TFL Landholdings at Northwood

Drainage Strategy

034233

28 October 2015

Revision 03

Revision	Description	Issued by	Date	Checked
00	First Draft	GL	07/10/2015	NP
01	Second Draft Issue (revised following comments)	GL	14/10/2015	NP/GP
02	Final Draft Issue (revised following comments)	GL	19/10/2015	NP
03	Final Issue	GL	28/10/2015	NP

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date	**28/10/2015**
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signature	
date	**28/10/2015**

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Glossary

Term	Definition
Attenuation	A method to reduce a flood peak to prevent flooding, increasing the duration of the flow.
Brownfield	Land previously developed that has potential to be regenerated.
Catchment	A river catchment is the area to which the river drains either naturally or with artificial engineering. - A surface water catchment is the area from which water drains into a river. - A groundwater catchment is the area that consists of the groundwater river flow.
Climate Change	An expected change in the world's climate.
Discharge	The rate of flow of water measured in terms of volume per unit time.
Greenfield	Land which has not been previously developed.
Groundwater	Water present within underground strata known as aquifers.
Management Train	A series of staged SuDS processes utilised to mimic natural run off characteristics.
Previously Developed Land	Land which is or was occupied by a permanent structure (excluding agricultural or forestry buildings) and associated fixed surface infrastructure (see also Brownfield).
Run-off	Flow over surfaces to the drainage system due to impermeable ground or saturated permeable ground.
Sustainable Drainage Systems (SuDS)	SuDS are used as a strategy to manage surface water in a sustainable or least damaging manner through management practices and physical structures.
Sustainable Development	Development which meets the needs of the present without compromising the ability of future generations to meet their own needs.

1 Executive Summary

This drainage strategy has been prepared by Buro Happold (BH) in relation to a mixed use development at Transport for London's Landholdings at Northwood for Transport for London (TfL). This report should be read in conjunction with the Flood Risk Assessment (FRA).

The proposed development will involve the abandonment of existing foul and surface water sewers in Station Approach and the station car park.

Two drainage catchments to the north of the development site have been identified as contributing flows to the 300mm dia. surface water sewer in Station Approach which is to be abandoned and the flows diverted into a new sewer laid in Green Lane and Central Way on the eastern boundary.

A new surface water sewer will be constructed to receive the flow emanating from the external catchments and the attenuated flows from the development.

During a severe storm, the surface water run off which currently flows along Station Approach and into the station car park, will be intercepted in a combined kerb/channel along the site's frontage in Green Lane and diverted into a new surface water sewer.

It is proposed to attenuate this runoff by installing oversized pipes at the southern end of the new surface water sewer, by restricting the flow from the sewer to the same rate that would be experienced in the pre-development situation. The attenuation is designed to accommodate the runoff from a 1% AEP storm event plus 30% climate change allowance.

This attenuation measures proposed will not adversely affect flood conditions downstream or have a significant impact on the capacity of the existing railway crossing culvert/ditch system to the south of the site.

The new sewer will be designed in accordance with Thames Water Utilities requirements and in accordance with 'Sewers for Adoption' 7th Edition.

The surface water runoff from the proposed development will be managed in a sustainable manner, restricting the discharge to a level equivalent to three times the greenfield rate, in accordance with the London Plan.

Due the ground conditions and other site constraints, a system of source control utilising geo cellular units has been selected to provide the attenuation of the runoff.

The measures outlined in the report are subject to the agreement of the drainage undertaker Thames Water Utilities Limited. A capacity check will be required and undertaken by Thames Water to establish whether any up-grading of the system is necessary.

2 Introduction

Buro Happold has been instructed by Transport for London (TfL) to prepare a drainage strategy regarding the proposed development for TfL's Landholdings at Northwood, London, HA6 2QB. The drainage strategy has been prepared in conjunction with the Flood Risk Assessment (FRA) also prepared by Buro Happold.

The site is located on the junction of Green Lane (B469) and Eastbury Road within the London Borough of Hillingdon (LBH).

The site comprises land north and south of Green Lane including part of the highway. The area of land north of Green Lane comprises a parade of single storey retail units located over the railway bridge with a two storey adjoining unit on the Corner of Eastbury Road. The northern part of the site is bounded by the Eastbury Surgery to the north; Green Lane to the south; Eastbury Road to the east and the retail units on the bridge to the west.

The majority of the site lies south of Green Lane, in Northwood and comprises the existing London Underground (LU) station and a mix of A-Class uses, residential flats, a light industrial use and an area of surface car parking. The southern part of the site is bounded by Green Lane to the north; the London Underground compound to the south; the railway line to the east; and the rear boundaries of the Northwood Central Club, St John's United Reformed Church and residential properties fronting Hallowell Road to the west.

A site plan for Phase 1 of the proposed development is shown in **Appendix A**.

The planning application proposals are:
A hybrid planning application for comprehensive redevelopment of the site comprising full planning permission involving demolition of existing buildings to provide 93 residential units (C3) and associated car parking, 1,440 sq.m retail (A1-A5), a new operational railway station (Sui Generis) with step free access and associated station car parking; new bus interchange, and a new piazza. Outline planning consent for up to 34 residential units, car parking (all matters reserved apart from access) and refurbishment works to existing retail units along Station Approach.

Proposal details:
- 127 residential units comprising:
  - 32 x 1 bed apartments
  - 56 x 2 bed apartments
  - 5 x 3 bed apartments
  - 34 x townhouses (3/4 bed)

The detailed planning application applies to the northern development area comprising of seven residential/retail blocks with a central section formed by a two level basement structure forming an underground car park as described in **Appendix A**.

The outline comprises 34 townhouses in a linear form on a north/south axis, with car parking spaces in front and gardens to the rear, the residential units are served by Central Way.

2.1 Planning Policy

The London Plan (Greater London Authority, March 2015; *'The London Plan: Spatial Development Strategy for Greater London '*) sets out the overall development strategy for London for the next 20 to 25 years, consisting of an integrated economic, environmental, transport and social framework. It contains policies specific to flood risk management and the use of sustainable drainage.

The flood risk management policy (5.12) reiterates that set out in the National Planning Policy Framework (NPPF).

The sustainable drainage policy (5.13) states that unless there are practical reasons for not doing so, development should utilise sustainable urban drainage systems (SuDS). Such development should aim to achieve greenfield run-off rates in line with a drainage hierarchy that puts infiltration and the storage of water for later use as the most preferential mechanisms, and discharge to combined sewers as the least.

The London Plan sets out environmental targets for developers in London to incorporate into the design and operations of their developments. The Supplementary Planning Guidance (SPG) to the London Plan has been published to provide further information regarding drainage matters. Of particular relevance to surface water drainage is the SPG statement:

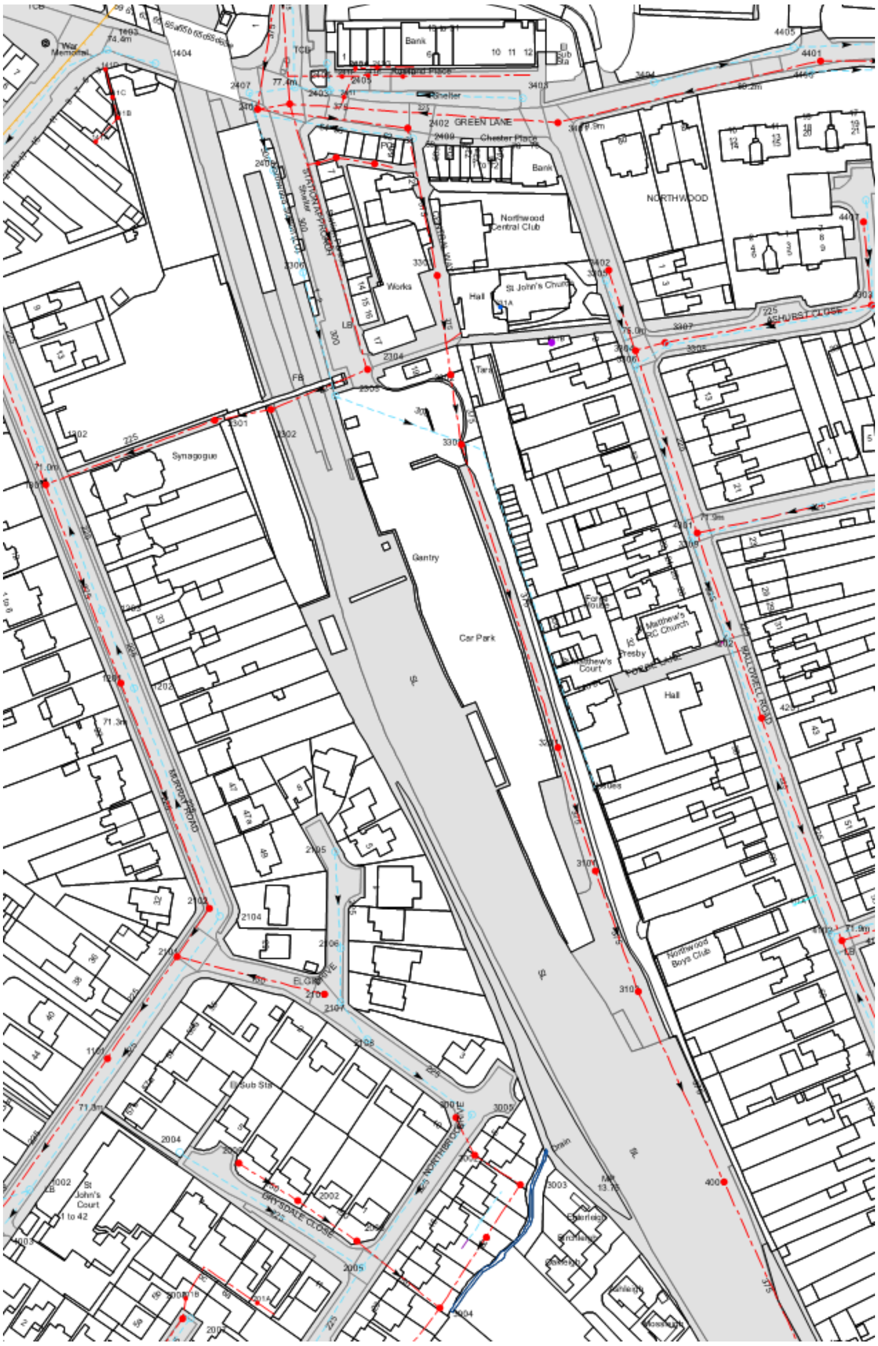
- Run-off from developments on brownfield sites should not exceed three times the greenfield run-off rate (Para 3.4.10)

The SPG also states that SuDS should be utilised for all developments wherever practical and should aim to provide additional benefits to a scheme as well as reduce flood risk.

3 Existing Drainage Arrangement

Thames Water Utilities Limited is the drainage undertaker for the Northwood area and has supplied mapping of their sewerage systems in the vicinity of the station. Figure 3-1 shows the location of public storm and foul water sewers and is shown below. The foul sewers are shown in red and storm water sewers are shown in blue. Details of the sewer sizes and manhole cover and invert levels can be found in **Appendix B** of this report.

Figure 3—1: Thames Water Utilities Ltd.'s sewer map (see also Appendix B)



3.1 Foul Water

There are two foul sewers which are within the proposed development area. The first is a 225 mm dia. pipe located in Station Approach which runs from north to south before turning 135 degree angle before the existing car park entrance. It then runs westwards under the railway line and connects with the foul sewer in Murray Road. The second sewer is a 375 mm dia. pipe laid in Central Way and runs southwards from Green Lane along the eastern boundary of the station car park towards Highfield Road.

3.2 Storm Water

There is a 300 mm dia. surface water sewer which runs north/south on the western side of Station Approach, parallel with the railway until the car park entrance where it turns 135 degrees across the northern part of the car park then southwards along the western boundary of the properties in Hallowell Road. The sewer discharges into an open ditch and then into a culvert, see Figures 3-2, 3-3 and 3-4 below (no dimensions provided), which crosses at an angle under the railway and emerges as an open watercourse which runs in a south westerly direction along the rear gardens of properties in North Brook Drive.

Figure 3—2 View of culvert of railway culvert at upstream end

Figure 3—3 Open ditch at entrance to culvert

Figure 3—4 Headwall at upstream end of railway culvert

3.3 Sewers Affected by the Development

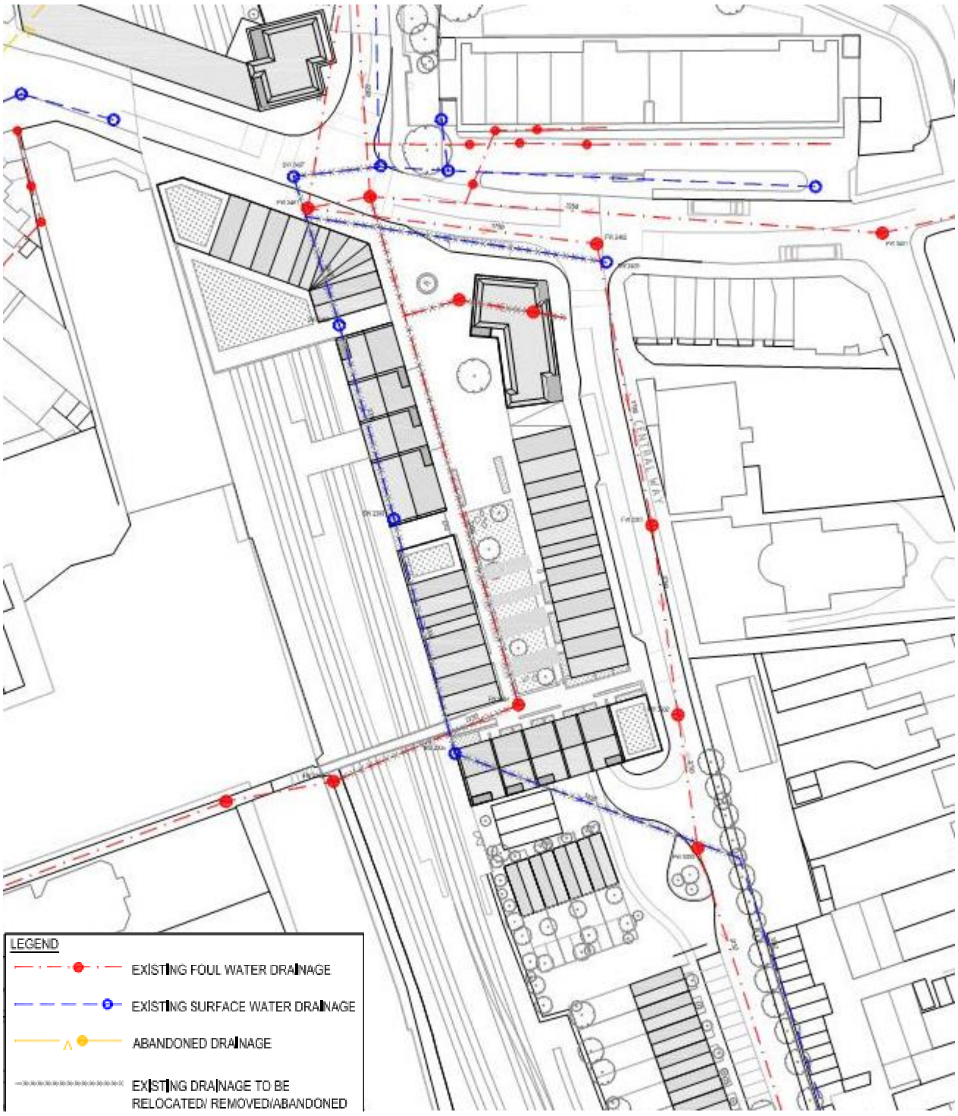
To facilitate the proposed development it will be necessary to divert both foul and surface water sewers which currently cross the site. The sewers that will need to be diverted are shown below in Figure 3—5. The Thames Water sewer network shown in the layout plan is indicative only as it is traced from the Thames Water Asset plan. The exact location is to be verified through a ground investigation and survey.

The existing sewers required to be diverted or relocated are:

- existing 225mm diameter surface water drainage running in a north-south direction along the Station Approach and continue in east direction through the existing car park;
- existing surface water drainage running in east-west direction along the Green Lane before turning into Station Approach and connects with above 225mm diameter surface water drainage;
- existing 225mm diameter foul water drainage running in a north-south direction along the Station Approach that continues west crossing the railway track;
- existing 375mm diameter foul water drainage running in a west-east direction at the junction between Green Lane and Station Approach; and
- existing 150mm diameter foul water drainage running in an east-west direction behind the existing retail units.

The existing sewers that are likely to be affected by the development are indicated below Figure 3—5.

Figure 3—5: Sewers affected by the proposed development



It is proposed to divert the surface water flows from the upstream catchments 1 & 2 (refer to Section 4.2) into a new piped system with sufficient capacity to accommodate the existing flow and the attenuated discharge from the development.

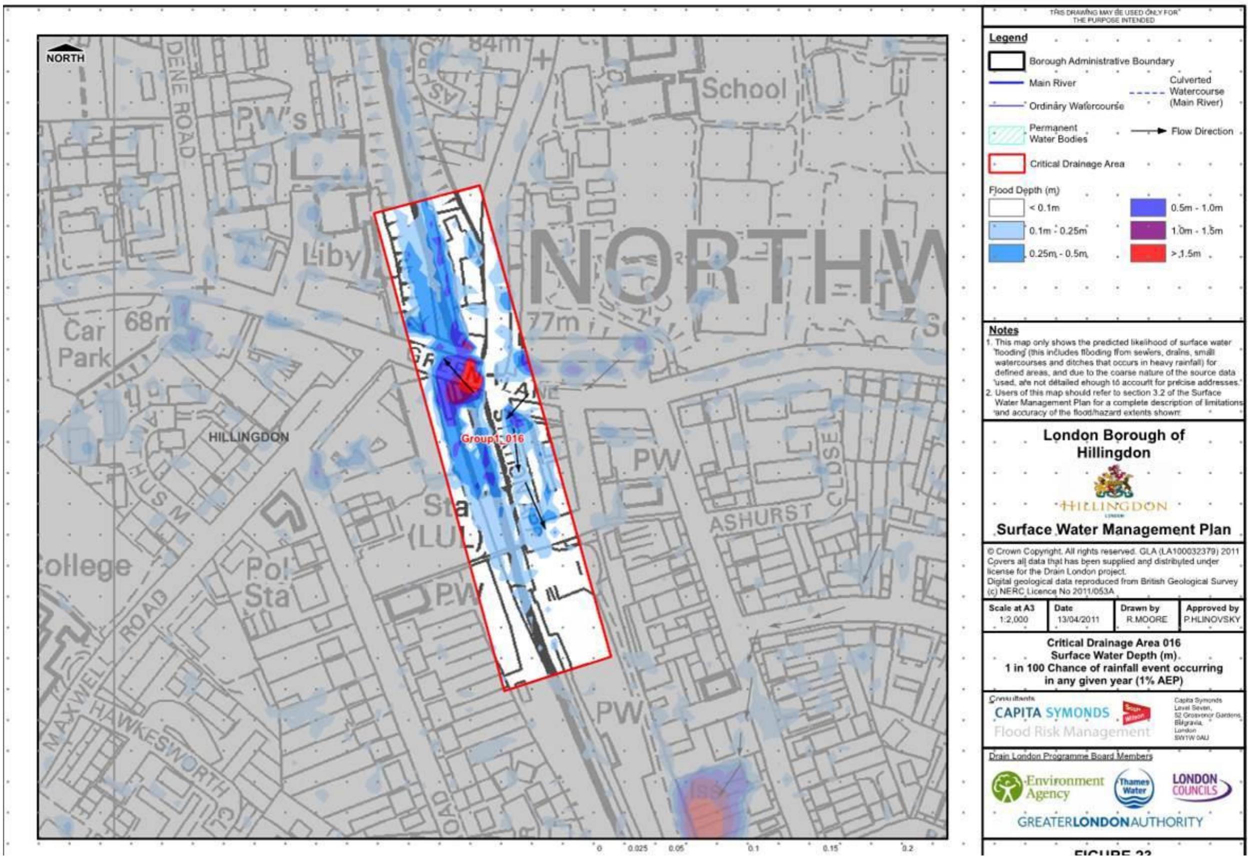
The following chapter describes the proposed development's surface water and foul drainage strategies.

4 Surface Water Drainage Strategy

4.1 Critical Drainage Area

The LBH's Surface Water Management Plan has identified that part of the site is designated as a 'critical drainage area'.

Figure 4—1: Extract form L B of Hillingdon's Surface Water Management Plan

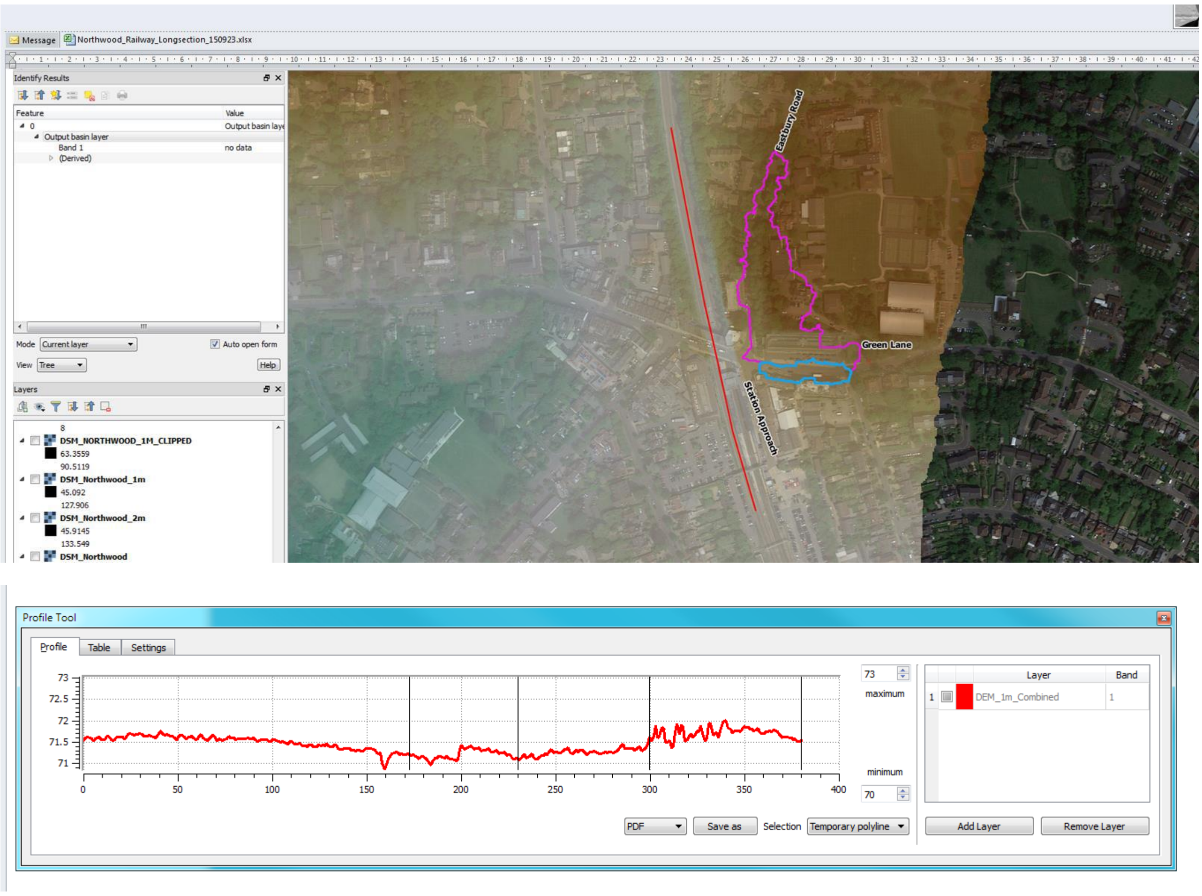


The above mapping shows the predicted area where it is likely that surface water flooding could occur due to the existing surface water drainage system being unable to cope with an estimated 1 in 100 AEP rainfall event. By reference to the LIDAR information available from the Environment Agency it is clear that the maximum depth of flooding, indicated in red, occurs at track level and would not therefore be exacerbated by the proposed development.

Currently the surface water runoff from the site is not attenuated; the drainage strategy to be adopted for the proposed development will reduce the peak flow and volume of runoff from the site by limiting the flows into the downstream sewerage system.

A copy of the LIDAR data is shown below, which illustrates that, the railway track dips at the station.

Figure 4—2: LIDAR plot section through railway track

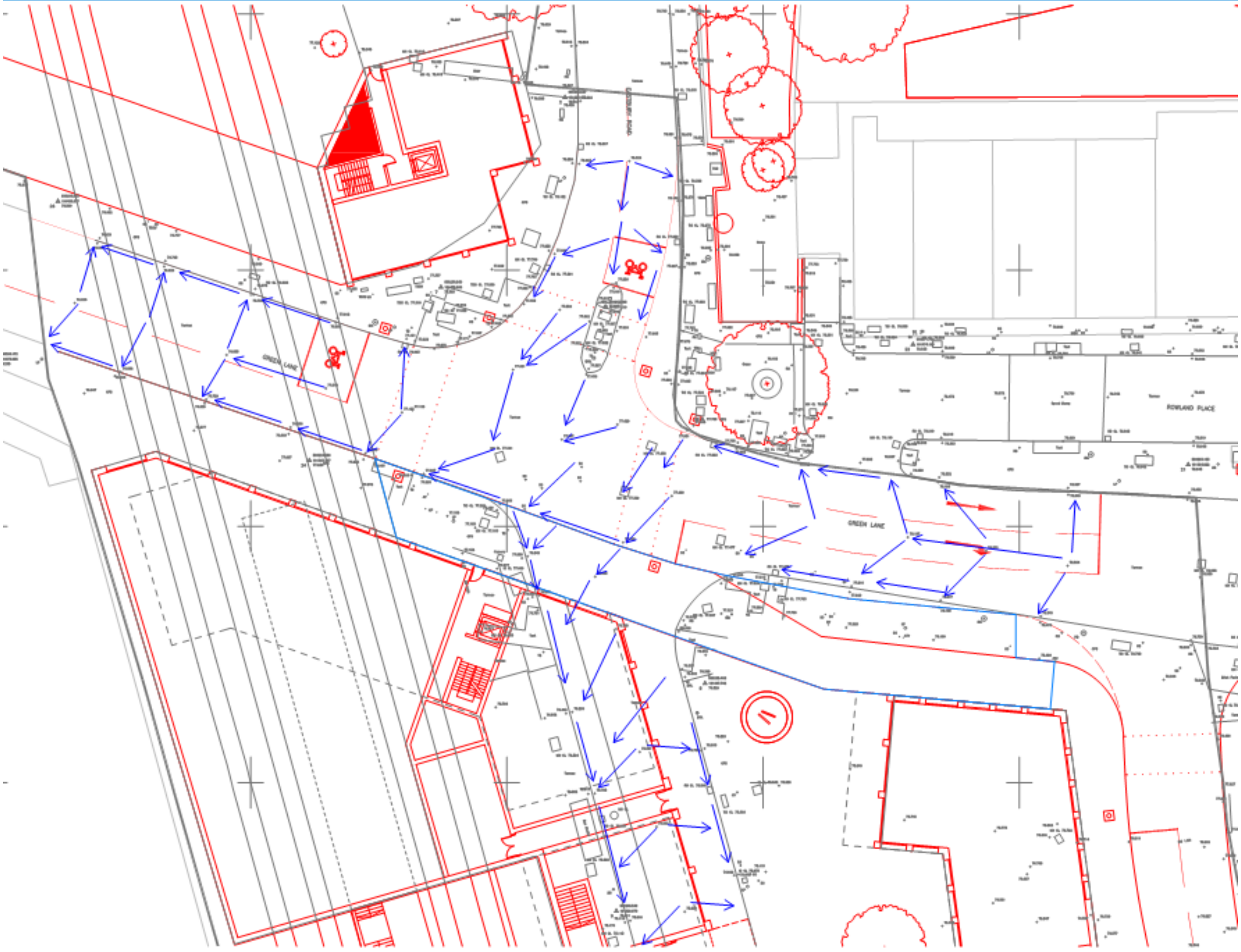


The topographical survey shows a level difference of around 3 m from the junction of Eastbury Road and the junction of Maxwell Road. Surface flow in Eastbury Road, unable to enter the drainage system, will be routed westwards along Green Lane away from Station Approach, although, there will still be a proportion of the flow which will travel down Station Approach into the existing car park and most likely some will flow onto the railway track.

The proposed development will block off this flow route and divert the surface flow into the proposed sewer system away from the railway.

The flood flow paths at the Junction of Green Lane /Eastbury Road / Station Approach. Flow are indicated at Figure 4—3:

Figure 4—3: Flood Flow Paths at the junction of Green Lane, Eastbury Road and Station Approach.

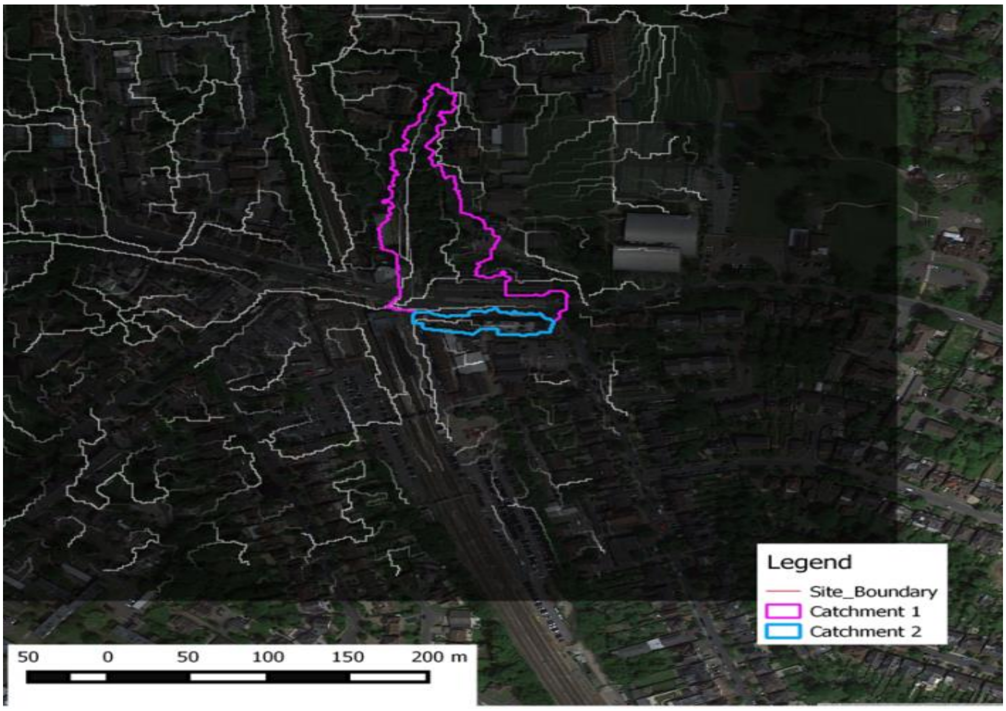


The impact of the proposed development has been considered and the findings of an investigation show that the proposed development is unlikely to exacerbate this existing drainage problem by diverting surface waters flows away from the critical area. An assessment of the external catchment areas has been undertaken and is discussed in the following section.

4.2 External Catchment Areas

Two external catchment areas have been identified from the Government's LIDAR Composite DSM -1m as contributing to the surface water flow entering the existing sewer system which passes through the development site, see Figure 4—4.

Figure 4—4 Catchment areas.



The catchment areas contributing to the flooding are shown as:

Catchment 1 Area= 0.933 ha and Catchment 2 Area= 0.140 ha.

Based on an inspection of the ratio of permeable to impermeable area within each catchment, the assumption is made that the 'worst case' can be obtained by taking 50% of catchment 1 area and 100% of catchment 2 area.

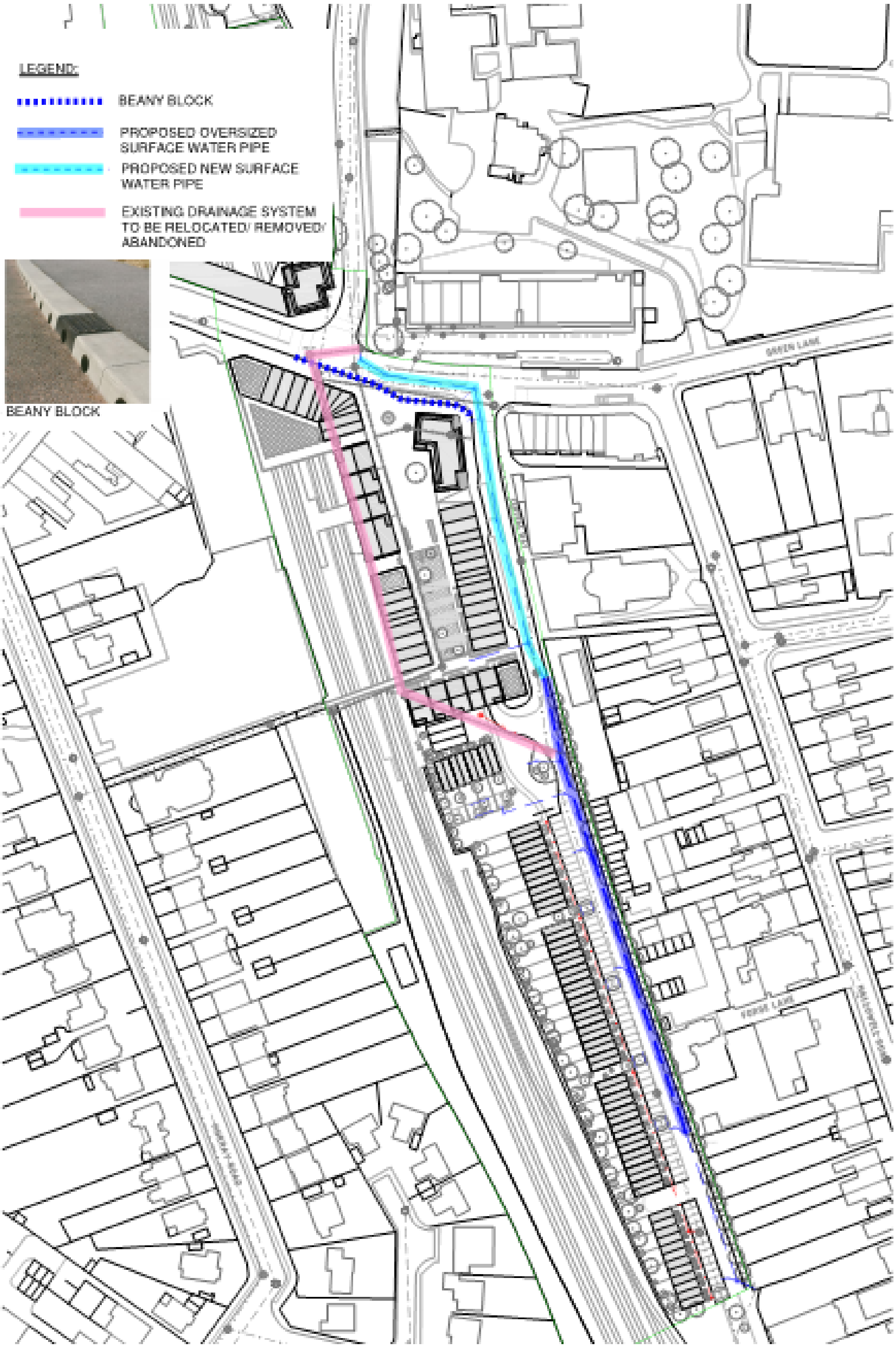
It is assumed that the existing sewers have been built to guidelines set out within the 'sewers for adoption'. As a minimum these sewers are designed to convey storm events up to and including the 1 in 30 year event without flooding. It is also assumed that flows up to the 5 year event would be contained in the drainage system of catchment areas 1& 2. WINDES calculations are included at **Appendix D.**

Surface flow from the off-site catchments that currently flow down Station Approach will be intercepted by the new kerb laid on the southern side of Green Lane. The collected runoff will be directed to a new surface water sewer located along Central Way.

At the southern end of the new surface water sewer 'oversized pipes' will be introduced to attenuate the runoff to the same level that would have been experienced from the site in its current state for events up to and including the 1 in 100 year event with an allowance for climate change. The flow that enters the culvert/ditch system to the south of the development will not exceed the existing rate of run off, and therefore, the flood risk to areas downstream of the site will be unaffected.

This drainage arrangement is illustrated in Figure 4—5.

Figure 4—5: Proposed Surface Water Sewer in Central Way



5 Sustainable Drainage

5.1 Objectives

The strategy to be adopted at this site is guided by the Consolidated London Plan 2015, and the Supplementary Planning Guidance (SPG) 'Sustainable Design and Construction 'April 2014. The objective of the guidance is to incorporate sustainable drainage in all developments to prevent the volume of surface water runoff increasing during heavy rainfall and to ensure the run off from the existing catchments upstream of the development is accommodated within the development's sewerage system to prevent exacerbating flooding downstream.

5.2 Sustainable Drainage

In accordance with the London Plan Policy (5.13), the development's surface water run-off is to be managed as close as possible to the location where it is generated i.e. at source and it is to be controlled and disposed of in line with the SUDS hierarchy.

- surface water re-uses;
- infiltration into the natural ground;
- attenuation of surface water in open water features and ponds for slow release;
- attenuation of surface water in underground tanks for slow release;
- discharge of surface water run-off to a watercourse;
- discharge of surface water run-off to a surface water sewer; and
- discharge of surface water run-off to a combined sewer.

There are a number of SUDS devices that can be employed but not all are suitable for high density urban developments. Those considered suitable for this development are shown below:

Table 5—1: Sustainable Drainage Systems

	Green Roofs	Filter trenches*	Permeable surfaces*	Swales	Ponds/basins	Attenuation tanks	Rainwater harvesting
Full Application	✗	✗	✓	✗	✗	✓	✓
Outline Application	✗	✗	✓	✗	✗	✓	✓

The London Plan requires the design of surface water runoff management to be carried out following a sustainable drainage hierarchy. A preliminary assessment of the site has considered this hierarchy and concluded that:

- the use of infiltration for the management of surface water runoff is not appropriate due to the expected impermeable nature of the underlying soils e.g. London Clay;
- the configuration of the development does not support the use of ponds or swales on site; and
- the most appropriate mitigation for surface water runoff from on-site sources is to store surface water runoff in tanks and discharge the attenuated runoff into local sewers at a controlled rate of three times the greenfield run off rate in accordance with the London Plan.

5.3 Sustainable Urban Drainage Systems (SuDS)

SuDS take account of the quantity and quality of surface water run-off together with the amenity value of surface water in the urban environment. These systems aim to provide a more sustainable solution than traditional piped drainage systems and should:

- manage run-off flow rates, reducing the impact of urbanisation on flooding;
- protect or enhance water quality; and
- be sympathetic to the environmental setting and the needs of the local community.

There are several advantages to using SuDS which include:

- effective control of peak flows;
- improved water quality;
- reduction in surface erosion;
- reduced sewer surcharging and flooding as discharge flow rates are reduced; and
- water conservation through rainwater harvesting and surface water re-use egg irrigation and/or top-up to water features and ponds.

At Para 3.4.10 of the SPG the level of runoff permitted from a development is stated as:

> *All developments on green field sites must maintain green run-off rates. On previously developed sites, run-off rates should not be more than three times the calculated Greenfield rate. The only exception to this, where greater discharge rates may be acceptable, are where pumped discharge would be required to meet the standards or where surface water drainage is to tidal waters and therefore would be able to discharge at unrestricted rates provided unacceptable scour would result.*

5.4 Attenuation of development run off

Preliminary design calculations for on-site drainage have established the volume of rainfall to be stored on site (via underground tanks) following a 1 in 100 year rainfall event with an allowance made for climate change. Each of the storage tanks will be fitted with a discharge control device to reduce the outflow to three times the greenfield run off rate, before discharging into the new storm water sewer in Central Way. The proposed drainage layout is shown at **Appendix C.**

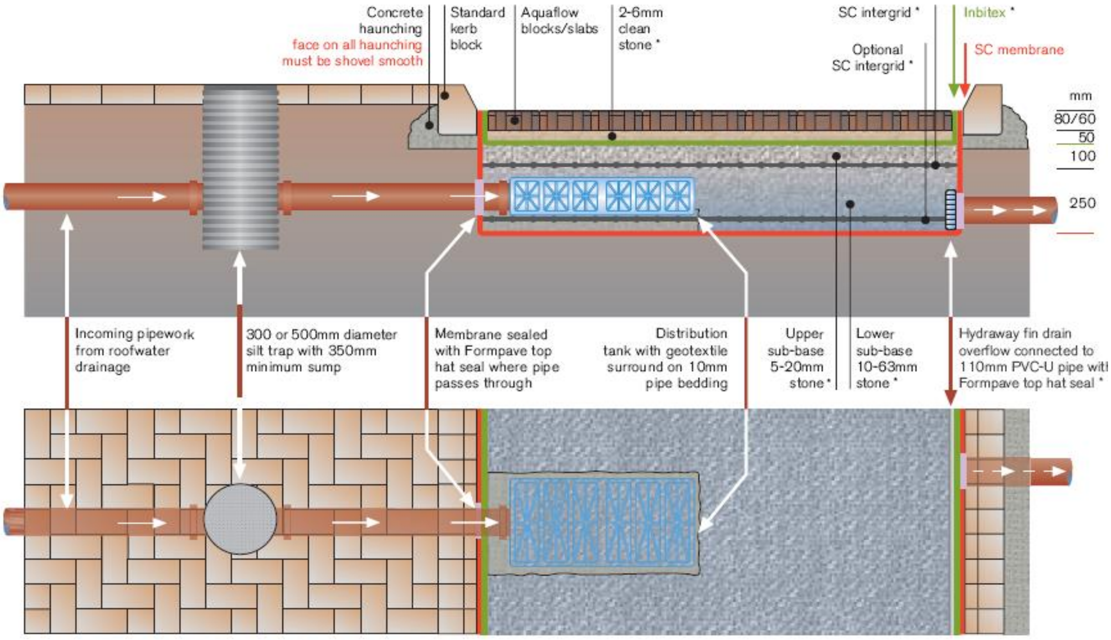
As part of the full application, on–site storage is provided within geo cellular units at the podium level. All roof water drainage is connected into the storage units, also. surface water will drain through permeable surfacing into the storage units. WINDES storage calculations are shown at **Appendix D**.

The outline part of the application where the proposed development is residential, car parking spaces are provided to the front of the properties. The car parking spaces and other hardstanding will be constructed with a permeable surface allowing the rainfall to permeate through to the geo-cellular storage units below. The rainwater downpipes at the properties are also connected into the storage tank, the collected storm water is then released into the storm water sewer at three times the greenfield rate. The impact downstream will be to reduce the peak flow in the downstream storm water system and reduce flood risk.

Examples of the podium and the car parking storage units are illustrated below:

Figure 5—1: Example of geo cellular units for storage at podium level (Aquaflow)

Figure 5—2: Permeable paving to car parking areas with geo-cellular units under to attenuate surface flows and roof drainage

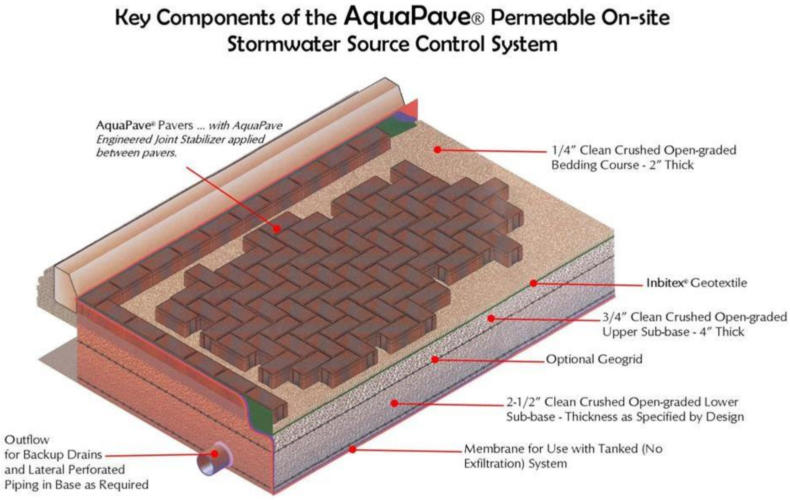


5.5 Water Quality

To ensure that the quality of the surface water run-off from the proposed development does not compromise the downstream receiving sewer network, a number of treatment systems are to be installed within the drainage network to improve water quality, they are:

- all gullies within hardstanding areas are to be fully rodable and trapped;
- drainage systems serving car park areas are to drain to the surface water sewer system via appropriate oil separators as outlined in the Environment Agency's *'Pollution Prevention Guidance – Use and design of oil separators in surface water drainage systems : PPG 3'*;
- the drainage from the podium level over the underground car park will drain directly into the surface water sewer system having undergone filtration through the permeable paving and attenuation tank;
- filtration trenches are to be installed along hardstanding areas/footpaths as a means of providing the first stage of treatment; and
- permeable pavements are to be installed with geotextile 'inbitex' to promote the removal and filtering out of oils and hydrocarbons (illustrated below Figure 5—3).

Figure 5—3: Example of storm water source control system with water treatment membrane



5.6 Maintenance of Sustainable Drainage Systems

To ensure that sustainable drainage systems operate efficiently and retain the attenuation capacity that they are designed for, they will require regular inspection and maintenance. A SuDS Management Plan is to be developed during the detailed design of the drainage network, both on-plot and within the external public realm, to identify:

- the purpose of each SuDS feature and its contribution to the overall drainage network;
- the location of the SuDS and any access routes or restricted access;
- the type of maintenance activity required for each drainage system and the anticipated frequency of this activity;
- access requirements in terms of man entry versus restricted access;
- health and safety considerations;
- manufacturer's specifications and recommendations for cleaning and replacement; and
- the management body responsible for maintaining the SuDS e.g. estate facilities management.

6 Foul Water Drainage

Foul Water

The proposed development's foul water discharges will be collected in a separate foul drainage system and connected to the existing public foul sewers. The points of connection will be subject to agreement with the drainage undertaker Thames Water Utilities. A capacity check will be required and undertaken by Thames Water on the receiving sewers to establish whether any up-grading of the system downstream of the development will be required.

A comparison of the estimated foul water discharges from the existing and proposed development is shown in the table below:

Table 6—1: Foul water discharge calculations

Variable	Existing	Proposed	Comment
Commercial			
Daily Discharge Rate 300l/day/100m^2			
Area	1.847	1,436	
Daily Foul Discharge	5.541	4,308	DWF
Allowable Peak + Infiltration	33,246	25,848	6 DWF
Infiltration Allowance	3,325	2,585	10% (6DWF)
Peak Flow	0.42	0.33	litres/sec
Residential			
Daily Discharge Rate 4000l/day/unit			
Number of Units	0	127	
Daily Foul Drainage	0	508.000	6DWF
Infiltration Allowance	0	50,800	10%(5DWF)
Peak Flow	0	6.47	Litres/sec
Peak Flow	**0.42**	**6.80**	**Litres/sec**

The impact of the increased discharge of 6.40 litres/second, from the proposed development will be modelled by Thames Water Utilities to determine the most appropriate points of connection to the foul sewer system and whether any reinforcement to the downstream system is required to mitigate the impact.

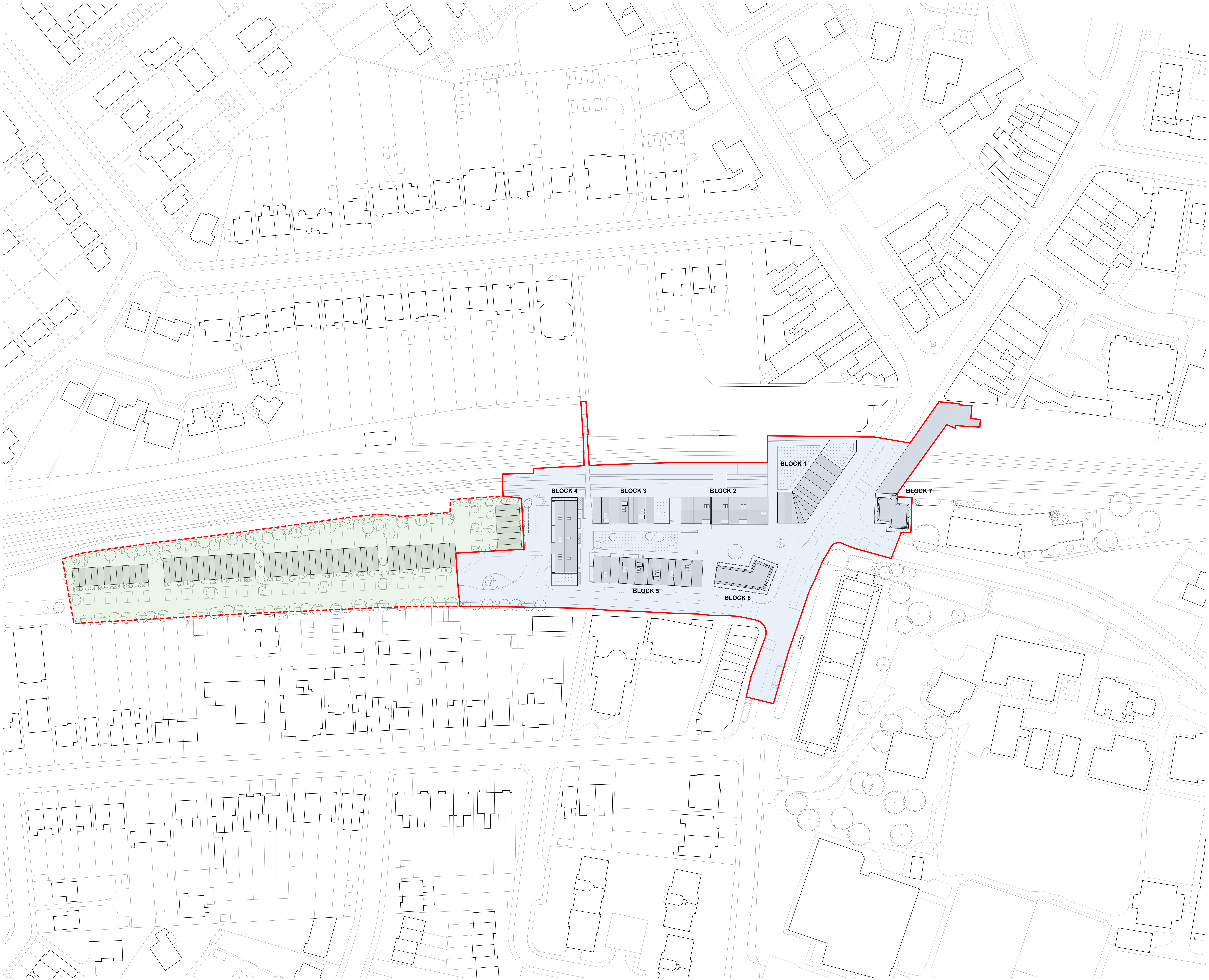
A preliminary foul water drainage strategy is shown at **Appendix B**

7 Conclusions

The conclusions of this drainage strategy report are:

- the proposed development will be drained by separate foul and surface water drainage system;
- surface flow from off-site catchments that currently flow down Station Approach will be intercepted by the new kerb laid on the southern side of Green Lane. The collected runoff will be directed to a new surface water sewer located along Central Way;
- at the southern end of the new surface water sewer 'oversized pipes' will be introduced to attenuate the run off to the same level that would have been experienced from the site for events up to and including the 1in 100 year event with an allowance for climate change. The flow that enters the culvert /ditch system to the south of the development will not exceed the existing rate of runoff, therefore, the flood risk to areas downstream of the site is considered to be unaffected;
- the surface water runoff from the proposed development will be restricted to three times the greenfield run off rate in accordance with the London Plan (SPG) guidance;
- overall there will be a reduction in the run off from the site following the development as the existing site's run off is not attenuated;
- SuDS measures will be incorporated within the development suitable for the prevailing ground conditions and land availability;
- 30% climate change has been considered in establishing the volume of attenuation required for the site;
- the issue of the critical drainage area has been investigated, and found to be confined to the railway track. The proposed development will not exacerbate the flooding, but the proposed development provides an opportunity to improve the situation, subject to detailed level information at the detail design stage, by diverting overland flow away from the railway track;
- the surface water runoff from the development can be managed in a sustainable manner; and
- the points of connection for the development's foul and surface water drainage will be subject to agreement with the drainage undertaker Thames Water Utilities. Capacity checks are required and will be undertaken by Thames Water on the receiving sewers to establish whether any up-grading of the system downstream of the development will be required.

Appendix A Proposed Development



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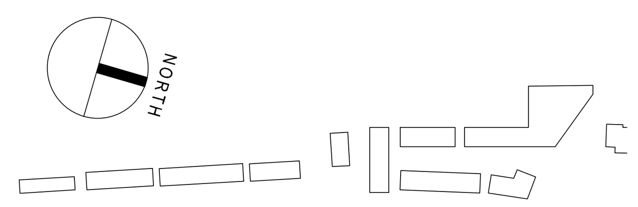
KEY

ZONE A - Detail Application (12,194.4m²)

ZONE B - Outline Application (6,193.6m²)

REV	DESCRIPTION	BY	CHK	DATE
A	GA FREEZE	AH	LR	16.10.15
-	DRAFT ISSUE	AH	LR	25.09.15

FOR INFORMATION



TRANSPORT FOR LONDON NORTHWOOD

05 SITE
Location Plan
Application Boundaries

DRAWING NUMBER / REVISION
A 1323 GA 0502 A

SCALE
1:750 @A1 / 1:1500 @A3

DATE / DRAWN BY / CHECKED BY
31.07.2015 AH / LR

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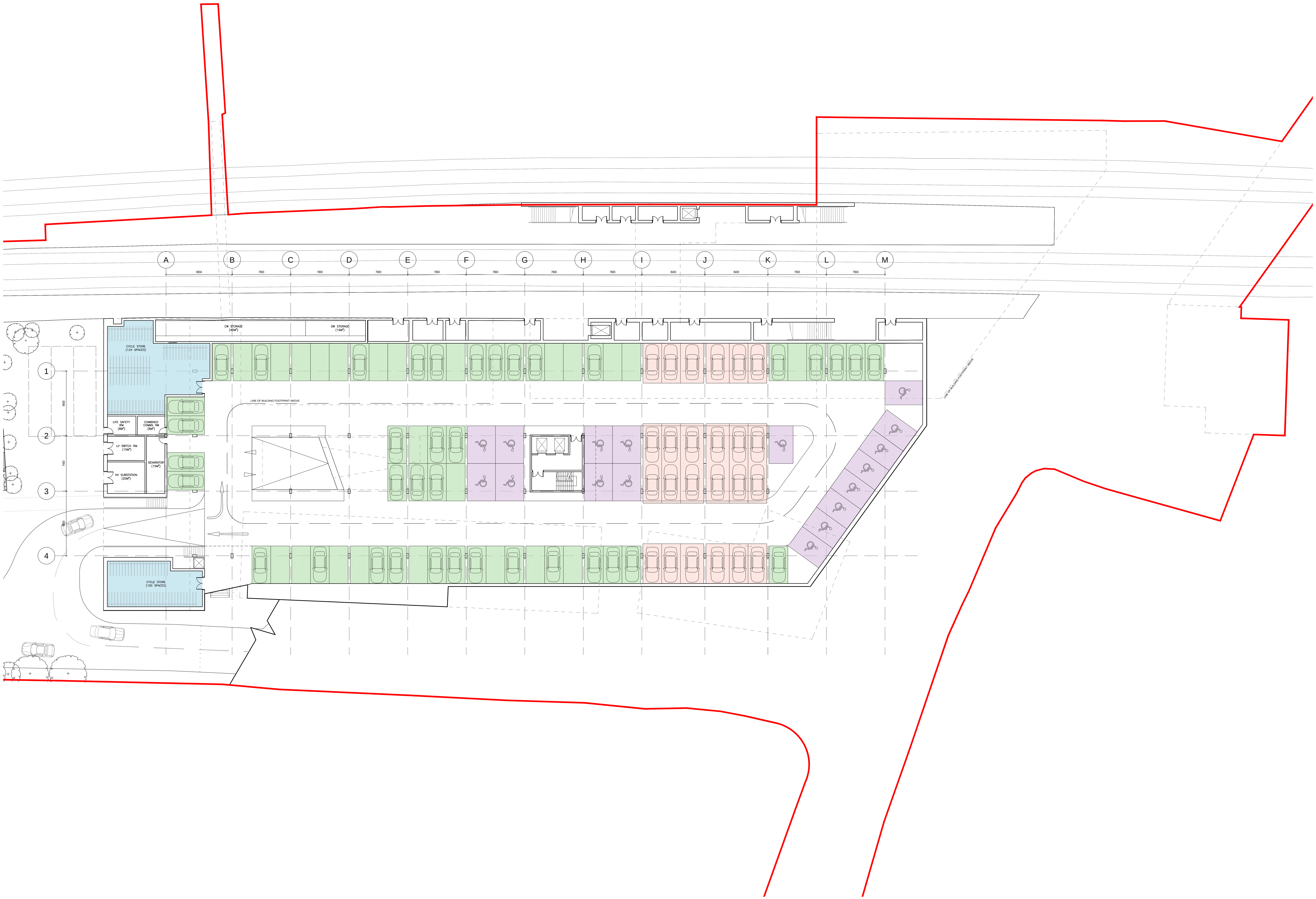
KEY:

- Site Boundary
- Residential
- Retail
- Station
- Single Parking
- Car Stackers
- Disabled Parking
- Cycle Store
- Refuse Store

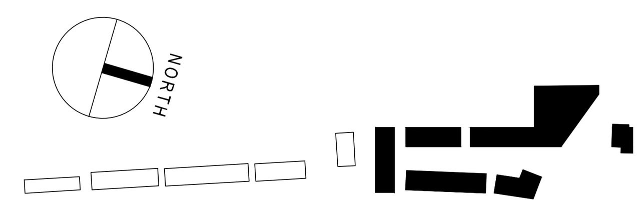


TOTAL CAR SPACES - 126
(61 Commuter / 17 Accessible / 48 Residential)

IN ABEYANCE, STRUCTURES/SERVICES TO BE COORDINATED WITH BH.

REV	DESCRIPTION	BY	CHK	DATE
B	GA FREEZE	AH	LR	16.10.15
A	GA FREEZE	AH	LR	09.10.15
-	DRAFT ISSUE	AH	LR	25.09.15

FOR INFORMATION



TRANSPORT FOR LONDON
NORTHWOOD

20 GA PLANS
Zones A Blocks 1-7
Lower Ground 2 Floor Plan

DRAWING NUMBER / REVISION
A 1323 GA 2000 B

SCALE
1:250 @A1 / 1:500 @A3

DATE / DRAWN BY / CHECKED BY
31.07.2015 RE / LR

fletcher priest architects
london + köln + riga
middlesex house
34/42 cleveland st
london W1T 4JE
t +44 (0)20 7034 2200
f +44 (0)20 7637 5347
www.fletcherpriest.com

NOTES

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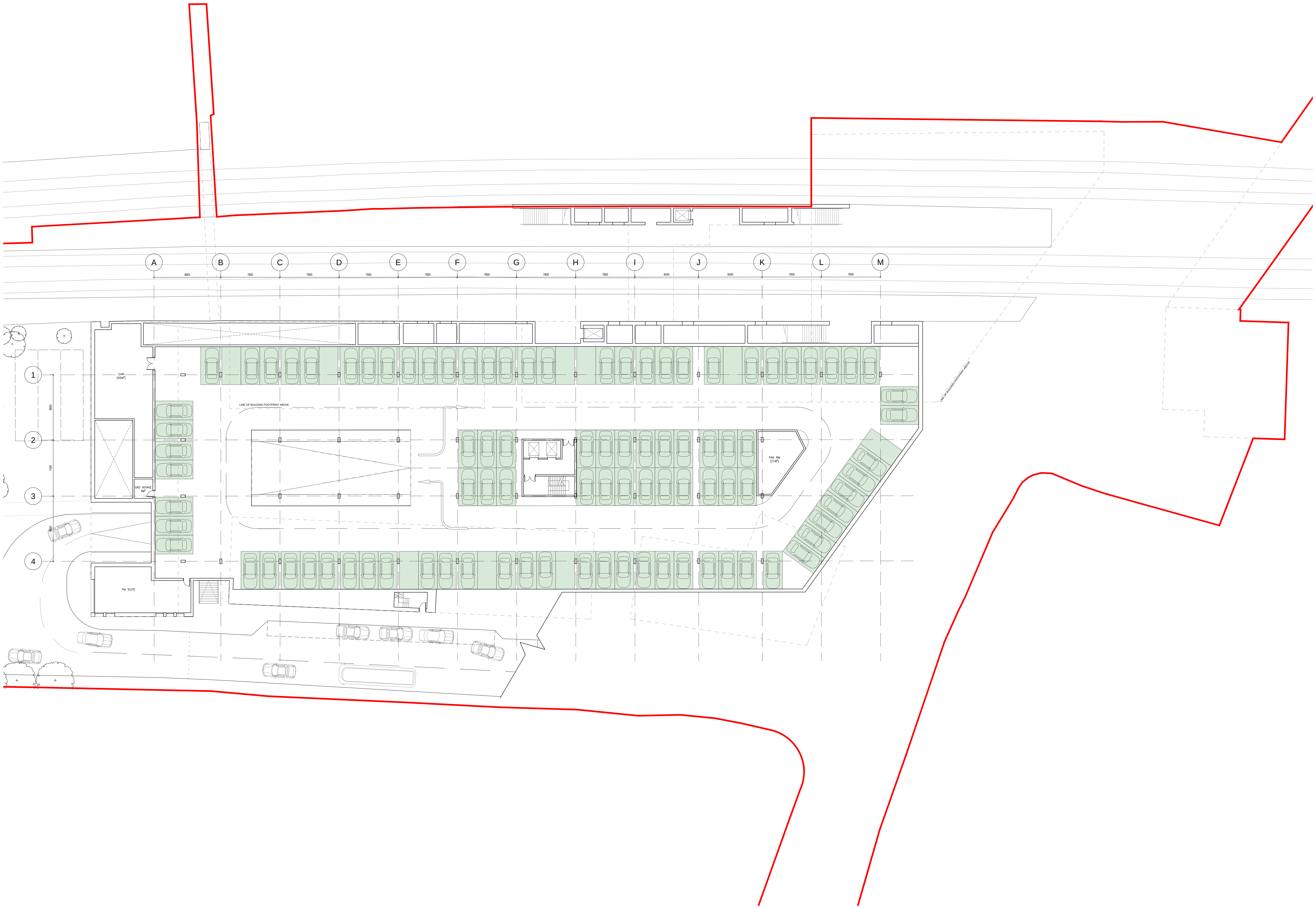
KEY:

- Site Boundary
- Residential
- Retail
- Station
- Single Parking
- Car Stackers
- Disabled Parking
- Cycle Store
- Refuse Store

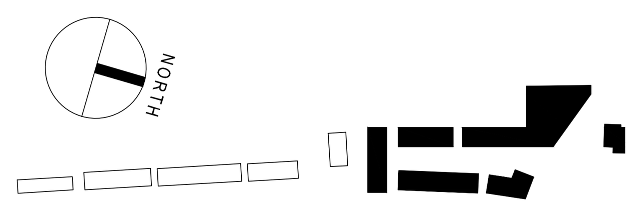


TOTAL CAR SPACES - 126
(61 Commuter / 17 Accessible / 48 Residential)

IN ABEYANCE, STRUCTURES/SERVICES TO BE COORDINATED WITH BH.

REV	DESCRIPTION	BY	CHK	DATE
B	GA FREEZE	AH	LR	16.10.15
A	GA FREEZE	AH	LR	09.10.15
-	DRAFT ISSUE	AH	LR	25.09.15

FOR INFORMATION



TRANSPORT FOR LONDON
NORTHWOOD

20 GA PLANS
Zone A Blocks 1-7
Lower Ground 1 Floor Plan

DRAWING NUMBER / REVISION
A 1323 GA 2001 B

SCALE
1:250 @A1 / 1:500 @A3

DATE / DRAWN BY / CHECKED BY
31.07.2015 RE / LR

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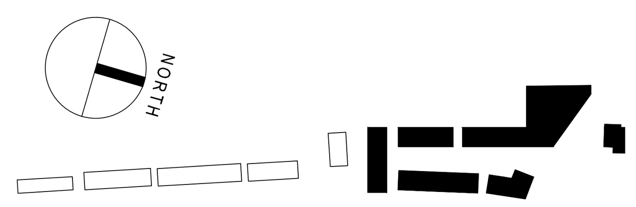
KEY:

- Site Boundary
- Residential
- Retail
- Station
- Single Parking
- Car Stackers
- Disabled Parking
- Cycle Store
- Refuse Store

REV	DESCRIPTION	BY	CHK	DATE
B	GA FREEZE	AH	LR	16.10.15
A	GA FREEZE	AH	LR	09.10.15
-	DRAFT ISSUE	AH	LR	25.09.15

FOR INFORMATION



TRANSPORT FOR LONDON
NORTHWOOD

20 GA PLANS
Zone A Blocks 1-7
Ground Floor Plan

DRAWING NUMBER / REVISION
A 1323 GA 2002 B

SCALE
1:250 @A1 / 1:500 @A3

DATE / DRAWN BY / CHECKED BY
31.07.2015 AH / LR

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Appendix B Thames Water Sewer Mapping

Asset Location Search Sewer Map - ALS/ALS Standard/2015_3043538	TQ0991SW

The width of the displayed area is 500m and the centre of the map is located at OS coordinates 509250,191250

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Manhole Reference	Manhole Cover Level	Manhole Invert Level
4406	79.97	78.96
4403	79.67	78.53
4402	79.61	75.84
4401	80.03	76.14
4405	80.14	79.22
4404	79.88	78.89
141C	n/a	n/a
141B	n/a	n/a
1404	76.1	74.36
2407	77.2	75.59
2401	77.02	70.1
2408	75.69	74.13
2403	77.41	74.76
2406	77.43	75.93
2306	73.5	72.27
241L	n/a	n/a
2404	78.33	76.17
2405	78.01	76.17
241K	n/a	n/a
241F	n/a	n/a
241I	n/a	n/a
241H	n/a	n/a
2304	72.09	69.84
241E	n/a	n/a
241J	n/a	n/a
241G	n/a	n/a
241D	n/a	n/a
2402	78.88	69.91
2409	78.85	77.93
3301	75.36	69.76
3302	73.7	69.64
3303	72.37	69.48
331A	n/a	n/a
3403	80.47	79.65
331B	n/a	n/a
3401	80.11	76.37
3201	71.77	68.98
3305	76.07	74.64
3402	76.36	74.47
3306	n/a	n/a
3304	n/a	n/a
3404	80.53	79.21
3307	n/a	n/a
3308	n/a	n/a
3309	71.96	70.5
4301	71.99	69.88
4202	71.01	69.31
4201	70.92	68.95
4407	n/a	n/a
4408	n/a	n/a
4303	n/a	n/a
4304	n/a	n/a
4307	73.2	71.03
4302	73.29	70.58
201A	n/a	n/a
201B	n/a	n/a
2005	65.97	64.42
2003	67.12	65.7
1001	69.84	67.53
1003	69.83	68.09
1004	n/a	n/a
1008	n/a	n/a
2002	68.61	67.56
1002	70.56	69.03
0001	n/a	n/a
0002	n/a	n/a
2006	70.17	69.34
2004	70.63	69.03
1007	n/a	n/a
1005	n/a	n/a
1006	n/a	n/a
0004	n/a	n/a
1101	71.43	68.57
2108	70.26	68.7
0108	n/a	n/a
2107	72.03	70.77
2103	71.14	69.59
2101	71.46	68.86
2106	71.19	70.02
2104	71.49	70.05
2102	71.49	69.03
411A	n/a	n/a
4102	71.79	70.14
4101	71.83	68.78
4103	72.48	70.86
4107	n/a	n/a
401A	n/a	n/a
4106	n/a	n/a
4104	n/a	n/a

Manhole Reference	Manhole Cover Level	Manhole Invert Level
4002	72.34	71.12
4105	n/a	n/a
3004	n/a	n/a
3001	67.34	66.34
3005	67.03	65.56
3002	66.89	65.57
301A	n/a	n/a
301B	n/a	n/a
3003	n/a	n/a
3101	71.52	68.89
3102	71.27	68.73
4001	71.76	68.48
031A	n/a	n/a
1406	70.83	66.77
1402	70.89	69.45
141A	n/a	n/a
141D	n/a	n/a
1403	74.69	72.89
2105	71.1	70.14
0110	n/a	n/a
0112	n/a	n/a
0102	n/a	n/a
0211	n/a	n/a
0202	n/a	n/a
0203	n/a	n/a
1202	72.34	70.78
1201	71.35	69.22
0204	n/a	n/a
1203	71.24	69.38
0201	69.37	65.42
1301	71.24	69.41
0303	69.32	68.14
1302	71.18	69.5
2301	71.65	69.52
2302	n/a	n/a
031C	n/a	n/a
2305	72.04	70.51
0302	69.43	68.34
031B	n/a	n/a
0301	69.42	65.64
0114	n/a	n/a
0109	n/a	n/a
0113	n/a	n/a
0103	n/a	n/a
0104	n/a	n/a
0111	n/a	n/a
0005	n/a	n/a
0105	n/a	n/a
0106	n/a	n/a
0003	n/a	n/a
0101	n/a	n/a
0107	n/a	n/a
2007	n/a	n/a
2008	n/a	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Appendix C Proposed Drainage Layout

DO NOT SCALE THIS DRAWING.

HEALTH AND SAFETY INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING

CONSTRUCTION.

MAINTENANCE/CLEANING/OPERATION.

DECOMMISSIONING/DEMOLITION.

Notes

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH 034233_C3111 AND 034233_C3112.

2. THIS LAYOUT PLAN IS BASED ON:
- FLETCHER PRIEST ARCHITECTS DRAWINGS RECEIVED ON 30th SEPTEMBER 2015.
- THAMES WATER ASSET LOCATION SEARCH SEWER MAP.

3. EXISTING SEWER INFORMATION IS INDICATIVE ONLY.

LEGEND

- EXISTING FOUL WATER DRAINAGE
- EXISTING SURFACE WATER DRAINAGE
- ABANDONED DRAINAGE
- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED BEANY BLOCK HALF BATTERED WITH 295 BASE UNIT FROM MARSHALLS WITH OUTLET
- PROPOSED PODIUM AREA WITH GEOCELLULAR ATTENUATION DRAINAGE
- PROPOSED PERMEABLE PAVING AREAS WITH GEOCELLULAR ATTENUATION DRAINAGE
- PROPOSED FOUL WATER DRAINAGE
- EXISTING DRAINAGE TO BE
- SITE BOUNDARY

Rev	Description	Date	Drn	Ch'd
A	INITIAL ISSUE	06.10.15	MCD	NP

INFORMATION

Status of drawing

BUROHAPPOLD ENGINEERING

Camden Mill
Lower Bristol Road
Bath BA2 3DQ
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Tel: +44 (0)1225 320600
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Email: 034233@burohappold.com
Web: www.burohappold.com

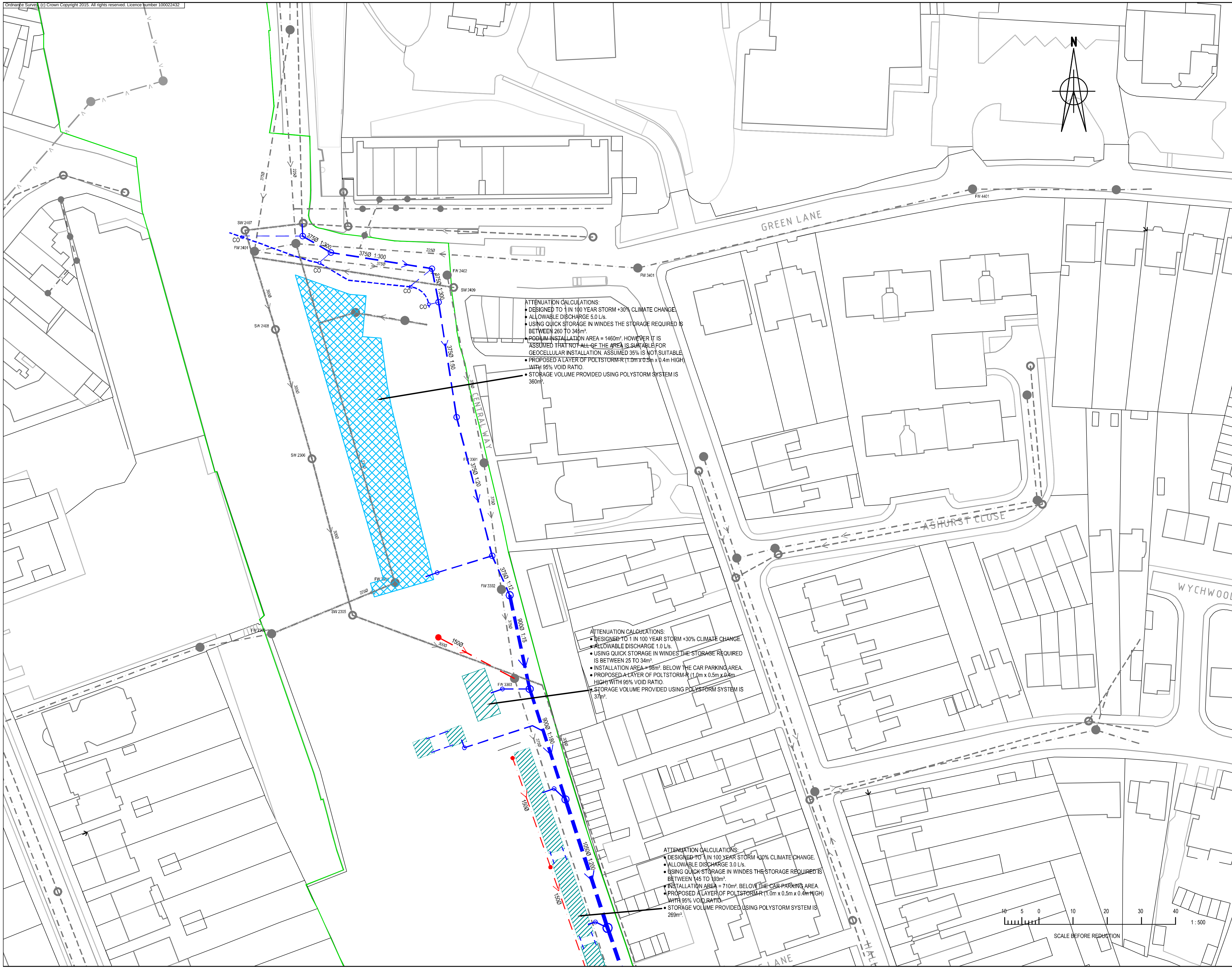
Architect: *FLETCHER PRIEST ARCHITECTS*

Project: **NORTHWOOD STATION PHASE 2**

Drg Title: PROPOSED DRAINAGE LAYOUT GENERAL ARRANGEMENT

Scales@A1	1:1000	Job No.	034233
Drawn by	MCD	Drawing No.	C3110
Checked by	NP	Rev	A
Date	Oct. 2015		

Richard Larkham \\srv-bath03\Project CAD\034233 Green Lane, Northwood Station Phase 2\F08 Civils - Infrastructure\Sheet\034233_C3110.dwg



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- PROPOSED PERMEABLE PAVING AREAS WITH GEOCELLULAR ATTENUATION DRAINAGE
- PROPOSED FOUL WATER DRAINAGE
- EXISTING DRAINAGE TO BE RELOCATED/ REMOVED/ABANDONED.
- SITE BOUNDARY

Rev	Description	Date	Drn	Ch'd
A	INITIAL ISSUE	06.10.15	MCD	NP

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Web: www.burohappold.com

Architect FLETCHER PRIEST ARCHITECTS

Project **NORTHWOOD STATION PHASE 2**

Drg Title PROPOSED DRAINAGE LAYOUT SHEET 1 OF 2

Scales@A1	1:500	Job No.	034233
Drawn by	MCD	Drawing No.	C3111
Checked by	NP	Rev	A
Date	Oct. 2015		

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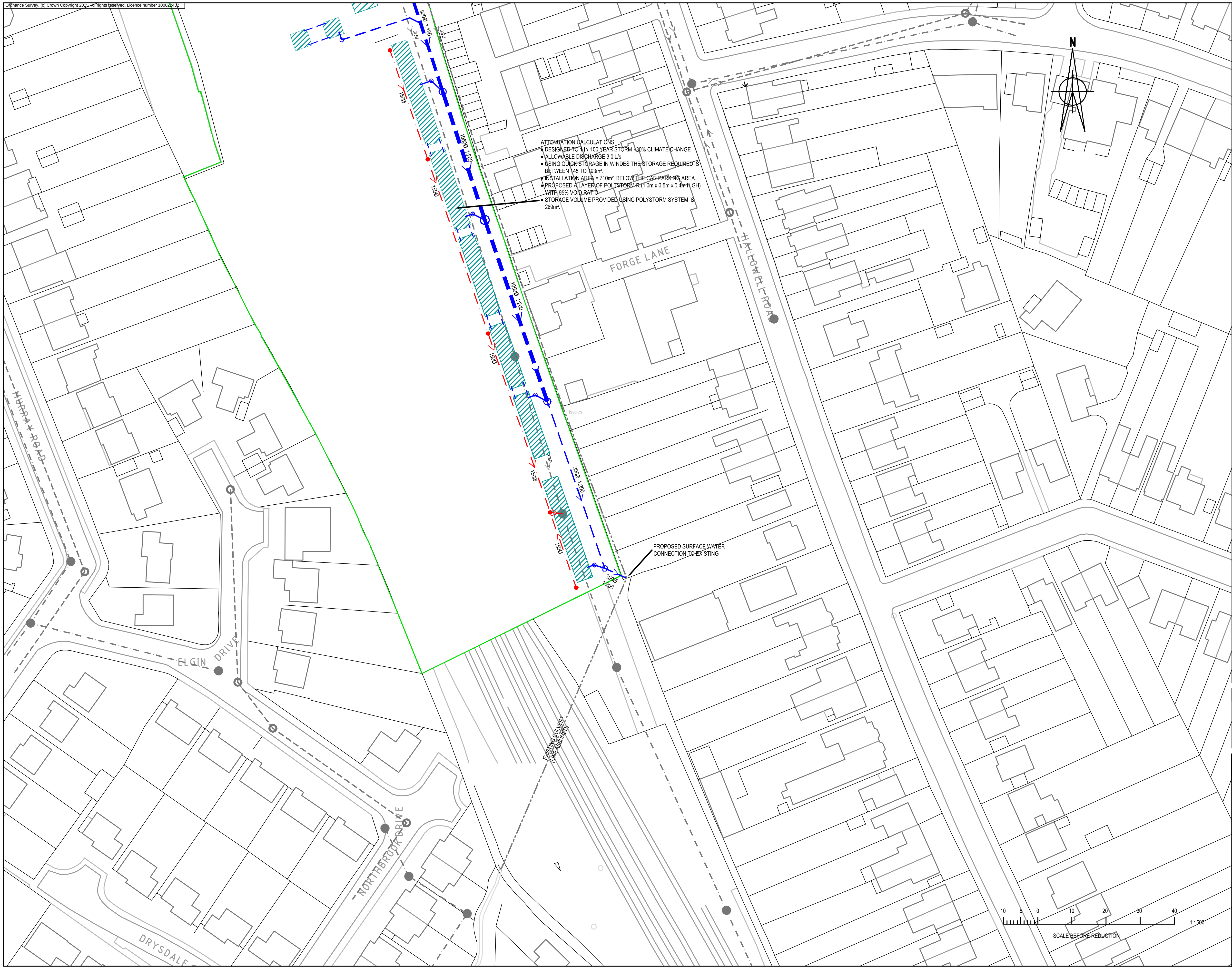

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Rev	Description	Date	Drn	Ch'd
A	INITIAL ISSUE	06.10.15	MCD	NP

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Web: www.burohappold.com

Architect: FLETCHER PRIEST ARCHITECTS

Project: **NORTHWOOD STATION PHASE 2**

Drg Title: PROPOSED DRAINAGE LAYOUT SHEET 2 OF 2

Scales@A1	1:500	Job No.	034233
Drawn by	MCD	Drawing No.	C3112
Checked by	NP		
Date	Oct. 2015	Rev	A

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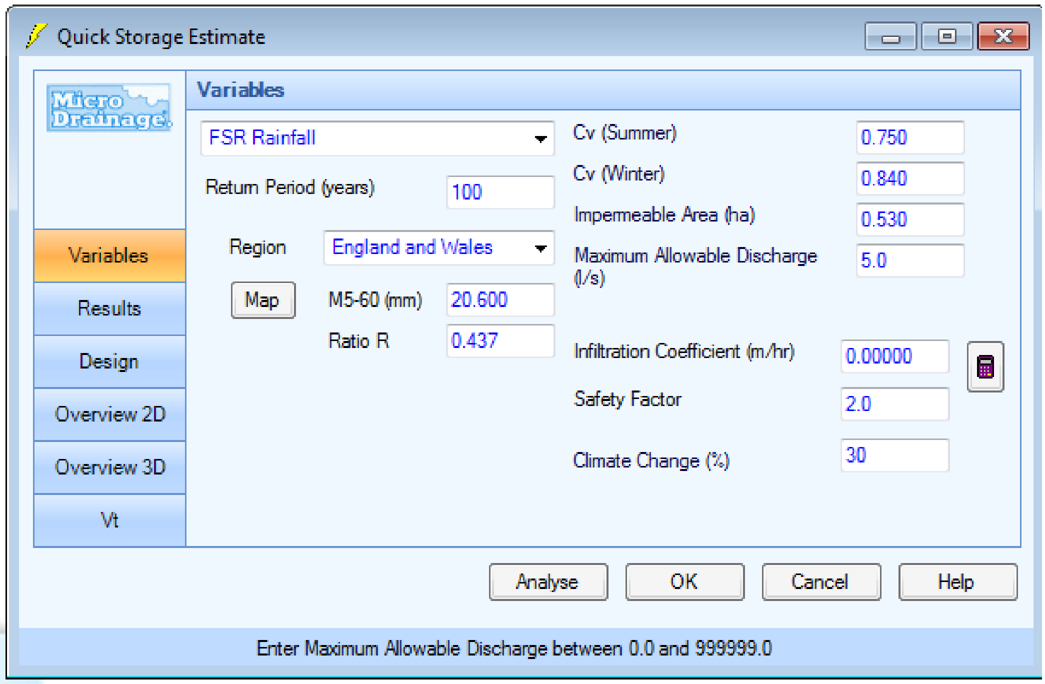
Appendix D WINDES Calculations

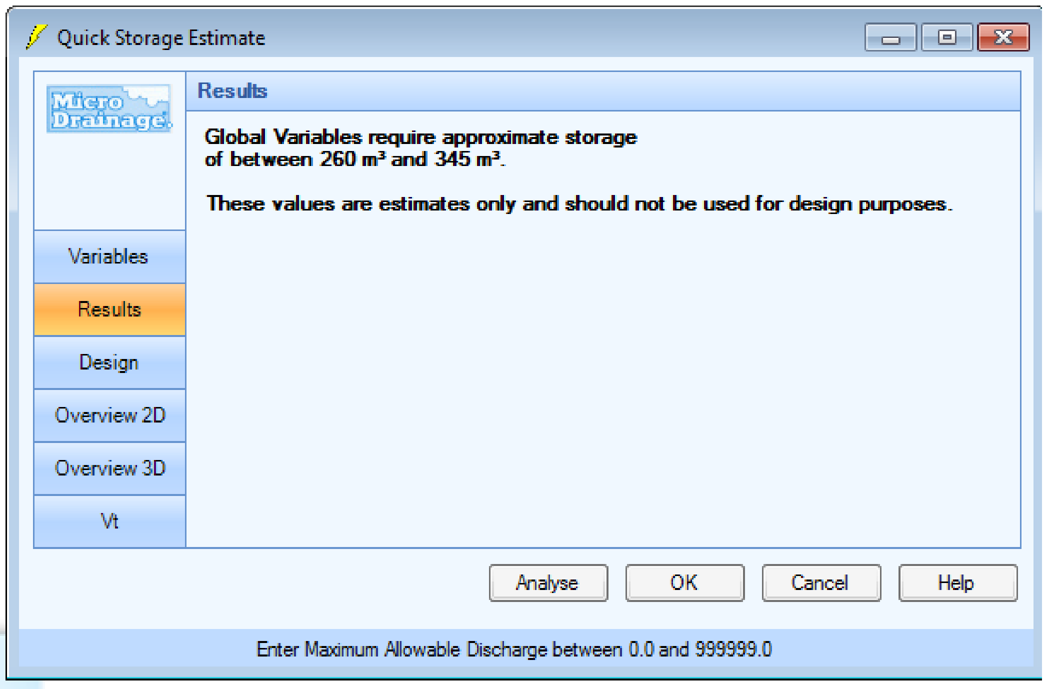
Project: 034233 Green Lane, Northwood Station Phase 2

Quick Storage Estimate

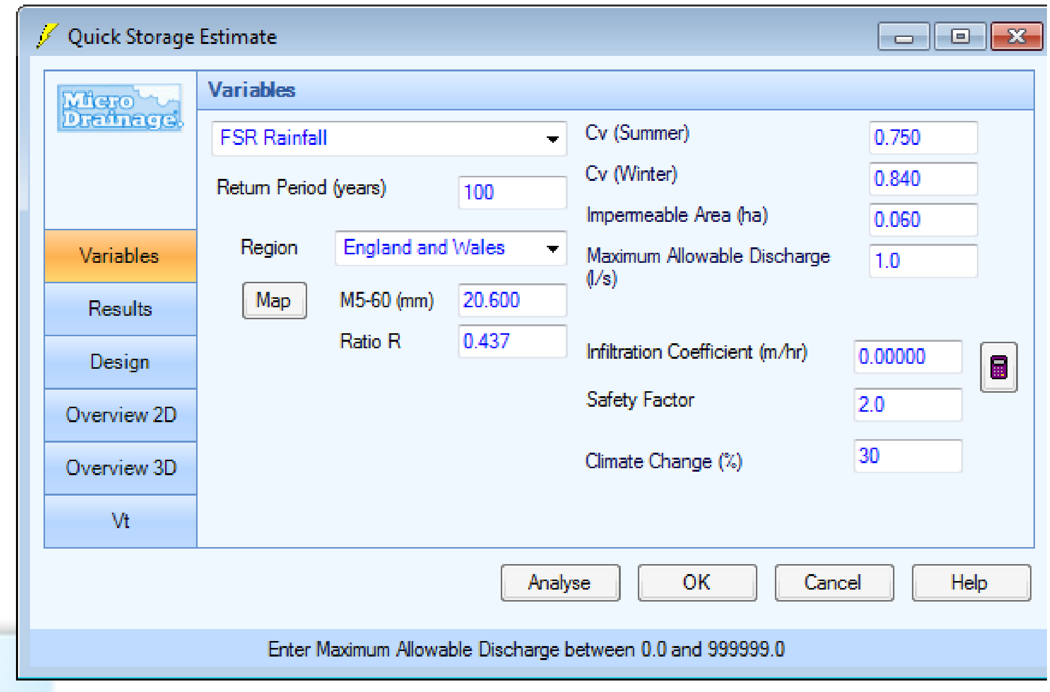
<u>100 year Storm Event + 20% Climate Change</u>

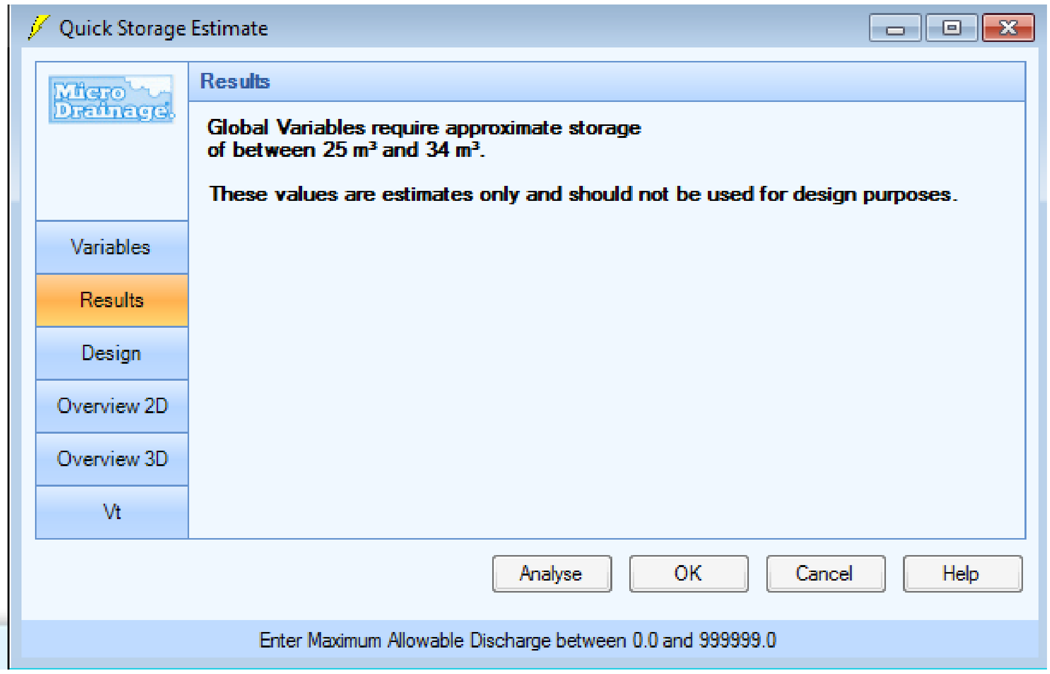
Apartment Block Phase 1



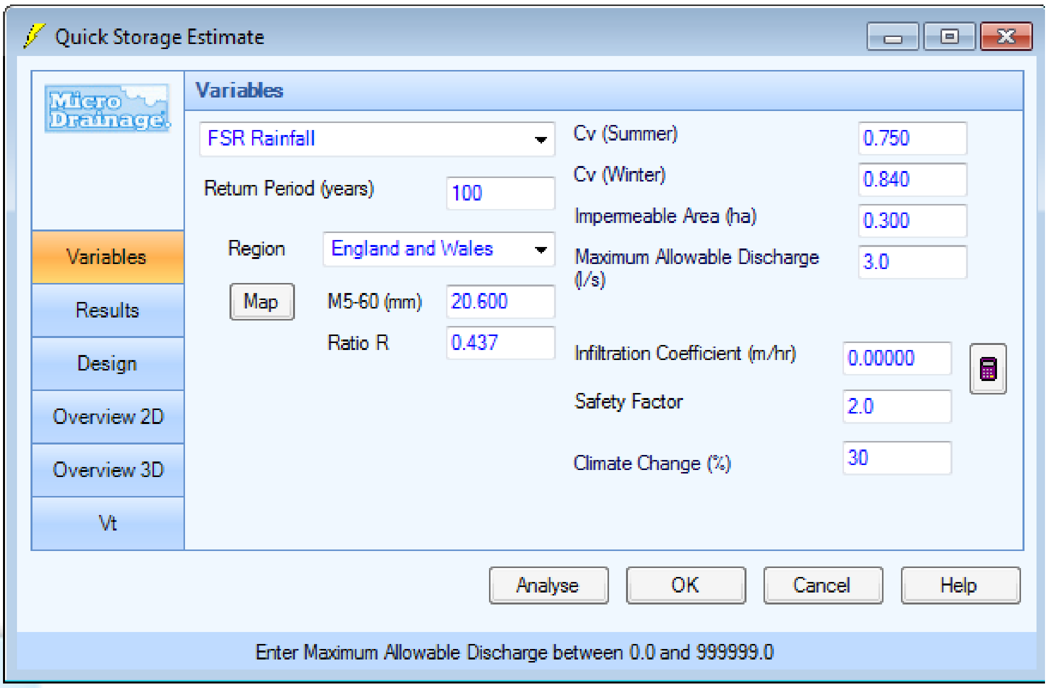


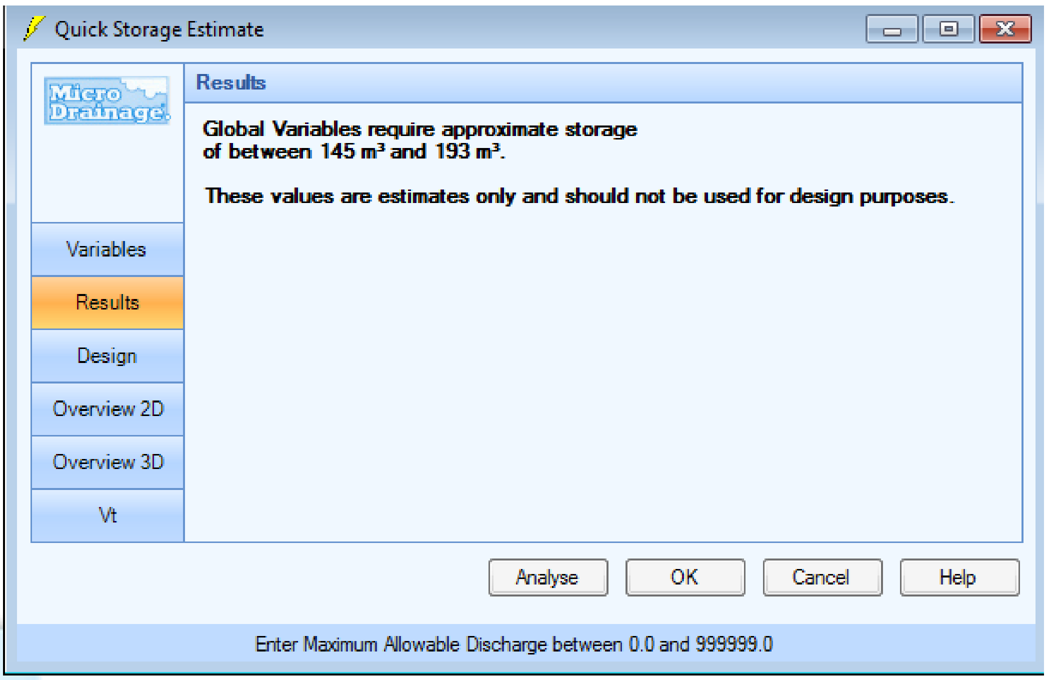
Apartment Block Phase 2





Townhouses Phase 2





Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.194	4-8	0.403	8-12	0.080	12-16	0.029

Total Area Contributing (ha) = 0.707

Total Pipe Volume (m^3) = 139.760

CATCHMENT AREA FROM CRITICAL DRAINAGE ISSUE

RESTRICTED DISCHARGE FROM APARTMENT BLOCK PHASE 1

Existing Network Details 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)
P1.000	21.892	0.073	299.9	0.200	10.00	0.0	0.600	o	375
P1.001	35.312	0.118	299.3	0.200	0.00	0.0	0.600	o	375
P1.002	12.299	0.041	300.0	0.207	0.00	0.0	0.600	o	375
P1.003	34.072	0.681	50.0	0.000	0.00	0.0	0.600	o	375
P1.004	33.958	1.698	20.0	0.000	0.00	0.0	0.600	o	375
P1.005	22.753	1.896	12.0	0.000	0.00	0.0	0.600	o	375
P1.006	20.752	0.138	150.4	0.050	0.00	5.0	0.600	o	900
P1.007	33.821	0.188	179.9	0.000	0.00	1.0	0.600	o	900
P1.008	42.172	0.211	199.9	0.000	0.00	0.0	0.600	o	1050
P1.009	53.856	0.269	200.2	0.000	0.00	0.0	0.600	o	1050
P1.010	54.782	0.274	199.9	0.050	0.00	3.0	0.600	o	300
P1.011	4.470	0.022	200.0	0.000	0.00	0.0	0.600	o	300

RESTRICTED DISCHARGE FROM APARTMENT BLOCK PHASE 2

OVERSIZED PIPE

RESTRICTED DISCHARGE FROM TOWNHOUSES PHASE 2

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
P1.000	74.825	0.200	0.0	1.04	115.0
P1.001	74.752	0.400	0.0	1.04	115.1
P1.002	74.634	0.607	0.0	1.04	115.0
P1.003	74.593	0.607	0.0	2.57	283.5
P1.004	73.912	0.607	0.0	4.07	449.3
P1.005	72.214	0.607	0.0	5.25	580.4
P1.006	69.568	0.657	5.0	2.55	1624.1
P1.007	69.430	0.657	6.0	2.33	1484.2
P1.008	69.242	0.657	6.0	2.43	2107.7
P1.009	69.031	0.657	6.0	2.43	2105.9
P1.010	68.762	0.707	9.0	1.11	78.3
P1.011	68.488	0.707	9.0	1.11	78.3

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)
MH1	77.200	2.375	Open Manhole	1500	P1.000	74.825	375				
MH2	77.477	2.725	Open Manhole	1500	P1.001	74.752	375	P1.000	74.752	375	
MH3	78.800	4.166	Open Manhole	1500	P1.002	74.634	375	P1.001	74.634	375	
MH4	78.700	4.107	Open Manhole	1500	P1.003	74.593	375	P1.002	74.593	375	
MH5	75.900	1.988	Open Manhole	1500	P1.004	73.912	375	P1.003	73.912	375	
MH6	74.210	1.996	Open Manhole	1500	P1.005	72.214	375	P1.004	72.214	375	
MH7	72.398	2.830	Open Manhole	2100	P1.006	69.568	900	P1.005	70.318	375	225
MH8	72.000	2.570	Open Manhole	2100	P1.007	69.430	900	P1.006	69.430	900	
MH9	71.600	2.358	Open Manhole	2100	P1.008	69.242	1050	P1.007	69.242	900	
MH10	71.600	2.569	Open Manhole	2100	P1.009	69.031	1050	P1.008	69.031	1050	
MH11	71.600	2.838	Open Manhole	1200	P1.010	68.762	300	P1.009	68.762	1050	
MH12	71.390	2.902	Open Manhole	1200	P1.011	68.488	300	P1.010	68.488	300	
MHEXT	71.577	3.111	Open Manhole	1500		OUTFALL		P1.011	68.466	300	

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)
P1.000	o	375	MH1	77.200	74.825	2.000	Open Manhole	1500
P1.001	o	375	MH2	77.477	74.752	2.350	Open Manhole	1500
P1.002	o	375	MH3	78.800	74.634	3.791	Open Manhole	1500
P1.003	o	375	MH4	78.700	74.593	3.732	Open Manhole	1500
P1.004	o	375	MH5	75.900	73.912	1.613	Open Manhole	1500
P1.005	o	375	MH6	74.210	72.214	1.621	Open Manhole	1500
P1.006	o	900	MH7	72.398	69.568	1.930	Open Manhole	2100
P1.007	o	900	MH8	72.000	69.430	1.670	Open Manhole	2100
P1.008	o	1050	MH9	71.600	69.242	1.308	Open Manhole	2100
P1.009	o	1050	MH10	71.600	69.031	1.519	Open Manhole	2100
P1.010	o	300	MH11	71.600	68.762	2.538	Open Manhole	1200
P1.011	o	300	MH12	71.390	68.488	2.602	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)
P1.000	21.892	299.9	MH2	77.477	74.752	2.350	Open Manhole	1500
P1.001	35.312	299.3	MH3	78.800	74.634	3.791	Open Manhole	1500
P1.002	12.299	300.0	MH4	78.700	74.593	3.732	Open Manhole	1500
P1.003	34.072	50.0	MH5	75.900	73.912	1.613	Open Manhole	1500
P1.004	33.958	20.0	MH6	74.210	72.214	1.621	Open Manhole	1500
P1.005	22.753	12.0	MH7	72.398	70.318	1.705	Open Manhole	2100
P1.006	20.752	150.4	MH8	72.000	69.430	1.670	Open Manhole	2100
P1.007	33.821	179.9	MH9	71.600	69.242	1.458	Open Manhole	2100
P1.008	42.172	199.9	MH10	71.600	69.031	1.519	Open Manhole	2100
P1.009	53.856	200.2	MH11	71.600	68.762	1.788	Open Manhole	1200
P1.010	54.782	199.9	MH12	71.390	68.488	2.602	Open Manhole	1200
P1.011	4.470	200.0	MHEXT	71.577	68.466	2.811	Open Manhole	1500

Setting Out Information - True Coordinates (Storm)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Layout (North)
P1.000	MH1	1500		509235.799	191467.217	
P1.001	MH2	1500		509256.507	191460.117	
P1.002	MH3	1500		509291.268	191453.904	
P1.003	MH4	1500		509292.008	191441.627	
P1.004	MH5	1500		509297.878	191408.065	
P1.005	MH6	1500		509305.634	191375.005	
P1.006	MH7	2100		509311.413	191352.998	
P1.007	MH8	2100		509317.623	191333.197	
P1.008	MH9	2100		509326.423	191300.541	
P1.009	MH10	2100		509339.677	191260.505	
P1.010	MH11	1200		509357.536	191209.696	
P1.011	MH12	1200		509375.425	191157.917	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
P1.011	MHEXT	1500		509378.675	191154.849	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.200	0.200	0.200
1.001	-	-	100	0.200	0.200	0.200
1.002	-	-	100	0.207	0.207	0.207
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.050	0.050	0.050
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.050	0.050	0.050
1.011	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.707	0.707	0.707

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)
P1.011	MHEXT	71.577	68.466	69.500	1500	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 Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.800	Storm Duration (mins)	30
Ratio R	0.438		

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

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	20.800	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.438	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	2, 10, 30, 100
Climate Change (%)	0, 30, 30, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
P1.000	15 Winter	2	0%	10/15 Summer				
P1.001	15 Winter	2	0%	10/15 Summer				
P1.002	15 Winter	2	0%	10/15 Summer				
P1.003	15 Winter	2	0%	100/15 Summer				
P1.004	15 Winter	2	0%					
P1.005	15 Winter	2	0%					
P1.006	15 Winter	2	0%					
P1.007	15 Winter	2	0%					
P1.008	15 Winter	2	0%					
P1.009	15 Winter	2	0%					
P1.010	15 Winter	2	0%	2/15 Summer				
P1.011	15 Winter	2	0%	2/15 Summer				

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
P1.000	MH1	75.003	-0.197	0.000	0.27	0.0	26.7	OK
P1.001	MH2	74.979	-0.148	0.000	0.53	0.0	55.1	OK
P1.002	MH3	74.927	-0.082	0.000	0.96	0.0	85.3	OK
P1.003	MH4	74.743	-0.225	0.000	0.34	0.0	85.0	OK
P1.004	MH5	74.029	-0.258	0.000	0.21	0.0	85.0	OK
P1.005	MH6	72.318	-0.271	0.000	0.17	0.0	85.2	OK
P1.006	MH7	69.760	-0.708	0.000	0.10	0.0	96.9	OK
P1.007	MH8	69.620	-0.710	0.000	0.10	0.0	97.7	OK

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

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
P1.008	MH9	69.422	-0.870	0.000	0.07	0.0	97.2	OK
P1.009	MH10	69.235	-0.846	0.000	0.06	0.0	92.9	OK
P1.010	MH11	69.175	0.113	0.000	1.08	0.0	80.2	SURCHARGED
P1.011	MH12	68.853	0.065	0.000	1.59	0.0	80.0	SURCHARGED

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.800 Cv (Summer) 0.750
Region England and Wales Ratio R 0.438 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 10, 30, 100
Climate Change (%) 0, 30, 30, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
P1.000	15 Winter	10	+30%	10/15 Summer				
P1.001	15 Winter	10	+30%	10/15 Summer				
P1.002	15 Winter	10	+30%	10/15 Summer				
P1.003	15 Winter	10	+30%	100/15 Summer				
P1.004	15 Winter	10	+30%					
P1.005	15 Winter	10	+30%					
P1.006	15 Winter	10	+30%					
P1.007	15 Winter	10	+30%					
P1.008	15 Winter	10	+30%					
P1.009	15 Winter	10	+30%					
P1.010	15 Winter	10	+30%	2/15 Summer				
P1.011	15 Winter	10	+30%	2/15 Summer				

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
P1.000	MH1	75.390	0.190	0.000	0.58	0.0	57.0	SURCHARGED
P1.001	MH2	75.362	0.235	0.000	1.13	0.0	116.9	SURCHARGED
P1.002	MH3	75.201	0.192	0.000	2.14	0.0	189.6	SURCHARGED
P1.003	MH4	74.839	-0.129	0.000	0.75	0.0	190.3	OK
P1.004	MH5	74.093	-0.194	0.000	0.47	0.0	190.2	OK
P1.005	MH6	72.373	-0.216	0.000	0.38	0.0	189.3	OK
P1.006	MH7	69.854	-0.614	0.000	0.22	0.0	210.1	OK
P1.007	MH8	69.714	-0.616	0.000	0.22	0.0	210.7	OK

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

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
P1.008	MH9	69.544	-0.748	0.000	0.14	0.0	203.6	OK
P1.009	MH10	69.524	-0.557	0.000	0.11	0.0	168.4	OK
P1.010	MH11	69.517	0.455	0.000	1.45	0.0	107.8	SURCHARGED
P1.011	MH12	68.936	0.148	0.000	2.15	0.0	107.8	SURCHARGED

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.800 Cv (Summer) 0.750
Region England and Wales Ratio R 0.438 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 10, 30, 100
Climate Change (%) 0, 30, 30, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
P1.000	15 Winter	30	+30%	10/15 Summer				
P1.001	15 Winter	30	+30%	10/15 Summer				
P1.002	15 Winter	30	+30%	10/15 Summer				
P1.003	15 Winter	30	+30%	100/15 Summer				
P1.004	15 Winter	30	+30%					
P1.005	15 Winter	30	+30%					
P1.006	15 Winter	30	+30%					
P1.007	15 Winter	30	+30%					
P1.008	30 Winter	30	+30%					
P1.009	30 Winter	30	+30%					
P1.010	30 Winter	30	+30%	2/15 Summer				
P1.011	30 Winter	30	+30%	2/15 Summer				

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
P1.000	MH1	75.640	0.440	0.000	0.76	0.0	74.3	SURCHARGED
P1.001	MH2	75.605	0.478	0.000	1.43	0.0	147.9	SURCHARGED
P1.002	MH3	75.351	0.342	0.000	2.71	0.0	240.3	SURCHARGED
P1.003	MH4	74.885	-0.083	0.000	0.95	0.0	241.1	OK
P1.004	MH5	74.121	-0.166	0.000	0.60	0.0	241.0	OK
P1.005	MH6	72.397	-0.192	0.000	0.48	0.0	240.0	OK
P1.006	MH7	69.891	-0.577	0.000	0.28	0.0	265.2	OK
P1.007	MH8	69.751	-0.579	0.000	0.27	0.0	265.6	OK

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

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
P1.008	MH9	69.717	-0.575	0.000	0.15	0.0	205.6	OK
P1.009	MH10	69.710	-0.371	0.000	0.10	0.0	159.1	OK
P1.010	MH11	69.702	0.640	0.000	1.62	0.0	120.2	SURCHARGED
P1.011	MH12	68.981	0.193	0.000	2.39	0.0	120.2	SURCHARGED

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.800 Cv (Summer) 0.750
Region England and Wales Ratio R 0.438 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 2, 10, 30, 100
Climate Change (%) 0, 30, 30, 30

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
P1.000	15 Winter	100	+30%	10/15 Summer				
P1.001	15 Winter	100	+30%	10/15 Summer				
P1.002	15 Winter	100	+30%	10/15 Summer				
P1.003	15 Winter	100	+30%	100/15 Summer				
P1.004	15 Winter	100	+30%					
P1.005	15 Winter	100	+30%					
P1.006	30 Winter	100	+30%					
P1.007	30 Winter	100	+30%					
P1.008	30 Winter	100	+30%					
P1.009	30 Winter	100	+30%					
P1.010	30 Winter	100	+30%	2/15 Summer				
P1.011	30 Winter	100	+30%	2/15 Summer				

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
P1.000	MH1	76.228	1.028	0.000	1.05	0.0	102.8	SURCHARGED
P1.001	MH2	76.179	1.052	0.000	1.80	0.0	186.5	SURCHARGED
P1.002	MH3	75.786	0.777	0.000	3.34	0.0	296.1	SURCHARGED
P1.003	MH4	75.200	0.232	0.000	1.16	0.0	295.3	SURCHARGED
P1.004	MH5	74.152	-0.135	0.000	0.73	0.0	293.9	OK
P1.005	MH6	72.423	-0.166	0.000	0.60	0.0	294.9	OK
P1.006	MH7	70.055	-0.413	0.000	0.29	0.0	280.8	OK
P1.007	MH8	70.046	-0.284	0.000	0.29	0.0	280.3	OK

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

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
P1.008	MH9	70.034	-0.258	0.000	0.18	0.0	249.0	OK
P1.009	MH10	70.025	-0.056	0.000	0.11	0.0	176.2	OK
P1.010	MH11	70.005	0.943	0.000	1.86	0.0	137.7	SURCHARGED
P1.011	MH12	69.053	0.265	0.000	2.74	0.0	137.8	SURCHARGED


MH1
MH2
P1.001
MH3
P1.002
MH4
P1.003
MH5
P1.004
MH6
P1.005
MH7
P1.006
MH8
P1.007
MH9
P1.008
MH10
P1.009
MH11
P1.010
MH12
P1.011
MHEXT

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