Title:	2180008/2180009 – 6A & 6B Nutley Terrace: Response to LLFA Comments	Date Approved:	16.11.2018
Discipline:	Civils	Author:	Julson Delishaj
Note Ref:	EWR001		

			Issued for information				
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Aim

The purpose of this Technical Note is to address the Lead Local Flood Authority comments on the SuDS design with regards to Planning Application: 2012/2632/P – 6 Nutley Terrace, London NW3 5BX.

LLFA Comment 1

"No information given on the steps of investigation of the Drainage Hierarchy, and reasons for discounting more sustainable options."

Elliott Wood Response to Comment 1

Surface water from the existing site discharges at an unrestricted rate to a 300mmØ combined Thames Water sewer within Nutley Terrace. The proposed SuDS design has been prepared in line with the drainage hierarchy as per the *'London Plan - Policy 5.13 Sustainable drainage'*. Table 1 below list the drainage hierarchy and the suitability of each drainage method to the development.

Table 1. Drainage Hierarchy as per '*London Plan - Policy 5.13 Sustainable drainage'*

Drainage Method	Applicable to the development	Comments
Store rainwater for later use	No	Rainwater harvesting has not been identified as a feasible solution on this development due to spatial constraints.
Use infiltration techniques, such as porous surfaces in non-clay areas	No	The site investigation found that the site is underlain by London Clay. Infiltration will not be practical due to the low permeability characteristics associated with London Clay.
Attenuate rainwater in ponds or open water features for gradual release	No	The spatial and topographical constraints of the site do not allow for above ground surface water storage features.
Attenuate rainwater by storing in tanks or sealed water features for gradual release	**Yes**	**Surface water storage will be provided for both properties using geo-cellular attenuation tanks. The tanks have been sized to ensure that no flooding occurs on either development for up to and including the 1in100yr + 40% CC Event.**

Discharge rainwater direct to a watercourse	No	No watercourses are identified to be in close proximity to the site.
Discharge rainwater to a surface water sewer/drain	No	No surface water sewers exist in close proximity to the site.
Discharge rainwater to the combined sewer.	**Yes**	**Both properties will continue to discharge (at a restricted rate) to the 300mmØ combined Thames Water sewer running within Nutley Terrace.**

LLFA Comment 2

"Specifically, no evidence given for discounting *soakaway in the rear garden i.e. infiltration test results."*

Elliott Wood Response to Comment 2

The site investigation found that the site is underlain by London Clay. Although infiltration testing has not been undertaken, infiltration has been discounted due to the low permeability characteristics associated with London Clay.

LLFA Comment 3

"No supporting calculations for sizing the selected SuDS"

Elliott Wood Response to Comment 3

The surface water storage will be provided for both properties using geo-cellular tanks. The tanks have been sized to ensure that no flooding occurs on either development for up to and including the 1in100yr + 40% CC Event. Please see attached within **Appendix A** and **Appendix B** the supporting MicroDrainage calculations.

LLFA Comment 4

"No SuDS lifetime maintenance plan included"

Elliott Wood Response to Comment 4

The below tables detail the typical maintenance regime and frequency which will be required to ensure efficient operation. It will be emphasised to the property owner that it is vital that a record of inspections and maintenance work that has been carried out is kept so it can be inspected and reviewing by others at a later date.

All SuDS will need to be maintained in accordance with the CIRIA SuDS Manual and associated references, some of the maintenance requirements are summarised below:

Attenuation Storage Tanks:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly

	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/ or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

Gullies / Linear Channels:
Inspection and removal of debris from silt trap every 3 months; preferably after leaf fall in the autumn. (Timeframe can be adjusted to suit actual site conditions)

Drainage pipes, manholes & Silt traps:
Inspect manholes & silt traps for build-up of silt and general debris (minimum of 6 monthly or to suit site requirements). If silt/debris is building up then clean with jetting lorry / gully sucker and inspect pipe – repeat cleaning if required.

NOTE: Manhole covers can be heavy and suitable lifting equipment / procedures should be used. Where possible, personnel should not enter manholes to carry out maintenance.

Example Maintenance Schedule

Attenuation Storage Tanks:

Maintenance	Required action	Typical frequency	Date Inspection Undertaken	Actions
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually		
	Remove debris from the catchment surface (where it may cause risks to	Monthly		
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually		
	Remove sediment from pre-treatment structures and/ or internal forebays	Annually, or as required		
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required		
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually		
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required		

llies / Linear Channels:

Maintenance	Required action	Typical frequency	Date Inspection Undertaken	Actions
Routine maintenance	Inspection and removal of debris from silt trap; preferably after leaf fall in the autumn. (Timeframe can be adjusted to suit actual site conditions)	Three months		
Remedial actions	Replace malfunctioning parts or structures	As required		
Monitoring	Inspect for evidence of poor operation	Six monthly		
	Inspect filter media and establish appropriate replacement frequencies	Six monthly		
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months		
	Inspect inlets, trench surfaces and perforated pipework for silt accumulation. Establish appropriate silt removal frequencies	Half yearly		

Drainage pipes, manholes & Silt traps:

Maintenance	Required action	Typical frequency	Date Inspection Undertaken	Actions
Routine maintenance	Inspect manholes & silt traps for build-up of silt and general debris. If silt/debris is building up then clean with jetting lorry / gully sucker and inspect pipe – repeat cleaning if required.	Three months		
Remedial actions	Replace malfunctioning parts or structures	As required		
Monitoring	Inspect for evidence of poor operation	Six monthly		
	Inspect filter media and establish appropriate replacement frequencies	Six monthly		
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months		
	Inspect inlets, trench surfaces and perforated pipework for silt accumulation. Establish appropriate silt removal frequencies	Half yearly		

Appendix A – 6A Nutley Terrace MicroDrainage Calculations

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

Half Drain Time : 62 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	74.017	1.017	0.0	2.1	2.1	9.7	O K
30 min Summer	74.211	1.211	0.0	2.3	2.3	11.5	O K
60 min Summer	74.253	1.253	0.0	2.3	2.3	11.9	O K
120 min Summer	74.166	1.166	0.0	2.3	2.3	11.1	O K
180 min Summer	74.059	1.059	0.0	2.2	2.2	10.1	O K
240 min Summer	73.953	0.953	0.0	2.1	2.1	9.1	O K
360 min Summer	73.764	0.764	0.0	2.0	2.0	7.3	O K
480 min Summer	73.581	0.581	0.0	2.0	2.0	5.5	O K
600 min Summer	73.380	0.380	0.0	2.0	2.0	3.6	O K
720 min Summer	73.259	0.259	0.0	2.0	2.0	2.5	O K
960 min Summer	73.126	0.126	0.0	2.0	2.0	1.2	O K
1440 min Summer	73.039	0.039	0.0	1.6	1.6	0.4	O K
2160 min Summer	73.013	0.013	0.0	1.2	1.2	0.1	O K
2880 min Summer	73.003	0.003	0.0	0.9	0.9	0.0	O K
4320 min Summer	73.000	0.000	0.0	0.7	0.7	0.0	O K
5760 min Summer	73.000	0.000	0.0	0.5	0.5	0.0	O K
7200 min Summer	73.000	0.000	0.0	0.4	0.4	0.0	O K
8640 min Summer	73.000	0.000	0.0	0.4	0.4	0.0	O K
10080 min Summer	73.000	0.000	0.0	0.3	0.3	0.0	O K
15 min Winter	74.159	1.159	0.0	2.3	2.3	11.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	150.176	0.0	11.8	20
30 min Summer	97.039	0.0	15.3	32
60 min Summer	59.609	0.0	18.8	52
120 min Summer	35.353	0.0	22.3	86
180 min Summer	25.703	0.0	24.3	120
240 min Summer	20.385	0.0	25.7	156
360 min Summer	14.704	0.0	27.8	222
480 min Summer	11.652	0.0	29.4	290
600 min Summer	9.722	0.0	30.6	342
720 min Summer	8.381	0.0	31.7	396
960 min Summer	6.627	0.0	33.4	504
1440 min Summer	4.754	0.0	35.9	736
2160 min Summer	3.405	0.0	38.6	1084
2880 min Summer	2.685	0.0	40.6	1468
4320 min Summer	1.919	0.0	43.5	0
5760 min Summer	1.511	0.0	45.7	0
7200 min Summer	1.254	0.0	47.4	0
8640 min Summer	1.077	0.0	48.9	0
10080 min Summer	0.947	0.0	50.1	0
15 min Winter	150.176	0.0	13.3	20

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	74.394	1.394	0.0	2.5	2.5	13.2	O K
60 min Winter	74.462	1.462	0.0	2.5	2.5	13.9	O K
120 min Winter	74.344	1.344	0.0	2.4	2.4	12.8	O K
180 min Winter	74.187	1.187	0.0	2.3	2.3	11.3	O K
240 min Winter	74.030	1.030	0.0	2.1	2.1	9.8	O K
360 min Winter	73.750	0.750	0.0	2.0	2.0	7.1	O K
480 min Winter	73.417	0.417	0.0	2.0	2.0	4.0	O K
600 min Winter	73.215	0.215	0.0	2.0	2.0	2.0	O K
720 min Winter	73.115	0.115	0.0	1.9	1.9	1.1	O K
960 min Winter	73.040	0.040	0.0	1.6	1.6	0.4	O K
1440 min Winter	73.014	0.014	0.0	1.2	1.2	0.1	O K
2160 min Winter	73.000	0.000	0.0	0.8	0.8	0.0	O K
2880 min Winter	73.000	0.000	0.0	0.7	0.7	0.0	O K
4320 min Winter	73.000	0.000	0.0	0.5	0.5	0.0	O K
5760 min Winter	73.000	0.000	0.0	0.4	0.4	0.0	O K
7200 min Winter	73.000	0.000	0.0	0.3	0.3	0.0	O K
8640 min Winter	73.000	0.000	0.0	0.3	0.3	0.0	O K
10080 min Winter	73.000	0.000	0.0	0.2	0.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	97.039	0.0	17.1	32
60 min Winter	59.609	0.0	21.1	56
120 min Winter	35.353	0.0	25.0	92
180 min Winter	25.703	0.0	27.2	130
240 min Winter	20.385	0.0	28.8	168
360 min Winter	14.704	0.0	31.1	240
480 min Winter	11.652	0.0	32.9	298
600 min Winter	9.722	0.0	34.3	344
720 min Winter	8.381	0.0	35.5	392
960 min Winter	6.627	0.0	37.4	494
1440 min Winter	4.754	0.0	40.2	734
2160 min Winter	3.405	0.0	43.2	0
2880 min Winter	2.685	0.0	45.5	0
4320 min Winter	1.919	0.0	48.7	0
5760 min Winter	1.511	0.0	51.2	0
7200 min Winter	1.254	0.0	53.1	0
8640 min Winter	1.077	0.0	54.7	0
10080 min Winter	0.947	0.0	56.1	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)	21.000	Shortest Storm (mins)	15
Ratio R	0.436	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.042

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.021	4	8	0.021

Model Details

Storage is Online Cover Level (m) 75.000

Cellular Storage Structure

Invert Level (m) 73.000 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	10.0	0.0	1.501	0.0	0.0
1.500	10.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0068-2500-1500-2500
Design Head (m)	1.500
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	68
Invert Level (m)	72.950
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	2.5	Kick-Flo®	0.609	1.7
Flush-Flo™	0.300	2.0	Mean Flow over Head Range	-	2.0

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	3.4	7.000	5.1
0.200	2.0	1.400	2.4	3.500	3.7	7.500	5.3
0.300	2.0	1.600	2.6	4.000	3.9	8.000	5.4
0.400	2.0	1.800	2.7	4.500	4.2	8.500	5.6
0.500	1.9	2.000	2.9	5.000	4.4	9.000	5.8
0.600	1.7	2.200	3.0	5.500	4.6	9.500	5.9
0.800	1.9	2.400	3.1	6.000	4.8		
1.000	2.1	2.600	3.2	6.500	4.9		

Appendix B – 6B Nutley Terrace MicroDrainage Calculations

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

Half Drain Time : 36 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	74.016	1.016	0.0	2.5	2.5	7.7	O K
30 min Summer	74.191	1.191	0.0	2.6	2.6	9.1	O K
60 min Summer	74.213	1.213	0.0	2.6	2.6	9.2	O K
120 min Summer	74.091	1.091	0.0	2.5	2.5	8.3	O K
180 min Summer	73.949	0.949	0.0	2.5	2.5	7.2	O K
240 min Summer	73.805	0.805	0.0	2.5	2.5	6.1	O K
360 min Summer	73.509	0.509	0.0	2.5	2.5	3.9	O K
480 min Summer	73.349	0.349	0.0	2.5	2.5	2.7	O K
600 min Summer	73.265	0.265	0.0	2.3	2.3	2.0	O K
720 min Summer	73.219	0.219	0.0	2.2	2.2	1.7	O K
960 min Summer	73.186	0.186	0.0	1.8	1.8	1.4	O K
1440 min Summer	73.163	0.163	0.0	1.3	1.3	1.2	O K
2160 min Summer	73.150	0.150	0.0	1.0	1.0	1.1	O K
2880 min Summer	73.143	0.143	0.0	0.7	0.7	1.1	O K
4320 min Summer	73.136	0.136	0.0	0.5	0.5	1.0	O K
5760 min Summer	73.131	0.131	0.0	0.4	0.4	1.0	O K
7200 min Summer	73.128	0.128	0.0	0.4	0.4	1.0	O K
8640 min Summer	73.126	0.126	0.0	0.3	0.3	1.0	O K
10080 min Summer	73.124	0.124	0.0	0.3	0.3	0.9	O K
15 min Winter	74.152	1.152	0.0	2.6	2.6	8.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	150.176	0.0	8.8	19
30 min Summer	97.039	0.0	11.6	30
60 min Summer	59.609	0.0	14.4	48
120 min Summer	35.353	0.0	17.3	82
180 min Summer	25.703	0.0	18.9	116
240 min Summer	20.385	0.0	20.0	150
360 min Summer	14.704	0.0	21.7	206
480 min Summer	11.652	0.0	23.0	260
600 min Summer	9.722	0.0	24.0	316
720 min Summer	8.381	0.0	24.9	374
960 min Summer	6.627	0.0	26.3	490
1440 min Summer	4.754	0.0	28.3	734
2160 min Summer	3.405	0.0	30.5	1100
2880 min Summer	2.685	0.0	32.1	1468
4320 min Summer	1.919	0.0	34.5	2172
5760 min Summer	1.511	0.0	36.2	2848
7200 min Summer	1.254	0.0	37.6	3552
8640 min Summer	1.077	0.0	38.8	4264
10080 min Summer	0.947	0.0	39.8	5088
15 min Winter	150.176	0.0	10.0	19

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	74.358	1.358	0.0	2.8	2.8	10.3	O K
60 min Winter	74.376	1.376	0.0	2.8	2.8	10.5	O K
120 min Winter	74.197	1.197	0.0	2.6	2.6	9.1	O K
180 min Winter	73.982	0.982	0.0	2.5	2.5	7.5	O K
240 min Winter	73.756	0.756	0.0	2.5	2.5	5.7	O K
360 min Winter	73.362	0.362	0.0	2.5	2.5	2.8	O K
480 min Winter	73.232	0.232	0.0	2.2	2.2	1.8	O K
600 min Winter	73.192	0.192	0.0	1.9	1.9	1.5	O K
720 min Winter	73.178	0.178	0.0	1.7	1.7	1.4	O K
960 min Winter	73.163	0.163	0.0	1.3	1.3	1.2	O K
1440 min Winter	73.150	0.150	0.0	1.0	1.0	1.1	O K
2160 min Winter	73.141	0.141	0.0	0.7	0.7	1.1	O K
2880 min Winter	73.136	0.136	0.0	0.5	0.5	1.0	O K
4320 min Winter	73.130	0.130	0.0	0.4	0.4	1.0	O K
5760 min Winter	73.126	0.126	0.0	0.3	0.3	1.0	O K
7200 min Winter	73.124	0.124	0.0	0.3	0.3	0.9	O K
8640 min Winter	73.122	0.122	0.0	0.2	0.2	0.9	O K
10080 min Winter	73.121	0.121	0.0	0.2	0.2	0.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	97.039	0.0	13.1	31
60 min Winter	59.609	0.0	16.3	50
120 min Winter	35.353	0.0	19.4	88
180 min Winter	25.703	0.0	21.3	124
240 min Winter	20.385	0.0	22.5	162
360 min Winter	14.704	0.0	24.4	208
480 min Winter	11.652	0.0	25.9	260
600 min Winter	9.722	0.0	27.0	310
720 min Winter	8.381	0.0	28.0	370
960 min Winter	6.627	0.0	29.5	492
1440 min Winter	4.754	0.0	31.8	736
2160 min Winter	3.405	0.0	34.3	1076
2880 min Winter	2.685	0.0	36.0	1468
4320 min Winter	1.919	0.0	38.7	2148
5760 min Winter	1.511	0.0	40.7	2840
7200 min Winter	1.254	0.0	42.2	3560
8640 min Winter	1.077	0.0	43.5	4208
10080 min Winter	0.947	0.0	44.7	5088

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)	21.000	Shortest Storm (mins)	15
Ratio R	0.436	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.034

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.017	4	8	0.017

Model Details

Storage is Online Cover Level (m) 75.000

Cellular Storage Structure

Invert Level (m) 73.000 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	8.0	0.0	1.501	0.0	0.0
1.500	8.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0075-2500-1000-2500
Design Head (m)	1.000
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	73.100
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.5	Kick-Flo®	0.627	2.0
Flush-Flo™	0.307	2.5	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	2.1	1.200	2.7	3.000	4.1	7.000	6.2
0.200	2.4	1.400	2.9	3.500	4.5	7.500	6.4
0.300	2.5	1.600	3.1	4.000	4.7	8.000	6.6
0.400	2.5	1.800	3.3	4.500	5.0	8.500	6.8
0.500	2.4	2.000	3.4	5.000	5.3	9.000	7.0
0.600	2.1	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.3	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.9	6.500	6.0		