Land off B4235, Bayfield, Chepstow.

BDW South Wales

Drainage Strategy &

Flood Risk Assessment

November 2018

Document Control Sheet

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Checked	James Phillips
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Contents

APPENDICES

Introduction

1.1 This report provides preliminary information on the design strategy of the surface and foul water sewers to serve the proposed development South of the B4235, Chepstow.

1.2 The details of this report demonstrate how the drainage for the development will be discharged and how flows will be managed to prevent increased flooding.

1.3 This report includes a statement on the flood risk for the development and outlines what further work, if any, are required should the site progress to detailed design.

2.0 The Site

2.1 The development site is located approximately 1.5km to the west of Chepstow town centre in the suburb of Bayfield with an approximate National Grid Reference of 352189,194042 which can be seen in Figure 1 below.

2.2 The proposed site is currently divided into 3 irregularly shaped agricultural fields used for grazing purposes. The land is undulating with a maximum level difference of between 69 and 102m AOD falling, in the main from south to north.

2.3 The proposed development is bounded by a small unnamed watercourse along the northern boundary which runs from east to west. The western boundaries are shared with woodland known as Bishops Barnets Wood and further pasture land. The eastern and southern boundaries are shared with the wider residential setting of Bayfield.

2.4 Main access will be obtained off the B4235 via an existing 'farming' entrance which crosses the unnamed watercourse.

2.5 The unnamed watercourse runs along the northern boundary, before running northwards and crosses the B4235. Shortly afterwards, the watercourse crosses back underneath the B4235 in a southerly direction through the Bishops Barnets Wood before running off to the south west.

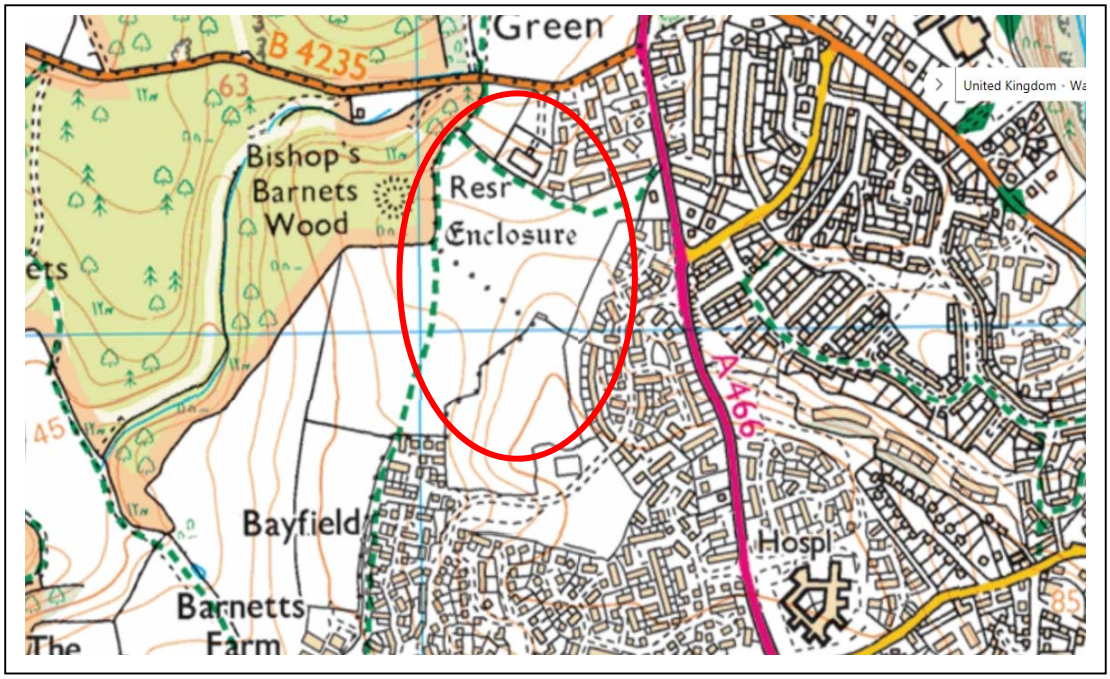

Figure 1 – Site Location

3.0 Ground Conditions

3.1 Preliminary soakaway tests were carried out in accordance with BRE365 during November 2017 by Johnson Poole and Bloomer, a copy of the findings can be seen in Appendix A.

3.2 The development site, in the main consists of CLAY/clayey topsoil overlaying a silty CLAY up to 0.5m to 1.2m in depth. The deeper ground is considered to be variable

across the site, consisting on the main clays and gravels overlaying limestone and on occasion sandstone.

3.3 Trial Pit 1 encountered possible Limestone bedrock at 2.3m bgl, however bedrock was not encountered in other trial pits despite excavating to 3m bgl.

3.4 Groundwater was encountered within trial pit 3 located to the north east of the site.

3.5 BRE soakaway tests concluded variable infiltration rates across the site varying between $2.53x10^{-3}$ and $7.63x10^{-5}$. Trial Pit 1 provided the more favourable rates, probably due to the presence of the limestone bedrock.

3.6 Based upon the presence of clay in the topsoil layers and general observation of our site visit, a soil type 3.5 should be considered where calculating QBAR.

4.0 Key Design Criteria

4.1 Existing Surface Water

As indicated above, the proposed site consists of pasture land which undulates in all directions. In the main, the levels fall from south to north, however flow routes indicate that storm water run off runs to both the north and to the west – see drawing 10233 – 201 – Catchment Plan in Appendix B for our existing catchment analysis.

4.2 The following observations can be made based upon the identified catchments:

4.2.1 Catchment A drains to the north intercepted by the unnamed watercourse.

4.2.2 Catchment B drains towards the woodland to the west; however, site observations consider the run off to be intercepted by the unnamed watercourse

4.2.3 Catchment C also runs to the north, to a low point behind the new residential development known as Edmond Locard Court. A land drain has been installed to intercept the surface water runoff water, which discharges to the unnamed watercourse.

4.2.4 Catchment D & F runs to the west, overland through the woodland to the unnamed watercourse.

4.2.5 Catchment E consist of a small parcel which runs to the greenspace to the east.

4.3 Proposed Surface Water

Based upon the proposed layout and existing catchment plan, the surface water system will be split into 3 separate networks as follows:

Network 1 – This will accommodate the access road only and will drain directly to the unnamed watercourse. Due to the small area associated with the road, we propose a minimum flow rate of 5l/s which is considered the smallest aperture to be used to avoid potential blockages. Attenuation will be via shallow basin, approximately 700mm in depth and have a footprint of approximately 150-200sqm.

Network 2 – The network will consist of 'Catchments B & C' and will drain to an infiltration basin located to the north west of the catchment zone, between the existing watermains. For the purposes of this report, infiltration results from TP1 have been used for the initial sizing of the basin, however targeted testing will be required at detailed design to confirm actual size. Indicative calculations indicate that a basin approximately 600sqm, 1.5m deep will be required with an allowance for 300mm freeboard.

Network 3 – The network will consist of 'Catchment D' in the main and will drain to an infiltration basin located to the south west of the catchment. For the purposes of this report, the infiltration result from TP7 have been used for the initial sizing of the basin, however targeted testing will be required at detailed design to confirm actual size. Indicative calculations indicate that the basin will be 750sqm in plan, 1.5m in depth with an allowance for 300mm freeboard.

A copy of the Microdrainage calculations can be seen in Appendix D

4.4 Ciria SuDS Manual

In accordance with the SUDS manual the following criteria has been considered:

- In accordance with Table 25.2 a FOS of 5 has been applied to the calculations
- Pond A will have an emergency spillway running to the unnamed watercourse to the north – this will provide protection to the residents of Edmond Locard Court.
- Pond B will have an emergency spillway directing water to the west, which will be intercepted by the unnamed watercourse. Water from the spillway will be spread where possible to mimic the current run off.
- A 5-10% Urban Creep factor will need to be applied to the basins. Value to be agreed with MCC at detailed design.
- Targeted infiltration tests to be carried out at the basin location in accordance with BRE 365.

- Geotechnical engineer to confirm potential impact of infiltration on the slope to the west if any.

4.5 Design Criteria

Surface water sewers serving the proposed development will be designed to meet the hydraulic design and construction requirements within "Sewers for Adoption" 7th Edition.

4.6 Climate Change

To take in to account climate change impact for the 100-year life of the residential development a 30% allowance for the predicted increase in rainfall intensity should be assumed for the design of the surface water drainage in accordance with Technical Advice Note 15 (TAN15).

4.7 Foul Water Sewer Design

4.7.1 DCWW have confirmed that a viable connection has been identified on St Lawrence Road near the junction with Kingsmark Lane between manholes ST52941101 and ST52943102. DCWW correspondence and sewer records can be seen in Appendix E

4.7.2 Due to site topography the foul sewer networks will be divided into two separate networks, split as per the surface water 'Networks 2 and 3'. Each network will require an adoptable pumping station, located along the western boundary. On site gravity sewers will convey flows to the pumping stations (located at the low point of each catchment) which will then pump to the eastern boundary. From the boundary, a new foul sewer will convey flows to the public sewer as identified above.

4.7.3 Foul sewers serving the proposed development will be designed to meet the hydraulic design and construction requirements within "Sewers for Adoption" 7th Edition. It is intended to offer the foul sewer to Welsh Water for adoption under a Section 104 Agreement in accordance with The Water Industries Act 1991

5.0 Flood Risk Assessment

5.1 Flood Zone

According to the Natural Resources Wales Flood Zone Map (see figure 2), the site is identified as being located within Flood Zone A

Flood Zone A is defined in the Welsh Assemblies Technical Advice Note 15 (TAN 15) as land assessed having the following annual probability of flooding: -

Flood Zone A "Low Risk"

The Proposed site is considered to be at little or no risk of fluvial or tidal/coastal flooding

Figure 2 – NRW Flood Maps

5.2 Flood Risk Vulnerability Classification

The Flood Risk Vulnerability Classification of the proposed development (i.e. Residential) is 'Highly Vulnerable' in accordance with Figure 2 within TAN 15.

5.3 Flood Risk Vulnerability and Flood Zone Compatibility

In accordance with Section 6, TAN 15, all development is appropriate for the site with it being located within Flood Zone A.

5.4 Flooding Hazards

5.4.1 Fluvial & Tidal

The nearest main watercourse is the River Wye to the east of the site. This does not pose a risk to the site as identified in figure 2.

The sea (Bristol Channel) is located approx. 4km to the south and the site is not at risk from flooding from the sea.

5.4.2 Surface Water (Overland Flow)

Intense periods of rainfall over a short duration can often lead to overland flow as rainwater is unable to infiltrate into the ground or enter drainage systems. Overland runoff is expected from the undeveloped areas of site to the south and a such a land drainage system should be installed to prevent flooding.

NRW maps shows limited evidence of overland flooding and is not considered a risk. The site is located on a highpoint of the Chepstow area and as such very little flow paths come through the site. As indicated above overland flows from the southern area of the site (not to be developed) will need to be intercepted.

5.4.3 Groundwater Flooding

Groundwater flooding is when the water levels in the ground rise above surface elevations, which is most likely to occur in low lying areas underlain by permeable rocks (aquifers).

The ground investigation encountered ground water to the east, however this was in excess of 2m in depth. Due the local topography i.e. the site is higher than the local areas, ground water is not considered to pose a risk.

5.4.4 Sewer Flooding

There have been no reported flooding incidents from sewers adjacent to the site and not considered a risk.

6.0 Summary

6.1 This report provides information on the surface & foul water drainage as required by the undertaking given by BDW South Wales

6.2 Surface water will drain via 3 sub catchments, 1 of which will discharge restricted flows into the unnamed watercourse, the mains systems will drain via infiltration basins located along the western boundary.

6.3 Foul drainage shall discharge to the existing public system to the east of the development, initially by pumping station.

6.4 To take in to account climate change impact for the 100-year life of the residential development a 30% allowance for the predicted increase in rainfall intensity has been assumed for the design of the surface water drainage in accordance with Technical Advise Note (TAN 15).

6.5 The site is located within Flood Zone A and considered to be at little or no risk of fluvial or tidal/coastal flooding.

Appendix A
Soakaway Testing

RC597-23/TNO

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BDW Trading Limited
Oak House
Village Way
Tongwynlais
Cardiff
CF15 7NE

22 December 2017

Attention: Mr D J Lloyd

Dear David,

RE: IN-SITU SOAKAWAY TESTING – BAYFIELDS, CHEPSTOW

INTRODUCTION

Further to an e-mail instruction received from Mr David Lloyd of BDW Trading Limited, the Client, dated 14 November 2017, we have pleasure in outlining the findings and conclusions of an in-situ Soakaway testing exercise conducted at the above site on the 22 and 23 November 2017.

It is understood that the site is to be developed for future housing. The purpose of the works was to assess the drainage capabilities of the underlying natural near surface soils and bedrock strata, in the context of the future use of soakaway drainage on site.

THE SITE

The site is located within the suburb of Bayfields located approximately 1.5 kilometres to the west of the town centre of Chepstow.

The site consists of three unequal sized undeveloped agricultural fields. The site has an undulating topography with the highest point being located in the south-east corner of the site and the lowest point in the north-west corner. Vegetation on site consists of grassed agricultural fields, with trees and bushes along the boundaries.

Access to the site was via a single track with a farm gate located at the eastern boundary of the site.

SITE INVESTIGATION WORKS

The site investigation works were conducted in general accordance with BS5930:2015 “Code of Practice for Ground Investigations” on the 22 and 23 November 2017.

The works consisted of nine trial pits, eight of which were used for large scale in-situ Soakaway Testing. The depths of the trial pits ranged between 1.70 and 3.10 metres below ground level.

It should be noted that physical site constraints associated with large diameter underground water pipes bisecting parts of the site locally influenced trial pit locations. Furthermore, at the request of the Client, no trial pits or in-situ Soakaway tests were undertaken in the smallest of the three fields to the north.

The supervision and logging of the trial pits and soakaway testing were carried out in the presence of Geologists, who examined the ground conditions revealed in-situ and prepared the logs and tables/graphs attached in Appendices A and B, respectively.

The approximate location of the site investigation works are indicated on our Drawing No. G/RC597/03.

GROUND CONDTIONS

Soil Succession

Detailed logs of the trial pitting exercise undertaken are included in Appendix A, whilst the ground conditions can be briefly summarised as follows.

No evidence of any Made Ground was encountered at the site, with the trial pits undertaken encountering a dark brown silty clay topsoil from surface typically attaining 0.20 to 0.25 metres in thickness.

Trial Pit 1 (north-west area) mainly consisted of a firm or firm to stiff silty clay with variable proportions of gravel and with increasing depths, cobbles of limestone. Possible limestone bedrock strata was recorded at 2.30 metres below ground level, with no further excavation possible at the base of the pit.

In Trial Pits 2, 4, 5 and 6 (central, western and eastern site area) the soil succession consisted of a firm to stiff and stiff locally slightly gravelly slightly silty clay. This strata was recorded to depths of approximately 3.00 metres below ground level in Trial Pits 2, 5 and 6, with cobbles of limestone being recorded in Trial Pits 5 and 6 at depths of 2.90 metres and 2.70 metres below ground level, respectively.

Trial Pit 3 (north-east corner) encountered cobbles and large boulders at shallow depths of 0.60 metres below ground level. The cobbles and boulders consisted of limestone in a firm to stiff gravelly silty clay matrix.

Trial Pit 7 (south-west area) recorded firm, gravelly silty clay (and estimated as medium dense by virtue of its increased gravel content). At 1.70 metres below ground level, cobbles of sandstone and limestone were recorded within.

Trial Pits 8 and 9 (southern/ south-east site area) recorded a gravelly silty clay matrix with interlocking sub-angular cobbles of limestone. The soils are firm, (and again estimated as medium dense due to the more granular constituent of the material).

GROUNDWATER CONDITIONS

No evidence of groundwater was recorded in Trial Pits 1, 2, 4, 5, 6, 7, 8 and 9 during their excavation.

In Trial Pit 3 a groundwater flow was recorded at a depth of 2.10 metres below ground level.

It should be noted that the groundwater regime beneath the site may be subject to seasonal and other variations and as such, different groundwater conditions may be encountered whilst undertaking any future investigations or development works at the site.

IN-SITU SOAKAWAY TEST RESULTS

Large-scale in-situ Soakaway tests were undertaken in Trial Pits 1 to 4 and 6 to 9 in general accordance with BRE Digest 365:2016; the testing being undertaken with response zones at various depths in the natural soils or in the case of Trial Pit 1 extending into the likely top of the limestone bedrock.

Highly variable drainage conditions were recorded in the soakaway pits with a combination of single, double and triple test cycles being able to be conducted in the trial pits (in the timescales available).

BRE Digest 365: 2016 recommends calculation of infiltration rates from the time taken for the water volume to fall from 75 to 25% of the effective storage depth of the pit.

If full drainage of the test pit was not achieved, it is our normal policy to only calculate infiltration rates where the fall in water level is greater than 50% of the water height during individual test cycles.

In Trial Pit 2 (1.43% water drop), Trial Pits 3 and 4 (zero % water drop) and Trial Pit 6 (7.97% water drop) the above drainage percentage was not achieved and hence we have not calculated Infiltration Rates for these particular tests.

In Trial Pits 3 and 4 the test water in the trial pits actually rose over the duration of the tests.

In Trial Pits 1, 7, 8 and 9 a drainage percentage of over 50% was achieved. Three test cycles were undertaken in Trial Pits 1 and 7, two test cycles achieved in Trial Pit 9 and one test cycle achieved in Trial Pit 8.

The results of the in-situ Soakaway Tests are summarised in tabular form below and in Appendix C.

Trial Pit Location	Test Cycle	Base of Pit (mbgl)	Infiltration Rate (A) (m/sec) BRE Digest 365	Infiltration Rate (B) (m/sec)- Full Undrained Area
TP1	1	2.30	2.53E-03	2.53E-03
TP1	2	2.30	1.59E-03	1.59E-03
TP1	3	2.30	8.05E-04	8.05E-04
TP7	1	2.40	3.02E-04	2.28E-04
TP7	2	2.40	3.76E-04	2.37E-04
TP7	3	2.40	3.97E-04	2.26E-04
TP8	1	2.00	2.49E-05	2.09E-05
TP9	1	1.70	7.63E-05	7.63E-05
TP9	2	1.70	7.03E-05	7.03E-05

Where it has been possible to calculate Infiltration Rates, the In-situ Soakaway Tests have recorded highly variable infiltration rates in the range 2.50×10^{-3} to 2.09×10^{-5} m/s when taking account of the most "conservative" full undrained area of the trial pit.

The highest infiltration rates were recorded in Trial Pit 1, which range between 2.53×10^{-3} to 8.05×10^{-4} m/s. This probably relates to the presence of Limestone bedrock which was encountered at the base of the pit. In comparison, Trial Pit 7 recorded lower infiltration rate values of 10^{-4} m/s in the three test cycles; the soils in the pit being recorded as a gravelly silty clay, with cobbles and boulders of limestone.

Lower infiltration rates were recorded in Trial Pits 8 and 9 of 2.09×10^{-5} to 7.63×10^{-5} m/s in which the ground conditions consisted of a "more granular" gravelly silty clay matrix with interlocking cobbles of limestone.

In summary, highly variable infiltration characteristics have been recorded in the Soakaway Tests, and these variations are in part considered to reflect near surface "soil" composition and in particular fines (silt and clay) content; the percentage of more "granular" (limestone) constituents within, and in the case of Trial Pit 1 (where the highest soil infiltration rates were recorded) limestone bedrock strata at depth; the variability recorded also possibly being influenced/reflecting differing published geology extending beneath the site.

The local presence of groundwater (as proven in Trial Pit 3) will also locally influence/impair infiltration rates.

Due to the variable Infiltration rates recorded we would recommend that the Designer adopts a "conservative" infiltration rate for design purposes and some redundancy also be incorporated into the drainage system, as "silting up" could occur in the future.

Furthermore, once the preferred location of soakaways have been finalised, it is recommended that consideration be given to undertaking additional in-situ tests on an "area-by-area" basis, to establish definitive local soil infiltration characteristics, with possible consideration also being given to undertaking soakaway tests at greater depths in the underlying bedrock strata, if practically possible.

The principle of adopting soakaway drainage on-site will also need to be considered in the context of the overall "sensitive" environmental setting of the site and its location lying above a Principal Aquifer extending beneath the southern, central and north-western areas of the site. Therefore, it is suggested that the overall use and acceptance of soakaway drainage be discussed and agreed with Natural Resources Wales.

We trust the above information is sufficient for your immediate purpose, however, if you have any queries please do not hesitate to contact us.

Yours sincerely

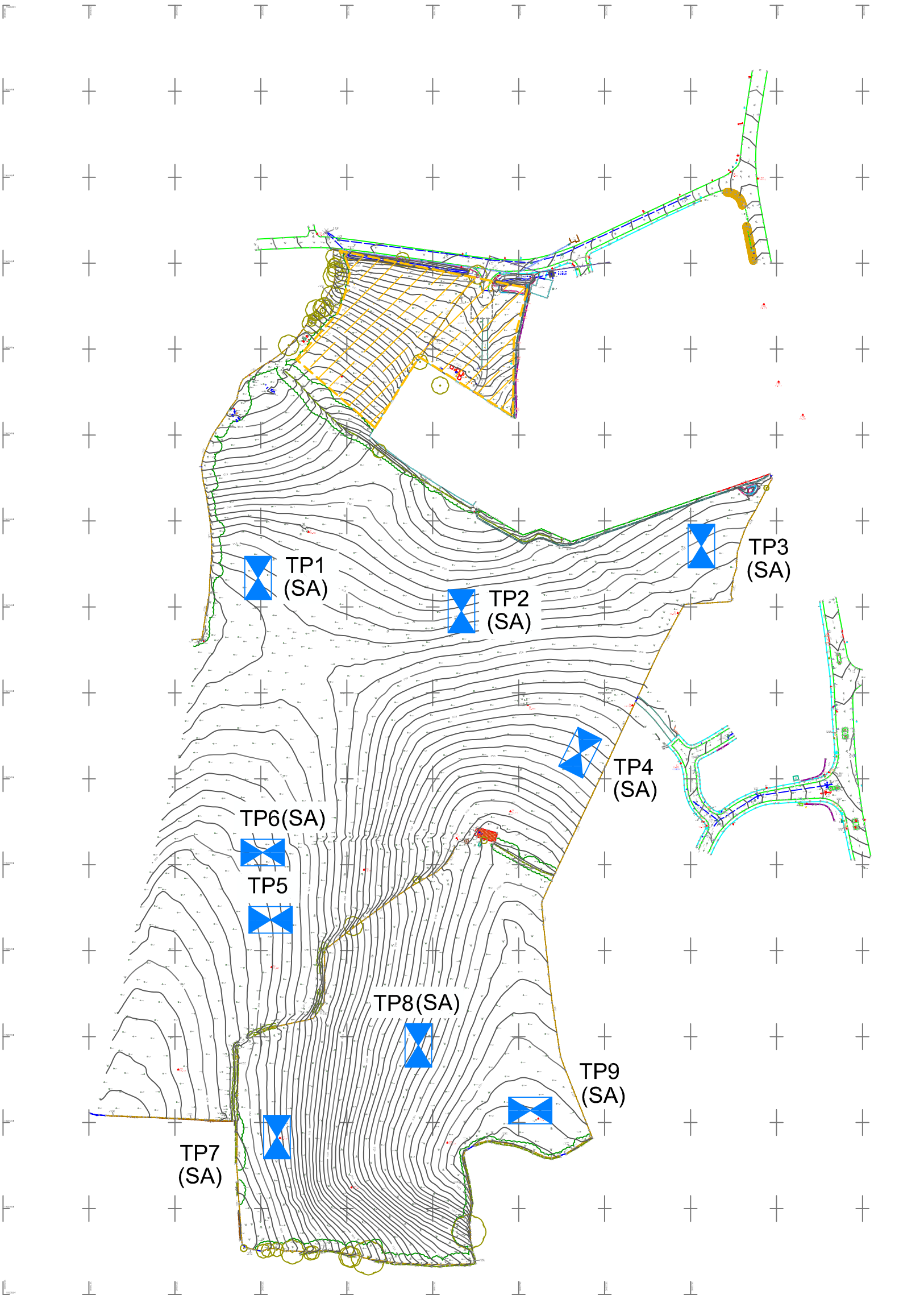
A E Stratford BSc MSc
Project Engineer

T N Owens BSc CGeol FGS
Associate Director

N J Waite BSc CGeol FGS
Director

Encs

Drawing No. G/RC597/03
Appendix A Trial Pit Logs
Appendix B In-Situ Soakaway Field Record Sheets and Graphs
Appendix C Table of Infiltration Rate Calculations



KEY

Trial Pit Location

(SA) In-Situ Soakaway Test undertaken in Trial Pit

Area excluded for Soakaway Tests on Clients Instruction

JOHNSON POOLE & BLOOMER LIMITED

LAND CONSULTANTS

Engineer AES	Client BDW Trading Limited		Title Approximate Location of In-Situ Soakaway Tests
Checked TNO	Project Bayfields, Chepstow		
Approved TNO	Date December '17	Scale 1:2500 @A3	Drawing G/RC597/03

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Appendix B
Existing Catchment Plan

N

CATCHMENT A

CATCHMENT B

CATCHMENT C

CATCHMENT D

CATCHMENT E

CATCHMENT F

Revisions

Project:	Land South of B4235 Bayfield, Chepstow
Client:	BARRATT HOMES
Drawing:	SW CATCHMENT PLAN
Scale:	1:1000
Date:	Nov 18
Drawn by:	NL
Drawing No:	10233 - 201
Rev:	-

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Drg.Status: PRELIMINARY

Appendix C
Proposed Drainage Network Catchment Plan

N

KEY

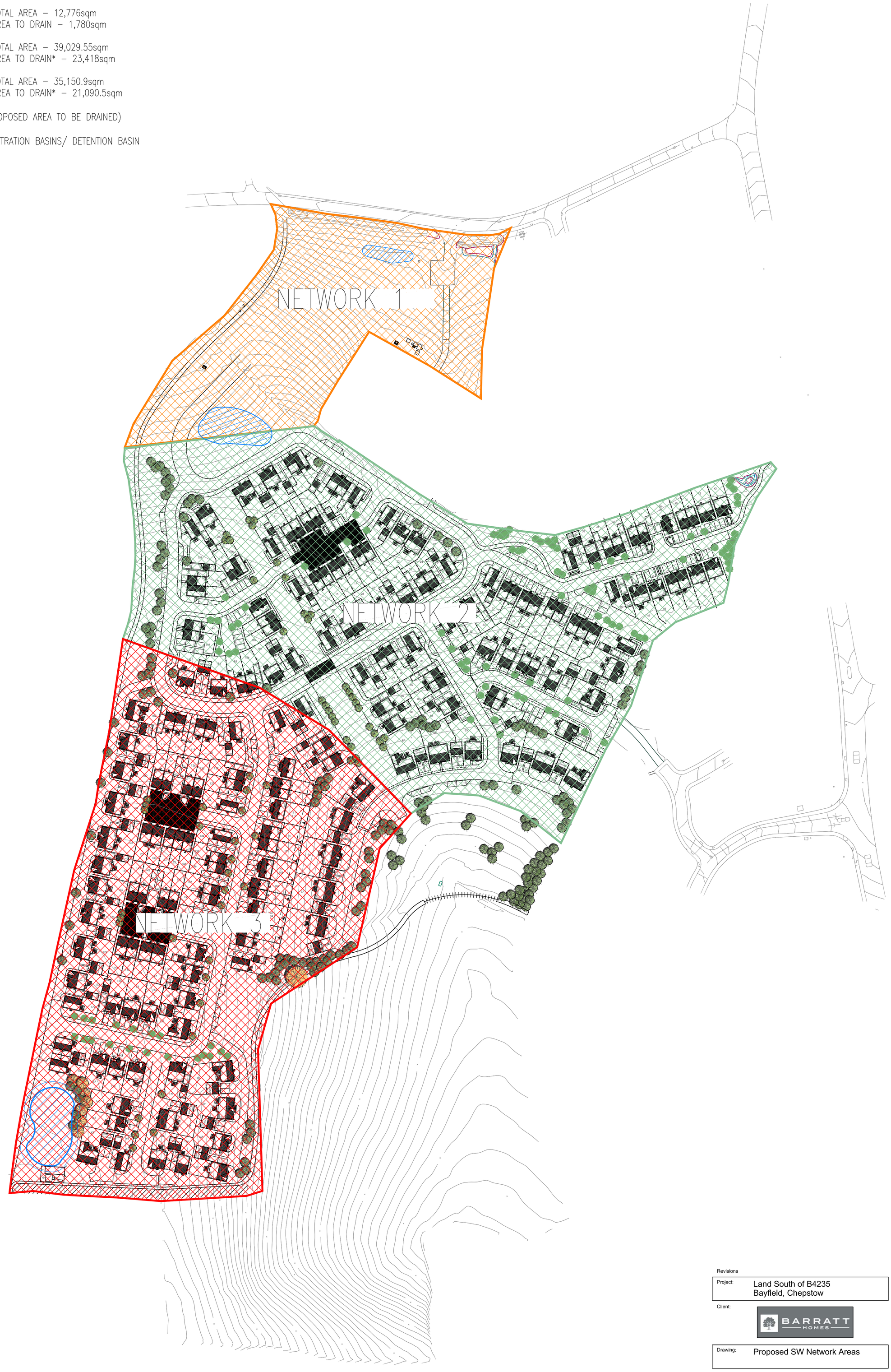
NETWORK 1 TOTAL AREA – 12,776sqm
AREA TO DRAIN – 1,780sqm

NETWORK 2 TOTAL AREA – 39,029.55sqm
AREA TO DRAIN* – 23,418sqm

NETWORK 3 TOTAL AREA – 35,150.9sqm
AREA TO DRAIN* – 21,090.5sqm

(*ASSUME 60% OF PROPOSED AREA TO BE DRAINED)

PROPOSED INFILTRATION BASINS/ DETENTION BASIN



Revisions

Project: Land South of B4235
Bayfield, Chepstow

Client: BARRATT HOMES

Drawing: Proposed SW Network Areas

Scale: 1:1000 Date: Nov 18 Drawn by: NL

Drawing No: 10233 - 203 Rev: -

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Drg.Status: PRELIMINARY

Appendix D
Microdrainage Calculations

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 102 minutes.

	Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15	min Summer	80.343	0.843	56.5	395.1	O K
30	min Summer	80.566	1.066	64.9	528.4	O K
60	min Summer	80.742	1.242	71.6	642.8	O K
120	min Summer	80.826	1.326	74.9	700.4	O K
180	min Summer	80.829	1.329	75.0	702.7	O K
240	min Summer	80.812	1.312	74.3	690.2	O K
360	min Summer	80.760	1.260	72.3	654.8	O K
480	min Summer	80.704	1.204	70.1	617.5	O K
600	min Summer	80.649	1.149	68.0	581.4	O K
720	min Summer	80.596	1.096	66.0	547.0	O K
960	min Summer	80.494	0.994	62.2	483.9	O K
1440	min Summer	80.318	0.818	55.6	380.9	O K
2160	min Summer	80.111	0.611	48.1	269.9	O K
2880	min Summer	79.954	0.454	42.5	192.4	O K
4320	min Summer	79.738	0.238	34.9	95.3	O K
5760	min Summer	79.606	0.106	30.4	40.9	O K
7200	min Summer	79.548	0.048	27.5	18.3	O K
8640	min Summer	79.542	0.042	24.0	16.0	O K
10080	min Summer	79.538	0.038	21.4	14.3	O K
15	min Winter	80.432	0.932	59.8	446.8	O K
30	min Winter	80.676	1.176	69.1	599.0	O K
60	min Winter	80.873	1.373	76.7	733.6	O K
120	min Winter	80.968	1.468	80.4	801.9	O K
180	min Winter	80.967	1.467	80.4	801.6	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15	min Summer	116.002	0.0	27
30	min Summer	79.998	0.0	39
60	min Summer	52.662	0.0	64
120	min Summer	33.322	0.0	100
180	min Summer	24.998	0.0	134
240	min Summer	20.313	0.0	168
360	min Summer	15.144	0.0	238
480	min Summer	12.271	0.0	306
600	min Summer	10.413	0.0	372
720	min Summer	9.099	0.0	438
960	min Summer	7.345	0.0	568
1440	min Summer	5.419	0.0	818
2160	min Summer	3.986	0.0	1184
2880	min Summer	3.200	0.0	1540
4320	min Summer	2.349	0.0	2256
5760	min Summer	1.888	0.0	2952
7200	min Summer	1.594	0.0	3600
8640	min Summer	1.389	0.0	4320
10080	min Summer	1.237	0.0	5128
15	min Winter	116.002	0.0	27
30	min Winter	79.998	0.0	39
60	min Winter	52.662	0.0	64
120	min Winter	33.322	0.0	106
180	min Winter	24.998	0.0	142

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
240 min Winter	80.940	1.440	79.3	781.7	O K
360 min Winter	80.861	1.361	76.2	724.6	O K
480 min Winter	80.773	1.273	72.8	663.8	O K
600 min Winter	80.691	1.191	69.6	608.5	O K
720 min Winter	80.612	1.112	66.6	557.4	O K
960 min Winter	80.468	0.968	61.2	467.8	O K
1440 min Winter	80.229	0.729	52.3	331.5	O K
2160 min Winter	79.967	0.467	42.9	198.4	O K
2880 min Winter	79.782	0.282	36.4	114.0	O K
4320 min Winter	79.558	0.058	28.8	22.1	O K
5760 min Winter	79.542	0.042	23.7	15.8	O K
7200 min Winter	79.535	0.035	19.9	13.3	O K
8640 min Winter	79.531	0.031	17.3	11.6	O K
10080 min Winter	79.528	0.028	15.6	10.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
240 min Winter	20.313	0.0	180
360 min Winter	15.144	0.0	256
480 min Winter	12.271	0.0	326
600 min Winter	10.413	0.0	396
720 min Winter	9.099	0.0	464
960 min Winter	7.345	0.0	598
1440 min Winter	5.419	0.0	852
2160 min Winter	3.986	0.0	1220
2880 min Winter	3.200	0.0	1584
4320 min Winter	2.349	0.0	2220
5760 min Winter	1.888	0.0	2888
7200 min Winter	1.594	0.0	3576
8640 min Winter	1.389	0.0	4360
10080 min Winter	1.237	0.0	5024

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 2.108

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.527	4	8	0.527	8	12	0.527	12	16	0.527

Model Details

Storage is Online Cover Level (m) 81.000

Infiltration Basin Structure

Invert Level (m) 79.500 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 1.29000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 1.29000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	375.0	1.500	747.5

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 21 minutes.

	Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15	min Summer	80.426	0.926	208.3	310.9	O K
30	min Summer	80.624	1.124	237.5	400.4	O K
60	min Summer	80.691	1.191	247.6	432.8	O K
120	min Summer	80.638	1.138	239.6	407.2	O K
180	min Summer	80.542	1.042	225.3	362.3	O K
240	min Summer	80.447	0.947	211.4	320.1	O K
360	min Summer	80.283	0.783	187.8	251.8	O K
480	min Summer	80.149	0.649	168.9	200.3	O K
600	min Summer	80.039	0.539	153.6	160.7	O K
720	min Summer	79.947	0.447	141.0	129.4	O K
960	min Summer	79.803	0.303	121.6	83.9	O K
1440	min Summer	79.619	0.119	97.4	31.0	O K
2160	min Summer	79.543	0.043	76.1	10.9	O K
2880	min Summer	79.535	0.035	61.7	8.9	O K
4320	min Summer	79.526	0.026	45.6	6.6	O K
5760	min Summer	79.521	0.021	36.8	5.4	O K
7200	min Summer	79.518	0.018	31.5	4.6	O K
8640	min Summer	79.516	0.016	27.1	4.0	O K
10080	min Summer	79.514	0.014	24.5	3.5	O K
15	min Winter	80.525	1.025	222.9	354.9	O K
30	min Winter	80.737	1.237	254.5	455.5	O K
60	min Winter	80.796	1.296	263.6	486.0	O K
120	min Winter	80.687	1.187	247.0	430.9	O K
180	min Winter	80.536	1.036	224.5	359.6	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15	min Summer	116.002	0.0	24
30	min Summer	79.998	0.0	33
60	min Summer	52.662	0.0	50
120	min Summer	33.322	0.0	82
180	min Summer	24.998	0.0	114
240	min Summer	20.313	0.0	146
360	min Summer	15.144	0.0	208
480	min Summer	12.271	0.0	268
600	min Summer	10.413	0.0	328
720	min Summer	9.099	0.0	388
960	min Summer	7.345	0.0	508
1440	min Summer	5.419	0.0	746
2160	min Summer	3.986	0.0	1104
2880	min Summer	3.200	0.0	1460
4320	min Summer	2.349	0.0	2148
5760	min Summer	1.888	0.0	2848
7200	min Summer	1.594	0.0	3552
8640	min Summer	1.389	0.0	4400
10080	min Summer	1.237	0.0	5016
15	min Winter	116.002	0.0	24
30	min Winter	79.998	0.0	33
60	min Winter	52.662	0.0	52
120	min Winter	33.322	0.0	86
180	min Winter	24.998	0.0	120

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
240 min Winter	80.398	0.898	204.4	299.1	O K
360 min Winter	80.176	0.676	172.7	210.3	O K
480 min Winter	80.008	0.508	149.3	149.8	O K
600 min Winter	79.878	0.378	131.6	106.9	O K
720 min Winter	79.775	0.275	117.8	75.3	O K
960 min Winter	79.625	0.125	98.1	32.5	O K
1440 min Winter	79.543	0.043	75.2	10.8	O K
2160 min Winter	79.532	0.032	55.4	8.0	O K
2880 min Winter	79.526	0.026	44.7	6.5	O K
4320 min Winter	79.519	0.019	33.2	4.8	O K
5760 min Winter	79.515	0.015	26.2	3.9	O K
7200 min Winter	79.513	0.013	22.8	3.4	O K
8640 min Winter	79.512	0.012	20.2	3.0	O K
10080 min Winter	79.510	0.010	17.6	2.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
240 min Winter	20.313	0.0	152
360 min Winter	15.144	0.0	214
480 min Winter	12.271	0.0	276
600 min Winter	10.413	0.0	336
720 min Winter	9.099	0.0	394
960 min Winter	7.345	0.0	512
1440 min Winter	5.419	0.0	726
2160 min Winter	3.986	0.0	1076
2880 min Winter	3.200	0.0	1424
4320 min Winter	2.349	0.0	2180
5760 min Winter	1.888	0.0	2920
7200 min Winter	1.594	0.0	3584
8640 min Winter	1.389	0.0	4336
10080 min Winter	1.237	0.0	4968

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 2.340

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.585	4	8	0.585	8	12	0.585	12	16	0.585

Model Details

Storage is Online Cover Level (m) 81.000

Infiltration Basin Structure

Invert Level (m) 79.500 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 5.91000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 5.91000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	250.0	1.500	565.8

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	70.743	0.343	5.0	33.4	O K
30 min Summer	70.831	0.431	5.0	44.1	O K
60 min Summer	70.897	0.497	5.0	52.7	O K
120 min Summer	70.919	0.519	5.0	55.6	O K
180 min Summer	70.911	0.511	5.0	54.6	O K
240 min Summer	70.901	0.501	5.0	53.3	O K
360 min Summer	70.878	0.478	5.0	50.1	O K
480 min Summer	70.850	0.450	5.0	46.5	O K
600 min Summer	70.819	0.419	5.0	42.6	O K
720 min Summer	70.784	0.384	5.0	38.3	O K
960 min Summer	70.706	0.306	5.0	29.2	O K
1440 min Summer	70.576	0.176	5.0	15.6	O K
2160 min Summer	70.458	0.058	4.9	4.8	O K
2880 min Summer	70.418	0.018	4.5	1.4	O K
4320 min Summer	70.400	0.000	3.4	0.0	O K
5760 min Summer	70.400	0.000	2.7	0.0	O K
7200 min Summer	70.400	0.000	2.3	0.0	O K
8640 min Summer	70.400	0.000	2.0	0.0	O K
10080 min Summer	70.400	0.000	1.8	0.0	O K
15 min Winter	70.783	0.383	5.0	38.1	O K
30 min Winter	70.881	0.481	5.0	50.5	O K
60 min Winter	70.958	0.558	5.0	61.1	O K
120 min Winter	70.992	0.592	5.0	66.0	O K
180 min Winter	70.981	0.581	5.0	64.3	O K
240 min Winter	70.965	0.565	5.0	62.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	116.002	0.0	38.2	18
30 min Summer	79.998	0.0	52.7	32
60 min Summer	52.662	0.0	69.5	62
120 min Summer	33.322	0.0	87.8	106
180 min Summer	24.998	0.0	98.9	140
240 min Summer	20.313	0.0	107.4	172
360 min Summer	15.144	0.0	120.1	242
480 min Summer	12.271	0.0	129.5	312
600 min Summer	10.413	0.0	137.5	380
720 min Summer	9.099	0.0	144.0	450
960 min Summer	7.345	0.0	155.1	570
1440 min Summer	5.419	0.0	171.5	806
2160 min Summer	3.986	0.0	189.3	1128
2880 min Summer	3.200	0.0	202.8	1468
4320 min Summer	2.349	0.0	223.3	0
5760 min Summer	1.888	0.0	239.3	0
7200 min Summer	1.594	0.0	252.6	0
8640 min Summer	1.389	0.0	264.1	0
10080 min Summer	1.237	0.0	274.3	0
15 min Winter	116.002	0.0	42.8	18
30 min Winter	79.998	0.0	59.2	32
60 min Winter	52.662	0.0	77.6	60
120 min Winter	33.322	0.0	98.4	116
180 min Winter	24.998	0.0	110.9	146
240 min Winter	20.313	0.0	120.0	184

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
360 min Winter	70.930	0.530	5.0	57.2	O K
480 min Winter	70.887	0.487	5.0	51.3	O K
600 min Winter	70.839	0.439	5.0	45.0	O K
720 min Winter	70.782	0.382	5.0	38.1	O K
960 min Winter	70.657	0.257	5.0	23.9	O K
1440 min Winter	70.477	0.077	5.0	6.4	O K
2160 min Winter	70.408	0.008	4.1	0.6	O K
2880 min Winter	70.400	0.000	3.3	0.0	O K
4320 min Winter	70.400	0.000	2.4	0.0	O K
5760 min Winter	70.400	0.000	2.0	0.0	O K
7200 min Winter	70.400	0.000	1.7	0.0	O K
8640 min Winter	70.400	0.000	1.4	0.0	O K
10080 min Winter	70.400	0.000	1.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	15.144	0.0	134.4	262
480 min Winter	12.271	0.0	145.0	338
600 min Winter	10.413	0.0	154.1	412
720 min Winter	9.099	0.0	161.2	486
960 min Winter	7.345	0.0	173.8	598
1440 min Winter	5.419	0.0	192.2	806
2160 min Winter	3.986	0.0	212.1	1104
2880 min Winter	3.200	0.0	227.1	0
4320 min Winter	2.349	0.0	250.0	0
5760 min Winter	1.888	0.0	268.0	0
7200 min Winter	1.594	0.0	282.9	0
8640 min Winter	1.389	0.0	295.8	0
10080 min Winter	1.237	0.0	307.2	0

Appendix E
DCWW Correspondence

Dŵr Cymru
Welsh Water

Developer Services
PO Box 3146
Cardiff
CF30 0EH

Tel: +44 (0)800 917 2652
Fax: +44 (0)2920 740472
E.mail: developer.services@dwrcymru.com

Gwasanaethau Datblygu
Blwch Post 3146
Caerdydd
CF30 0EH

Ffôn: +44 (0)800 917 2652
Ffacs: +44 (0)2920 740472
E.bost: developer.services@dwrcymru.com

Mr Richard Jones
BDW Trading Limited
Oak House
Village Way
Tongwynlais
Cardiff
CF15 7NE

Date: 28/03/2018
Our Ref: PPA0002870

Dear Mr Jones,

Grid Ref: 352121 194039
Site Address: Bayfield, Land off Wallwern Wood, Chepstow
Development: Residential new build - 225 units

I refer to your pre-planning enquiry received relating to the above site, seeking our views on the capacity of our network of assets and infrastructure to accommodate your proposed development. Having reviewed the details submitted I can provide the following comments which should be taken into account within any future planning application for the development.

SEWERAGE

The foul flows only from the proposed development can be accommodated within the public sewerage system. We advise that the flows should be communicated with to the foul/combined sewer between manholes ST52944102 and ST52944101 located in (highway/road) to the East of the proposed development site.

Should a planning application be submitted for this development we will seek to control these points of communication via appropriate planning conditions and therefore recommend that any drainage layout or strategy submitted as part of your application takes this into account.

However, should you wish for an alternative connection point to be considered please provide further information to us in the form of a drainage strategy, preferably in advance of a planning application being submitted.

With reference to the surface water flows from the proposed development, you are required to fully exhaust all technical options outlined under Sections 3.2 and 3.4 of Part H of the publication 'Building Regulations 2000; Disposal should be made through the hierarchical approach, preferring infiltration and, where infiltration is not possible, disposal to watercourses in liaison with the Land Drainage Authority and/or Natural Resources Wales. Discharge of surface water to the public sewer is only to be made as a last resort. Please refer to further detailed advice relating to surface water management included in our attached Advice & Guidance note.

In addition, please note that no highway or land drainage run-off will be permitted to discharge directly or indirectly into the public sewerage system.

Advisory Notes

You may need to apply to Dwr Cymru Welsh Water for any connection to the public sewer under Section 106 of the Water industry Act 1991. However, if the connection to the public sewer network is either via a lateral drain (i.e. a drain which extends beyond the connecting property boundary) or via a new sewer (i.e. serves more than one property), it is now a mandatory requirement to first enter into a Section 104 Adoption Agreement (Water Industry Act 1991). The design of the sewers and lateral drains must also conform to the Welsh Ministers Standards for Foul Sewers and Lateral Drains, and conform with the publication "Sewers for Adoption"- 7th Edition. Further information can be obtained via the Developer Services pages of www.dwrcymru.com

You are also advised that some public sewers and lateral drains may not be recorded on our maps of public sewers because they were originally privately owned and were transferred into public ownership by nature of the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011. The presence of such assets may affect the proposal. In order to assist you may contact Dwr Cymru Welsh Water on 0800 085 3968 to establish the location and status of the apparatus in and around your site. Please be mindful that under the Water Industry Act 1991 Dwr Cymru Welsh Water has rights of access to its apparatus at all times.

SEWAGE TREATMENT

No problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from this site.

WATER SUPPLY

A water supply can be made available to service this proposed development. Initial indications are that a connection can be made from the 9 inch diameter watermain near Woolpitch Wood or nearby fields. The cost of providing new on-site watermains can be calculated upon the receipt of detailed site layout plans which should be sent to the above address.

The proposed development is crossed by various trunk watermains, the approximate positions being shown on the attached plan. Dwr Cymru Welsh Water as Statutory Undertaker has statutory powers to access our apparatus at all times. I enclose our Conditions for Development near Watermain(s). It may be possible for this watermain to be diverted under Section 185 of the Water Industry Act 1991, the cost of which will be re-charged to the developer. The developer must consult Dwr Cymru Welsh Water before any development commences on site.

I trust the above information is helpful and will assist you in forming water and drainage strategies that should accompany any future planning application. I also attach copies of our water and sewer extract plans for the area, and a copy of our Planning Guidance Note which provides further information on our approach to the planning process, making connections to our systems and ensuring any existing public assets or infrastructure located within new development sites are protected.

Please note that our response is based on the information provided in your enquiry and should the information change we reserve the right to make a new representation. Should you have any queries or wish to discuss any aspect of our response please do not hesitate to contact our dedicated team of planning officers, either on 0800 917 2652 or via email at **developer.services@dwrcymru.com**

Please quote our reference number in all communications and correspondence.

Yours faithfully,

Owain George
Planning Liaison Manager
Developer Services

Enc. Sewer Plan
Water Plan
Receipt
Advice Note

***Please Note** that demands upon the water and sewerage systems change continually; consequently the information given above should be regarded as reliable for a maximum period of 12 months from the date of this letter*

Dŵr Cymru
Welsh Water

PPA0002870

N
W E
S

LEGEND(Representative of most common features)

Waste network:

- Foul chamber
- Surface water chamber
- Combined chamber
- Combined sewer overflow
- Special purpose chamber
- Treatment works
- Pumping station
- Outfall
- Lamphole (LH)
- Storm Overflow
- Rising main
- Gravity sewer
- Private sewer
- Private sewer subject to Sect. 104 adoption agreement (S 104)
- Private Sewer Transfer
- Lateral Drain
- Inspection Chamber

NB: Sewer symbol colour indicates the type.

RED - Combined
GREEN - Surface Water
BROWN - Foul
Purple - Former S24 sewers (for indicative purposes only)

Notes:

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases, pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be asbestos cement (AC) or Pitch Fibre (PF) . It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation

Map Ref:	352121,194039
Map scale:	1:1250
Printed by:	Parker David
Printed on:	27 Mar 2018