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SURFACE WATER DRAINAGE DESIGN

HOWE BARRACKS

April 2018
34109/R004/AJB

SURFACE WATER DRAINAGE DESIGN
FOR
HOWE BARRACKS

Report Status: DRAFT Date of Issue: April 2018 REV B		
	Name	Signature & Date
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1 INTRODUCTION

This report details the proposed surface water drainage design for the development to the Howe Barracks development and has been written to address planning conditions for that site.

2 SITE DESCRIPTION

The site is located at NGR TR 16583 58162 to the East of Canterbury city centre. It is a brownfield site which has previously been used as a military barracks.

It is a roughly trapezoidal site with frontage onto Littlebourne Road and benefits from access onto Chaucer Road. The site is currently a partial brownfield site which covers a total area measuring 28 Ha.

The site has a gentle fall from east to west and from south to north but falls sharply through Chaucer Road and in the northwest corner near the proposed Legacy Park area.

3 EXISTING DRAINAGE

The sewer map for the locality shows surface and foul water sewers adjacent to the site in Littlebourne Road. It is believed that there is not capacity within the existing surface water sewer network to accept any additional flows. However, the existing development located within Howe barracks is estimated to contribute into the public surface water sewer with discharge rates estimated to be approximately 115L/s for the 1 in 30 year storm return period (see existing contributing area plan, Appendix A) and 145L/s for the 1 in 100 year storm return period

The developed site would cover an area of 13.8Ha with the additional land given over to park land and conservation areas; and this would have an estimated greenfield run-off rate of 27.3L/s.

The equivalent area based on Canterbury City Council's Brownfield run off rate, at a maximum of 4L/s/ha, would produce a peak controlled discharge rate site wide of approximately 55L/s which would be an improvement over the existing surface water sewer discharge. All existing and new connections would be subject to the agreement of Southern Water and will require a Section 106 agreement.

Proposals are for Phase 1 to discharge at a controlled 15L/s and for the remaining phases to discharge at a controlled rate of 40L/s and that the surface water sewers will be offered for adoption under a formal Section 106 agreement with Southern Water.

4 GEOLOGY & HYDROGEOLOGY

Following on from recent ground investigations, the prevailing ground conditions consist of a gravelly clay head deposits overlying fine sand with localised deposits of made ground.

Infiltration across the development has been found to be variable with results indicating that within the gravelly head deposits infiltration rates are medium to low but within the fine sand these are low to very low intrusive

Infiltration tests have revealed soakage rates of $1.6x10^{-5}$m/s within the gravely head deposits, and 1.00×10^{-10}m/s within the fine sandy strata (see appendix A).

The site is set upon a minor aquifer and is located outside of an Environment Agency area defined Groundwater Source Protection Zone,

5 PROPOSED PHASE 1 DEVELOPMENT

For Phase 1 it is proposed to construct 171 dwellings with associated access roads and hardstanding areas.

It is proposed to discharge the majority of the surface water runoff generated by roof and private areas from this development to ground via a series of shallow soakaways into the gravely head deposits. A proportion of the residential surface water run-off will discharge into a new surface water sewer located in the carriageway. The new surface water sewer will be offered for adoption under a formal section 104 agreement with Southern water and will discharge to the existing public surface water in Littlebourne Road.

The proposed residential soakaways would be in the form of permeable paving located in private parking areas and forecourts.

The following table indicates depth of permeable sub-base required for a 1 in 100 year rainfall event plus 20% allowance for climate change. Allowing for a further additional 10% increase in area for urban sprawl, Sub-base depth have been standardised to allow for the maximum sub-base depth of 440mm. Additional volumes predicted during the 40% climate change event would be located within the sand and block courses with a slight possibility of minimal surface water flooding in a few locations. It is not believe that any surface water flows will be generated during the 1 in 100 year event plus 40% allowance for climate change. Finished floor levels have been set 150mm above finished ground levels and no flooding has been predicted

PRIVATE IMPERMEABLE AREAS					
Plot Numbers	Contributing Area (m^2)	Private Impermeable Area (m^2)	Depth Of Sub-Base Required (mm)	Half drain time (minutes)	Urban Sprawl
1-2	250	85	401	206	440
3-4	250	85	401	206	440
5-13	740	437	183	93	204
14-15	220	80	350	177	393
16-17	220	80	350	177	393
18-19	240	80	393	200	437
20-25	490	214	275	145	304
26-27	220	85	323	162	363
28-29	210	75	359	181	405
30-31	210	75	359	181	405
32	100	37	342	225	389
33	110	37	389	172	435
34	90	31	377	199	432
35	90	31	377	190	432
36	100	37	342	190	435
37	100	37	342	199	389
38-39	210	75	359	172	382
40-41	200	75	336	187	382
42-49	860	448	217	169	248
50-56 59-60 63-69	1410	595	319	160	363
54-56	260	85	401	212	440
57	110	38	375	172	430

58	110	38	375	172	430
61	110	38	375	212	430
62	110	38	375	212	430
63-65	260	85	403	112	440
70-77	690	224	407	208	440
78	90	38	287	153	330
79-81	170	64	334	167	415
82-86 & 93	820	400	237	123	268
87	180	82	260	136	298
88	130	46	326	164	363
89	170	71	291	153	338
90-93	570	500	177	89	190
94-95	160	70	274	144	320
96-97	230	78	384	195	429
98-99	230	78	384	195	429
100-101	220	78	362	184	407
102	130	46	326	180	363
103-104	260	95	348	176	392
105-106	260	95	348	176	392
107-108	260	95	348	176	392
109-110	240	80	393	200	437
111-113	220	87	313	167	352
114	85	30	281	169	336
115	110	42	328	175	369
116-117	210	80	329	166	372
118-120	320	106	397	202	435
121-125	480	230	243	127	270
126-128	460	243	213	110	238
129-130	240	95	312	167	348
131-132	200	77	324	163	369
136-137	380	240	163	90	187
138-139	220	79	356	180	400
140-141	250	106	285	151	306
142	110	46	326	172	363
143-144	200	69	376	191	426
145-148	400	182	260	136	294
149	110	40	339	200	375
150-153	700	352	228	118	258
155-158	430	207	242	126	271
159-171	840	404	242	126	271

Based on a infiltration rate of $1.6x10^{-5}$m/s

6 PUBLIC SURFACE WATER SEWERS

Highway drainage and a proportion of the residential drainage is proposed to flow into a Public Surface Water Sewer located within the adoptable highway and to discharge into the existing Public Surface Water Sewer in Littlebourne Road. Discharge would be controlled via a hydro brake to a maximum of 15 L/s.

Current design criteria for adoptable drainage is for the 1 in 30 year event plus 30% allowance for climate change. Windes calculations indicate that the current design complies with this storm event.

Discussions with Southern Water have been progressed and a verbal agreement has been reached on the surface water discharge from Phase 1 into Littlebourne Road. These are

currently being vetted by Southern Water with a view to offering the onsite drainage for adoption under a Section 104 agreement.

Projecting the rainfall event to allow for the 1 in 100 year plus 20% allowance for climate change indicate flooding from the system at MH AS12 close to plots 150-153. Flooding route would indicate that any flooding would flow westwards away from the dwelling and into the buffer zone area. Predicted flooding from the 1 in 100 year event plus 20% allowance for climate change is 36 m^3 and would cover an area of approximately 3720 m^2 to a depth of 9.6mm. The predicted flooding depth from the 1 in 100 year plus 40% climate change would be 23mm. These areas would be within the soakage strata and therefore any flooding would be soak over time.

7 CLIMATE CHANGE

Surface water run-off has be calculated for the 1 in 100 year return period plus a 20% allowance for climate change. Any flooding for the 1 in 100 year return period with 40% allowance for climate change should be reviewed for potential flooding issues.

A 10% allowance for urban sprawl should also be factored into the calculations.

As the design and planning consent pre-dates the advice from Flood and Water Managements issued in June 2017, regarding using a modified FSR or FEH value has not been incorporated in the design, as discussed with FWM. However, estimates from the worst case system indicates that using the revised figures, these areas would be liable to flooding to a depth of 5.2mm across the surface area of the driveway, this depth of water would not be likely to run-off into the carriageways but be contained within the area covered by the permeable paving and eventually soak back into the permeable pavement.

8 POTENTIAL ADVERSE IMPACTS ON GROUNDWATER

Water Quality

The proposed land use for this site is residential thus there will be no pollution generated beyond the usual road runoff. This is likely to contain the following pollutants which would have varying effects on the receiving groundwater:-

- sediments
- metals (zinc, copper, cadmium)
- hydrocarbons (oil and fuel) including polycyclic aromatic hydrocarbons (PAH)
- pesticides and herbicides (from landscaping maintenance)
- chlorides (from de-icing).

The level of pollution associated with any runoff event depends on a number of factors including the type of site, the length of time since the last rainfall event (runoff that occurs after long dry periods will tend to be more polluted), and the duration and intensity of the rainfall itself.

Surface water runoff has higher concentrations of pollutants near the beginning of a storm, known as the "first flush", due to higher initial rainfall intensities, greater erosion potential and greater availability of solids and pollutants that have built up on urban surfaces during the preceding dry weather period. Consequently it is most important that the surface water from these storms is dealt with effectively.

9 MITIGATION STRATEGY

Water Quality

The SUDS Manual (CIRIA C697) recommends that the best solution for dealing with surface water runoff from a development is to mimic the natural catchment processes as closely as possible which is done by creating a "management train" of treatment processes. This concept is fundamental to designing a successful SUDS scheme – it uses drainage techniques in series to incrementally reduce pollution, flow rates and volumes.

Wherever possible, storm water should be managed as close to its source as possible rather than being conveyed to large systems at the bottom of drainage areas (end of pipe solutions). The techniques that are higher in the hierarchy are preferred to those further down so that prevention and control of water at source should always be considered before site or regional controls. However, where upstream control opportunities are restricted, a number of lower hierarchy options should be used in series. Water should be conveyed elsewhere only if it cannot be dealt with on site.

The SUDS Manual goes on to recommend the appropriate number of treatment processes for each area depending upon the end land use and the sensitivity of the receiving waters, ranging from low to high. Table 5.6, summarised below, indicates that for a receiving environment such as this the following numbers of treatment processes will be required

	Table 5.6
Receiving Water Sensitivity	MEDIUM
Runoff catchment	
Roofs Only	1
Residential Roads, Parking Areas,	2

The current surface water drainage scheme for the development comprises two stages for the adoptable highways and residential parking and one stages for the roof area as listed below.

Treatment Stage	Adoptable Roads	Residential Area Roads	Roofs
1	Trapped Gully	Trapped Gully	Permeable Paving
2	Catchpits	Permeable Paving	

The typical pollutants to be expected on this site as discussed earlier are likely to be

- sediments
- metals (zinc, copper, cadmium)
- hydrocarbons (oil and fuel) including polycyclic aromatic hydrocarbons (PAH)
- pesticides and herbicides (from landscaping maintenance)
- chlorides (from de-icing).

These need differing methods to remove them from the surface water.

Improvements to stormwater quality can be achieved by filtering the runoff using, for example, sand filters, gravels (e.g. permeable pavements, filter trenches), soils (e.g. bioretention), grasses and other surface vegetation (e.g. swales, detention basins) or aquatic vegetation (e.g. wetlands). The travel time or flow velocity through the system is specified to maximise treatment benefits.

Storing runoff volumes within detention basins contributes mainly to meeting the runoff rate criteria, but such systems also allow sedimentation to take place which contributes to water quality improvement.

Maintenance Requirements

It is essential that a regular maintenance programme is established and carried out to ensure the optimum performance of the SUDS elements. This will establish who owns each facility and who is responsible for its maintenance. It will also detail the required actions and the frequency with which they should be undertaken.

Device	Location	Responsibility
Permeable Surfaces	Located within the curtilage of owner occupied properties	Freeholder of the property
	Located within shared areas	Management company on behalf of the site owner.
Sediment sumps & hydrodynamic vortex separator	Located within public highway	Kent Highways and or Southern water
Swales	Located within the Public open space	Management company on behalf of the site owner.

Permeable Pavements

Permeable pavements provide hardstanding areas and roads suitable for vehicular traffic whilst allowing rainwater to infiltrate through the surface and into the underlying layers. The water is temporarily stored in a specially designed sub-base before discharge to a soakaway system. At this site they will be surfaced using concrete blocks designed for permeable systems.

Before handing over these pavements to the site owner they should be inspected for clogging, litter, weeds and water ponding and all failures should be rectified. After handover, the facility should be inspected regularly, preferably during and after heavy rainfall to check effective operation and to identify any areas of ponding.

Permeable surfaces need to be regularly cleaned of silt and other sediments so that their infiltration capacity is retained. CIRIA advise a minimum of three surface sweepings per year, as noted below, using a brush and suction cleaner, which can be a lorry-mounted device or a smaller precinct sweeper.

To prevent the loss of permeable areas form re-development or re-use, a covenant needs to be included in the sale to protect the integrity of the soakaways.

1. End of winter (April) – to collect winter debris.
2. Mid-summer (July/August) – to collect dust, flower and grass-type deposits.
3. After autumn leaf fall (November).

Care should be taken in adjusting vacuuming equipment to avoid removal of jointing material and any lost material should be replaced.

Maintenance Schedule	Required action	Frequency
Regular maintenance	Brushing and vacuuming.	Three times/year as described above, or as required based on site-specific observations of clogging or manufacturers' recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required
	Removal of weeds	As required
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required
	Remedial work to any depressions or rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users.	As required
	Rehabilitation of surface and upper sub-structure if infiltration performance is reduced as a result of significant clogging.	As required
Monitoring	Initial inspection Inspect for evidence of poor operation and/or weed growth. If required take remedial action. Inspect silt accumulation rates and establish appropriate brushing frequencies.	Monthly for 3 months after installation 3-monthly and 48 h after large storms Annually.

Catchpits and Hydrodynamic Vortex Separators

Catchpits should be inspected on an annual basis by lifting the cover of the inspection points to observe the condition of the base and the inlet points.

As with the soakaway chambers regular sweeping of all contributing hard surfaces will reduce the sediment load within the surface water discharge.

The table below summarises the recommended maintenance regime for catchpits on the site:-

Maintenance Schedule	Required action	Frequency
Regular maintenance	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Remove sediment	Annually, or as required
Remedial actions	Repair/rehabilitation of 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 and after large storms

10 FOUL WATER

The existing site has a number of connections onto the public foul sewer in Littlebourne Road. A capacity check with Southern Water has confirmed that there is not sufficient capacity within the existing public sewer for the whole of the new development and that upgrade works will be required or an alternate route provided for this site.

A section 98 application with Southern water undertaken and Southern Water have proposed a preferred connection onto the sewers in Chaucer Road which would not include offsite upgrade works. This would have sufficient capacity for the whole of the development. It is proposed to discharge 83 units located in phase 1 into Littlebourne Road, being the current compatible discharge volume and to take the remaining 418 units into Chaucer Road.

11 PHASES 2 AND 3

It is proposed to construct 500 dwellings with associated access roads and hardstanding areas in a three phase development. Phase 1 of the development has an impermeable are of approximately 58% of the total site area. Phase 2 and 3 have been apportioned appropriately.

The total impermeable area for the proposed development has been summarised in the table below.

Impermeable Area	Total Area	Dwellings	Roofs	Private Drives	Shared Accesses	Public Highway
PHASE 1	57,539	171	10,322	3,669	4,367	12,778
PHASE 2#	48,173	217	10,598	2,410	4,820	10,838
PHASE 3#	35,752	112	7,865	1,678	3,572	8,044
SPINE ROAD	7,414	0				

based on projected areas from phase 1

Phases 2 & 3 will be subject to a separate reserved matters application, each subject to its own detailed surface water drainage scheme. Current proposals anticipate using a similar strategy as used in the phase 1 development.

12 CONCLUSION

1) The surface water from the site is currently being discharged into the public surface water sewer located in Littlebourne Road at an estimated peak rate of 115L/s and via deep soakaways located elsewhere on site.

2) The deep soakaway are founded in the fine sands and although provide sufficient volumes for the current site would not meet the half drain time required for current standards.

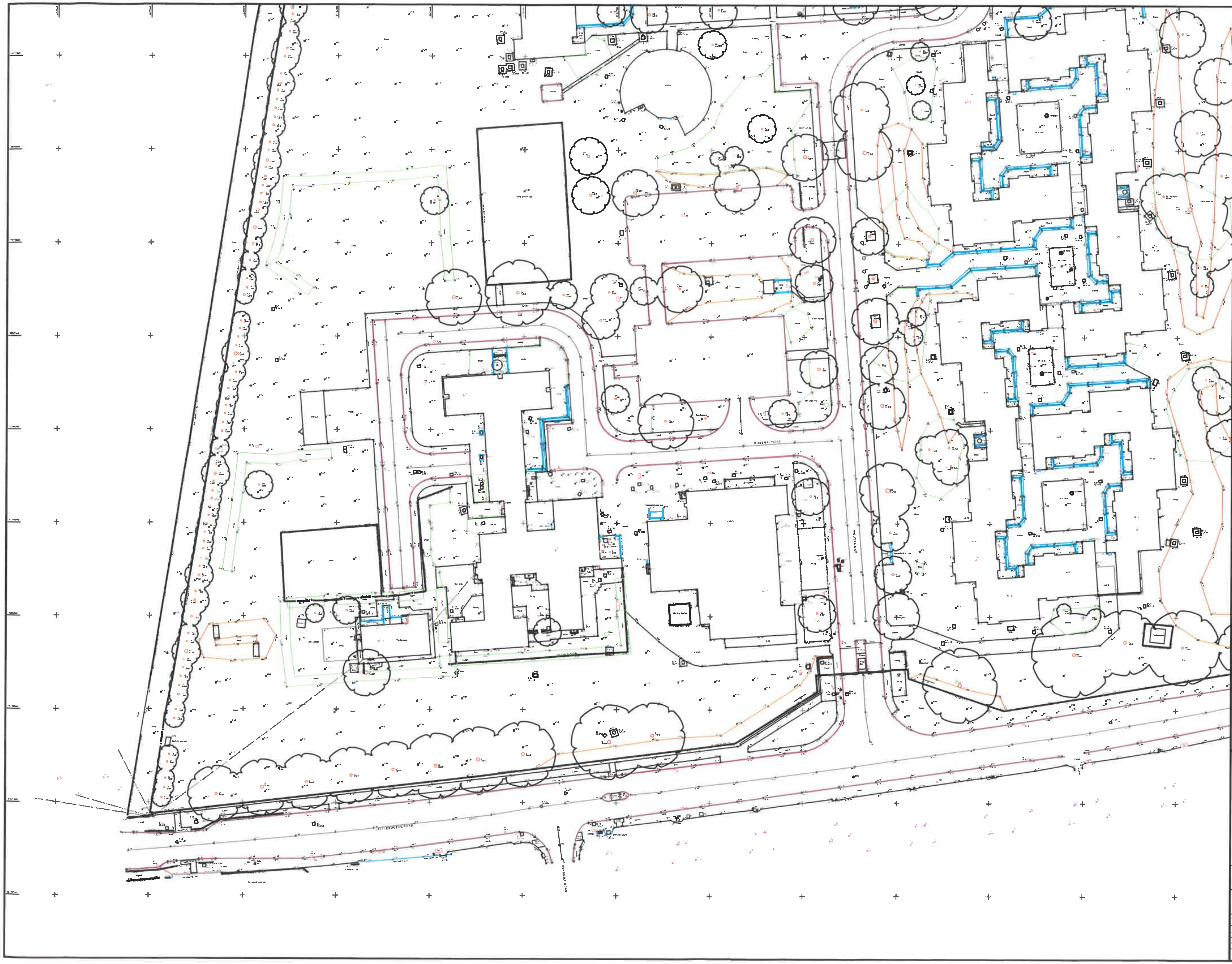
3) Infiltration test carried out across the site suggest that infiltration within the shallow gravely clayey head deposits would provide sufficient infiltration for the residential units and private drives.

4) Surface water sewers are to be offered for adoption with Southern Water under a Section 104 agreement. Highway drainage is proposed to discharge into the onsite surface water sewers and into the existing surface water sewer in Littlebourne Road at a controlled rate of not more than 15L/s and 40l/s for the remaining phases. Attenuation and flow controls will limit peak surface water across the development to a maximum 55L/s based on Canterbury City Council's Brownfield run off rate. The existing highway drainage from Chaucer Road which is to be modified to account for the realignment of the carriageway is to be updated to accommodate the 1 in 100 year storm plus climate change.

5) In agreement with Southern Water, and as a site wide strategy it is proposed to discharge 418 units into the existing public foul water from the development into Chaucer Road and to discharge 83 units from Phase 1 into Littlebourne Road. Having undertaken a Section 98 agreement with Southern Water for these works it has been concluded that no upgrade works are required.

APPENDIX A

Existing Site Plan
Existing Utility Plan
Existing Contributing Areas
Borehole soakage rates
Greenfield Run-off Calculations
Sewer Records



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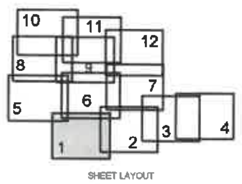

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CLIENT	PETER BRETT ASSOCIATES
PROJECT	HOWE BARRACKS CANTERBURY, KENT, CT1
TITLE	TOPOGRAPHICAL SURVEY

JOB Ref.	13-0255	DATE	DEC 2013
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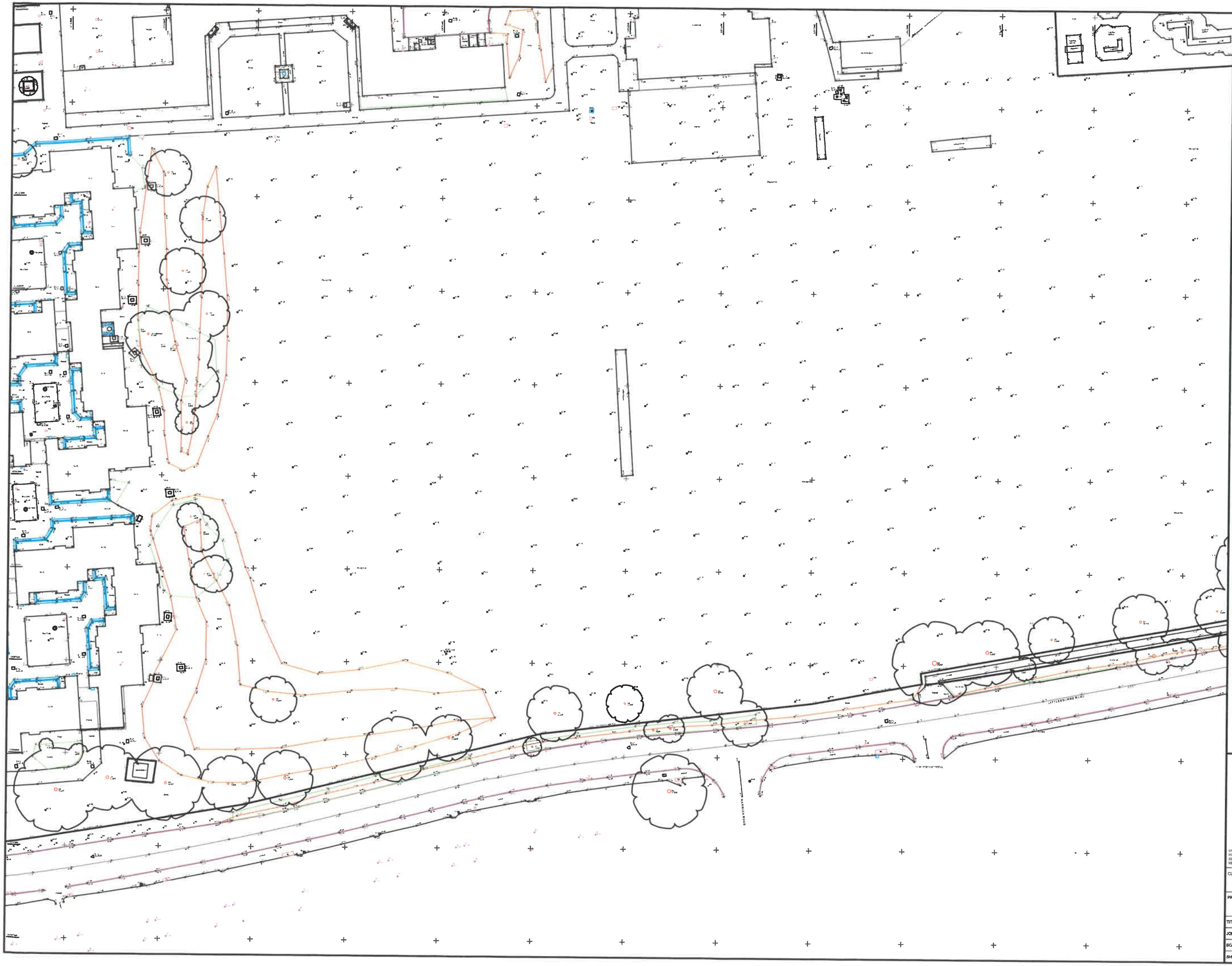

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ALL LEVELS AND CO-ORDINATES ARE RELATED TO THE ORDNANCE SURVEY NATIONAL GRID BY MEANS OF GPS USING LEICA SMARTNET RTK NETWORK. THE SITE HAS BEEN CENTERED TO THE OS GRID USING GPS AND THEN ORIENTATED.

ALL DIMENSIONS ARE IN METERS.

DO NOT SCALE FROM THIS DRAWING.

TREE GIRTHS AND SPREADS ARE QUOTED AS A MEAN SIZE AND SHOWN TO SCALE.

EAVE LEVELS ARE TAKEN AT THE BOTTOM OF THE LOWEST ROOF TILE.

WHILST EVERY EFFORT IS MADE TO IDENTIFY TREE SPECIES AND SIZES, NO RESPONSIBILITY CAN BE TAKEN FOR THE ACCURACY OF THIS INFORMATION.

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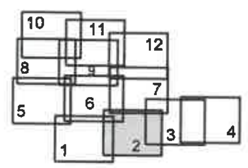

SHEET LAYOUT

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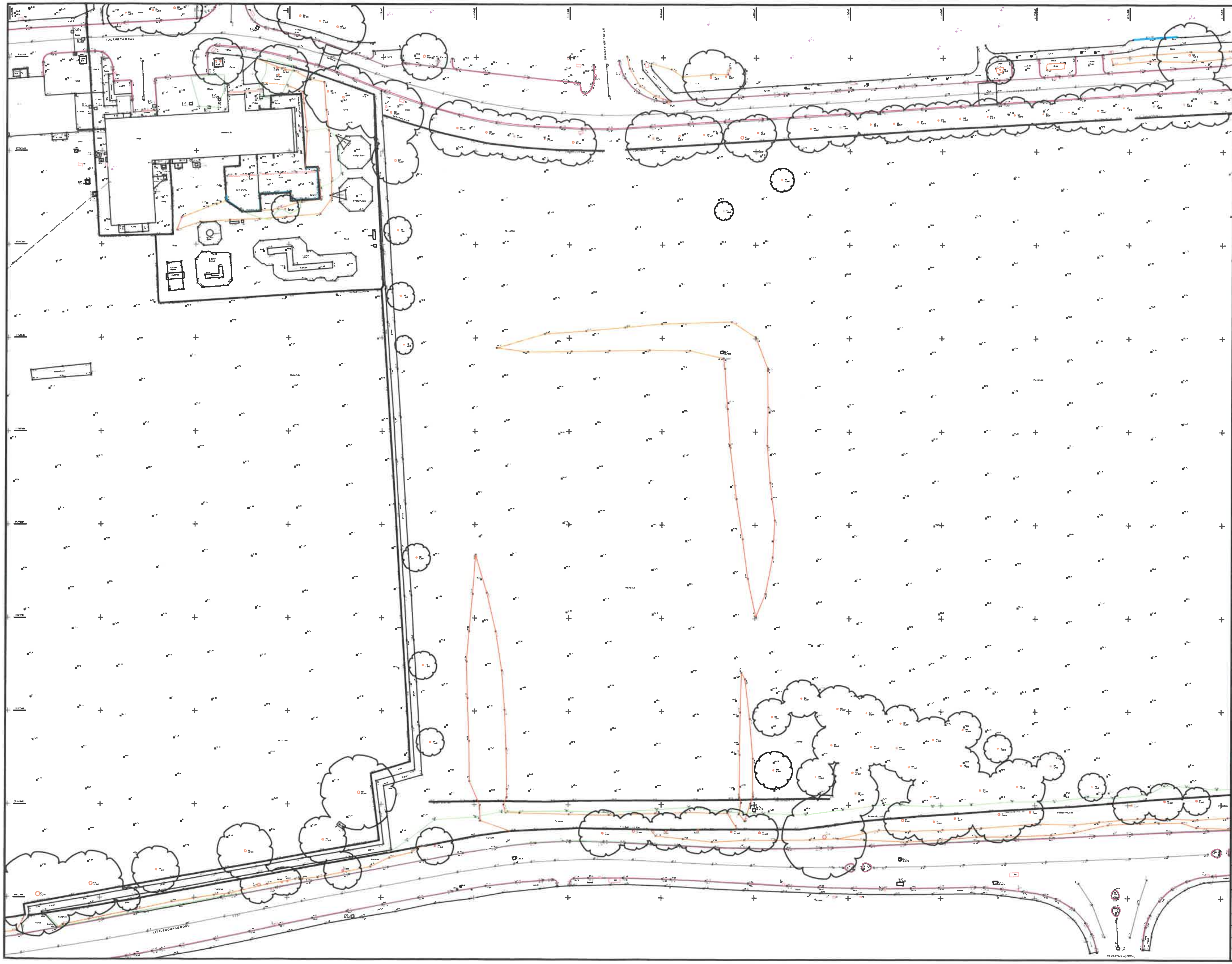

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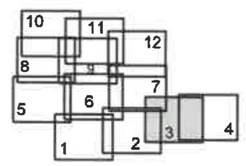

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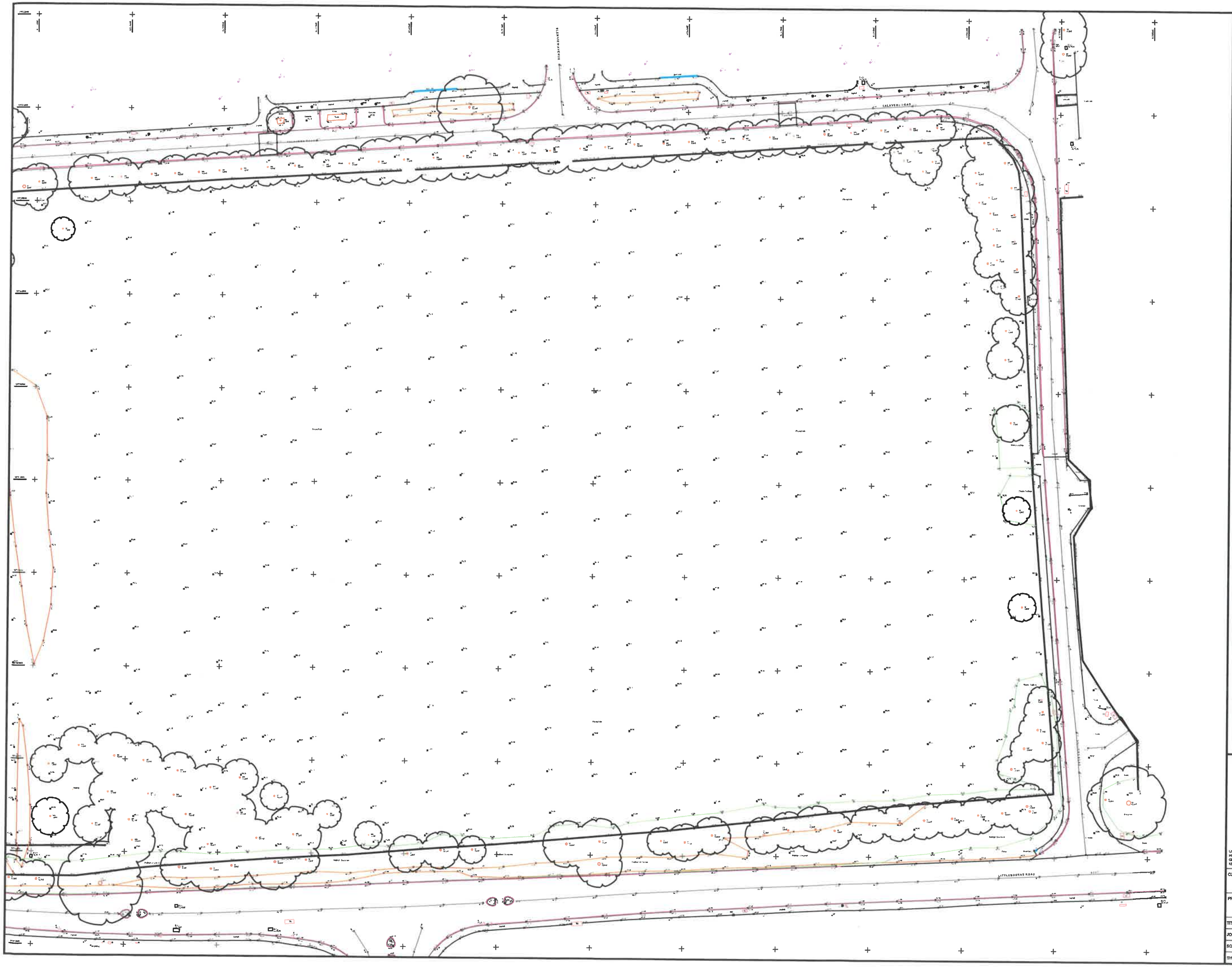

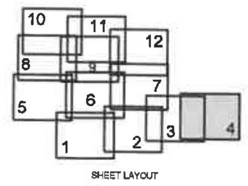

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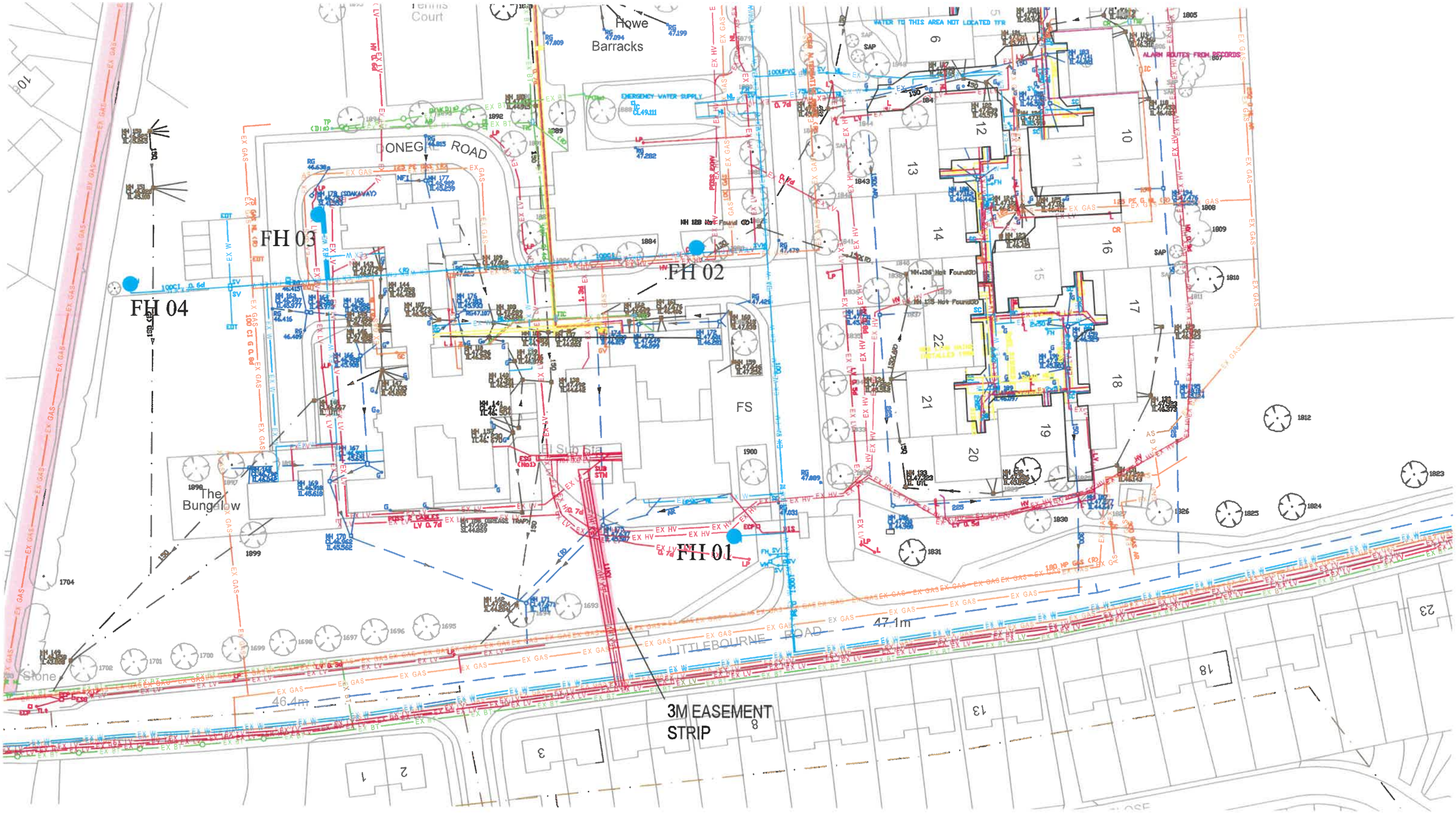
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46.4m
3M EASEMENT STRIP

EXISTING AREA = 8302m²

DISCHARGE RATE BASED ON
50MM PER HOUR = 115L/s

KEY OF SYMBOLS

RISK OF COLLAPSE

OBSTACLE CONSIDERATION ACCESS TO ELEMENTS AT HIGH LEVEL

RISK OF FALLING

LIFTING HAZARD

CAUTION STEEP ROOF PITCH - ACCESS BY SUITABLY QUALIFIED PERSONS/EQUIPMENT ONLY

NOTES.

1) GENERAL

A) .....
B) .....

CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 2007

DESIGNERS HAZARD INFORMATION FOR CONSTRUCTION

1. SERVICES TO BE LOCATED
2. MANUAL LIFTING
3. HOT MATERIAL WORKING
4. CUTTING/DUST
5. CONCRETE, HANDING, LIFTING, PLACEMENT
6. DEEP EXCAVATIONS, COLLAPSE/FALLING
7. SERVICE VOIDS/RISERS, FALLING

PRELIMINARY

Rev.	Date	Revision	By	Chk
-	16.12.16	PRELIMINARY	AJB	CET

Client

Project
HOWE BARRACKS
CANTERBURY

Title
EXISTING CONTRIBUTING AREAS

KNAPP HICKS AND PARTNERS LTD.
CONSULTING STRUCTURAL, CIVIL AND GEOTECHNICAL ENGINEERS
Prospect House, 1 Highpoint Business Village
Henwood, Ashford, Kent, TN24 8DH
T: 01233 502255
W: www.knapphicks.co.uk
F: 01233 502266
E: info@knapphicks.co.uk
also at:
Prospect House 57 - 60 St John's Road Isleworth Middlesex TW7 6NL
T: 020 8567 1000 F: 020 8567 1001

SCALE 1/500 DRAWN AJB
DATE DEC 16 CHECK CET
A1

34109/C/SK 11/ -

BGS1 (1)

BGS1 (2)

PBBH13

TP104
3.6m

TP103
3m

PBBH11

BH11

TP108

TP113
3.7m

SS102
2.4E-5

SS104
4.7E-6

TP112
2.3m

TP105
1.25m

TP102
2.3m

DCP 1

DCP 3

DCP 2

PBTP10

SS101
2.1E-5

TP111
2.2m

TP114
4.1m

TP110
2.85

TP106
1.7m

PBTP9

TP129
1.75m

PBBH10

SS103
1.1E-5

TP101
2.5m

BH12

PBBH12

2.3m

PBTP8

TP115(BH)
1.25m

TP107S
2.4E-6

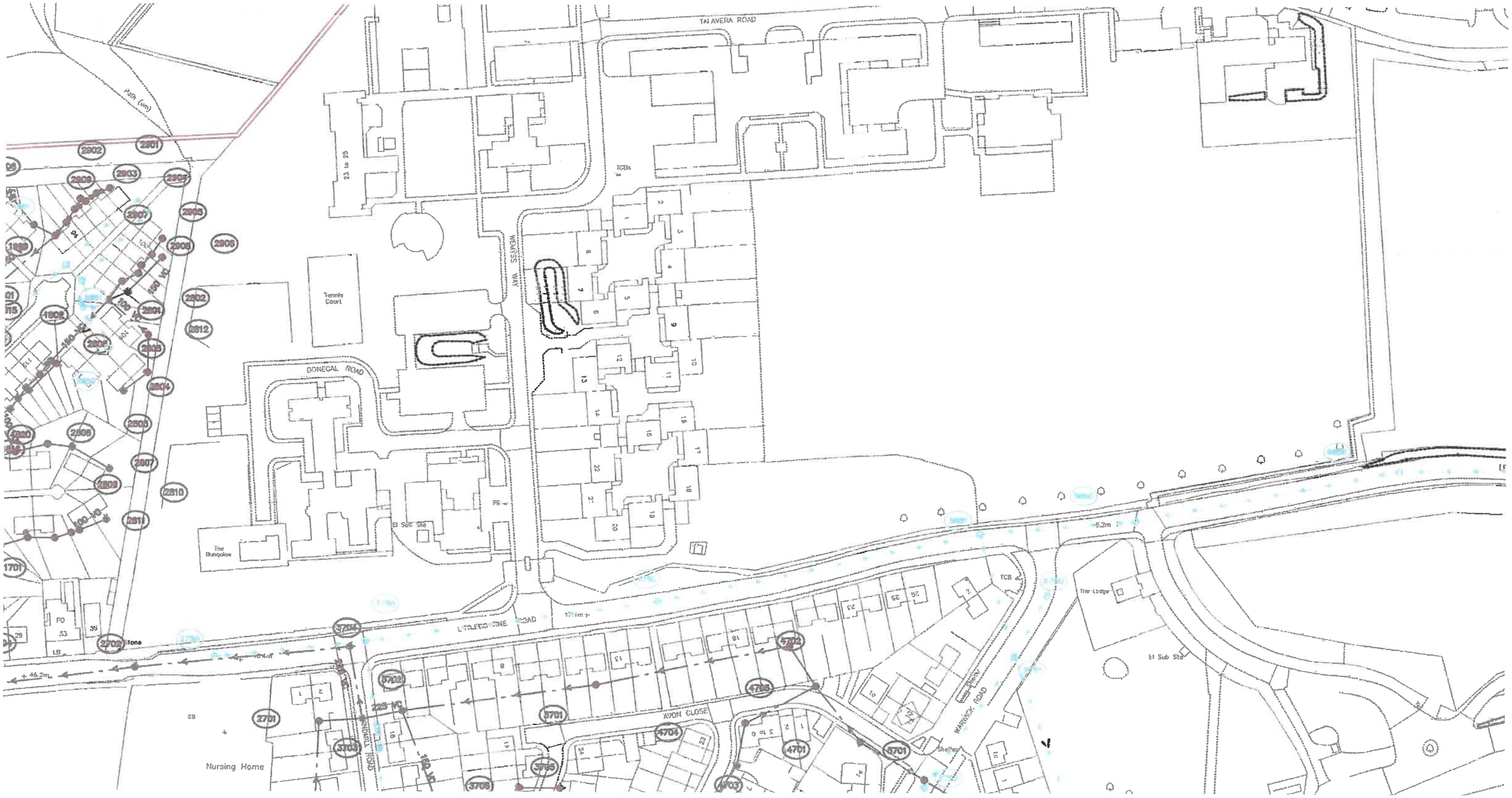
ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	19.000	Urban	0.000
SAAR (mm)	700	Region Number	Region 7

Results l/s

QBAR Rural	83.5
QBAR Urban	83.5
Q100 years	266.3
Q1 year	70.9
Q30 years	189.2
Q100 years	266.3


TAI AVERA ROAD
Path (um)
23 to 25
TCBs
MEWS WAY
Tennis Court
DONEGAL ROAD
El Sub Sta
The Bungalow
LITLEDOWNE ROAD
AXON CLOSE
WARWICK ROAD
Nursing Home
The Lodge
El Sub Sta
225 MC
150 MC
2901
2902
2903
2904
2905
2906
2907
2908
2909
2910
2911
2912
1701
1702
1703
1704
1705
1706
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3701
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3707
3708
4701
4702
4703
4704
4705
4706

APPENDIX B

Proposed Master Plan
Permeable Area Plan
Phase1 Strategy
Overall Drainage Strategy
Proposed Foul Water Sewer
Surface water exceedance flows
Drainage schematic
Adoptable Highway Drainage Calculations


Balaclava House
Alma House
Lutyens House
PILCKEN CLOSE
SQUARE COURT
ALBUHERA SQUARE
ST JULIEN AVENUE
CAMBRAI COURT
TUNIS COURT
AISNE DRIVE
DOURO CLOSE
BLENHEIM AVENUE
SEVASTOPOL PLACE
RANGRO PLACE
YPRES SOUTH
TALAVERA ROAD
CYCLE CONNECTION
CHAPEL
LANDSCAPE FOCAL SPACE
NURSERY
OPEN SPACE
visibility splay 4.5m x 90m
LITTLEBOURNE ROAD
The Lodge
El Sub Sta
A 2

Roads	11,112m²	Controlled discharge to public sewer
Permeable paving	4,367m²	Permeable paving (houses and drives)
Buildings	10,322m²	
Driveways	3,669m²	Permeable paving (garages and drives only)
Total Impermeable		29,470m²
Phase 1 Area	57,539m²	

KEY OF SYMBOLS

RISK OF COLLAPSE

OBSTACLE CONSIDERATION ACCESS TO ELEMENTS AT HIGH LEVEL

RISK OF FALLING

LIFTING HAZARD

CAUTION STEEP ROOF PITCH - ACCESS BY SUITABLY QUALIFIED PERSONS/EQUIPMENT ONLY

Use figured dimensions only; Do not scale from drawing.
All levels and dimensions are to be checked on site.
This drawing is to be read in conjunction with all relevant documents

KNAPP HICKS & PARTNERS LTD. (DATE AS TITLE)

NOTES.

1) GENERAL

A) .....
B) .....

CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 2007

DESIGNERS HAZARD INFORMATION FOR CONSTRUCTION

1. SERVICES TO BE LOCATED
2. MANUAL LIFTING
3. HOT MATERIAL WORKING
4. CUTTING/DUST
5. CONCRETE, HANDING, LIFTING, PLACEMENT
6. DEEP EXCAVATIONS, COLLAPSE/FALLING
7. SERVICE VOIDS/RISERS, FALLING

Rev.	Date	Revision	By	Chk
X	00.00.00	X	X	X

Client

Project
HOWE BARRACKS
PHASE !

Title
PRELIMINARY
DRAINAGE STRATEGY

KNAPP HICKS AND PARTNERS LTD.
CONSULTING STRUCTURAL, CIVIL AND GEOTECHNICAL ENGINEERS
Prospect House, 1 Highpoint Business Village
Henwood, Ashford, Kent, TN24 8DH
T: 01233 502255
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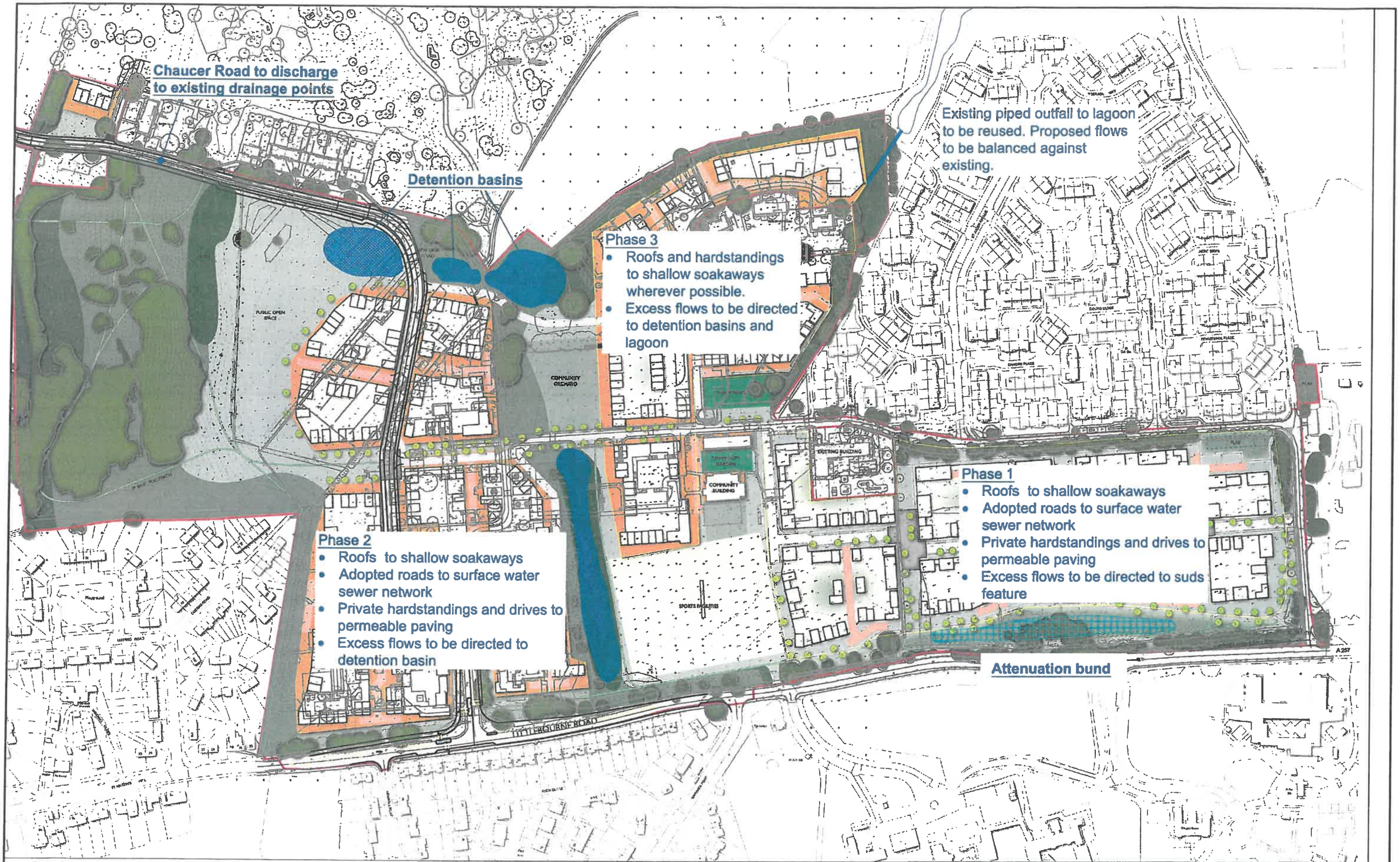
F: 01233 502288
E: info@knapphicks.co.uk
also at:
Prospect House 57 - 59 St John's Road Isleworth Middlesex TW7 6NL
T: 020 8567 1000 F: 020 8567 1001

SCALE nts DRAWN AJB
DATE 28.11.16 CHECK CET
A1

34109/C/ P1 / -



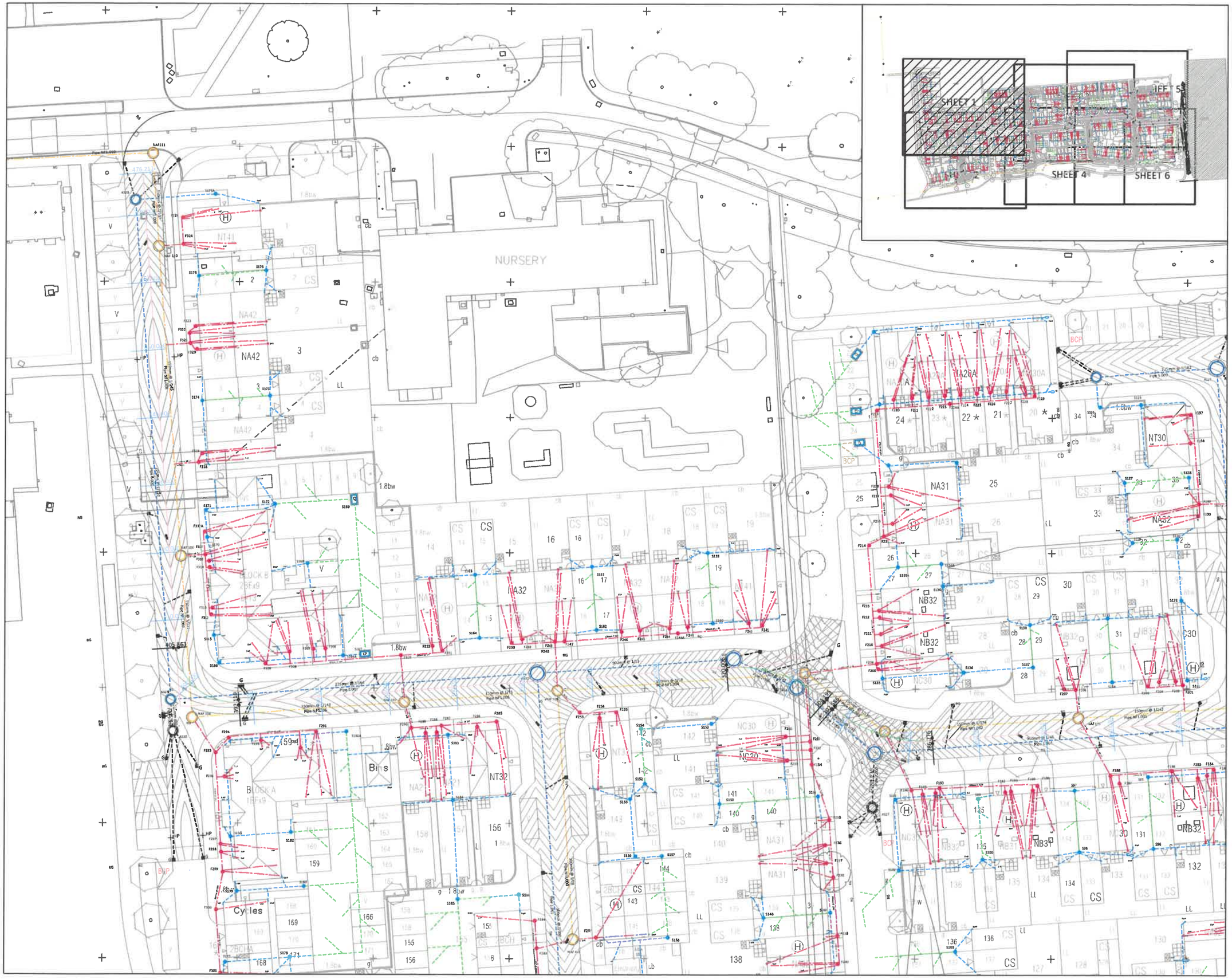
Taylor Wimpey

Project: HOWE BARRACKS, CANTERBURY

Title: SURFACE WATER STRATEGY

KNAPP HICKS AND PARTNERS LTD.
CONSULTING ENGINEERS
Prospect House, 1 Highpoint Business Village
Henwood, Ashford, TN24 8DH
Tel: +44 (0) 1233 502255
Fax: +44 (0) 1233 502288

Drn.	JS
Date	NOV16
Scale	1:2500
Drawing No.	Rev.
34109/SK03	-



Use figured dimensions only; Do not scale from drawing.
All levels and dimensions are to be checked on site.
This drawing is to be read in conjunction with all relevant documents

KNAPP HICKS & PARTNERS LTD. (DATE AS TITLE)

NOTES.

1) GENERAL

A) Do not scale.

LEGEND

- PUBLIC SURFACE WATER SEWER
- PUBLIC FOUL WATER SEWER
- PUBLIC PCC INSPECTION CHAMBER (SW)
- PUBLIC PCC INSPECTION CHAMBER (C)
- HIGHWAY PCC INSPECTION CHAMBER
- RG ROAD GULLEY (PRIVATE)
- EXISTING SURFACE WATER MANHOLE AND SEWER BY OTHERS.
- EXISTING FOUL WATER MANHOLE AND SEWER BY OTHERS.
- NEW FOUL WATER DRAINAGE (1500MM) MAC MANHOLE AND FW PIPE.
- NEW PRIVATE SURFACE WATER (1500MM) MAC MANHOLE AND SW PIPE.
- NEW FOUL WATER DRAINAGE (450MM) PVC MANHOLE AND FW PIPE.
- NEW PRIVATE SURFACE WATER (450MM) PVC MANHOLE AND SW PIPE.
- NEW PRIVATE SURFACE WATER (150MM) PERFORATED PIPE
- SMH 35 PROPOSED MANHOLE DETAILS
- RWP RAIN WATER PIPE
- SVP SOIL VENT PIPE
- YG SURFACE WATER YARD GULLEY
- FG FOUL WATER YARD GULLEY
- BG BACK INLET GULLEY
- RG ROAD GULLEY (PRIVATE)
- RE RODDING EYE
- CHANNEL DRAIN

C1	04.04.18	MAIN DRAINAGE AMENDED, CONSTRUCTION	JAS	AB
C	20.02.18	OFFSITE ROUTE AMENDED	CJH	AB
B	17.10.17	TENDER	CJH	AB
A	08.09.17	TENDER	CJH	AB
Rev	Date	Revision	By	Chk

Client: Taylor Wimpey

Project: HOWE BARRACKS CANTERBURY

Drawing Title: ON SITE - PRIVATE DRAINAGE AND CONTOURS Sheet 1 of 6

Knapp Hicks
Consulting Structural, Civil & Geotechnical Engineers
Prospect House, 1 Highpoint Business Village
Henwood, Ashford, Kent TN24 8DH
tel 01233 502255 website www.knapphicks.co.uk

SCALE	1:250	DRAWN	CJH
DATE	08.09.17	CHECK	AB

A1

CONSTRUCTION

34109 / C / 131 | C1

Use figured dimensions only: Do not scale from drawing.
All levels and dimensions are to be checked on site.
This drawing is to be read in conjunction with all relevant documents
KNAPP HICKS & PARTNERS LTD. (DATE AS TITLE)

NOTES.

1) GENERAL

A) Do not scale.

LEGEND

- PUBLIC SURFACE WATER SEWER
- PUBLIC FOUL WATER SEWER
- PUBLIC PCC INSPECTION CHAMBER(SW)
- PUBLIC PCC INSPECTION CHAMBER (FC)
- HIGHWAY PCC INSPECTION CHAMBER
- RG ROAD GULLEY (PRIVATE)
- EXISTING SURFACE WATER MANHOLE AND SEWER BY OTHERS.
- EXISTING FOUL WATER MANHOLE AND SEWER BY OTHERS.
- NEW FOUL WATER DRAINAGE(250&MM) MAC MANHOLE AND FW PIPE.
- NEW PRIVATE SURFACE WATER (250&MM) MAC MANHOLE AND SW PIPE.
- NEW FOUL WATER DRAINAGE(450&MM) PVC MANHOLE AND FW PIPE.
- NEW PRIVATE SURFACE WATER (450&MM) PVC MANHOLE AND SW PIPE.
- NEW PRIVATE SURFACE WATER (300&MM) PERFORATED PIPE
- SMH 55 PROPOSED MANHOLE DETAILS
- RWP RAIN WATER PIPE
- SVP SOIL VENT PIPE
- YG SURFACE WATER YARD GULLEY
- YG FOUL WATER YARD GULLEY
- BG BACK INLET GULLEY
- RG ROAD GULLEY (PRIVATE)
- RE RODDING EYE
- CHANNEL DRAIN

Rev	Date	Revision	By	Chk
C1	04.04.18	MAIN DRAINAGE AMENDED, CONSTRUCTION	JAS	AB
C	20.02.18	OFFSITE ROUTE AMENDED	CJH	AB
B	17.10.17	TENDER	CJH	AB
A	08.09.17	TENDER	CJH	AB

Client: Taylor Wimpey

Project: HOWE BARRACKS CANTERBURY

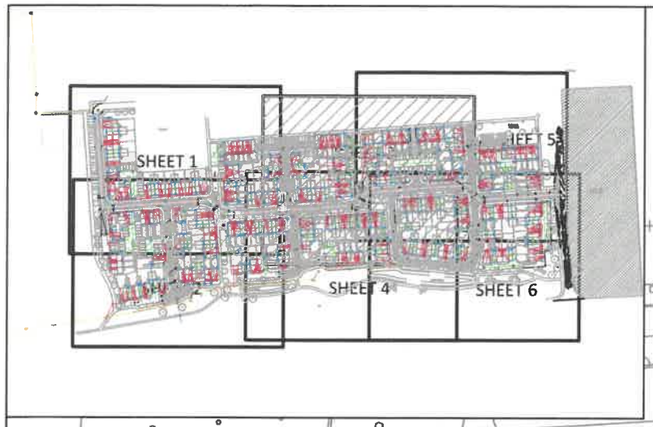
Drawing Title: ON SITE - PRIVATE DRAINAGE AND CONTOURS Sheet 2 of 6

Knapp Hicks
Consulting Structural, Civil & Geotechnical Engineers
Prospect House, 1 Highpoint Business Village, Henwood, Ashford, Kent TN24 8DH
tel: 01233 502256 website: www.knapphicks.co.uk

SCALE 1:250 DRAWN CJH
DATE 08.09.17 CHECK AB
A1

CONSTRUCTION

34109 / C / 132 C1



OPEN SPACE

Use figured dimensions only: Do not scale from drawing.
All levels and dimensions are to be checked on site.
This drawing is to be read in conjunction with all relevant documents

KNAPP HICKS & PARTNERS LTD. [DATE AS TITLE]

NOTES.

1) GENERAL

A) Do not scale.

LEGEND

- PUBLIC SURFACE WATER SEWER
- PUBLIC FOUL WATER SEWER
- PUBLIC PCC INSPECTION CHAMBER.(SW)
- PUBLIC PCC INSPECTION CHAMBER.(FC)
- HIGHWAY PCC INSPECTION CHAMBER
- RG — ROAD GULLEY (PRIVATE)
- EXISTING SURFACE WATER MANHOLE AND SEWER BY OTHERS.
- EXISTING FOUL WATER MANHOLE AND SEWER BY OTHERS.
- NEW FOUL WATER DRAINAGE.(250(MM) MAC MANHOLE AND FW PIPE.
- NEW PRIVATE SURFACE WATER (250(MM) MAC MANHOLE AND SW PIPE.
- NEW FOUL WATER DRAINAGE.(450(MM) PPIC MANHOLE AND FW PIPE.
- NEW PRIVATE SURFACE WATER (450(MM) PPIC MANHOLE AND SW PIPE.
- NEW PRIVATE SURFACE WATER (100(MM) PERFORATED PIPE
- SMH 15 — PROPOSED MANHOLE DETAILS
- RWP — RAIN WATER PIPE
- SVP — SOIL VENT PIPE
- YG — SURFACE WATER YARD GULLEY
- YG — FOUL WATER YARD GULLEY
- BIG — BACK INLET GULLEY
- RG — ROAD GULLEY (PRIVATE)
- RE — RODDING EYE
- CHANNEL DRAIN

Rev	Date	Revision	By	Chk
C1	04.04.18	MAIN DRAINAGE AMENDED, CONSTRUCTION	JAS	AB
C	20.02.18	OFFSITE ROUTE AMENDED	CJH	AB
B	17.10.17	TENDER	CJH	AB
A	08.09.17	TENDER	CJH	AB

Client: Taylor Wimpey

Project: HOWE BARRACKS CANTERBURY

Drawing Title: ON SITE - PRIVATE DRAINAGE AND CONTOURS Sheet 3 of 6

Knapp Hicks
Consulting Structural, Civil & Geotechnical Engineers
Prospect House, 1 Highpoint Business Village
Henwood, Ashford, Kent TN24 8DH
tel: 01233 502555 website: www.knapphicks.co.uk

SCALE 1:250 DRAWN CJH
DATE 08.09.17 CHECK AB
A1

CONSTRUCTION

34109 / C / 133 C1

Use figured dimensions only: Do not scale from drawing.
All levels and dimensions are to be checked on site.
This drawing is to be read in conjunction with all relevant documents

 (DATE AS TITLE)

NOTES.

1) GENERAL

A) Do not scale.

LEGEND

- PUBLIC SURFACE WATER SEWER
- PUBLIC FOUL WATER SEWER
- PUBLIC PCC INSPECTION CHAMBER,(SW)
- PUBLIC PCC INSPECTION CHAMBER (C)
- HIGHWAY PCC INSPECTION CHAMBER
- RG ROAD GULLEY (PRIVATE)
- EXISTING SURFACE WATER MANHOLE AND SEWER BY OTHERS.
- EXISTING FOUL WATER MANHOLE AND SEWER BY OTHERS.
- NEW FOUL WATER DRAINAGE,(2500MM) MAC MANHOLE AND FW PIPE.
- NEW PRIVATE SURFACE WATER (2500MM) MAC MANHOLE AND SW PIPE.
- NEW FOUL WATER DRAINAGE,(1500MM) PPIC MANHOLE AND FW PIPE.
- NEW PRIVATE SURFACE WATER (1500MM) PPIC MANHOLE AND SW PIPE.
- NEW PRIVATE SURFACE WATER (100MM) PERFORATED PIPE
- SMH 13 PROPOSED MANHOLE DETAILS
- RWP RAIN WATER PIPE
- SVP SOIL VENT PIPE
- YG SURFACE WATER YARD GULLEY
- YS FOUL WATER YARD GULLEY
- BIG BACK INLET GULLEY
- RG ROAD GULLEY (PRIVATE)
- RE RODDING EYE
- CHANNEL DRAIN

Rev	Date	Revision	By	Chk
C1	04.04.18	MAIN DRAINAGE AMENDED, CONSTRUCTION	JAS	AB
C	20.02.18	OFFSITE ROUTE AMENDED	CJH	AB
B	17.10.17	TENDER	CJH	AB
A	08.09.17	TENDER	CJH	AB

Client

Taylor Wimpey

Project

HOWE BARRACKS
CANTERBURY

Drawing Title

ON SITE - PRIVATE
DRAINAGE AND CONTOURS
Sheet 4 of 6

Knapp Hicks
Consulting Structural, Civil & Geotechnical Engineers
Prospect House, 1 Hithpoint Business Village
Hernwood, Ashford, Kent TN24 8DH
tel: 01233 502256 website: www.knapphicks.co.uk

SCALE	1:250	DRAWN	CJH	A1
DATE	08.09.17	CHECK	AB	

CONSTRUCTION

34109 / C / 134 C1

CHILDRENS PLAY AREA

OPEN SPACE

2.4m x 45m VISIBILITY

Use figured dimensions only: Do not scale from drawing.
All levels and dimensions are to be checked on site.
This drawing is to be read in conjunction with all relevant documents

KNAPP HICKS & PARTNERS LTD. (DATE AS TITLE)

NOTES.

1) GENERAL

A) Do not scale.

LEGEND

- PUBLIC SURFACE WATER SEWER
- PUBLIC FOUL WATER SEWER
- PUBLIC PCC INSPECTION CHAMBER (SW)
- PUBLIC PCC INSPECTION CHAMBER (FC)
- HIGHWAY PCC INSPECTION CHAMBER
- RG — ROAD GULLEY (PRIVATE)
- EXISTING SURFACE WATER MANHOLE AND SEWER BY OTHERS.
- EXISTING FOUL WATER MANHOLE AND SEWER BY OTHERS.
- NEW FOUL WATER DRAINAGE (250&450MM) MAC MANHOLE AND PW PIPE.
- NEW PRIVATE SURFACE WATER (250&450MM) MAC MANHOLE AND SW PIPE.
- NEW FOUL WATER DRAINAGE (450&600MM) PPIC MANHOLE AND PW PIPE.
- NEW PRIVATE SURFACE WATER (450&600MM) PPIC MANHOLE AND SW PIPE.
- NEW PRIVATE SURFACE WATER (150&MM) PERFORATED PIPE
- SMH 33 — PROPOSED MANHOLE DETAILS
- RWP — RAIN WATER PIPE
- SVP — SOIL VENT PIPE
- YG — SURFACE WATER YARD GULLEY
- FG — FOUL WATER YARD GULLEY
- BG — BACK INLET GULLEY
- RG — ROAD GULLEY (PRIVATE)
- RE / PE — RODDING EYE
- CHANNEL DRAIN

Rev	Date	Revision	By	Chk
C1	04.04.18	MAIN DRAINAGE AMENDED, CONSTRUCTION	JAS	AB
C	20.02.18	OFFSITE ROUTE AMENDED	CJH	AB
B	17.10.17	TENDER	CJH	AB
A	08.09.17	TENDER	CJH	AB

Client: Taylor Wimpey

Project: HOWE BARRACKS CANTERBURY

Drawing Title:

ON SITE - PRIVATE DRAINAGE AND CONTOURS
Sheet 5 of 6

Knapp Hicks
Consulting Structural, Civil & Geotechnical Engineers
Prospect House, 1 Highpoint Business Village
Henwood, Ashford, Kent TN24 8DH
Tel: 01233 502265 website: www.knapphicks.co.uk

SCALE 1:250 DRAWN CJH
DATE 08.09.17 CHECK AB
A1

CONSTRUCTION

34109 / C / 135 C1

Use figured dimensions only: Do not scale from drawing.
All levels and dimensions are to be checked on site.
This drawing is to be read in conjunction with all relevant documents

NOTES.

1) GENERAL

A) Do not scale.

LEGEND

- PUBLIC SURFACE WATER SEWER
- PUBLIC FOUL WATER SEWER
- PUBLIC PCC INSPECTION CHAMBER (SW)
- PUBLIC PCC INSPECTION CHAMBER (C)
- HIGHWAY PCC INSPECTION CHAMBER
- RG — ROAD GULLEY (PRIVATE)
- EXISTING SURFACE WATER MANHOLE AND SEWER BY OTHERS.
- EXISTING FOUL WATER MANHOLE AND SEWER BY OTHERS.
- NEW FOUL WATER DRAINAGE (150/300MM) MAC MANHOLE AND PW PIPE.
- NEW PRIVATE SURFACE WATER (150/300MM) MAC MANHOLE AND SW PIPE.
- NEW FOUL WATER DRAINAGE (450/600MM) PPIC MANHOLE AND PW PIPE.
- NEW PRIVATE SURFACE WATER (450/600MM) PPIC MANHOLE AND SW PIPE.
- NEW PRIVATE SURFACE WATER (100/150MM) PERFORATED PIPE
- SMH 13 — PROPOSED MANHOLE DETAILS
- RWP — RAIN WATER PIPE
- SVP — SOIL VENT PIPE
- YG — SURFACE WATER YARD GULLEY
- YG — FOUL WATER YARD GULLEY
- BIG — BACK INLET GULLEY
- RG — ROAD GULLEY (PRIVATE)
- RE, FE — RODDING EYE
- CHANNEL DRAIN

Rev	Date	Revision	By	Chk
C1	04.04.18	MAIN DRAINAGE AMENDED, CONSTRUCTION	JAS	AB
C	20.02.18	OFFSITE ROUTE AMENDED	CJH	AB
B	17.10.17	TENDER	CJH	AB
A	08.09.17	TENDER	CJH	AB

Client: Taylor Wimpey

Project: HOWE BARRACKS CANTERBURY

Drawing Title: ON SITE - PRIVATE DRAINAGE AND CONTOURS Sheet 6 of 6

Knapp Hicks
Consulting Structural, Civil & Geotechnical Engineers
Prospect House, 1 Highpoint Business Village
Henwood, Ashford, Kent TN24 8DH
tel: 01233 502755 website: www.knapphicks.co.uk

SCALE 1:250 DRAWN CJH
DATE 08.09.17 CHECK AB
A1

CONSTRUCTION

34109 / C / 136 C1

Use figured dimensions only; Do not scale from drawing.
All levels and dimensions are to be checked on site.
This drawing is to be read in conjunction with all relevant documents

KNAPP HICKS & PARTNERS LTD. (DATE AS TITLE)

NOTES.

1. Northern Foul Sewer Run which include Manholes NAF101-111, NAF201-202, NAF301 and NAF401 is subject to a separate S104 Application to submitted at a later date.
2. Invert levels and positions of existing drains / chambers / sewers where new connections are to be made must be checked and confirmed to the engineer prior to the commencement of any works.
3. All drainage works shall be carried out in accordance with the requirements of the Local Authority, the Environment Agency and in conjunction with all relevant British Standards, Codes of Practice and 'Sewers for Adoption' 6th Edition and any addendums as appropriate.
4. All drainage shall comply with the typical details and the requirements of BS EN 752 and Part H of the Building Regulations.
5. Refer to manhole schedules or drawings for manhole types, sizes, depths and specific requirements.

IMPORTANT NOTE:
The existing FW & SW sewer connection is be successfully confirmed prior to commencing any upstream drainage works.

IMPORTANT NOTE:
Before commencing any Sewer or drainage works, the Groundworker must satisfy themselves, The Client and the Local Authority of actual levels and conditions of existing sewers.

IMPORTANT NOTE:
Any treeplanting should comply with the requirements set out in Sewers for Adoption 6th Edition clause no B1.13 and C3.1.13

LEGEND

- PUBLIC SURFACE WATER SEWER
- PUBLIC FOUL WATER SEWER
- PUBLIC PCC INSPECTION CHAMBER.(FW)
- PUBLIC PCC INSPECTION CHAMBER.(SW)
- PHASE 1 SITE BOUNDARY
- EASEMENT

SUBJECT TO THE APPROVAL OF SOUTHERN WATER

Rev	Date	Revision	By	Chk
C1	10.04.18	CONSTRUCTION	CET	AB

Client: Taylor Wimpey

Project: HOWE BARRACKS CANTERBURY PHASE 1

Drawing Title: SECTION 104 ADOPTABLE DRAINAGE AND CONTOURS FOR SURFACE WATER AND SA FOUL SEWER RUN Sheet 1 of 6

Knapp Hicks
Consulting Structural, Civil & Geotechnical Engineers
Prospect House, 1 Highpoint Business Village Henwood, Ashford, Kent TN24 8DH
tel: 01233 502255 website: www.knapphicks.co.uk

SCALE 1:250 DRAWN CJH DATE 08.09.17 CHECK AB A1

CONSTRUCTION

34109 / C / 165 C1

Use figured dimensions only: Do not scale from drawing.
All levels and dimensions are to be checked on site.
This drawing is to be read in conjunction with all relevant documents

KNAPP HICKS & PARTNERS LTD. (DATE AS TITLE)

NOTES.

1. Northern Foul Sewer Run which include Manholes NAF101-111, NAF201-202, NAF301 and NAF401 is subject to a separate S104 Application to submitted at a later date.
2. Invert levels and positions of existing drains / chambers / sewers where new connections are to be made must be checked and confirmed to the engineer prior to the commencement of any works.
3. All drainage works shall be carried out in accordance with the requirements of the Local Authority, the Environment Agency and in conjunction with all relevant British Standards, Codes of Practice and 'Sewers for Adoption' 6th Edition and any addendums as appropriate.
4. All drainage shall comply with the typical details and the requirements of BS EN 752 and Part H of the Building Regulations.
5. Refer to manhole schedules or drawings for manhole types, sizes, depths and specific requirements.

IMPORTANT NOTE:
The existing FW & SW sewer connection is be successfully confirmed prior to commencing any upstream drainage works.

IMPORTANT NOTE:
Before commencing any Sewer or drainage works, the Groundworker must satisfy themselves, The Client and the Local Authority of actual levels and conditions of existing sewers.

IMPORTANT NOTE:
Any treeplanting should comply with the requirements set out in Sewers for Adoption 6th Edition clause no B1.13 and C3.1.13

LEGEND

- PUBLIC SURFACE WATER SEWER
- PUBLIC FOUL WATER SEWER
- PUBLIC PCC INSPECTION CHAMBER.(FW)
- PUBLIC PCC INSPECTION CHAMBER.(SW)
- PHASE 1 SITE BOUNDARY
- EASEMENT

SUBJECT TO THE APPROVAL OF SOUTHERN WATER

Rev	Date	Revision	By	Chk
C1	10.04.18	CONSTRUCTION	CET	AB

Client: Taylor Wimpey

Project: HOWE BARRACKS
CANTERBURY
PHASE 1

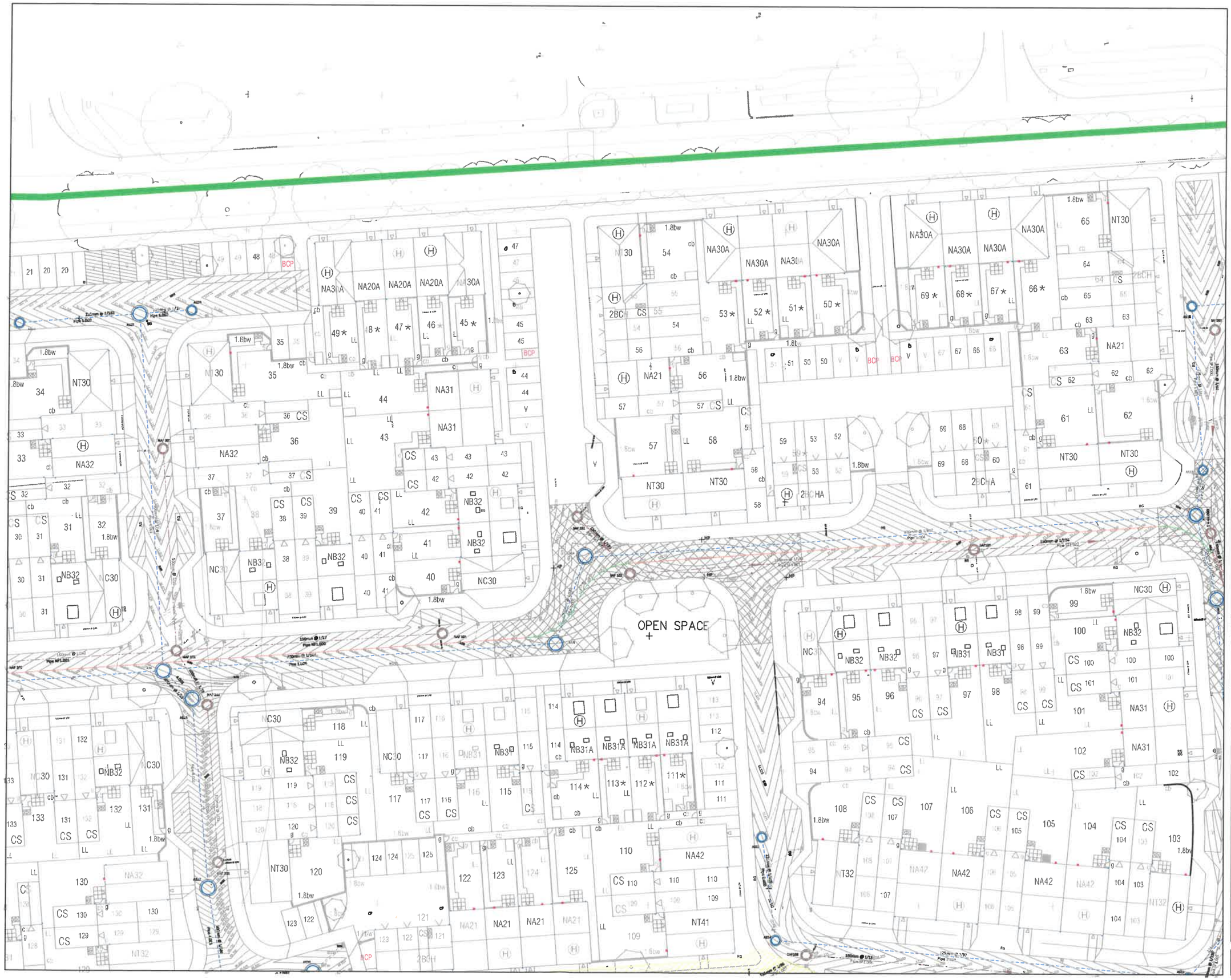
Drawing Title: SECTION 104
ADOPTABLE DRAINAGE AND CONTOURS FOR SURFACE WATER AND SA FOUL SEWER RUN
Sheet 2 of 6

Knapp Hicks
Consulting Structural, Civil & Geotechnical Engineers
Prospect House, 1 Highpoint Business Village
Henwood, Ashford, Kent TN24 8DH
tel: 01233 502255 website: www.knapphicks.co.uk

SCALE	1:250	DRAWN	CJH	A1
DATE	08.09.17	CHECK	AB	

CONSTRUCTION

34109 / C / 166 | C1



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KNAPP HICKS & PARTNERS LTD. (DATE AS TITLE)

NOTES.

1. Northern Foul Sewer Run which include Manholes NAF101-111, NAF201-202, NAF301 and NAF401 is subject to a separate S104 Application to submitted at a later date.
2. Invert levels and positions of existing drains / chambers / sewers where new connections are to be made must be checked and confirmed to the engineer prior to the commencement of any works.
3. All drainage works shall be carried out in accordance with the requirements of the Local Authority, the Environment Agency and in conjunction with all relevant British Standards, Codes of Practice and 'Sewers for Adoption' 6th Edition and any addendums as appropriate.
4. All drainage shall comply with the typical details and the requirements of BS EN 752 and Part H of the Building Regulations.
5. Refer to manhole schedules or drawings for manhole types, sizes, depths and specific requirements.

IMPORTANT NOTE:
The existing FW & SW sewer connection is be successfully confirmed prior to commencing any upstream drainage works.

IMPORTANT NOTE:
Before commencing any Sewer or drainage works, the Groundworker must satisfy themselves, The Client and the Local Authority of actual levels and conditions of existing sewers.

IMPORTANT NOTE:
Any treeplanting should comply with the requirements set out in Sewers for Adoption 6th Edition clause no B1.13 and C3.1.13

LEGEND

- PUBLIC SURFACE WATER SEWER
- PUBLIC FOUL WATER SEWER
- PUBLIC PCC INSPECTION CHAMBER.(FW)
- PUBLIC PCC INSPECTION CHAMBER.(SW)
- PHASE 1 S/TE BOUNDARY
- EASEMENT

SUBJECT TO THE APPROVAL OF SOUTHERN WATER

Rev	Date	Revision	By	Chk
C1	10.04.18	CONSTRUCTION	CET	AB

Client: Taylor Wimpey

Project: HOWE BARRACKS CANTERBURY PHASE 1

Drawing Title: SECTION 104 ADOPTABLE DRAINAGE AND CONTOURS FOR SURFACE WATER AND SA FOUL SEWER RUN Sheet 3 of 6

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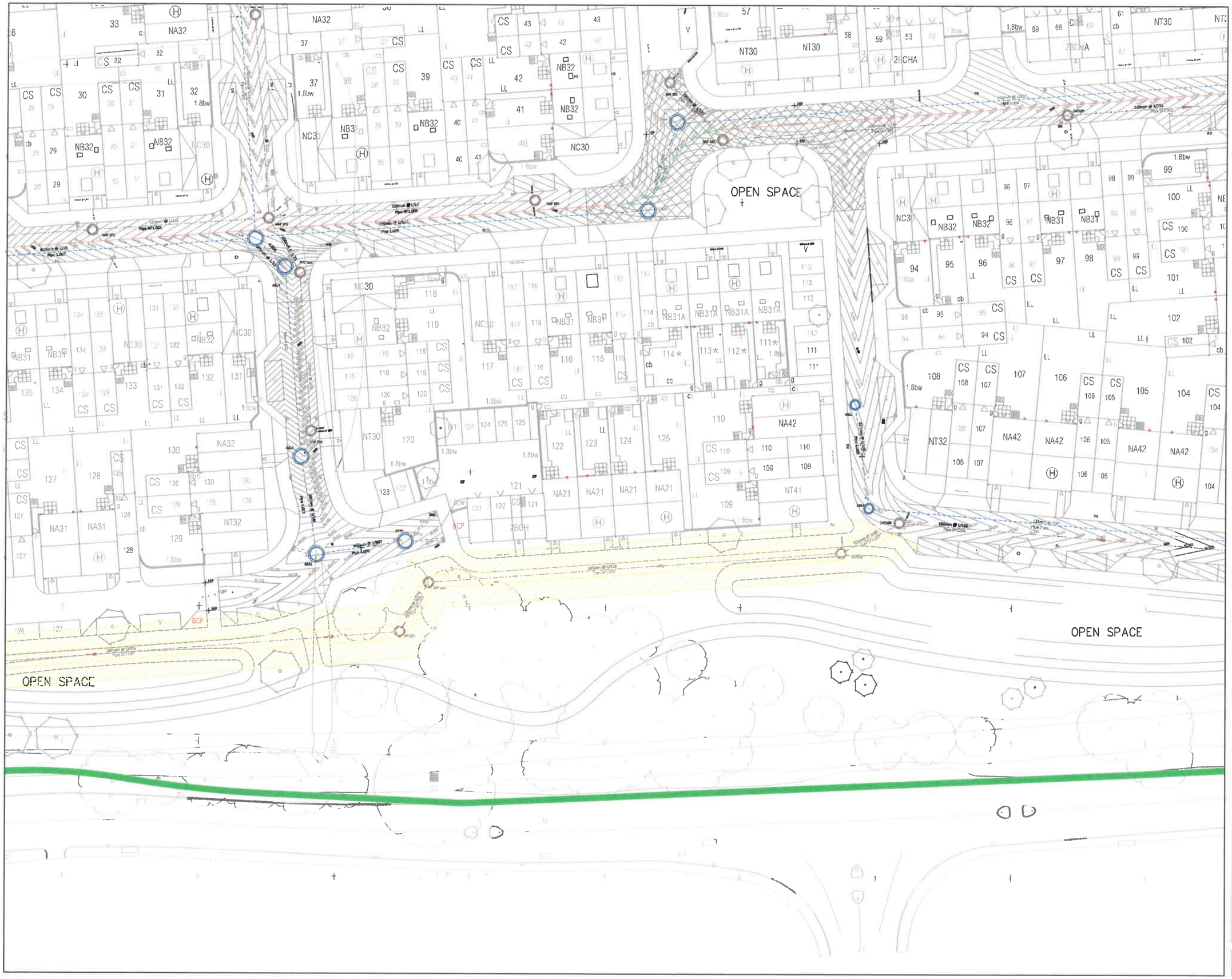

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- PUBLIC PCC INSPECTION CHAMBER.(FW)
- PUBLIC PCC INSPECTION CHAMBER.(SW)
- PHASE 1 SITE BOUNDARY
- EASEMENT

SUBJECT TO THE APPROVAL OF SOUTHERN WATER

Rev	Date	Revision	By	Chk
C1	10.04.18	CONSTRUCTION	CET	AB

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Drawing Title: SECTION 104 ADOPTABLE DRAINAGE AND CONTOURS FOR SURFACE WATER AND SA FOUL SEWER RUN Sheet 4 of 6

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SUBJECT TO THE APPROVAL OF SOUTHERN WATER

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C1	10.04.18	CONSTRUCTION	CET	AB

Client: Taylor Wimpey

Project: HOWE BARRACKS
CANTERBURY
PHASE 1

Drawing Title: SECTION 104
ADOPTABLE DRAINAGE AND CONTOURS FOR SURFACE WATER AND SA FOUL SEWER RUN
Sheet 5 of 6

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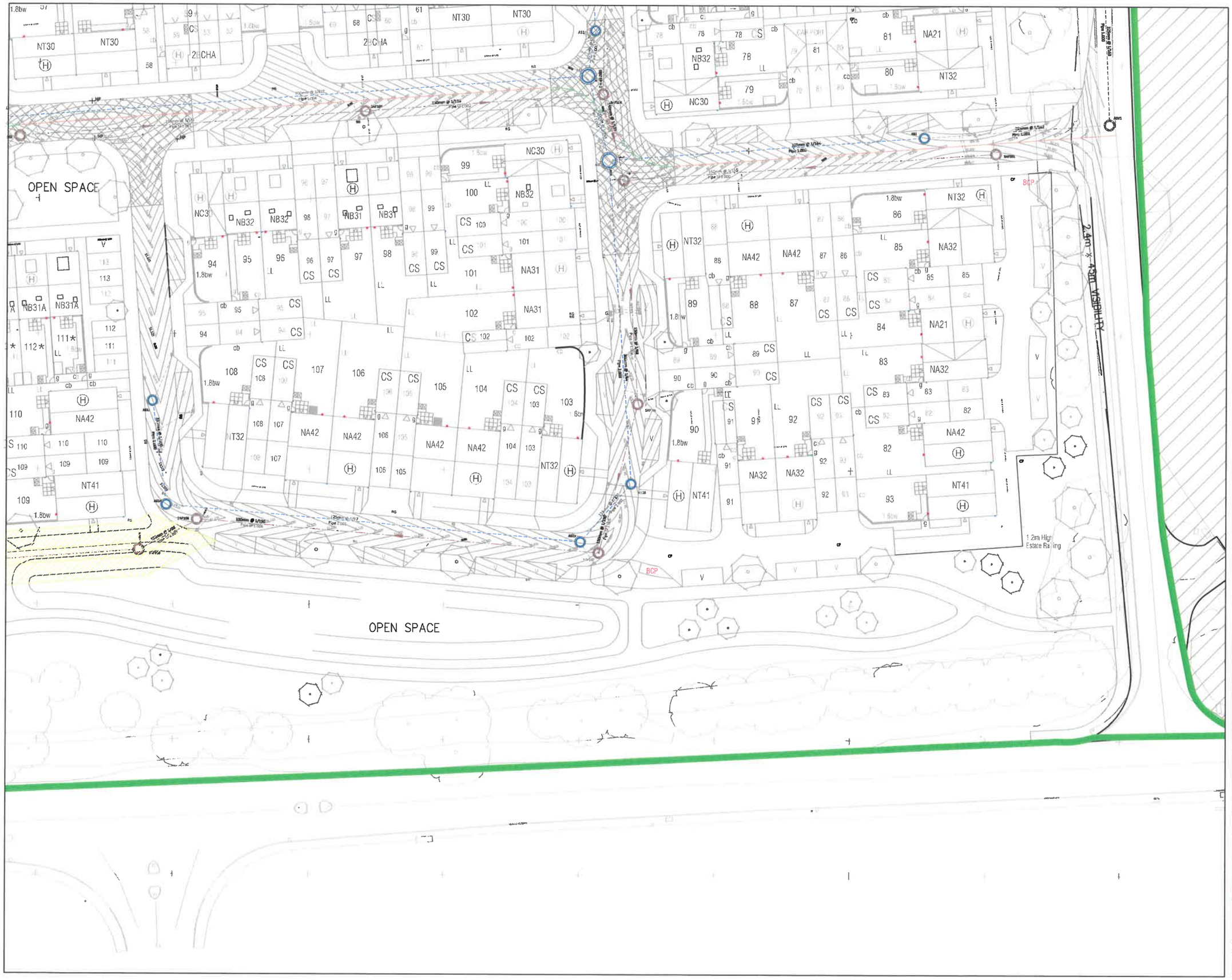

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CANTERBURY
PHASE 1

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Sheet 6 of 6

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NOTES.

1) GENERAL

A) .....
B) .....

RAINFALL EXCEEDANCE FLOW ARROW

CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 2007

DESIGNERS HAZARD INFORMATION FOR CONSTRUCTION

1. SERVICES TO BE LOCATED
2. MANUAL LIFTING
3. HOT MATERIAL WORKING
4. CUTTING/DUST
5. CONCRETE, HANDING, LIFTING, PLACEMENT
6. DEEP EXCAVATIONS, COLLAPSE/FALLING
7. SERVICE VOIDS/RISERS, FALLING

PRELIMINARY

Rev.	Date	Revision	By	Chk
	25.01.17	INITIAL ISSUE	AJB	CET

Client

Project
HOWE BARRACKS
CANTERBURY

Title
PRELIMINARY
RAINFALL EXCEEDANCE ROUTES

KNAPP HICKS AND PARTNERS LTD.
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Prospect House 67 - 69 St John's Road Isleworth Middlesex TW7 6NL
T: 020 8567 1000 F: 020 8567 1001

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DATE DEC 16 CHECK CET
A1

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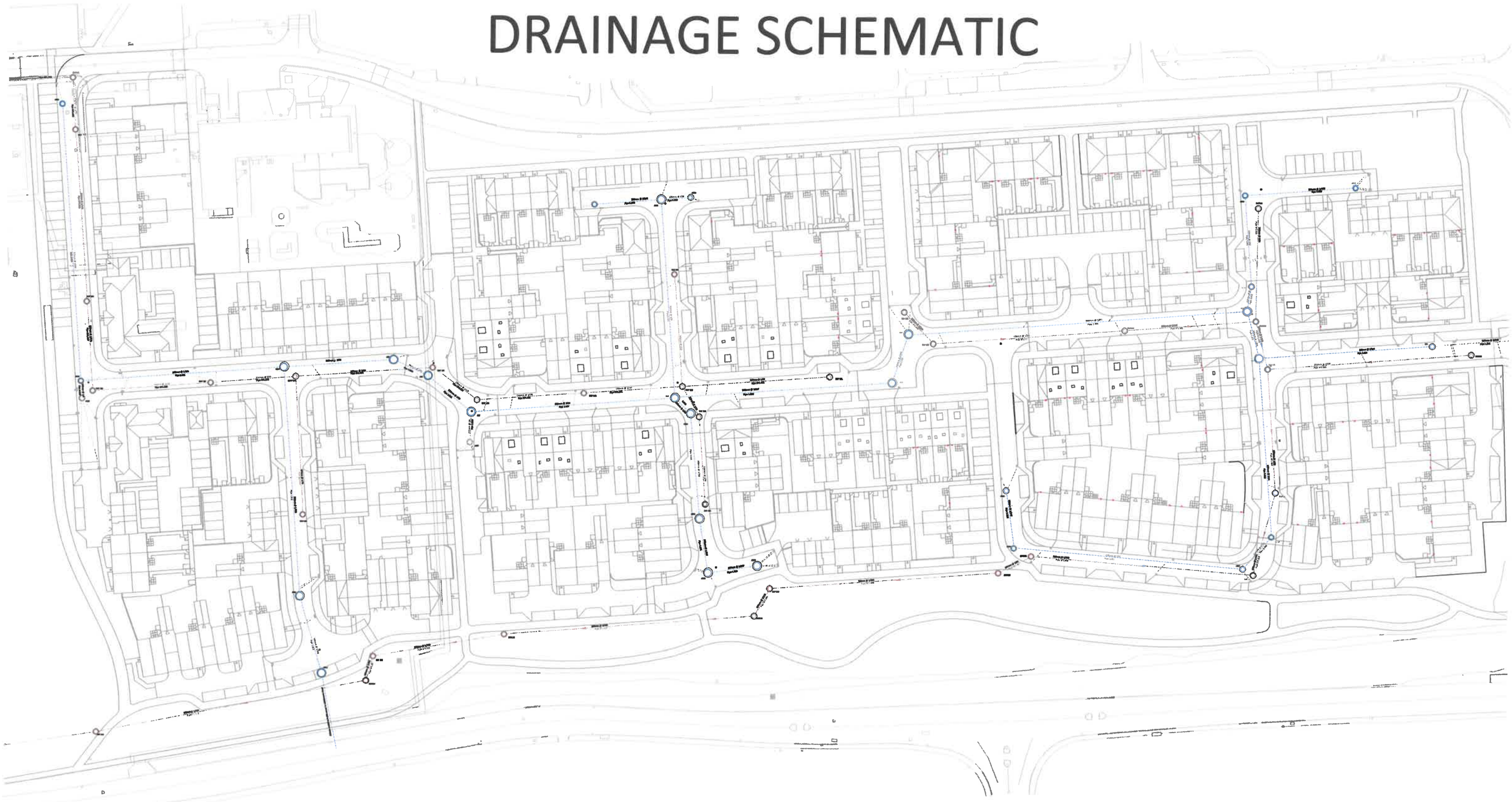
Knapp Hicks & Partners Ltd		Page 1
Kingston House Long Barrow Road Orbital Park Ashford		
Date 24/04/2018 15:29 File PHASE 1 SW REV.mdx	Designed by andrewb Checked by	
Causeway	Network 2015.1	

DRAINAGE SCHEMATIC



STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes surf1 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.800	Minimum Backdrop Height (m)	0.200
Ratio R	0.378	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.374	4-8	0.627	8-12	0.064

Total Area Contributing (ha) = 1.066

Total Pipe Volume (m³) = 358.140

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	23.607	0.145	162.8	0.021	5.00	0.0	0.600	o	225	
1.001	27.460	0.170	161.5	0.046	0.00	0.0	0.600	o	225	
1.002	46.782	0.285	164.1	0.033	0.00	0.0	0.600	o	225	
2.000	15.503	0.155	100.0	0.033	5.00	0.0	0.600	o	225	
2.001	61.381	0.630	97.4	0.054	0.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.38	48.985	0.021	0.0	0.0	0.0	1.02	40.6	2.8
1.001	50.00	5.83	48.840	0.067	0.0	0.0	0.0	1.03	40.8	9.1
1.002	50.00	6.60	48.670	0.100	0.0	0.0	0.0	1.02	40.5	13.5
2.000	50.00	5.20	50.035	0.033	0.0	0.0	0.0	1.31	52.0	4.5
2.001	50.00	5.97	49.880	0.087	0.0	0.0	0.0	1.32	52.7	11.8

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
2.002	11.439	0.115	99.5	0.016	0.00	0.0	0.600	o	225	
2.003	47.915	0.750	63.9	0.069	0.00	0.0	0.600	o	300	
1.003	12.867	0.015	857.8	0.000	0.00	0.0	0.600	o	900	
3.000	29.614	0.195	151.9	0.045	5.00	0.0	0.600	o	225	
3.001	24.394	0.575	42.4	0.043	0.00	0.0	0.600	o	225	
3.002	6.733	0.150	44.9	0.000	0.00	0.0	0.600	o	225	
1.004	90.000	0.105	857.1	0.067	0.00	0.0	0.600	o	900	
1.005	13.752	0.020	687.6	0.024	0.00	0.0	0.600	o	900	
1.006	58.100	0.395	147.1	0.062	0.00	0.0	0.600	o	900	
4.000	13.301	0.015	886.7	0.022	5.00	0.0	0.600	o	900	
4.001	14.639	0.025	585.6	0.027	0.00	0.0	0.600	o	900	
4.002	28.242	0.040	706.1	0.043	0.00	0.0	0.600	o	900	
4.003	5.941	0.195	30.5	0.000	0.00	0.0	0.600	o	900	
5.000	17.797	0.110	161.8	0.032	5.00	0.0	0.600	o	225	
6.000	7.769	0.445	17.5	0.018	5.00	0.0	0.600	o	225	
5.001	53.115	1.490	35.6	0.046	0.00	0.0	0.600	o	900	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.002	50.00	6.12	49.250	0.103	0.0	0.0	0.0	1.31	52.1	13.9
2.003	50.00	6.52	49.060	0.172	0.0	0.0	0.0	1.97	139.3	23.3
1.003	50.00	6.80	47.710	0.272	0.0	0.0	0.0	1.06	675.4	36.8
3.000	50.00	5.47	49.290	0.045	0.0	0.0	0.0	1.06	42.1	6.1
3.001	50.00	5.67	49.095	0.088	0.0	0.0	0.0	2.01	80.1	11.9
3.002	50.00	5.73	48.520	0.088	0.0	0.0	0.0	1.96	77.8	11.9
1.004	50.00	8.21	47.695	0.427	0.0	0.0	0.0	1.06	675.7	57.8
1.005	50.00	8.40	47.590	0.451	0.0	0.0	0.0	1.19	755.3	61.1
1.006	50.00	8.78	47.570	0.513	0.0	0.0	0.0	2.58	1642.3	69.5
4.000	50.00	5.21	47.450	0.022	0.0	0.0	0.0	1.04	664.2	3.0
4.001	50.00	5.40	47.435	0.049	0.0	0.0	0.0	1.29	819.1	6.6
4.002	50.00	5.80	47.410	0.092	0.0	0.0	0.0	1.17	745.2	12.5
4.003	50.00	5.82	47.370	0.092	0.0	0.0	0.0	5.69	3618.4	12.5
5.000	50.00	5.29	49.450	0.032	0.0	0.0	0.0	1.03	40.8	4.3
6.000	50.00	5.04	49.785	0.018	0.0	0.0	0.0	3.15	125.1	2.4
5.001	50.00	5.46	48.665	0.096	0.0	0.0	0.0	5.26	3344.5	13.0

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.007	54.412	1.215	44.8	0.061	0.00	0.0	0.600	o	900	
7.000	8.020	1.325	6.1	0.015	5.00	0.0	0.600	o	225	
1.008	15.103	0.335	45.1	0.000	0.00	0.0	0.600	o	900	
1.009	10.146	0.240	42.3	0.026	0.00	0.0	0.600	o	900	
1.010	29.122	0.545	53.4	0.019	0.00	0.0	0.600	o	900	
8.000	74.053	0.435	170.2	0.072	5.00	0.0	0.600	o	600	
9.000	4.645	0.895	5.2	0.021	5.00	0.0	0.600	o	225	
8.001	54.212	0.380	142.7	0.059	0.00	0.0	0.600	o	600	
1.011	61.354	0.205	299.3	0.036	0.00	0.0	0.600	o	900	
1.012	21.422	0.075	285.6	0.021	0.00	0.0	0.600	o	900	
1.013	20.673	0.130	159.0	0.035	0.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.007	50.00	8.97	47.175	0.762	0.0	0.0	0.0	4.69	2983.0	103.2
7.000	50.00	5.02	47.960	0.015	0.0	0.0	0.0	5.35	212.9	2.0
1.008	50.00	9.03	45.960	0.777	0.0	0.0	0.0	4.67	2973.1	105.2
1.009	50.00	9.06	45.625	0.803	0.0	0.0	0.0	4.83	3070.5	108.7
1.010	50.00	9.18	45.385	0.822	0.0	0.0	0.0	4.29	2730.2	111.3
8.000	50.00	5.66	45.955	0.072	0.0	0.0	0.0	1.86	526.9	9.7
9.000	50.00	5.01	46.790	0.021	0.0	0.0	0.0	5.78	229.9	2.8
8.001	50.00	6.11	45.520	0.152	0.0	0.0	0.0	2.04	575.9	20.6
1.011	49.29	9.74	44.840	1.010	0.0	0.0	0.0	1.81	1148.9	134.8
1.012	48.79	9.93	44.635	1.031	0.0	0.0	0.0	1.85	1176.2	136.2
1.013	47.96	10.27	44.560	1.066	0.0	0.0	0.0	1.03	41.1*	138.5

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
ASV2	50.590	1.605	Open Manhole	1200	1.000	48.985	225				
ASV1	50.530	1.690	Open Manhole	1200	1.001	48.840	225	1.000	48.840	225	
AS1	50.302	1.632	Open Manhole	1200	1.002	48.670	225	1.001	48.670	225	
AS13	51.424	1.389	Open Manhole	1200	2.000	50.035	225				
AS14	51.299	1.419	Open Manhole	1200	2.001	49.880	225	2.000	49.880	225	
AS15	50.846	1.596	Open Manhole	1200	2.002	49.250	225	2.001	49.250	225	
AS16	50.744	1.684	Open Manhole	1200	2.003	49.060	300	2.002	49.135	225	
AS2	50.829	3.119	Open Manhole	1800	1.003	47.710	900	1.002	48.385	225	
								2.003	48.310	300	
AS17	50.717	1.427	Open Manhole	1200	3.000	49.290	225				
AS18	50.964	1.869	Open Manhole	1200	3.001	49.095	225	3.000	49.095	225	
AS19	50.842	2.322	Open Manhole	1200	3.002	48.520	225	3.001	48.520	225	
AS3	50.989	3.294	Open Manhole	1800	1.004	47.695	900	1.003	47.695	900	
								3.002	48.370	225	
AS4	51.728	4.138	Open Manhole	1800	1.005	47.590	900	1.004	47.590	900	
AS5	51.624	4.054	Open Manhole	1800	1.006	47.570	900	1.005	47.570	900	
AS20	49.578	2.128	Open Manhole	1800	4.000	47.450	900				
AS21	49.646	2.211	Open Manhole	1800	4.001	47.435	900	4.000	47.435	900	
AS22	50.014	2.604	Open Manhole	1800	4.002	47.410	900	4.001	47.410	900	
AS23	50.832	3.462	Open Manhole	1800	4.003	47.370	900	4.002	47.370	900	
AS24	51.175	1.725	Open Manhole	1200	5.000	49.450	225				
AS26	51.510	1.725	Open Manhole	1200	6.000	49.785	225				
AS25	51.409	2.744	Open Manhole	1800	5.001	48.665	900	5.000	49.340	225	
								6.000	49.340	225	
AS6	50.926	3.751	Open Manhole	1800	1.007	47.175	900	1.006	47.175	900	
								4.003	47.175	900	
								5.001	47.175	900	
AS27	49.664	1.704	Open Manhole	1200	7.000	47.960	225				
AS7	49.939	3.979	Open Manhole	1800	1.008	45.960	900	1.007	45.960	900	
								7.000	46.635	225	
AS8	49.624	3.999	Open Manhole	1800	1.009	45.625	900	1.008	45.625	900	
AS9	49.360	3.975	Open Manhole	1800	1.010	45.385	900	1.009	45.385	900	
AS28	47.862	1.907	Open Manhole	1500	8.000	45.955	600				
AS30	47.767	0.977	Open Manhole	1200	9.000	46.790	225				
AS29	47.750	2.230	Open Manhole	1500	8.001	45.520	600	8.000	45.520	600	
								9.000	45.895	225	
AS10	48.615	3.775	Open Manhole	1800	1.011	44.840	900	1.010	44.840	900	
								8.001	45.140	600	
AS11	47.750	3.115	Open Manhole	1800	1.012	44.635	900	1.011	44.635	900	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
AS12	47.862	3.302	Open Manhole	1800	1.013	44.560	225	1.012	44.560	900	
AS12A	46.100	1.670	Open Manhole	1200		OUTFALL		1.013	44.430	225	

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 8 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.800	Storm Duration (mins)	30
Ratio R	0.378		

Online Controls for Storm

Orifice Manhole: AS5, DS/PN: 1.006, Volume (m³): 17.9

Diameter (m) 0.115 Discharge Coefficient 0.600 Invert Level (m) 47.570

Orifice Manhole: AS22, DS/PN: 4.002, Volume (m³): 14.8

Diameter (m) 0.115 Discharge Coefficient 0.600 Invert Level (m) 47.410

Orifice Manhole: AS23, DS/PN: 4.003, Volume (m³): 25.6

Diameter (m) 0.115 Discharge Coefficient 0.600 Invert Level (m) 47.370

Orifice Manhole: AS6, DS/PN: 1.007, Volume (m³): 80.6

Diameter (m) 0.115 Discharge Coefficient 0.600 Invert Level (m) 47.175

Orifice Manhole: AS7, DS/PN: 1.008, Volume (m³): 43.9

Diameter (m) 0.115 Discharge Coefficient 0.600 Invert Level (m) 45.960

Orifice Manhole: AS8, DS/PN: 1.009, Volume (m³): 18.6

Diameter (m) 0.115 Discharge Coefficient 0.600 Invert Level (m) 45.625

Orifice Manhole: AS9, DS/PN: 1.010, Volume (m³): 15.4

Diameter (m) 0.115 Discharge Coefficient 0.600 Invert Level (m) 45.385

Hydro-Brake® Manhole: AS12, DS/PN: 1.013, Volume (m³): 20.9

Design Head (m) 2.760 Hydro-Brake® Type Md6 SW Only Invert Level (m) 44.560
Design Flow (l/s) 14.0 Diameter (mm) 121

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	9.2	3.000	14.5	7.000	22.1
0.200	7.4	1.400	9.9	3.500	15.6	7.500	22.9
0.300	7.6	1.600	10.6	4.000	16.7	8.000	23.6
0.400	7.3	1.800	11.2	4.500	17.7	8.500	24.4
0.500	7.1	2.000	11.8	5.000	18.7	9.000	25.1
0.600	7.1	2.200	12.4	5.500	19.6	9.500	25.7
0.800	7.7	2.400	12.9	6.000	20.5		
1.000	8.4	2.600	13.5	6.500	21.3		

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 8 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.379
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.800	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	30
Climate Change (%)	30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	ASV2	60 Winter	30	+30%	30/30 Winter				49.468
1.001	ASV1	60 Winter	30	+30%	30/30 Winter				49.465
1.002	AS1	60 Winter	30	+30%	30/15 Summer				49.456
2.000	AS13	15 Winter	30	+30%					50.121
2.001	AS14	15 Winter	30	+30%					50.029
2.002	AS15	60 Winter	30	+30%					49.463
2.003	AS16	60 Winter	30	+30%	30/60 Winter				49.454
1.003	AS2	60 Winter	30	+30%	30/15 Winter				49.438
3.000	AS17	60 Winter	30	+30%					49.461
3.001	AS18	60 Winter	30	+30%	30/60 Winter				49.454
3.002	AS19	60 Winter	30	+30%	30/30 Summer				49.442
1.004	AS3	60 Winter	30	+30%	30/15 Winter				49.437
1.005	AS4	60 Winter	30	+30%	30/15 Winter				49.434
1.006	AS5	60 Winter	30	+30%	30/15 Winter				49.432
4.000	AS20	240 Winter	30	+30%	30/240 Winter				48.358
4.001	AS21	240 Winter	30	+30%	30/180 Winter				48.358
4.002	AS22	240 Winter	30	+30%	30/180 Winter				48.359
4.003	AS23	240 Winter	30	+30%	30/120 Winter				48.346
5.000	AS24	15 Winter	30	+30%					49.546
6.000	AS26	15 Winter	30	+30%					49.828
5.001	AS25	15 Winter	30	+30%					48.732

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	ASV2	0.258	0.000	0.13		4.8	SURCHARGED	
1.001	ASV1	0.400	0.000	0.40		15.2	SURCHARGED	
1.002	AS1	0.561	0.000	0.59		22.7	SURCHARGED	
2.000	AS13	-0.139	0.000	0.31		14.2	OK	
2.001	AS14	-0.076	0.000	0.74		37.4	OK	
2.002	AS15	-0.012	0.000	0.53		23.3	OK	
2.003	AS16	0.094	0.000	0.30		39.0	SURCHARGED	
1.003	AS2	0.828	0.000	0.19		58.5	SURCHARGED	
3.000	AS17	-0.054	0.000	0.26		10.2	OK	
3.001	AS18	0.134	0.000	0.27		20.0	SURCHARGED	
3.002	AS19	0.697	0.000	0.37		20.0	SURCHARGED	
1.004	AS3	0.842	0.000	0.13		78.9	SURCHARGED	
1.005	AS4	0.944	0.000	0.11		31.9	SURCHARGED	
1.006	AS5	0.962	0.000	0.02		31.7	SURCHARGED	
4.000	AS20	0.008	0.000	0.00		1.5	SURCHARGED	
4.001	AS21	0.023	0.000	0.01		2.0	SURCHARGED	
4.002	AS22	0.049	0.000	0.01		3.7	SURCHARGED	
4.003	AS23	0.076	0.000	0.00		4.1	SURCHARGED	
5.000	AS24	-0.129	0.000	0.37		13.6	OK	
6.000	AS26	-0.182	0.000	0.08		7.8	OK	
5.001	AS25	-0.833	0.000	0.02		42.4	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.007	AS6	180 Winter	30	+30%	30/30 Winter				48.341
7.000	AS27	240 Winter	30	+30%					48.163
1.008	AS7	240 Winter	30	+30%	30/15 Summer				48.163
1.009	AS8	240 Winter	30	+30%	30/30 Winter				47.988
1.010	AS9	240 Winter	30	+30%	30/60 Summer				47.808
8.000	AS28	240 Winter	30	+30%	30/120 Summer				47.623
9.000	AS30	240 Winter	30	+30%	30/120 Summer				47.623
8.001	AS29	240 Winter	30	+30%	30/60 Summer				47.623
1.011	AS10	240 Winter	30	+30%	30/30 Winter				47.623
1.012	AS11	240 Winter	30	+30%	30/15 Summer				47.622
1.013	AS12	240 Winter	30	+30%	30/15 Summer				47.621

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.007	AS6	0.266	0.000	0.01		26.1	SURCHARGED	
7.000	AS27	-0.022	0.000	0.01		1.3	OK	
1.008	AS7	1.303	0.000	0.01		16.1	SURCHARGED	
1.009	AS8	1.463	0.000	0.01		15.1	SURCHARGED	
1.010	AS9	1.523	0.000	0.01		15.4	SURCHARGED	
8.000	AS28	1.068	0.000	0.01		6.1	FLOOD RISK	
9.000	AS30	0.608	0.000	0.01		1.8	FLOOD RISK	
8.001	AS29	1.503	0.000	0.02		11.2	FLOOD RISK	
1.011	AS10	1.883	0.000	0.02		19.0	SURCHARGED	
1.012	AS11	2.087	0.000	0.02		14.2	FLOOD RISK	
1.013	AS12	2.836	0.000	0.39		14.6	FLOOD RISK	