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Priory Llanarth Court, Monmouthshire

Drainage Strategy Report

24/01/2020

Document Owner(s)	Project/Organization Role
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Project Report Control

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Contents

1.0 INTRODUCTION

Following a devastating accidental fire on 28th April 2020 which completely destroyed the existing secure mental hospital building, the Hospital Trust are proposing to reconstruct a new unit on the site of the former unit, whilst updating the facilities to provide care for the residents.

2.0 COMPETENCY OF DESIGNER

MDA, Wirral LTD is a long established multi-discipline Consultancy which provides design solutions for a range of site drainage and Flood Risk Assessments for developers in the UK. MDA liaise regularly with the Environment Agency, Natural Resources Wales, LLFA's and Water Authorities, to ensure the designs comply with current statutory and regulatory requirements.

3.0 SITE LOCATION AND DESCRIPTION

The site is located 0.7km to the South-East of Llanarth Town Centre and 25km North-East of Newport Town Centre

The fire damaged building is located within the Llanarth Court Hospital grounds, consisting of a number of hospital buildings, access, parking and landscaping.
This report relates specifically to the re-development area of the fire damaged structure, within the wider site confines.

Following the devastating fire, it was necessary to make the area safe and as such the site has retained the original building foundation and floor slab with demolition rubble still present on site. An existing gravel path, macadam and surfaced access road are still present on site, with the remaining areas given over to grass.

Reference (NGR) for the approximate center of the site is 338242E, 210732N. The site location plan is included in Appendix A.

The total site re-development zone covers an area of approximately 0.644ha.

The sites boundaries are flanked by open fields east, existing hospital units to the west and woodland to the north and south.

Historically the earliest map of 1881 show the main site as a stately home with the re-development area of the site as farmland, until it was developed between 1985 & 2004.

The British Geological Society (BGS) maps indicate the site geology as:

- Superficial deposits of Alluvium – Clay, Silt, Sand and Gravel.
- Bedrock geology of St Maughans Formation - Argillaceous rocks and subequal/subordinate sandstone, interbedded.
- A BH log located approximately 1.6km to the SE indicates a mixture of sandstone and marl bands to a depth of 60m (end of BH). Water was struck at 5m level with the 'at rest' level 15m below ground level.
- A series of BH's relating to the A4 construction works, 1.2km to the south indicate stiff sandy clays with some gravel and sandstone fragments to 3.5m depth.

- Sandstone was present at 4.5m depth with overlying superficial deposits to the North East of the site, similarly sandy clays of 5m depth overlying sandstones, marl and mudstone to the North-West.
- In the absence of site borehole logs it is assessed that the site will have approx. 4m depth of sandy silty clays overlying bands of marl and sandstone to depth.

4.0 POTENTIAL FLOOD RISK

Natural Resources Wales flood map indicates the site lies within a Flood Zone B (area known to have previously flooded).
However, looking at the detailed flood risk maps from rivers, surface water and small watercourses, this indicates that only the surrounding area of the development is at risk of flooding to a depth less than 150mm depth, whilst the actual re-development shows no risk of flooding.

The Flood Risk Maps have been examined and are included in Appendix B.

5.0 EXISTING SITE DRAINAGE

The on-site drainage is classed as Private and thus maintained by the Hospital Trust's maintenance team.

The Foul Drainage network connected the building along its eastern and western facades, before joining at the southern facade. The Foul Drainage then connects via a 150mm diameter pipe to the wider site drainage system to the east of the development boundary, with connections from the remainder of the on-site structures, prior to discharging to either of two storage tanks located to the South-West area of the wider site. An air ram injector station passes forward these foul flows to the off-site Dwr Cymru / Welsh Water Treatment Works located to the north of the hospital site.

The roof drainage is collected on the north, east and west building façades, interconnecting at the south-west corner of the building, before it outfalls to the south into a French drain located along the southern boundary of the site. This has been laid to fall in both an easterly and westerly direction.

The drain exits at the eastern corner of the site via a piped system into a catchpit, which also connects an open ditch south of and outside of the site boundary limits. From the catchpit the outflow enters the Clawdd Brook flowing in a south-westerly direction.

The westerly exit point of the French drain is into an open ditch, where it crosses under the track via a pipeline, exiting into an open ditch which again connects to the Clawdd Brook.

There are a number of additional outfalls from the wider site, discharging into the Clawdd Brook, which opens into a man-made 'pond' at the south-western edge of the wider site. The outflow from this pond is controlled by a weir gate, with the outflow continuing south-westerly, discharging into the River Usk.

6.0 DRAINAGE COMPLIANCE STANDARDS

The development shall be in accordance with all current codes of practice and legislation. Hydraulic design of all sewers will be carried out using industry standard software Causeway Flow.

The Building Regulations - Approved Document H (2002) details a hierarchy of potential methods for disposing of surface water as shown below in order of preference:

- Discharge via infiltration
- Discharge to watercourse
- Discharge to sewer

Schedule 3 of the Flood and Water Management Act (FWMA) 2010 requires surface water drainage for new developments to comply with mandatory National Standards for sustainable drainage (SuDS).
Surface water drainage systems must be designed and built in accordance with these mandatory standards for sustainable drainage published by Welsh Ministers. These systems must be approved by the local authority acting in its Sustainable Drainage Systems (SuDS) Approving Body (SAB) role before construction work begins.

In line with Sewers for Adoption (7th Edition), the requirements for the design of a new surface water drainage systems are as follows:

- Below ground piped drainage to be sized to accommodate the 1 in 2 (50% AEP) design storm without surcharge.
- System to be designed not to flood any part of the site in a 1 in 30 (3% AEP) design storm.
- For events in exceedance of the 1 in 30 design storm and up to and including the 1 in 100 event, site drainage and topography should be designed where practicable to route surface water run-off away from buildings to safe above-ground storage areas on site, thereby preventing this run-off from leaving the site and increasing flood risk elsewhere.

For each design case described above, the design storm is the critical storm duration for the site conditions. For the 1 in 100 design case, a 30% increase in the peak rainfall intensity is applied to allow for the estimated worst case impacts of climate change. This is in accordance with Table 5 of the Technical Guidance to the National Planning Policy Framework.

Therefore, the surface water drainage systems are to be designed to restrict the discharge to the required rate, up to and including a 1 in 100 return period design storm (+30% climate change allowance).

Foul water drainage disposal is set out in Part H of the Building Regulations in order of priority the preferred methods are:

1. Public sewer

2. Septic tank

3. Cesspool.

The foul water system shall be designed in accordance with;

- BS EN 752:2008 (Drain and sewer systems outside buildings)
- Sewers for Adoption (7th Edition)
- Technical Guidance to the National Planning Policy Framework document (Department for Communities and Local Government, March 2012)
- BS EN 12056-2:2000 (Drainage systems inside buildings)
- Building Regulations Approved Document H, Drainage and waste disposal. (Office of the Deputy Prime Minister, December 2010)

7.0 ASSESSMENT OF EXISTING AND PROPOSED RUN-OFF

As detailed in section 3.0 above, the existing site has a total area of 0.644Ha, of which the existing impermeable areas affected by the re-development zone have been measured as 1821m2 and the proposed impermeable areas being 2322m2. This will result in a 27% increase in impermeable areas.

The proposed surface water discharge rates will be assessed against the following conditions:

- 1 in 1 storm event
- 1 in 30 storm event
- 1 in 100 storm event plus an allowance of 30% for climate change

8.0 DRAINAGE STRATEGY

The drainage networks have been designed to suit the proposed site layout and topography, with the aim to provide an effective and efficient design, mimicking the existing drainage as far as practicably possible
All site drainage will remain the responsibility of the Hospital Trust as it will form an extension of the current on-site drainage systems.

7.1 Surface Water

As indicated in Section 6, there is a requirement for the mandatory use of SUDS techniques. At present the results of the BRE 365 percolation tests are still outstanding and as such the drainage calculations have used generic permeability figures associated with sandy silty clays and will be adjusted at a later date to reflect the actual on-site results.

Based on these results it is unlikely that effective infiltration solutions will be viable on their own in providing the design solutions.
This is born-out by the existing site drainage utilizing the Brook for the outflow. The Hospital Trust's maintenance manager has further confirmed the site is generally wet, hence the wider site containing numerous open water courses etc.

The nearest suitable water course within close proximity to the proposed development site is the Clawdd Brook located slightly to the south of the proposed site

The scheme is to be designed to achieve a discharge rate of no greater than 70% of the current brownfield site for the 2-year critical storm event, plus greenfield run-off rate.

The current brownfield element for 2-year storm events have been calculated as 17.1 l/sec.
Therefore, the surface water drainage systems are to be designed to restrict the discharge to the required rate of no greater than 12 l/sec ;(70% of 17.1), up to and including a 1 in 100 (+CC) return period design storm.

The intention is to collect the roof drainage and discharge this into a new attenuation pond located at the SW corner of the development area with a controlled outflow limiting the discharge rate to 12 l/sec maximum, utilising the existing outfall to the existing French drain and thus on to the brook. The new pond will be set at a level that ensures the available volume, from dry weather water level to the top of embankment, provides adequate storage capacity for all storm durations up to and including the 1:30 events.
The proposed access road will be designed such that the surface water runs off to the south and east kerb channels where they will be directed to a new stone filter drain running alongside. This will remove the risk of pollution entering the pond which may adversely impact the eco system which it assumed will take advantage of this habitat, whilst mimicking the previous site access drainage.

As the discharge rate will be less than the existing rates it is assessed that this will result in additional downstream storage being available providing additional on-site benefits with regards to future storm flooding events.

For the 1:100 storm duration events it has been calculated that any exceedance volume will be contained fully within the pond, resulting in no on-site flooding. As the pond is located at the lowest area of the site with the ground levels generally falling away to the south, should any flood exceedance water events occur, the overspill will exit into the woods and thence onto the brook ensuring no on-site flooding of new or existing buildings can occur.
The same would apply should a catastrophic failure of the network occur, the flood route would be away from any buildings and to the south.

A preliminary enquiry has been made to the Natural Resources Wales (NRW) team to determine if the above is acceptable. Initial responses have been received from NRW but discussions are currently ongoing.

Storm event	Existing discharge rate (l/sec)	Proposed discharge rate (l/sec)
1:1	13.5	6.4
1:2	17.1	7.1
1:30	28.7	9.3
1:100	33.7	11.3

7.2 Foul Water

The intention for the development is to collect all of the required foul water discharge from the proposed development and discharge these via a 150mm diameter gravity system to the on-site sewer which will remain a private system

It has been estimated that the original foul discharge rate was approximately 7.1 l/sec and the proposed development will generate approximately 7.3 l/sec. As such there is a very small increase in flow and is therefore assessed as not having any detrimental impact on the existing site drainage.

9.0 CONCLUSIONS

- The site is located within Flood Zone B, with a low probability of flooding.

- It is a legal requirement to utilise SuDS for all new schemes

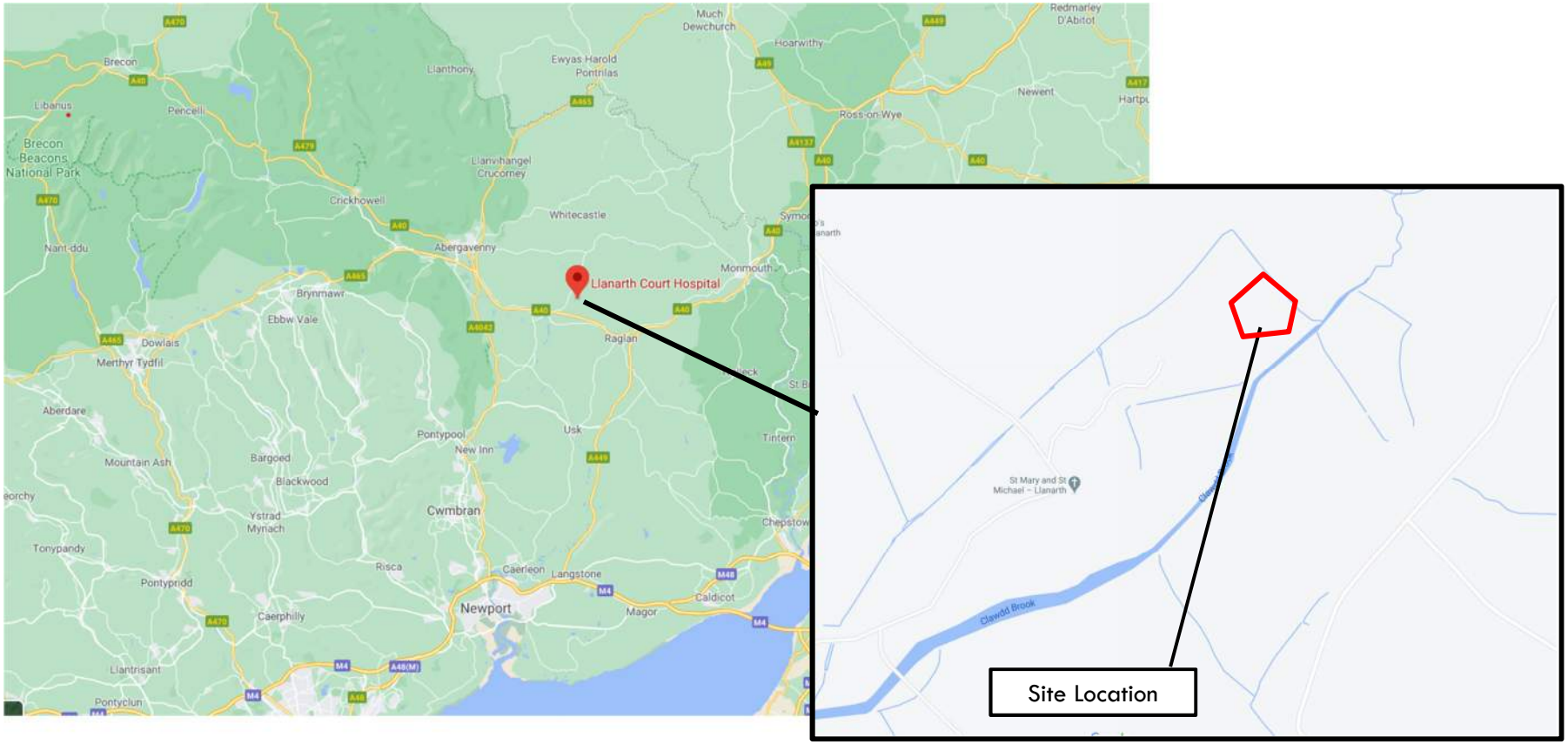
- A suitable water course for direct discharge exists within the site and has an existing outfall which will be utilised where possible.

- The flow of surface water from the proposed development is to be restricted to a maximum of 12 l/sec, discharging to the on-site outfall with a new detention/percolation pond providing storm storage capacity. The actual calculated discharge rate however is 11.3 l/sec

- The Surface Water discharge rate has been reduced by approximately 50% for the 1:1 and 1:2 storm events with a 70% reduction in discharge rate for the 1:30 and 1:100 storm events.

- Foul water drainage is required to serve the proposed development and will discharge to the on-site sewer network. As the estimated flow rate is only marginally greater than the existing rates it is determined that there is no requirement to approach the local water authority to obtain consent for this development.

Appendix A - Site Location Plan



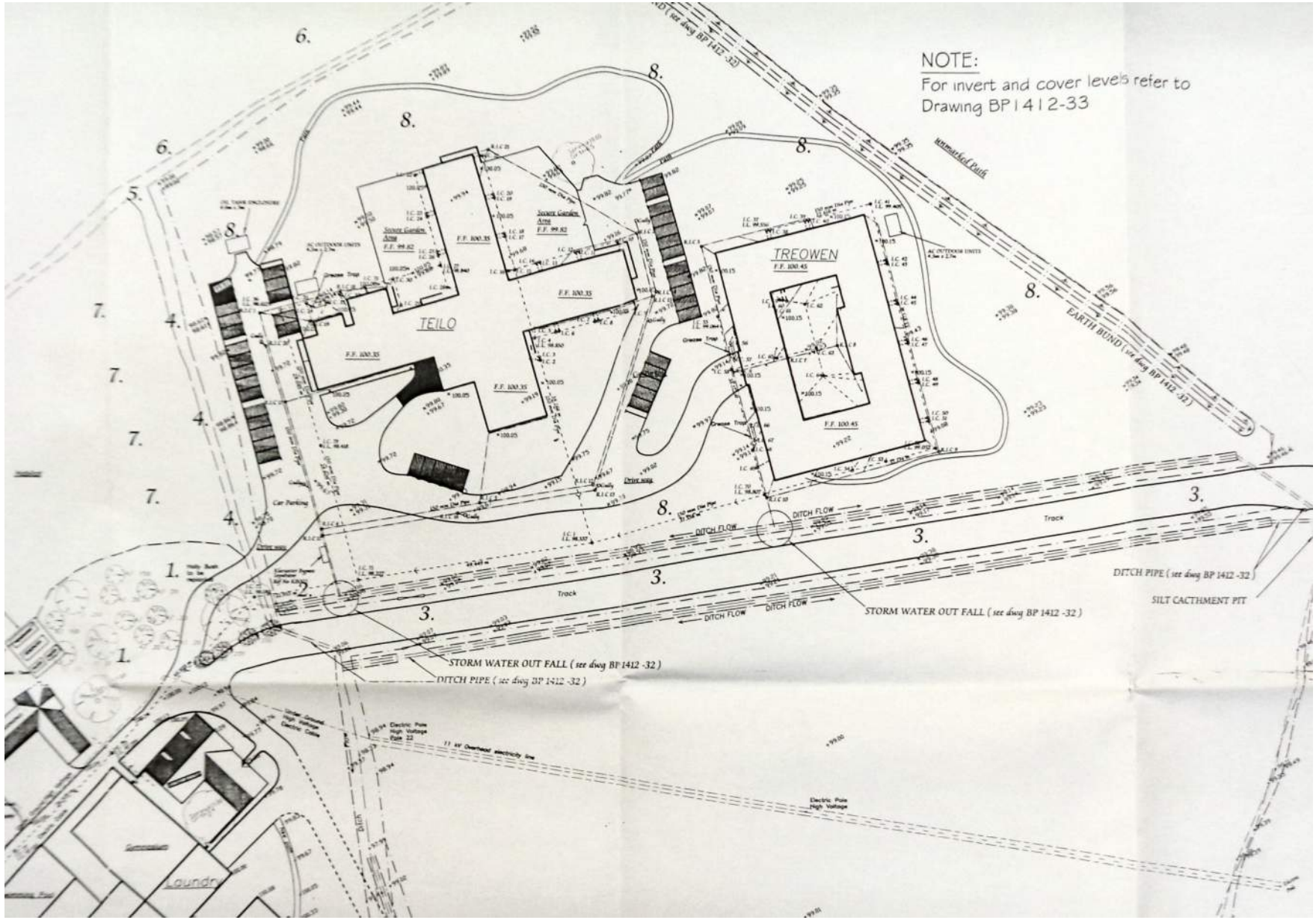
Appendix B - Flood Map

Appendix C - Existing Site Layout

Appendix D - Proposed Site Layout

Appendix E - Drainage Layout Plan

Existing



Proposed

Appendix F - Surface Water Calculations

Existing Drainage

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Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	14.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.200	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S1	0.091	5.00	36.800	1200	338265.847	210767.289	1.300
S2			36.500	1200	338277.778	210716.756	1.515
S3			36.700	1200	338226.824	210705.472	2.233
S4	0.091	5.00	37.100	1200	338216.053	210753.808	1.600
OUTFALL			36.700	1200	338216.022	210705.966	2.341

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)
S1.0	S1	S2	51.922	0.600	35.500	34.985	0.515	100.8	150	5.86	32.6
S1.1	S2	S3	52.188	0.600	34.985	34.467	0.518	100.7	150	6.73	31.1
S2.0	S4	S3	49.522	0.600	35.500	35.009	0.491	100.9	150	5.83	32.7
S1.2	S3	OUTFALL	10.813	0.600	34.467	34.359	0.108	100.1	150	6.91	30.8

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)
S1.0	1.000	17.7	8.0	1.150	1.365	0.091	0.0	71	0.978
S1.1	1.001	17.7	7.7	1.365	2.083	0.091	0.0	69	0.964
S2.0	1.000	17.7	8.1	1.450	1.541	0.091	0.0	71	0.978
S1.2	1.004	17.7	15.2	2.083	2.191	0.182	0.0	107	1.126

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)
S1.0	51.922	100.8	150	Circular	36.800	35.500	1.150	36.500	34.985	1.365
S1.1	52.188	100.7	150	Circular	36.500	34.985	1.365	36.700	34.467	2.083
S2.0	49.522	100.9	150	Circular	37.100	35.500	1.450	36.700	35.009	1.541
S1.2	10.813	100.1	150	Circular	36.700	34.467	2.083	36.700	34.359	2.191

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
S1.0	S1	1200	Manhole	Adoptable	S2	1200	Manhole	Adoptable
S1.1	S2	1200	Manhole	Adoptable	S3	1200	Manhole	Adoptable
S2.0	S4	1200	Manhole	Adoptable	S3	1200	Manhole	Adoptable
S1.2	S3	1200	Manhole	Adoptable	OUTFALL	1200	Manhole	Adoptable

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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1	338265.847	210767.289	36.800	1.300	1200	 0	S1.0	35.500	150
S2	338277.778	210716.756	36.500	1.515	1200	 1	S1.0	34.985	150
						0	S1.1	34.985	150
S3	338226.824	210705.472	36.700	2.233	1200	 1	S2.0	35.009	150
						2	S1.1	34.467	150
						0	S1.2	34.467	150
S4	338216.053	210753.808	37.100	1.600	1200	 0	S2.0	35.500	150
OUTFALL	338216.022	210705.966	36.700	2.341	1200	 1	S1.2	34.359	150

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	14.000	Drain Down Time (mins)	240
Ratio-R	0.200	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	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 %)
1	0	0	0
2	0	0	0
30	0	0	0
100	0	0	0

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Results for 1 year Critical Storm Duration. Lowest mass balance: 99.54%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	10	35.567	0.067	7.2	0.1702	0.0000	OK
15 minute winter	S2	11	35.050	0.065	7.0	0.0730	0.0000	OK
15 minute winter	S3	12	34.573	0.106	13.7	0.1199	0.0000	OK
15 minute winter	S4	11	35.566	0.066	7.2	0.1493	0.0000	OK
15 minute winter	OUTFALL	12	34.456	0.097	13.5	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	S1.0	S2	7.0	0.969	0.398	0.3841	
15 minute winter	S2	S1.1	S3	6.8	0.665	0.387	0.5339	
15 minute winter	S3	S1.2	OUTFALL	13.5	1.061	0.761	0.1375	6.6
15 minute winter	S4	S2.0	S3	6.9	0.937	0.390	0.3647	

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Results for 2 year Critical Storm Duration. Lowest mass balance: 99.54%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
15 minute winter	S1	10	35.578	0.078	9.2	0.1965	0.0000	OK
15 minute winter	S2	11	35.060	0.075	9.0	0.0844	0.0000	OK
15 minute winter	S3	12	34.602	0.135	17.7	0.1530	0.0000	OK
15 minute winter	S4	11	35.576	0.076	9.2	0.1726	0.0000	OK
15 minute winter	OUTFALL	12	34.480	0.121	17.1	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
15 minute winter	S1	S1.0	S2	9.0	1.027	0.508	0.4624	
15 minute winter	S2	S1.1	S3	8.8	0.691	0.498	0.6597	
15 minute winter	S3	S1.2	OUTFALL	17.1	1.092	0.965	0.1726	8.5
15 minute winter	S4	S2.0	S3	8.8	0.998	0.501	0.4393	

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Results for 30 year Critical Storm Duration. Lowest mass balance: 99.54%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	10	35.619	0.119	17.0	0.3011	0.0000	OK
15 minute winter	S2	12	35.194	0.209	16.9	0.2367	0.0000	SURCHARGED
15 minute winter	S3	11	34.863	0.396	29.7	0.4475	0.0000	SURCHARGED
15 minute winter	S4	11	35.617	0.117	17.0	0.2647	0.0000	OK
15 minute summer	OUTFALL	12	34.501	0.142	28.1	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	S1.0	S2	16.9	1.151	0.954	0.8179	
15 minute winter	S2	S1.1	S3	14.8	0.848	0.835	0.9188	
15 minute winter	S3	S1.2	OUTFALL	28.7	1.633	1.620	0.1884	15.7
15 minute winter	S4	S2.0	S3	16.3	1.126	0.921	0.7164	

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Results for 100 year Critical Storm Duration. Lowest mass balance: 99.54%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	S1	20	35.883	0.383	20.9	0.9685	0.0000	SURCHARGED
30 minute summer	S2	20	35.431	0.446	18.7	0.5039	0.0000	SURCHARGED
30 minute summer	S3	20	34.997	0.530	33.7	0.5989	0.0000	SURCHARGED
30 minute summer	S4	19	35.688	0.188	20.9	0.4270	0.0000	SURCHARGED
15 minute summer	OUTFALL	10	34.501	0.142	32.5	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	S1	S1.0	S2	18.7	1.169	1.057	0.9141	
30 minute summer	S2	S1.1	S3	16.2	0.919	0.914	0.9188	
30 minute summer	S3	S1.2	OUTFALL	33.7	1.916	1.901	0.1884	26.4
30 minute summer	S4	S2.0	S3	19.0	1.146	1.074	0.8282	

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Proposed Drainage

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Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	14.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.200	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S1	0.091	5.00	36.800	1200	338265.847	210767.289	0.900
S2			37.000	1200	338277.778	210716.756	1.360
S3			36.890	1800	338226.824	210705.472	1.724
S4	0.091	5.00	37.100	1200	338216.053	210753.808	1.300
POND		5.00	36.700	1200	338212.244	210710.151	1.350
CONTROL			36.890	150	338228.475	210703.892	1.735
OUTLET			36.470	150	338229.285	210697.492	1.424

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)
S1.0	S1	S2	51.922	0.600	35.900	35.640	0.260	200.0	225	5.94	32.5
S1.1	S2	S3	52.188	0.600	35.640	35.379	0.261	200.0	225	6.88	30.8
S2.0	S4	S3	49.522	0.600	35.800	35.446	0.354	140.0	150	5.97	32.4
S1.2	POND	S3	15.312	0.600	35.350	35.241	0.109	140.0	150	5.30	33.8
S1.3	S3	CONTROL	2.285	0.600	35.166	35.155	0.011	200.0	225	6.93	30.8
NODE	CONTROL	OUTLET	6.451	0.600	35.155	35.046	0.109	59.2	225	6.99	30.7

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)
S1.0	0.921	36.6	8.0	0.675	1.135	0.091	0.0	72	0.742
S1.1	0.921	36.6	7.6	1.135	1.286	0.091	0.0	69	0.727
S2.0	0.847	15.0	8.0	1.150	1.294	0.091	0.0	78	0.862
S1.2	0.847	15.0	0.0	1.200	1.499	0.000	0.0	0	0.000
S1.3	0.921	36.6	15.2	1.499	1.510	0.182	0.0	101	0.877
NODE	1.703	67.7	15.1	1.510	1.199	0.182	0.0	72	1.374

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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)
S1.0	51.922	200.0	225	Circular	36.800	35.900	0.675	37.000	35.640	1.135
S1.1	52.188	200.0	225	Circular	37.000	35.640	1.135	36.890	35.379	1.286
S2.0	49.522	140.0	150	Circular	37.100	35.800	1.150	36.890	35.446	1.294
S1.2	15.312	140.0	150	Circular	36.700	35.350	1.200	36.890	35.241	1.499
S1.3	2.285	200.0	225	Circular	36.890	35.166	1.499	36.890	35.155	1.510
NODE	6.451	59.2	225	Circular	36.890	35.155	1.510	36.470	35.046	1.199

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
S1.0	S1	1200	Manhole	Adoptable	S2	1200	Manhole	Adoptable
S1.1	S2	1200	Manhole	Adoptable	S3	1800	Manhole	Adoptable
S2.0	S4	1200	Manhole	Adoptable	S3	1800	Manhole	Adoptable
S1.2	POND	1200	Manhole	Adoptable	S3	1800	Manhole	Adoptable
S1.3	S3	1800	Manhole	Adoptable	CONTROL	150	Manhole	Adoptable
NODE	CONTROL	150	Manhole	Adoptable	OUTLET	150	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1	338265.847	210767.289	36.800	0.900	1200	 0	S1.0	35.900	225
S2	338277.778	210716.756	37.000	1.360	1200	 1	S1.0	35.640	225
						0	S1.1	35.640	225
S3	338226.824	210705.472	36.890	1.724	1800	 1	S1.2	35.241	150
						2	S2.0	35.446	150
						3	S1.1	35.379	225
						0	S1.3	35.166	225
S4	338216.053	210753.808	37.100	1.300	1200	 0	S2.0	35.800	150
POND	338212.244	210710.151	36.700	1.350	1200	 0	S1.2	35.350	150
CONTROL	338228.475	210703.892	36.890	1.735	150	1	S1.3	35.155	225
						 0	NODE	35.155	225
OUTLET	338229.285	210697.492	36.470	1.424	150	 1	NODE	35.046	225

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Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	14.000	Drain Down Time (mins)	240
Ratio-R	0.200	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	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 %)
1	0	0	0
2	0	0	0
30	0	0	0
100	30	0	0

Node CONTROL Online Orifice Control

Flap Valve	x	Design Depth (m)	1.000	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	12.0		
Invert Level (m)	35.155	Diameter (m)	0.076		

Node POND Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00180	Safety Factor	1.5	Invert Level (m)	35.350
Side Inf Coefficient (m/hr)	0.00180	Porosity	0.20	Time to half empty (mins)	25

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	4.0	100.0	1.500	99.5	100.0	1.501	99.6	100.0

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Results for 1 year Critical Storm Duration. Lowest mass balance: 97.44%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	10	35.968	0.068	7.2	0.2154	0.0000	OK
15 minute winter	S2	12	35.704	0.064	7.1	0.0727	0.0000	OK
30 minute winter	S3	24	35.517	0.351	11.7	0.8934	0.0000	SURCHARGED
15 minute winter	S4	11	35.872	0.072	7.2	0.1820	0.0000	OK
30 minute winter	POND	24	35.518	0.168	2.8	0.5048	0.0000	SURCHARGED
30 minute winter	CONTROL	24	35.517	0.362	6.8	0.0065	0.0000	SURCHARGED
15 minute summer	OUTLET	1	35.046	0.000	6.4	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	S1.0	S2	7.1	0.776	0.193	0.4923	
15 minute winter	S2	S1.1	S3	6.6	0.674	0.181	0.7529	
60 minute winter	S3	S1.3	CONTROL	7.2	0.357	0.196	0.0909	
15 minute winter	S4	S2.0	S3	6.8	0.826	0.455	0.4085	
15 minute winter	POND	S1.2	S3	-4.3	-0.332	-0.290	0.2696	
15 minute summer	POND	Infiltration		0.0				
30 minute winter	CONTROL	Orifice	OUTLET	6.9				9.4

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Results for 2 year Critical Storm Duration. Lowest mass balance: 97.44%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	10	35.978	0.078	9.2	0.2449	0.0000	OK
15 minute winter	S2	12	35.713	0.073	9.1	0.0831	0.0000	OK
30 minute winter	S3	24	35.609	0.443	15.3	1.1267	0.0000	SURCHARGED
15 minute winter	S4	11	35.884	0.084	9.2	0.2118	0.0000	OK
30 minute winter	POND	24	35.610	0.260	3.6	0.9307	0.0000	SURCHARGED
30 minute winter	CONTROL	24	35.608	0.453	7.7	0.0081	0.0000	SURCHARGED
15 minute summer	OUTLET	1	35.046	0.000	7.1	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	S1.0	S2	9.1	0.820	0.247	0.6000	
15 minute winter	S2	S1.1	S3	8.6	0.686	0.235	1.1599	
60 minute summer	S3	S1.3	CONTROL	7.9	0.362	0.215	0.0909	
15 minute winter	S4	S2.0	S3	8.8	0.878	0.585	0.5307	
15 minute summer	POND	S1.2	S3	-5.7	-0.366	-0.381	0.2696	
15 minute summer	POND	Infiltration		0.0				
30 minute winter	CONTROL	Orifice	OUTLET	7.8				12.1

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Results for 30 year Critical Storm Duration. Lowest mass balance: 97.44%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	S1	10	36.009	0.109	17.0	0.3423	0.0000	OK
60 minute winter	S2	43	35.968	0.328	11.2	0.3711	0.0000	SURCHARGED
60 minute winter	S3	43	35.963	0.797	20.6	2.0280	0.0000	SURCHARGED
30 minute winter	S4	21	36.063	0.263	14.7	0.6658	0.0000	SURCHARGED
60 minute winter	POND	42	35.964	0.614	5.4	3.5812	0.0000	SURCHARGED
60 minute winter	CONTROL	43	35.960	0.805	10.6	0.0145	0.0000	SURCHARGED
15 minute summer	OUTLET	1	35.046	0.000	9.3	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	S1.0	S2	16.6	0.926	0.453	1.1944	
15 minute winter	S2	S1.1	S3	16.1	0.709	0.441	2.0248	
30 minute winter	S3	S1.3	CONTROL	10.6	0.407	0.291	0.0909	
15 minute winter	S4	S2.0	S3	15.2	0.949	1.013	0.8718	
15 minute winter	POND	S1.2	S3	-9.6	-0.543	-0.638	0.2696	
15 minute summer	POND	Infiltration		0.0				
60 minute winter	CONTROL	Orifice	OUTLET	10.6				32.7

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Results for 100 year +30% CC Critical Storm Duration. Lowest mass balance: 97.44%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	S1	43	36.541	0.641	18.8	2.0224	0.0000	FLOOD RISK
60 minute winter	S2	44	36.529	0.889	16.2	1.0052	0.0000	SURCHARGED
60 minute winter	S3	46	36.521	1.355	28.7	3.4473	0.0000	SURCHARGED
30 minute winter	S4	21	36.862	1.062	24.6	2.6867	0.0000	FLOOD RISK
60 minute winter	POND	45	36.522	1.172	12.6	11.0161	0.0000	FLOOD RISK
60 minute winter	CONTROL	46	36.515	1.360	14.4	0.0245	0.0000	SURCHARGED
15 minute summer	OUTLET	1	35.046	0.000	11.3	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	S1	S1.0	S2	27.4	1.023	0.748	2.0650	
15 minute winter	S2	S1.1	S3	19.8	0.701	0.542	2.0756	
30 minute winter	S3	S1.3	CONTROL	14.4	0.495	0.395	0.0909	
30 minute summer	S4	S2.0	S3	19.3	1.095	1.288	0.8718	
30 minute summer	POND	S1.2	S3	-15.9	-0.901	-1.060	0.2696	
15 minute summer	POND	Infiltration		0.0				
60 minute winter	CONTROL	Orifice	OUTLET	13.9				55.3

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Appendix G – Maintenance Strategy Report

1.0 INTRODUCTION

This maintenance strategy report has been prepared in connection with a planning application for the re-development of a secure mental health unit at the existing Priory Llanarth Court hospital, providing state-of-the-art care for residents; and is to be read in conjunction with all manufacturer's recommendations and the Drainage Strategy Report

2.0 FUTURE MAINTENANCE

The proposed drainage solution uses SUDS techniques in accordance with the CIRIA SUDS Manual C753. The surface water run-off is restricted using a flow control device and the attenuated run-off stored using a detention pond, positioned upstream of the flow control.

The Surface water system within the development has been designed to accommodate upto the 30 year storm events as part of an on-line attenuation system, with the discharge being controlled utilising a flow control system, excess flows during a 100 year event will surcharge and overflow south into the wooded area, into the existing ditches and on to the Brook.

It is proposed that the plot drainage and attenuation pond will remain private.

The maintenance of the private systems as specified within this report will be detailed within the developments Operation and Maintenance Manual (O&M) which will be transferred to the Hospital Trust and form part of the inspection, maintenance and repair regime by their in-house maintenance team. The wider hospital site already has a number of open water courses and a large pond; as such, the Hospital's maintenance team are familiar with the ongoing requirements associated with the proposed detention pond.

During the construction phase and defects liability period pre-handover of properties; the contractor, or his maintenance contractor, will be responsible for ensuring the ongoing inspection, maintenance and repairs of any drainage and SuDS systems as a minimum requirement identified within the report.

The works as detailed below are detailed in accordance with the CIRIA SuDS Manual C753 as per the operation and maintenance table 21.3 (modified) where relevant with additional information provided for systems not covered within the SuDS manual.

Table 21.3 (modified) : Operation and maintenance requirements for

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly
	Cut grass – meadow grass in and around ba	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start,then as required)
	Inspect inlets, outlets and overflows for blockages,and clear if required	Monthly
	Inspect bank sides, structures, pipework etc for evidence of physical damage	Monthly

	Remove sediment from inlets and outlet	Annually or as required
Remedial Action	Repair erosion or other damage by reseeding or re-turfing	As required
Monitoring	Inspect / check all inletsand outlets ensure they are in good condition and operating as designed	Annually

The attenuation system has been provided with catchpit chambers The flow controller is to be maintained by the Hospital Trust's existing maintenance team.