Land off Danson Road, Bexleyheat

Drainage Strategy

Carebase Ltd.

10304363

19 August 2021

Quality Control

Prepared by	Checked by	Approved by
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Revision History

Revision	Revision date	Details	Authorized	Name	Position

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1. Introduction

HDR Bradbrook Consulting Limited (Bradbrook) was commissioned by the Applicant, Carebase Ltd. to produce a Drainage Strategy for a proposed care home development at a land off Danson Road, in Bexleyheath. The site lies within the authority of the London Borough Bexley (LBB).

1.1 London Plan

The London Plan is the overall strategic plan for London, setting out an integrated economic, environmental, transport and social framework for the development of London over the next 20–25 years. The key policies included in the London Plan related to *Policy SI 13 Sustainable drainage:*

A Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks. Increases in surface water run-off outside these areas also need to be identified and addressed.

B Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:

1) rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)

2) rainwater infiltration to ground at or close to source

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

4) rainwater discharge direct to a watercourse (unless not appropriate)

5) controlled rainwater discharge to a surface water sewer or drain

6) controlled rainwater discharge to a combined sewer.

C Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.

D Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation.

1.2 Climate Change

The Flood risk assessments: Climate Change Allowances Guidance published in February 2016 indicates that climate change is currently expected to result in increased rainfall and rising sea levels. Table 1 below shows anticipated changes in extreme rainfall intensity in small and urban catchments. Therefore, a 40% increase in rainfall intensity will be considered.

Table 1: Peak rainfall intensity allowance in small and urban catchments (Ref: Flood risk assessments: climate change allowances Guidance by EA, February 2016)

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

2. Site Description

The application site is situated to west of Bexleyheath (as illustrated in Figure 1), which is within the administrative boundary fo London Borough of Bexley, Greater London. The site's boundaries are formed by Danson Park to the north and west; the highway of Danson Road to the east; and residential properties to the south.

The application site is situated on an Ordnance Survey grid reference of 547590, 175490 and comprises an area of circa 0.353 hectare.

The site is currently occupied by residential dwellings. The site location plan is shown in Figure 1 below.

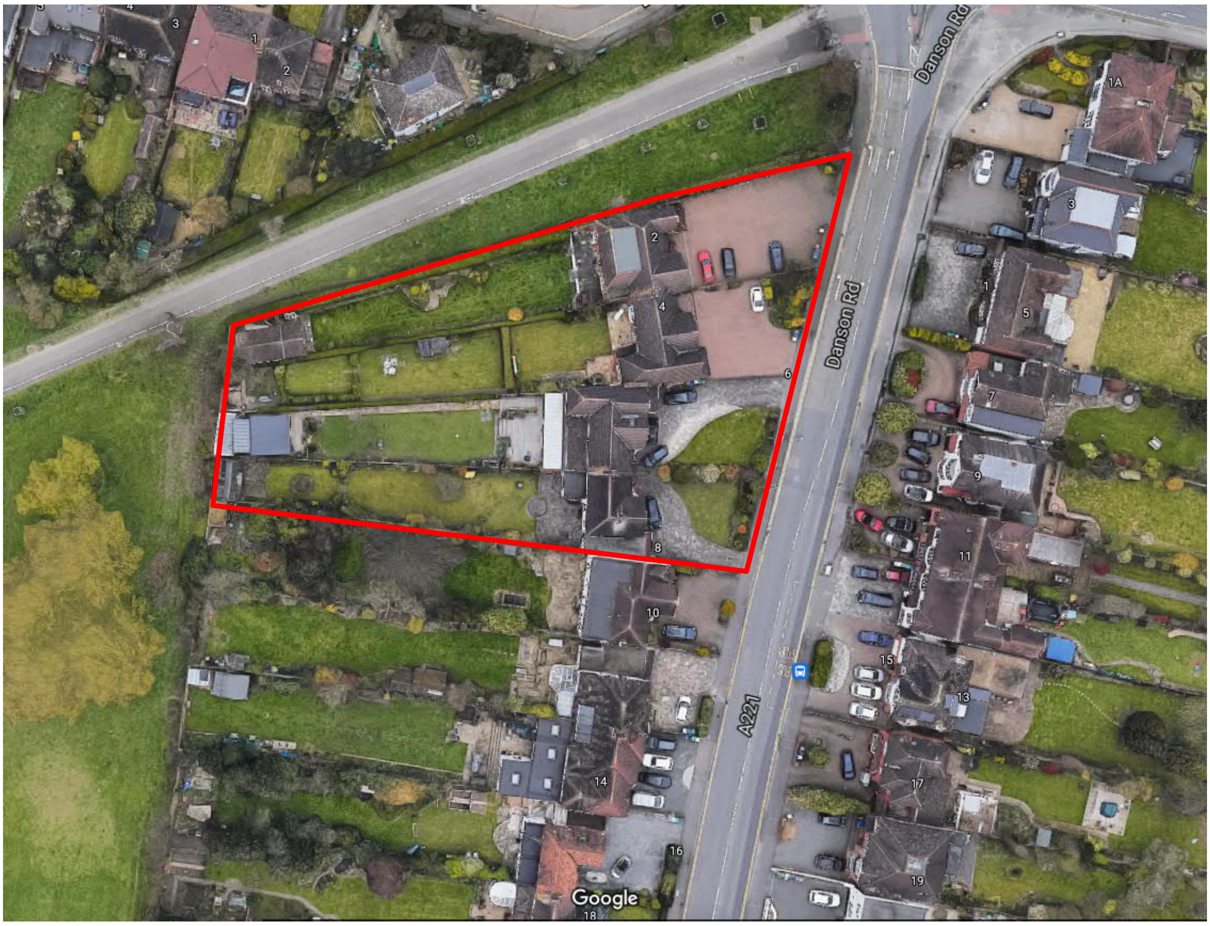


Figure 1: Site Location Plan (Source: Google Map)

2.1 Topography and Hydrological Setting

The nearest watercourse to the site is Boating Pool approximately 750m south west of the site. The nearest point of River Thames is located over 4 KM to the north.

The topographic survey plan (Appendix A) shows that the site is almost flat in nature with a gradual fall toward west. Levels vary from 43.1m AOD to 44.2m AOD. The site is located within a Source Protection Zone (SPZ), Zone 3 – Total Catchment. As per the topographic survey and available drainage information (Appendix B), the surface water from the site is discharged in to a 225 mm diameter TWUL surface water sewer running along Danson Road towards north. Foul water from the site is discharged via a 225mm TWUL foul water sewer, running along Danson Road.

2.2 Geology and Hydrogeology

The British Geological Survey record plans for the Bexley area indicate the site is underlain by the London Clay Formation which is described as Clay and Silt and not suitable for infiltration.

3. Proposed Drainage Strategy

The proposal involves the demolition of existing properties and provide a three-storey 70-bed care home with an internal access road, parking provision, landscaping and supporting infrastructure.

The proposed drainage strategy is for a separate foul and surface water drainage network within the site. Both foul and surface water to discharge in the separate TWUL foul and surface water network as existing manner.

The proposed development plan is presented in Appendix C.

3.1 Surface Water Drainage Strategy

The surface water drainage strategy for the proposed development is based on the guidance in The Sustainable Drainage Design and Evaluation Guide and the principles of integrated Construction Industry Research and Information Association (CIRIA) Sustainable Drainage System SuDS and source control methods to convey surface water runoff flows from the site.

A flood risk and drainage assessment report produced by Ardent Consulting Engineers, in support of the planning application of the development, confirmed the existing discharge rate of 19.4 l/s from the existing 1,435 m^2 of hardstanding areas.

The proposal is to reduce the discharge rate to provide betterment. The report by Ardent confirmed a reduction of 60% of existing discharge rate to 7.8 l/s for a 1:100 year plus 40% climate change factor.

The table below assesses the feasibility of surface runoff discharge option as per the London Plan drainage hierarchy.

Table 2: London Plan drainage hierarchy for discharge

Rank	Discharge type	Viability	Comments
1	Store rainwater for later use	Recommended	Reuse of some portion of the rainwater for gardening is recommended, if feasible
2	Use infiltration techniques, such as porous surfaces in non-clay areas	Not suitable	Infiltration is not feasible due to ground condition and type of the development. It is advised to carryout infiltration at detailed design stage
3	Attenuate rainwater for gradual release	Recommended	It is recommended to store in permeable pavement and attenuation tank for a gradual realese
4	Discharge rainwater direct to a watercourse	Not suitable	No watercourse in the vicinity of the site
5	Discharge rainwater to a surface water sewer/drain	Recommended	Existing surface water sewer will be used to
6	Discharge rainwater to the combined sewer	Not recommended	No combined sewer available

Therefore, as per the local guidance the proposed drainage strategy as follows:

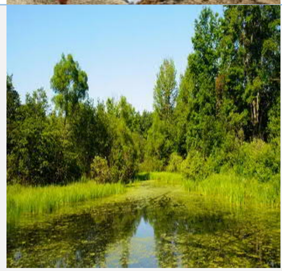
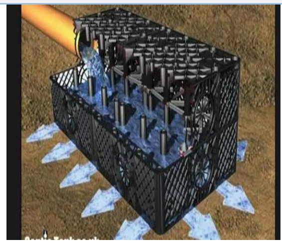
- Reduce the existing discharge rate to 60% by maximising the implementation of SuDS approach and provide betterment over existing;
- Excess runoff to be attenuated on site to accommodate the 1:100 year + 40% CC event;
- The surface water drainage design will follow the principles listed in the Approved Document Part H of the Building Regulations and Sewers for Adoption 7th Edition. The Building Regulations established a hierarchy for surface water disposal which encourages a SuDS approach;
- Surface water sewers shall be designed to a 1 in 30 year no flooding standard in accordance with BS EN 752: 2017. There will be no flooding of buildings or off-site areas during a 1 in 100 year return period storm event including climate change allowance;
- Rainwater butts is recommended to store rainwater for irrigation;
- Treatment of the surface water runoff will be provided via the permeable materials; petrol interceptor is not preferred for a method of treatment. Considering this is a care home facility, permeable pavements are only recommended where there is no possibility of standing water causing health & safety risk; and
- The development to promote infiltration, where feasible. It is recommended to

The rainfall events in exceedance of 1 in 30 years return period will be managed without any flooding of buildings or overflow from the site onto adjacent land. Therefore, for the 1 in 100 year plus 40% increase of rainfall intensity for climate change, adequate storage of surface runoff will be provided within the permeable subbase and below ground attenuation tank.

The required storage volume of 155 m^3 is calculated using Windes MicroDrainage and included in Appendix D. It is recommended to carry out on site infiltration test as per BRE 365 guideline during detailed design stage. Controlled discharge will be made to the TWUL surface water sewer, potentially using existing connection (subject to approval from TWUL).

The drawing in Appendix E shows the proposed drainage network and extent of permeable pavement. The completed SuDS proforma is included in Appendix F.

Table 3: Assessment of Suitability of SuDS at the Site

SuDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for Use at Site
Retention	Attenuation Pond		Provides both storm water attenuation and treatment. Run-off from each rain event is detained and treated in the pool. The retention time promotes pollutant removal through sedimentation.	Good removal of pollutants, can be used where groundwater is vulnerable, good community acceptability, high ecological, and amenity benefits.	No reduction in run-off volume, land take may limit use in high density sites.	✗ Not suitable for the site and proposed development due to lack of space and shallow depth public sewer.
	Sub-surface Storage		Oversized pipes, tank systems and modular geocellular systems that can be used to create a below ground storage structure.	Modular and flexible, dual usage (infiltration/storage, high void ratios), can be installed beneath trafficked and soft landscaped areas.	No water quality treatment.	✓ Shallow depth Sub-surface storage can be used
Wetland	Shallow wetland Extended detention wetland Pond wetland Pocket wetland Submerged gravel wetland Wetland channel		Wetlands provide storm water attenuation and treatment. They comprise shallow ponds and marshy areas, covered in aquatic vegetation. Wetlands detail flows for an extended period to allow sediments to settle and to remove contaminants. They can provide significant ecological benefits.	Good pollutant removal and if lined can be used where groundwater I vulnerable. Good community acceptability, ecological and amenity benefits.	Land take is high, requires base flow, little reduction in run-off volume, not suitable for steep sites.	✗ Not suitable for the site and proposed development
Infiltration	Infiltration trench Infiltration basin Soakaway		Surface water run-off can be discharged directly to ground for infiltration by soakaways, basins, or trenches. A prerequisite is that both groundwater and ground conditions are appropriate to receive the quality and quantity of water generated.	Reduces the volume of run-off, effective at pollutant removal, contributes to groundwater recharge, simple and cost-effective.	Requires appropriate pre-treatment, basins require a large flat area, offset from foundations.	✗ The BGS records show the existing soils on site is not suitable to infiltration techniques. However, it is recommended to carryout infiltration test during detailed design stage.
	Porous paving					

SuDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for Use at Site
	Permeable paving		Block or porous paving allows run-off to infiltrate through to sub base layer. Water can then be infiltrated into ground or conveyed into storage or drainage systems.	Reduces the volume of run-off and if designed for infiltration contributes towards groundwater recharge. East to install and retrofit. Simple to manage. If lined can be used where groundwater is sensitive.	Not suitable for heavily trafficked areas or adoptable roads. Requires regular sweeping to prevent clogging with dirt.	✓ The proposed car parking Areas could be used as a porous pavement with the subbase attenuating peak runoff. Health & Safety requirements should be considered.
Filtration	Surface sand filter Sub-surface sand filter Perimeter sand filter		Structures designed to treat surface water run-off through filtration using a sand bed filter medium. The filters can be designed with or without infiltration. Temporary storage of run-off is achieved through ponding above the filter layer. They are used where particularly high pollutant removal is required.	Flexibility of design, efficient in removing pollutants, suitable for retrofits and in tightly constrained urban locations.	Not for high sediment content, detention times can support algae growth, minimum hydraulic head of 1.2m required, possible odour problems, high capital and maintenance cost.	✗ There is no requirement for high pollution reduction at this employment site
	Bioretention/filter swale		Vegetated strips of land designed to accept run-off as overland sheet flow between a hard-surfaced area and a receiving system.	Landscaping features, effective in removing pollutants, flexible layout to fit into landscape, suited for highly impervious areas, good retrofit, capability, effective pre-treatment option.	Requires landscaping and management, large land required, not suitable for steep sites; no significant attenuation or reduction of flows.	✗ No requirement for high pollution reduction; large land areas not available.
	Filter trench/drain		Shallow excavations filled with rubble or stone that create temporary subsurface storage for filtration of storm water run-off. Receive lateral inflow from an adjacent impermeable surface.	Hydraulic benefits achieved with filter trenches, trenches can be incorporated into site landscaping and fit well beside roads and car parks.	High clogging potential without effective pre-treatment, limited to small catchments, high cost of replacing filter material.	✗ Unlikely to suit the site and proposed development

SuDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for Use at Site
Detention	Detention basin		Surface storage basins that provide flow control through attenuation. Normally dry and in certain situations the land may also function as a recreational facility	Cater for a wide range of rainfall events, can be used where groundwater is vulnerable, potential for dual land use, easy to maintain.	Land take, little reduction in run-off volume, detention depths constrained by levels.	✗ There is limited area available for areas of detention basin storage.
	Enhanced dry swale		Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate.	Incorporate into landscaping, good removal of pollutants, reduces run-off rates and volumes, low cost.	Not suitable for steep areas, significant land take, not suitable in areas with roadside parking.	✗ Unlikely to suit site with the proposed levels and topography of the site.
	Enhanced wet swale					
Conveyance	Conveyance swales		Formal linear drainage features in which surface water can be stored or conveyed. They can be incorporated with water features such as ponds or waterfalls where appropriate.	Negate the need for underground pipework. Can provide some attenuation. Possible reduction in run-off volume via plant uptake and infiltration.	Potential trip/wheel hazard, disable access issues.	✗ Could be used where conveyance is required, but the lack of formal outside spaces at the site makes the aesthetic aspects unnecessary.
	Rills					
Source control	Green/brown roof		Multi-layered system that covers the roof of a building with vegetation cover/landscaping over a drainage layer. Designed to intercept and retain precipitation, reducing the volume of run-off and attenuating peak flows.	Mimics greenfield state of building footprint for high density developments, good removal of pollutants, ecological benefits, insulates buildings, sound absorption.	Additional weight, not appropriate for steep roofs, maintenance of roof vegetation.	✗ Unlikely to be suitable due to the pitch of the roofs and because of the additional weight on the structure.

3.1.1 Maintenance of SUDS

The on-site drainage will be managed by the site management company who will be responsible to maintain any on-site services including drainage. To comply with the Flood and Water Management Act 2010 any off-site drainage will be put forward for adoption.

Table 4: Management and Maintenance Strategy

Drainage Feature	Regular Maintenance	Occasional/Remedial Maintenance	Monitoring
Drainage channels/Gullies	• Inspections will include gratings; covers including their locking bolts; sumps and sump buckets; exposed concrete surround and adjacent surfacing. • Check for accumulation of debris and silt and cleaned as necessary • Gratings, frames and all associated locking parts to be checked for damage. • Exposed concrete and adjacent surfacing to be checked for cracking and general damage. • Check condition of inlet and outlet pipes, flow controls, baffles and isolation structures	• Channel/Slot cleaning will be by flushing with water or high pressure jetting (no boiling water or cleaning agent will be used). All silt buckets and sumps will be cleaned out replaced back into the units ensuring they are correctly fitted. • All channel surfaces and joints will be checked and repaired as necessary. • Repair/rehabilitation of inlets, outlet, as required.	• Inspect every 4 months or after large storm.
Manholes/Inspection Chambers	• Check for accumulation of debris and silt and clean as necessary. • Covers and frames to be checked for damage. • Exposed concrete and adjacent surfacing to be checked for cracking and general damage. • Check condition of inlet and outlet pipes, flap valves, baffles etc.	• Clean as necessary. • All manhole and inspection chamber covers and frames to be replaced as necessary. • Repair exposed concrete and surfacing as necessary • Repair/rehabilitation of inlets, outlet, overflows and vents, as required.	• Inspect every 6 months or after large storm.
Attenuation Tanks	• Check for accumulation of debris and silt and clean as necessary. • Check condition of inlet and outlet pipes and ventilation structures	• Clean as necessary. • Repair/rehabilitation of inlets, outlet and vents, as required.	• Inspect every 6 months or after large storm.
Permeable pavements	• Check for accumulation of debris and silt and clean as necessary. • Check condition of inlet and outlet pipes and flow control structures	• Clean as necessary. • Repair/rehabilitation of inlets, outlet, as required.	• Inspect every 6 months or after large storm.

3.2 Foul Water Strategy

All foul water flow from the proposed development will be collected and conveyed via the on-site foul drainage network prior to discharge into the TWUL foul drainage located along Danson Road via existing connection point, subject to approval from TWUL.

The proposed peak flow rate generated by the site is shown in Table 5 below.

Table 5: Design Foul Flow Rates

	Type	No. of units/rooms	Flow Rate, l/day per house or person	Peak Factor	Design Flow (l/s)
Existing	Residential	4	4000*	6	0.18
Proposed	Care Home	70	350**	3	0.85

** SFA 7, includes peak factor, ** British Water Code of Practice*

The proposed development will generate a total foul water peak flow rate of ~ 0.85 l/s (to be confirmed during the detailed design stage) compared to the existing peak flow rate of ~0.18 l/s and unlikely to have an impact on the public sewer.

The calculated peak foul water discharge rate will be agreed with TWUL during detailed design stage.

4. Conclusion

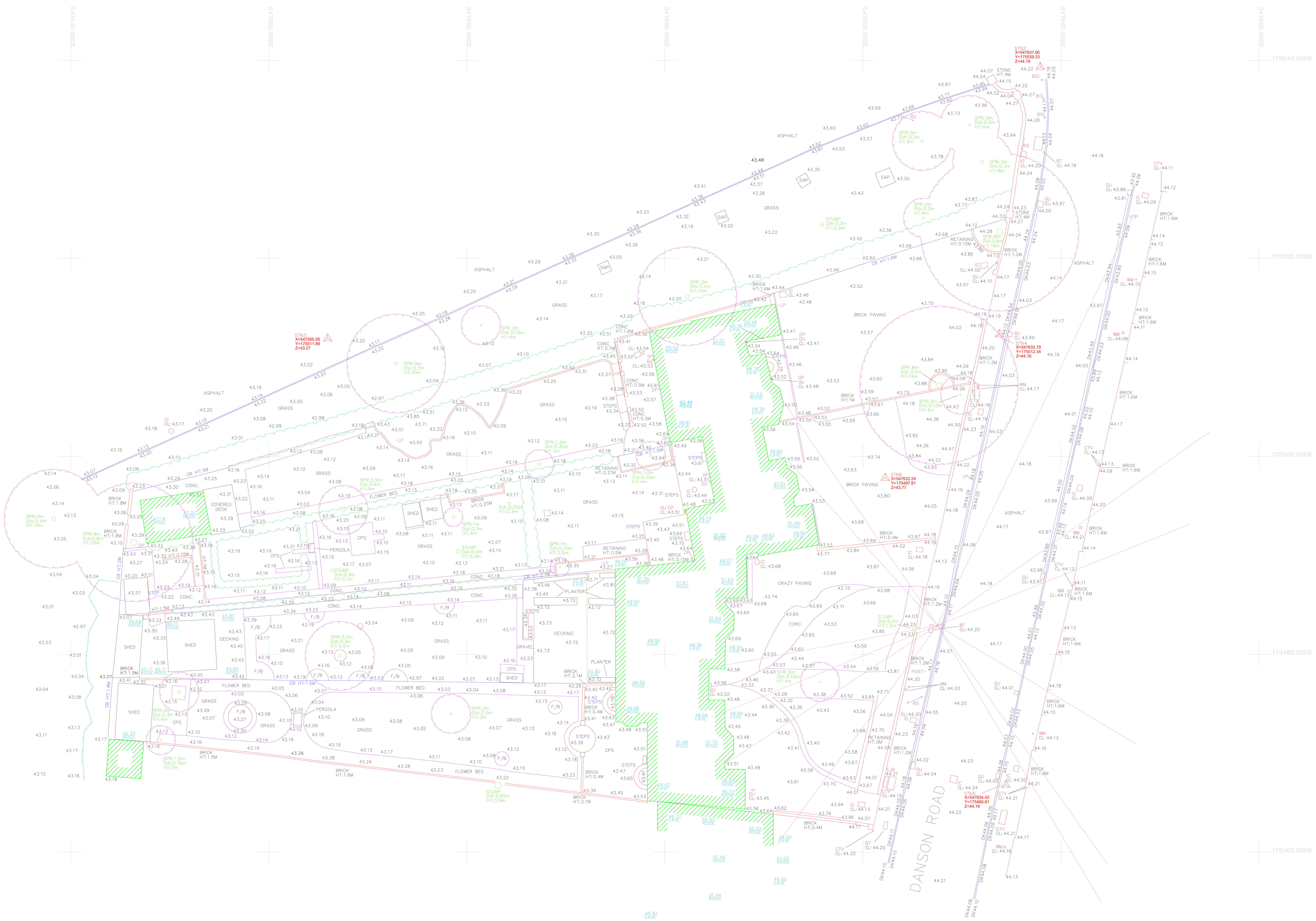
The proposals are to demolish the existing residential buildings and construction of care home facility with associated infrastructure and landscapes.

The proposed drainage strategy is for a separate foul and surface water drainage network, where foul and surface water will discharge to the TWUL foul and surface water sewers respectively using the existing connections from the site, where suitable.

Surface water runoff will be collected and conveyed via a combination of pipes, attenuation tank and permeable pavements to discharge into the TWUL surface water sewer at 60% reduced rate of existing flow. Water butt to be used to store rainwater for later use for irrigation.

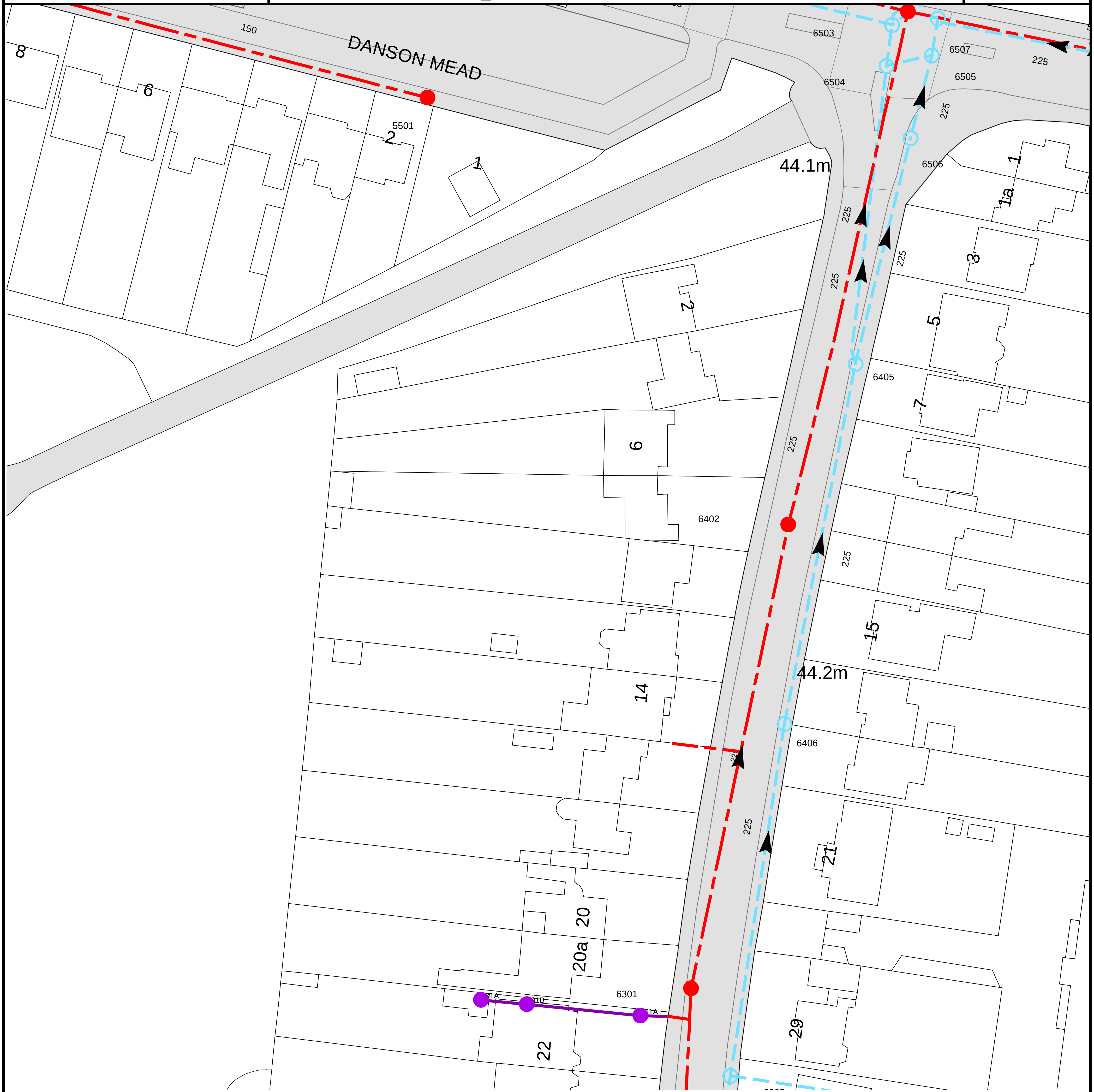
The surface water drainage would provide a protection against surface water flooding for a rainfall event up to 1 in 100 year including climate change factor and the SuDS and landscape would help enhance the natural landscape providing aesthetic and biodiversity benefits.

Appendix A Topographical Survey Plan


DANSON ROAD
ASPHALT
BRICK PAVING
CRAZY PAVING
GRASS
175540.000N
175520.000N
175500.000N
175480.000N
175460.000N

Appendix B TWUL Asset Plan

Asset Location Search Sewer Map - ALS/ALS Standard/2019_4063440



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 547585,175464

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.

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
5501	43.33	42.24
6406	44.2	43.36
6402	n/a	n/a
6405	44.07	43.21
6504	44.23	42.81
6503	44.12	41.12
6501	44.11	39
6506	44.27	43.36
6505	44.25	43.35
6507	44.12	43.06
6305	n/a	n/a
631A	n/a	n/a
531B	n/a	n/a
531A	n/a	n/a
6301	44.47	40.95

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
- Gulley
- 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 '0' 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 milimetres. 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 Insight on 0845 070 9148.

Appendix C Proposed Development Plan

Ground Floor

1 : 100

The use of this data by the recipient acts as an agreement of the fo[llowing] statements.
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Scale Bar (m)
0 1 2 4 8

N

Rev.	Description	Drawn	Checked	Date
P10	Additional updates following consultation	HBR	RFR	13/10/2020
P9	Revised Plans Site Boundary Amended	MWI	HBR	30/03/2020
P8	Revised Planning Issue site boundary amended	RFR	RFRE	17/03/2020
P7	Planning Issue	HBR		08/10/2019
P6	Refuse store adjusted	HBR		17/09/2019
P5	Internal layout adjusted in line with meeting comments 15/08/2019	HBR		27/08/2019
P4	Internal layout updated in line with client's comments	HBR		14/08/2019
P3	Plans shifted in response to arboriculture survey	HBR		19/07/2019
P2	Revision 2	HBR		05/07/2019
P1	Revision 1	HBR		05/06/2019

Amendment

Suitability
Issued for information

Project
Danson Road
Carebase

Drawing
GA Ground Floor Plan

Drawing No.

Project ID	Originator	Zone	Level	Type	Role	Number
DAN	–RYD –	00 –	00 –	DR –	A	–3000

Ryder Project No.	Scale at A0	Status	Revision
10020–00	1 : 100	S2	P10

info@ryderarchitecture.com
www.ryderarchitecture.com

Ryder

Appendix D Windes MicroDrainage Results

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 181 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	40.685	0.685	0.0	7.2	7.2	83.3	O K
30 min Summer	40.872	0.872	0.0	7.2	7.2	106.0	O K
60 min Summer	41.021	1.021	0.0	7.2	7.2	124.1	O K
120 min Summer	41.087	1.087	0.0	7.2	7.2	132.1	O K
180 min Summer	41.062	1.062	0.0	7.2	7.2	129.1	O K
240 min Summer	41.015	1.015	0.0	7.2	7.2	123.4	O K
360 min Summer	40.920	0.920	0.0	7.2	7.2	111.9	O K
480 min Summer	40.835	0.835	0.0	7.2	7.2	101.5	O K
600 min Summer	40.759	0.759	0.0	7.2	7.2	92.3	O K
720 min Summer	40.690	0.690	0.0	7.2	7.2	83.9	O K
960 min Summer	40.565	0.565	0.0	7.2	7.2	68.8	O K
1440 min Summer	40.369	0.369	0.0	7.2	7.2	44.9	O K
2160 min Summer	40.190	0.190	0.0	6.8	6.8	23.1	O K
2880 min Summer	40.095	0.095	0.0	6.2	6.2	11.6	O K
4320 min Summer	40.025	0.025	0.0	5.1	5.1	3.0	O K
5760 min Summer	40.001	0.001	0.0	4.1	4.1	0.2	O K
7200 min Summer	40.000	0.000	0.0	3.4	3.4	0.0	O K
8640 min Summer	40.000	0.000	0.0	2.9	2.9	0.0	O K
10080 min Summer	40.000	0.000	0.0	2.6	2.6	0.0	O K
15 min Winter	40.778	0.778	0.0	7.2	7.2	94.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	142.943	0.0	93.8	27
30 min Summer	92.297	0.0	120.9	41
60 min Summer	56.713	0.0	148.7	68
120 min Summer	33.696	0.0	176.8	124
180 min Summer	24.548	0.0	193.3	180
240 min Summer	19.508	0.0	204.5	208
360 min Summer	14.036	0.0	221.1	270
480 min Summer	11.119	0.0	233.2	332
600 min Summer	9.275	0.0	243.5	396
720 min Summer	7.995	0.0	251.9	460
960 min Summer	6.320	0.0	265.3	588
1440 min Summer	4.532	0.0	285.5	828
2160 min Summer	3.246	0.0	306.5	1172
2880 min Summer	2.559	0.0	322.4	1512
4320 min Summer	1.828	0.0	345.5	2208
5760 min Summer	1.439	0.0	362.7	2936
7200 min Summer	1.195	0.0	376.4	0
8640 min Summer	1.026	0.0	387.9	0
10080 min Summer	0.902	0.0	397.8	0
15 min Winter	142.943	0.0	104.9	28

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	40.995	0.995	0.0	7.2	7.2	120.9	O K
60 min Winter	41.168	1.168	0.0	7.2	7.2	142.0	O K
120 min Winter	41.936	1.936	0.0	7.9	7.9	152.7	O K
180 min Winter	41.246	1.246	0.0	7.2	7.2	151.5	O K
240 min Winter	41.196	1.196	0.0	7.2	7.2	145.4	O K
360 min Winter	41.082	1.082	0.0	7.2	7.2	131.6	O K
480 min Winter	40.976	0.976	0.0	7.2	7.2	118.7	O K
600 min Winter	40.856	0.856	0.0	7.2	7.2	104.1	O K
720 min Winter	40.744	0.744	0.0	7.2	7.2	90.4	O K
960 min Winter	40.552	0.552	0.0	7.2	7.2	67.1	O K
1440 min Winter	40.281	0.281	0.0	7.1	7.1	34.2	O K
2160 min Winter	40.090	0.090	0.0	6.2	6.2	11.0	O K
2880 min Winter	40.028	0.028	0.0	5.2	5.2	3.4	O K
4320 min Winter	40.000	0.000	0.0	3.8	3.8	0.0	O K
5760 min Winter	40.000	0.000	0.0	3.0	3.0	0.0	O K
7200 min Winter	40.000	0.000	0.0	2.5	2.5	0.0	O K
8640 min Winter	40.000	0.000	0.0	2.1	2.1	0.0	O K
10080 min Winter	40.000	0.000	0.0	1.9	1.9	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	92.297	0.0	135.7	41
60 min Winter	56.713	0.0	166.6	68
120 min Winter	33.696	0.0	198.1	122
180 min Winter	24.548	0.0	216.4	178
240 min Winter	19.508	0.0	229.6	230
360 min Winter	14.036	0.0	247.7	288
480 min Winter	11.119	0.0	261.3	366
600 min Winter	9.275	0.0	272.5	436
720 min Winter	7.995	0.0	281.9	500
960 min Winter	6.320	0.0	297.3	628
1440 min Winter	4.532	0.0	319.6	858
2160 min Winter	3.246	0.0	343.5	1180
2880 min Winter	2.559	0.0	361.1	1496
4320 min Winter	1.828	0.0	387.0	0
5760 min Winter	1.439	0.0	406.2	0
7200 min Winter	1.195	0.0	421.6	0
8640 min Winter	1.026	0.0	434.5	0
10080 min Winter	0.902	0.0	445.5	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.441	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.350

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	5	0.117	5	10	0.117	10	15	0.117

Model Details

Storage is Online Cover Level (m) 42.250

Cellular Storage Structure

Invert Level (m) 40.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	128.0	0.0	1.251	0.0	0.0
1.250	128.0	0.0			

Hydro-Brake® Optimum Outflow Control

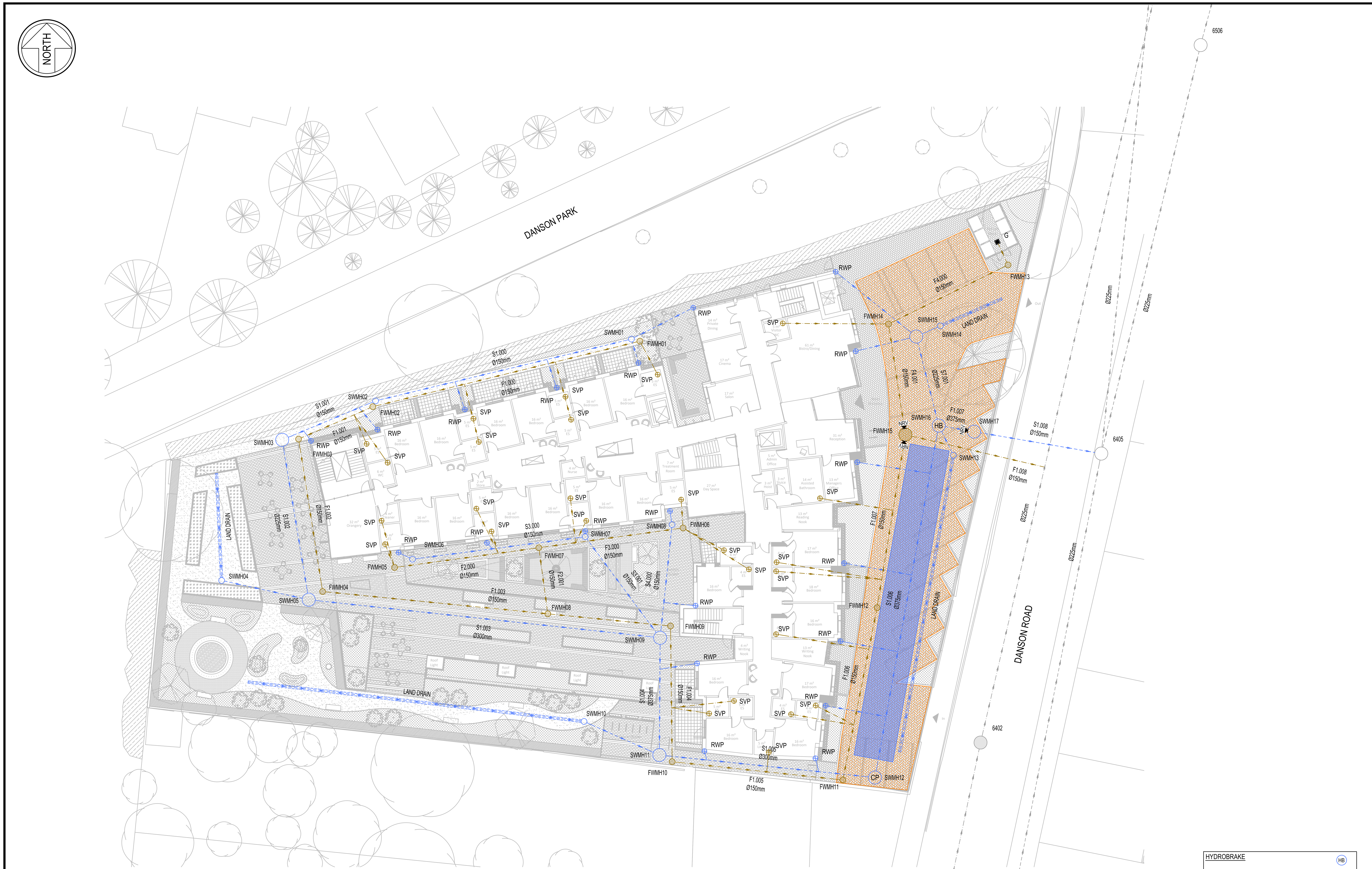
Unit Reference	MD-SHE-0115-7800-2000-7800
Design Head (m)	2.000
Design Flow (l/s)	7.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	115
Invert Level (m)	39.900
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	2.000	7.8
Flush-Flo™	0.507	7.2
Kick-Flo®	1.032	5.7
Mean Flow over Head Range	-	6.5

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	4.0	1.200	6.1	3.000	9.4	7.000	14.1
0.200	6.3	1.400	6.6	3.500	10.2	7.500	14.6
0.300	6.9	1.600	7.0	4.000	10.8	8.000	15.1
0.400	7.1	1.800	7.4	4.500	11.4	8.500	15.5
0.500	7.2	2.000	7.8	5.000	12.0	9.000	15.9
0.600	7.2	2.200	8.2	5.500	12.6	9.500	16.3
0.800	6.8	2.400	8.5	6.000	13.1		
1.000	6.0	2.600	8.8	6.500	13.6		

Appendix E Proposed Drainage Strategy Plan



LEGEND

- PROPOSED SW PIPE
- PROPOSED LAND DRAINAGE PIPE
- PROPOSED SW MANHOLE
- PROPOSED SW MANHOLE - CATCHPIT
- PROPOSED SW MANHOLE - HYDROBRAKE
- PROPOSED RWP WITH RAIN HARVESTING SYSTEM
- PROPOSED GEO-CELLULAR ATTENUATION TANK
- PROPOSED POROUS PAVING
- PROPOSED GULLY
- PROPOSED FW PIPE - GRAVITY
- PROPOSED FW MANHOLE - CIRCULAR
- PROPOSED SVP
- PROPOSED NON RETURN VALVE TO INCOMING PIPE

NOTES:

1. SITE PLAN BY: RYDER, DWG. No. DAN-RYD-00-00-DR-A-3000, REV. P10 DATED 13.10.20
2. TOPOGRAPHICAL SURVEY BY: UNKNOWN, CAD FILE TOPO SURVEY.DWG
3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION AND ALL OTHER RELEVANT DRAWINGS ISSUED BY THE ENGINEER AND ARCHITECT.
4. ALL LEVELS AND DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
5. PUBLIC SEWERS ARE SHOWN INDICATIVELY, LOCATIONS TO BE CONFIRMED.
6. RWP AND SVP LOCATIONS ARE SHOWN INDICATIVELY, LOCATIONS TO BE CONFIRMED BY ARCHITECT.
7. ATTENUATION VOLUME AND LOCATION TO BE CONFIRMED DURING DETAILED DESIGN STAGE.

FIG. 1: PROPOSED RAINWATER HARVESTING SYSTEM AT RWP LOCATION FOR IRRIGATION

HYDROBRAKE

- SUPPLIER	HYDRO INT OR SIMILAR APPROVED
- SPECIFICATION	*SUPPLIER DETAILS*
- DESIGN FLOW	7.80l/s
- DESIGN HEAD	2.00m

POROUS PAVING

- CONTRIBUTING AREA	700m^2
- POROUS PAVEMENT SUBBASE AREA	500m^2
- SUBBASE STORAGE DEPTH	250mm
- SUB-BASE STORAGE POROSITY	30%
- SUB-BASE STORAGE VOLUME	37.5m^3

- OUTFALL RESTRICTED BY Ø100 PIPE

ATTENUATION TANK FOR 100YR+40%CC

- SUPPLIER	**TO CONTRACTOR'S CHOICE**
- AREA DRAINED	3,500m^2
- SIZE	32 x 4 x 1m (128m^3)
- WATER VOLUME	121m^3 (95% POROSITY TBC BY MANUFACTURER)

** SUBJECT TO SUPPLIER DETAILS.

Rev.	Tech	Date	Description
I1	RS	18.08.21	ISSUED FOR INFORMATION

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Client
CAREBASE LTD.

Project Title
DANSON ROAD

Drawing Title
BELOW GROUND DRAINAGE STRATEGY

Purpose of Issue
Information ● Preliminary ○ Approval ○ Tender ○ Construction ○ Record Copy ○

First Issue Date	Drawn By	Scale	Checked
AUG'21	RS	1:200 @ A1	MR

Drawing Number	Rev.
10304363D_300	I1

Appendix F SuDS Pro-forma

LONDON BOROUGH OF BEXLEY
Trusted by Bexley residents

GREATERLONDONAUTHORITY

LoDEG

The London Sustainable Drainage Proforma

Introduction

This proforma is intended to accompany a drainage strategy prepared for a planning application where required by national or local planning policy. It should be used to summarise the key outputs from the strategy to allow assessing officers at the Lead Local Flood Authority (LLFA) to quickly assess compliance with sustainable drainage (SuDS) planning

The proforma is divided into 4 sections, which are intended to be used as follows:

1. Site and project information - Provide summary details of the development, site and drainage
2. Proposed discharge arrangement – Summarise site ground conditions to determine potential for infiltration. Select a surface water discharge method (or mix of methods) following the hierarchical approach set out in the London Plan.
3. Drainage strategy – Prioritise SuDS measures that manage runoff as close to source as possible and contribute to the four main pillars of SuDS; amenity, biodiversity, water quality and water quantity.
4. Supporting information – Provide cross references to the page or section of the drainage strategy report where the detailed information to support each element can be found. This may be more than one reference for each

Policy

SuDS:

1. London Borough of Bexley Local Plan policy CS08.
2. London Plan policy 5.13 and draft New London Plan policy SI13
3. The National Planning Policy Framework (NPPF)

Technical Guidance

- Post-development surface water discharge rate should be limited to greenfield runoff rates. Proposals for higher discharge rates should be agreed with the LLFA ahead of submission of the Planning Application. Clear evidence should be provided with the Planning Application to show why greenfield rates cannot be achieved.
- Greenfield runoff rate is the runoff rate from a site in its natural state, prior to any development. This should be calculated using one of the runoff estimation methods set out in Table 24.1 of CIRIA C753 The SuDS Manual.
- Attenuation storage volumes required to reduce post-development discharge rates to greenfield rates should be calculated using one of the runoff estimation methods set out in Table 24.1 of CIRIA C753 The SuDS Manual.
- ‘CC’ refers to climate change allowance from the current Environment Agency guidance.
- An operation and maintenance strategy for proposed SuDS measures should be submitted with the Planning Application and include the details set out in section 32.2 of CIRIA C753 The SuDS Manual. The manual should be site-specific and not directly reproduce parts of The SuDS Manual.
- Other useful sources of guidance are:
  - The London Borough of Bexley's Sustainable Design and Construction SPG
  - The London Plan Sustainable Design and Construction SPG
  - DEFRA non-statutory technical standards for sustainable drainage
  - Environment Agency climate change guidance
  - CIRIA C753 The SuDS Manual
  - London Borough of Bexley SuDS Design & Evaluation Guide

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1. Project & Site Details

Project / Site Name (including sub-catchment / stage / phase where appropriate)	Care home off the Danson ROad
Address & post code	2 - 8 Danson Road, BEXLEY
OS Grid ref. (Easting, Northing)	E 547590 N 175490
LPA reference (if applicable)	
Brief description of proposed work	the construction of care home facility
Total site Area	3,530 m^2
Total existing impervious area	1435 m^2
Total proposed impervious area	2618 m^2
Is the site in a surface water flood risk catchment (ref. local Surface Water Management Plan)?	No
Existing drainage connection type and location	to public sewer at Danson Road
Designer Name	Ruben Sanmartin
Designer Position	Civil Engineer
Designer Company	HDR Bradbrook Consulting

2. Proposed Discharge Arrangements

2a. Infiltration Feasibility

Superficial geology classification	Clay, Silty, Peaty, Sandy
Bedrock geology classification	London Clay Formation
Site infiltration rate	- m/s
Depth to groundwater level	> 9 m below ground level
Is infiltration feasible?	No

2b. Drainage Hierarchy

	Feasible (Y/N)	*Proposed (Y/N)*
1 store rainwater for later use	Y	Y
2 use infiltration techniques, such as porous surfaces in non-clay areas	N	Y
3 attenuate rainwater in ponds or open water features for gradual release	N	N
4 attenuate rainwater by storing in tanks or sealed water features for gradual release	Y	Y
5 discharge rainwater direct to a watercourse	N	N
6 discharge rainwater to a surface water sewer/drain	Y	Y
7 discharge rainwater to the combined sewer.	Y	N

2c. Proposed Discharge Details

Proposed discharge location	TWUL Surfae water sewer
Has the owner/regulator of the discharge location been consulted?	Yes

LONDON BOROUGH OF BEXLEY

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3. Drainage Strategy

3a. Discharge Rates & Required Storage				
	Greenfield (GF) runoff rate (l/s)	*Existing discharge rate (l/s)*	*Required storage for GF rate (m^3)*	*Proposed discharge rate (l/s)*
Qbar	0.05			
1 in 1	0.04	11.8	155	7.8
1 in 30	0.11	19.4	155	7.8
1 in 100	0.16	34.4	155	7.8
1 in 100 + CC			155	7.8
Climate change allowance used		40%		
3b. Principal Method of Flow Control		Hydrobrake		

3c. Proposed SuDS Measures	*Catchment area (m^2)*	*Plan area (m^2)*	*Storage vol. (m^3)*
Rainwater harvesting	TBC		0
Infiltration systems	0		0
Green roofs	0	0	0
Blue roofs	0	0	0
Filter strips	0	0	0
Filter drains	0	0	0
Bioretention / tree pits	0	0	0
Pervious pavements	700	0	0
Swales	0	0	0
Basins/ponds	0	0	0
Attenuation tanks	2830		0
Total	**3530**	**0**	**0**

4. Supporting Information

4a. Discharge & Drainage Strategy	*Page/section of drainage report*
Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results	Secction 2.2, page 5
Drainage hierarchy (2b)	Secction 3.1, page 6
Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location	Section 3 and appendix B &E
Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations	Section 3.1, and appendix D
Proposed SuDS measures & specifications (3b)	Section 3.1, and appendix E

4b. Other Supporting Details	*Page/section of drainage report*
Detailed Development Layout	Appendix C
Detailed drainage design drawings, including exceedance flow routes	Appendix E
Detailed landscaping plans	
Maintenance strategy	Section 3.1.1, Page 11
Demonstration of how the proposed SuDS measures improve:	
a) water quality of the runoff?	Landscape & porous paving
b) biodiversity?	landscpae
c) amenity?	landscape