

ENVIRONMENT

Henry Boot Developments
Tewin Road
Welwyn Garden City
Sustainable Drainage Statement

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Henry Boot Developments Tewin Road Welwyn Garden City Sustainable Drainage Statement

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- (ii) The date on which the final report is delivered

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All Environment Agency mapping data used under special license. Data is current as of September 2021 and is subject to change.

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Table 1.1: Site Details

Site Name	Tewin Road
Location	Tewin Road, Welwyn Garden City, AL7 1BD
NGR (approx.)	TL245131
Application Site Area (ha)	1.212
Development Type	Brownfield
Lead Local Flood Authority	Hertfordshire Council
Local Planning Authority	Welwyn Hatfield Council
Sewerage Undertaker	Thames Water

Sustainable Drainage Guidance

- 1.7 The LLFA do not have any specific SuDS guidance to inform planning applications and in the absence of further information, the Non-Statutory Technical Standards for Sustainable Drainage Systems¹ as published by DEFRA have been utilised to inform the strategy.
- 1.8 40% Climate change has been applied to the development, according to Hertfordshire Councils "Climate Change Allowance Note".

¹ 2015, DEFRA. Non-statutory technical standards for sustainable drainage systems

2. EXISTING CONDITIONS

- 2.1 The existing site is brownfield, where there an even split of impermeable and permeable land. At the writing of this report, the silo's have been removed, only leaving the concrete base, car park and access in the adjacent site.
- 2.2 The main site constraint's is the easement for the existing gas route, service compound and access to the service compound; please refer to Jefferson Sheard Architect's (JSA) drawing in **Appendix 2**.
- 2.3 A topographic survey of the existing site has been undertaken and is included as **Appendix 3**; the existing levels vary from 84.50mAOD and 81.10mAOD.
- 2.4 The intrusive ground investigation works were completed in two stages, stage one was completed between 7th and 9th July with stage two completed between 19th and 23rd July. The ground investigation has identified ground conditions to generally comprise Made Ground over superficial deposits of the Kesgrave Catchment Subgroup (Sand and Gravel)
- 2.5 Please refer to BWB's Phase 2 Geo-Environmental Assessment, TRW-BWB-00-XX-RP-YE-0002-Ph2; for more details on the ground investigation works.
- 2.6 The existing site comprises of 50% impermeable surface and 50% permeable surface. The existing drainage for the existing car park drains to the channel drains/gullies, however there is no evidence in the surveys to where this drains to but it's likely the existing drainage drains into the adjacent highway drainage.

Existing Runoff Rates

An assessment of the existing surface water runoff rates from Tewin Road, Welwyn Garden City has been undertaken and is summarised within Table 2.1. Calculations are included within **Appendix 4**.

- 2.7 The runoff rates have been estimated using the ICP SUDS method, with appropriate prorated adjustments for a site of less than 50ha, as recommended in Interim Code of Practice for Sustainable Drainage². This was undertaken within Micro Drainage, which makes the necessary adjustments for small sites automatically.
- 2.8 The contributing runoff rates from the 0.597 ha of drained impermeable surfaces within the site have been estimated using the Rational method, as described within **Figure 2.1**. The results are presented within **Appendix 4**, which demonstrates that it is the existing pipe capacity which controls the current discharge rate from the site.

² The National SUDS Working Group (2004), Interim Code of Practice for Sustainable Drainage

$Q = 2.78 \times A_p \times i$

Where:
 Q = runoff rate (l/s)
 A_p = impermeable area (ha)
 i = rainfall intensity (mm/hr)

Figure 2.1: Rational Method

Table 2.1: Existing Runoff Rate from the Site

Return Period (Yrs.)	Rainfall intensity (mm/hr) – 30-minute duration	Runoff Rate (l/s)
1	59.1	95.7
2 Mean Annual Flow Rate (QBAR)	75.3	121.9
30	136	220.1
100	170.6	276.2

- 2.9 The Hertfordshire County Council guidance recommends discharge rates from brownfield sites are restricted to the equivalent greenfield runoff rate where reasonably practicable.
- 2.10 An assessment of the equivalent greenfield surface water runoff rates from the Tewin Road, Welwyn Garden City have been undertaken and area summarised within **Table 2.2**. Calculations are included within **Appendix 5**.
- 2.11 The runoff rates have been estimated using the ICP SUDS method, with appropriate prorated adjustments for a site of less than 50ha, as recommended in Interim Code of Practice for Sustainable Drainage³. This was undertaken within Micro Drainage, which makes the necessary adjustments for small sites automatically.

³ The National SUDS Working Group (2004), Interim Code of Practice for Sustainable Drainage

Table 2.2: Equivalent Greenfield Runoff Rates from the Site

The screenshot shows the 'Rural Runoff Calculator' software interface. The 'ICP SUDS' section contains the following input parameters:

- Return Period (Years): 100
- Area (ha): 1.212
- SAAR (mm): 664
- Soil: 0.300
- Growth Curve: (None)
- Partly Urbanised Catchment (QBAR): Urban = 0.500, Region = Region 6

The 'Results' section shows:

- QBAR rural (l/s): 2.1
- QBAR urban (l/s): 5.0

The 'Return Period Flood' table is as follows:

Region	QBAR (l/s)	Q (100yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
Region 1	5.0	9.4	4.3	8.1	9.4
Region 2	5.0	9.7	4.4	8.1	9.7
Region 3	5.0	8.7	4.3	7.9	8.7
Region 4	5.0	9.8	4.2	8.4	9.8
Region 5	5.0	12.2	4.4	9.8	12.2
Region 6/Region 7	5.0	11.4	4.3	9.4	11.4
Region 8	5.0	9.5	3.9	8.4	9.5
Region 9	5.0	8.8	4.4	7.8	8.8
Region 10	5.0	8.5	4.4	7.6	8.5

At the bottom of the software window, there are 'OK', 'Cancel', and 'Help' buttons, and a status bar that reads 'Enter Return Period between 1 and 1000'.

Return Period (Yrs.)	Runoff Rate (l/s)
1	4.3
2 Mean Annual Flow Rate (QBAR)	5.0
30	9.4
100	11.4

Existing Runoff Volume

- 2.12 An assessment of the existing surface water runoff rates from Tewin Road, Welwyn Garden City has been made for a 1 in 100-year, 6 hour storm.
- 2.13 As the existing site is partially impermeable, the runoff volume has been calculated using an average rainfall intensity of 10.422mm/hr as calculated using FSR rainfall data within Micro Drainage, and multiplied by the impermeable area, as described within **Figure 2.2**. The 100-year, 6 hour rainfall profile is shown in **Figure 2.3**.

$$\text{Av. Rainfall (m/hr)} \times 6 \text{ (hours)} \times \text{Impermeable Area (m}^2\text{)} = \text{Runoff Volume (m}^3\text{)}$$
$$0.0104 \times 6 \times 5973 = 372\text{m}^3$$

Figure 2.2: 1 in 100-Year, 6 Hour Runoff Volume

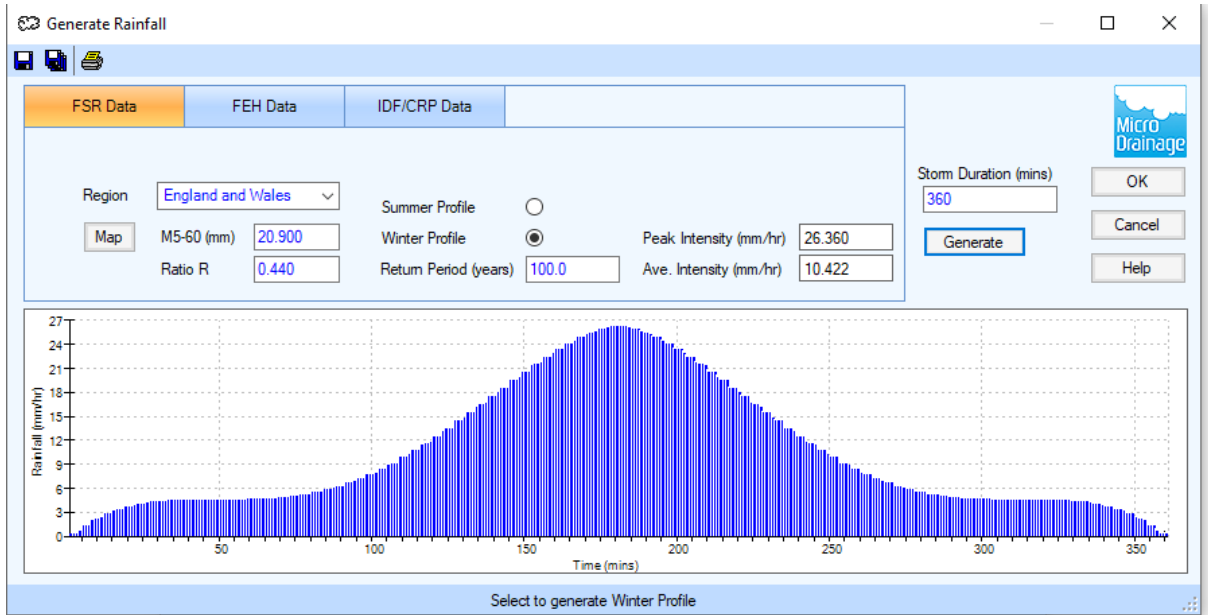


Figure 2.3: 100-Year 6 Hour Rainfall Intensity

3. SURFACE WATER DRAINAGE STRATEGY

- 3.1 The illustrative masterplan (included as **Appendix 1**) identifies the proposed redevelopment to be entirely distribution with external hard landscaping.
- 3.2 Despite the increase of an impermeable area from the existing to proposed, the drainage strategy aims to mitigate any increase in runoff through attenuation and reduction of brownfield runoff rates.
- 3.3 The Surface Water Drainage design has been shown in Drainage Layout (**Appendix 7**); this layout shows the drainage network including the attenuation, proposed discharge rates and the connections to the existing network.
- 3.4 The proposed Surface Water Drainage network has been simulated into MicroDrainage, to show the network complies with 1 in 1 year, 30 year, 100 year and 100 year + 40% CC requirements (included as **Appendix 8**).

Drainage Hierarchy

- 3.5 The Planning Policy Guidance⁴ and the SuDS Manual⁵ identify that surface water runoff from a development should be disposed of as high up the following hierarchy as reasonably practicable:
 - i. into the ground (infiltration);
 - ii. to a surface water body;
 - iii. to a surface water sewer, highway drain, or another drainage system;
 - iv. to a combined sewer.
- 3.6 The aim of this approach is to manage surface water runoff close to where it falls and mimic natural drainage as closely as possible.
- 3.7 Due to the unfavourable underlying ground conditions and groundwater levels, disposal of surface water via infiltration is not feasible in this instance.
- 3.8 Due to the nearest watercourse, River Mimran, being 1.5km from the proposed development, disposal of water via a surface water body is not feasible.
- 3.9 The presence of a significant network of adopted sewers, as shown on the Thames Water sewer records included as **Appendix 6** would appear to demonstrate that the surrounding area drains to these. It is therefore proposed to connect to the 300mm diameter surface water sewer at two locations on Tewin Road.
- 3.10 The existing invert levels have been estimated using the Thames Water records for manholes ref. 5901, 5002, 5102 and 6101. The IL of the proposed outfall manholes, SW114 and SW205, are deemed to be higher than the existing levels of the surface water sewer.

⁴ Planning Practice Guidance. <http://planningguidance.planningportal.gov.uk/>.

⁵ The SuDS Manual (C753). CIRIA 2015.

Therefore, the proposed network will be able to connect to the existing network by gravity.

- 3.11 A S106 (Water Industry Act 1991) application should be made to Thames Water for approval prior to the connection being made. As connection to a sewer is shown to be the most preferred option, approval at a restricted rate will be acceptable.
- 3.12 At the time of this report, the proposed surface water connection is subject to a S106 connection.

Peak Flow Control

- 3.13 In order to comply with the Non-Statutory Technical Standards for Sustainable Drainage Systems S2-S3⁶, for previously developed sites, the proposed runoff rate must be “as close as reasonably practicable” to the greenfield runoff rates, but should never exceed the rate of discharge prior to redevelopment for that event.
- 3.14 Hertfordshire's ‘LLFA Summary Guidance for developers’ states that for brownfield sites the peak discharge rates should aim to provide greenfield run-off rates, up to 1 in 100 year storm event including allowance for climate change.
- 3.15 It is proposed to restrict the discharge rate from the development, for all rainfall periods, to the 1 in 100 year event Greenfield runoff rate. This is summarised within **Table 3.1**.

Table 3.1: Existing & Proposed Runoff Rates

Return Period (Yr.)	Existing Runoff Rate (l/s)	Proposed Discharge Rate (l/s)	Betterment (%)
1	95.7	11.4	88
QBAR	121.9	11.4	91
30	220.1	11.4	95
100	276.2	11.4	96
100 + 40%	386.7	11.4	97

⁶ 2015, DEFRA. Non-statutory technical standards for sustainable drainage systems

Attenuated Storage

- 3.16 After considering the site constraints and development aspirations, it is suggested that the necessary surface water storage volume is provided via 2no. attenuation tanks located in the 2no service yards of the site, between the proposed development and the main road.
- 3.17 A simulation has been run using Micro Drainage to identify the necessary storage provision. Using a restriction of 11.4 l/s, the volume of attenuated storage required for the development has been calculated for storm events up to 100 year + 40% storm.
- 3.18 From the modelling results, the total attenuation storage is estimated to be 835m³. This will be split between the 2no. tanks proportionally to the catchment areas they serve. Please refer to "Storage Structures" as part of the Micro Drainage results in **Appendix 8**.

Runoff Volume Control

- 3.19 The Non-Statutory Technical Standards for Sustainable Drainage Systems S4-S6⁷ states that *where reasonably practicable* the runoff volume from a development for the 1 in 100-year 6 hour rainfall event should not exceed the runoff volume prior to development or redevelopment. Additionally, if practicable on previously developed sites, the runoff volume should not exceed the equivalent greenfield runoff volume. Where it is not reasonably practicable to constrain the volume of runoff from a development at or below the existing volume, then the runoff must be discharged in a manner that does not adversely affect flood risk, i.e.:
- i. The additional runoff volume resulting from the development (the 'long term storage volume') should be discharged separately from the site at a rate of 2L/s/ha or less. Or,
 - ii. All the runoff volume from the development should be discharged at a rate equivalent to the mean annual flow rate (QBAR) rate under greenfield conditions or less. Or,
 - iii. All the runoff volume from the development should be discharged at a rate of 2L/s/ha or less.
- 3.20 An estimate of the post-development runoff volume from the 1 in 100-year 6 hour storm can be derived from the Micro Drainage calculations, as provided within **Appendix 8**. The existing and post-development runoff volumes prior to mitigation are compared within **Table 3.2**.

Table 3.2: Runoff Volume Comparison

Existing Volume (m ³)	Proposed Volume (m ³)	Difference (m ³)
372	754	+382

- 3.21 The 1 in 100-year 6 hour storm runoff volume from the site has been shown to increase as a result of the proposed development due to the increase in impermeable area. However, proposed mitigations include restricting flow rates to the Greenfield runoff rate

⁷ 2015, DEFRA. Non-statutory technical standards for sustainable drainage systems

of 11.4 l/s and providing a total of 835m³ of attenuation which will contain the additional volume. Following the implementation of those mitigation measures, there will be no additional runoff volume post-development.

Sustainable Drainage Systems

- 3.22 Due to contamination risk in the underlying made ground, infiltration techniques are not deemed suitable and would increase the risk of migrating contaminants. This coupled with the extensive constraints on site (gas mains and easements) the scope for significant SuDS features is limited.
- 3.23 Aside from ponds and other above ground suds features, the following have been incorporated to deal with runoff quantity and quality.
- Full retention Separators have been specified to capture oil spills in the event of an accident
 - Channel drain sumps and catchpit manholes will be used extensively to help filter sediment from first flush
 - Lined Geo-cellular Attenuation tanks for storage
 - Lined Gravel Drains have been specified around buildings to treat runoff from roofs and footways
- 3.24 An indicative surface and foul water layout for the development is shown on BWB drawing ref. TRW-BWB-GEN-XX-DR-C-0500 which is included as **Appendix 7**.

Residual Risk and Designing for Exceedance

- 3.25 In addition to the volume of storage provided within the main attenuation, there will be capacity within upstream pipes, channels and filter drains which has not been accounted for at this stage and a further level of redundancy to the network will therefore be provided.
- 3.26 Levels fall away from buildings to minimise the risk of flooding in exceedance events. Refer to the Flood Risk Assessment reference "TRW-BWB-ZZ-XX-RP-YE-0003_FRA_S2_P02" for further information.

4. MAINTENANCE

- 4.1 Unless buildings are sold in the future, a management company should be appointed to maintain the drainage features, including vegetation maintenance, and regular manhole and gully inspections.
- 4.2 Requirements for ongoing maintenance of the drainage network should form part of the Operation and Maintenance manual for the site and should be undertaken by the site management. Any specialist or proprietary products that are specified at detailed design should have a manufacturer specific maintenance regime which should be included within the document.
- 4.3 It is envisaged that the Operation and Maintenance manual will be developed at the detailed design stage, but some examples are included below.
- i. All drainage features should be located in open areas which are readily accessible.
 - ii. Gullies should be inspected and de-silted at least once a year, where necessary.
 - iii. Pipes, manholes and silt traps should be inspected and de-silted at least once a year, where necessary.
 - iv. Regular inspections of the attenuation tank should be undertaken to remove litter/debris, invasive/colonising vegetation and silt build up as necessary. Inlet and outlet structures to be regularly inspected, with remedial work as required to maintain water flows and prevent silt/vegetation build up.
 - v. Hydro-brakes should be inspected every 6 months, litter/debris and silt build up should be removed as necessary.

5. FOUL WATER DRAINAGE

- 5.1 An existing Thames Water foul water network is located within Tewin Road, adjacent to the proposed development. Please refer to Thames Water sewer records, in **Appendix 6**.
- 5.2 The proposed foul water network will be connecting into the existing Thames Water foul sewer. Please refer to the Proposed Drainage Layout, in **Appendix 7**.
- 5.3 Based on the current layouts and design, all of the foul network is expected to drain by gravity.
- 5.4 As the number of staff is currently unknown, a conservative peak flow rate has been calculated using the Discharge Unit Method BS:EN 12056-2:2000 System II, which has been estimated to be 1.9 l/s; in reality average flows will be much lower than this.
- 5.5 The proposed connection is subject to a S106 application to Thames Water and confirmation of invert levels.

6. SUMMARY

- 6.1 This statement and supporting appendices demonstrate that the drainage design for the development will comply with the relevant local and national standards, specifically the hierarchy of discharge, runoff rate and volume criterion.
- 6.2 This SDS is intended to support a full planning application and as such the level of detail included is commensurate and subject to the nature of the proposals.

Table 6.1: Sustainable Drainage Statement Summary

		Existing Site	Proposed Development
Site Area (Ha)		1.212	
Impermeable Area (Ha)		0.597	1.153
Outfall Location		Varies - TBC	Highway Sewer
Peak Runoff Rate (l/s)	QBAR	121.9	11.4
	1 in 30-Year	220.1	11.4
	1 in 100-Year	276.2	11.4
	1 in 100-Year + CC	386.7	11.4
Runoff Volume (100yr RP 6 hour Storm)		382m ³	754m ³ (prior to mitigation)
Proposed Storage Volume		-	IC835m ³
Interception Volume		-	[IMP Area (ha) x 5 (mm)] 12,115m ² x 0.005m = 60.5m ³
Flow Control Type		-	Vortex Flow Control - Hydrobrake or similar
SuDS Features		-	Channel Drains, Catchpits Gravel Trench Full Retention Separators
Maintenance Responsibility		-	Management Company/ Site Owner

- 6.3 Final construction issue drawings will be issued for inclusion in the O&M manuals during construction.

APPENDICES

Appendix 1: Site Plan

Sorting Office

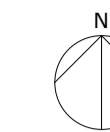
ESS

BRIDGEFIELDS

Mast

0m 10m 20m 30m 40m 50m

VISUAL SCALE 1:500 @ A1



AREA SCHEDULE : GEA

	GEA						Total GEA	
	UNIT 01		UNIT 02		UNIT 03		Sqm	Sqft
Ground Floor	3,296.10	35,479	1,080.39	11,629	1,467.96	15,801		
First Floor	408.45	4,397	164.11	1,766	202.04	2,175		
Total	3,704.55	39,876	1,244.50	13,396	1,670.00	17,976	6,619.05	71,247

The contractor is to check all dimensions on site and report any discrepancies to the architect. All rights described in chapter IV of the copyright, designs and patents act 1988 have been generally asserted.

Notes

- APPLICATION BOUNDARY
- ⚡ ELECTRIC CAR CHARGING BAYS
- ⚡ ELECTRIC VEHICLE CHARGING CABLES
- ♻️ CYCLE RACKS WITH BASKETED STANDBY
- ♻️ LITTER BIN
- ♻️ BENCH AND ASSESS BICYCLE REPAIR FACILITIES
- ♻️ ARTS AND CRAFT BOLLARD
- ♻️ BICYCLE REPAIR STAND WITH REFLECTIVE PAINT
- FURMS LANDSCAPE KEY
- REDUCE ROAD WIDTH TO BE CREST LOCATED TO THE INTERIOR SPECIFICATIONS
- REMOVE WALLS TO BE REMOVED FROM ANY CAR PARKING BAYS TO INSURE ALL TO BEING SPECIFICATION
- PROTECTURE PAINTING TO BE Laid WITH CHECK COURSE OF ROAD TO BE IN LINE OF LOOK AND CARE ONLY PARKERS LAD AT BENCH SYSTEM
- RETAINING STRUCTURE TO STRUCTURAL ENGINEERS DESIGN

Aquarius House

El Sub Sta

Tank

UNIT 01
3704.55 Sqm
39,876 Sqft
(Total GEA)

CAR PARK 16 SPACES

UNIT 02
1244.50 Sqm
13,396 Sqft
(Total GEA)

CAR PARK 24 SPACES

UNIT 03
1578 Sqm
17,976 Sqft
(Total GEA)

CAR PARK 30 SPACES

Depot

EXISTING TREE REMOVED

El Sub Sta

Garden Court

P11	Building moved to allow for HVV easement along rear boundary associated site layout changes. No change to building areas. Redline boundary adjusted to ownership extents	11/05/21	CC	JD
P10	Planning Submission	05/10/21	CC	JD
P9	Planning Submission	17/09/21	CC	JD
P8	Planning Submission	10/09/21	CC	JD
P7	Planning Submission	27/08/21	CC	JD
P6	Substation added. General layout updates	19/08/21	CC	JD
P5	Unit 03 Loading dock position updated	26/07/21	CC	JD
P4	Site Plan Updates based on latest Topo Survey	15/07/21	CC	JD
P3	General Updates	18/06/21	CC	JD
P2	Indicative Site plan - General Updates	04/06/21	CC	JD
P1	Initial Issue	21/05/21	CC	JD
Rev	Description	Date	By	Chk

First Floor
3 Bleeding Heart Yard
Greville Street, London EC1R 4SP
Telephone +44(0)2038746707
Website www.jeffersonsheard.com



Project
Tewin Road
Welwyn Garden City

Drawing
Site Block Plan

Scale	Drawn	Date
1:500	CC	MAY 21
Drawing Purpose	Status	
PLANNING SUBMISSION	S5	
Ref	Rev.	
1734-JSA-WY-XX-DR-A-01201	P11	
Job No. Origin, Zone, Level, Type, Dis, Number		

Appendix 2: Site Constraints

Sorting Office

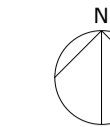
ESS

BRIDGEFIELDS

Mast

0m 10m 20m 30m 40m 50m

VISUAL SCALE 1:500 @ A1



The contractor is to check all dimensions on site and report any discrepancies to the architect. All rights described in chapter IV of the copyright, designs and patents act 1988 have been generally asserted.

Notes

- Application Boundary
- National Grid Eastings
- Pipeline Equipment
- Access Easements
- Retention Area

Indicates location of the cable and trial hole drilling. Equipment entries to be installed with SWA.

Location of Trial Holes using British Code

Location of Trial Holes using US Code

Aquarius House

EI Sub Sta

Tank

ET1001 No Cable Found at this Location
X = 524528360
Y = 213224910

GTH 02
X = 524548360
Y = 213241470

GTH 01
X = 524564000
Y = 213249200

UNIT 01

CAR PARK 15 SPACES

Depth of Cover from top of Slab- 1.1m
1 x SWA
1 x Plastic Pilot
X = 524516280
Y = 213199010

Depth of Cover from top of Slab- 500mm
1 x SWA
1 x Plastic Pilot
X = 524507600
Y = 213165410

UNIT 02

CAR PARK 4 SPACES

UNIT 03

CAR PARK 31 SPACES

Depth of Cover from top of Slab- 550mm
1 x SWA
1 x Plastic Pilot
X = 524492200
Y = 213110670

Depot

EI Sub Sta

Garden Court

P7	HV Cable and Trial Hole locations added	27/04/22	CC	JD
P6	Issued for Tender	07/01/22	CC	JD
P5	Issued for Tender	13/12/21	CC	JD
P4	Planning Submission	05/10/21	CC	JD
P3	Tree to be removed added. Planning Submission.	10/09/21	JD	CC
P2	Planning Submission	27/08/21	CC	JD
P1	Initial Issue	20/08/21	CC	JD
Rev	Description	Date	By	Chk

3rd Floor
7-15 Rosebery Avenue
London EC1R 4SP
Telephone +44(0)2038746707
Website www.jeffersonsheard.com



Project
Tewin Road
Welwyn Garden City

Drawing
Site Constraints Overlay

Scale	1:500	Drawn	CC	Date	Dec 21	
Drawing Purpose	FOR INFORMATION				Status	S2
Ref	1734-JSA-WY-XX-DR-A-01202				Rev.	P7
Job No.	Origin	Zone	Level	Type	Dis.	Number

Appendix 3: Topological Survey



Station Coordinates			
Station Name	Eastings (m)	Northings (m)	Height (m)
BWB01	524603.110	213153.138	81.890
BWB02	524570.789	213089.706	82.366
BWB03	524597.917	213160.164	81.826
BWB04	524574.055	213172.140	81.921
BWB05	524535.636	213132.943	82.457

- Notes**
- Do not scale this drawing. All dimensions must be checked/verified on site. If in doubt ask.
 - This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
 - All dimensions in metres unless noted otherwise. All levels in metres unless noted otherwise.
 - Any discrepancies noted on site are to be reported to the engineer immediately.
 - No scale factor has been applied to this survey, therefore the OS coordinates are to be treated as arbitrary. Please refer to survey station information below for on site control establishment.
 - All coordinates and height data relate to OSGB36(15). Control stations are coordinated by means of GPS receiving real time corrections via OS smart net.
 - All manhole data is collected from ground level therefore discrepancies may occur. More accurate data is only achievable via confined space entry.
 - OS license number: 100022432

Legend

OS Buildings	Contour Lines
Surveyed Buildings	Inspection Chamber
Building	Flow direction and pipe diameter
Wall	Station and Name
Kerb Channel Line	Monitoring Borehole
Top of Kerb	Tree / Bush / Sapling
Edge of Surface	Area of Vegetation/ Extent of Tree Canopy
Top of Bank	Hedge
Bottom of Bank	Body of Water
Canopy / Overhang	Body of Water from OS
Line Marking	Spot Level
Centre Line	Assumed Surface
Watercourse	Water Drainage Line
Centre Line	Surface Water Drainage Line
Barrier	
Fence	
Gate	
Overhead Powerline	
Overhead Utilities	

AP	Anchor Point	FBW	Fence Barbed Wire	LB	Litter Bin
BG	Back Gully	FCB	Fence Closed Board	LP	Lamp Post
BO	Bollard	FCL	Fence Chain Link	MH	Manhole
BS	Bus Stop	FEL	Fence Electric	Mkr	Service Marker
BT	British Telecom	FMP	Fence Metal Panel	PB	Post Box
C	Crest	FMR	Fence Metal Railing	PT	Post
CL	Cover Level	FOB	Fence Open Board	RE	Rodding Eye
CMP	Cable Marker	FPW	Fence Post & Wire	SP	Sign Post
Post		FSP	Fence Steel Palisade	ST	Stop Tap
CCTV	Security Camera	FWM	Fence Wire Mesh	SV	Stop Valve
CTV	Cable TV	FFL	Finished Floor Level	TCB	Telephone Call Box
DC	Drainage Channel	FP	Flagpole	THL	Threshold Level
DK	Drop Kerb	Gas	Gas	TL	Traffic Light
DP	Down Pipe	GV	Gas Valve	TP	Telegraph Post
Elec	Electric	GY	Gully	TS	Traffic Signal
EP	Electricity Post	Ht	Height	UTS	Unable to Survey
ER	Earth Rod	IC	Inspection Chamber	WL	Water Level
FH	Fire Hydrant	IFL	Internal Floor Level	WM	Water Meter
FL	Floodlight	IL	Invert Level (as a reduced level)	WVO	Wash Out

P2	30.06.21	Additional Area Added	PQ	SS
P1	24.06.21	First Issue	PQ	SS
Rev	Date	Details of issue / revision	Drw	Rev

Issues & Revisions

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 Nottingham | 0115 924 1100
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Client
Henry Boot Developments

Project Title
**Tewin Road,
 Welwyn Garden City**

Drawing Title
Existing Site Plan


Drawn:	P Quelch	Reviewed:	S Shreeves
BWB Ref:	LNH 2043	Date:	24.06.21
Scale@A1:	1:500		

INFORMATION

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
TRW-BWB-00-001-DR-G-0001	S2	P2

Appendix 4: Existing Peak Flow Rates

Appendix 5: Greenfield Runoff Rates

BWB Consulting Ltd		Page 1
5th Floor, Waterfront House 35 Station Street Nottingham, NG2 3DQ		
Date 21/06/2022 12:40 File	Designed by Jean.Benard Checked by	
Innovyze		Source Control 2020.1

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	1.212	Urban	0.500
SAAR (mm)	664	Region Number	Region 6

Results 1/s

QBAR Rural	2.1
QBAR Urban	5.0

Q100 years 11.4

Q1 year	4.3
Q30 years	9.4
Q100 years	11.4

Appendix 6: Thames Water Sewer Records



Your reference	tewin court
Our reference	ALS/ALS Standard/2021_4456405
Search date	25 June 2021

Knowledge of features below the surface is essential for every development

The benefits of this knowledge not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility of any development.

Did you know that Thames Water Property Searches can also provide a variety of utility searches including a more comprehensive view of utility providers' assets (across up to 35-45 different providers), as well as more focused searches relating to specific major utility companies such as National Grid (gas and electric).

Contact us to find out more.



Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13



searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk



0800 009 4540

Search address supplied: Tewin Road Cafe, Tewin Road, Welwyn Garden City, AL7 1BD

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This search provides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0800 009 4540, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk

Web: www.thameswater-propertysearches.co.uk

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

With regard to the fresh water supply, this site falls within the boundary of another water company. For more information, please redirect your enquiry to the following address:

Affinity Water Ltd
Tamblin Way
Hatfield
AL10 9EZ
Tel: 0345 3572401

Asset location search



Property Searches

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

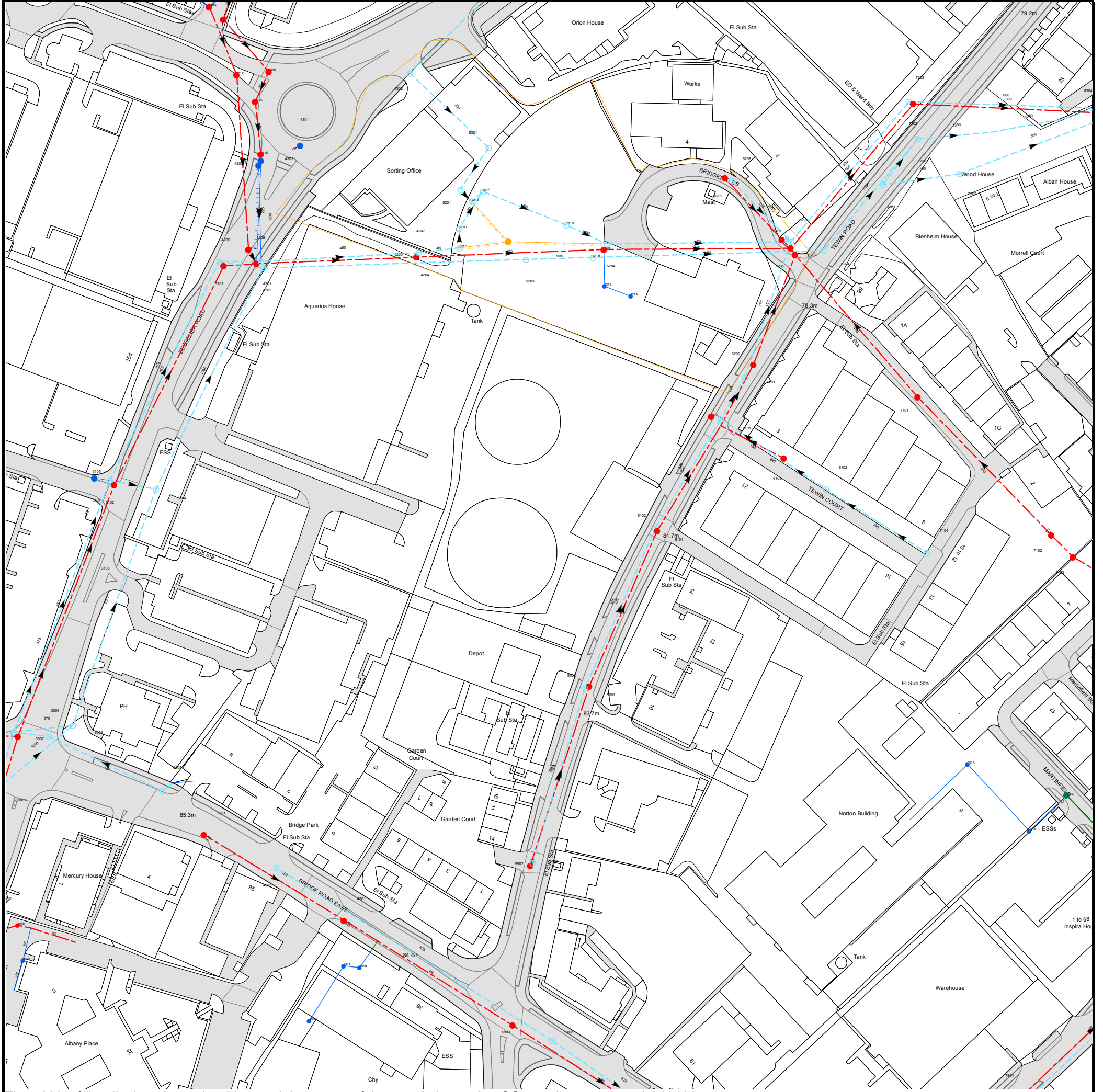
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2021 4456405



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 524551,213126

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.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available



















Manhole Reference	Manhole Cover Level	Manhole Invert Level
7302	80.85	75.21
7303	80.87	75.23
8305	n/a	n/a
8304	n/a	n/a
3101	82.05	79.38
4202	81.23	74.19
4205	81.67	77.2
4206	81.61	77.96
4201	81.67	76.96
3201	81.67	75.64
5203	n/a	n/a
4207	79.87	76.63
4204	79.86	76.62
421A	81.63	78.03
5201	80.96	76.78
4203	82.54	79.5
4303	82.53	79.03
431E	n/a	n/a
5301	82.14	76.88
4301	82.57	80.28
431C	n/a	n/a
431F	83.49	79.89
4302	81.86	77.23
431B	n/a	n/a
431A	n/a	n/a
331A	83.95	80.49
391B	n/a	n/a
4901	84.73	81.77
4902	85.22	83.35
5902	83.08	80.94
5901	83.09	80.48
3901	85.54	83
3005	85.46	83.43
3004	84.83	79.96
3006	n/a	n/a
3002	84.25	80.51
3003	84.86	77.61
5001	82.51	80.13
5002	82.53	79.66
3103	83.18	79.57
3104	82.99	76.3
3105	81.99	78.51
3102	82	79
521A	n/a	n/a
5101	81.98	79.34
5102	81.99	78.88
611A	n/a	n/a
6101	80.88	78.27
6208	79.67	78.26
6203	79.64	77.93
6201	80.22	77.82
6209	79.93	n/a
6207	78.38	76.94
6103	80.95	78.85
6202	78.19	75.58
6206	78.19	75.57
6205	78.01	75.89
6204	77.08	72.83
6102	80.81	79.14
7201	76.1	75.03
7101	80.97	76.14
7301	76.49	72.45
7104	80.67	79.85
7202	76.11	73.88
7102	81.08	76.37
7103	n/a	n/a
5801	83.19	81.03
5903	83.52	80.4
491C	n/a	n/a
491B	n/a	n/a
491A	n/a	n/a
391A	n/a	n/a
791B	n/a	n/a
701C	n/a	n/a
701A	n/a	n/a
521B	n/a	n/a
521H	79.75	73.8
5205	79.24	76.27
521C	81	77.03
5204	79.4	76.1
521D	81.2	76.89
521G	79.98	76.27
521E	81.15	76.72
521F	80.74	76.6

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.



ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

-  **Foul:** A sewer designed to convey waste water from domestic and industrial sources to a treatment works.
-  **Surface Water:** A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.
-  **Combined:** A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.
-  Trunk Surface Water
-  Trunk Foul
-  Storm Relief
-  Trunk Combined
-  Vent Pipe
-  Bio-solids (Sludge)
-  Proposed Thames Surface Water Sewer
-  Proposed Thames Water Foul Sewer
-  Gallery
-  Foul Rising Main
-  Surface Water Rising Main
-  Combined Rising Main
-  Sludge Rising Main
-  Proposed Thames Water Rising Main
-  Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

-  Air Valve
-  Dam Chase
-  Fitting
-  Meter
-  Vent Column




Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

-  Control Valve
-  Drop Pipe
-  Ancillary
-  Weir





End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

-  Outfall
-  Undefined End
-  Inlet


Other Symbols

Symbols used on maps which do not fall under other general categories








-  Public/Private Pumping Station
-  Change of characteristic indicator (C.O.C.I.)
-  Invert Level
-  Summit

Areas

Lines denoting areas of underground surveys, etc.

-  Agreement
-  Operational Site
-  Chamber
-  Tunnel
-  Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

-  Foul Sewer
-  Surface Water Sewer
-  Combined Sewer
-  Gully
-  Culverted Watercourse
-  Proposed
-  Abandoned Sewer

Notes:

- 1) All levels associated with the plans are to Ordnance Datum Newlyn.
- 2) All measurements on the plans are metric.
- 3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
- 4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
- 5) 'na' or 'D' on a manhole level indicates that data is unavailable.

- 6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Searches on 0800 009 4540.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL's terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

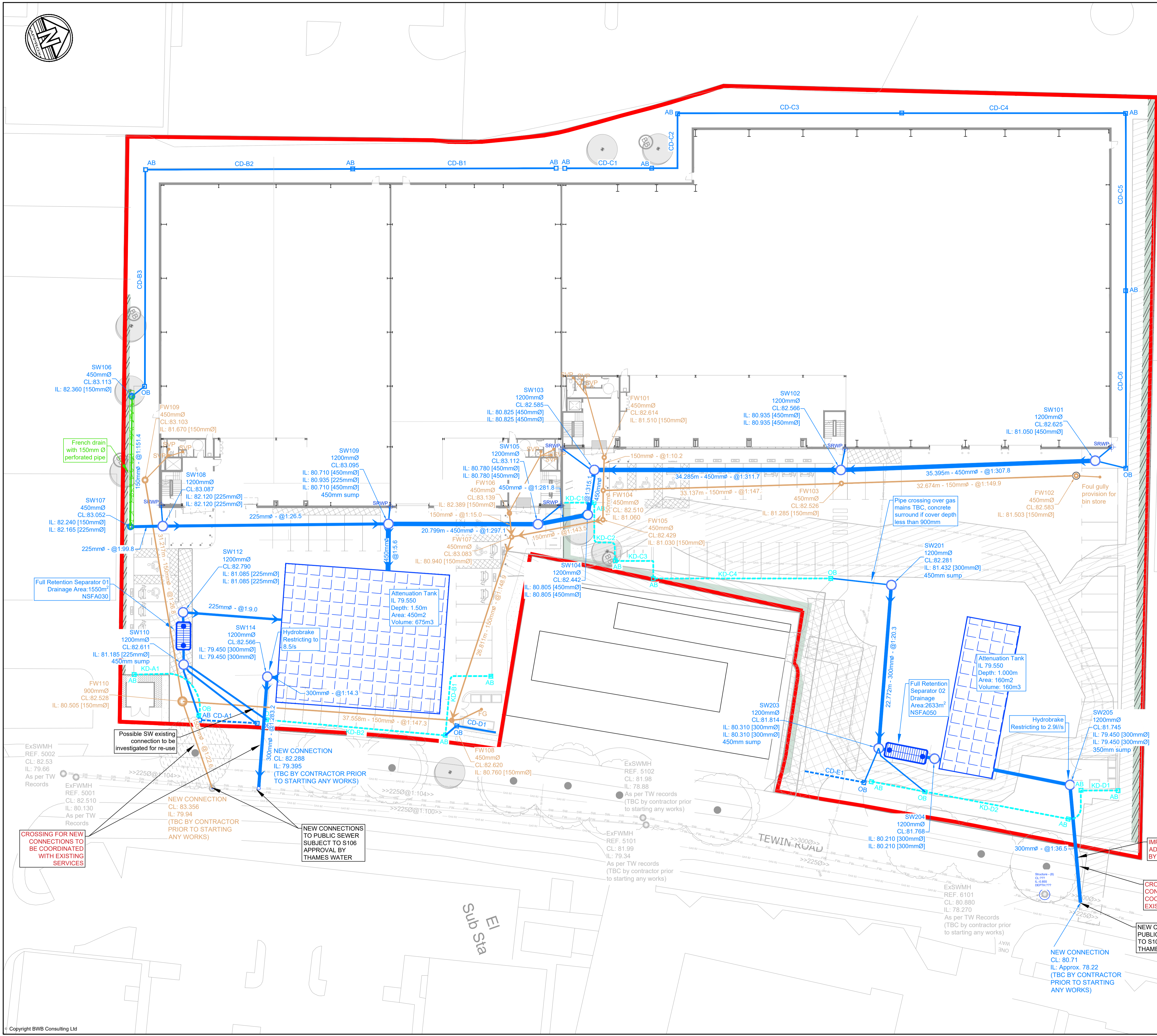
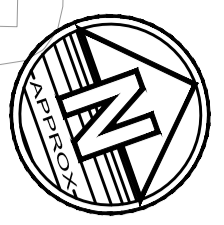
If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	BACS Payment	Telephone Banking	Cheque
Call 0800 009 4540 quoting your invoice number starting CBA or ADS / OSS	Account number 90478703 Sort code 60-00-01 A remittance advice must be sent to: Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW. or email ps.billing@thameswater.co.uk	By calling your bank and quoting: Account number 90478703 Sort code 60-00-01 and your invoice number	Made payable to ' Thames Water Utilities Ltd ' Write your Thames Water account number on the back. Send to: Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW or by DX to 151280 Slough 13

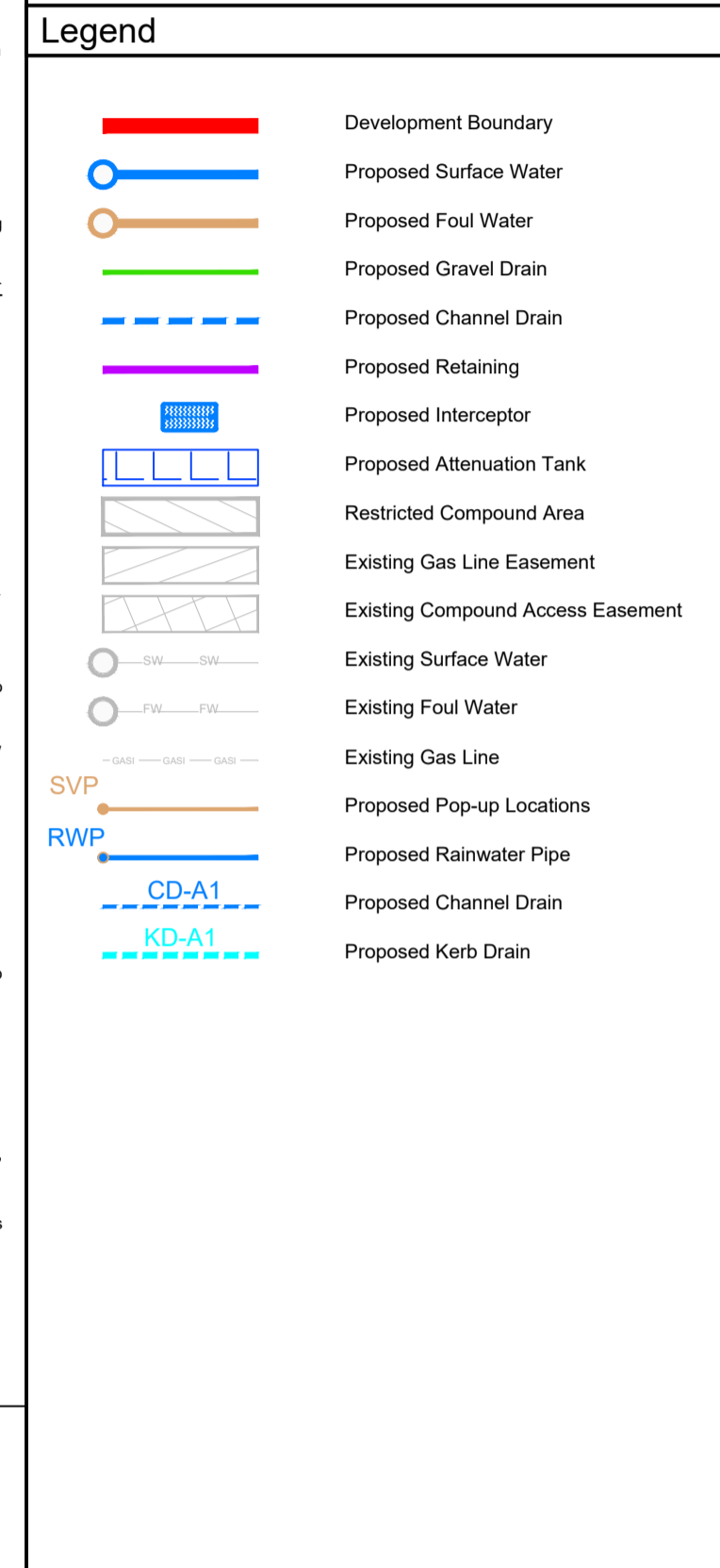
Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.

Appendix 7: Proposed Drainage Layout



- ### Drainage Notes
- All adoptable surface and foul water drainage works to be carried out in strict accordance with 'Sewers for Adoption' (7th edition) and any specific requirements of the adopting authority.
 - All adoptable highway drainage works to be carried out in strict accordance with the Local Highway Authority requirements and the DT MCHW specification for highway works.
 - All private drainage works are to be carried out in accordance with Building Regulations Part H, BS EN 12222, the Civil Engineering Specification for the Water Industry and, where provided, the BWB Drainage Specification.
 - Where applicable the contractor shall allow free and full access to the drainage works for the local authority, highway authority, drainage authority or the overseeing organisation.
 - The exact position, level, line, size and use of existing drainage is to be confirmed on site. Any discrepancies to be reported to the engineer prior to the commencement of works.
 - For new connections to existing manholes, existing benching is to be broken out and reformed to suit. Concrete/brick surround to be made good.
 - All temporary works associated with the construction of the drainage works shall be the responsibility of the contractor, including the protection of any uncovered/shallow pipework against construction traffic.
 - The Contractor is responsible for obtaining and paying for all necessary permissions to enable construction of the works to be undertaken, including but not limited to licences for street works and connections to existing sewers. This includes Section 106 applications when connecting directly or indirectly to the public sewerage network (complete application to be made at least 3 weeks prior to the planned outfall construction works).
 - Any damage caused to existing footways, roads or other third party property to be made good.
 - Under roads and external paved areas all materials within 450mm of finished levels to be non-frost susceptible. Reinstatements shall be undertaken in accordance with the BWB standard detail.
 - All proposed chamber covers are to be marked permanently with 'SWS' (or equiv.) on surface water sewers and 'TWS' (or equiv.) on foul sewers, all covers to be in accordance with BS EN 124.
 - Unless noted otherwise, all lateral connections are to be installed with level soffits to the diameters and gradients shown on the layout drawing. Any pipe bends should be provided to suit the direction of flow & no pipework should be downsized in the direction of flow.
 - The number and location of all RWP's is shown indicatively only. To be confirmed by Architect / MSE contractor prior to commencement of works.
 - Foul water 'pop up positions' are shown indicatively only, to be confirmed by the Architect / MSE contractor prior to commencement of works. Refer to Architect plans for setting out of internal foul pop up positions.
 - All RWP's and SVP's to be fitted with rotable access plates. All foul drains to have rotable access.
 - Above ground drainage details to be designed/confirmed by the Architect/MSE contractor, including ventilation of the foul drainage system.
 - Proposed drainage passing through new foundations to be sleeved with cast-in oversized pipework.
 - All specialist/proprietary products such as separators, attenuation tanks, channel drains, soakaways, package pumping station and water treatment units to be installed as per the manufacturer's installation details and specifications.

- ### Notes
- Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
 - This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
 - All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
 - Any discrepancies noted on site are to be reported to the engineer immediately.
 - For more information on the site layout, please refer to Jefferson Sheard Architects drawing ref. 1734-JSA-WY-XX-DR-A-012021_Site Plan
 - For more information on the easements, please refer to Jefferson Sheard Architects drawing ref. 1734-JSA-WY-XX-M2-A-01101_Site Constraints
 - For more information on the existing utilities, please refer to Solum Surveying Ltd's drawing ref. 6708_PAS128 Utility Survey
 - For more information on the proposed retaining, please refer to BWB's drawing ref. TRW-BWB-GEN-XX-DR-C-0600_Proposed Levels



P03	21.06.22	Tender Issue	DC	JB
P02	16.05.22	For Planning	MT	EV
T02	26.01.22	FW11 CL and IL added	DC	EV
T01	07.01.22	Tender Issue	DC	EV
P01	20.09.21	Preliminary Issue	DC	JM
Rev	Date	Details of issue / revision	Drw	Rev

Issues & Revisions

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- Leeds | 0113 233 8000
- London | 020 7407 3879
- Manchester | 0161 233 4260
- Nottingham | 0115 924 1100
- www.bwbconsulting.com

Client
Henry Boot Developments

Project Title
Tewin Road, Welwyn Garden City

Drawing Title
Proposed Drainage Layout

Drawn:	D. Cronin	Reviewed:	E. Veillard
BWB Ref:	LNH 2043	Date:	20.09.21
Scale:	@A1: 1:250	Status:	PRELIMINARY
Project - Originator - Zone - Level - Type - Role - Number	TRW-BWB-GEN-XX-DR-C-0500	Status	S2
Rev	P03		


Appendix 8: Micro Drainage Results

Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (%)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
1.000	7.260	0.100	1.377	0.160	5.00	0.0	0.600	o	225	Pipe/Conduit
1.001	28.490	1.535	5.388	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
2.000	18.195	0.120	0.660	0.016	5.00	0.0	0.600	o	150	Pipe/Conduit
2.001	4.626	0.045	0.973	0.011	0.00	0.0	0.600	o	225	Pipe/Conduit
2.002	31.387	1.127	3.591	0.072	0.00	0.0	0.600	o	225	Pipe/Conduit
3.000	35.395	0.115	0.325	0.106	5.00	0.0	0.600	o	450	Pipe/Conduit
3.001	34.285	0.110	0.321	0.178	0.00	0.0	0.600	o	450	Pipe/Conduit
3.002	5.534	0.020	0.361	0.066	0.00	0.0	0.600	o	450	Pipe/Conduit
3.003	7.217	0.025	0.346	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit
3.004	20.799	0.070	0.337	0.055	0.00	0.0	0.600	o	450	Pipe/Conduit
2.003	14.094	1.160	8.230	0.126	0.00	0.0	0.600	o	450	Pipe/Conduit
1.002	18.192	0.100	0.550	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit
1.003	15.620	0.055	0.352	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit
4.000	22.772	1.122	4.927	0.060	5.00	0.0	0.600	o	300	Pipe/Conduit
4.001	7.910	0.100	1.264	0.202	0.00	0.0	0.600	o	300	Pipe/Conduit
4.002	4.892	0.660	13.491	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit
4.003	14.296	0.100	0.699	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
1.000	81.185	0.160	0.0	1.54	61.1
1.001	81.085	0.160	0.0	3.05	121.3
2.000	82.360	0.016	0.0	0.81	14.4
2.001	82.165	0.027	0.0	1.29	51.3
2.002	82.120	0.099	0.0	2.49	99.0
3.000	81.050	0.106	0.0	1.15	183.5
3.001	80.935	0.284	0.0	1.15	182.3
3.002	80.825	0.351	0.0	1.22	193.6
3.003	80.805	0.351	0.0	1.19	189.5
3.004	80.780	0.406	0.0	1.17	186.8
2.003	80.710	0.631	0.0	5.86	931.5
1.002	79.550	0.791	0.0	1.16	82.2
1.003	79.450	0.791	0.0	0.93	65.6
4.000	81.432	0.060	0.0	3.51	247.8
4.001	80.310	0.262	0.0	1.77	125.1
4.002	80.210	0.262	0.0	5.81	410.7
4.003	79.550	0.262	0.0	1.31	92.8

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Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (%)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
4.004	16.130	1.230	7.626	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
4.004	79.450	0.262	0.0	4.36	308.5

Area Summary for Storm


Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.160	0.160	0.160
1.001	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.016	0.016	0.016
2.001	User	-	100	0.011	0.011	0.011
2.002	User	-	100	0.072	0.072	0.072
3.000	User	-	100	0.083	0.083	0.083
	User	-	100	0.023	0.023	0.106
3.001	User	-	100	0.178	0.178	0.178
3.002	User	-	100	0.066	0.066	0.066
3.003	-	-	100	0.000	0.000	0.000
3.004	User	-	100	0.055	0.055	0.055
2.003	User	-	100	0.126	0.126	0.126
1.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
4.000	User	-	100	0.060	0.060	0.060
4.001	User	-	100	0.202	0.202	0.202
4.002	-	-	100	0.000	0.000	0.000
4.003	-	-	100	0.000	0.000	0.000
4.004	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.053	1.053	1.053

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1
Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0


Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	1
FEH Rainfall Version	1999
Site Location	GB 524800 213300 TL 24800 13300
C (1km)	-0.028
D1 (1km)	0.292
D2 (1km)	0.317
D3 (1km)	0.283
E (1km)	0.322
F (1km)	2.478
Summer Storms	Yes
Winter Storms	Yes

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Synthetic Rainfall Details

Cv (Summer) 0.750
 Cv (Winter) 0.840
 Storm Duration (mins) 30

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 6, DS/PN: 1.003, Volume (m³): 4.7

Unit Reference	MD-SHE-0123-8500-1800-8500
Design Head (m)	1.800
Design Flow (l/s)	8.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	123
Invert Level (m)	79.450
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200


Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	8.5
Flush-Flo™	0.534	8.4
Kick-Flo®	1.091	6.7
Mean Flow over Head Range	-	7.4

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	4.4	1.200	7.0	3.000	10.8	7.000	16.1
0.200	7.2	1.400	7.5	3.500	11.6	7.500	16.7
0.300	8.0	1.600	8.0	4.000	12.4	8.000	17.2
0.400	8.3	1.800	8.5	4.500	13.1	8.500	17.7
0.500	8.4	2.000	8.9	5.000	13.7	9.000	18.2
0.600	8.4	2.200	9.3	5.500	14.4	9.500	18.7
0.800	8.1	2.400	9.7	6.000	15.0		
1.000	7.4	2.600	10.1	6.500	15.6		

Hydro-Brake® Optimum Manhole: 20, DS/PN: 4.004, Volume (m³): 3.5

Unit Reference	MD-SHE-0069-2900-2000-2900
Design Head (m)	2.000
Design Flow (l/s)	2.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	69
Invert Level (m)	79.450
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200


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Hydro-Brake® Optimum Manhole: 20, DS/PN: 4.004, Volume (m³): 3.5

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	2.9
Flush-Flo™	0.303	2.1
Kick-Flo®	0.619	1.7
Mean Flow over Head Range	-	2.2

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	1.7	1.200	2.3	3.000	3.5	7.000	5.2
0.200	2.0	1.400	2.5	3.500	3.8	7.500	5.4
0.300	2.1	1.600	2.6	4.000	4.0	8.000	5.5
0.400	2.1	1.800	2.8	4.500	4.2	8.500	5.7
0.500	2.0	2.000	2.9	5.000	4.4	9.000	5.9
0.600	1.8	2.200	3.0	5.500	4.6	9.500	6.0
0.800	1.9	2.400	3.2	6.000	4.8		
1.000	2.1	2.600	3.3	6.500	5.0		

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Storage Structures for Storm

Tank or Pond Manhole: 13, DS/PN: 1.002


Invert Level (m) 79.550

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	450.0	1.500	450.0	1.501	0.0

Tank or Pond Manhole: 18, DS/PN: 4.003

Invert Level (m) 79.550

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	160.0	1.000	160.0	1.001	0.0

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	11	81.300	-0.110	0.000	0.51		22.7	OK	2
1.001	12	81.154	-0.156	0.000	0.20		22.6	OK	
2.000	SW106	82.402	-0.108	0.000	0.17		2.3	OK	
2.001	SW106	82.217	-0.173	0.000	0.12		3.6	OK	
2.002	W03	82.174	-0.171	0.000	0.13		12.2	OK	
3.000	SW101	81.150	-0.350	0.000	0.09		14.7	OK	2
3.001	SW102	81.087	-0.298	0.000	0.22		34.4	OK	2
3.002	SW103	81.014	-0.261	0.000	0.37		41.7	OK	
3.003	SW104	80.987	-0.268	0.000	0.34		41.5	OK	
3.004	SW105	80.952	-0.278	0.000	0.31		47.1	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
2.003	9	15	Winter	1	+0%			
1.002	13	120	Winter	1	+0%	30/15	Summer	
1.003	6	120	Winter	1	+0%	30/15	Summer	
4.000	16	15	Winter	1	+0%	100/15	Summer	
4.001	17	15	Winter	1	+0%	30/15	Summer	100/15 Summer
4.002	17	15	Winter	1	+0%	100/15	Summer	
4.003	18	120	Winter	1	+0%	30/15	Summer	
4.004	20	120	Winter	1	+0%	30/15	Summer	

PN	US/MH Name	Water Surcharged			Flooded		Half Drain Pipe		Level Exceeded
		Level (m)	Depth (m)	Volume (m ³)	Flow / Overflow Cap. (l/s)	Time (mins)	Flow (l/s)	Status	
2.003	9	80.813	-0.347	0.000	0.12		71.3	OK	
1.002	13	79.694	-0.156	0.000	0.11		7.6	OK	
1.003	6	79.687	-0.063	0.000	0.14		7.6	OK	
4.000	16	81.470	-0.262	0.000	0.04		8.6	OK	
4.001	17	80.446	-0.164	0.000	0.41		32.8	OK	2
4.002	17	80.291	-0.219	0.000	0.16		33.0	OK	
4.003	18	79.680	-0.170	0.000	0.03		2.3	OK	
4.004	20	79.678	-0.072	0.000	0.01		2.1	OK	

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	11	81.610	0.200	0.000	1.72		76.8	SURCHARGED
1.001	12	81.223	-0.087	0.000	0.68		77.2	OK
2.000	SW106	82.443	-0.067	0.000	0.57		7.7	OK
2.001	SW106	82.270	-0.120	0.000	0.43		13.0	OK
2.002	W03	82.239	-0.106	0.000	0.54		50.2	OK
3.000	SW101	81.503	0.003	0.000	0.29		46.5	SURCHARGED
3.001	SW102	81.406	0.021	0.000	0.76		120.6	SURCHARGED
3.002	SW103	81.310	0.035	0.000	1.31		148.4	SURCHARGED
3.003	SW104	81.275	0.020	0.000	1.22		147.0	SURCHARGED
3.004	SW105	81.234	0.004	0.000	1.11		168.3	SURCHARGED

PN	US/MH Name	Level Exceeded
1.000	11	2
1.001	12	
2.000	SW106	
2.001	SW106	
2.002	W03	
3.000	SW101	2
3.001	SW102	2
3.002	SW103	
3.003	SW104	
3.004	SW105	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
2.003	9	15 Winter	30	+0%				
1.002	13	180 Winter	30	+0%	30/15 Summer			
1.003	6	60 Winter	30	+0%	30/15 Summer			
4.000	16	15 Winter	30	+0%	100/15 Summer			
4.001	17	15 Winter	30	+0%	30/15 Summer	100/15 Summer		
4.002	17	15 Winter	30	+0%	100/15 Summer			
4.003	18	180 Winter	30	+0%	30/15 Summer			
4.004	20	180 Winter	30	+0%	30/15 Summer			

PN	US/MH Name	Water Surcharged Flooded			Half Drain Pipe		Status
		Level (m)	Depth (m)	Volume (m³)	Flow / Overflow Cap. (l/s)	Time (mins)	
2.003	9	80.921	-0.239	0.000	0.43	260.7	OK
1.002	13	80.044	0.194	0.000	0.15	10.8	SURCHARGED
1.003	6	80.312	0.562	0.000	0.15	8.4	SURCHARGED
4.000	16	81.505	-0.227	0.000	0.13	29.2	OK
4.001	17	80.783	0.173	0.000	1.68	133.2	SURCHARGED
4.002	17	80.388	-0.122	0.000	0.65	132.4	OK
4.003	18	80.026	0.176	0.000	0.03	2.6	SURCHARGED
4.004	20	80.029	0.279	0.000	0.01	2.1	SURCHARGED

PN	US/MH Name	Level Exceeded
2.003	9	
1.002	13	
1.003	6	
4.000	16	
4.001	17	2
4.002	17	
4.003	18	
4.004	20	

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Overflow Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	11	82.616	1.206	5.215	2.88		128.4	FLOOD
1.001	12	81.905	0.595	0.000	1.12		126.2	SURCHARGED
2.000	SW106	82.724	0.214	0.000	1.27		17.1	SURCHARGED
2.001	SW106	82.583	0.193	0.000	0.99		29.7	SURCHARGED
2.002	W03	82.526	0.181	0.000	1.07		98.9	SURCHARGED
3.000	SW101	82.625	1.125	0.491	0.62		99.8	FLOOD
3.001	SW102	82.567	1.182	1.235	1.67		266.1	FLOOD
3.002	SW103	82.301	1.026	0.000	2.89		326.6	FLOOD RISK
3.003	SW104	81.949	0.694	0.000	2.72		327.1	SURCHARGED
3.004	SW105	81.602	0.372	0.000	2.49		378.4	SURCHARGED

PN	US/MH Name	Level Exceeded
1.000	11	2
1.001	12	
2.000	SW106	
2.001	SW106	
2.002	W03	
3.000	SW101	2
3.001	SW102	2
3.002	SW103	
3.003	SW104	
3.004	SW105	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
2.003	9	15 Winter	100	+40%				
1.002	13	240 Winter	100	+40%	30/15 Summer			
1.003	6	60 Winter	100	+40%	30/15 Summer			
4.000	16	15 Winter	100	+40%	100/15 Summer			
4.001	17	15 Winter	100	+40%	30/15 Summer	100/15 Summer		
4.002	17	240 Winter	100	+40%	100/15 Summer			
4.003	18	240 Winter	100	+40%	30/15 Summer			
4.004	20	240 Winter	100	+40%	30/15 Summer			

PN	US/MH Name	Water Surcharged			Flooded		Half Drain Pipe		Status
		Level (m)	Depth (m)	Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Time (mins)	Flow (l/s)	
2.003	9	81.079	-0.081	0.000	0.99			599.1	OK
1.002	13	80.680	0.830	0.000	0.18			12.7	SURCHARGED
1.003	6	81.226	1.476	0.000	0.15			8.3	SURCHARGED
4.000	16	82.024	0.292	0.000	0.29			63.7	FLOOD RISK
4.001	17	81.816	1.206	2.897	3.11			246.7	FLOOD
4.002	17	81.382	0.872	0.000	0.17			35.5	SURCHARGED
4.003	18	81.381	1.531	0.000	0.04			3.1	SURCHARGED
4.004	20	81.378	1.628	0.000	0.01			2.8	SURCHARGED

PN	US/MH Name	Level Exceeded
2.003	9	
1.002	13	
1.003	6	
4.000	16	
4.001	17	2
4.002	17	
4.003	18	
4.004	20	

