

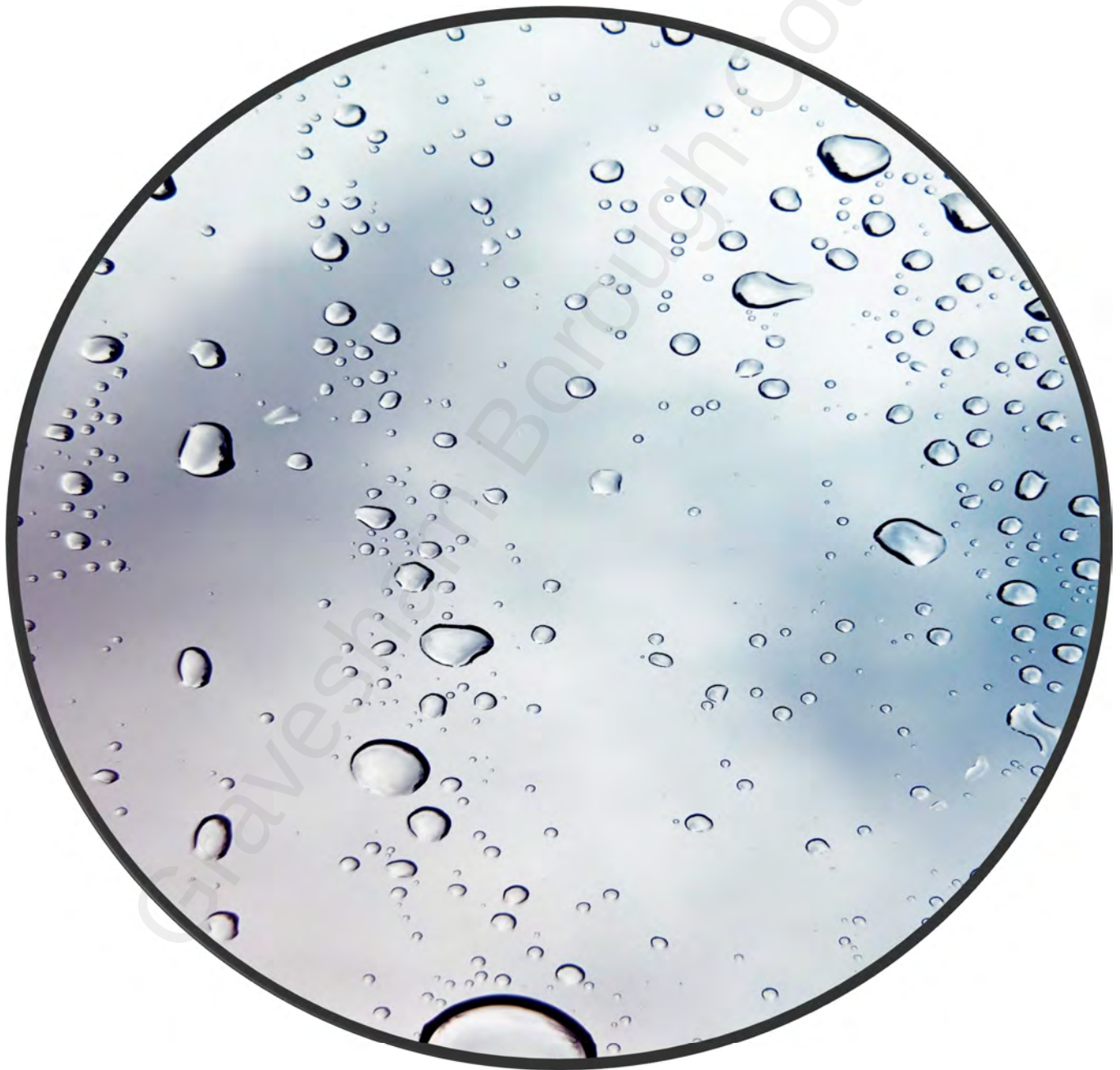
DRAINAGE STRATEGY REPORT

GRFC BOWLS CLUB, CHURCH WALK, GRAVESEND, KENT DA12 2QU

ON BEHALF OF MCCARTHY & STONE RETIREMENT LIFESTYLES LIMITED

OCTOBER 2022

IDL/1129/DS/001



Gravesham Borough Council

INFRASTRUCTURE DESIGN LTD

33 THE POINT
MARKET HARBOURGH
LEICESTERSHIRE
LE16 7QU

+44 (0)1858 411570

www.infrades.co.uk

DRAINAGE STRATEGY REPORT

IDL/1129/DS/001

REPORT ISSUE

Revision	Date	Notes
P01	03/10/2022	Preliminary Issue
P02	20/10/2022	Report revised, Preliminary Issue

PREPARED BY

Brijesh Mistry
Infrastructure Engineer

Oct 2022

REVIEWED BY

Phil Tomes
Director

Oct 2022

DISCLAIMER

This report has been prepared by Infrastructure Design Ltd for the sole use of the client. It may not be assigned to, relied upon or used by any third party in part or in whole without the written permission of Infrastructure Design Ltd.

CONTENTS

1	INTRODUCTION	1
2	FOUL WATER DRAINAGE	3
3	SURFACE WATER DRAINAGE & SUDS	4
4	ENCLOSURES	6

APPENDIX A – SUDS HIERARCHY

APPENDIX B – SOUTHERN WATER ASSET SEARCH

APPENDIX C – TOPOGRAPHICAL AND SEWER SURVEY

APPENDIX D – PROPOSED DRAINAGE STRATEGY LAYOUTS

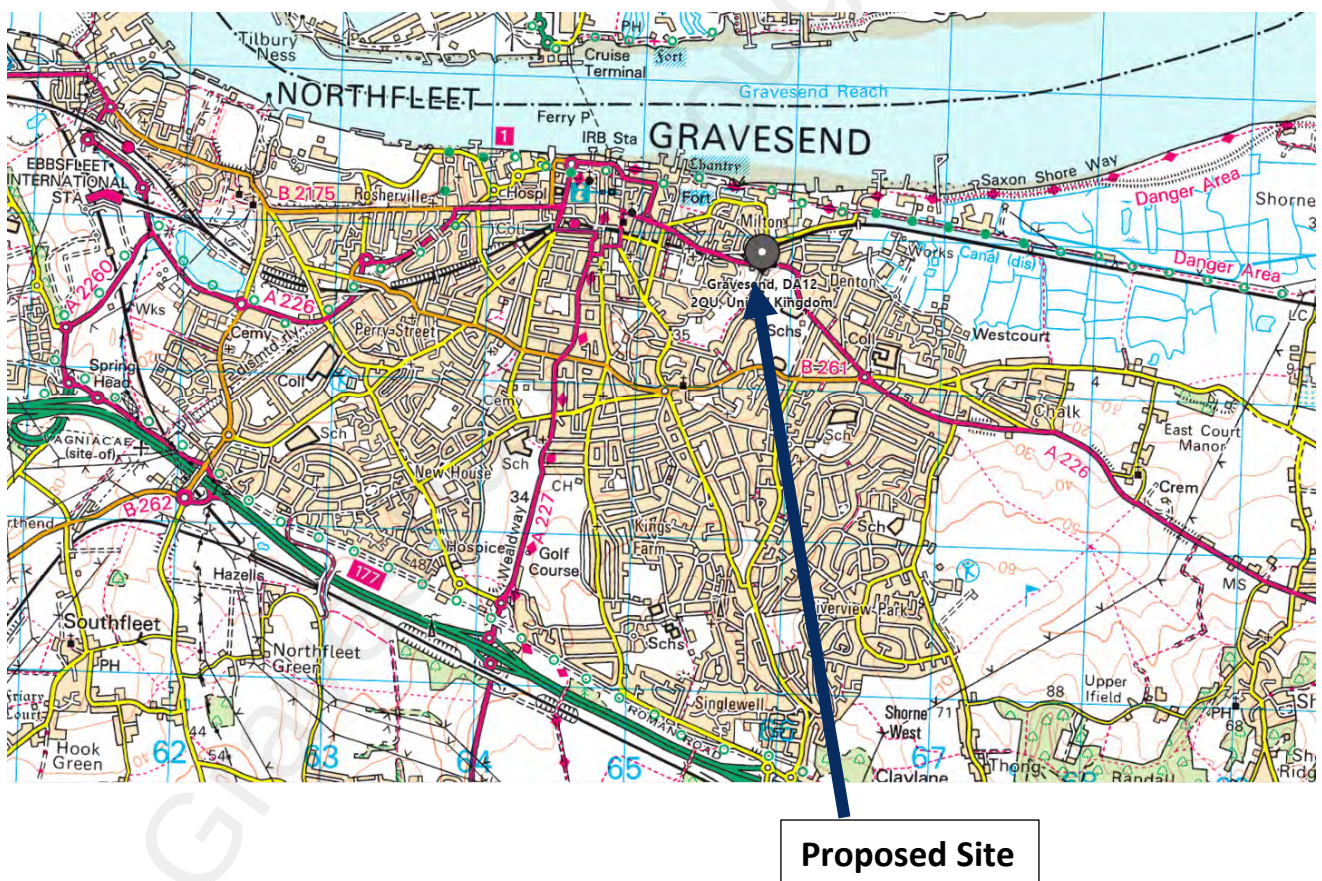
APPENDIX E – SURFACE WATER DRAINAGE CALCULATION

APPENDIX F – MANAGEMENT & MAINTENANCE REGIME

1 INTRODUCTION

- 1.1 Infrastructure Design Ltd (IDL) has been appointed by McCarthy Stone Ltd to prepare this initial Drainage Strategy Summary Report in support of their planning application for their proposed retirement living accommodation development site.
- 1.2 This report has been prepared in accordance with both national and local planning policy and takes guidance from Ciria 753, The SuDS Manual and The Building Regulations, Approved Document Part H.
- 1.3 The site is located on Church Walk, Gravesend. Milton Road bounds the site to the north, Church Walk to the east, a road identified as Ellerslie on the western boundary and sports playing field to the south. The National Grid Reference for the site is TQ 65754 73773.

Figure 1 – Site Location Plan



1.4 Reference Documents:-

- Crossfield Consulting Desk Study Appraisal report No. CCL03636.CP31.
- Proscaplan Limited topographical survey drawing No.PP/4081/Gravesend/F1 Rev B
- Subvision 2d drainage line and level survey drawing No.SS-IDL-008
- Southern Water sewer record map.
- 22 008 – On Architecture Site Layout Plan

1.5 The Gravesend Rugby Football Club (GRFC) Bowls Club comprises a single-storey wooden pavilion west of the green. The rest of the site includes an open grassed area. The site's approximate area is 0.65 ha. The topographical survey indicates that the site slopes to the northeast. Refer to Appendix C for a copy of the topographical survey.

1.6 The proposed main access to the site will be from the existing vehicle entrances from Ellerslie Road.

1.7 The proposed development comprises three- to four-storey blocks of retirement age apartments, car parking, and managed landscaping areas. Appendix D provides a copy of the proposed site plan.

1.8 An approximately 800mm dia concrete Southern Water Combined sewer is crossing the site, which heads from the northwest to the southeast towards Church Walk. A 225mm diameter Southern Water foul water sewer crosses the site from Ellerslie Road and joins the combined sewer, which heads towards the Church Walk. There are no surface water sewers within or near the site. Also, soakaways at the Church Walk and Milton Road junction are believed to be taking surface water runoff highways. Refer to Appendix B for a copy of the Southern Water sewer record map and Appendix C for a topographical survey and Subvision survey showing the location of the surveyed sewers.

1.9 Crossfield Consulting has carried out a desk study appraisal for the scheme. The report suggested that shallow head deposits are likely to comprise low permeability. The clays, silts and underlying chalk strata are likely to include a weathered upper horizon with significant fines that may prevent conventional shallow soakaways. An alternative drainage solution is recommended for the proposed development.

- 1.10 The site is not located within the groundwater source protection zone.
- 1.11 The proposed finish floor level for the buildings is set at 8.05m AOD. The upper car park level has been set between 10.65-9.30 AOD. The lower car park has been set between 7.95-7.60 AOD. The vehicle entrance to the site is from Ellerslie Road.

2 FOUL WATER DRAINAGE

- 2.1 The new onsite FW drainage for the proposed buildings will connect via a gravity drain to the existing Southern Water combined sewer manhole located car park located at the proposed lower car park. Before making the foul connection, the exact location and levels of the existing sewer manhole require to be surveyed.
- 2.2 The drainage strategy layout is included in Appendix D.

3 SURFACE WATER DRAINAGE & SUDS

- 3.1 The majority of the existing site is grass land; the total site area is 6500m²(0.65 hectares).
- 3.2 The proposed impermeable area is approximately 3100 m²(0.310Ha) from the roofs and the external paved areas. The impermeable area layout is included in Appendix D.
- 3.3 SuDS hierarchy approach has been considered for the surface water drainage system outfalls. As mentioned in section 1.9, the infiltration technique is not a viable option to discharge the proposed surface water runoff from the site. Discharging the proposed surface water runoff to the Southern Water combined sewer is considered the most feasible option for the site.
- 3.4 Once developed, the impermeable area will be generated. It is proposed to incorporate flow controls that limit the flow off the site to as close as practicable to the greenfield runoff rates whilst ensuring that the system will endure minimal maintenance. Figure 2 below gives the greenfield discharge rates for the site;

Figure 2 Greenfield Runoff Rates – Using Proposed Site Impermeable Area

<u>Pre-development Discharge Rate</u>				
Site Makeup	Greenfield	Growth Factor 30 year	1.95	
Greenfield Method	IH124	Growth Factor 100 year	2.48	
Positively Drained Area (ha)	0.310	Betterment (%)	0	
SAAR (mm)	555	QBar	1.5	
Soil Index	5	Q 2 year (l/s)	1.3	
SPR	0.53	Q 30 year (l/s)	2.9	
Region	6	Q 100 year (l/s)	3.7	
Growth Factor 2 year	0.88			

- 3.5 The proposed development will incorporate the use of SuDS techniques selected for their suitability given the site layout, topographical levels and geotechnical constraints. Refer to Appendix A to view the SuDS Hierarchy.
- 3.6 To summarise, the following SuDs devices will be applied to the scheme;

Permeable paving - To parking areas and access road

Crate Storage - To accommodate the runoff from all storm events, including peak 1 in 100 years, plus climate change storm events.

Surface Water conveyance Swales – Surface WaterFlooding conveyance swales

- 3.7 Permeable paving with a subbase lined in an impermeable membrane will be used in forming parking areas. This will slowly delay runoff into the crate soakaway outfall via perforated pipes surrounded by granular stones and improve water quality.
- 3.8 Where the sub-base is laid level, a minimum permeable stone layer of 350mm is required.
- 3.9 All of the building roof areas will be drained through conventional gravity drainage and stored within the crate attenuation tank located in the landscape area southeast of the site.
- 3.10 Appendix E provides the *Flow* software results summary for the 1 in 1, 1 in 30 and 1 in 100 years (plus a 40% allowance for climate change) return period events for the crate soakaway. Refer to Appendix E for the surface water calculations and simulation.
- 3.11 The tables below summarise the greenfield runoff & post-development runoff rates and the storage volumes available within each SuDs feature.

Figure 3 Comparison of pre & post-development runoff rates

Location / Storm Event	Greenfield Rate (l/s)	Proposed Runoff Rate (l/s)
(QBar)	1.5	-
1 in 2 year	1.3	1.5
1 in 30 year	2.9	1.5
1 in 100 year	3.7	1.5
1 in 100 years (+40%cc)	-	1.5

Figure 4 Storage volumes available within each SuDS feature

LOCATION	SuDS DEVICE	AVAILABLE STORAGE
Parking areas	Granular sub-base /Permeable Paving- 1200m ² x 0.35m x 0.33	378 m ³
Crates soakaway storage	Crate system A (140m ² x 0.4m) 56 m ³	136 m ³
	Crate system B (100m ² x 0.8m) 78 m ³	

4 ENCLOSURES

- 4.1 Appendix A includes the SuDS Hierarchy.
- 4.2 Appendix B includes a copy of the Southern Water asset search.
- 4.3 Appendix C includes a copy of the Topographical and Sewer Survey.
- 4.4 Appendix D includes a copy of the Drainage Strategy Layouts.
- 4.5 Appendix E includes the Surface Water / SuDS calculations and simulation results.
- 4.6 Appendix F Management & Maintenance Regime.

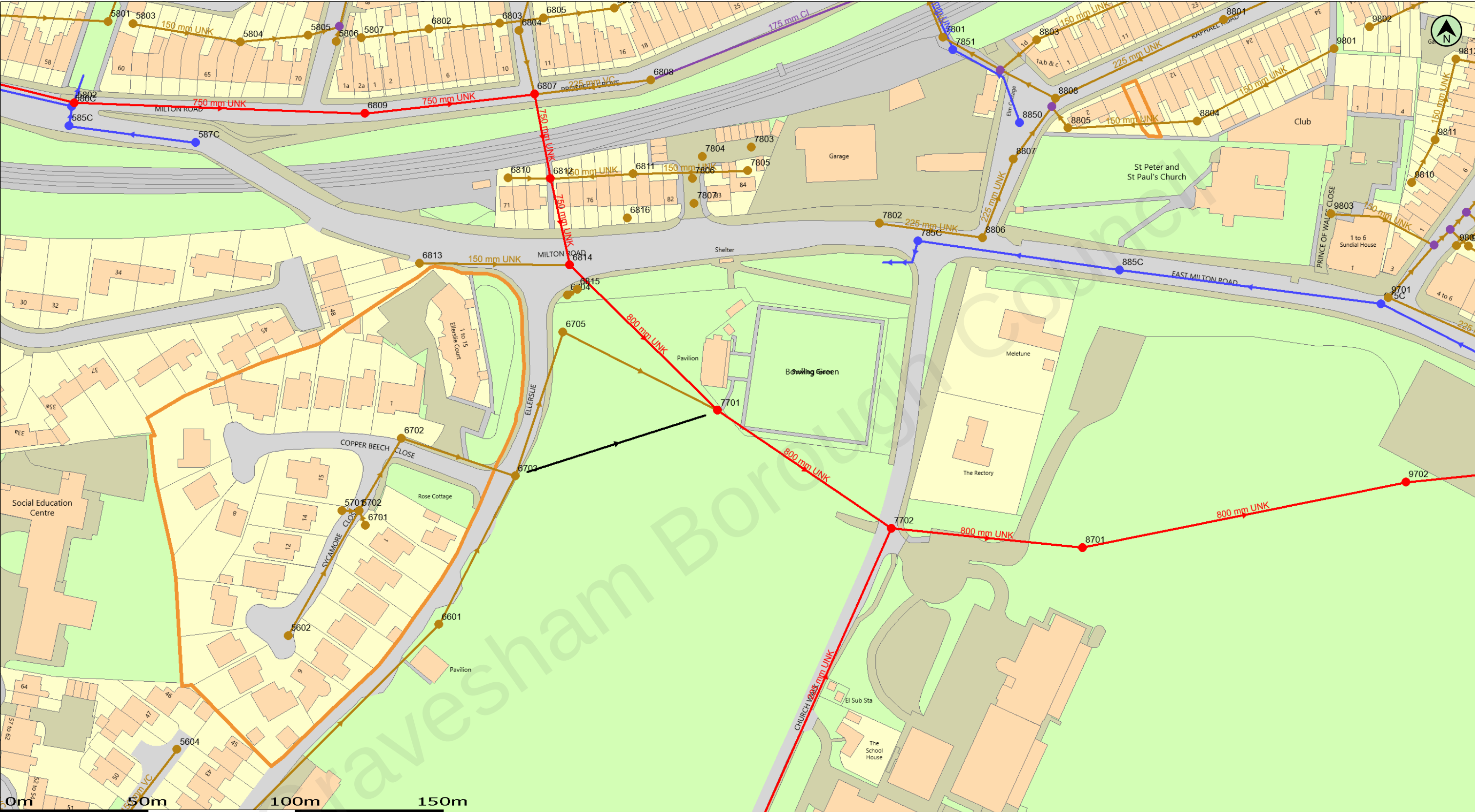
APPENDIX A – SUDS HIERARCHY

Most Sustainable	SUDS technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit	Included in the scheme?	Comments
	Living roofs	✓	✓	✓		The proposed roof finishes preclude the use of green roofs
	Basins and ponds	✓	✓	✓		Given the proposed layout of this site, these SuDS features are not suitable.
	Filter strips and swales	✓	✓	✓		Given the site density and insufficient space exists within the main body of the site for these types of SuDS features.
	Infiltration devices	✓	✓	✓		Due to impermeable soil strata infiltration techniques, are not suitable for this site. An alternative drainage solution is recommended for the proposed development.
	Permeable surfaces and infiltration blanket	✓	✓		✓	Permeable paving with subbase wrapped with impermeable membrane is proposed for the access road and parking areas. This will assist in pollution reduction and the 'delay' of runoff.
	Tanked systems-Over size Pipes	✓	✓		✓	Crate storage is proposed to store extreme storm events and surface water runoff
Least Sustainable						



APPENDIX B – SOUTHERN WATER ASSET SEARCH

Gravesham Borough Council



(c) Crown copyright and database rights 2021 Ordnance Survey 100031673

Date: 31/12/21

Scale: 1:1250

Map Centre: 565727,173760

Data updated: 22/12/21

Our Ref: 746036 - 3

Wastewater Plan A3

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2021 Ordnance Survey 100031673. This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

Foul Gravity Sewer	Combined Gravity Sewer	Culverted Water Course or Treated Effluent	Surface Water Gravity Sewer
Rising Main, Vacuum or Syphon	Combined Outfall	Foul Outfall	Surface Water Outfall
Surface Water Inlet	Combined Pumping Station	Surface Water Pumping Station	Foul Pumping Station
Water Treatment Works	Section 104 Area	Building Over	Agreement Area
Foul Manhole	Combined Manhole	Surface Water Manhole	Side Entry Manhole, Decarction Chamber, Dummy Manhole or Surface Water Soakaway

john.duncan@nrswa.net

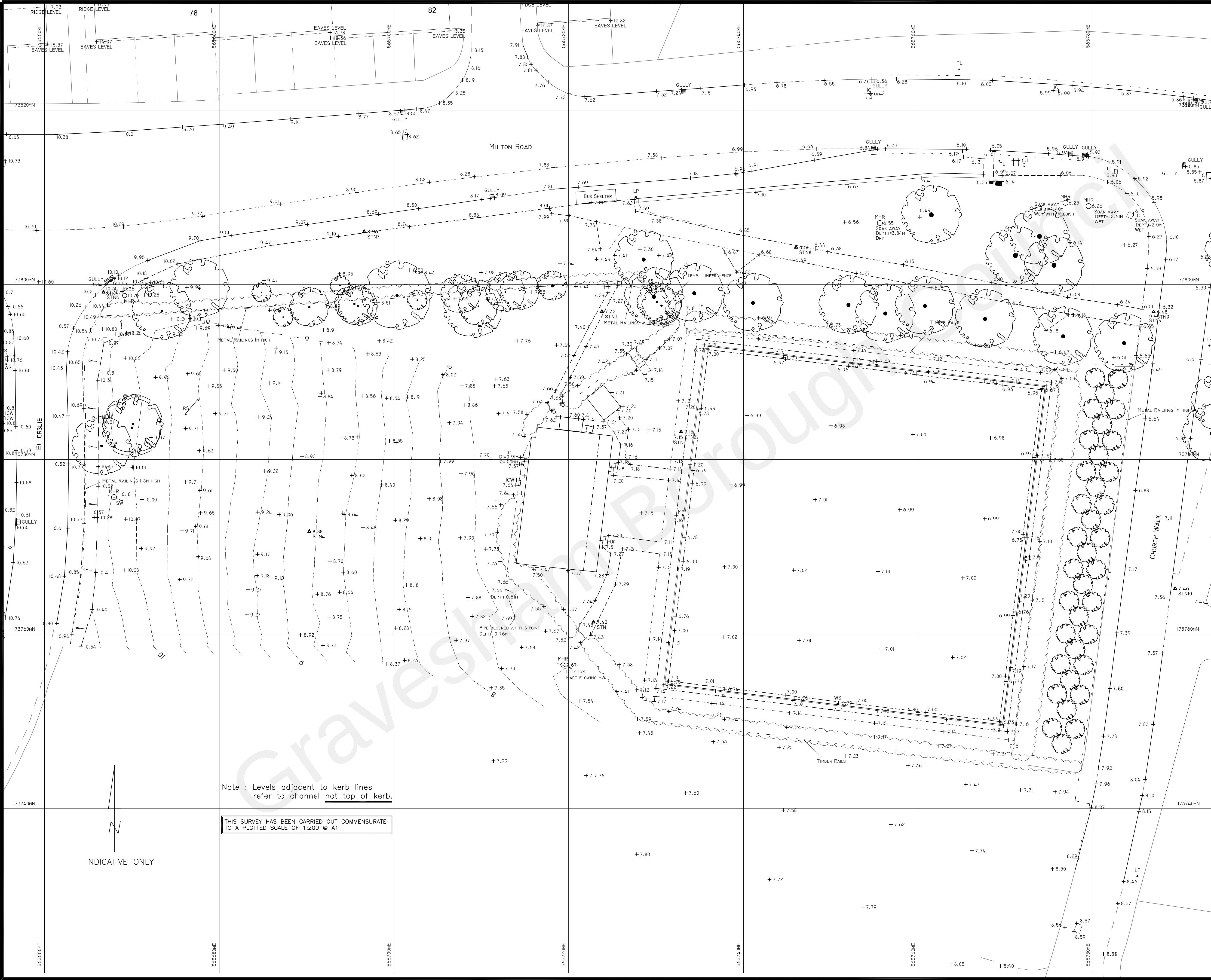
Gravesend





APPENDIX C – TOPOGRAPHICAL AND SEWER SURVEY

Gravesham Borough Council



DRG NO: PP/4081/GRAVESEND/FI

LEGEND

- A AREA
- CATV CABLE TV SERVICE COVER
- CF CELLAR FLAP
- CP COAL PLATE
- E ELECTRICITY SUPPLY
- FH FIRE HYDRANT
- IC INSPECTION CHAMBER
- KL LOWERED KERB FOR ACCESS
- LP LAMP POST
- MH MANHOLE
- NP ROAD NAME PLATE
- PL PAVEMENT LIGHT
- RS ROAD SIGN
- STN SURVEY STATION
- T BT SERVICE BOX
- TGB TELEPHONE CALL BOX
- TL TRAFFIC LIGHTS
- TP TELEGRAPH POLE
- UP STEP ARROW
- DN RAMP ARROW
- (D) DEAD OR (P) POLLARDED TREE
- DECIDUOUS TREE (INDIVIDUALLY SHOWN)
- EVERGREEN TREE (INDIVIDUALLY SHOWN)
- TREES (DECIDUOUS) - PART OF A GROUP OF TREES

4081-Gravesend-F1.dwg

STATION CO-ORDINATES

STATION	TYPE	EASTING	NORTHING	LEVEL
STN5	NAIL	565653.698	173760.255	10.949
STN6	NAIL	565666.769	173799.143	10.354
STN7	NAIL	565696.588	173806.082	8.956
STN8	NAIL	565746.023	173804.283	6.510
STN9	NAIL	565786.941	173796.899	6.475
STN10	NAIL	565789.405	173765.214	7.463

COORDINATE INFORMATION:
ALL LEVELS IN METRES TO ORDNANCE SURVEY
DATUM AND BASED ON NATIONAL GRID FROM RTK GPS
AND ADJUSTED INTO OS ACTIVE NETWORK

REV	DRG. AMENDMENTS	BY	DATE
B	ADDITIONAL LEVELS ADDED AND MANHOLE IN CHURCH WALK LOCATED	RW	17-05-22
A	LEVEL TYPE CORRECTED ALONG ELLERSLIE RD. COVERS INVESTIGATED & TRACED.	RW	11-04-22

MCCARTHY & STONE

85 GREAT NORTH ROAD
HATFIELD
HERTS AL9 5DA

GRAVESEND RFC BOWLS CLUB

GRAVESEND
KENT DA12 2TL

TOPOGRAPHICAL SURVEY

PROSPAPLANS LIMITED

LAND & ENGINEERING SURVEYORS
O'HANA HOUSE
BEETLEY
NORFOLK
NR20 4FE

T: +44 (0) 1362 668504
E: INFO@PROSPAPLANS.COM
W: WWW.PROSPAPLANS.COM

Operating to ISO9001:2000

SCALE: 1:200@A1

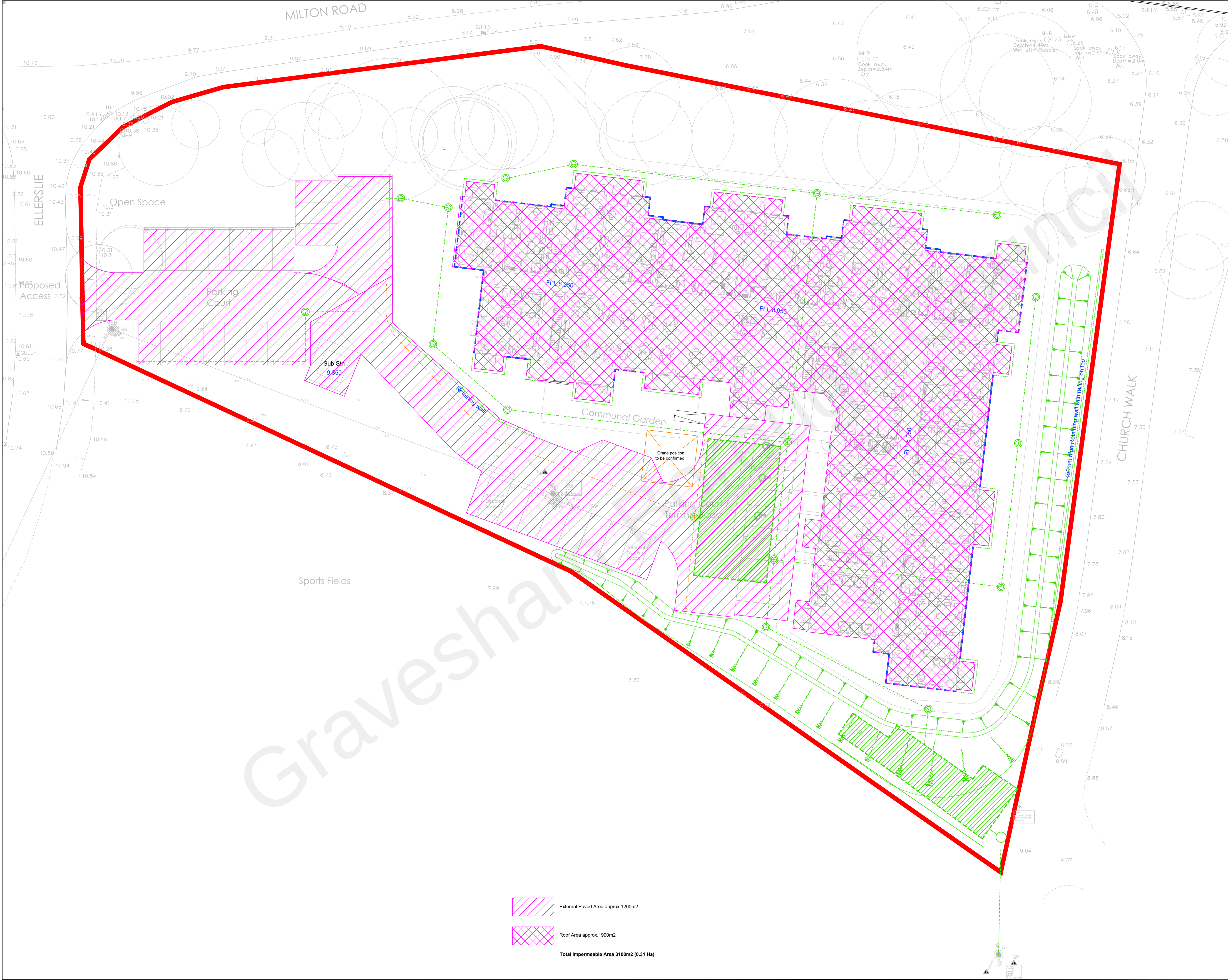
DATE: DEC 2021

DRAWN BY: R WELTON
CHECKED BY: G RUTHERFORD

DRG NO: PP/4081/GRAVESEND/FI

**APPENDIX D – PROPOSED DRAINAGE STRATEGY LAYOUTS
& DRAINAGE AREA PLANS**

Gravesham Borough Council



PRELIMINARY

Notes

B	Site Plan and drainage revised	21.10.22
A	Site Plan and drainage revised	20.10.22
-	First Issue	03.10.22

Rev	Description	Date
Status:		
Stage 3		

Scale : 1:200@A1

Date : Oct 22

Drawn : IDL

Checked: BM

Approved: PT

Title :
Drainage Area Plan

Project :
Bowls Club, Gravesend

Dwg. No:	Rev:	File Ref:	LSE-2821-03-DE-102
LSE-2821-03-DE-102	B	Plot Ref:	LSE-2821-03-DE-102

33 The Point
Rockingham Road
Market Harborough
Leicestershire LE16 7QU
Tel: 01858 411570 Fax: 01858 411571
Email: info@infrades.co.uk URL: www.infrades.co.uk

INFRASTRUCTURE DESIGN LIMITED
working for
McCarthy Stone
Life, well lived

PRELIMINARY

Notes

C	Site Plan and drainage revised	21.10.22
B	Site Plan and drainage revised	20.10.22
A	Site Plan and drainage revised	28.09.22
-	First Issue-sketch proposal	25.05.22

Rev	Description	Date
-----	-------------	------

Status:

Stage 3

	Scale : 1:200@A1		
	Date : May 22	Checked:	Approved:
	Drawn : IDL	BM	PT

Title :
Proposed Drainage Plan

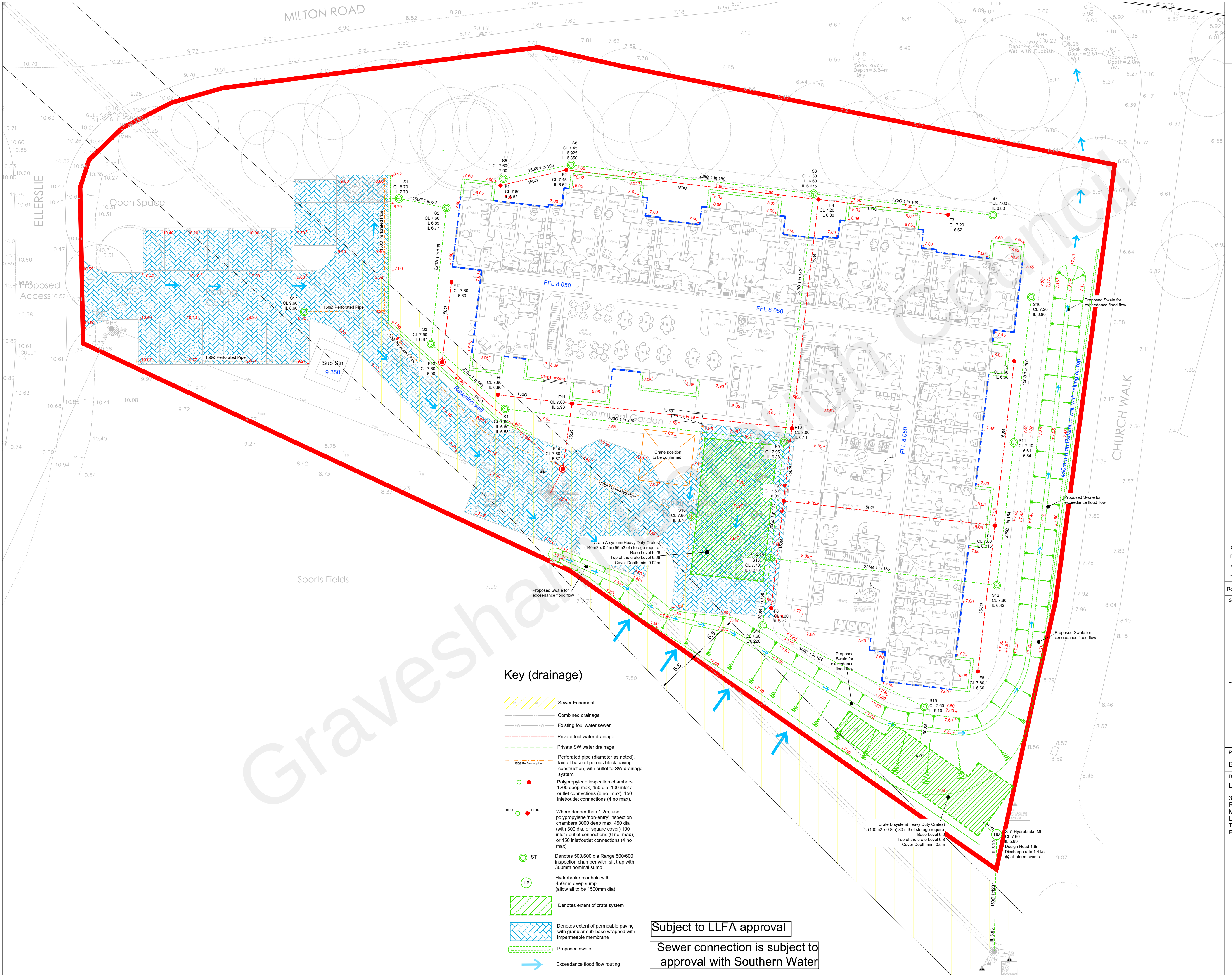
Project :
Bowls Club, Gravesend

Drg. No:	Rev:	File Ref:	LSE-2821-03-DE-101
LSE-2821-03-DE-101	C	Plot Ref:	LSE-2821-03-DE-101

33 The Point
Rockingham Road
Market Harborough
Leicestershire LE16 7QU
Tel: 01858 411570 Fax: 01858 411571
Email: info@infrades.co.uk URL: www.infrades.co.uk

iDLTD
INFRASTRUCTURE DESIGN LIMITED
working for

McCARTHY STONE
Life, well lived



Key (drainage)

- Sewer Easement
- Combined drainage
- FW - FW Existing foul water sewer
- Private foul water drainage
- Private SW water drainage
- Perforated pipe (diameter as noted), laid at base of porous block paving construction, with outlet to SW drainage system.
- Polypropylene inspection chambers 1200 deep max, 450 dia, 100 inlet / outlet connections (6 no. max), 150 inlet/outlet connections (4 no max).
- Where deeper than 1.2m, use polypropylene 'non-entry' inspection chambers 3000 deep max, 450 dia (with 300 dia. or square cover) 100 inlet / outlet connections (6 no. max), or 150 inlet/outlet connections (4 no max)
- ST Denotes 500/600 dia Range 500/600 inspection chamber with silt trap with 300mm nominal sump
- HB Hydrobrake manhole with 450mm deep sump (allow all to be 1500mm dia)
- Denotes extent of grate system
- Denotes extent of permeable paving with granular sub-base wrapped with Impermeable membrane
- Proposed swale
- Exceedance flood flow routing

Subject to LLFA approval

Sewer connection is subject to approval with Southern Water

Notes

B	Site Plan and levels revised	21.10.22
A	Site Plan and levels revised	20.10.22
-	First Issue	03.10.22

Rev	Description	Date
-----	-------------	------

Status:

Stage 3

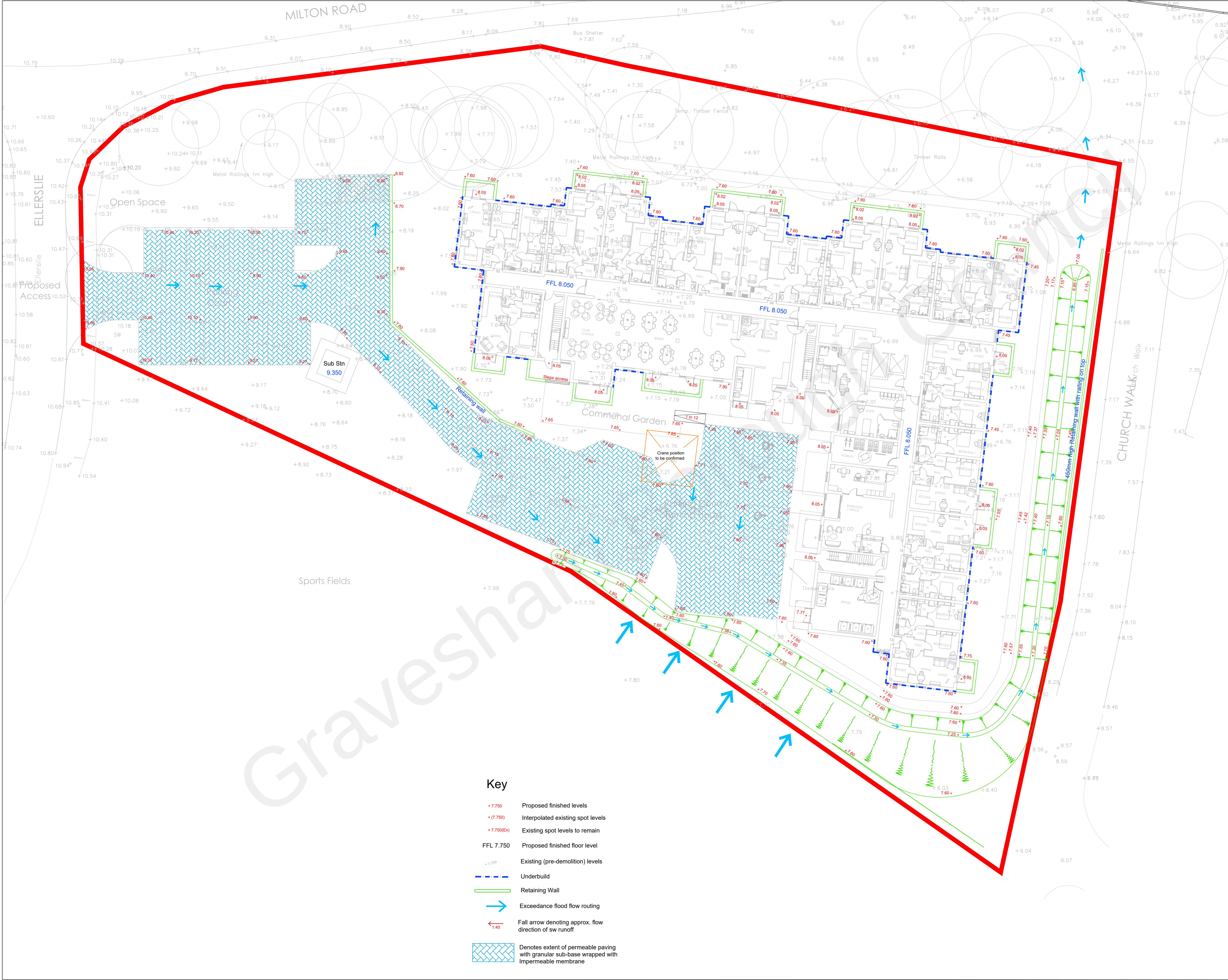
	Scale : 1:200@A1		
	Date : Oct 22	Checked:	Approved:
	Drawn : IDL	BM	PT

Title :
Proposed Levels Plan

Project :
Bowls Club, Gravesend

Dwg. No:	Rev:	File Ref:	LSE-2821-03-DE-102
LSE-2821-03-DE-102	B	Plot Ref:	LSE-2821-03-DE-102

33 The Point
Rockingham Road
Market Harborough
Leicestershire LE16 7QU
Tel: 01858 411570 Fax: 01858 411571
Email: info@infrades.co.uk URL: www.infrades.co.uk



Key

- +7.750 Proposed finished levels
- + (7.750) Interpolated existing spot levels
- +7.750(Ex) Existing spot levels to remain
- FFL 7.750 Proposed finished floor level
- +7.750 Existing (pre-demolition) levels
- Underbuild
- Retaining Wall
- Exceedance flood flow routing
- Fall arrow denoting approx. flow direction of sw runoff
- Denotes extent of permeable paving with granular sub-base wrapped with impermeable membrane



APPENDIX E – SURFACE WATER DRAINAGE CALCULATION

Gravesham Borough Council

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	100	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)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Circular Default Sewer Type Link Type

Shape	Circular	Auto Increment (mm)	75
Barrels	1	Follow Ground	x

Available Diameters (mm)

150

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.012	5.00	8.700	600	565701.606	173790.891	1.000
2			7.600	600	565707.154	173789.803	0.830
3			7.600	600	565705.345	173773.889	0.930
4	0.019	5.00	7.600	600	565714.028	173766.275	1.070
5	0.019	5.00	7.600	450	565713.833	173793.184	0.600
6	0.019	5.00	7.450	600	565721.742	173794.852	0.600
7	0.019	5.00	7.600	600	565771.069	173788.963	0.800
8	0.019	5.00	7.300	600	565750.106	173791.465	0.700
9	0.019	5.00	7.950	600	565746.657	173762.458	1.570
10	0.019	5.00	7.300	450	565775.568	173779.367	0.500
11	0.019	5.00	7.200	600	565773.533	173762.361	0.660
12	0.019	5.00	7.400	600	565771.534	173745.637	0.970
13	0.019	5.00	7.600	600	565745.062	173748.812	1.330
14	0.108	5.00	7.600	600	565744.143	173740.945	1.380
15			7.600	600	565763.049	173731.419	1.576
16		5.00	7.600	1500	565771.522	173716.488	1.610
Ourfall			9.300	1	565771.224	173702.801	3.450

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	1	2	5.654	0.600	7.700	6.850	0.850	6.7	150	5.02	50.0
1.001	2	3	16.016	0.600	6.770	6.670	0.100	160.2	225	5.28	50.0
1.002	3	4	11.548	0.600	6.670	6.600	0.070	165.0	225	5.47	50.0
1.003	4	9	32.852	0.600	6.530	6.380	0.150	219.0	300	5.99	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	3.932	69.5	1.6	0.850	0.600	0.012	0.0	16	1.652
1.001	1.030	41.0	1.6	0.605	0.705	0.012	0.0	30	0.501
1.002	1.015	40.4	1.6	0.705	0.775	0.012	0.0	30	0.494
1.003	1.058	74.8	4.2	0.770	1.270	0.031	0.0	48	0.575

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)
2.000	5	6	8.083	0.600	7.000	6.925	0.075	107.8	150	5.14	50.0
2.001	6	8	28.566	0.600	6.850	6.675	0.175	163.2	225	5.61	50.0
3.000	7	8	21.112	0.600	6.800	6.675	0.125	168.9	225	5.35	50.0
2.002	8	9	29.211	0.600	6.600	6.380	0.220	132.8	300	5.96	50.0
1.004	9	13	13.739	0.600	6.380	6.270	0.110	124.9	300	6.15	50.0
4.000	10	11	17.127	0.600	6.800	6.610	0.190	90.1	150	5.27	50.0
4.001	11	12	16.843	0.600	6.540	6.430	0.110	153.1	225	5.54	50.0
4.002	12	13	26.662	0.600	6.430	6.270	0.160	166.6	225	5.98	50.0
1.005	13	14	7.920	0.600	6.270	6.220	0.050	158.4	300	6.26	50.0
1.006	14	15	21.170	0.600	6.220	6.100	0.120	176.4	300	6.56	50.0
5.000	16	Ourfall	13.690	0.600	5.990	5.850	0.140	97.8	150	5.22	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)
2.000	0.967	17.1	2.6	0.450	0.375	0.019	0.0	40	0.700
2.001	1.020	40.6	5.1	0.375	0.400	0.038	0.0	54	0.704
3.000	1.003	39.9	2.6	0.575	0.400	0.019	0.0	38	0.564
2.002	1.363	96.3	10.3	0.400	1.270	0.076	0.0	66	0.898
1.004	1.405	99.3	17.1	1.270	1.030	0.126	0.0	83	1.057
4.000	1.059	18.7	2.6	0.350	0.440	0.019	0.0	38	0.747
4.001	1.054	41.9	5.1	0.435	0.745	0.038	0.0	53	0.721
4.002	1.010	40.2	7.7	0.745	1.105	0.057	0.0	66	0.781
1.005	1.246	88.1	27.4	1.030	1.080	0.202	0.0	115	1.104
1.006	1.180	83.4	42.0	1.080	1.200	0.310	0.0	151	1.183
5.000	1.016	18.0	0.0	1.460	3.300	0.000	0.0	0	0.000

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	5.654	6.7	150	Circular_Default Sewer Type	8.700	7.700	0.850	7.600	6.850	0.600
1.001	16.016	160.2	225	Circular_Default Sewer Type	7.600	6.770	0.605	7.600	6.670	0.705
1.002	11.548	165.0	225	Circular_Default Sewer Type	7.600	6.670	0.705	7.600	6.600	0.775
1.003	32.852	219.0	300	Circular_Default Sewer Type	7.600	6.530	0.770	7.950	6.380	1.270
2.000	8.083	107.8	150	Circular_Default Sewer Type	7.600	7.000	0.450	7.450	6.925	0.375
2.001	28.566	163.2	225	Circular_Default Sewer Type	7.450	6.850	0.375	7.300	6.675	0.400
3.000	21.112	168.9	225	Circular_Default Sewer Type	7.600	6.800	0.575	7.300	6.675	0.400
2.002	29.211	132.8	300	Circular_Default Sewer Type	7.300	6.600	0.400	7.950	6.380	1.270
1.004	13.739	124.9	300	Circular_Default Sewer Type	7.950	6.380	1.270	7.600	6.270	1.030

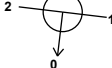
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	600	Manhole	Adoptable	2	600	Manhole	Adoptable
1.001	2	600	Manhole	Adoptable	3	600	Manhole	Adoptable
1.002	3	600	Manhole	Adoptable	4	600	Manhole	Adoptable
1.003	4	600	Manhole	Adoptable	9	600	Manhole	Adoptable
2.000	5	450	Manhole	Adoptable	6	600	Manhole	Adoptable
2.001	6	600	Manhole	Adoptable	8	600	Manhole	Adoptable
3.000	7	600	Manhole	Adoptable	8	600	Manhole	Adoptable
2.002	8	600	Manhole	Adoptable	9	600	Manhole	Adoptable
1.004	9	600	Manhole	Adoptable	13	600	Manhole	Adoptable

Pipeline Schedule

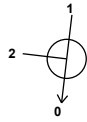
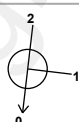
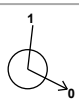
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
4.000	17.127	90.1	150	Circular_Default Sewer Type	7.300	6.800	0.350	7.200	6.610	0.440
4.001	16.843	153.1	225	Circular_Default Sewer Type	7.200	6.540	0.435	7.400	6.430	0.745
4.002	26.662	166.6	225	Circular_Default Sewer Type	7.400	6.430	0.745	7.600	6.270	1.105
1.005	7.920	158.4	300	Circular_Default Sewer Type	7.600	6.270	1.030	7.600	6.220	1.080
1.006	21.170	176.4	300	Circular_Default Sewer Type	7.600	6.220	1.080	7.600	6.100	1.200
5.000	13.690	97.8	150	Circular_Default Sewer Type	7.600	5.990	1.460	9.300	5.850	3.300

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
4.000	10	450	Manhole	Adoptable	11	600	Manhole	Adoptable
4.001	11	600	Manhole	Adoptable	12	600	Manhole	Adoptable
4.002	12	600	Manhole	Adoptable	13	600	Manhole	Adoptable
1.005	13	600	Manhole	Adoptable	14	600	Manhole	Adoptable
1.006	14	600	Manhole	Adoptable	15	600	Manhole	Adoptable
5.000	16	1500	Manhole	Adoptable	Ourfall	1	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	565701.606	173790.891	8.700	1.000	600				
						0	1.000	7.700	150
2	565707.154	173789.803	7.600	0.830	600				
						0	1.001	6.770	225
3	565705.345	173773.889	7.600	0.930	600				
						0	1.002	6.670	225
4	565714.028	173766.275	7.600	1.070	600				
						0	1.003	6.530	300
5	565713.833	173793.184	7.600	0.600	450				
						0	2.000	7.000	150
6	565721.742	173794.852	7.450	0.600	600				
						0	2.001	6.850	225
7	565771.069	173788.963	7.600	0.800	600				
						0	3.000	6.800	225
8	565750.106	173791.465	7.300	0.700	600				
						1	3.000	6.675	225
						2	2.001	6.675	225
						0	2.002	6.600	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
9	565746.657	173762.458	7.950	1.570	600		1	2.002	6.380	300
							2	1.003	6.380	300
							0	1.004	6.380	300
10	565775.568	173779.367	7.300	0.500	450		0	4.000	6.800	150
11	565773.533	173762.361	7.200	0.660	600		1	4.000	6.610	150
							0	4.001	6.540	225
12	565771.534	173745.637	7.400	0.970	600		1	4.001	6.430	225
							0	4.002	6.430	225
13	565745.062	173748.812	7.600	1.330	600		1	4.002	6.270	225
							2	1.004	6.270	300
						0	1.005	6.270	300	
14	565744.143	173740.945	7.600	1.380	600		1	1.005	6.220	300
							0	1.006	6.220	300
15	565763.049	173731.419	7.600	1.576	600		1	1.006	6.100	300
16	565771.522	173716.488	7.600	1.610	1500		0	5.000	5.990	150
Ourfall	565771.224	173702.801	9.300	3.450	1		1	5.000	5.850	150

Simulation Settings

Rainfall Methodology	FEH-13	Skip Steady State	x	2 year (l/s)	1.3
Summer CV	0.950	Drain Down Time (mins)	240	30 year (l/s)	2.9
Winter CV	0.950	Additional Storage (m³/ha)	20.0	100 year (l/s)	3.7
Analysis Speed	Normal	Check Discharge Rate(s)	✓	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

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

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)	0.310	Betterment (%)	0
SAAR (mm)	555	QBar	1.5
Soil Index	5	Q 2 year (l/s)	1.3
SPR	0.53	Q 30 year (l/s)	2.9
Region	6	Q 100 year (l/s)	3.7
Growth Factor 2 year	0.88		

Node 16 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	5.990	Product Number	CTL-SHE-0050-1400-1600-1400
Design Depth (m)	1.600	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.4	Min Node Diameter (mm)	1200

Node 16 Flow through Pond Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Main Channel Length (m)	17.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	5.990	Main Channel Slope (1:X)	500.0
Safety Factor	2.0	Time to half empty (mins)		Main Channel n	0.030

Inlets

15

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	100.0	0.0	0.400	100.0	0.0	0.800	100.0	0.0	0.801	0.0	0.0

Node 13 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	6.270
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	136.0	0.0	0.400	136.0	0.0	0.401	0.0	0.0

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

APPENDIX F – MANAGEMENT & MAINTENANCE REGIME

The Management Company

The responsibility for maintenance of all elements of the development remains with McCarthy and Stone Lifestyle Developments Ltd until handed over to the Management Company. Once handed over, the building will be managed by McCarthy & Stone Management Services (MSMS), the in-house management company for McCarthy & Stone. Following the handover, MSMS is responsible for all aspects of the maintenance. Handover of the building to the Management Company typically takes place prior to occupation. At handover the Management Company and Managing Agent receive as built information together with operating and maintenance manuals which detail all maintenance protocols.

Within the first two years from the first occupation, there is a two-year warranty on the communal parts of the building. There is also a two-year warranty on the individual apartments, which commences from the date of legal completion of the individual apartment. Defects should be reported to the Estates Manager, who is an employee of MSMS, and they will log the defect with McCarthy & Stone's Customer Services team

Crate Attenuation

The principle means of surface water attenuation/disposal from the development is by way of cellular storage.

The Management Company will ensure that the following measures are undertaken to ensure the longevity of the surface water drainage system;

Inspections to identify any areas not operating correctly, pollution, blocked inlets or outlets, standing water etc.

Collect and remove from site all extraneous rubbish that is detrimental to the operation or detract from the appearance of the site, including paper, bottles, cans and similar debris.

Onsite Surface Water Drainage System (generally)

The Management Company will ensure that the following measures are undertaken to ensure the longevity of the surface water drainage system;

Every 6 months: Remove silt build up from **all** catchpits and road gullies.

Annually: elect approx. 20% of the development's surface water inspection chambers (situated in accessible non-private areas) and inspect for blockages / silt build up. Remove silt and debris. Rotate on a 5 yearly cycle to cover all such chambers over this period.

Every 2-5 years (depending on outcome of aforementioned inspections)

Commission a CCTV survey and report on condition of the surface water piped drainage system upstream of the soakaways to check for structural integrity and hydraulic fluidity. Carry out promptly any remedial work as advised by CCTV company.

Flow Control Chambers

Flow control chambers are to be maintained by the McCarthy & Stone Management Services (MSMS). Their maintenance regime shall be as follows:

Following installation of the Flow Controls any extraneous material i.e. Building materials are removed from the unit and the chamber. After the system is made live, the unit is to be inspected monthly for three months and thereafter at six monthly intervals with hose down if required. The Hydrobrake Flow Control is fitted with a pivoting by-pass door, which allows the manhole chamber to be drained down should blockages occur. Following the drain down and clearance of the blockage the pivoting by-pass door must be returned to the closed position to enable the hydrobrake to function as designed.

The chambers are to be cleared checked for structural integrity at the six monthly interval. Any damage/problems should be made good as per the original design drawings.

Permeable Paving

External parking areas and access roads are to be constructed in permeable block paving in order to;

- a) Delay the surface water runoff from these areas, and
- b) Enhance the quality of the rainwater prior to discharge into the receiving sewer.

The Management Company will ensure that the following measures are undertaken to ensure the longevity of the pervious pavement;

Quarterly

- i) Inspect the pervious pavement for signs of ponding and ensure there is no migration of soils from adjacent landscaped areas or other deleterious material that may prematurely clog up the jointing stone situated in the gaps between the blocks. Ideally this type of inspection should be undertaken immediately following a heavy rainfall event.
- ii) Commission vacuum sweeping and brushing of the pervious pavement to ensure joints are kept free of silt. Minimum 3 sweeping per year, thus;
 - a) End of Winter (April) – to collect winter debris
 - b) Mid-Summer (July/August) – to collect dust, flower and grass-type deposits.
 - c) After Autumn leaf fall (November)

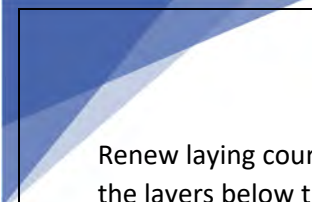
The company commissioned to carry out this work should ensure that their vacuum equipment is adjusted accordingly to avoid the removal of jointing material.

Any lost material should be replaced promptly to avoid the blocks from being dislodged.

Last Resort Remedial Action

- i) Should a portion of the pervious pavement become substantially impervious due to excessive siltation, the following procedure should be followed;
 - a) Lift block paving and laying course
 - b) Break out underlying bitmac base layer and replace with similar compacted depth of course aggregate subbase material to BS EN 13242:2002 Type 4/20, wrapped in geotextile as Terram 1000 or similar.
 - c) Renew laying course, replace blocks and renew jointing material

NB. Material removed from the voids or the layers below the surface may contain heavy metals and hydrocarbons and as such may need to be disposed of as 'controlled waste'. Sediment testing should be carried out before disposal to confirm its classification and appropriate disposal methods.



Renew laying course, replace blocks and renew jointing material.NB. Material removed from the voids or the layers below the surface may contain heavy metals and hydrocarbons and as such may need to be disposed of as 'controlled waste'. Sediment testing should be carried out before disposal to confirm its classification and appropriate disposal methods.

Gravesham Borough Council