

Discharge of Condition Drainage Technical Note



The Civil Engineering Practice
11 Tungsten Building
George Street
Fishersgate
Sussex
BN41 1RA

Project	Stakers Farm, Yapton
Project Number	23452
By	Martin Kempshall CEng MICE
Date	26 February 2021

1 Introduction

- 1.1 This Technical Note has been produced in support of the Discharge of Condition Application in relation to Condition 5 of Planning Permission Y/105/19/PL comprising alterations to create three new dwellings, car barns and store, replacement pump house and associated landscaping.
- 1.2 This Technical Note is to be read in conjunction with all planning, architectural and other reports that accompany the Planning Application for the proposed development.
- 1.3 The proposed development will incorporate a sustainable drainage system which will discharge all surface water at a restricted rate of 2l/s via the existing onsite combined drainage system which connects to the public foul sewer located beneath the B2132 North End Road. The restricted surface water discharge will reduce peak loadings on the public foul sewer by at least 4l/s.

2 Condition 5

- 2.1 *'Development shall not commence, other than works of site survey and investigation, until full details of the proposed surface water drainage scheme have been submitted to and approved in writing by the Local Planning Authority. The design should follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations, and the recommendations of the SuDS Manual produced by CIRIA. Winter groundwater monitoring to establish highest annual ground water levels and winter Percolation testing to BRE 365, or similar approved, will be required to support the design of any Infiltration drainage. No building / No part of the extended building shall be occupied until the complete surface water drainage system serving the property has been implemented in accordance with the agreed details and the details so agreed shall be maintained in good working order in perpetuity.'*



3 Information to support discharge of Planning Condition 5

3.1 Existing Site

- 3.1.1 The development site is located on land west of the B2132 North End Road, Yapton at Ordnance Survey reference SU 977 035. The nearest postcode is BN18 0DU.
- 3.1.2 The site is bounded to the north by residential properties, the east by B2132 North End Road, the south by open fields and to the west by agricultural buildings.
- 3.1.3 A copy of the site location plan is located at the rear of this Technical Note.

3.2 Existing Drainage

- 3.2.1 Surface and foul water from the existing site is currently discharged in an unrestricted manner via a combined onsite drainage system to the foul water sewer beneath the B2132 North End Road located to the southeast of the site.
- 3.2.2 The connection to the existing public foul water system is at least 100mm in diameter with a minimum gradient of at least 1 in 80, which equates to a full-bore discharge capacity of 6.7l/s.

3.3 Geology

- 3.3.1 Site investigation completed by Ashdown Site Investigation in February 2020 confirms the presence of made ground to a depth of 0.6m below ground level, which is underlain by slightly gravelly, slightly sandy clay classified as River Terrace Deposits.
- 3.3.2 Infiltration testing completed by Ashdown Site Investigation at a depth of 0.6m below existing ground level in general accordance with BRE Digest 365 methodology concluded that the underlying ground had moderate to poor infiltration with infiltration rates varying from 3.2×10^{-5} m/s to 5.0×10^{-7} m/s.
- 3.3.3 Winter groundwater monitoring was completed between 14 February 2020 to 3 April 2020. Groundwater peaked at location WS01 at 0.58m below ground level and 0.38m below ground level at WS02.
- 3.3.4 Extracts from the site investigation by Ashdown Site Investigations are located at the rear of this Technical Note.

3.4 Proposed Development

- 3.4.1 The proposed development comprises alterations to create three new dwellings, car barns and store, replacement pump house and associated landscaping. The impermeable areas of the various elements of the development are summarised as follows:

- Roof areas 662m²
- Patios and Parking Area 1,165m²

- 3.4.2 A copy of the proposed site layout plan together with an impermeable areas plan is located at the rear of this Technical Note.

3.5 Surface Water Drainage

- 3.5.1 The surface water drainage design is in compliance with the principles of Arun District Council's Supplementary Requirements for Surface Water Drainage Proposals and recognised best practice.
- 3.5.2 For surface water discharge, the drainage hierarchy notes the following list of drainage options in order of preference:
1. Infiltration to ground
 2. Discharge to a watercourse
 3. Discharge to a surface water sewer
 4. Discharge to a foul water sewer
- 3.5.3 Due to groundwater being recorded at shallow depths an infiltration system is not feasible.
- 3.5.4 As there are no watercourses adjacent to the site surface water will be discharged to the public foul water sewer located beneath B2132 North End Road via the existing combined drainage system which serves the current site and buildings.
- 3.5.5 All surface water runoff from roofs and hard paved areas will be attenuated using a lined voided subbase system located beneath permeable paving which will serve all parking and vehicular access areas before discharging via a hydrobrake at a restricted rate of 2l/s to the public foul water sewer.
- 3.5.6 The lined subbase attenuation system will ensure that groundwater is unable to be drained through the voided subbase into the public foul water sewer.
- 3.5.7 Detailed calculations and design drawings have been prepared in order to demonstrate that surface water drainage can be adequately accommodated and managed within the site without any increased flood risk elsewhere.
- 3.5.8 Sufficient storage will be provided to accommodate a 1:100 year storm event, including an additional 40% to account for the predicted effects of future climate change.
- 3.5.9 A minimum storage volume of 98.3m³ will be provided within a lined voided subbase located beneath permeable paving. The system has an estimated half drain time of 444 minutes, approximately 7.5 hours.
- 3.5.10 Surface water loadings on the public foul water sewer will be reduced by at least 4l/s during heavy rainfall events compared to the predeveloped site.

3.6 Foul Water

- 3.6.1 Foul water will discharge to the existing foul water sewer via the existing foul water drainage connection located beneath the B2132 North End Road.
- 3.6.2 The anticipated peak foul water discharge in accordance with Sewer for Adoption guidance is 0.14l/s.
- 3.6.3 Sewerage undertakers have an obligation to upgrade the existing public sewer networks if a connection to an equivalent or larger sized public sewer is technically achievable.
- 3.6.4 A S106 application for an indirect connection to the public foul sewer will be made to Southern Water prior to any new connections being made.
- 3.6.5 The proposed drainage layout plan together with construction details and calculations are located at the rear of this Technical Note.

3.7 Surface Water Quality

- 3.7.1 In accordance with CIRIA SuDS Manual 2015 (Report C753) the pollution hazard level for the proposed residential development is very low to low.
- 3.7.2 The surface water scheme will include mitigation to ensure that surface water is suitably treated, and any pollution risk adequately managed prior to discharge.
- 3.7.3 Table 26.2 in Chapter 26 of CIRIA report C753 The SuDS Manual provides Pollution Hazard Indices for varying land types and those determined as most relevant to the development proposals are as follows:

Land Use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very Low	0.2	0.2	0.05
Individual property driveways, residential car park, low-traffic roads	Low	0.5	0.4	0.4

Table 1: Pollution Hazard Indices

- 3.7.4 Table 26.3 in Chapter 26 of CIRIA Report C753 The SuDS Manual identifies the water quality mitigation index of SuDS features. An extract from Table 26.3 of CIRIA Report C753 The SuDS Manual is shown below:

SuDS Type	Total suspended solids (TSS)	Metals	Hydrocarbons
Permeable pavement	0.7	0.6	0.7

Table 2: Pollution Mitigation Indices

- 3.7.5 Permeable paving provides the target treatment level required for runoff with very low to low risk of pollution hazard, thus demonstrating that the surface water drainage system for the site can be designed to adequately meet water quality requirements.

3.8 Maintenance During Construction

- 3.8.1 Once appointed the Contractor will prepare a site specific method statement for the control of silt and other pollutants during construction. CIRIA Report C532 'Control of Water Pollution from Construction Sites' provides further guidance on this.
- 3.8.2 Appropriate water quality mitigation will be undertaken in accordance with CIRIA Report C532 to allow surface water to be attenuated and sediments to be captured during the construction phase.
- 3.8.3 The Contractor will maintain the proposed drainage system during construction and until the site is handed over to the private Management Company.

3.9 Management and Maintenance of Proposed SuDS Drainage System

- 3.9.1 Upon completion, management of the shared drainage facilities will be passed on to a private Management Company appointed by the Developer on behalf of the new Residents.
- 3.9.2 The regular and corrective maintenance of all shared elements of the drainage system will be managed and funded through the private Management Company on behalf of the Residents.
- 3.9.3 In the event that the private Management Company becomes unable to discharge its duties within 2 years of first appointment the Developer will endeavour to appoint an alternative on behalf of the Residents.
- 3.9.4 A copy of the proposed drainage maintenance plan showing ownership responsibilities is identified on Drawing 104 located at the rear of this Technical Note.

4 Summary

- 4.1 A detailed sustainable surface water drainage scheme has been submitted for the site in support of the discharging of Planning Condition 5 of Planning Permission granted by Arun District Council under Application Y/105/19/PL.
- 4.2 Site investigations recording infiltration rates and winter groundwater levels confirm that an infiltration system for the discharging of surface water to ground is not feasible.
- 4.3 Surface water is proposed to discharge via the existing combined drainage connection to the public foul water sewer located beneath B2132 North End Road at a restricted rate of 2l/s providing a reduction of at least 4l/s compared to predeveloped peak flow rate.
- 4.4 Sufficient surface water storage is to be provided within a lined voided subbase storage to attenuate the 1:100 year storm with a 40% allowance for climate change.
- 4.5 The submitted surface water scheme meets the local and national requirements for SuDS drainage, provide appropriate water quality mitigation and are achievable for this development.
- 4.6 The requirements of Planning Condition 5 of Planning Permission granted by Arun District Council under Application Y/105/19/PL have been met.

5 Appended Documents

Drawing 101 – Site Location Plan

Drawing 102 – Existing Site Layout Plan

Drawing 103 – Existing and Proposed Impermeable Areas Plan

Drawing 104 – Proposed Drainage Maintenance Plan

Drawing 201 – Proposed Drainage Layout Plan

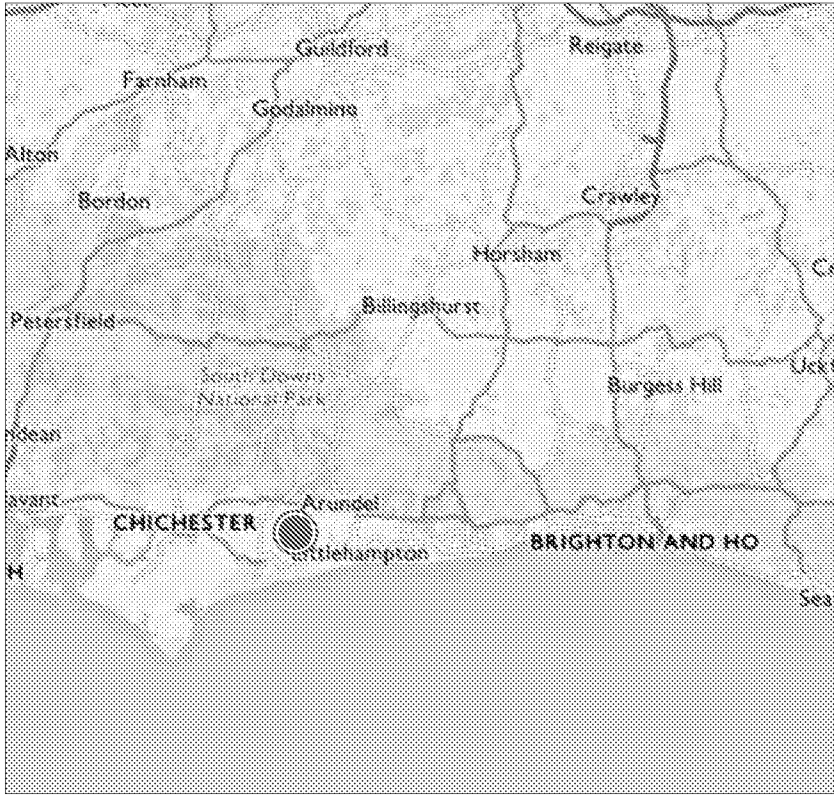
Drawing 501 – Construction Details

Ashdown Site Investigation Site Investigation Extracts

Existing Foul Water Sewer Calculations

Causeway Flow Calculations

Southern Water Sewer Records



TITLE	
Site Location Plan - Stakers Farm Barns, Yapton, BN18 0DU - OS Ref: SU 797 035	
SCALE	PROJECT No.
1:10000 @ A3	23452
REPORT TYPE	DRG. No.
INFORMATION	101



All dimensions to be checked on site. All details and dimensions relating to sub-Contractors work must be checked and agreed between the sub-Contractor or supplier and the general Contractor.

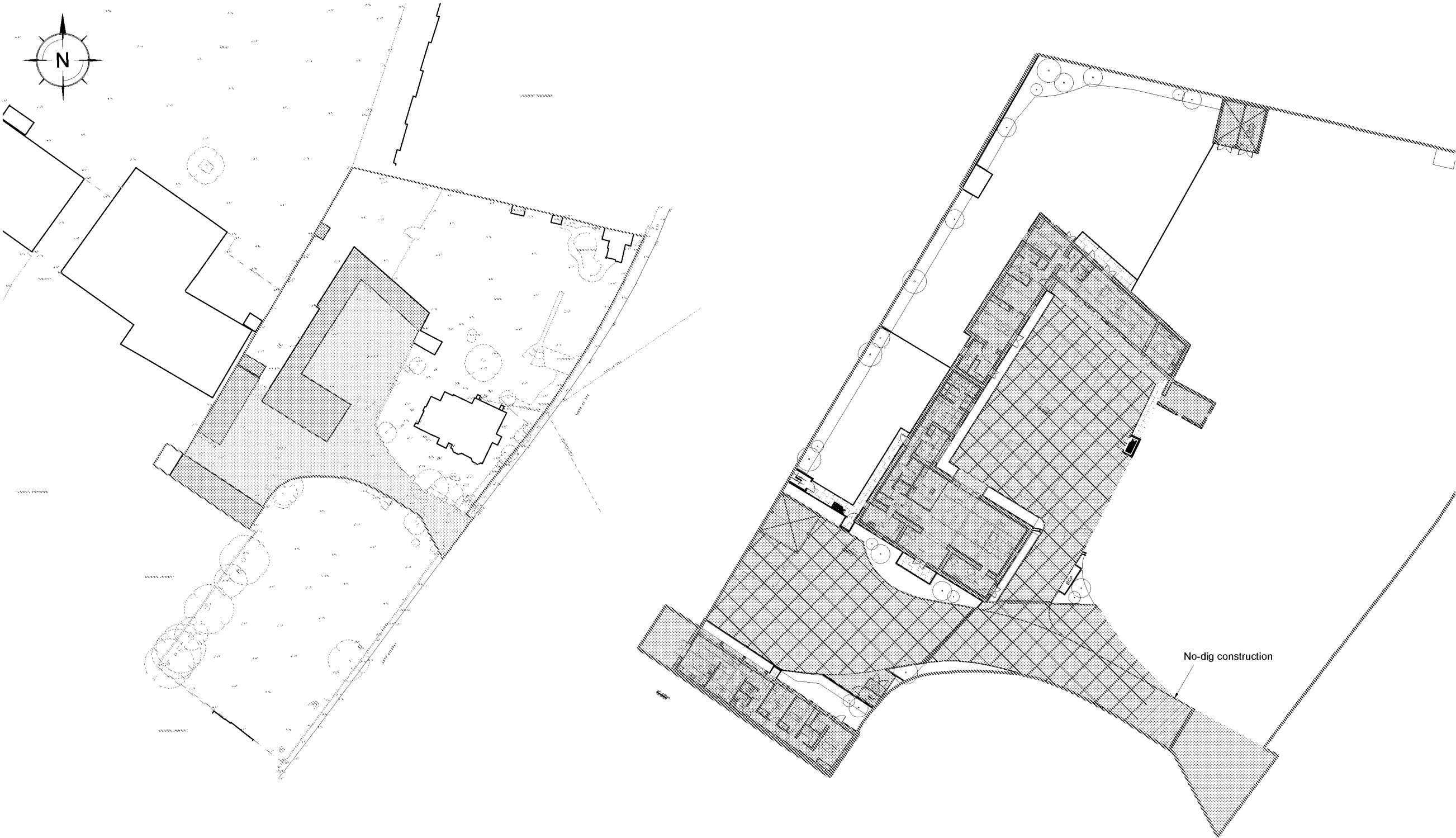
This drawing is to be read in conjunction with all relevant Architect's and Engineer's drawings and specification.

The main Contractor is responsible for ensuring the stability of the structure whilst the works are in progress.

Any information given regarding existing underground services is given on good faith after consultation with the relevant authority. No liability is accepted by the Consultant and the main Contractor is responsible for obtaining and checking all information and taking due care and attention whilst undertaking the works.

Issue Status **FOR APPROVAL**

CLIENT		Granite Gate Ltd					
PROJECT		Stakers Farm, North End Road, Yapton					
TITLE							
Existing Site Layout Plan							
DRAWN		DATE					
M Pacifico		Feb 2011					
ENGINEER		CHECKED					
M Kempshall							
SCALE		PROJECT NO.					
1:250 @ A1, 1:500 @ A3		23452					
		<table border="1"> <tr> <td>DWG. No.</td> <td>REV.</td> </tr> <tr> <td>102</td> <td>-</td> </tr> </table>		DWG. No.	REV.	102	-
DWG. No.	REV.						
102	-						



Key

Existing Roofs 705m²

Existing Impermeable surfaces 1318m²

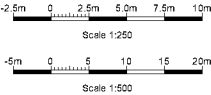
Red Line Boundary 5611m²

Key

Proposed Roofs 662m²

Proposed Impermeable surfaces 1165m²

Area for voided subbase 971m²



- NOTES:
1. All dimensions to be checked on site. All details and dimensions relating to sub-Contractors work must be checked and agreed between the sub-Contractor or supplier and the general Contractor.
 2. This drawing is to be read in conjunction with all relevant Architect's and Engineer's drawings and specification.
 3. The main Contractor is responsible for ensuring the stability of the structure whilst the works are in progress.
 4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority. No liability is accepted by the Consultant and the main Contractor is responsible for obtaining and checking all information and taking due care and attention whilst undertaking the works.

REV	DATE	INT	DESCRIPTION	CHK
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Issue Status FOR APPROVAL

11

11

11

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CLIENT
Granite Gate Ltd

PROJECT
Stakers Farm, North End Road, Yapton

TITLE
Proposed Drainage and Levels Layout plan

DRAWN
M Pacifico

DATE
Feb 2021

DESIGNED
M Kempshall

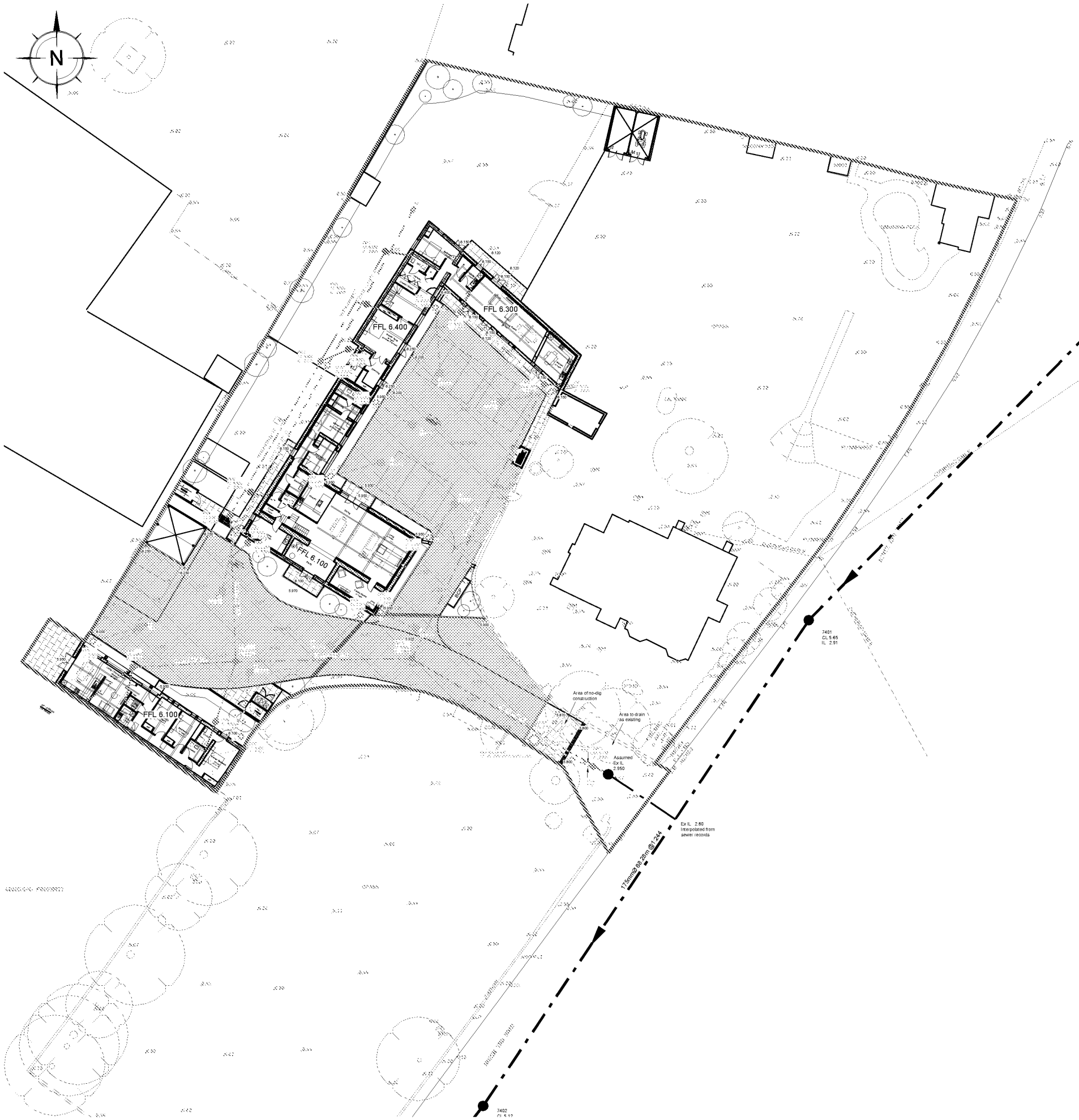
CHECKED

PROJECT NO.
23452

DWG NO.
103

REV.
-

SCALE
1:500 & 1:250 @ A1



Drainage Legend:

- Existing Storm Sewer
- Existing Foul Sewer
- Private Type 4 Storm Water Inspection Chamber
- Private Storm Water Rodding Eye
- ACC or similar approved linear channel drain and sump
- Catchpit
- Diffuser tanks
- Voided subbase for attenuation and filtration 97m³ Minimum 66.2m³ of storage required
- Fin Drain to voided subbase
- Hydrabrace Reference: CTL-SHE-0064-2000-1250-2000 Storm water drainage to be maintained by the estates management company
- Private Type 4 Foul Water Inspection Chamber
- Foul water drainage to be maintained by the estates management company
- Site boundary

Surface Finishes Legend:

- Paving flags impermeable with falls to landscaping areas
- Permeable paving with voided subbase beneath.

Note:
Surface finishes are shown for illustrative purposes only.
See architect's design and details

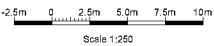
- NOTES:**
- All dimensions to be checked on site. All details and dimensions relating to sub-Contractors work must be checked and agreed between the sub-Contractor or supplier and the general Contractor.
 - This drawing is to be read in conjunction with all relevant Architect's and Engineer's drawings and specification.
 - The main Contractor is responsible for ensuring the stability of the structure whilst the works are in progress.
 - Any information given regarding existing underground services is given in good faith after consultation with the relevant authority. No liability is accepted by the Consultant and the main Contractor is responsible for obtaining and checking all information and taking due care and attention whilst undertaking the works.
 - All pipes, bends and junctions shall be verified clay to BS EN 205-1, with flexible joints and kitemark certified. Alternatively all pipes and fittings can be UPVC conforming to BS EN 1401-1 and shall be laid in accordance with the manufacturers specification. If UPVC pipes are to be used then the manufacturer shall be approved by the Engineer prior to construction.
 - All adoptable sewers shall be in strict accordance with the current edition of Sewers For Adoption. Unless otherwise stated adoptable sewers shall be 150mm diameter and shall be laid in a class S bedding. Where the depth to soffit is less than 1.2m under a public highway or 0.8m elsewhere the pipe shall be laid with a class Z bedding.
 - All private building drainage shall be constructed in strict accordance with BS EN 752:1996. Unless otherwise specified building drainage shall be 100mm diameter and shall be laid at a minimum gradient of 1 in 40 for foul drains and 1 in 80 for surface water drains. All building drains shall be laid in class B bedding unless otherwise specified.
 - Where the service trench is near to the foundation of any building, refer to the guidance in Approved Document H, Building Regulations Part H1.
 - Where pipes, external to the structures, have a depth to soffit from ground level of less than 450mm they shall have a class GEN 3 concrete encasement (150mm thick), in all other cases the pipes shall be bedded and surrounded with 100mm thick granular material.
 - In any circumstances where pipes are bedded and surrounded in concrete flexible joints should be provided. Compressible boards (flexboard or polystyrene) shall be provided at a maximum of 5m centres (coinciding with pipe joints). The boards shall be pre-cut to pipe diameter and to a height and width equal to the concrete cross section. A board thickness of 18mm for pipes up to 450mm nominal diameter and 36mm for pipes over 450mm nominal diameter.
 - All svps shall have rodding access plates fitted at their bases (ground floor level).
 - Where existing pipes are to be abandoned they shall be dug out together with any abandoned manholes.

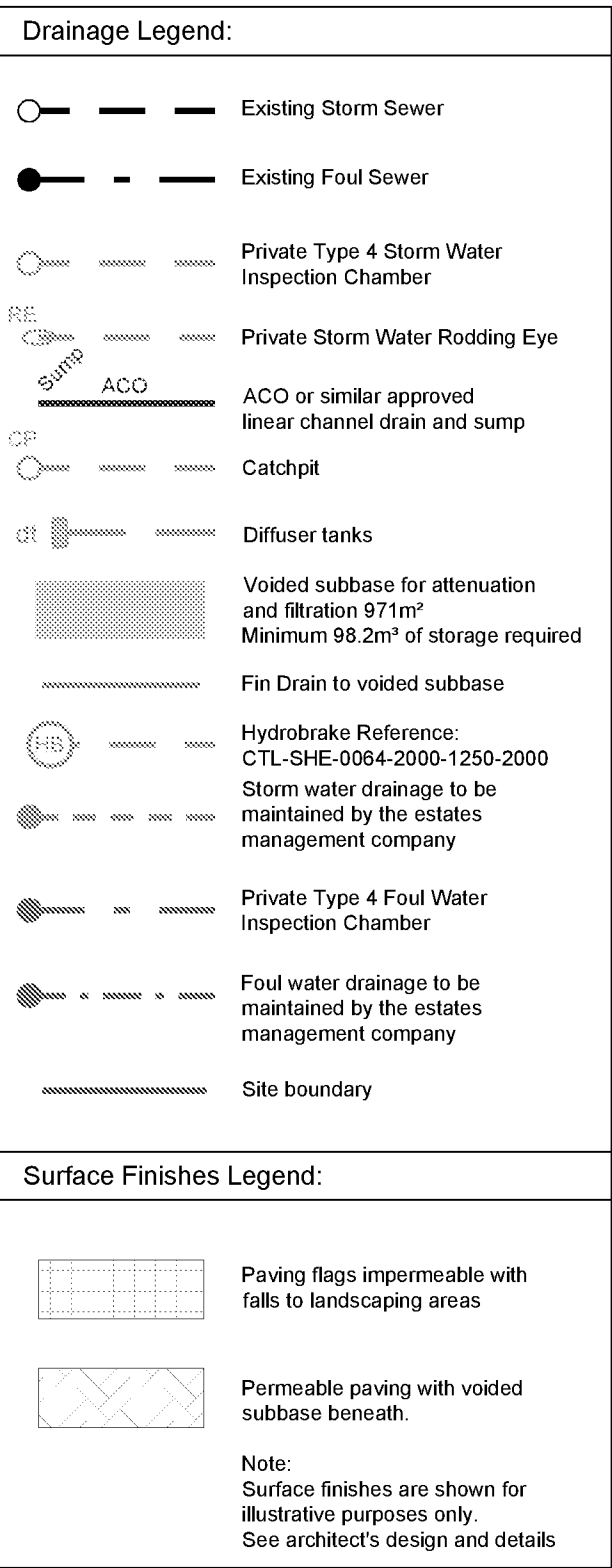
REV	DATE	INT	DESCRIPTION	CHK
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Issue Status **FOR APPROVAL**

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CLIENT Granite Gate Ltd	
PROJECT Stakers Farm, North End Road, Yapton	
TITLE Proposed Drainage Maintenance Plan	
DRAWN M Pacifico	DATE Feb 2021
ENGINEER M Kempshall	CHECKED
SCALE 1:250 @ A1, 1:500 @ A3	
PROJECT NO 2345	
Dwg No 104	





1. All dimensions to be checked on site. All details and dimensions relating to sub-Contractors work must be checked and agreed between the sub-Contractor or supplier and the general Contractor.
2. This drawing is to be read in conjunction with all relevant Architect's and Engineer's drawings and specification.
3. The main Contractor is responsible for ensuring the stability of the structure whilst the works are in progress.
4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority. No liability is accepted by the Consultant and the main Contractor is responsible for the establishment of the information and taking due care and attention whilst undertaking the works.
5. All pipes, bends and junctions shall be vitrified clay to BS EN 295-1, with flexible joints and kitemark certified. Alternatively all pipes and fittings can be UPVC conforming to BS EN 1401-1 and shall be laid in accordance with the manufacturers specification. If UPVC pipes are to be used then the manufacturer shall be approved by the Engineer prior to construction.
6. All Adorable sewers shall be in strict accordance with the current edition of Sewers For Adoption. Unless otherwise stated adoptable sewers shall be 150mm diameter and shall be laid in a class B bedding. Where the depth to soffit is less than 1.2m under a public highway or 0.9m elsewhere the pipe shall be laid with a class 2 bedding.
7. All private building drainage shall be constructed in strict accordance with BS EN 752:1996. Unless otherwise specified building drainage shall be 100mm diameter and shall be laid at a minimum gradient of 1 in 40 for a length of 1 or 60 for a length of 100m. All building drains of 1 in 40 shall be laid in class B bedding unless otherwise specified.
8. Where the service trench is near to the foundation of any building, refer to the guidance in Approved Document H1, Building Regulations Part H1.
9. Where pipes, external to the structures, have a depth to soffit from the ground level of less than 450mm they shall have a class GEN 3 concrete encasement (150mm thick). In all other cases the pipes shall be bedded and surrounded with 100mm thick granular material.
10. In any circumstances where pipes are bedded and surrounded in concrete flexible joints should be provided. Compressible boards (fibreglass or polystyrene) shall be provided at a maximum of 8m centres (concrete) and 10m centres (polystyrene). The pre-cast to pipe diameter and to a height and width equal to the concrete cross section. A board thickness of 18mm for pipes up to 450mm nominal diameter and 38mm for pipes over 450mm nominal diameter.
11. All sumps shall have rodding access plates fitted at their bases (ground floor level).
12. Where existing pipes are to be abandoned they shall be dug out together with any abandoned manholes.

Issue Status **FOR APPROVAL**

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CLIENT		Granite Gate Ltd	
PROJECT		Stakers Farm, North End Road, Yapton	
TITLE			
Proposed Drainage and Levels Layout plan			
DRAWN	DATE	PROJECT NO.	
M Pacifico	Feb 2021	23452	
ENGINEER	CHECKED	DWG. No.	REV.
M Kempshall		201	-
SCALE			
1:250 @ A1, 1:500 @ A3			

4. GROUND CONDITIONS

4.1 Stratigraphy

4.1.1 Surface Covering

Each of the exploratory holes was excavated through a surface cover of asphalt or topsoil some 50mm to 150mm in thickness.

4.1.2 Made Ground

Made ground, generally comprising gravelly sandy clay and/or clayey gravel, was recorded to depths of between 0.25m and 0.60m below ground level. The gravel fraction comprised variable quantities of chalk, flint, brick, tile, concrete, breeze block, crystalline rock and clinker-like material.

No made ground soils were recorded with trial pit TP04.

4.1.3 River Terrace Deposits

Underlying the surfacing/made ground, the investigation progressed into undisturbed slightly gravelly slightly sandy clay deposits. These soils were recorded to the full depth of the trial pits and borehole WS01, and to a depth of 2.30m within borehole WS02.

These soils are considered to represent the River Terrace Deposits indicated on the published geological map.

4.1.4 White Chalk Subgroup

Beneath the River Terrace Deposits, where penetrated, the dynamic sampler borehole WS02 encountered structureless chalk to the full depth of the borehole of 4.00m. These deposits are considered to be representative of the White chalk Subgroup indicated on the published geology map.

4.2 Stability

Each of the exploratory holes was recorded to remain stable during the course of drilling / excavation.

4.3 Groundwater Conditions

The trial pits remind dry during excavation. Groundwater was recorded within the boreholes WS01 and WS02 at depths of 1.67m and 1.73m below ground level, respectively, on completion of drilling, although some instability was recorded during the soakage tests.

It should be noted that water levels within the boreholes may not have equilibrated with the groundwater table at the time the readings were recorded and that groundwater levels should be expected to fluctuate seasonally.

Further groundwater data is to be provided under separate cover on completion of the monitoring programme.

5. STORMWATER INFILTRATION SYSTEMS

In-situ infiltration testing³ was carried out in each of the trial pits. For the first test carried out in trial pit TP03, TP04 and TP05, the tests were continued overnight and were recorded to be dry in the morning. Therefore these tests the soil infiltration rate (f) was calculated by dividing the volume of water lost between 75% and 25% of the initial test depth by the sum of the average surface area of the sides of the trial pit in contact with the water during the test monitoring period, and its base area. This figure was then divided by the test duration (time taken for the water level to fall between 75% and 25% of the initial test depth based on the overnight reading) to give the soil infiltration rate in metres per second.

For the remaining tests, the water level within the test pits did not fall below 25% of the initial test depth and calculation of the soil infiltration rates in accordance with the BRE digest was not possible. For these tests, the soil infiltration rate has been calculated by dividing the volume of water lost during the test by the product of the average surface area of the trial pit in contact with water during the test period and the test duration in seconds.

In-situ infiltration testing⁴ was also undertaken in borehole WS02. From the test results, calculations were made to estimate the infiltration rate that could be expected for soakaways constructed to discharge into the underlying soils within the test zone.

Non-standard falling head infiltration testing was carried out in the uncased dynamic sampler borehole WS01. The soil infiltration rate has been calculated by dividing the volume of water lost during the test by the product of the average surface area of the sides in contact with water during the test period and the test duration in seconds.

The infiltration rates derived from the tests are summarised in the following table.

Table 2. Calculated Infiltration Rates

Exploratory Hole	Test Response Zone Depth (m)		Stratum	Infiltration Rate (f) (m/sec)	Driving Head of Water (m)
	Top	Bottom			
TP01 Test 1	0.30	0.55	Made Ground	1.3×10^{-5}	-
TP01 Test 2	0.24	0.55	Made Ground	2.1×10^{-5}	-
TP01 Test 3	0.23	0.55	Made Ground	3.2×10^{-5}	-
TP02 Test 1	0.33	0.60	River Terrace Deposits	6.2×10^{-7}	-
TP02 Test 2	0.30	0.60	River Terrace Deposits	5.0×10^{-7}	-
TP03 Test 1	0.33	0.55	River Terrace Deposits	1.6×10^{-6}	-
TP03 Test 2	0.30	0.55	River Terrace Deposits	Negligible – no fall in water level recorded in 210 minutes	
TP04 Test 1	0.30	0.55	River Terrace Deposits	1.4×10^{-6}	-
TP04 Test 2	0.24	0.55	River Terrace Deposits	1.5×10^{-6}	-

³ Conducted in general accordance with the requirements of BRE 365, Soakaway Design.

⁴ Conducted in accordance with The Soakaway Design Guide, published by Kent County Council, July 2000.

R14124

TP05 Test 1	0.35	0.55	River Terrace Deposits	1.7×10^{-6}	-
TP05 Test 2	0.29	0.55	River Terrace Deposits	6.5×10^{-7}	-
WS01	0.30	4.00	River Terrace Deposits	7.7×10^{-7}	-
WS02 Test 1	1.00	2.00	River Terrace Deposits	1.5×10^{-5}	1.0
WS02 Test 2	1.00	2.00	River Terrace Deposits	4.6×10^{-6}	1.0

The value 'f' is equivalent to the soil infiltration coefficient 'q' quoted in the Construction Industry Research and Information Association (CIRIA) Report 156.

The results from the infiltration tests indicate that the made ground and River Terrace Deposits soils possess negligible to poor infiltration characteristics. The results from the infiltration tests should be provided to engineers responsible for the design of the drainage system.

Ashdown Site Investigation Ltd.

FIGURES

Figure 1 Site Location Plan

Figure 2 Site Walkover Plan

Exploratory Hole Notes

Exploratory Hole Records

Summary of Trial Pit Falling Head Soakage Test Results

Summary of Borehole Falling Head Soakage Test Results



© OpenStreetMap contributors, CC BY-SA

ASHDOWN SITE INVESTIGATION LIMITED	Site Location Plan	Site Name	Figure No.	Project Reference
		Stakers Farm Barn, North End Road, Yapton, West Sussex	1	P14458



ASHDOWN SITE INVESTIGATION LIMITED	2/DOC	Site Plan	Site Name	Figure No.	Project Reference
			Stakers Farm Barn, North End Road, Yapton, West Sussex	2	P14458

NOTES FOR THE INTERPRETATION OF EXPLORATORY HOLE RECORDS

1 Symbols and abbreviations

Samples

U	'Undisturbed' Sample: - 100mm diameter by 450mm long. The number of blows to drive in the sampling tube is shown after the test index letter in the SPT column.
U _o	Sample not obtained
U*	Full penetration of sample not obtained
Pi	Piston Sample: 'Undisturbed' sample 100mm diameter by 600mm long.
D	Disturbed Sample
R	Root Sample
B	Bulk Disturbed Sample
W	Water Sample
J	Jar Sample (sample taken in amber glass jar fitted with gas tight lid)
T	Tub Sample
Vi	Vial Sample

In situ Testing

S	Standard penetration test (SPT): Using the split spoon sampler.
C	Standard Penetration Test (SPT): using a solid cone instead of the sampler - conducted usually in coarse grained soils or weak rocks.
V	Shear Vane Test: Undrained shear strength (cohesion) (kN/m ²) shown within the Vane/Pen Test and N Value column.
H	Hand penetrometer Test: Undrained shear strength (cohesion) (kN/m ²) shown within the Vane/Pen Test and N Value column.
P	Perth Penetrometer Test: Number of blows for 300mm penetration shown under Vane/Pen Test and N Value column.

Excavation Method

CP	Cable Percussion Borehole
WLS	Dynamic Sampler Borehole using windowless sampler tubes
WS	Dynamic Sampler Borehole using window sampler tubes
TP	Trial Pit excavated using mechanic excavator
HDP	Trial Pit excavated using hand tools

2 Soil Description

Description and classification of soils has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of soil, Part 1 Identification and description (BS EN ISO 14688-1) and Part 2 Principles of classification (BS EN 14688-2) as well as the BS5930 code of Practice for Ground Investigations.

3 Rock Description

Description and classification of rocks has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of rock, Part 1 Identification and classification (BS EN ISO 14689-1) as well as the BS5930 code of Practice for Ground Investigations. TCR – Total Core Recovery, SCR – Solid Core Recovery, RQD – Rock Quality Designation, NI – Non Intact, If – indicative fracture spacing (min/ave/max), FI – Fracture Index.

4 Chalk Description

Chalk description is based on BS EN ISO 14688, BS EN ISO 14689 and BS5930. The classification of chalk generally follows the guidance offered by the Construction Industry Research and Information Association (CIRIA) C574, 'Engineering in Chalk'. This is based on assessment of chalk density, discontinuity and aperture spacing, and the proportion of intact chalk to silt of chalk.



Site Name: Stakers Farm Barn, North End Road, Yapton, West Sussex

Job Number: P14458

Start Date: 14/02/2020

End Date: 14/02/2020

Borehole Number: **WS01**

Sheet 1 of 1

Standpipe		Samples and In Situ Testing		Dynamic Probe		Legend		Depth		Stratum Description	
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	0	5	10	15	20	25	30	
D	0.30										0.00 Asphalt.
											0.10 MADE GROUND: Brown grey sandy clayey angular to subrounded fine to coarse gravel of flint. Sand is fine to coarse.
	0.80										0.20 MADE GROUND: Off white compacted chalk.
											0.60 Brown and orange brown slightly gravelly slightly sandy CLAY. Gravel is angular to subrounded fine to coarse flint. (River Terrace Deposits)
D	1.50										
	2.50										
D	3.70										3.70 Green brown gravelly sandy CLAY. Gravel is angular to subrounded fine to coarse flint. Sand is fine to coarse. (River Terrace Deposits)
	4.00										End of borehole at 4.00m

Remarks

Groundwater: Groundwater at 1.67m depth on completion.

Stability: Borehole cased to 1.00m depth.
Borehole stable on completion.

Notes: Standpipe installed to 4.00m depth; 4.00m to 2.00m slotted pipe with gravel surround; 2.00m to ground level plain pipe with bentonite seal; completed with end cap and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: RJ



Site Name: Stakers Farm Barn, North End Road, Yapton, West Sussex

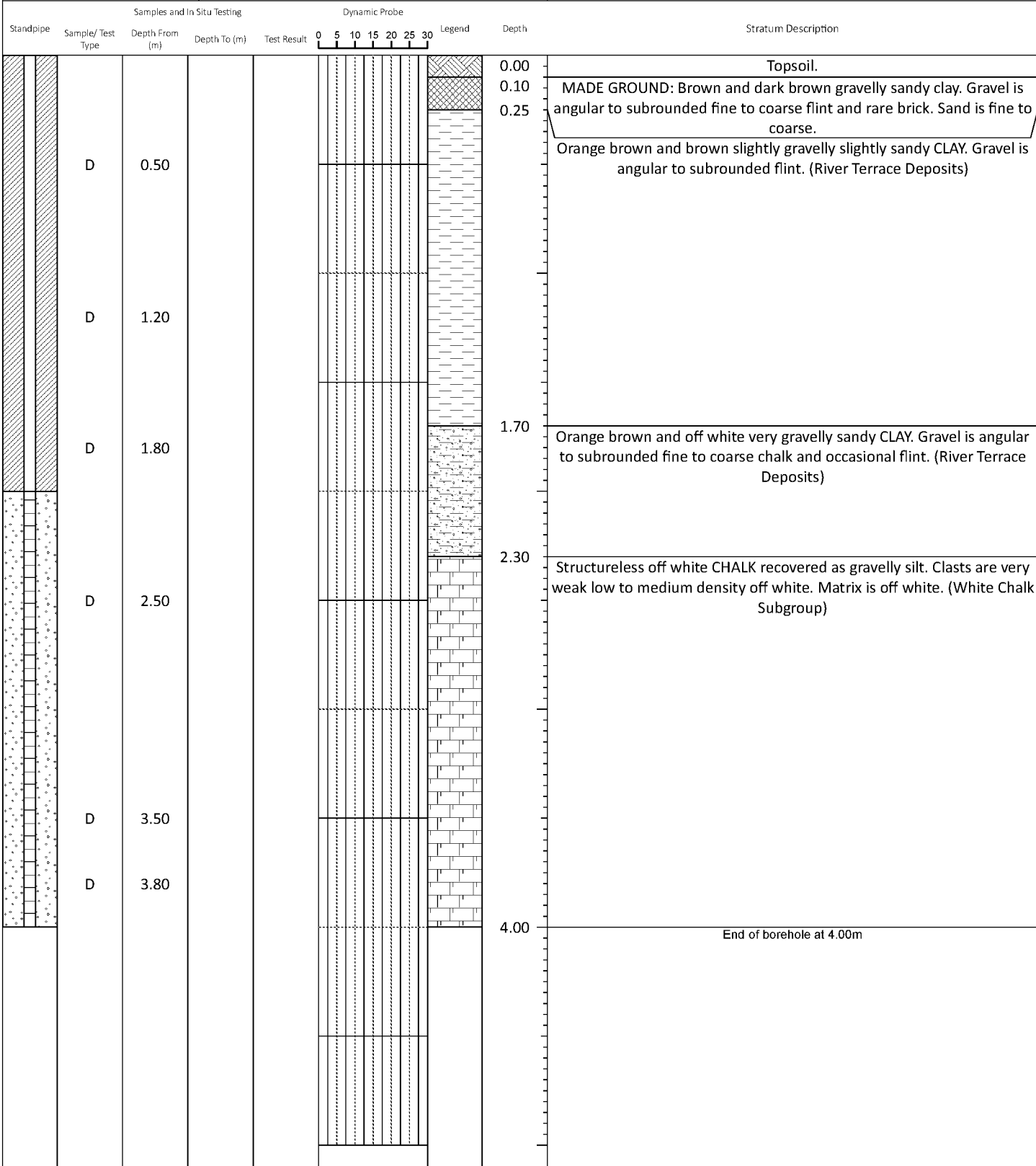
Job Number: P14458

Start Date: 14/02/2020

End Date: 14/02/2020

Borehole Number: **WS02**

Sheet 1 of 1



Remarks

Groundwater: Groundwater at 1.73m on completion.

Stability: Borehole cased to 1.00m depth.
Borehole stable on completion.

Notes: Standpipe installed to 4.00m depth; 4.00m to 2.00m slotted pipe with gravel surround; 2.00m to ground level plain pipe with bentonite seal; completed with end cap and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: RJ

End Date: 13/02/2020

Sheet 1 of 1

Remarks Groundwater: Trial pit dry on completion. Stability: Trial pit stable on completion. Notes: n/a	Excavation Method: TP
	Pit Length: 1.00m
	Pit Width: 0.40m
	Made By: RJ

Site Name: Stakers Farm Barn, North End Road, Yapton, West Sussex

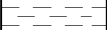
Job Number: P14458

Start Date: 13/02/2020

End Date: 13/02/2020

Trial Pit Number: **TP02**

Sheet 1 of 1

Samples and In Situ testing				Legend	Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
D	0.25				0.00	Asphalt.
					0.08	MADE GROUND: Cream/ off white sandy silty angular to subrounded fine to coarse gravel of flint and chalk.
					0.20	
D	0.60				0.35	MADE GROUND: Brown and dark brown gravelly very sandy clay. Gravel is angular to subrounded fine to coarse brick, flint, clinker-like material, concrete and occasional breeze block. Sand is fine to coarse.
						Orange brown and brown slightly gravelly slightly sandy CLAY. Gravel is angular to subrounded fine to coarse flint. Sand is fine to coarse. (River Terrace Deposits)
					0.60	
						End of trial pit at 0.60m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: n/a

Excavation Method: TP

Pit Length: 1.00m

Pit Width: 0.35m

Made By: RJ

Site Name: Stakers Farm Barn, North End Road, Yapton, West Sussex

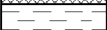
Job Number: P14458

Start Date: 13/02/2020

End Date: 13/02/2020

Trial Pit Number: **TP03**

Sheet 1 of 1

Samples and In Situ Testing				Legend	Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
D	0.25				0.00	Asphalt.
					0.10	MADE GROUND: Off white and grey compacted chalk.
					0.20	MADE GROUND: Orange brown and brown gravelly sandy clay. Gravel is angular to subrounded fine to coarse flint, brick, concrete, crystalline rock and occasional chalk.
D	0.55				0.30	Stiff brown and orange brown slightly gravelly slightly CLAY. Gravel is angular to subrounded fine to coarse flint and rare brick. (Possibly Reworked/ River Terrace Deposits)
					0.55	End of trial pit at 0.55m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: n/a

Excavation Method: TP

Pit Length: 1.00m

Pit Width: 0.30m

Made By: RJ

Site Name: Stakers Farm Barn, North End Road, Yapton, West Sussex

Job Number: P14458

Start Date: 13/02/2020

End Date: 13/02/2020

Trial Pit Number: **TP04**

Sheet 1 of 1

Samples and In Situ Testing					Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend		
					0.00	Topsoil.
D	0.30				0.15	Orange brown slightly gravelly slightly sandy CLAY. Gravel is angular to subrounded fine to coarse flint. Sand is fine to coarse. (River Terrace Deposits) becoming gravelly below 0.40m depth.
D	0.55				0.55	
						End of trial pit at 0.55m

Remarks
Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: n/a

Excavation Method: TP

Pit Length: 1.00m

Pit Width: 0.30m

Made By: RJ

Site Name: Stakers Farm Barn, North End Road, Yapton, West Sussex

Job Number: P14458

Start Date: 13/02/2020

End Date: 13/02/2020

Trial Pit Number: **TP05**

Sheet 1 of 1

Samples and In Situ Testing						Stratum Description	
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Legend	Depth/ Reduced Level		
D	0.20				0.00	Topsoil.	
					0.10	MADE GROUND/ Reworked: Brown and dark brown slightly gravelly slightly sandy clay. Gravel is angular to subrounded fine to coarse flint and rare brick.	
					0.25		
D	0.50				0.55	Brown and orange brown slightly gravelly slightly sandy CLAY. Gravel is angular to subrounded fine to coarse flint. Sand is fine to medium. (River Terrace Deposits)	
						End of trial pit at 0.55m	

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: n/a

Excavation Method: TP

Pit Length: 1.00m

Pit Width: 0.30m

Made By: RJ

ASHDOWN SITE INVESTIGATION LIMITED

Site: Stakers Barn Farm, North End Road, Yapton, West Sussex	Project No: P14458 Sheet No.: 1 of 5
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SUMMARY OF TRIAL PIT FALLING HEAD SOAKAGE TEST RESULTS

TP01 (Test 1)		TP01 (Test 2)		TP01 (Test 3)	
Time (mins)	Depth to water (m bgl)	Time (mins)	Depth to water (m bgl)	Time (mins)	Depth to water (m bgl)
0	0.30	0	0.24	0	0.23
1	0.30	1	0.24	1	0.23
2	0.30	2	0.24	2	0.24
3	0.30	3	0.24	4	0.26
6	0.30	5	0.26	5	0.27
10	0.30	7	0.26	6	0.27
15	0.30	8	0.26	8	0.29
19	0.31	10	0.27	10	0.30
25	0.33	12	0.27	12	0.31
32	0.33	15	0.27	15	0.32
40	0.35	22	0.28	20	0.33
65	0.36	30	0.28	26	0.34
80	0.38	35	0.29	28	0.36
92	0.42	38	0.30	32	0.38
110	0.48	40	0.30	38	0.42
		46	0.32		
		60	0.43		
Pit Length - 1.00m Pit Width - 0.40m Pit Depth - 0.55m bgl		Pit Length - 1.00m Pit Width - 0.40m Pit Depth - 0.55m* bgl		Pit Length - 1.00m Pit Width - 0.40m Pit Depth - 0.55m* bgl	

Remarks: bgl - below ground level.

*Within trial pit TP01 the pit collapsed to 0.45m during test 2 and test 3.

ASHDOWN SITE INVESTIGATION LIMITED

Site: Stakers Barn Farm, North End Road, Yapton, West Sussex	Project No: P14458 Sheet No.: 2 of 5
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SUMMARY OF TRIAL PIT FALLING HEAD SOAKAGE TEST RESULTS

TP02 (Test 1)		TP02 (Test 2)	
Time (mins)	Depth to water (m bgl)	Time (mins)	Depth to water (m bgl)
0	0.33	0	0.30
3	0.33	1	0.30
5	0.33	3	0.30
10	0.33	6	0.30
12	0.33	8	0.30
15	0.34	12	0.30
29	0.34	16	0.30
37	0.34	18	0.30
54	0.33#	25	0.30
75	0.33#	28	0.31
88	0.32#	32	0.31
109	0.33#	45	0.31
118	0.33#	60	0.31
137	0.32#	80	0.32
163	0.32#	125	0.32
183	0.33#	140	0.32
193	0.34#	170	0.32
213	0.34#	205	0.32
1323	0.45		
Pit Length - 1.00m Pit Width - 0.35m Pit Depth - 0.60m bgl		Pit Length - 1.00m Pit Width - 0.35m Pit Depth - 0.60m bgl	

Remarks: bgl - below ground level.

#During test 1 within TP02 water ingress/ surface run off during heavy precipitation started to fill pit. Last reading on test 1 taken overnight prior to refilling pit for test 2.

ASHDOWN SITE INVESTIGATION LIMITED

Site: Stakers Barn Farm, North End Road, Yapton, West Sussex	Project No: P14458 Sheet No.: 3 of 5
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SUMMARY OF TRIAL PIT FALLING HEAD SOAKAGE TEST RESULTS

TP03 (Test 1)		TP03 (Test 2)	
Time (mins)	Depth to water (m bgl)	Time (mins)	Depth to water (m bgl)
0	0.33	0	0.30
1	0.33	1	0.30
5	0.33	3	0.30
9	0.33	9	0.30
15	0.33	12	0.30
21	0.33	23	0.30
34	0.33	38	0.30
40	0.33	55	0.30
55	0.33	83	0.30
67	0.33	95	0.30
92	0.30#	118	0.30
112	0.32#	128	0.30
122	0.32#	158	0.30
132	0.32#	171	0.30
142	0.33#	198	0.30
167	0.33#	210	0.30
182	0.33#		
197	0.33#		
222	0.34#		
1328	Dry		
Pit Length - 1.00m Pit Width - 0.30m Pit Depth - 0.55m bgl		Pit Length - 1.00m Pit Width - 0.30m Pit Depth - 0.55m bgl	

Remarks: bgl - below ground level.

#During test 1 within TP03 water ingress and surface runoff during heavy precipitation started to fill pit. Last reading for test 1 taken overnight prior to refilling pit for test 2.

ASHDOWN SITE INVESTIGATION LIMITED

Site: Stakers Barn Farm, North End Road, Yapton, West Sussex	Project No: P14458 Sheet No.: 4 of 5
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SUMMARY OF TRIAL PIT FALLING HEAD SOAKAGE TEST RESULTS

TP04 (Test 1)		TP04 (Test 2)	
Time (mins)	Depth to water (m bgl)	Time (mins)	Depth to water (m bgl)
0	0.30	0	0.24
4	0.30	1	0.24
7	0.30	2	0.24
10	0.30	4	0.24
16	0.30	6	0.24
21	0.30	8	0.24
29	0.30	10	0.24
34	0.30	12	0.24
46	0.30	18	0.25
67	0.30	26	0.25
77	0.30	30	0.25
97	0.31	45	0.25
101	0.31	60	0.25
118	0.33	82	0.26
131	0.33	100	0.26
146	0.34	120	0.27
156	0.34	145	0.28
183	0.35	162	0.28
1333	Dry	205	0.30
		220	0.31
Pit Length - 1.00m Pit Width - 0.30m Pit Depth - 0.55m bgl		Pit Length - 1.00m Pit Width - 0.30m Pit Depth - 0.55m bgl	

Remarks: bgl - below ground level.

Last reading for test 1 taken overnight prior to refilling pit for test 2.

ASHDOWN SITE INVESTIGATION LIMITED

Site: Stakers Barn Farm, North End Road, Yapton, West Sussex	Project No: P14458 Sheet No.: 5 of 5
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SUMMARY OF TRIAL PIT FALLING HEAD SOAKAGE TEST RESULTS

TP05 (Test 1)		TP05 (Test 2)	
Time (mins)	Depth to water (m bgl)	Time (mins)	Depth to water (m bgl)
0	0.35	0	0.29
5	0.35	1	0.29
12	0.35	2	0.29
17	0.35	4	0.29
29	0.35	8	0.29
31	0.32#	10	0.30
37	0.31#	15	0.30
43	0.30#	20	0.30
57	0.30#	24	0.30
72	0.30#	30	0.30
80	0.30#	40	0.30
92	0.30#	55	0.30
112	0.30#	74	0.30
137	0.32#	105	0.30
152	0.32#	125	0.31
172	0.33#	160	0.31
185	0.33#	185	0.31
1339	Dry	195	0.31
		210	0.32
		245	0.32
Pit Length - 1.00m Pit Width - 0.30m Pit Depth - 0.55m bgl		Pit Length - 1.00m Pit Width - 0.30m Pit Depth - 0.55m bgl	

Remarks: bgl - below ground level.

#During test 1 within TP05 water ingress/ surface runoff during heavy precipitation started to fill pit. Last reading for test 1 taken overnight prior to refilling pit for test 2.

ASHDOWN SITE INVESTIGATION LIMITED

Site: Stakers Farm Barn, North End Road, Yapton, West
Sussex

Report No.: P14458
Sheet No.: 1 of 1

SUMMARY OF BOREHOLE FALLING HEAD SOAKAGE TEST RESULTS

WS01	
Time (mins)	Depth to water (m bgl)
0	0.30
1	0.41
2	0.43
3	0.45
4	0.60
5	0.64
6	0.68
8	0.71
10	0.77
15	0.92
22	1.00
28	1.05
35	1.10
42	1.13
60	1.14
65	1.14
80	1.15
105	1.15
120	1.15
Borehole Depth (m bgl)	4.00
Casing Depth (m bgl)	N/A
Borehole Diameter (mm)	85.50
Casing Diameter (mm)	N/A

WS02 (Test 1)	
Time (mins)	Depth to water (m bgl)
0	0.30
1	0.33
2	0.39
4	0.42
5	0.46
7	0.55
8	0.64
10	0.70
13	0.78
15	0.82
22	0.91
30	0.96
35	1.12
Borehole Depth (m bgl)	2.00
Casing Depth (m bgl)	1.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

WS02 (Test 2)	
Time (mins)	Depth to water (m bgl)
0	0.35
1	0.38
3	0.41
4	0.43
6	0.48
12	0.55
16	0.59
22	0.63
24	0.67
30	0.70
34	0.75
42	0.79
45	0.86
50	0.94
Borehole Depth (m bgl)	2.00
Casing Depth (m bgl)	1.00
Borehole Diameter (mm)	92.00
Casing Diameter (mm)	105.00

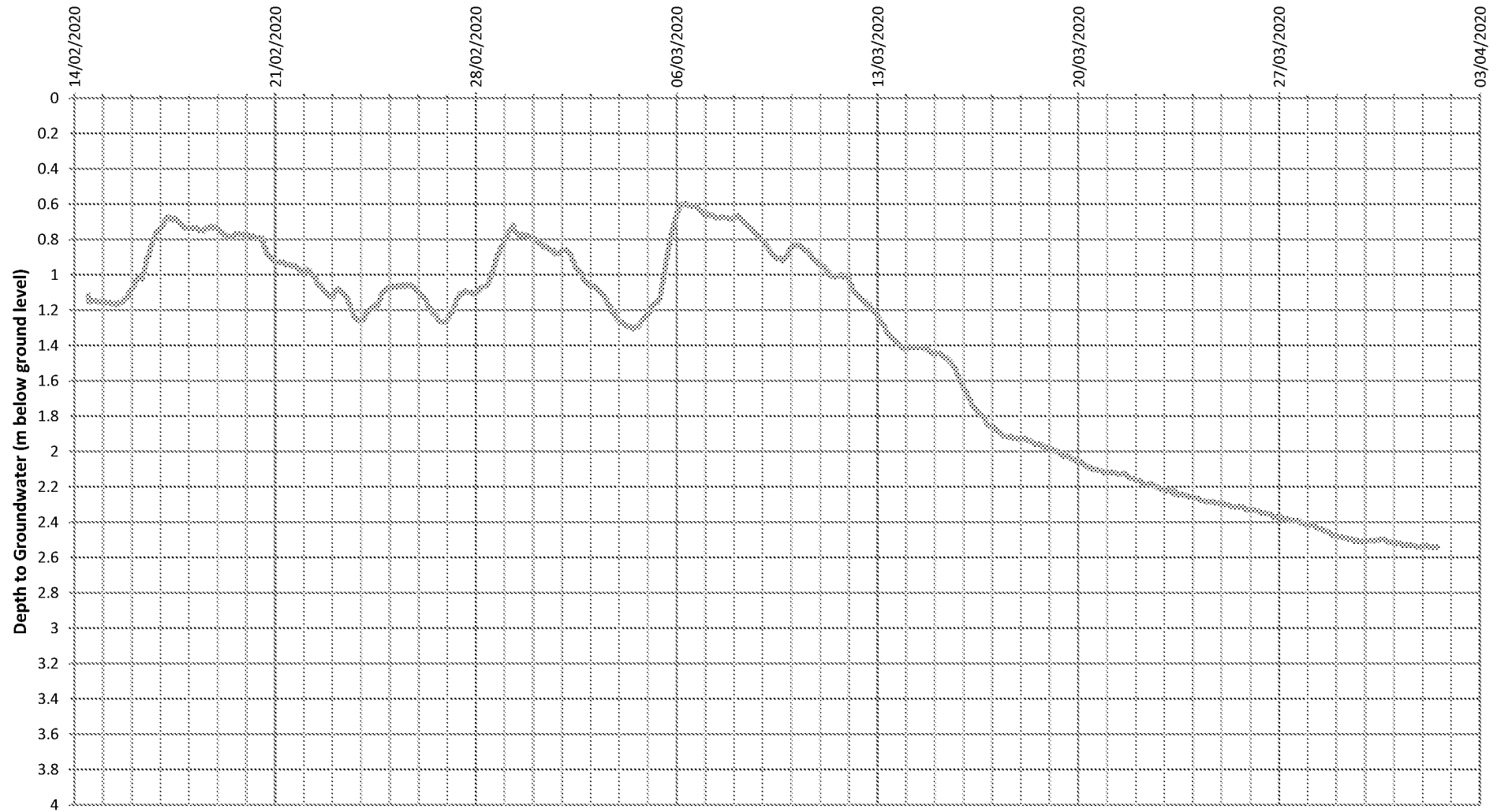
Notes: bgl – below ground level.

Ashdown Site Investigation Limited

Site: Stakers Farm, North End Road, Yapton, West Sussex

Project Ref.: P14458

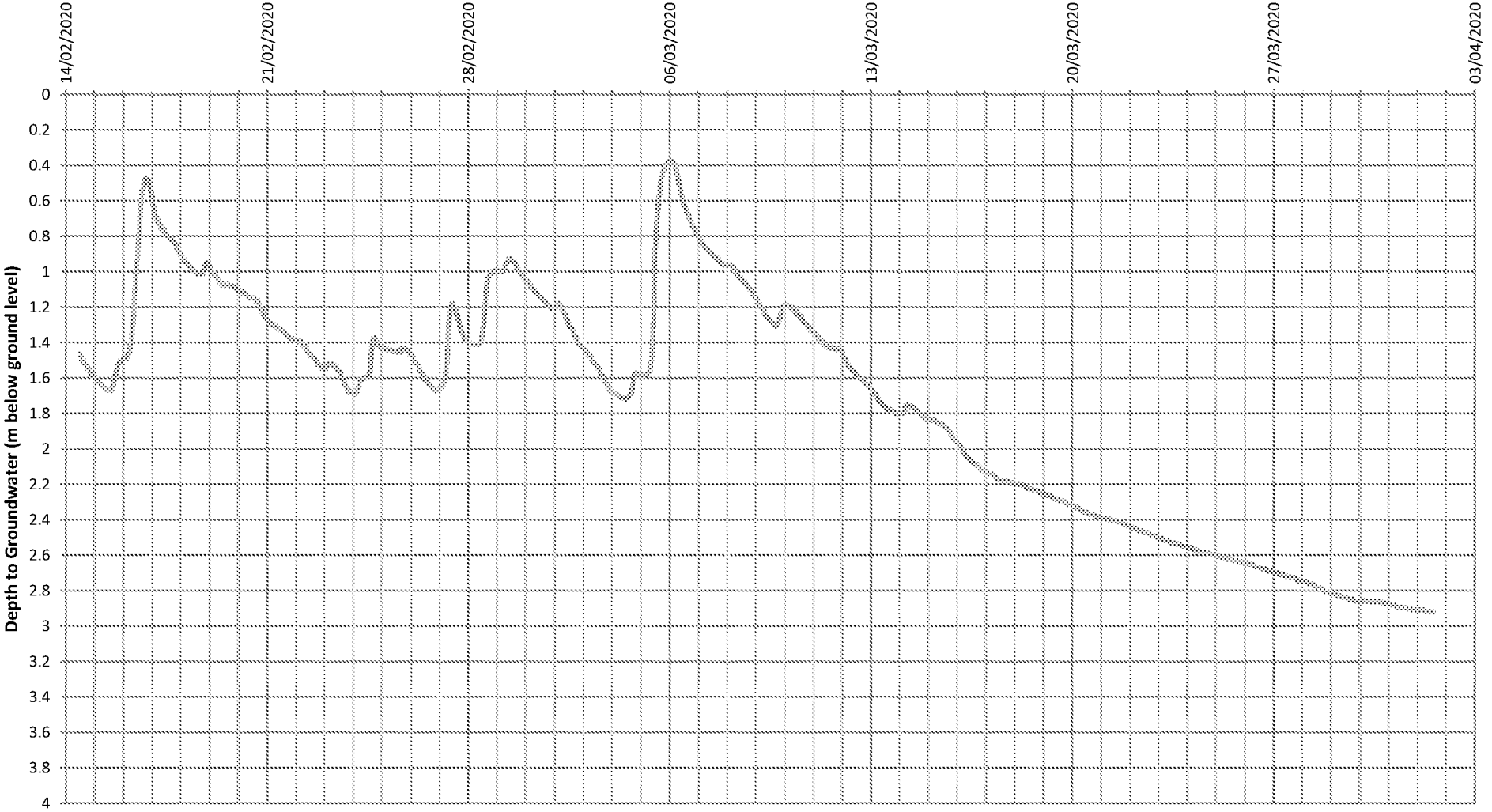
Groundwater Monitoring Results - WS01



Ashdown Site Investigation Limited

Site: Stakers Farm, North End Road, Yapton, West Sussex	Project Ref.: P14458
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Groundwater Monitoring Results - WS02



Colebrook White Equation / Darcy Weisbach Formula for Circular Pipes under Full Bore Conditions

$$V = -2\sqrt{(2gDS)} \log \left[\frac{k_s}{3.7D} + \frac{2.51\nu}{D\sqrt{2gDS}} \right]$$

Where:

g= gravitational acceleration	9.81 m/s ²	
ν = kinematic velocity of fluid	1.139E-06 m ² /s	(1.139E-6 for water at 15 Celsius)
k_s = roughness value	0.6 mm	(Storm Sewer 0.6mm Foul Sewer 1.
D= pipe diameter	100 mm	
S= hydraulic gradient	1: 80.0	
V=	0.86 m/s	
Q=	0.01 m³/s	6.7 l/s

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
1	0.175	5.00	5.900	1200	0.540

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	1440	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
10	0	0	0
30	0	0	0
100	0	0	0
100	20	0	0
100	40	0	0

Node 1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	4.560	Product Number	CTL-SHE-0064-2000-1250-2000
Design Depth (m)	1.250	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	5.360	Slope (1:X)	1000.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	444	Depth (m)	0.450
Safety Factor	2.0	Width (m)	24.300	Inf Depth (m)	0.450
Porosity	0.30	Length (m)	40.000		

Results for 10 year Critical Storm Duration. Lowest mass balance: 95.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	1	172	5.497	0.137	12.3	35.0146	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
180 minute winter	1	Hydro-Brake®	1.8	53.3

 The Civil Engineering Practice BN41 1RA 	File: 1 in 100 2Is.pfd Network: Storm Network Martin Kempshall 26 February 2021	Page 3 Stakers Barn Farm North End Road, Yapton
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Results for 30 year Critical Storm Duration. Lowest mass balance: 95.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
180 minute winter	1	176	5.541	0.181	15.5	48.2424	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m ³)
180 minute winter	1	Hydro-Brake®	1.8	66.9



Results for 100 year Critical Storm Duration. Lowest mass balance: 95.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
180 minute winter	1	180	5.595	0.235	19.2	64.1504	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m ³)
180 minute winter	1	Hydro-Brake®	1.8	83.3

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 95.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	1	236	5.651	0.291	18.6	80.9484	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
240 minute winter	1	Hydro-Brake®	1.9	106.4



Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 95.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
240 minute winter	1	236	5.709	0.349	21.7	98.2231	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m ³)
240 minute winter	1	Hydro-Brake®	1.9	124.2



Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape
0001X	8.32	6.31	150	VC	CIRC	*	9101X	6.61	3.01	350	PF	CIRC					
0001X	5.9	4.02	175	VC	CIRC	*	9102X	3.22	-0.06	350	PF	CIRC					
0001X	6.08	3.61	225	VC	CIRC	*	9301X	5.93	4.18	175	VC	CIRC					
0002X	5.83	3.49	225	VC	CIRC	*	9302X	5.56	4.18	175	VC	CIRC					
0002X	6.96	4.79	150	VC	CIRC	*	9303X	5.54	4.08	175	VC	CIRC					
0002X	5.93	3.76	175	VC	CIRC	*	9402X	6.999	5.79	150	VC	CIRC					
0003X			150	VC	CIRC		9502X	6.936	5.057	150	VC	CIRC					
0004X			150	VC	CIRC		9505X	7.037		150	VC	CIRC					
0101X	6.13	2.98	350	PF	CIRC		9801X	6.29	3.98	175	VC	CIRC					
0301X	5.67	4.49	175	VC	CIRC		9803X	6.288		175	VC	CIRC					
0401X	5.92	4.58	150	VC	CIRC		9801X	6.27	4.77	175	VC	CIRC					
0402X	5.8	5.03	150	VC	CIRC		9801X	6.27	4.85	175	VC	CIRC					
0403X	6.32	5.24	150	VC	CIRC		9802X	6.13	4.56	175	VC	CIRC					
0404X	6.48	5.42	150	VC	CIRC												
0405X	6.35	5.38	150	VC	CIRC												
0406X	6.72	5.55	150	VC	CIRC												
0407X	7.03	5.69	150	VC	CIRC												
0408X	6.82	5.6	150	VC	CIRC												
0501X	5.69	4.78	175	VC	CIRC												
0502X	3.86	4.41	175	VC	CIRC												
0503X	5.99		175	VC	CIRC												
0504X	6.05	4.53	175	VC	CIRC												
0801X	5.38	3.83	175	VC	CIRC	*											
0801X	6.25	4.12	225	VC	CIRC	*											
0802X	7.44	4.75	175	VC	CIRC	*											
0802X	4.67	3.24	175	VC	CIRC	*											
0803X	7.4	4.64	175	VC	CIRC	*											
0804X	7.47	4.43	175	VC	CIRC	*											
0901X	6.53	3.91	225	VC	CIRC	*											
0901X	5.39	3.49	150	VC	CIRC	*											
0902X	6.5	3.8	225	VC	CIRC	*											
0903X	6.23	3.79	225	VC	CIRC	*											
1001X	5.78	4.38	150	VC	CIRC	*											
1001X	5.73	3.46	350	PF	CIRC	*											
1002X	6.88	3.85	150	VC	CIRC	*											
1003X	6.53	3.87	175	VC	CIRC	*											
1004X	7.13	6.1	150	VC	CIRC	*											
1005X	6.414	3.974	150	VC	CIRC	*											
1006X	6.06	4.145	150	VC	CIRC	*											
1007X	6.96	4.445	150	VC	CIRC	*											
1101X	6.908	4.753	150	VC	CIRC	*											
1101X	5.91	3.81	175	VC	CIRC	*											
1102X			150	VC	CIRC	*											
1103X	6.887	4.987	150	VC	CIRC	*											
1104X			150	VC	CIRC	*											
1105X			150	VC	CIRC	*											
1201X			150	VC	CIRC	*											
1401X	6.39	5.24	175	VC	CIRC	*											
1501X	6.45	4.65	175	VC	CIRC	*											
1502X	6.39	4.58	175	VC	CIRC	*											
1701X	5.34	2.61	175	VC	CIRC	*											
1801X	4.84	3	175	VC	CIRC	*											
1802X	7.14	5	175	VC	CIRC	*											
1803X			175	VC	CIRC	*											
1804X	7.23	6.16	150	VC	CIRC	*											
1902X	7.12	5.95	150	VC	CIRC	*											
1903X	7.31	5.78	150	VC	CIRC	*											
1904X	7.11	5.92	150	VC	CIRC	*											
2001X	6.59	4.81	175	VC	CIRC	*											
2002X	6.82	4.02	175	VC	CIRC	*											
2003X	6.78		175	VC	CIRC	*											
2101X	6.5	5.38	175	VC	CIRC	*											
2102X	6.092	4.332	150	VC	CIRC	*											
2103X		4.551	150	VC	CIRC	*											
2104X	6.684	4.669	150	VC	CIRC	*											
2105X			150	VC	CIRC	*											
2106X			150	VC	CIRC	*											
2402X			150	VC	CIRC	*											
2405X	6.453	5.647	UNK	UNK	CIRC	*											
2601X	4.42	2.1	175	VC	CIRC	*											
2701X	4.91	2.31	175	VC	CIRC	*											
2801X	7.02	5.74	150	VC	CIRC	*											
2802X	6.67	5.54	175	VC	CIRC	*											
2803X	7.06	5.33	175	VC	CIRC	*											
2901X	6.91	6.02	150	VC	CIRC	*											
2902X	6.99	5.88	150	VC	CIRC	*											
3001X	7.06	4.28	175	VC	CIRC	*											
3002X	6.98	4.99	150	VC	CIRC	*											
3003X	6.92	5.15	150	VC	CIRC	*											
3005X	7.02		150	VC	CIRC	*											
3006X			UNK	UNK	CIRC	*											
3007X			UNK	UNK	CIRC	*											
3008X			UNK	UNK	CIRC	*											
3401X	3.95	1.25	350	PF	CIRC	*											
3501X	3.02	1.08	350	PF	CIRC	*											
3502X	2.58	0.9	350	PF	CIRC	*											
3801X	3.96	2.11	175	VC	CIRC	*											
3802X	3.14	0.74	350	PF	CIRC	*											
3804X	3.19	0.88	150	VC	CIRC	*											
3805X	3.15		225	VC	CIRC	*											
3806X	3.15		225	VC	CIRC	*											
3806X	3.42		150	VC	CIRC	*											
3806X	3.42	3.41	300	BAC	CIRC	*											
3701X	5	3.44	150	VC	CIRC	*											
3901X	7.06	4.38	175	VC	CIRC	*											
4301X	4.78	1.72	350	PF	CIRC	*											
4401X	4.49	1.27	350	PF	CIRC	*											
4801X	4.46	2.99	150	VC	CIRC	*											
4801X	6.59	4.6	175	VC	CIRC	*											
5101X	6.35	2.81	150	VC	CIRC	*											
5102X	6.42	3.08	150	VC	CIRC	*											
5301X	4.63	2.12	350	PF	CIRC	*											
5302X	4.66	2.04	350	PF	CIRC	*											
5303X	5.39	1.81	350	PF	CIRC	*											
5304X	5.33	1.81	350	PF	CIRC	*											
5305X	5.32	1.96	350	PF	CIRC	*											
6001X			UNK	UNK	CIRC	*											
6201X	5.19	2.63	175	VC	CIRC	*											
6202X	7.82	2.69	175	VC	CIRC	*											
6203X	4.67	2.37	350	PF	CIRC	*											
6204X			UNK	UNK	CIRC	*											
6205X			UNK	UNK	CIRC	*											
6206X	5.59	1.48	150	VC	CIRC	*											
6251X	6.18	3.46	150	VC	CIRC	*											
6254X	5.43	3.28	150	VC	CIRC	*											
6301X	4.63	2.37	175	VC	CIRC	*											
6304X	4.66	2.2	350	PF	CIRC	*											
6305X			100	VC	CIRC	*											
6306X			175	VC	CIRC	*											
6801X			150	VC	CIRC	*											
6802X			UNK	UNK	CIRC	*											

Brown	 Road
	 First Sycamore Sewer
	 First Vacuum Main
	 First Flaring Main
Red	 Combined
	 Combined Siphon Sewer
	 Combined Flaring Sewer
	 Lateral Drains
Orange	 Stabling Over Highway
Dark Blue	 Treated Effluent
Purple	 Sludge
	 Sewer Collection
	 Section "M" Area
Light Blue	 Surface Water
	 Surface Water Flaring Main
Yellow	 Private
Green	 Access Street
	 Decommissioned

- AK Alkylphenol
- BAK Butadiene Acrylonitrile Copolymer
- BNC Brink (Common)
- BRE Breck (Zeigman-type)
- CC Concrete Box Collector
- CI Coal Iron
- CO Concrete (Cellulose)
- CP Concrete (Pre-Cast)
- CSR Concrete Segments (Pre-Cast)
- CSZ Concrete Segments (Pre-Cast)
- DI Diethylene Glycol
- DMS Dimethyl Sulfoxide
- GRS Glass Reinforced Plastic
- MAC Measuring in random Co.
- MAR Measuring in random Co.
- PE Polyethylene
- PF Pitch Fibre
- PP Polypropylene
- PVC Polyvinyl Chloride
- RFM Reinforced Plastic Mortar
- SI Spun Iron
- ST Steel
- VAC Vitrified Clay
- XCX Chloro

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Drawn by:

Date: 12/04/2018