
1.003	3	30 Winter	1	+40%	30/15 Summer				3.917
1.004	5	15 Winter	1	+40%	1/240 Winter				3.804
1.005	4	15 Winter	1	+40%	1/30 Winter				3.811
1.006	5	30 Winter	1	+40%	1/15 Summer				3.834
3.000	6	960 Winter	1	+40%	1/120 Winter				3.965
3.001	11	960 Winter	1	+40%	1/60 Summer				3.965
3.002	8	480 Winter	1	+40%	1/15 Summer				3.966
1.007	6	480 Winter	1	+40%	1/15 Summer				3.973
1.008	7	480 Winter	1	+40%					3.372
1.009	8	480 Winter	1	+40%					3.304

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.096	0.000	0.28		7.3	OK	
1.001	2	-0.111	0.000	0.51		22.8	OK	
1.002	3	-0.144	0.000	0.28		12.7	OK	
2.000	3	-0.044	0.000	0.25		1.3	FLOOD RISK*	
2.001	3	-0.002	0.000	0.01		0.8	FLOOD RISK*	
1.003	3	-0.096	0.000	0.62		22.9	OK	
1.004	5	-0.113	0.000	0.22		8.0	OK	
1.005	4	-0.010	0.000	0.26		8.1	OK	
1.006	5	0.062	0.000	0.23		8.9	SURCHARGED	
3.000	6	0.076	0.000	0.00		0.0	SURCHARGED	
3.001	11	0.163	0.000	0.02		0.3	SURCHARGED*	
3.002	8	0.251	0.000	0.05		0.9	SURCHARGED*	
1.007	6	0.432	0.000	0.09		1.2	SURCHARGED	
1.008	7	-0.122	0.000	0.08		1.2	OK	
1.009	8	-0.134	0.000	0.03		1.2	OK	

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30 year Return Period Summary of Critical Results by Maximum Outflow (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 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 Storage Structures 10
Number of Online Controls 2 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 0.426
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status ON
Inertia 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 (%) 40, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	30	+40%	100/15 Summer				4.891
1.001	2	15 Winter	30	+40%	30/15 Summer				4.424
1.002	3	15 Summer	30	+40%	30/15 Winter				4.145
2.000	3	30 Winter	30	+40%					9.108
2.001	3	120 Winter	30	+40%					9.075
1.003	3	15 Winter	30	+40%	30/15 Summer				4.138
1.004	5	30 Winter	30	+40%	1/240 Winter				4.123
1.005	4	30 Winter	30	+40%	1/30 Winter				4.099
1.006	5	30 Winter	30	+40%	1/15 Summer				4.084
3.000	6	1440 Winter	30	+40%	1/120 Winter				4.371
3.001	11	960 Winter	30	+40%	1/60 Summer				4.394
3.002	8	960 Summer	30	+40%	1/15 Summer				4.296
1.007	6	960 Winter	30	+40%	1/15 Summer				4.407
1.008	7	960 Winter	30	+40%					3.376
1.009	8	960 Winter	30	+40%					3.306

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.059	0.000	0.68		17.9	OK	
1.001	2	0.147	0.000	1.47		66.0	SURCHARGED	
1.002	3	0.000	0.000	0.64		28.8	OK	
2.000	3	0.000	0.000	0.44		2.2	FLOOD RISK*	
2.001	3	0.000	0.000	0.03		2.1	FLOOD RISK*	
1.003	3	0.125	0.000	1.39		51.7	SURCHARGED	
1.004	5	0.206	0.000	0.44		16.5	SURCHARGED	
1.005	4	0.278	0.000	0.53		16.6	SURCHARGED	
1.006	5	0.312	0.000	0.44		17.0	SURCHARGED	
3.000	6	0.482	0.000	0.00		0.0	SURCHARGED	
3.001	11	0.592	0.000	0.03		0.5	SURCHARGED*	
3.002	8	0.581	0.000	0.06		1.1	SURCHARGED*	
1.007	6	0.866	0.000	0.11		1.5	SURCHARGED	
1.008	7	-0.118	0.000	0.10		1.5	OK	
1.009	8	-0.132	0.000	0.03		1.5	OK	

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100 year Return Period Summary of Critical Results by Maximum Outflow (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 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 Storage Structures 10
Number of Online Controls 2 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 0.426
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status ON
Inertia 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 (%) 40, 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	100	+40%	100/15 Summer				5.067
1.001	2	15 Summer	100	+40%	30/15 Summer				4.596
1.002	3	15 Summer	100	+40%	30/15 Winter				4.238
2.000	3	30 Winter	100	+40%					9.108
2.001	3	120 Winter	100	+40%					9.075
1.003	3	15 Winter	100	+40%	30/15 Summer				4.252
1.004	5	15 Winter	100	+40%	1/240 Winter				4.141
1.005	4	30 Winter	100	+40%	1/30 Winter				4.227
1.006	5	30 Winter	100	+40%	1/15 Summer				4.211
3.000	6	960 Winter	100	+40%	1/120 Winter				4.963
3.001	11	360 Summer	100	+40%	1/60 Summer				4.458
3.002	8	960 Winter	100	+40%	1/15 Summer				4.366
1.007	6	960 Winter	100	+40%	1/15 Summer				4.964
1.008	7	960 Winter	100	+40%					3.379
1.009	8	960 Winter	100	+40%					3.308

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.117	0.000	0.84		22.0	SURCHARGED	
1.001	2	0.319	0.000	1.84		82.6	SURCHARGED	
1.002	3	0.093	0.000	0.62		27.7	SURCHARGED	
2.000	3	0.000	0.000	0.61		3.1	FLOOD RISK*	
2.001	3	0.000	0.000	0.04		2.7	FLOOD RISK*	
1.003	3	0.239	0.000	1.56		57.8	SURCHARGED	
1.004	5	0.224	0.000	0.49		18.2	SURCHARGED	
1.005	4	0.406	0.000	0.58		18.1	SURCHARGED	
1.006	5	0.439	0.000	0.49		19.2	SURCHARGED	
3.000	6	1.074	0.000	0.01		0.2	SURCHARGED	
3.001	11	0.656	0.000	0.08		1.4	SURCHARGED*	
3.002	8	0.651	0.000	0.07		1.3	SURCHARGED*	
1.007	6	1.423	0.000	0.14		1.9	SURCHARGED	
1.008	7	-0.115	0.000	0.13		1.9	OK	
1.009	8	-0.130	0.000	0.04		1.9	OK	

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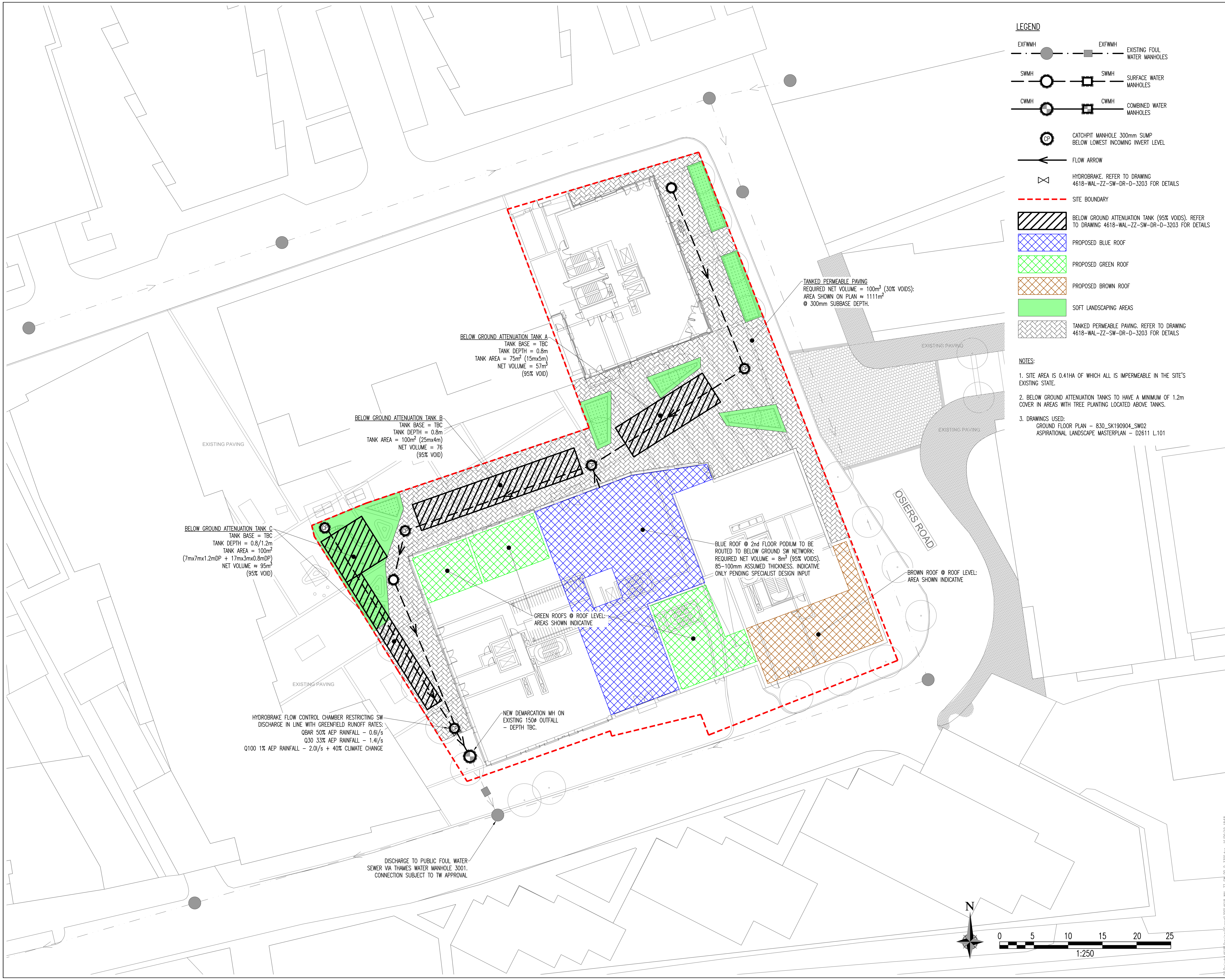
Appendix E – Proposed Schematic Drawings



Notes

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS IN METRES.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH RELEVANT ARCHITECT'S AND ENGINEER'S DRAWINGS AND SPECIFICATIONS.
3. THIS DRAWING HAS BEEN PRODUCED ELECTRONICALLY AND MAY HAVE BEEN PHOTO REDUCED OR ENLARGED WHEN COPIED. HENCE, DO NOT RELY ON ANY SCALES QUOTED. WORK ONLY TO FIGURED DIMENSIONS (DO NOT SCALE). ALL DIMENSIONS TO BE CHECKED ON SITE. ANY ERRORS OR OMISSIONS TO BE REPORTED TO THE ENGINEER IMMEDIATELY.

C.D.M.

SIGNIFICANT RISKS AND HAZARDS:

KEY DESIGN DECISIONS TO REDUCE OR ELIMINATE HAZARDS:

Rev.	Date	By	Details Of Revision
P01	16.09.19	WA	FIRST ISSUE

Client
HOLLYBROOK HOMES

Project
OSIERS ROAD

Title
INDICATIVE SUDS STRATEGY

WALSH
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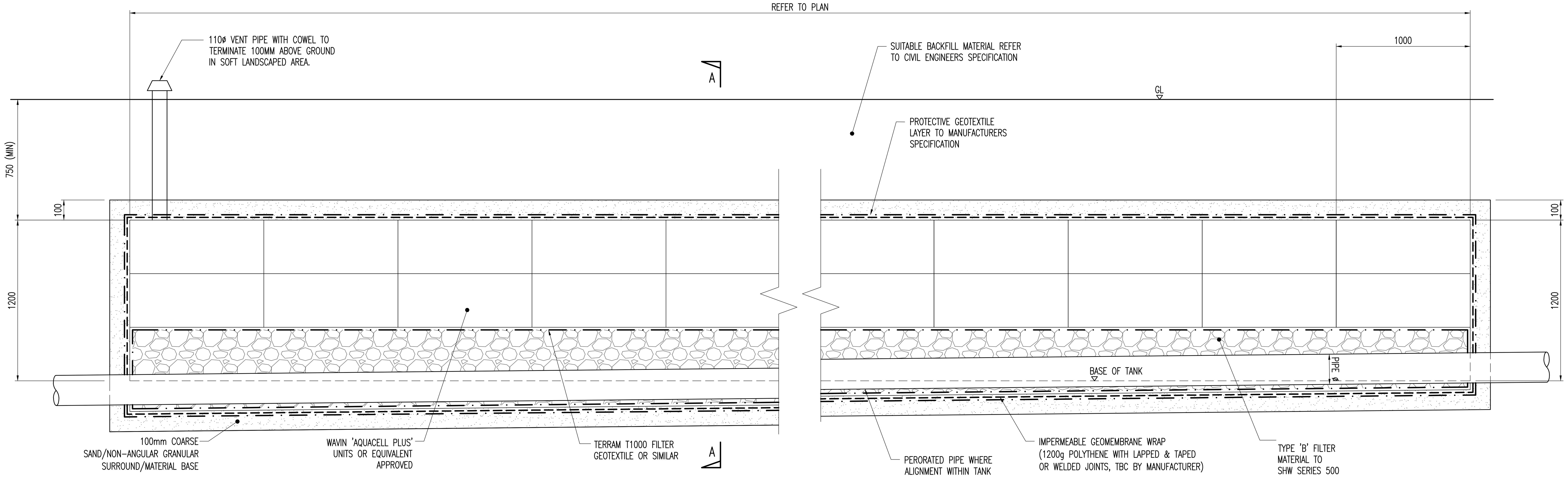
Status
PRELIMINARY

Drawn	EB	A1 Scales	1:250		
Date	11.09.19	Eng.	WA	Chk. KM	App'd. AS
WA Ref.	4618				Suitblty.

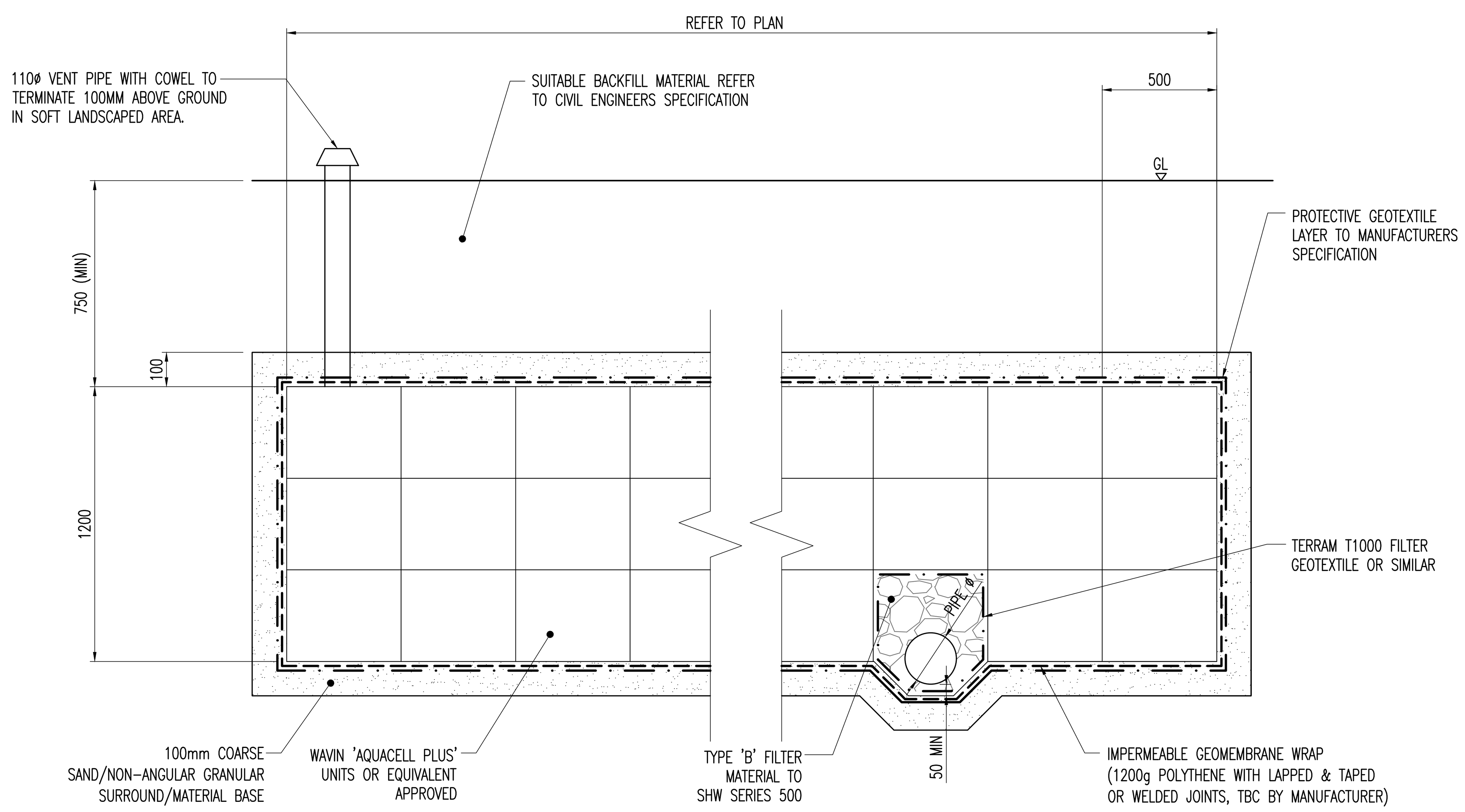
ACTUAL DIMENSION = 80mm

Drawing No.	Rev.
4618-WAL-ZZ-SW-DR-D-3300	P01



ATTENUATION TANK – LONG SECTION

SCALE 1:20



ATTENUATION TANK – SECTION A–A

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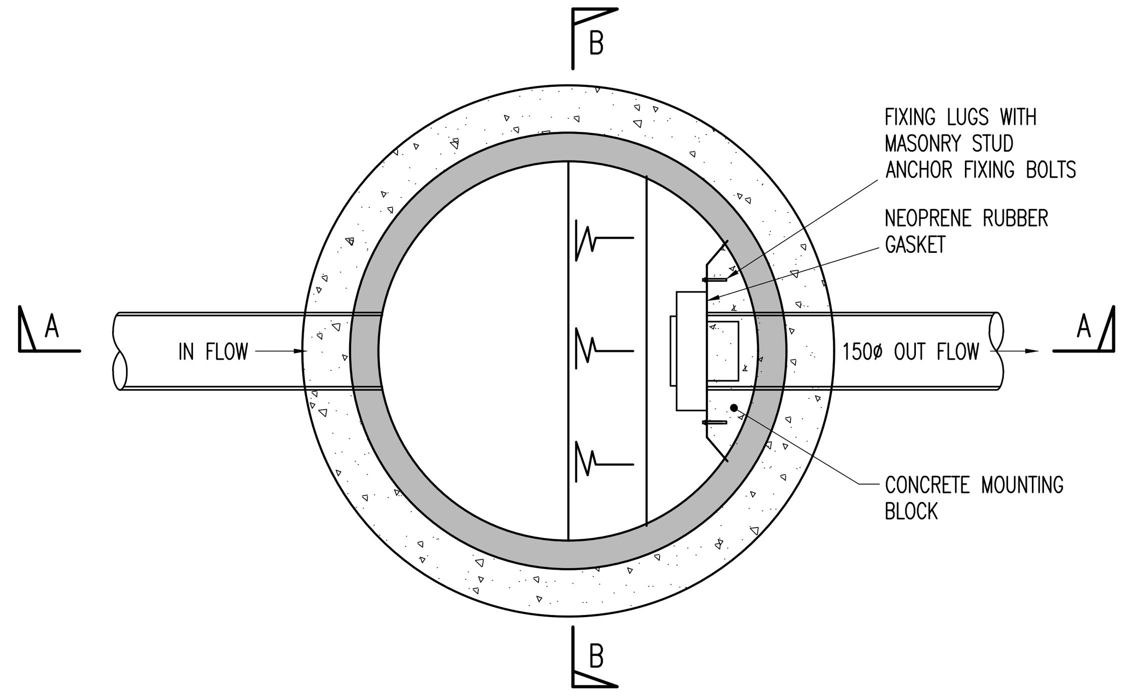
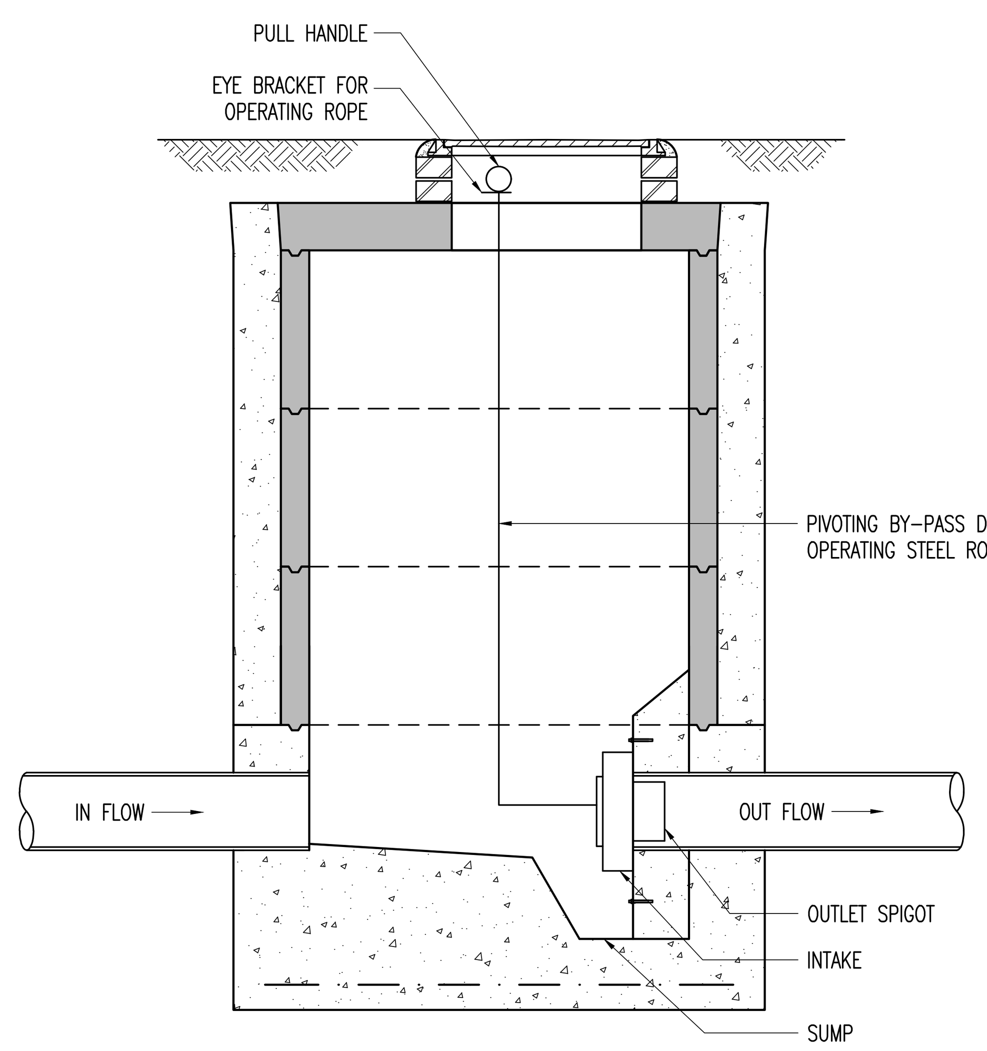
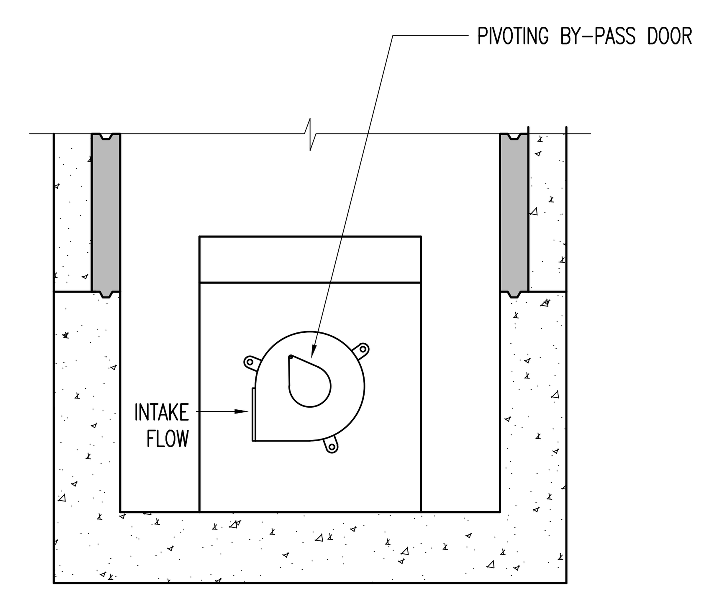


PLAN



SECTION A–A

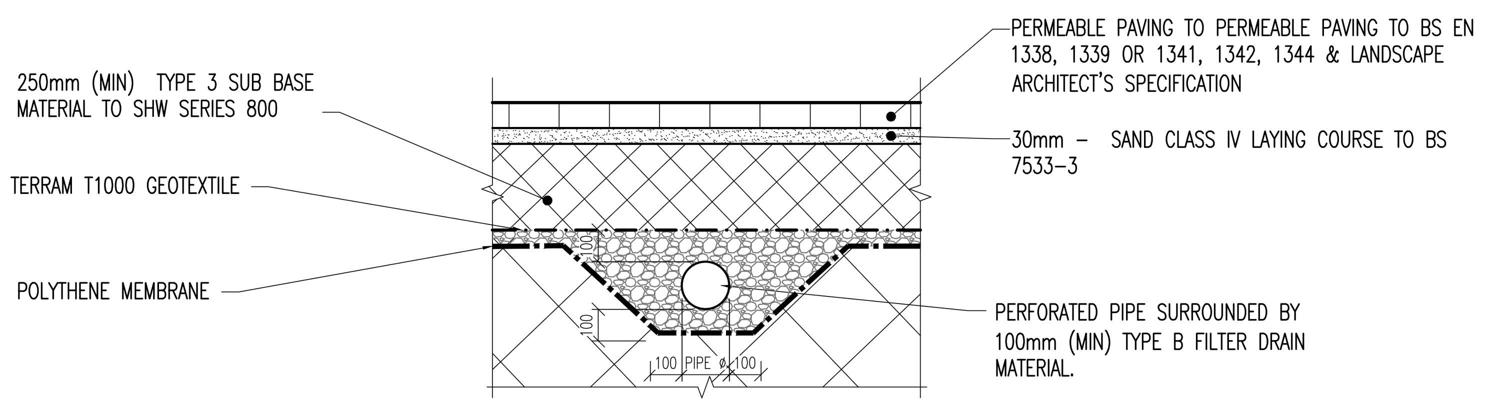
NB: HYDROBRAKE MODEL: MD-SCU-0037-2000-1850-2000
DESIGN FLOW @ 1.85m DESIGN HEAD = 2.0 l/s



SECTION B–B

DETAIL OF FLOW CONTROL MANHOLE

SCALE 1:20



PERMEABLE PAVING SURFACE PEDESTRIANISED AREA (TANKED)

LOADING CATEGORY VI, PER BS 7533-2:2001, TABLE 4

SCALE 1:20

Notes

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS IN METRES.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH RELEVANT ARCHITECT'S AND ENGINEER'S DRAWINGS AND SPECIFICATIONS.
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C.D.M.

SIGNIFICANT RISKS AND HAZARDS:

KEY DESIGN DECISIONS TO REDUCE OR ELIMINATE HAZARDS:

Rev.	Date	By	Details Of Revision
P01	16.09.19	MDL	FIRST ISSUE

Client: HOLLYBROOKS

Project: OSIERS ROAD

Title: FLOW CONTROL AND ATTENUATION TANK DETAILS

WALSH
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Status: **PRELIMINARY**

Drawn: MDL	A1 Scales: AS SHOWN				
Date: 11.09.19	Eng.: WA	Chk.: KM	App'd.		
WA Ref.: 4618			Suitblty.		

ACTUAL DIMENSION = 80mm

Drawing No.: 4618-WAL-ZZ-SW-DR-D-3203

Rev.: P01

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