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21 February 2024
MES/2402/JCB002

FAO: Haya AlRawaf

Ref: 42 Teddington High Street, TW11 8EW –
Flood Risk Assessment and Sustainable Drainage Strategy

Dear Ms AlRawaf

Further to your recent instruction, please find enclosed the Flood Risk Assessment (FRA) and Sustainable Drainage Strategy (SuDS) in regard to the proposed development (including basement construction works) at 42 Teddington High Street, London, TW11 8EW (the site, Figure 1).

The purpose of this assessment is to demonstrate that the proposals would not result in an increased risk of flooding at the property location or surrounding area, including for the effects of climate change, and that the surface water management measures to be adopted will provide betterment compared to the existing run-off drained from site.

The information contained within this assessment has been produced specifically to meet the requirements set out by the LBRUT (Good Practice Guide on Basement Developments, 2015; Basement Assessment User Guide, 2021; Local Plan LP21) and the London Plan 2021. The principal author is Chris Emm BEng MEng, a hydrologist and civil engineer with more than 20 years' relevant experience.

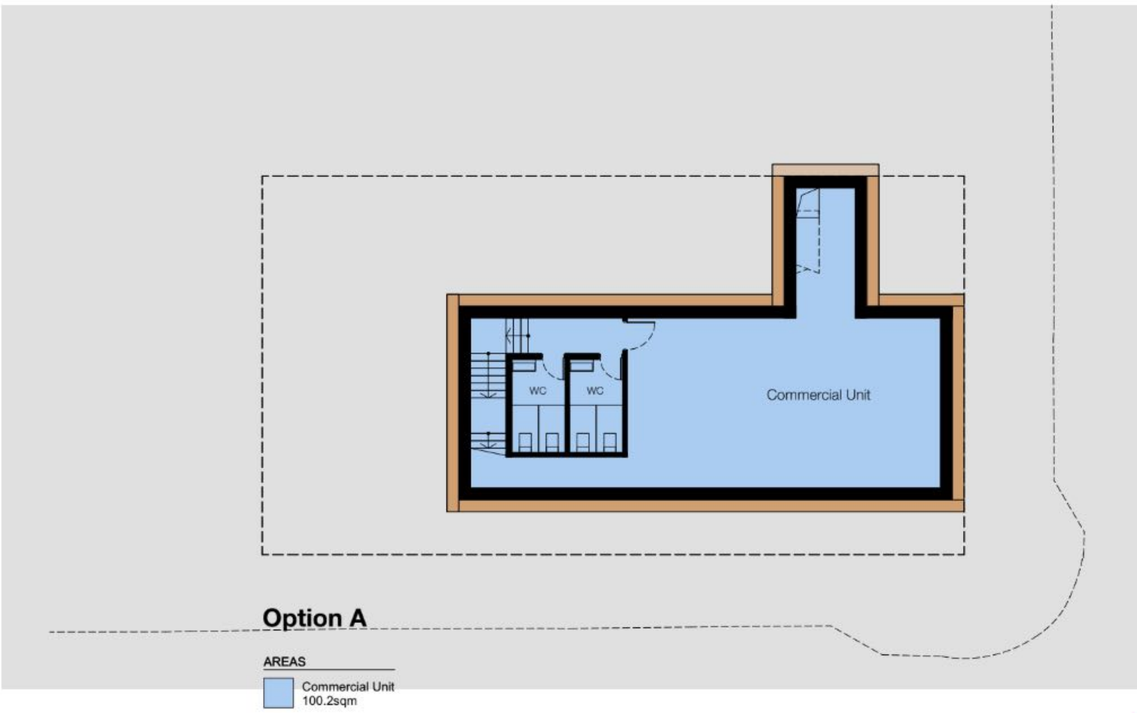
Existing and Proposed Development

The site location plan is provided in Figure 1 and proposed development plan in Figure 2.

The existing and proposed development works are described in detail within the Basement Impact Assessment (BIA) Addendum (ref MES/2402/JCB001).

Figure 1: Site Location (Red Line Boundary)

Basement



Ground Floor

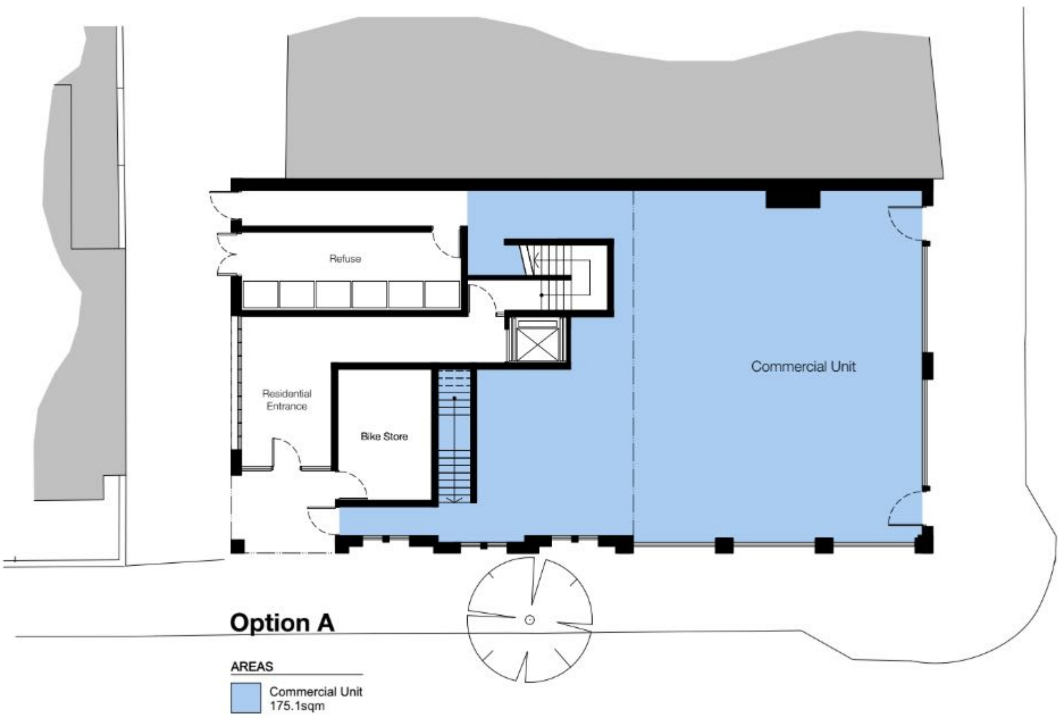


Figure 2: Basement and ground floor plan of proposed development

Sources of Flooding

Fluvial (Rivers and Seas)

The Environment Agency's Flood Map for Planning (Figure 3) shows the site to be in flood zone 1. This is defined as '*land having a less than 1 in 1,000 annual probability of river or sea flooding*' and the property can therefore be considered to have a low probability of fluvial flooding.

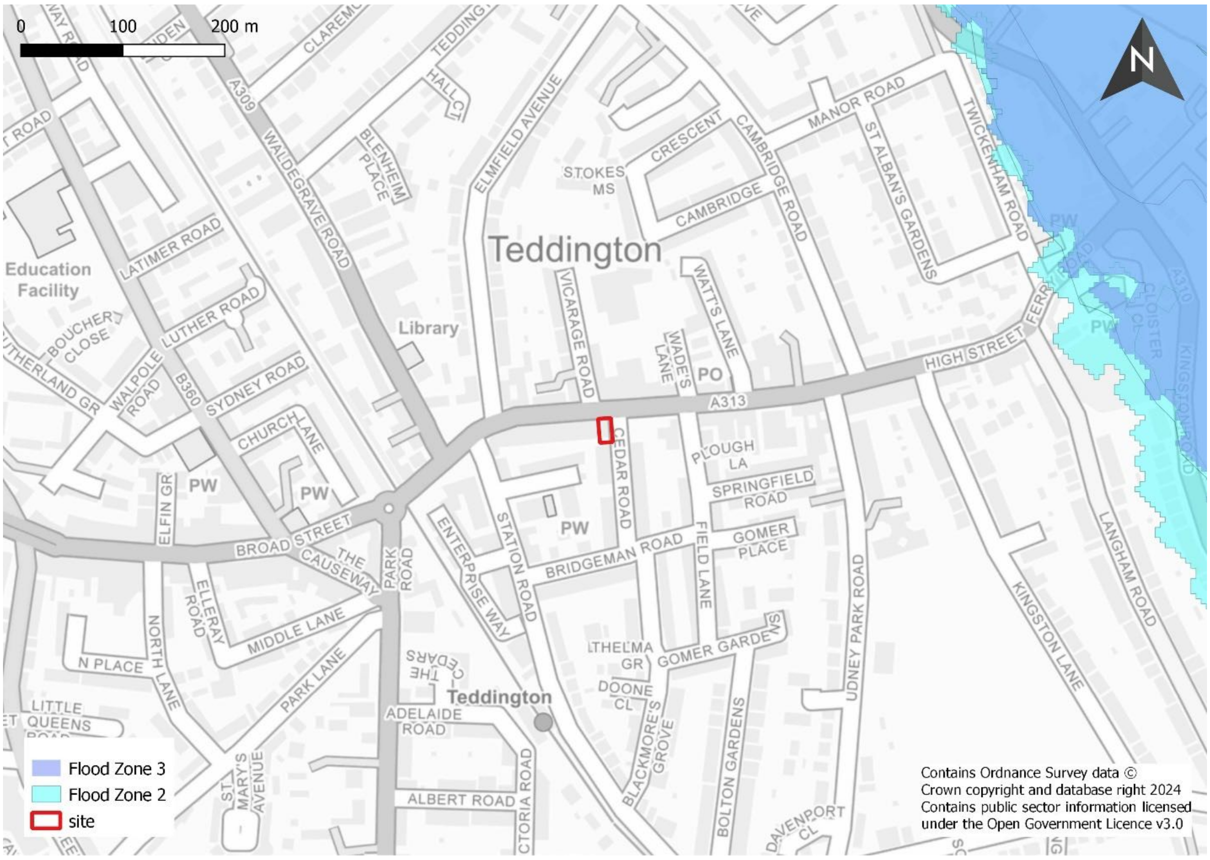


Figure 3: Flood Zone Extents[1]

Pluvial (Surface Water)

The Long-Term Flood Risk Map for Surface Water (Figure 4) does not show the subject property to be at direct risk of flooding from surface water. It can therefore be considered to be at very low risk of surface water flooding, meaning that each year the property has a chance of flooding of less than 0.1% (1 in 1,000).

[1] Flood Zone Extents from EA Flood Map for Planning Dataset, https://environment.data.gov.uk/

However, the eastern and southern edges of the site are shaded in light blue signifying a low risk of surface water flooding, meaning that each year the land at the property has a chance of flooding of between 0.1% (1 in 1,000) and 1% (1 in 100).

There is an area to the east of the site within Cedar Road with a medium risk of flooding from surface water, whilst the High Street to the north has a medium to high risk of flooding from surface water.

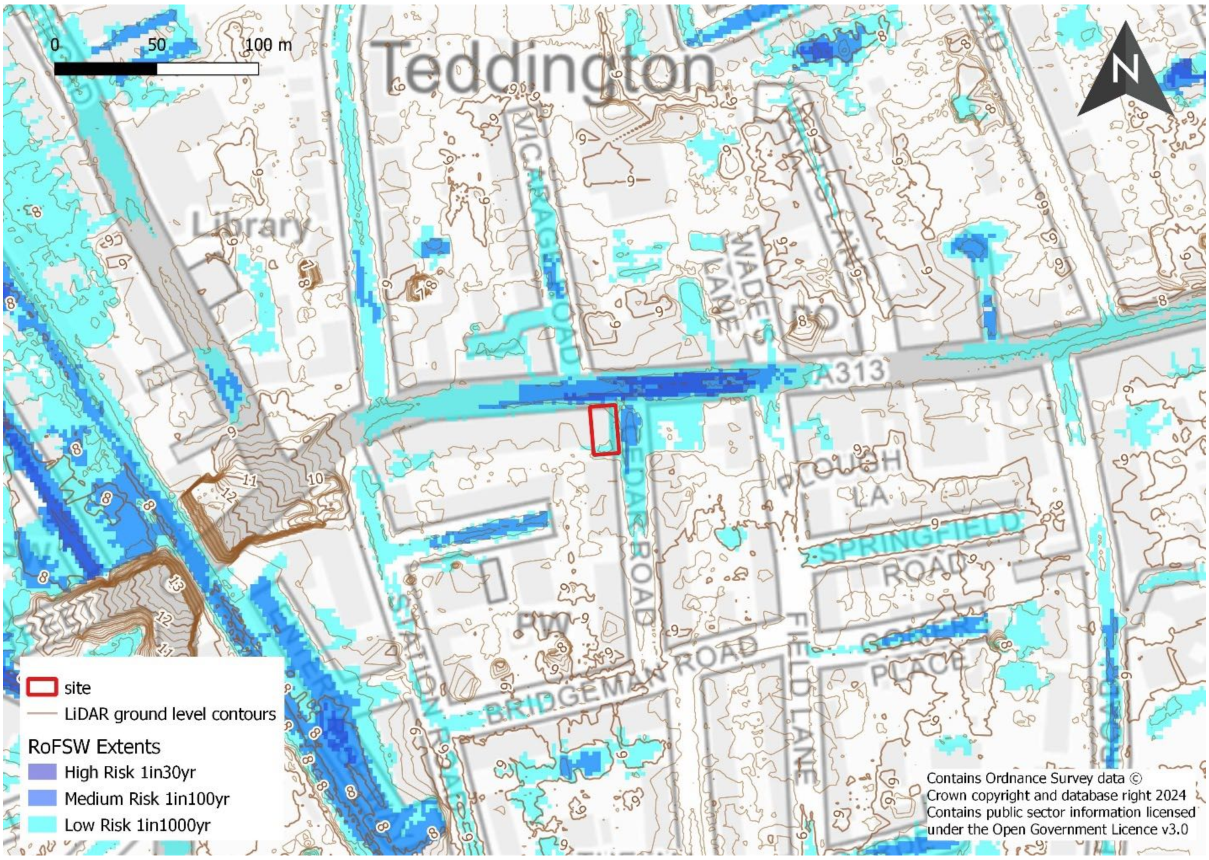


Figure 4: Risk of Flooding from Surface Water (RoFSW) Extents[2]

The RoFSW dataset is not intended to be used at property level, but it can be seen from Figure 5 that the low-risk flood extent would reach to the exposed perimeter of the property.

From inspection of topographic survey spot levels on Figure 5, it appears that the low-risk extent may equate to a ground level / flood horizon of 8.35m OD. The property threshold level is 8.47m OD equating to a nominal freeboard of 0.12m.

[2] RoFSW Extents from EA RoFSW Dataset, https://environment.data.gov.uk/

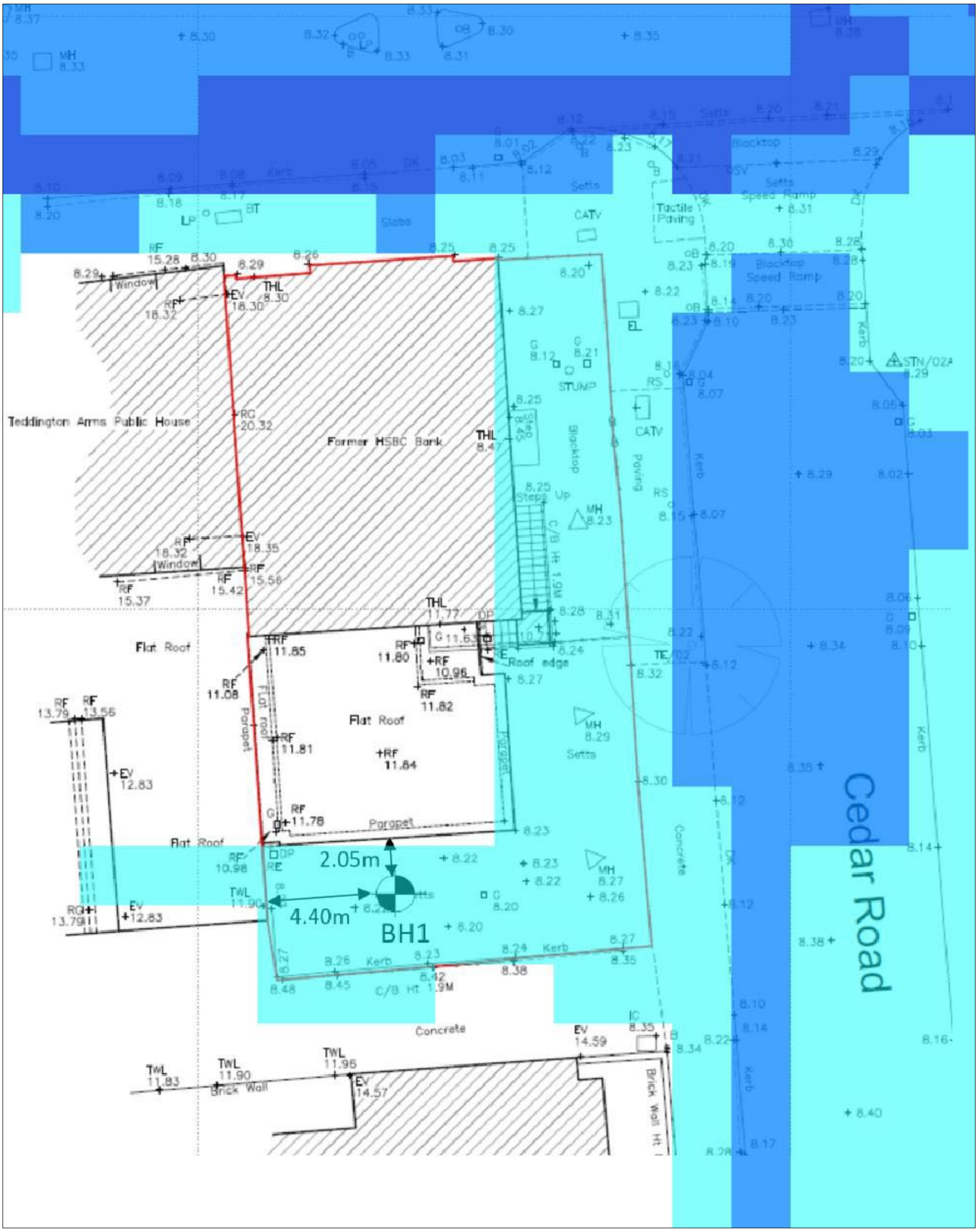


Figure 5: RoFSW Extents Compared to Topographical Survey of the Site

In the absence of more detailed modelling, the low risk (1 in 1,000 year) flood extent shown on Figure 5 can be used as a proxy for the future day medium risk (1 in 100 year plus climate change) flood extent. To allow for uncertainty in this method of determining the risk of floodwater entry to the property, a precautionary approach should be followed. Therefore, it is recommended that flood resilience measures are considered for the proposed property in line with best practice[3].

The RoFSW dataset also provides hazard rating (HR) values that are derived from parameters including the depth and velocity of water for a flood event. Figures 6, 7 and 8 present the hazard ratings graphically for the high risk (1 in 30 year), medium risk (1 in 100 year) and low risk (1 in 1,000 year) scenarios respectively.

The hazard rating increases with the reducing probability of occurrence of a flood event. In accordance with EA/DEFRA guidance[4], the green shading for a HR < 0.75 signifies '*Very low hazard – Caution*'. Yellow shading for a HR < 1.25 signifies '*Danger for some – includes children, the elderly and the infirm*'. Orange shading for a HR < 2.0 signifies '*Danger for most – includes the general public*'.

It should be noted that the RoFSW dataset has limitations due to assumptions made in the modelling process and specifically in urban areas, existing drainage capacity is the biggest uncertainty as it is generally considered via a nominal reduction in rainfall intensity. It is therefore possible that the drainage system present in the area may have sufficient capacity to mitigate the flooding suggested by the RoFSW dataset. However, all drainage systems are susceptible to failure either through localised blockage or long-term deterioration. Whilst good maintenance regimes can reduce the risk of drainage system failure, there is still a residual risk which is represented by the RoFSW dataset.

[3] https://nationalfloodforum.org.uk/about-flooding/reducing-your-risk/protecting-your-property/

[4] https://assets.publishing.service.gov.uk/media/602d04a98fa8f5037d371a08/FLOOD_HAZARD_RATINGS_AND_THRESHOLDS_explanatory_note.pdf

Figure 6: RoFSW Hazard Rating – High Risk (1 in 30 year)

Figure 7: RoFSW Hazard Rating – Medium Risk (1 in 100 year)

Figure 8: RoFSW Hazard Rating – Low Risk (1 in 1,000 year)

<u>Reservoir</u>

The Risk of Flooding from Reservoir failure (Figure 9) shows that the subject property is situated within the 'wet day' extent of flooding that could occur in the event of breach failure of a reservoir. This is considered to be the largest area that might be flooded if a reservoir were to fail and release the water it holds. Since this is a prediction of a credible worst-case scenario, it's unlikely that any actual flood would be this large.

The "dry-day" scenario predicts the flooding that would occur if the reservoir failed when rivers are at normal levels. The "wet day" scenario predicts how much worse the flooding might be if a river is already experiencing an extreme natural flood.

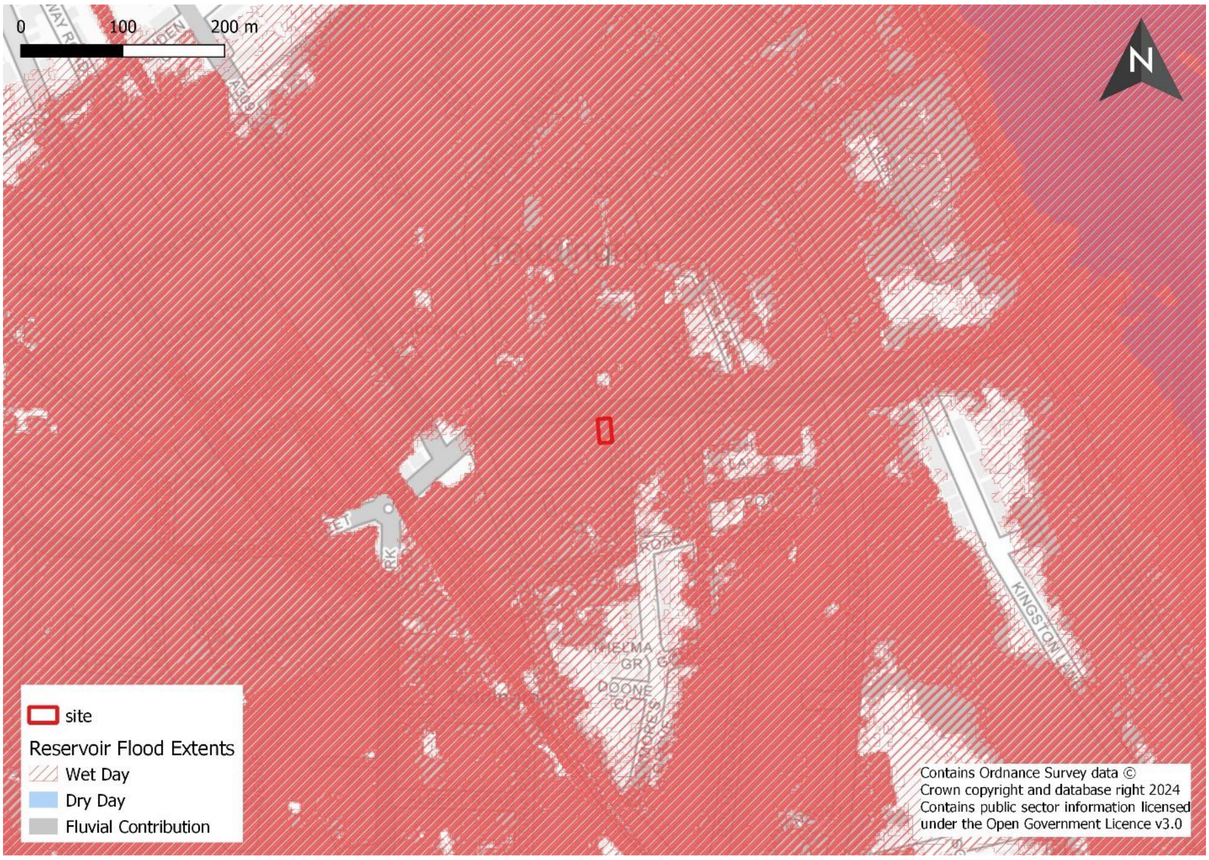


Figure 9: Reservoir Flood Extents[5]

Groundwater

A desk top study has been undertaken to review online data sets.

British Geological Survey (BGS) maps record Kempton Park Gravel Member underlying the site which are typically sand and gravel superficial deposits that are designated as a '*principal aquifer*' deemed to comprise '*layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifers*'. The superficial deposits have a groundwater vulnerability[6] of '*Medium to Low*'. The underlying bedrock geology is the London Clay Formation comprising Clay and Silt. The bedrock is designated[7] as '*unproductive*'.

[5] Risk of Flooding from Reservoir (RoFR) Extents from EA RoFR Dataset, https://environment.data.gov.uk/

[6] https://data.gov.uk/dataset/42d7d021-538c-46e2-abbb-644e01c63551/groundwater-vulnerability-maps-2017-on-magic

[7] https://data.gov.uk/dataset/616469ae-3ff2-41f4-901f-6686feb1d5b6/aquifer-designation-dataset-for-england-and-wales

The ground conditions beneath the site are confirmed by the site investigation reported within the BIA. The groundwater level within the Kempton Park Gravel Member at the site is indicated to be at 5.00m OD, based on monitoring data in 2018 and December 2023.

The property is not located within a groundwater source protection zone.

Soilscape[8] mapping shows the property to be in an area with '*freely draining slightly acid loamy soils*' that are '*freely draining*' to '*local groundwater and rivers*'.

Due to the low permeability and unproductive nature of the underlying bedrock geology, it is considered that the risk of groundwater egress would be low, occurring only where low spots in the terrain coincide with areas where infiltrated surface water run-off could accumulate and exceed the superficial aquifer capacity.

The LBRUT online interactive Strategic Flood Risk Assessment (SFRA) map[9] for Groundwater Flood Risk indicates the property to be within a 1km square grid where geological and hydrogeological conditions show that groundwater might emerge for > 50% <75% of the 1km square area. This is based on the EA's Areas Susceptible to Groundwater Flooding (AStGWF) strategic scale dataset and it does not indicate the likelihood of groundwater flooding occurring. The data should not be interpreted as identifying areas where groundwater is actually likely to flow or pond, thus causing flooding.

The online map shows the property to be within an area where there is an 'Increased Potential for Elevated Groundwater' relating to 'Permeable Superficial' geology (Figure 10). According to the SFRA, this map identifies areas that have increased potential to experience elevated groundwater levels in response to higher that average recharge from rainfall or from elevated river levels.

The online SFRA map does not show the property to be within a '*Throughflow Catchment Area (Throughflow and Groundwater Policy Zone)*' or within a '*Potential Throughflow Catchment Area*'.

[8] http://www.landis.org.uk/soilscapes/#

[9] https://mapping.richmond.gov.uk/map/Aurora.svc/run?script=%5CAurora%5Cpublic_SFRA_Groundwater_Etc_LBRUT.AuroraScript%24&resize=always

The provision of a new basement to the proposed building at the site will require appropriate waterproofing to allow for existing and anticipated future groundwater levels.

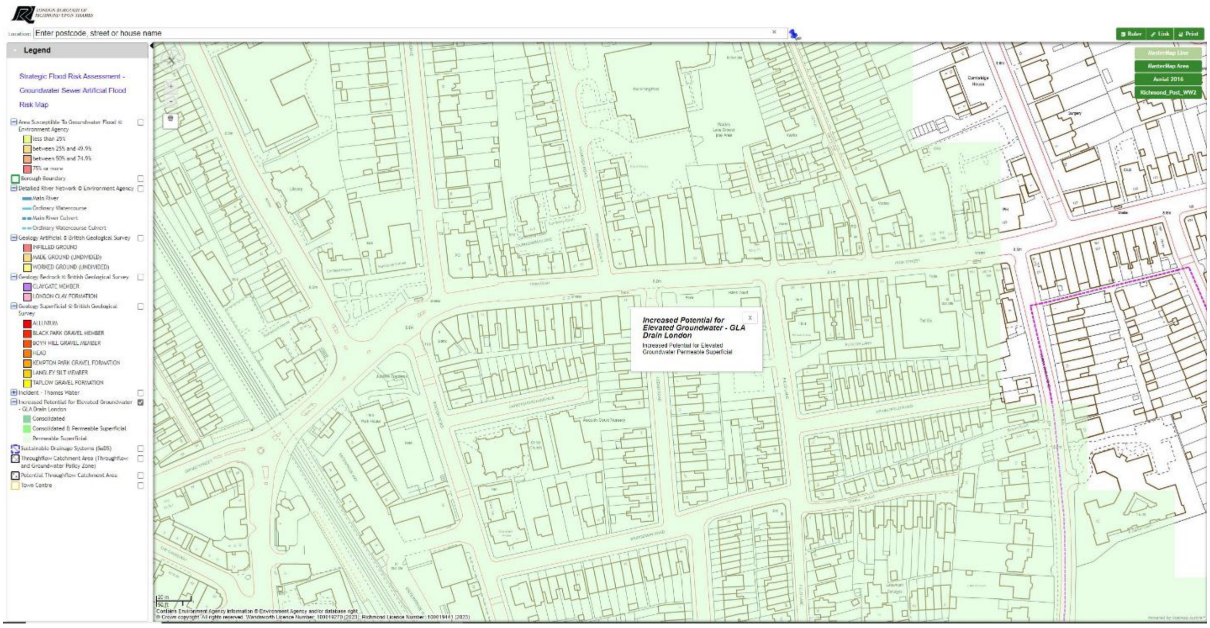


Figure 10: Increased Potential for Elevated Groundwater - GLA Drain London 2011

Sewer

It is expected that there will be a local sewer under the main highway adjacent to the property that will take run-off and effluent from the subject building and neighbouring properties.

According to the SFRA interactive map, the subject property is in an area where the number of indoor incidents attributed to sewer flooding is 3 and the number of outdoor incidents is 1. As advised by the SFRA, this data shows where Thames Water have received reports of sewer flooding. This data was provided in partial postcode format. Therefore, the dataset does not specify where the flooding is occurring at property level.

The records of historical flooding provide a good insight to the ability of the local network to manage foul water and surface water drainage. The low number of incidents suggests that the sewer network does not have significant problems and as such it is deemed that there is a low risk of flooding from sewers.

However, where properties incorporate basement areas, the use of non-return valves to the lower-level drainage systems and/or pumping from basement level to a higher-level gravity system must be included in the detailed development design.

It is also recommended that existing drainage on the site is investigated to confirm that it serves only the property situated on the site, otherwise Thames Water must be contacted to confirm their requirements for transferred sewers.

Risk of Flooding to and from the Development

From a review of the sources of flooding presented in the foregoing, it is considered that there is a low risk of flooding from all sources.

The predicted effects of climate change generally result in exacerbation of current day flooding due to increases in the rate and volume of flood water that can occur and the frequency of flood events. However, it is not considered that the effects of climate change will significantly alter the potential for flooding from the sources discussed other than locally in respect of surface water run-off management.

It follows that mitigation measures other than those inherent to standard building practice are not required, but a drainage strategy should be considered to account for the change in run-off areas that will result from the development proposals.

Drainage Strategy

Chapter 9 of The London Plan 2021 includes Policy SI 13 relating to Sustainable Drainage. It presents 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.*

From a review of the existing and proposed property plans, elevations and sections, it is apparent that there will not be a perceptible change in run-off areas that would otherwise occur if new roof or paved areas were to be created.

However, over the lifetime of the development, the predicted effects of climate change will increase rainfall intensities and the frequency of storm events. It is therefore important that where possible betterment is provided via new development works. Specifically for this property, there may be the potential to provide either a blue or green roof system with the latter a more likely option via the use of an extensive solution such as sedum due to its low weight and minimal maintenance requirements.

The area available for a green or blue roof solution is limited with most of the proposed roof geometry comprising pitches. Therefore, other interception methods such as through the incorporation of rainwater harvesting should be considered given the dual residential and commercial occupancy that is proposed for the building end use.

Near ground soils comprising sand and gravel are present at and in the vicinity of the property, but groundwater levels have been measured at 3.23m below ground level (bgl) in 2018, at 3.17m bgl on 5th December 2023 and at 3.15m bgl on 21st December 2023. Due to the high groundwater level and lack of space to allow soakaways to be sited more than 5m from structures, the disposal of surface water run-off to the ground is not suitable. Whilst there is no increase in building footprint, the predicted effects of climate change are significant and as such the implementation of measures to manage rainfall at source within the property curtilage would be appropriate.

The use of green roofing and rainwater harvesting offers good methods of interception that can manage frequent, everyday rainfall events of low depth. However, rainfall of greater depth or due to prolonged duration events would exceed the storage capacity of these source control methods and another form of attenuation should be employed. The proposed basement footprint does not extend to the site boundary on all sides and so it would be possible to provide a tank facility below ground floor level.

The surface water drainage system must be appraised for the effects of climate change over the lifetime of the development. Current guidance[10] for peak rainfall intensity increase states that the drainage system should be designed for an upper end allowance so that there is no increase in flood risk elsewhere and the development will be safe from surface water flooding.

[10] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#peak-rainfall-intensity-allowance

Planning Practice Guidance[11] for the National Planning Policy Framework assigns a 100 year design life to residential development, which corresponds to development with a lifetime between 2061 and 2125 (2070s epoch). The property is situated in the London Management Catchment where the upper end allowance for the 2070s epoch is 35% and 40% for 1 in 30 year and 1 in 100 year events respectively.

On the basis that the existing drainage is unrestricted, and allowing roof and paved areas of 304m^2, a pre-development discharge rate of approximately 4.2l/s would occur under a rainfall intensity of 50mm/hr. However, not all paved areas may be effectively drained. On the basis of roof areas of 173m^2 only, the pre-development discharge rate would be 2.4l/s.

Section 9.13.12 of The London plan 2021 advises that '*development proposals should aim to get as close to greenfield run-off rates as possible depending on site conditions*'. The LBRUT SFRA advises that Policy LP21 of the Local Plan requires developers and applicants to prioritise SuDS when proposing drainage measures to reduce local flood risk and that '*development on current brownfield sites should also aim to achieve greenfield runoff rates where practical*'. The SFRA also advises that '*If this is not achievable, proposals need to demonstrate a betterment of the current rate. Developers and applicants are therefore required to demonstrate that run-off rates are at least no more than three times the calculated greenfield rate and that the development can achieve at least a 50% attenuation of the site's surface water runoff at peak times*'.

Drainage calculations are appended. A greenfield run-off rate of qbar = 1.52l/s/ha has been determined, which for the overall site area of approximately 0.030ha is equivalent to 0.046l/s. This is a very low rate that would not be practical to achieve due to the low size of flow control aperture that would be needed which would be inherently susceptible to blockage.

Therefore, the lowest practical flow rate should be used. For instance, if a geo-cellular tank of 0.8m high and 20m^2 plan area is used, a capacity of 15.2m^3 would be available (allowing standard 95% void capacity). Allowing 1l/s discharge rate, controlled by a Hydrobrake Optimum unit (ref SHE-0049-1000-0800-1000), the attenuation volume needed to balance run-off from the site area under 1 in 100 year rainfall intensities that have been increased by

[11] https://www.gov.uk/guidance/flood-risk-and-coastal-change#what-is-lifetime-of-development

40% for the predicted effect of climate change is 14.014m^3. Therefore, the tank would be adequate.

In principle, the above is a viable drainage strategy that demonstrates that a crated tank and Hydrobrake flow control can manage runoff for 1 in 100 year + 40% rainfall and restrict discharge to less than 50% of the pre-development peak rate.

FRA and SuDS Summary

From a review of the sources of flooding that could influence the proposed works on site, it has been determined that there is a low risk of flooding to the development.

It is not considered that the proposals would result in an increased risk of flooding at the property location or surrounding area or that the effects of climate change will significantly change the current day regime.

The surface water management measures to be adopted will provide betterment compared to the existing run-off drained from site, in accordance with LBRUT's policies and guidance.

Yours faithfully,

Graham Kite

Director

Encs:

- BIA, Drainage Calculations

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Chris Emm
Site name:	42 High Street
Site location:	Teddington

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.42705° N
Longitude:	0.3316° W
Reference:	1065760200
Date:	Feb 06 2024 14:59

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 1

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	600	600
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	1.52	1.52
1 in 1 year (l/s):	1.29	1.29
1 in 30 years (l/s):	3.5	3.5
1 in 100 year (l/s):	4.85	4.85
1 in 200 years (l/s):	5.69	5.69

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Tank	0.030	4.00	102.000		-2.324	54.489	2.000
outfall			102.000	1200	11.454	52.296	2.050

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Tank	outfall	5.000	0.600	100.000	99.950	0.050	100.0	100	4.11	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.769	6.0	4.1	1.900	1.950	0.030	0.0	60	0.823

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	5.000	100.0	100	Circular	102.000	100.000	1.900	102.000	99.950	1.950

Link	US Node	Node Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Tank	Junction	outfall	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Tank	-2.324	54.489	102.000	2.000		0	1.000	100.000	100
outfall	11.454	52.296	102.000	2.050	1200	1	1.000	99.950	100

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Detailed	Additional Storage (m³/ha)	0.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	35	0	0
100	40	0	0

Node Tank Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Downstream Link	1.000	Sump Available	✓
Replaces Downstream Link	✓	Product Number	CTL-SHE-0049-1000-0800-1000
Invert Level (m)	100.000	Min Outlet Diameter (m)	0.075
Design Depth (m)	0.800	Min Node Diameter (mm)	1200
Design Flow (l/s)	1.0		

Node Tank Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	100.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	128

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	20.0	0.0	0.800	20.0	0.0	0.801	0.0	0.0

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	101.779	28.800	30 year +35% CC 15 minute winter	281.772	113.618
2 year 15 minute winter	71.424	28.800	30 year +35% CC 30 minute summer	258.337	73.101
2 year 30 minute summer	64.392	18.221	30 year +35% CC 30 minute winter	181.289	73.101
2 year 30 minute winter	45.187	18.221	30 year +35% CC 60 minute summer	170.127	44.959
2 year 60 minute summer	42.042	11.110	30 year +35% CC 60 minute winter	113.028	44.959
2 year 60 minute winter	27.931	11.110	30 year +35% CC 120 minute summer	109.257	28.873
2 year 120 minute summer	31.975	8.450	30 year +35% CC 120 minute winter	72.588	28.873
2 year 120 minute winter	21.244	8.450	30 year +35% CC 180 minute summer	84.513	21.748
2 year 180 minute summer	26.335	6.777	30 year +35% CC 180 minute winter	54.936	21.748
2 year 180 minute winter	17.118	6.777	30 year +35% CC 240 minute summer	66.490	17.571
2 year 240 minute summer	21.465	5.672	30 year +35% CC 240 minute winter	44.174	17.571
2 year 240 minute winter	14.261	5.672	30 year +35% CC 360 minute summer	49.619	12.769
2 year 360 minute summer	16.692	4.295	30 year +35% CC 360 minute winter	32.253	12.769
2 year 360 minute winter	10.850	4.295	30 year +35% CC 480 minute summer	38.171	10.088
2 year 480 minute summer	13.117	3.466	30 year +35% CC 480 minute winter	25.360	10.088
2 year 480 minute winter	8.715	3.466	30 year +35% CC 600 minute summer	30.587	8.366
2 year 600 minute summer	10.661	2.916	30 year +35% CC 600 minute winter	20.899	8.366
2 year 600 minute winter	7.284	2.916	30 year +35% CC 720 minute summer	26.726	7.163
2 year 720 minute summer	9.416	2.524	30 year +35% CC 720 minute winter	17.962	7.163
2 year 720 minute winter	6.328	2.524	30 year +35% CC 960 minute summer	21.202	5.583
2 year 960 minute summer	7.590	1.999	30 year +35% CC 960 minute winter	14.045	5.583
2 year 960 minute winter	5.028	1.999	30 year +35% CC 1440 minute summer	14.619	3.918
2 year 1440 minute summer	5.374	1.440	30 year +35% CC 1440 minute winter	9.825	3.918
2 year 1440 minute winter	3.611	1.440	100 year +40% CC 15 minute summer	537.615	152.126
30 year +35% CC 15 minute summer	401.526	113.618	100 year +40% CC 15 minute winter	377.274	152.126

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 30 minute summer	347.899	98.443
100 year +40% CC 30 minute winter	244.140	98.443
100 year +40% CC 60 minute summer	230.225	60.842
100 year +40% CC 60 minute winter	152.956	60.842
100 year +40% CC 120 minute summer	145.593	38.476
100 year +40% CC 120 minute winter	96.729	38.476
100 year +40% CC 180 minute summer	112.363	28.915
100 year +40% CC 180 minute winter	73.039	28.915
100 year +40% CC 240 minute summer	88.497	23.387
100 year +40% CC 240 minute winter	58.795	23.387
100 year +40% CC 360 minute summer	66.360	17.077
100 year +40% CC 360 minute winter	43.135	17.077
100 year +40% CC 480 minute summer	51.164	13.521
100 year +40% CC 480 minute winter	33.992	13.521
100 year +40% CC 600 minute summer	41.032	11.223
100 year +40% CC 600 minute winter	28.035	11.223
100 year +40% CC 720 minute summer	35.858	9.610
100 year +40% CC 720 minute winter	24.099	9.610
100 year +40% CC 960 minute summer	28.424	7.485
100 year +40% CC 960 minute winter	18.829	7.485
100 year +40% CC 1440 minute summer	19.514	5.230
100 year +40% CC 1440 minute winter	13.114	5.230

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Tank	80	100.092	0.092	1.5	1.7559	0.0000	OK
15 minute summer	outfall	1	99.950	0.000	0.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Discharge Vol (m³)
120 minute winter	Tank	Hydro-Brake®	outfall	0.8	4.3

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Tank	114	100.512	0.512	5.1	9.7286	0.0000	SURCHARGED
15 minute summer	outfall	1	99.950	0.000	0.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Discharge Vol (m³)
120 minute winter	Tank	Hydro-Brake®	outfall	0.9	14.3

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Tank	116	100.738	0.738	6.8	14.0143	0.0000	SURCHARGED
15 minute summer	outfall	1	99.950	0.000	0.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Discharge Vol (m³)
120 minute winter	Tank	Hydro-Brake®	outfall	1.0	18.1