



JACQUES WAY, WREXHAM

SURFACE WATER DRAINAGE ASSESSMENT

Final Report v1.0

May 2019

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Report Title	Jacques Way, Wrexham Surface Water Drainage Assessment Final Report v1.0
Client	Castlemead Group Limited
Date of issue	2 May 2019

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This document has been prepared solely as a Surface Water Drainage Assessment for Castlemead Group Limited. This report is confidential to Castlemead Group Limited and Weetwood Services Ltd accepts no responsibility or liability for any use that is made of this document other than by Castlemead Group Limited for the purposes for which it was originally commissioned and prepared.

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1 INTRODUCTION

1.1 PURPOSE OF REPORT

Weetwood Services Ltd ('Weetwood') has been instructed by Castlemead Group Limited to prepare a Surface Water Drainage Assessment report to accompany a planning application for the proposed redevelopment of the former Jacques Yard, Jacques Way, Wrexham.

The assessment has been undertaken in accordance with the requirements of Technical Advice Note 15 (TAN15).

1.2 STRUCTURE OF THE REPORT

The report is structured as follows:

- Section 1** Introduction and report structure
- Section 2** Provides background information relating to the development site, the development proposals, ground conditions and existing site access arrangements
- Section 3** Presents national and local flood risk and drainage planning policy
- Section 4** Addresses the effect of the proposed development on surface water runoff and presents an illustrative surface water drainage scheme to ensure that surface water runoff is sustainably managed and flood risk is not increased elsewhere.
- Section 5** Presents a summary of key findings

2 SITE DETAILS AND PROPOSED DEVELOPMENT

2.1 SITE LOCATION

The approximately 0.545 ha site is located south of Jacques Way at Ordnance Survey National Grid Reference SJ 328 506, as shown in **Figure 1**.

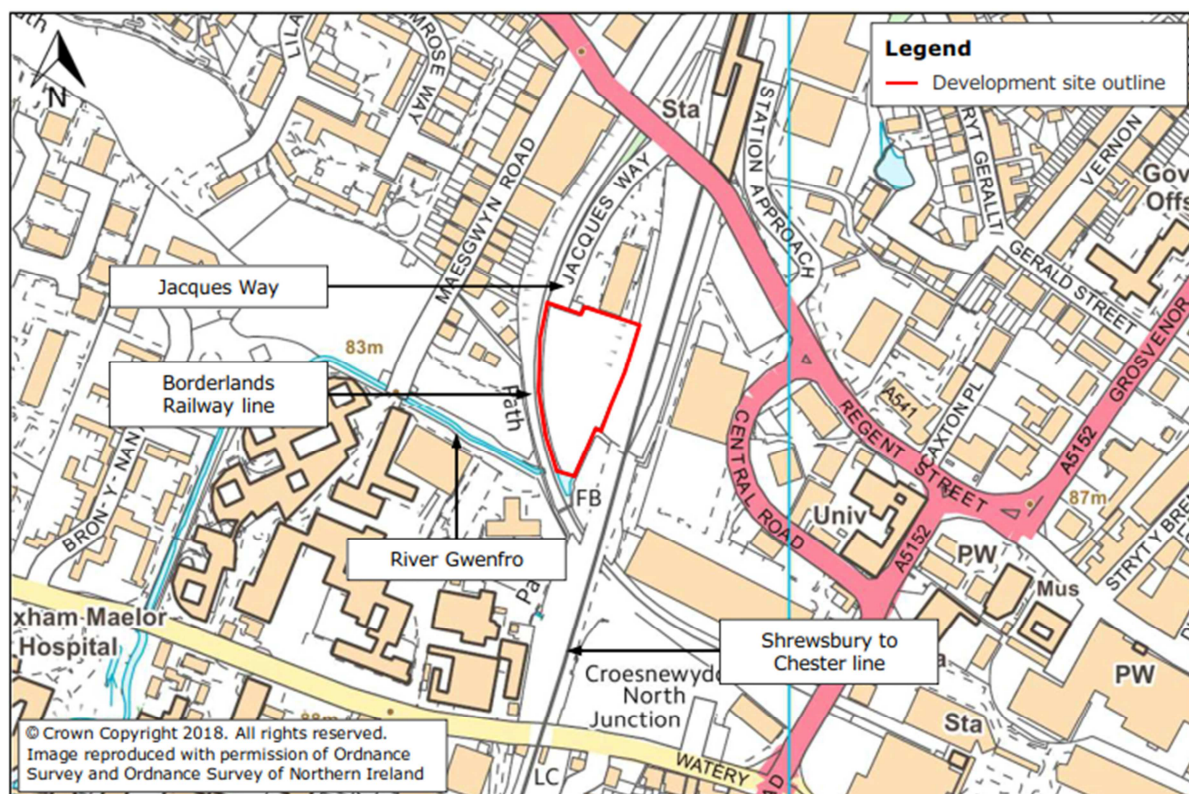


Figure 1: Site Location

2.2 EXISTING AND PROPOSED DEVELOPMENT

The site currently comprises of previously developed land which is now mainly levelled rough grassland and concrete.

The current proposals are for 25 residential dwellings with associated car parking. An illustrative layout is provided in **Appendix A**.

2.3 WATERBODIES IN THE VICINITY OF THE SITE

The River Gwenfro is classified as an 'ordinary watercourse'. The watercourse flows in a south-easterly direction to the south of the site where it is then culverted through Wrexham town centre before eventually outfalling to the River Cylwedog.

2.4 GROUND CONDITIONS

British Geological Survey (BGS) mapping indicates that the development site is underlain by alluvial and glaciofluvial deposits of clay, silt and gravel with some glaciofluvial sand and gravels to the north of the site, all of which overlays a bedrock of Mudstone (associated with the Etruria Formation).

BGS borehole records¹ in the vicinity of the site indicate ground conditions to comprise of made ground underlain by clay, dense sand and gravel in excess of depths of circa 3.5 metres below ground level (m bgl).

A Groundwater Contamination Assessment (**Appendix B**) was carried out by RPS Health, Safety & Environment in November 2007. The report states that made ground was present across the site up to depths of between 3.0 m and 3.9 m below ground level. The report also states that shallow groundwater is present and is perched upon less permeable bands of clayey and silty material.

This assessment also confirmed that groundwater present on site does not pose any significant risk to the underlying Minor Aquifer or the River Gwenfro.

The RPS assessment therefore confirms the BGS data to be correct.

2.5 SITE LEVELS

A topographic survey of the site has been undertaken by Invar Mapping Surveys and is provided in **Appendix C**.

This indicates that site levels are typically between 85.0 to 86.2 metres Above Ordnance Datum (m AOD). Along the western and southern boundaries of the site steep banks are present whereby ground levels fall down to 81.5 m AOD, adjacent to the Borderlands Railway Line.

2.6 ACCESS AND EGRESS

Existing access to the site is gained via Jacques Way.

Levels along Jacques Way are shown to be in the region of 84.79 to 88.94 m AOD, falling from Regent Street to the site.

¹ www.bgs.ac.uk/data/boreholescans/home.html, Ref: SJ35SW938, SJ35SW942

3 PLANNING POLICY AND GUIDANCE

3.1 NATIONAL PLANNING POLICY AND GUIDANCE

3.1.1 Technical Advice Note 15; Development and Flood Risk

The general approach of TAN15 is to set out a precautionary framework to guide planning decisions in areas at high risk of flooding. The overarching aim of the framework is, in order of preference, to:

- Direct new development away from those areas which are at a high risk of flooding.
- Where development has to be considered in high risk areas (i.e. Zone C) only those development which can be justified should be located in such areas.

3.1.1.1 Surface Water Drainage

TAN15 provides an overview of the requirements for the management of surface water to ensure that development does not increase flood risk at the site or elsewhere.

Paragraph 8.3 of TAN15 states that *"the aim should be for new development not to create additional run-off when compared with the undeveloped situation, and for redevelopment to reduce runoff where possible. It is accepted that there may be practical difficulties in achieving this aim"*.

3.1.2 Welsh Government

3.1.2.1 Statutory Standards for Sustainable Drainage Systems

For applications submitted from 7 January 2019, the Flood and Water Management Act 2010 (Schedule 3) requires new developments to include Sustainable Drainage Systems (SuDS) features that comply with national standards.

New developments of more than one dwelling or where the area covered by construction work equals or exceeds 100 m² require approval before construction can commence from the SuDS Approval Body (SAB) to ensure compliance with the SuDS standards.

The SAB will also be required to adopt the SuDS unless the scheme serves only a single property or is a publically maintained road to which Section 41 of the Highways Act 1980 applies.

The statutory standards are as follows:

Standard S1; Surface water runoff destination

- Priority Level 1: Surface water runoff is collected for use;
- Priority Level 2: Surface water runoff is infiltrated to ground;
- Priority Level 3: Surface water is discharged to a surface water body;
- Priority Level 4: Surface Water is discharged to surface water sewer, highway drain, or another drainage system;
- Priority Level 5: Surface water runoff is discharged to a combined sewer.

Standard S2; Surface water runoff hydraulic control

1. Surface water should be managed to prevent, so far as possible, any discharge from the site for the majority of rainfall events of less than 5 mm.

2. The surface water runoff rate for the 1:1 annual probability event (or agreed equivalent) should be controlled to help mitigate the negative impacts of the development runoff on the morphology and associated ecology of the receiving surface water bodies.
3. The surface water runoff (rate and volume) for the 1:100 annual probability event (or agreed equivalent) should be controlled to help mitigate negative impacts of the development on flood risk in the receiving water body.
4. The surface water runoff for events up to the 1:100 annual probability (or agreed equivalent) should be managed to protect people and property on and adjacent to the site from flooding from the drainage system.
5. The risks (both on site and off site) associated with the surface water runoff for events greater than the 1:100 annual probability should be considered. Where the consequences are excessive in terms of social disruption, damage or risk to life, mitigating proposals should be developed to reduce these impacts.
6. Drainage design proposals should be examined for the likelihood and consequences of any potential failure scenarios (e.g. structural failure or blockage), and the associated flood risks managed where possible.

Standard S3; Surface water quality management

Treatment for surface water runoff should be provided to prevent negative impacts on the receiving water quality and/or protect downstream drainage systems, including sewers.

Standard S4; Amenity

The design of surface water management systems should maximise amenity benefits.

Standard S5; Biodiversity

The design of the surface water management system should maximise biodiversity benefits.

Standard S6; Design of drainage or construction, operation and maintenance

1. All elements of the surface water drainage system should be designed so that they can be constructed easily, safely, cost-effective, in a timely manner, and with the aim of minimising the use of scarce resources and embedded carbon (energy).
2. All elements of the surface water drainage system should be designed to ensure maintain and operation can be undertaken (by the relevant responsible body) easily, safely, cost-effective, in a timely manner, and with the aim of minimising the use of scarce resources and embedded carbon (energy).
3. The surface water drainage system should be designed to ensure structural integrity of all elements under anticipated loading conditions over the design life of the development site, taking into account the requirement for reasonable levels of maintenance.

3.2 LOCAL PLANNING POLICY AND GUIDANCE

The Wrexham County Borough Council (WCBC) Unitary Development Plan (UDP) 1996-2011 was adopted in 2005 and is the current Development Plan for the Borough.

The following policies are relevant in respect of flood risk:

Policy EC12; Development and Flood Risk

Development (including the raising of land) within defined flood plains will only be permitted if it:-

- a. would not be subject to an unacceptable risk of flooding on-site; and/or
- b. does not result in an unacceptable risk of flooding on or off-site; and/or
- c. does not adversely affect flood management or maintenance schemes

WCBC is currently preparing a Local Development Plan for the Borough covering the period 2018-2028, which will replace the current UDP once adopted.

3.3 CONSENTS

An Environmental Permit for Flood Risk Activities may be required from Natural Resources Wales (NRW) for work:

- in, under, over or near a main river (including where the river is in a culvert)
- on or near a flood defence on a main river
- in the flood plain of a main river
- on or near a sea defence

Further information can be found by visiting the NRW website²

If the location of an activity is on any watercourse that lies within an Internal Drainage District (IDD) an application will need to be made to NRW for a Flood Risk Activity Permit.

Ordinary Watercourse Consent may be required from the lead local flood authority for work to an ordinary watercourse.

Undertaking activities controlled by local Byelaws (made under the Water Resources Act 1991) also requires the relevant consent.

3.4 RELEVANT DOCUMENTS

The assessment has been informed by the following documents:

- Local Flood Risk Management Strategy (LFRMS), WCBC, April 2013
- Flood Risk Management Plan (FRMP), WCBC, July 2016
- Dee Preliminary Flood Risk Assessment, NRW & Environment Agency (EA), December 2018

² <https://naturalresources.wales/apply-for-a-permit/flood-risk-activities/flood-risk-activity-permits-information/?lang=en>

4 SURFACE WATER MANAGEMENT

4.1 SURFACE WATER DRAINAGE AT THE EXISTING SITE

Whilst the site was previously developed, the site is now undeveloped and classed as greenfield. Based on site topography and ground conditions, surface water runoff would be expected to flow overland in a southerly direction towards the River Gwenfro, slowly infiltrating where conditions allow.

The developed site to the north, the existing Premier Inn, discharges attenuated surface water into the River Gwenfro via an existing 150 mm diameter pipe which crosses this development area. Please note that the Topographical Survey (**Appendix C**) incorrectly notes this pipe as 'foul' when it is in fact conveying surface water. The attenuated flow rate is currently unknown and will need to be confirmed at the detailed design stage.

Public sewer records (**Appendix D**) indicate that there are public surface water sewers approximately 100 m to the west of the proposed development with none recorded within the vicinity of the site.

4.1.1 Existing Runoff Rates

The site has a total area of 0.545 ha.

The greenfield surface water runoff rates for the site, calculated using the ICP SUDS method within MicroDrainage are presented in **Table 1**. Details of the input parameters and the output results are provided in **Appendix E**.

Table 1: Greenfield Runoff Rate

Annual probability of rainfall event	Greenfield Runoff Rate (l/s)
1:1	1.1
QBAR	1.3
1:30	2.2
1:100	2.8

4.2 SURFACE WATER DRAINAGE AT THE REDEVELOPED SITE

4.2.1 Disposal of Surface Water

In accordance with Welsh Government guidance³, surface water runoff should be disposed of according to the following hierarchy: Rainwater collected for use; Into the ground (infiltration); To a surface water body; To a surface water sewer or highway drain.

As detailed in **Section 2.4** the site is underlain by soils with impeded drainage. As such the disposal of surface water via infiltration is unlikely to be feasible; however, infiltration tests have not been undertaken at this stage. Such tests should be undertaken at the detailed design stage in accordance with the guidelines in BRE365⁴.

³ Section 3.1.2.1

⁴ BRE Digest 365: Soakaway Design

It is subsequently proposed to discharge surface water from the development into the existing 150 mm diameter sewer crossing the site.

4.2.2 Post Development Impermeable Area

The total area of impermeable surfaces within the proposed development has been estimated to be 0.354 ha, as illustrated in **Appendix F**.

4.2.3 Peak Flow Control

The runoff rates as outlined in **Table 1** will be achieved so far as is practicable; however, it is recognised that a flow control with a diameter of less than 75 mm and/or a design discharge rate of 1.3 l/s may pose a risk of blockage to the drainage system. As such a minimum discharge rate of 3.9 l/s is proposed which equates to a flow control diameter of 75mm.

4.2.4 Volume Control

Where reasonably practicable, for greenfield sites, the runoff volume from the proposed development to any highway drain, sewer or surface water body in the 1:100 annual probability, 6 hour rainfall event should not exceed the greenfield runoff volume for the same event.

This is usually addressed by designing a Long Term Storage (LTS) facility within the site. However, as outlined within the CIRIA SuDS Manual 2015 an alternative approach to managing extra runoff volumes from extreme events is to release all runoff (above the 1:1 annual probability event) from the site at a maximum rate of 2 l/s/ha or QBAR, whichever is the higher value.

It is therefore proposed to restrict peak discharge rates to the greenfield QBAR rate recognising a minimum rate of 3.9 l/s would apply in up to the 1:100 annual probability event, including an allowance for climate change.

4.2.5 Attenuation Storage

It is proposed to drain surface water by traditional means (rainwater pipes, gullies and a piped network) along with permeable paving within the shared private drive areas. The sub-base layer of the pavement construction across the site will be utilised as a means of attenuation.

The attenuation storage facilities have been modelled using the Detailed Design module of MicroDrainage Source Control (**Appendix G**). The required storage volumes have been sized to store the 1:100 annual probability rainfall event including a 30% increase in rainfall intensity in order to allow for climate change.

Based on a peak discharge rate of 3.9 l/s, a storage volume of approximately 165.75 m³ would be required. This could be accommodated within a 0.325 m deep sub-base layer (30% voids) of the pavement construction over an area of 1,700 m². The sub-base layer would fill to a depth of 0.315 m affording 0.010 m freeboard.

Due to the proposed site layout, it will be necessary to divert the existing 150 mm diameter surface water sewer crossing the site. Also, due to the site constraints, it may be necessary to accommodate the attenuated flow from the Premier Inn development within the proposed residential surface water system.

An indicative surface water drainage layout is provided in **Appendix H**.

The potential for additional SuDS features, such as rainwater harvesting or green roofs may be incorporated into the surface water drainage strategy at the discharge of conditions/reserved matters stage.

The calculations assume that all storage is provided within the formal attenuation storage facilities; with no storage being provided in the proposed pipe network. As such, the volumes of storage presented are likely to be an overestimate and would be expected to reduce when the drainage scheme is refined at the discharge of conditions/reserved matters stage.

4.2.6 Exceedance Routes

Flows resulting from rainfall in excess of the 1:100 annual probability rainfall event including an allowance for climate change will be managed in exceedance routes. It is assumed that as the development proposals progress, the design of the site would ensure flood flows are directed towards the River Gwenfro, with the site being profiled to ensure that flood flows are directed away from built development.

4.2.7 Maintenance of SuDS

SuDS elements within the curtilage of the site would be the responsibility of the owner of the property. An indicative maintenance schedule is presented in **Table 2**.

Table 2: Indicative Maintenance Requirements – Permeable Paving

Schedule	Required action	Frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosphate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth- if required, take remedial action	Three-monthly, 48h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies accumulation rates and establish appropriate removal frequencies	Annually
	Monitor inspection chambers	

5 SUMMARY

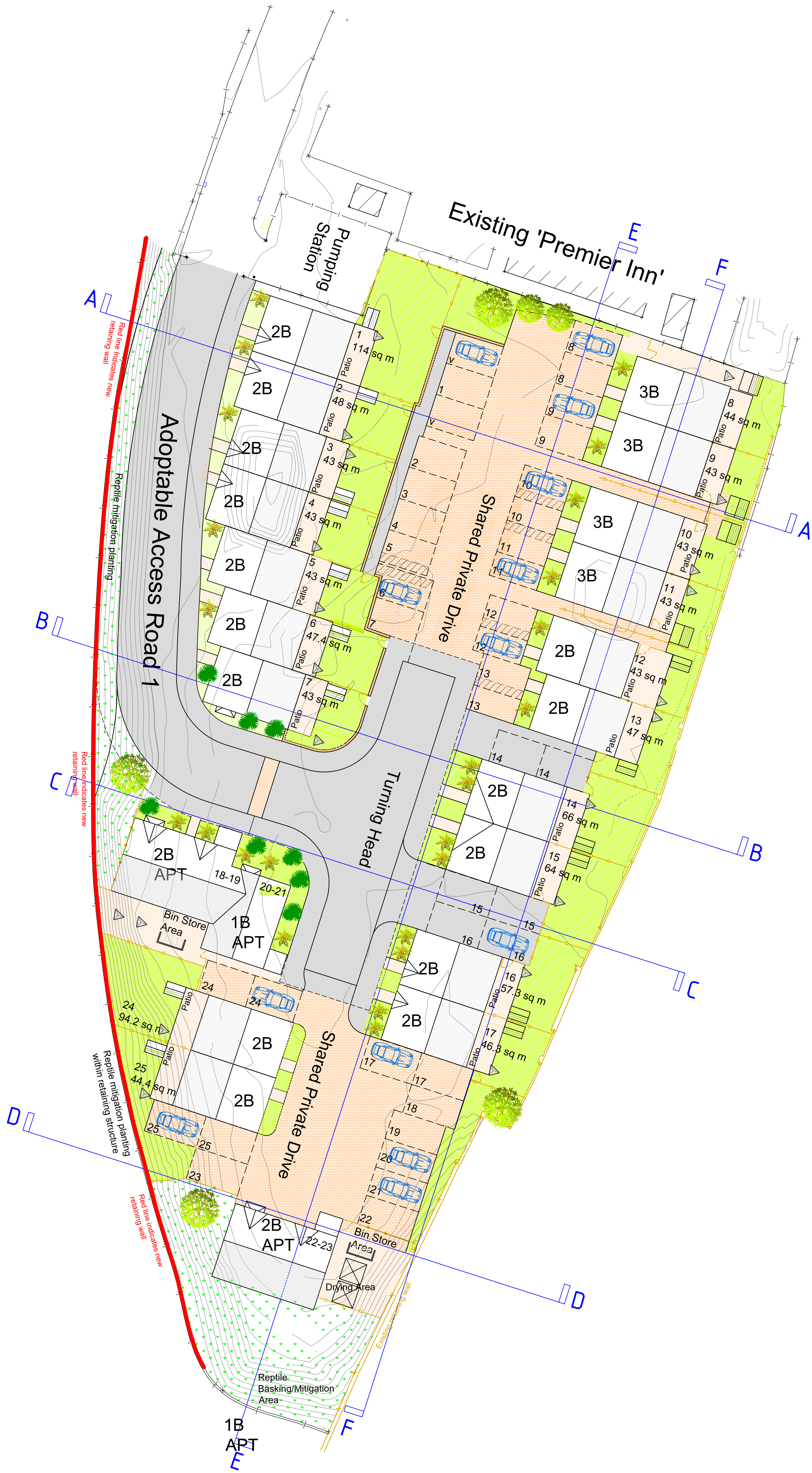
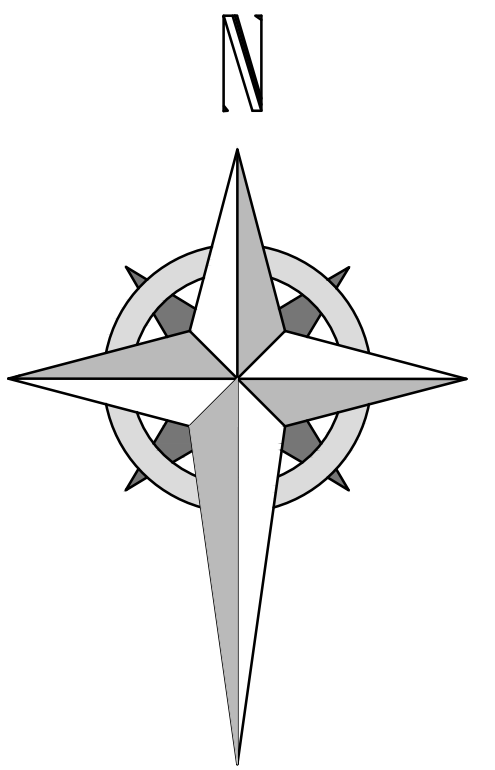
This report has been prepared on behalf of Castlemead Group Limited and relates to the proposed redevelopment of the former Jacques Yard, Jacques Way, Wrexham.

The report demonstrates that surface water from the proposed development can be managed in accordance with planning policy and relevant technical guidance subject to the implementation of a surface water drainage scheme that accords with the design principles set out in this report.

The proposed surface water drainage scheme ensures that there will be a controlled discharge of surface water runoff from the proposed development and provides the opportunity for the inclusion of SuDS elements. The design of the drainage system would be refined at the detailed design stage.

APPENDIX A:

Development Proposals



BLOCK PLAN
SCALE - 1:200



Ferndale Villa, 25 Manley Road,
Wrexham, LL13 8HD
Tel (01978) 353445
www.hdsarchitectural.co.uk

Project; Residential Development to Land adjoining 'Premier Inn', Jacques Way, Wrexham.	
Title; Site Plan As Proposed	Scale (A1); 1:200
Dwg No; JWA/PD/00	Date; February 2018
Revision; Rev A: Amend risk as requested by client - 28-03-17 Rev B: Add cotchrothwell etc - 04-04-18 Rev C: Amend layout to apartments - 01-10-18 Rev D: Amend layout to apartments - 05-10-18 Rev E: Add bin store and drying line - 06-10-18 Rev F: Remove security fence - 18-10-18 Rev G: Amend layout to suit latest scheme - 09-02-19 Rev H: Add further info as requested by Wrexham - 13-02-19 Rev I: Amend layout to suit latest scheme - 09-04-19	

APPENDIX B:

Site Investigation

Report provided separately.

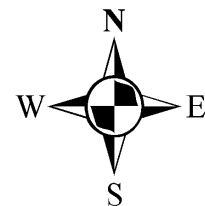
APPENDIX C:

Topographic Survey

APPENDIX D:

Public Sewer Records

Wrexham



LEGEND(Representative of most common features)

Waste network:			
Foul chamber	Surface water chamber	Outfall	Lamphole
Combined chamber	Combined sewer overflow	Storm Overflow	Rising main
Special purpose chamber	Treatment works	Gravity sewer	Private sewer
Pumping station	Private sewer subject to Sect. 104 adoption agreement	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.

Dŵr Cymru Cyfyngedig ('the Company') gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus. The onus of locating apparatus before carrying out any excavations rests entirely on you. The information which is supplied by the Company, is done so in accordance with statutory requirements of sections 198 and 199 of the Water Industry Act 1991 which is based upon the best information available and, in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a water main, service pipe, sewer, lateral drain or disposal main and any associated apparatus laid before 1 September 1989, or, if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the Company's right to be compensated for any damage to its apparatus.

Service pipes are not generally shown but their presence should be anticipated.

**EXACT LOCATIONS OF ALL APPARATUS
TO BE DETERMINED ON SITE.**

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Map Ref: 332885,350708
Map scale: 1:1250
Printed by: Powell Kelly-Ann
Printed on: 16 Apr 2019

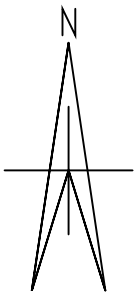
APPENDIX E:

Greenfield Runoff Calculations

Weetwood		Page 1
Joseph's Well Hanover Walk Leeds, LS3 1AB		
Date 29/04/2019 13:42 File	Designed by TimBrook Checked by	
XP Solutions Source Control 2018.1.1		
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 1 Soil 0.300 Area (ha) 0.545 Urban 0.000 SAAR (mm) 867 Region Number Region 9 Results 1/s QBAR Rural 1.3 QBAR Urban 1.3 Q1 year 1.1 Q1 year 1.1 Q30 years 2.2 Q100 years 2.8		
©1982-2018 Innovyze		

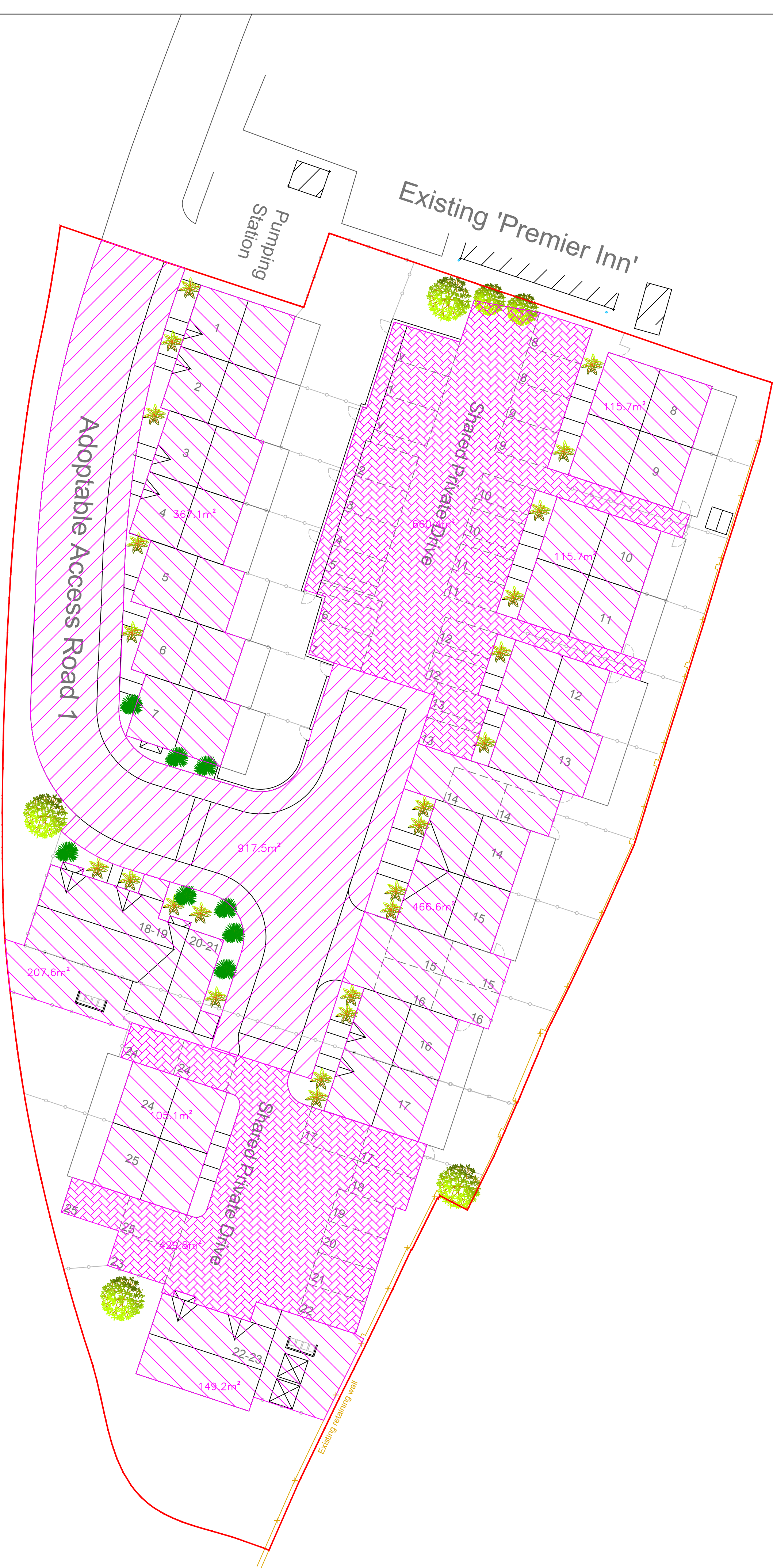
APPENDIX F:

Proposed Impermeable Area Layout



NOTES

1. This drawing to be read in conjunction with all relevant Weetwood drawings.



ADOPTABLE HIGHWAY = 917.5m²
SHARED PRIVATE DRIVE = 660.4+429.8 = 1090.2m²
ROOF & PRIVATE DRIVE = 367.1+115.7+115.7+466.6+149.2+105.1+207.6 = 1527.0m²
TOTAL PROPOSED IMPERMEABLE AREA = 3,534.7m² / 0.354ha

TOTAL SITE AREA (RED LINE BOUNDARY ONLY) = 5,448.9m² / 0.545ha

TOTAL EXISTING GREENFIELD RUNOFF AREA = 5,448.9m² / 0.545ha

EXISTING Q1 YEAR RATE = 1.1l/s
EXISTING QBAR YEAR RATE = 1.3l/s
EXISTING Q30 YEAR RATE = 2.2l/s
EXISTING Q100 YEAR RATE = 2.8l/s

TOTAL PROPOSED IMPERMEABLE AREA = 0.354ha

A PROPOSED QBAR GREENFIELD RATE OF 1.3l/s WOULD REQUIRE A SIGNIFICANTLY SMALL CONTROL UNIT WHICH WOULD BE PRONE TO BLOCKAGES. IT IS RECOMMENDED THAT A MINIMUM 75mm OPENING IS USED WHICH WOULD RESULT IN A 3.9l/s FLOW RATE

PROPOSED FLOW RATE = 3.9l/s

KEY

- DEVELOPMENT SITE BOUNDARY
- PROPOSED ADOPTABLE ROAD AREA (BITUMEN)
(917.5m² / 0.092ha)
- PROPOSED SHARED PRIVATE DRIVE AREA (BLOCK PAVED)
(1,090.2m² / 0.109ha)
- PROPOSED ROOF AND PRIVATE DRIVE AREA
(1,527.0m² / 0.153ha)

P1 01.05.19 Issued for Information TB GW

Rev	Date	Description	Drawn	Check
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Client
CASTLEMEAD GROUP LTD

Drawing Status	Date
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PRELIMINARY	MAY 2019
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Project	Scale (A1)
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JACQUES WAY WREXHAM	1:250
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Drawn	Checked
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TB	GW
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Project No

3972

Drawing No

PROPOSED IMPERMEABLE AREA LAYOUT

Revision

P1

APPENDIX G:

MicroDrainage Surface Water Calculations

Weetwood			Page 1																																																																																																																																																																																																																																																																																				
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XP Solutions			Source Control 2018.1.1																																																																																																																																																																																																																																																																																				
Summary of Results for 1 year Return Period Half Drain Time : 44 minutes. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Control (l/s)</th><th>Max Σ Outflow (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>85.011</td><td>0.011</td><td>0.0</td><td>3.8</td><td>3.8</td><td>5.7</td><td>O K</td></tr><tr><td>30 min Summer</td><td>85.019</td><td>0.019</td><td>0.0</td><td>3.8</td><td>3.8</td><td>9.9</td><td>O K</td></tr><tr><td>60 min Summer</td><td>85.027</td><td>0.027</td><td>0.0</td><td>3.8</td><td>3.8</td><td>13.7</td><td>O K</td></tr><tr><td>120 min Summer</td><td>85.032</td><td>0.032</td><td>0.0</td><td>3.8</td><td>3.8</td><td>16.5</td><td>O K</td></tr><tr><td>180 min Summer</td><td>85.034</td><td>0.034</td><td>0.0</td><td>3.8</td><td>3.8</td><td>17.3</td><td>O K</td></tr><tr><td>240 min Summer</td><td>85.033</td><td>0.033</td><td>0.0</td><td>3.8</td><td>3.8</td><td>17.0</td><td>O K</td></tr><tr><td>360 min Summer</td><td>85.029</td><td>0.029</td><td>0.0</td><td>3.8</td><td>3.8</td><td>15.0</td><td>O K</td></tr><tr><td>480 min Summer</td><td>85.025</td><td>0.025</td><td>0.0</td><td>3.8</td><td>3.8</td><td>12.6</td><td>O K</td></tr><tr><td>600 min Summer</td><td>85.020</td><td>0.020</td><td>0.0</td><td>3.8</td><td>3.8</td><td>10.4</td><td>O K</td></tr><tr><td>720 min Summer</td><td>85.016</td><td>0.016</td><td>0.0</td><td>3.8</td><td>3.8</td><td>8.3</td><td>O K</td></tr><tr><td>960 min Summer</td><td>85.010</td><td>0.010</td><td>0.0</td><td>3.8</td><td>3.8</td><td>4.9</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>85.002</td><td>0.002</td><td>0.0</td><td>3.8</td><td>3.8</td><td>0.8</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>85.000</td><td>0.000</td><td>0.0</td><td>3.2</td><td>3.2</td><td>0.0</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>85.000</td><td>0.000</td><td>0.0</td><td>2.6</td><td>2.6</td><td>0.0</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>85.000</td><td>0.000</td><td>0.0</td><td>2.0</td><td>2.0</td><td>0.0</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>85.000</td><td>0.000</td><td>0.0</td><td>1.7</td><td>1.7</td><td>0.0</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>85.000</td><td>0.000</td><td>0.0</td><td>1.4</td><td>1.4</td><td>0.0</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>85.000</td><td>0.000</td><td>0.0</td><td>1.2</td><td>1.2</td><td>0.0</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>85.000</td><td>0.000</td><td>0.0</td><td>1.1</td><td>1.1</td><td>0.0</td><td>O K</td></tr><tr><td>15 min Winter</td><td>85.015</td><td>0.015</td><td>0.0</td><td>3.8</td><td>3.8</td><td>7.5</td><td>O K</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>25.643</td><td>0.0</td><td>8.3</td><td>25</td></tr><tr><td>30 min Summer</td><td>17.288</td><td>0.0</td><td>14.2</td><td>35</td></tr><tr><td>60 min Summer</td><td>11.376</td><td>0.0</td><td>21.2</td><td>56</td></tr><tr><td>120 min Summer</td><td>7.387</td><td>0.0</td><td>29.8</td><td>92</td></tr><tr><td>180 min Summer</td><td>5.720</td><td>0.0</td><td>36.1</td><td>126</td></tr><tr><td>240 min Summer</td><td>4.768</td><td>0.0</td><td>40.8</td><td>160</td></tr><tr><td>360 min Summer</td><td>3.667</td><td>0.0</td><td>48.6</td><td>228</td></tr><tr><td>480 min Summer</td><td>3.032</td><td>0.0</td><td>53.8</td><td>292</td></tr><tr><td>600 min Summer</td><td>2.617</td><td>0.0</td><td>58.5</td><td>356</td></tr><tr><td>720 min Summer</td><td>2.321</td><td>0.0</td><td>62.7</td><td>416</td></tr><tr><td>960 min Summer</td><td>1.921</td><td>0.0</td><td>69.3</td><td>532</td></tr><tr><td>1440 min Summer</td><td>1.473</td><td>0.0</td><td>80.3</td><td>752</td></tr><tr><td>2160 min Summer</td><td>1.128</td><td>0.0</td><td>91.6</td><td>0</td></tr><tr><td>2880 min Summer</td><td>0.933</td><td>0.0</td><td>100.2</td><td>0</td></tr><tr><td>4320 min Summer</td><td>0.716</td><td>0.0</td><td>113.0</td><td>0</td></tr><tr><td>5760 min Summer</td><td>0.594</td><td>0.0</td><td>122.4</td><td>0</td></tr><tr><td>7200 min Summer</td><td>0.511</td><td>0.0</td><td>128.8</td><td>0</td></tr><tr><td>8640 min Summer</td><td>0.452</td><td>0.0</td><td>133.8</td><td>0</td></tr><tr><td>10080 min Summer</td><td>0.408</td><td>0.0</td><td>137.7</td><td>0</td></tr><tr><td>15 min Winter</td><td>25.643</td><td>0.0</td><td>10.4</td><td>25</td></tr></table>							Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status	15 min Summer	85.011	0.011	0.0	3.8	3.8	5.7	O K	30 min Summer	85.019	0.019	0.0	3.8	3.8	9.9	O K	60 min Summer	85.027	0.027	0.0	3.8	3.8	13.7	O K	120 min Summer	85.032	0.032	0.0	3.8	3.8	16.5	O K	180 min Summer	85.034	0.034	0.0	3.8	3.8	17.3	O K	240 min Summer	85.033	0.033	0.0	3.8	3.8	17.0	O K	360 min Summer	85.029	0.029	0.0	3.8	3.8	15.0	O K	480 min Summer	85.025	0.025	0.0	3.8	3.8	12.6	O K	600 min Summer	85.020	0.020	0.0	3.8	3.8	10.4	O K	720 min Summer	85.016	0.016	0.0	3.8	3.8	8.3	O K	960 min Summer	85.010	0.010	0.0	3.8	3.8	4.9	O K	1440 min Summer	85.002	0.002	0.0	3.8	3.8	0.8	O K	2160 min Summer	85.000	0.000	0.0	3.2	3.2	0.0	O K	2880 min Summer	85.000	0.000	0.0	2.6	2.6	0.0	O K	4320 min Summer	85.000	0.000	0.0	2.0	2.0	0.0	O K	5760 min Summer	85.000	0.000	0.0	1.7	1.7	0.0	O K	7200 min Summer	85.000	0.000	0.0	1.4	1.4	0.0	O K	8640 min Summer	85.000	0.000	0.0	1.2	1.2	0.0	O K	10080 min Summer	85.000	0.000	0.0	1.1	1.1	0.0	O K	15 min Winter	85.015	0.015	0.0	3.8	3.8	7.5	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	25.643	0.0	8.3	25	30 min Summer	17.288	0.0	14.2	35	60 min Summer	11.376	0.0	21.2	56	120 min Summer	7.387	0.0	29.8	92	180 min Summer	5.720	0.0	36.1	126	240 min Summer	4.768	0.0	40.8	160	360 min Summer	3.667	0.0	48.6	228	480 min Summer	3.032	0.0	53.8	292	600 min Summer	2.617	0.0	58.5	356	720 min Summer	2.321	0.0	62.7	416	960 min Summer	1.921	0.0	69.3	532	1440 min Summer	1.473	0.0	80.3	752	2160 min Summer	1.128	0.0	91.6	0	2880 min Summer	0.933	0.0	100.2	0	4320 min Summer	0.716	0.0	113.0	0	5760 min Summer	0.594	0.0	122.4	0	7200 min Summer	0.511	0.0	128.8	0	8640 min Summer	0.452	0.0	133.8	0	10080 min Summer	0.408	0.0	137.7	0	15 min Winter	25.643	0.0	10.4	25
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																																																																																
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1440 min Summer	85.002	0.002	0.0	3.8	3.8	0.8	O K																																																																																																																																																																																																																																																																																
2160 min Summer	85.000	0.000	0.0	3.2	3.2	0.0	O K																																																																																																																																																																																																																																																																																
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Joseph's Well
Hanover Walk
Leeds, LS3 1AB

3972 Jacques Way
Wrexham
SW Calcs - Permeable Paving

Date 02/05/2019 08:32
File 2019-05-02 3972 R2 SW C...

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Summary of Results for 1 year Return Period							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	85.024	0.024	0.0	3.8	3.8	12.3	O K
60 min Winter	85.033	0.033	0.0	3.8	3.8	16.7	O K
120 min Winter	85.038	0.038	0.0	3.8	3.8	19.5	O K
180 min Winter	85.038	0.038	0.0	3.8	3.8	19.6	O K
240 min Winter	85.037	0.037	0.0	3.8	3.8	18.6	O K
360 min Winter	85.029	0.029	0.0	3.8	3.8	15.0	O K
480 min Winter	85.022	0.022	0.0	3.8	3.8	11.1	O K
600 min Winter	85.015	0.015	0.0	3.8	3.8	7.5	O K
720 min Winter	85.009	0.009	0.0	3.8	3.8	4.5	O K
960 min Winter	85.001	0.001	0.0	3.8	3.8	0.5	O K
1440 min Winter	85.000	0.000	0.0	3.0	3.0	0.0	O K
2160 min Winter	85.000	0.000	0.0	2.3	2.3	0.0	O K
2880 min Winter	85.000	0.000	0.0	1.9	1.9	0.0	O K
4320 min Winter	85.000	0.000	0.0	1.4	1.4	0.0	O K
5760 min Winter	85.000	0.000	0.0	1.2	1.2	0.0	O K
7200 min Winter	85.000	0.000	0.0	1.0	1.0	0.0	O K
8640 min Winter	85.000	0.000	0.0	0.9	0.9	0.0	O K
10080 min Winter	85.000	0.000	0.0	0.8	0.8	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	17.288	0.0	16.9	36
60 min Winter	11.376	0.0	24.9	60
120 min Winter	7.387	0.0	34.9	98
180 min Winter	5.720	0.0	41.4	136
240 min Winter	4.768	0.0	47.1	174
360 min Winter	3.667	0.0	55.4	244
480 min Winter	3.032	0.0	61.6	310
600 min Winter	2.617	0.0	66.8	370
720 min Winter	2.321	0.0	71.5	428
960 min Winter	1.921	0.0	79.5	518
1440 min Winter	1.473	0.0	91.6	0
2160 min Winter	1.128	0.0	104.6	0
2880 min Winter	0.933	0.0	114.6	0
4320 min Winter	0.716	0.0	129.7	0
5760 min Winter	0.594	0.0	140.9	0
7200 min Winter	0.511	0.0	148.8	0
8640 min Winter	0.452	0.0	155.2	0
10080 min Winter	0.408	0.0	160.4	0

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Joseph's Well Hanover Walk Leeds, LS3 1AB	3972 Jacques Way Wrexham SW Calcs - Permeable Paving	
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Model Details

Storage is Online Cover Level (m) 85.600

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	42.5
Membrane Percolation (mm/hr)	1000	Length (m)	40.0
Max Percolation (l/s)	472.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	85.000	Cap Volume Depth (m)	0.325

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0075-3900-2700-3900
Design Head (m)	2.700
Design Flow (l/s)	3.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	82.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.700	3.9
Flush-Flo™	0.323	2.6
Kick-Flo®	0.669	2.1
Mean Flow over Head Range	-	2.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.5	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.6	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.5	1.800	3.2	4.500	4.9	8.500	6.7
0.500	2.5	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.3	2.200	3.5	5.500	5.4	9.500	7.0
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.8	6.500	5.9		

Weetwood		Page 3
Joseph's Well Hanover Walk Leeds, LS3 1AB	3972 Jacques Way Wrexham SW Calcs - Permeable Paving	
Date 02/05/2019 08:32 File 2019-05-02 3972 R2 SW C...	Designed by TB Checked by	
XP Solutions	Source Control 2018.1.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.314	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.354

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)
0 4 0.100	4 8 0.100	8 12 0.100	12 16 0.054				

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Joseph's Well

Hanover Walk

Leeds, LS3 1AB

3972 Jacques Way

Wrexham

SW Calcs - Permeable Paving

Date 02/05/2019 08:32

File 2019-05-02 3972 R2 SW C...

Designed by TB

Checked by

XP Solutions

Source Control 2018.1.1

Micro Drainage

Summary of Results for 30 year Return Period

Half Drain Time : 176 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	85.056	0.056	0.0	3.8	3.8	28.7	O K
30 min Summer	85.081	0.081	0.0	3.8	3.8	41.5	O K
60 min Summer	85.106	0.106	0.0	3.8	3.8	53.8	O K
120 min Summer	85.123	0.123	0.0	3.8	3.8	62.6	O K
180 min Summer	85.126	0.126	0.0	3.8	3.8	64.5	O K
240 min Summer	85.126	0.126	0.0	3.8	3.8	64.1	O K
360 min Summer	85.122	0.122	0.0	3.8	3.8	62.0	O K
480 min Summer	85.117	0.117	0.0	3.8	3.8	59.5	O K
600 min Summer	85.111	0.111	0.0	3.8	3.8	56.7	O K
720 min Summer	85.105	0.105	0.0	3.8	3.8	53.7	O K
960 min Summer	85.093	0.093	0.0	3.8	3.8	47.5	O K
1440 min Summer	85.069	0.069	0.0	3.8	3.8	35.4	O K
2160 min Summer	85.040	0.040	0.0	3.8	3.8	20.2	O K
2880 min Summer	85.019	0.019	0.0	3.8	3.8	9.4	O K
4320 min Summer	85.000	0.000	0.0	3.7	3.7	0.0	O K
5760 min Summer	85.000	0.000	0.0	3.0	3.0	0.0	O K
7200 min Summer	85.000	0.000	0.0	2.5	2.5	0.0	O K
8640 min Summer	85.000	0.000	0.0	2.2	2.2	0.0	O K
10080 min Summer	85.000	0.000	0.0	2.0	2.0	0.0	O K
15 min Winter	85.066	0.066	0.0	3.8	3.8	33.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	62.660	0.0	32.8	26
30 min Summer	42.477	0.0	47.4	39
60 min Summer	27.653	0.0	64.6	66
120 min Summer	17.496	0.0	83.4	122
180 min Summer	13.233	0.0	96.2	162
240 min Summer	10.796	0.0	104.8	194
360 min Summer	8.072	0.0	118.5	260
480 min Summer	6.565	0.0	129.1	330
600 min Summer	5.589	0.0	137.4	398
720 min Summer	4.898	0.0	144.7	466
960 min Summer	3.974	0.0	156.7	600
1440 min Summer	2.955	0.0	174.5	858
2160 min Summer	2.194	0.0	193.3	1216
2880 min Summer	1.774	0.0	207.2	1560
4320 min Summer	1.313	0.0	227.2	0
5760 min Summer	1.060	0.0	241.3	0
7200 min Summer	0.899	0.0	252.3	0
8640 min Summer	0.785	0.0	261.1	0
10080 min Summer	0.700	0.0	268.2	0
15 min Winter	62.660	0.0	37.6	27

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Weetwood						Page 2	
Joseph's Well Hanover Walk Leeds, LS3 1AB			3972 Jacques Way Wrexham SW Calcs - Permeable Paving				
Date 02/05/2019 08:32 File 2019-05-02 3972 R2 SW C...			Designed by TB Checked by				
XP Solutions			Source Control 2018.1.1				
<u>Summary of Results for 30 year Return Period</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	85.094	0.094	0.0	3.8	3.8	47.9	O K
60 min Winter	85.122	0.122	0.0	3.8	3.8	62.3	O K
120 min Winter	85.144	0.144	0.0	3.9	3.9	73.5	O K
180 min Winter	85.150	0.150	0.0	3.9	3.9	76.4	O K
240 min Winter	85.149	0.149	0.0	3.9	3.9	75.9	O K
360 min Winter	85.143	0.143	0.0	3.9	3.9	72.9	O K
480 min Winter	85.135	0.135	0.0	3.8	3.8	68.9	O K
600 min Winter	85.126	0.126	0.0	3.8	3.8	64.2	O K
720 min Winter	85.116	0.116	0.0	3.8	3.8	59.2	O K
960 min Winter	85.096	0.096	0.0	3.8	3.8	49.0	O K
1440 min Winter	85.059	0.059	0.0	3.8	3.8	30.0	O K
2160 min Winter	85.017	0.017	0.0	3.8	3.8	8.5	O K
2880 min Winter	85.000	0.000	0.0	3.6	3.6	0.0	O K
4320 min Winter	85.000	0.000	0.0	2.7	2.7	0.0	O K
5760 min Winter	85.000	0.000	0.0	2.2	2.2	0.0	O K
7200 min Winter	85.000	0.000	0.0	1.8	1.8	0.0	O K
8640 min Winter	85.000	0.000	0.0	1.6	1.6	0.0	O K
10080 min Winter	85.000	0.000	0.0	1.4	1.4	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	42.477	0.0	54.1	40			
60 min Winter	27.653	0.0	73.4	66			
120 min Winter	17.496	0.0	94.7	122			
180 min Winter	13.233	0.0	108.5	176			
240 min Winter	10.796	0.0	118.8	222			
360 min Winter	8.072	0.0	133.8	282			
480 min Winter	6.565	0.0	145.7	358			
600 min Winter	5.589	0.0	155.5	434			
720 min Winter	4.898	0.0	163.3	506			
960 min Winter	3.974	0.0	176.7	648			
1440 min Winter	2.955	0.0	196.9	908			
2160 min Winter	2.194	0.0	218.6	1240			
2880 min Winter	1.774	0.0	234.6	0			
4320 min Winter	1.313	0.0	257.5	0			
5760 min Winter	1.060	0.0	273.9	0			
7200 min Winter	0.899	0.0	287.0	0			
8640 min Winter	0.785	0.0	297.5	0			
10080 min Winter	0.700	0.0	306.2	0			
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Joseph's Well Hanover Walk Leeds, LS3 1AB	3972 Jacques Way Wrexham SW Calcs - Permeable Paving	
Date 02/05/2019 08:32 File 2019-05-02 3972 R2 SW C...	Designed by TB Checked by	
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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.314	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.354

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)	From: To: (ha)
0 4 0.100	4 8 0.100	8 12 0.100	12 16 0.054				

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Joseph's Well Hanover Walk Leeds, LS3 1AB	3972 Jacques Way Wrexham SW Calcs - Permeable Paving	
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XP Solutions	Source Control 2018.1.1	

Model Details

Storage is Online Cover Level (m) 85.600

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	42.5
Membrane Percolation (mm/hr)	1000	Length (m)	40.0
Max Percolation (l/s)	472.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	85.000	Cap Volume Depth (m)	0.325

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0075-3900-2700-3900
Design Head (m)	2.700
Design Flow (l/s)	3.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	82.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.700	3.9
Flush-Flo™	0.323	2.6
Kick-Flo®	0.669	2.1
Mean Flow over Head Range	-	2.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.5	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.6	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.5	1.800	3.2	4.500	4.9	8.500	6.7
0.500	2.5	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.3	2.200	3.5	5.500	5.4	9.500	7.0
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.8	6.500	5.9		

Weetwood		Page 1																																																																																																																																																																																																																																																																																		
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Summary of Results for 100 year Return Period Half Drain Time : 252 minutes. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Control (l/s)</th><th>Max Outflow (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>85.079</td><td>0.079</td><td>0.0</td><td>3.8</td><td>3.8</td><td>40.4</td><td>O K</td></tr><tr><td>30 min Summer</td><td>85.114</td><td>0.114</td><td>0.0</td><td>3.8</td><td>3.8</td><td>58.1</td><td>O K</td></tr><tr><td>60 min Summer</td><td>85.148</td><td>0.148</td><td>0.0</td><td>3.9</td><td>3.9</td><td>75.6</td><td>O K</td></tr><tr><td>120 min Summer</td><td>85.177</td><td>0.177</td><td>0.0</td><td>3.9</td><td>3.9</td><td>90.1</td><td>O K</td></tr><tr><td>180 min Summer</td><td>85.185</td><td>0.185</td><td>0.0</td><td>3.9</td><td>3.9</td><td>94.5</td><td>O K</td></tr><tr><td>240 min Summer</td><td>85.185</td><td>0.185</td><td>0.0</td><td>3.9</td><td>3.9</td><td>94.5</td><td>O K</td></tr><tr><td>360 min Summer</td><td>85.180</td><td>0.180</td><td>0.0</td><td>3.9</td><td>3.9</td><td>91.6</td><td>O K</td></tr><tr><td>480 min Summer</td><td>85.174</td><td>0.174</td><td>0.0</td><td>3.9</td><td>3.9</td><td>88.8</td><td>O K</td></tr><tr><td>600 min Summer</td><td>85.168</td><td>0.168</td><td>0.0</td><td>3.9</td><td>3.9</td><td>85.8</td><td>O K</td></tr><tr><td>720 min Summer</td><td>85.162</td><td>0.162</td><td>0.0</td><td>3.9</td><td>3.9</td><td>82.6</td><td>O K</td></tr><tr><td>960 min Summer</td><td>85.149</td><td>0.149</td><td>0.0</td><td>3.9</td><td>3.9</td><td>75.7</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>85.121</td><td>0.121</td><td>0.0</td><td>3.8</td><td>3.8</td><td>61.8</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>85.084</td><td>0.084</td><td>0.0</td><td>3.8</td><td>3.8</td><td>42.6</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>85.053</td><td>0.053</td><td>0.0</td><td>3.8</td><td>3.8</td><td>27.0</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>85.013</td><td>0.013</td><td>0.0</td><td>3.8</td><td>3.8</td><td>6.8</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>85.000</td><td>0.000</td><td>0.0</td><td>3.7</td><td>3.7</td><td>0.0</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>85.000</td><td>0.000</td><td>0.0</td><td>3.1</td><td>3.1</td><td>0.0</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>85.000</td><td>0.000</td><td>0.0</td><td>2.7</td><td>2.7</td><td>0.0</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>85.000</td><td>0.000</td><td>0.0</td><td>2.4</td><td>2.4</td><td>0.0</td><td>O K</td></tr><tr><td>15 min Winter</td><td>85.092</td><td>0.092</td><td>0.0</td><td>3.8</td><td>3.8</td><td>46.8</td><td>O K</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>80.762</td><td>0.0</td><td>44.7</td><td>27</td></tr><tr><td>30 min Summer</td><td>55.338</td><td>0.0</td><td>64.4</td><td>40</td></tr><tr><td>60 min Summer</td><td>36.294</td><td>0.0</td><td>87.3</td><td>68</td></tr><tr><td>120 min Summer</td><td>23.010</td><td>0.0</td><td>112.7</td><td>124</td></tr><tr><td>180 min Summer</td><td>17.358</td><td>0.0</td><td>128.8</td><td>182</td></tr><tr><td>240 min Summer</td><td>14.101</td><td>0.0</td><td>140.3</td><td>220</td></tr><tr><td>360 min Summer</td><td>10.464</td><td>0.0</td><td>156.8</td><td>282</td></tr><tr><td>480 min Summer</td><td>8.467</td><td>0.0</td><td>169.1</td><td>348</td></tr><tr><td>600 min Summer</td><td>7.178</td><td>0.0</td><td>179.9</td><td>416</td></tr><tr><td>720 min Summer</td><td>6.268</td><td>0.0</td><td>188.5</td><td>486</td></tr><tr><td>960 min Summer</td><td>5.055</td><td>0.0</td><td>202.5</td><td>622</td></tr><tr><td>1440 min Summer</td><td>3.725</td><td>0.0</td><td>223.6</td><td>888</td></tr><tr><td>2160 min Summer</td><td>2.738</td><td>0.0</td><td>245.2</td><td>1264</td></tr><tr><td>2880 min Summer</td><td>2.197</td><td>0.0</td><td>261.1</td><td>1620</td></tr><tr><td>4320 min Summer</td><td>1.608</td><td>0.0</td><td>283.1</td><td>2292</td></tr><tr><td>5760 min Summer</td><td>1.286</td><td>0.0</td><td>298.9</td><td>0</td></tr><tr><td>7200 min Summer</td><td>1.083</td><td>0.0</td><td>311.2</td><td>0</td></tr><tr><td>8640 min Summer</td><td>0.942</td><td>0.0</td><td>321.0</td><td>0</td></tr><tr><td>10080 min Summer</td><td>0.837</td><td>0.0</td><td>329.0</td><td>0</td></tr><tr><td>15 min Winter</td><td>80.762</td><td>0.0</td><td>51.1</td><td>27</td></tr></table>				Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status	15 min Summer	85.079	0.079	0.0	3.8	3.8	40.4	O K	30 min Summer	85.114	0.114	0.0	3.8	3.8	58.1	O K	60 min Summer	85.148	0.148	0.0	3.9	3.9	75.6	O K	120 min Summer	85.177	0.177	0.0	3.9	3.9	90.1	O K	180 min Summer	85.185	0.185	0.0	3.9	3.9	94.5	O K	240 min Summer	85.185	0.185	0.0	3.9	3.9	94.5	O K	360 min Summer	85.180	0.180	0.0	3.9	3.9	91.6	O K	480 min Summer	85.174	0.174	0.0	3.9	3.9	88.8	O K	600 min Summer	85.168	0.168	0.0	3.9	3.9	85.8	O K	720 min Summer	85.162	0.162	0.0	3.9	3.9	82.6	O K	960 min Summer	85.149	0.149	0.0	3.9	3.9	75.7	O K	1440 min Summer	85.121	0.121	0.0	3.8	3.8	61.8	O K	2160 min Summer	85.084	0.084	0.0	3.8	3.8	42.6	O K	2880 min Summer	85.053	0.053	0.0	3.8	3.8	27.0	O K	4320 min Summer	85.013	0.013	0.0	3.8	3.8	6.8	O K	5760 min Summer	85.000	0.000	0.0	3.7	3.7	0.0	O K	7200 min Summer	85.000	0.000	0.0	3.1	3.1	0.0	O K	8640 min Summer	85.000	0.000	0.0	2.7	2.7	0.0	O K	10080 min Summer	85.000	0.000	0.0	2.4	2.4	0.0	O K	15 min Winter	85.092	0.092	0.0	3.8	3.8	46.8	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	80.762	0.0	44.7	27	30 min Summer	55.338	0.0	64.4	40	60 min Summer	36.294	0.0	87.3	68	120 min Summer	23.010	0.0	112.7	124	180 min Summer	17.358	0.0	128.8	182	240 min Summer	14.101	0.0	140.3	220	360 min Summer	10.464	0.0	156.8	282	480 min Summer	8.467	0.0	169.1	348	600 min Summer	7.178	0.0	179.9	416	720 min Summer	6.268	0.0	188.5	486	960 min Summer	5.055	0.0	202.5	622	1440 min Summer	3.725	0.0	223.6	888	2160 min Summer	2.738	0.0	245.2	1264	2880 min Summer	2.197	0.0	261.1	1620	4320 min Summer	1.608	0.0	283.1	2292	5760 min Summer	1.286	0.0	298.9	0	7200 min Summer	1.083	0.0	311.2	0	8640 min Summer	0.942	0.0	321.0	0	10080 min Summer	0.837	0.0	329.0	0	15 min Winter	80.762	0.0	51.1	27
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																																																																													
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240 min Summer	85.185	0.185	0.0	3.9	3.9	94.5	O K																																																																																																																																																																																																																																																																													
360 min Summer	85.180	0.180	0.0	3.9	3.9	91.6	O K																																																																																																																																																																																																																																																																													
480 min Summer	85.174	0.174	0.0	3.9	3.9	88.8	O K																																																																																																																																																																																																																																																																													
600 min Summer	85.168	0.168	0.0	3.9	3.9	85.8	O K																																																																																																																																																																																																																																																																													
720 min Summer	85.162	0.162	0.0	3.9	3.9	82.6	O K																																																																																																																																																																																																																																																																													
960 min Summer	85.149	0.149	0.0	3.9	3.9	75.7	O K																																																																																																																																																																																																																																																																													
1440 min Summer	85.121	0.121	0.0	3.8	3.8	61.8	O K																																																																																																																																																																																																																																																																													
2160 min Summer	85.084	0.084	0.0	3.8	3.8	42.6	O K																																																																																																																																																																																																																																																																													
2880 min Summer	85.053	0.053	0.0	3.8	3.8	27.0	O K																																																																																																																																																																																																																																																																													
4320 min Summer	85.013	0.013	0.0	3.8	3.8	6.8	O K																																																																																																																																																																																																																																																																													
5760 min Summer	85.000	0.000	0.0	3.7	3.7	0.0	O K																																																																																																																																																																																																																																																																													
7200 min Summer	85.000	0.000	0.0	3.1	3.1	0.0	O K																																																																																																																																																																																																																																																																													
8640 min Summer	85.000	0.000	0.0	2.7	2.7	0.0	O K																																																																																																																																																																																																																																																																													
10080 min Summer	85.000	0.000	0.0	2.4	2.4	0.0	O K																																																																																																																																																																																																																																																																													
15 min Winter	85.092	0.092	0.0	3.8	3.8	46.8	O K																																																																																																																																																																																																																																																																													
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)																																																																																																																																																																																																																																																																																
15 min Summer	80.762	0.0	44.7	27																																																																																																																																																																																																																																																																																
30 min Summer	55.338	0.0	64.4	40																																																																																																																																																																																																																																																																																
60 min Summer	36.294	0.0	87.3	68																																																																																																																																																																																																																																																																																
120 min Summer	23.010	0.0	112.7	124																																																																																																																																																																																																																																																																																
180 min Summer	17.358	0.0	128.8	182																																																																																																																																																																																																																																																																																
240 min Summer	14.101	0.0	140.3	220																																																																																																																																																																																																																																																																																
360 min Summer	10.464	0.0	156.8	282																																																																																																																																																																																																																																																																																
480 min Summer	8.467	0.0	169.1	348																																																																																																																																																																																																																																																																																
600 min Summer	7.178	0.0	179.9	416																																																																																																																																																																																																																																																																																
720 min Summer	6.268	0.0	188.5	486																																																																																																																																																																																																																																																																																
960 min Summer	5.055	0.0	202.5	622																																																																																																																																																																																																																																																																																
1440 min Summer	3.725	0.0	223.6	888																																																																																																																																																																																																																																																																																
2160 min Summer	2.738	0.0	245.2	1264																																																																																																																																																																																																																																																																																
2880 min Summer	2.197	0.0	261.1	1620																																																																																																																																																																																																																																																																																
4320 min Summer	1.608	0.0	283.1	2292																																																																																																																																																																																																																																																																																
5760 min Summer	1.286	0.0	298.9	0																																																																																																																																																																																																																																																																																
7200 min Summer	1.083	0.0	311.2	0																																																																																																																																																																																																																																																																																
8640 min Summer	0.942	0.0	321.0	0																																																																																																																																																																																																																																																																																
10080 min Summer	0.837	0.0	329.0	0																																																																																																																																																																																																																																																																																
15 min Winter	80.762	0.0	51.1	27																																																																																																																																																																																																																																																																																
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Weetwood		Page 3
Joseph's Well Hanover Walk Leeds, LS3 1AB	3972 Jacques Way Wrexham SW Calcs - Permeable Paving	
Date 02/05/2019 08:32 File 2019-05-02 3972 R2 SW C...	Designed by TB Checked by	
XP Solutions	Source Control 2018.1.1	

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)	18.000	Shortest Storm (mins)	15
Ratio R	0.314	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.354

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.100	4 8	0.100	8 12	0.100	12 16	0.054

Weetwood		Page 4
Joseph's Well Hanover Walk Leeds, LS3 1AB	3972 Jacques Way Wrexham SW Calcs - Permeable Paving	
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XP Solutions	Source Control 2018.1.1	

Model Details

Storage is Online Cover Level (m) 85.600

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	42.5
Membrane Percolation (mm/hr)	1000	Length (m)	40.0
Max Percolation (l/s)	472.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	85.000	Cap Volume Depth (m)	0.325

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0075-3900-2700-3900
Design Head (m)	2.700
Design Flow (l/s)	3.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	82.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.700	3.9
Flush-Flo™	0.323	2.6
Kick-Flo®	0.669	2.1
Mean Flow over Head Range	-	2.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.5	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.6	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.5	1.800	3.2	4.500	4.9	8.500	6.7
0.500	2.5	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.3	2.200	3.5	5.500	5.4	9.500	7.0
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.8	6.500	5.9		

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Joseph's Well

Hanover Walk

Leeds, LS3 1AB

3972 Jacques Way

Wrexham

SW Calcs - Permeable Paving

Date 02/05/2019 08:31

File 2019-05-02 3972 R2 SW C...

Designed by TB

Checked by

XP Solutions

Source Control 2018.1.1

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

Half Drain Time : 348 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	85.111	0.111	0.0	3.8	3.8	56.4	O K
30 min Summer	85.156	0.156	0.0	3.9	3.9	79.8	O K
60 min Summer	85.204	0.204	0.0	3.9	3.9	103.8	O K
120 min Summer	85.246	0.246	0.0	3.9	3.9	125.5	O K
180 min Summer	85.263	0.263	0.0	3.9	3.9	133.9	O K
240 min Summer	85.268	0.268	0.0	3.9	3.9	136.5	O K
360 min Summer	85.264	0.264	0.0	3.9	3.9	134.4	O K
480 min Summer	85.257	0.257	0.0	3.9	3.9	131.3	O K
600 min Summer	85.251	0.251	0.0	3.9	3.9	128.3	O K
720 min Summer	85.245	0.245	0.0	3.9	3.9	125.2	O K
960 min Summer	85.233	0.233	0.0	3.9	3.9	118.6	O K
1440 min Summer	85.205	0.205	0.0	3.9	3.9	104.5	O K
2160 min Summer	85.163	0.163	0.0	3.9	3.9	83.3	O K
2880 min Summer	85.125	0.125	0.0	3.8	3.8	63.9	O K
4320 min Summer	85.064	0.064	0.0	3.8	3.8	32.7	O K
5760 min Summer	85.025	0.025	0.0	3.8	3.8	12.5	O K
7200 min Summer	85.004	0.004	0.0	3.8	3.8	2.2	O K
8640 min Summer	85.000	0.000	0.0	3.5	3.5	0.0	O K
10080 min Summer	85.000	0.000	0.0	3.1	3.1	0.0	O K
15 min Winter	85.126	0.126	0.0	3.8	3.8	64.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	104.991	0.0	60.8	28
30 min Summer	71.939	0.0	86.6	41
60 min Summer	47.182	0.0	116.1	70
120 min Summer	29.913	0.0	149.8	126
180 min Summer	22.565	0.0	170.3	184
240 min Summer	18.331	0.0	185.2	242
360 min Summer	13.603	0.0	206.5	316
480 min Summer	11.007	0.0	223.4	380
600 min Summer	9.331	0.0	236.8	444
720 min Summer	8.148	0.0	248.2	510
960 min Summer	6.571	0.0	267.1	648
1440 min Summer	4.842	0.0	294.8	922
2160 min Summer	3.559	0.0	324.0	1320
2880 min Summer	2.856	0.0	345.0	1700
4320 min Summer	2.090	0.0	375.4	2392
5760 min Summer	1.672	0.0	397.1	3064
7200 min Summer	1.409	0.0	414.5	3680
8640 min Summer	1.224	0.0	429.0	0
10080 min Summer	1.088	0.0	440.9	0
15 min Winter	104.991	0.0	69.3	28

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Weetwood		Page 3
Joseph's Well Hanover Walk Leeds, LS3 1AB	3972 Jacques Way Wrexham SW Calcs - Permeable Paving	
Date 02/05/2019 08:31 File 2019-05-02 3972 R2 SW C...	Designed by TB Checked by	
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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)	18.000	Shortest Storm (mins)	15
Ratio R	0.314	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.354

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.100	4 8	0.100	8 12	0.100	12 16	0.054

Weetwood		Page 4
Joseph's Well Hanover Walk Leeds, LS3 1AB	3972 Jacques Way Wrexham SW Calcs - Permeable Paving	
Date 02/05/2019 08:31 File 2019-05-02 3972 R2 SW C...	Designed by TB Checked by	
XP Solutions Source Control 2018.1.1		

Model Details

Storage is Online Cover Level (m) 85.600

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	42.5
Membrane Percolation (mm/hr)	1000	Length (m)	40.0
Max Percolation (l/s)	472.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	85.000	Cap Volume Depth (m)	0.325

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0075-3900-2700-3900
Design Head (m)	2.700
Design Flow (l/s)	3.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	82.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.700	3.9
Flush-Flo™	0.323	2.6
Kick-Flo®	0.669	2.1
Mean Flow over Head Range	-	2.9

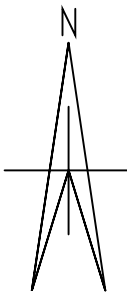
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.5	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.6	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.5	1.800	3.2	4.500	4.9	8.500	6.7
0.500	2.5	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.3	2.200	3.5	5.500	5.4	9.500	7.0
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.8	6.500	5.9		

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APPENDIX H:

Indicative Surface Water Drainage Layout



KEY

- EXISTING PRIVATE SURFACE WATER SEWER
- EXISTING WATERCOURSE
- EXISTING PUBLIC FOUL WATER RISING MAIN
- PROPOSED ABANDONED SEWER
- PROPOSED SURFACE WATER SEWER
- EXISTING FOUL WATER MANHOLE
- EXISTING SURFACE WATER MANHOLE
- PROPOSED SURFACE WATER PPIC/MANHOLE
- DEVELOPMENT SITE BOUNDARY

EXISTING 1500 TAKING
ATTENUATED SURFACE WATER
FLOWS FROM THE PREMIER
INN DEVELOPMENT

Ex.MH04
CL=85.22
IL=83.11

Pumping
Station

Existing 'Premier Inn'

SUB-BASE SUDS FEATURE
1,700m² x 0.325m (30%
VOIDS) = 165.75m³

2250 INLET FROM
PERMEABLE
PAVING SUB-BASE

Ex.MH03
CL=85.02
IL=82.39
(INCL.1500 STUB)

Ex.MH02
CL=85.74
IL=82.17
(INCL.1500 STUB)

SHARED PRIVATE DRIVES TO FORM SUDS FEATURE, CONSISTING
OF PERMEABLE BLOCK PAVING, BITUMEN ACCESS ROADS TO
DRAIN TRADITIONALLY USING GULLIES, ETC.
SHARED PRIVATE DRIVE CONSTRUCTION TO CONSIST OF:

80mm PERMEABLE BLOCK PAVING, ON
50mm BEDDING LAYER, ON
325mm SUB-BASE LAYER (MINIMUM 30% VOIDS), ON
IMPERMEABLE MEMBRANE, ON
CAPPING LAYER IF REQUIRED

1,700m² SUB-BASE TO BE UTILISED AS ATTENUATION ACROSS
SHARED PRIVATE DRIVES AND ADAPTABLE ACCESS ROAD

Ex.MH01
CL=85.28
IL=81.85
(INCL.1500 STUB)

FLOW CONTROL MH
FLOW=3.9l/s

2250 INLET FROM
PERMEABLE
PAVING SUB-BASE

APPROXIMATE OUTFALL
LOCATION
IL=TBC
(FURTHER INVESTIGATION
REQUIRED)

RIVER GWENFRO

SURFACE WATER GROUND INFILTRATION
TECHNIQUES ARE NOT CONSIDERED FEASIBLE
DUE TO THE EXISTING GROUND CONDITIONS
DEPICTED IN THE RPS GROUNDWATER
CONTAMINATION ASSESSMENT (REF:
RCM4642-009 R, NOV 2007). RPS NOTE THAT
MADE GROUND IS PRESENT UP TO 3.0-3.9m IN
DEPTH AND SHALLOW GROUNDWATER IS
PRESENT.

SURFACE WATER WILL THEREFORE DISCHARGE
INTO THE EXISTING 1500 PIPE CROSSING THE
SITE WHICH CONNECTS TO THE RIVER
GWENFRO.

SHOULD FLOW BE RESTRICTED TO THE
GREENFIELD QBAR RUNOFF RATE OF 1.3l/s, A
HYDRO-BRAKE CONTROL UNIT WITH AN
OPENING OF 42mm WOULD BE REQUIRED. THIS
COULD BE PRONE TO BLOCKAGES.

IF ACCEPTABLE TO THE SUSTAINABLE DRAINAGE
APPROVING BODY (SAB), A PROPOSED FLOW
RATE OF 3.9l/s WOULD REQUIRE A HYDRO-BRAKE
CONTROL UNIT OPENING OF 75mm, RESULTING
IN REDUCED BLOCKAGE RISK

TRADITIONAL SURFACE WATER PIPED SYSTEM
TO CONVEY HIGHWAY DRAINAGE, ROOF WATER
AND PRIVATE DRIVES.

STORM WATER TO BE ATTENUATED WITHIN THE
SUB-BASE LAYER OF THE PAVEMENT
CONSTRUCTION, DESIGNED TO ACCOMMODATE
UP TO THE 1:100 ANNUAL PROBABILITY EVENT
+20%CC

*CC=CLIMATE CHANGE

AT THE DETAILED DESIGN STAGE, PROPOSED
SURFACE WATER PIPES AND SUB-BASE
EXTENTS TO BE SIZED TO ACCOMMODATE THE
ATTENUATED FLOW FROM THE PREMIER INN
DEVELOPMENT AND THE FLOW FROM THE NEW
RESIDENTIAL SCHEME

NOTES

1. This drawing to be read in conjunction with all relevant Weetwood drawings.

DRAINAGE NOTES

1. ALL DIMENSIONS IN mm UNLESS NOTED OTHERWISE.
2. ALL LEVELS IN METRES.
3. ALL PROPOSED DRAINAGE TO BE MINIMUM 1500 UNLESS NOTED OTHERWISE.
4. MINIMUM GRADIENTS:
4.1. 1500 FOUL WATER = 1:100
4.2. 1500 SURFACE WATER = 1:100
5. ALL CONNECTING PIPES TO ADAPTABLE DRAINAGE TO BE MINIMUM 1500.
6. ALL RAINWATER PIPES MUST BE FITTED WITH A RODDABLE ACCESS ABOVE GROUND.
7. ALL PRIVATE DRAINAGE TO BE INSTALLED IN ACCORDANCE WITH PART H OF THE BUILDING REGULATIONS AND BS EN 752 & 12056.
8. PRIVATE DRAINAGE TO BE 1500 UPVC PIPES WITH GRP OR UPVC INSPECTION CHAMBERS. SYSTEM DESIGN & CONSTRUCTION TO CONFORM WITH MANUFACTURER'S INSTRUCTIONS & "GOOD PRACTICE GUIDE".
9. PROPOSED SITE LAYOUT TAKEN FROM HDS ARCHITECTURAL SERVICES DRAWING 'SITE PLAN AS PROPOSED' (REF: JWA/PD/001, APR 2019).
10. EXISTING LEVEL INFORMATION TAKEN FROM 'TOPOGRAPHICAL SURVEY' DRAWING PREPARED BY INVAR MAPPING SURVEYS (REF: G1080/2, MAY 2017).

P1 02.05.19 Issued for Information TB GW

Rev	Date	Description	Drawn	Check
-----	------	-------------	-------	-------

Weetwood
Development • Planning • Environment

70 Cowcross Street
London EC1M 6EJ
Tel 0203 757 5444
Fax 01352 756314
info@weetwood.net
www.weetwood.net

Client
CASTLEMEAD GROUP LTD

Drawing Status	Date
----------------	------

PRELIMINARY

MAY 2019

Project

JACQUES WAY
WREXHAM

Scale (A1)

1:250

Drawn

TB

Checked

GW

Project No

3972

Title

PROPOSED SURFACE WATER
DRAINAGE LAYOUT

Drawing No

102

Revision

P1



Development • Planning • Environment

Delivering client focussed services

Flood Risk Assessments
Flood Consequences Assessments
Surface Water Drainage
Foul Water Drainage
Environmental Impact Assessments
River Realignment and Restoration
Water Framework Directive Assessments
Flood Defence Consent Applications
Sequential, Justification and Exception Tests
Utility Assessments
Expert Witness and Planning Appeals
Discharge of Planning Conditions

www.weetwood.net