

GWK STRUCTURAL SOLUTIONS LTD

CONSULTING ENGINEERS

Drainage Strategy Report

PROJECT REFERENCE:

- **Project No:** GK3483
- **Project Location:** West Street, Rochdale, OL16 2EN
- **Client:** Rochement Ltd

				APPROVALS	
Issue	Date	Pages	Issue Description	By	Check
A	06.07.22		Issued to Support Planning Application	PG	GWK
☒ Entire Report Issued this Revision			Report Issued for:		
			☐ In-house Review	☐ Purchase	
☐ Revised Pages Only			☐ Client Approval	☐ Construction	
Issued this Revision			☐ Inquiry	☒ Planning	

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Executive Summary

Item	Brief Description
Development Proposed	Construction of three pairs of semi-detached houses with associated gardens and parking on land at a former church, off West Street, Rochdale, OL16 2EN
Flood Zone Classification	Flood Zone 1 – Low Risk
Geology	No formal site investigation has been undertaken at this time. According to the British Geological Survey (BGS), the superficial deposits encompass Glaciofluvial Deposits, Devensian - Sand and Gravel. The bedrock is identified as the Lawrence Rock - Sandstone.
Infiltration Rate	Although, the superficial deposits have been identified as potentially sands and gravels, the local boreholes are showing clay to depth. Due to the potential presence of the cohesive material, at this time infiltration is not considered a viable means of draining the development area.
Nearest Watercourses	The watercourse identified some 350m to the southeast of the site is the River Roch.
Nearest Adopted Sewers	The United Utilities sewer records have been reviewed. This has identified a 450mm diameter combined sewer in west street flowing south and a 300mm diameter combined sewer in Buckley Street to the north, flowing east. There are no surface water sewers in close proximity to the site.
Existing Drainage	The site is currently undeveloped and thus class as greenfield.
Surface Water Drainage Outfall and SuDS Hierarchal Approach	Based on the anticipated poor ground conditions, it is proposed to drain the site to the combined sewer via a new connection at restricted rates.
Existing Discharge Rate	Greenfield
Proposed Discharge Rate	5.0l/s for all events to allow for the minimum orifice size.
Climate Change Allowance	40% - based on a residential > 50-year design life to 'the 2080's'.
Proposed Attenuation Method and Volume	Geocellular storage, 3.8m ³ for the peak 100yr + 40% CC event.
SuDS features	Water butts & Geocellular Storage
Maintenance Responsibility	Property Owners
Foul Drainage Outfall	New connection to combined sewer.

1.0 Introduction

GWK Structural Solutions Limited (GWK) has been appointed by Rochement Ltd to prepare this Drainage Strategy Report to support a planning application for the construction of three pairs of semi-detached houses with landscaping and car parking at land off West Street, Rochdale, OL16 2EN.

The assessment has been undertaken in line with Section 10 of the 2019 'National Planning Policy Framework' plus the accompanying Technical Guidance on Flood Risk.

This report has been commissioned by Rochement Ltd and is specific to their interests in the development proposals as described by the Architectural plan in Appendix A. This report may not be assigned.

The report has been commissioned to identify any drainage related issues associated with the proposed development and any likely constraints that could be imposed. The following issues have been addressed within this report;

- Determine the current surface water drainage regime and assess any potential increase in surface water runoff as a result of the proposed development.
- Discuss Sustainable Drainage Systems (SUDS) as an option for reducing surface water flood risk and devise an outline Drainage layout.
- Devise an appropriate outline surface water drainage strategy (including calculation where appropriate) to deal with any potential increase in surface water runoff and include for climate change.
- Devise an appropriate outline foul water drainage strategy.

2.0 Development Description and Location

2.1 Site Location

The site is referenced in Figure 1, and a site location map is provided in Appendix A.

Item	Brief Description
Project name	West Street, Rochdale
Site address and location	Land off West Street, Rochdale, OL16 2EN
Council Area	Rochdale Borough Council
Approximate Grid Reference	OS: 390158, 413812
General Locality	The site is located on the edge of Rochdale Town Centre, some 0.5km to the east.

Figure 1: Site Referencing Information

2.1 Existing Site Description

The development site (Red Line Boundary) is roughly rectangular in plan shape and is situated on land off West Street and Buckley Street. The site previously encompassed a church, which has since been demolished, leaving the land unmade.

The development is bordered residential properties in all directions, with commercial and retail units along Yorkshire Street to the north.

The development is approximately 0.5km to the east of Rochdale Town Centre and 10km north of Oldham Town Centre.

Figure 2 overleaf identifies the overall site location details. Further details can be seen on the plans in Appendix A.



Figure 2: Site Location

2.3 Topography

A basic land survey has been completed and has identified that the land is extremely flat holding a level between 138.12m AOD and 138.50m AOD. Further detail can be found in Appendix B.

2.4 Hydrology

The nearest identified watercourse is the River Roch, located approximately 350m at its closest point to the southeast of the site, flowing generally in a westerly direction. Hey Brook, is shown to be 400m to the east of the site flowing south into the River Roch.

2.5 Development Proposals

As discussed in the earlier sections, the report is prepared to support a planning application for the development of three pairs of semi-detached dwellings with associated car parking and landscaping.

The outline Site Master Plan as indicated in Appendix A provides details of the proposed development intent. Access into the dwellings will continue to be off both West Street and Buckley Street.

3.0 Fluvial Flood Risk Review

Figure 3 below locates the site on the Environment Agency's indicative flood plain map. It is clear from this that the red line boundary sits outside of a fluvial generator of flood water from any identified water body or river. It is considered therefore that the site lays outside of the active 100-year and extreme event floodplains, thus lying within 'Flood Zone 1 Classification' in accordance with the 2021 National Planning Policy Framework (NPPF) Flood Risk Guidance Notes, i.e., probability of annual fluvial flooding significantly less than 1 in 1000 in any one year (<0.1%). The risk from fluvial flood water is diminished to acceptable levels, removing the requirement for further investigation and assessment of the fluvial flood regime.



Figure 3: EA Indicative Flood Maps

In addition, the development application boundary is less than 1ha in plan area. In line with criteria set within the NPPF a Flood Risk Assessment is not required to support a planning application if the development is less than 1ha and in Flood Zone 1.

4.0 Outline Drainage Strategy

4.1 Existing Drainage

The United Utilities sewer records have been reviewed. This has identified a 450mm diameter combined sewer in west street flowing south and a 300mm diameter combined sewer in Buckley Street to the north, flowing east. There are no surface water sewers in close proximity to the site. Refer to Figure 4 below for details.

There is no identified private drainage within the current site.

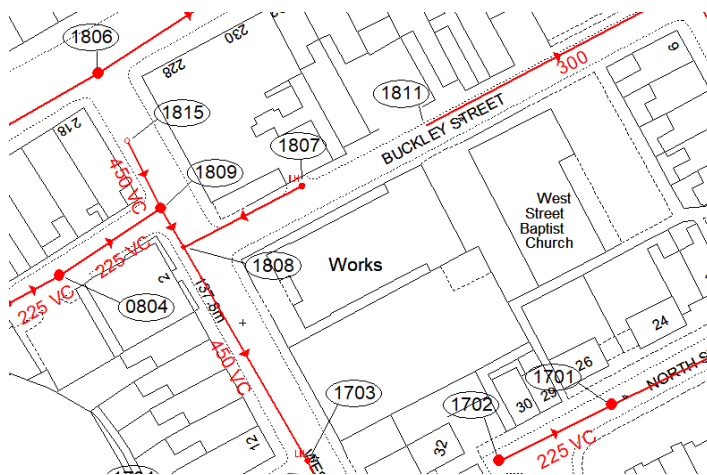


Figure 4: Existing United Utilities Sewer Records (from 2006)

4.2 Existing Runoff

The existing site is circa 690m² and classed as unmade. Due to the small area, the greenfield rates are considered too small to generate a value for them.

4.3 Geology

No site-specific intrusive Phase 2 Site Investigation has been carried out at the site. A review of the geology on the BGS website would indicate that the superficial geology comprises Glaciofluvial Deposits, Devensian - Sand and Gravel. The bedrock is identified as the Lawrence Rock - Sandstone. A review of local boreholes has identified the underlying ground to contradict this and encompass silt and clay. The cohesive nature of the underlying geology would preclude the use of infiltration as a means of draining the site.

4.4 Hydrological Assessment

As discussed in previous sections, a review of the topographical survey, OS Maps and Environment Agency maps would indicate the closest watercourse to be the River Roch, located approximately 350m to the south of the site flowing west.

4.5 Sustainable Drainage Systems (SuDS) Assessment

SuDS Objectives

Sustainable drainage developed in line with the ideals of sustainable development is collectively referred to as Sustainable Drainage Systems (SuDS). At a particular site, these systems are designed both to manage the environmental risks resulting from the urban runoff and to contribute wherever possible to environmental enhancement. SuDS objectives are therefore to minimise the impacts from the development on the quantity and quality of the runoff and maximise amenity and biodiversity opportunities (CIRIA C753, 2015).

SuDS Design Themes

The 'Management Train Approach' should be central to the surface water drainage strategy of the proposed site. The main objective is treatment and control of runoff as near to the source as possible protecting downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:

- i. **Prevention** – The use of good site design and housekeeping measures to prevent runoff and pollution and includes the use of rainwater reuse / harvesting.
- ii. **Source Controls** – Control of runoff at source or as close to source as possible (e.g. soakaways, green roofs, pervious pavements).
- iii. **Site Control** – Management of water in a local area and can include below ground storage / attenuation, detention basins, large infiltration devices.
- iv. **Regional Control** – Management of water from a site or various sites and can include wetlands and balancing ponds.

SuDS Site Constraints

SuDS techniques are suitable for all sites; therefore, an assessment of the existing site is required so that SuDS limitations can be determined.

- *Land Use Characteristics:* The size and type of development enables the potential range of prevention and site control SuDS devices to be considered.
- *Site Characteristics:* A site investigation has not been carried out at the site. Initial findings are that infiltration techniques would not be suitable. Further testing to be undertaken at detailed design stage.
- *Catchment Characteristics:* The site is currently classed for drainage purposes as 'Greenfield' and the discharge rate from the site will be in line with Rochdale Council policy.
- *Environmental and Amenity Performance:* The inclusion of SuDS within the overall development is a key driver in providing both amenity and habitat creation. All types of SuDS will be considered and blended into the landscaping zone, if possible. Safety to all future users is paramount and so best practice guidance will be incorporated so that these devices blend into the surrounding without the need for significant safety precautions. Maintenance plans will be prepared for all SuDS devices that are included.

SuDS Methods

Figure 5 and 6 on the following pages provide an assessment of various above and below ground SuDS methods that can provide water quality treatment and management of flows to reduce runoff rates and volumes and whether they can be suitably incorporated at this development site. The purpose of this assessment is to set out options to be considered at the planning stage with consideration to time constraints, viability and lifetime maintenance of the residential development.

Method	Comment	Suitability for Development
Green Roofs	Can be used on suitable low-rise buildings to provide retention, attenuation and treatment of rainwater, and promotes evaporation and local biodiversity.	<u>Not suitable:</u> Architectural proposals for the residential property with pitched roofs that are not viable.
Water Butts	Plastic tanks placed at the base of rainwater down pipes to collect rainwater runoff from the roof areas.	<u>Suitable:</u> To be included to the rear downpipes where possible and agreed with client.
Rainwater Harvesting	Rainwater harvesting reduces the total runoff volume from the developed site and reduces treated water consumption.	<u>Not Suitable:</u> - Additional costs of installation would have severe effect on viability of the development. - Running and maintenance costs would not be acceptable to our client and future occupiers. - The ability to restrict peak flow rates and short-term peak volumes is non-existent where a critical storm event occurs.
Infiltration Options	Reduces total run off volume from the development.	<u>Not Suitable:</u> Desk based information would indicate that the underlying soils are not suitable for infiltration options.
Permeable Surfacing (Infiltration)	- Reduces total run off volume from the development. - Can be used to enhance water quality.	<u>Not Suitable:</u> Desk based information would indicate that the underlying soils are not suitable for infiltration options.

Method	Comment	Suitability for Development
Permeable Surfacing (Standard)	- Can be used to enhance quality of runoff water. - Sub-base provides 'source' storage and reduces the volume of storage downstream. - The storage can be created with selection of the stone fill or plastic box stems. - Impermeable membrane at base of construction to prevent impact on pavement stability.	<u>Suitable:</u> Although the underlying ground is not suitable for full infiltration, permeable paving has the potential to be incorporated within the driveways to help reduce the impermeable fraction of the site and slow the rate of runoff to the downstream network. This will need to be confirmed with the client.
Swales, basins and ponds	- Provide areas for above ground surface runoff storage. - Swales also allow filtering of particulate matter, improving water quality	<u>Not suitable:</u> The available space and end use of the development being residential properties, discount the opportunity to include these features.
Bio-Retention	Collect and retain run-off to help improve water quality, prior to discharge in piped system on infiltration.	<u>Not suitable:</u> - Space constraints on site do not permit large above ground areas for flood storage. - No scope to reduce development area due to site viability.

Figure 5: Surface SuDS Methods

Method	Comment	Suitability for Development
Geocellular Storage	• Suitable for sites with insufficient space for basins etc. • Suitable for sites where topography prevents the use of open basins etc.	<u>Suitable:</u> • Subject to detailed design and drainage layout.
Large Diameter Pipes, Culverts or Tanks	• Suitable for sites with insufficient space for basins etc. • Provide a volume of below ground storage with a high void ratio and good man entry provision to allow for future maintenance and cleaning. Generally, be suitable for adoption by the statutory water company	<u>Not suitable:</u> • Scheme not large enough to require oversized pipes.

Figure 6: Sub-Surface SuDS Methods

SuDS Hierarchal Approach

Based on the SuDS assessment in Figure 5 and 6, plus an assessment of the local site conditions, the SuDS hierarchal approach for discharge of surface water at the development site is considered in greater detail below:

Method	Suitability	Suitability for Development
Infiltration to Ground	No	Desk based information would indicate that the underlying soils would not be suitable for infiltration-based options. Furthermore the dense development layout would not allow the minimum 5m offset from soakaways to be achieved.
Connection to Watercourse	No	No watercourse in close proximity
Connection to Surface Water Sewer	No	No surface water sewer in close proximity
Connection to a Combined Sewer	Yes	New connection to be made to the adjacent combined sewer

Figure 7: SuDS Hierarchal Approach

SuDS Design Philosophy

SuDS assessment and hierarchical approach discussed in Figure 5, 6 and 7 above has defined the overall SuDS strategy. Thus, the SuDS philosophy for the development site is the promotion of Prevention and Site Control techniques with discharge to the adjacent combined sewer.

The following design philosophy is proposed:

- Surface water treatment using the 'Management Train' approach to remove and isolate contamination at all SuDS facilities prior to conveyance to the existing drainage infrastructure.
- Reduce the impermeable fraction of the post development area.
- Include Water butts at the base of the rear rainwater pipes.
- Geocellular crate attenuation measures to retain the peak storm events.

4.6 Outline Surface Water Drainage Strategy

The general principal of the surface water drainage strategy is to collect the runoff from the roof of the new residential properties via water butts from the rear downpipes. The water will then be directed to a new below ground surface water drainage network that will flow along the front of the properties and outfall to the combined public sewer via a new connection at a restricted runoff rate of 5l/s. This is deemed the minimum rate to prevent blockage and in line with RMBC policy.

The proposed private drainage layout for the new development building will be designed in accordance with BS EN 752: 2008 and Building Regulations Part H guidance. This is to indicate no surcharge for the 2-year storm event and no flooding for up to the 30-year storm event.

Flooding can occur on a local scale beyond the 30yr criterion due to runoff exceeding the capacity of the minor system during extreme events and it can only be addressed on a site-specific basis. NPPF Guidance states that properties should be protected against flooding from extreme events (1 in 30 year) and that flood pathways are identified when the drainage system is exceeded.

A small hydraulic model has been simulated in the Microdrainage design software and confirms that no flooding would occur for the peak 100 year plus 40% allowance for climate change. Drawing GW3483-C-001 in Appendix C indicates the Drainage Strategy based on the Architects masterplan intent, with the outline hydraulic calculations in Appendix D.

Any future drainage calculations carried out as part of a site wide drainage strategy or for the development layouts themselves must include the appropriate increase in rainfall to satisfy the future Climate change allowances. In the case of this development, this would be 40%.

4.7 Pollution Control

Runoff from roofs is generally considered to be clean and will be discharged directly into the new drainage network. Surface water run-off from hard paved areas at risk of contamination should receive water quality treatment. The driveway is considered as a low hazard in terms of contamination.

4.8 Maintenance

The long-term maintenance of the new drainage infrastructure will be with the property owners or potentially a management company. This would include cleaning out of gullies & drainage channels and annual inspection of SuDS devices and manhole chambers.

Typically, the maintenance regime will be in line with Figure 8 below.

<u>Future Maintenance of the Drainage System</u>			
Responsibility	Feature	Maintenance	Frequency
Owner	Drainage Channel.	Regular maintenance / removal of blockages and silts.	Ad-hoc flushing/jetting and emptying of silt traps required.
	Rainwater gutters, downpipes and above ground drainage.	Regular maintenance and inspections.	Ad-hoc sweeping and emptying of silt and debris required. Annual visual inspections to check for damage / leaks.
	Flow control chambers.	Regular maintenance / removal of blockages and debris.	Annual inspection and following significant rainfall events.
	Geocellular Attenuation Tanks	Regular maintenance / removal of blockages and debris.	Annual inspection and following significant rainfall events.
	Pipes, sewers, manholes, outfall headwall.	Regular maintenance / removal of blockages and debris.	Annual inspection and removal of silts if required.

Figure 8: Maintenance Regime for Drainage & SuDS features

4.9 Foul Water Drainage

Foul drainage generated from the new development will connect to a new below ground foul water network that outfalls to the UU combined water sewer in Buckley Street via a new connection.

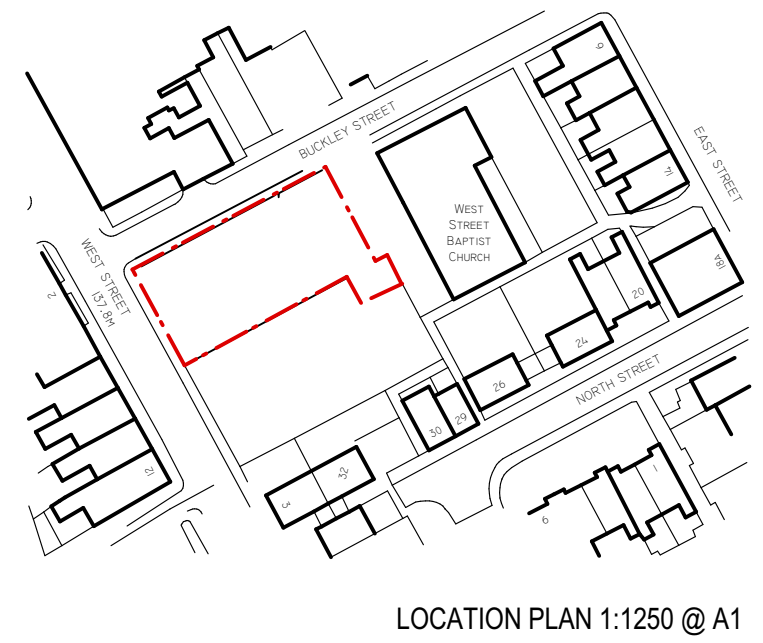
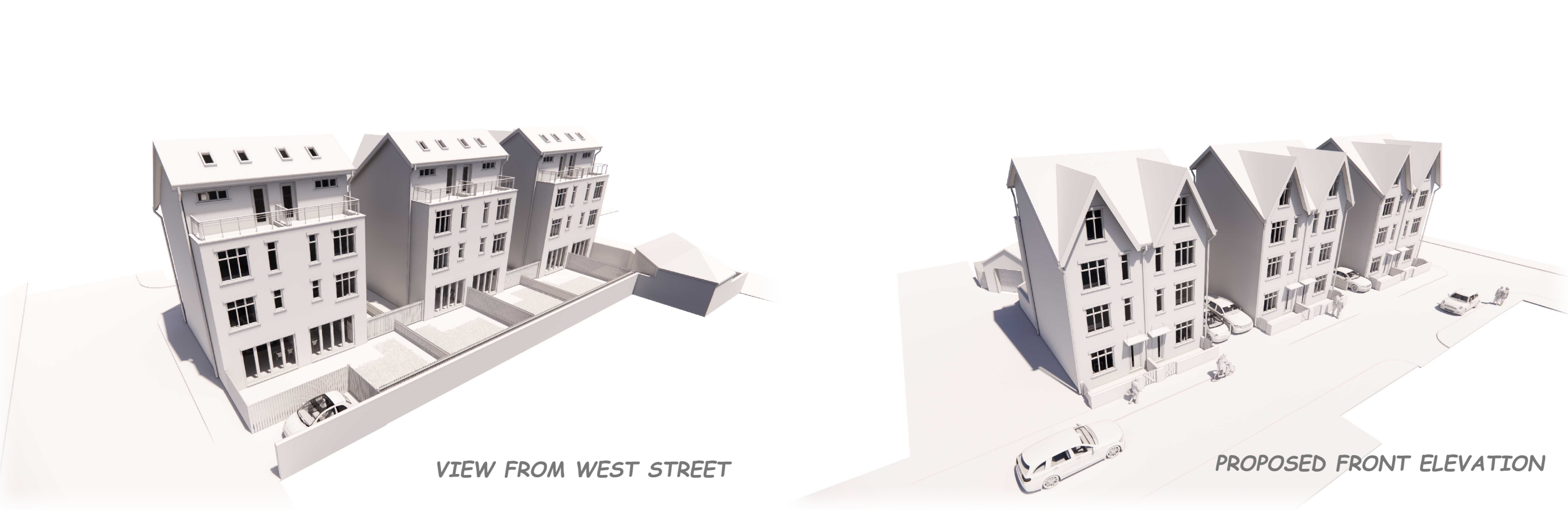
The proposed private drainage layout for the new development site will be designed in accordance with BS EN 752: 2008 and Building Regulations Part H guidance.

An indicative foul water drainage layout can be found on the GWK drawing in Appendix C.

Appendix A – Architect Drawings



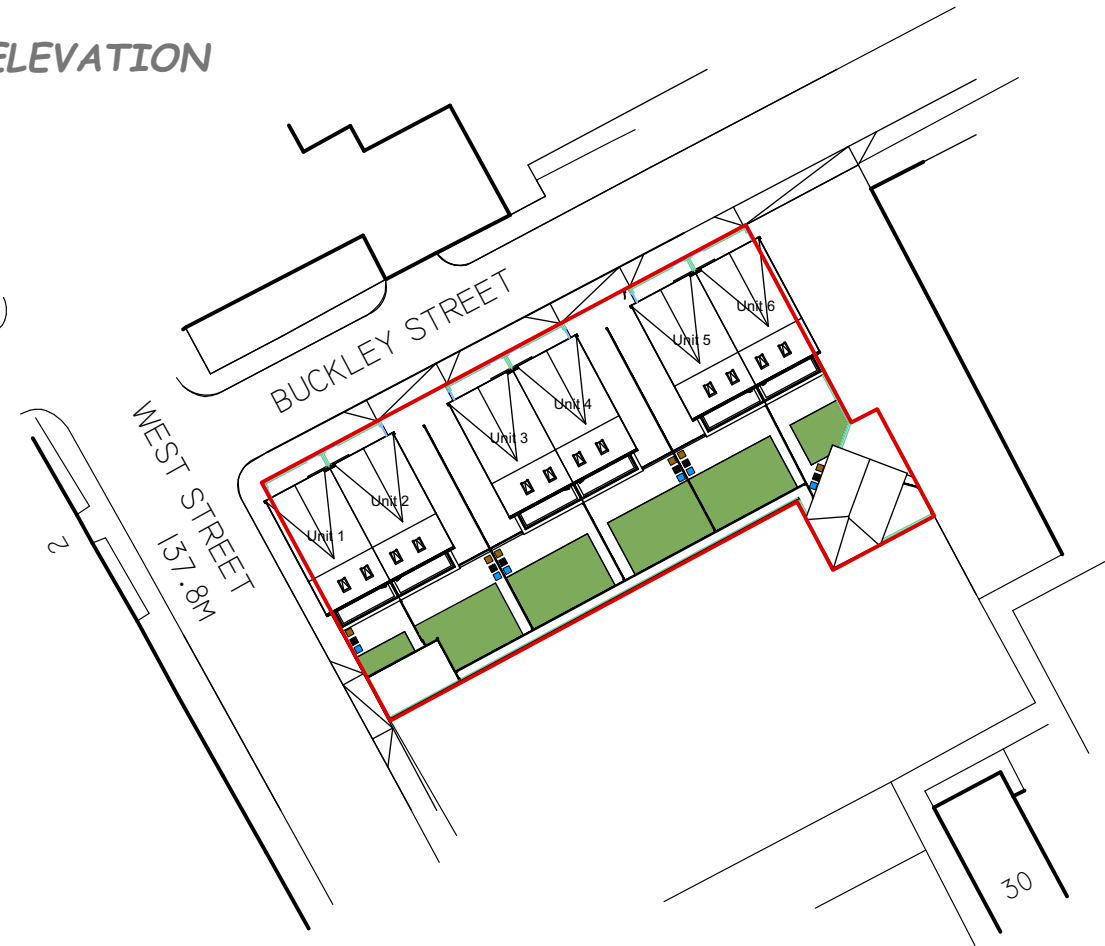
EXISTING SITE PLAN LEVELS 1:500 @ A1



LOCATION PLAN 1:1250 @ A1



PROPOSED REAR ELEVATION



SITE PLAN 1:500 @ A1



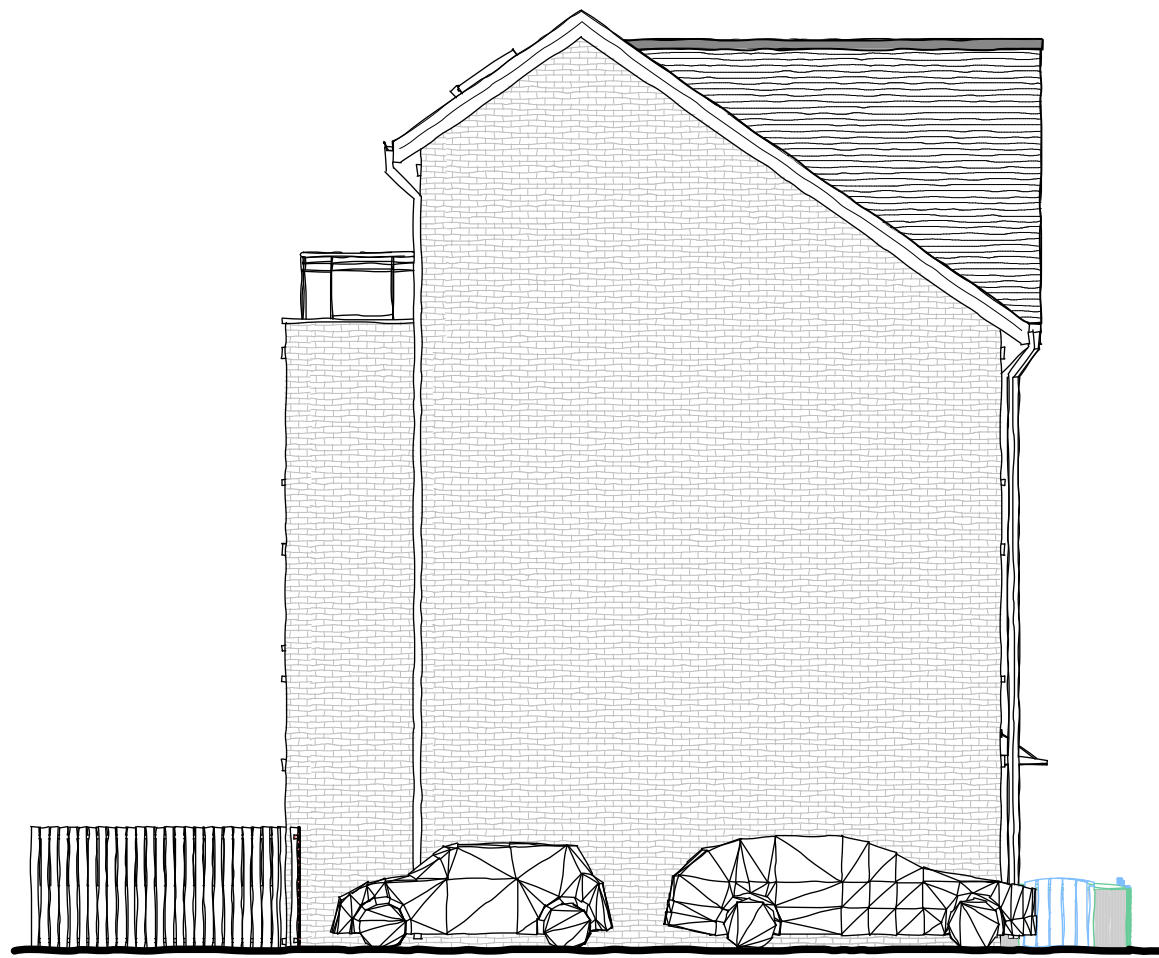
SITE AERIAL VIEW - NTS



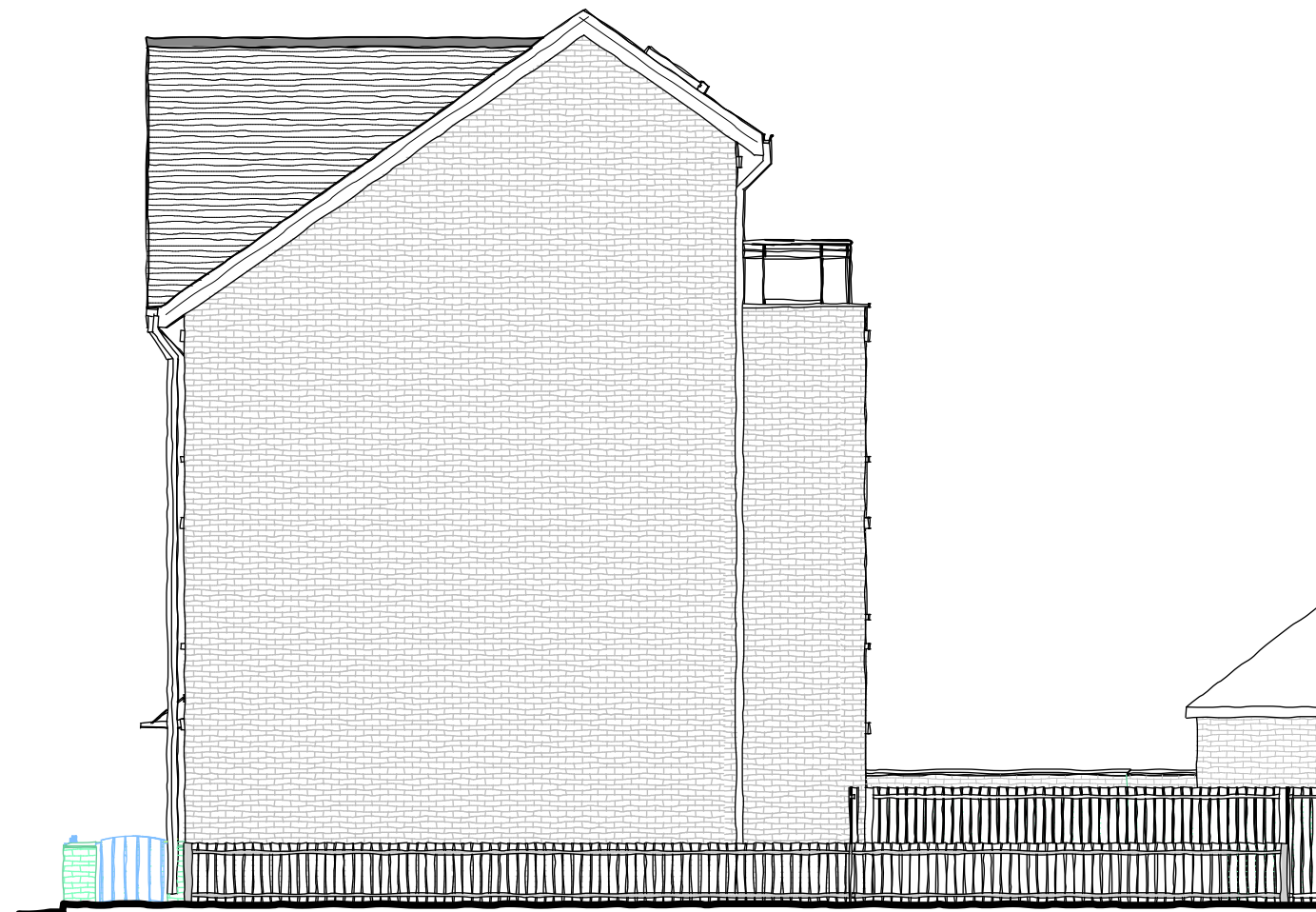
PROPOSED FRONT ELEVATION 1:100 @ A1



PROPOSED REAR ELEVATION 1:100 @ A1



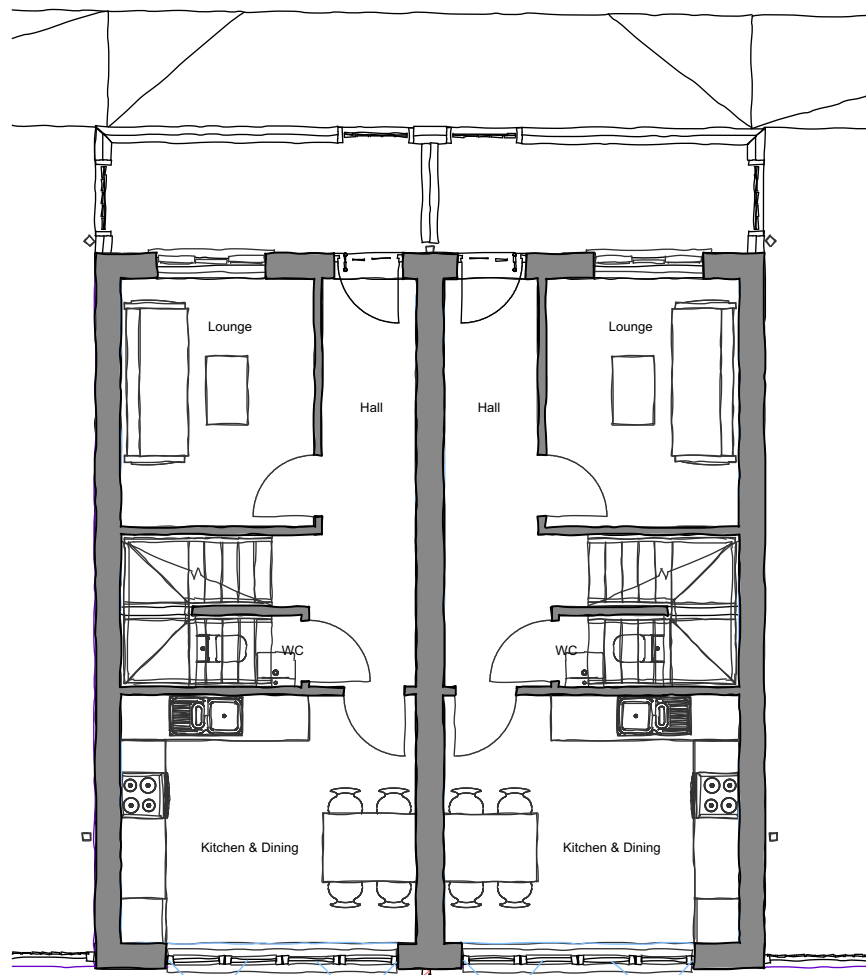
PROPOSED EAST ELEVATION 1:100 @ A1



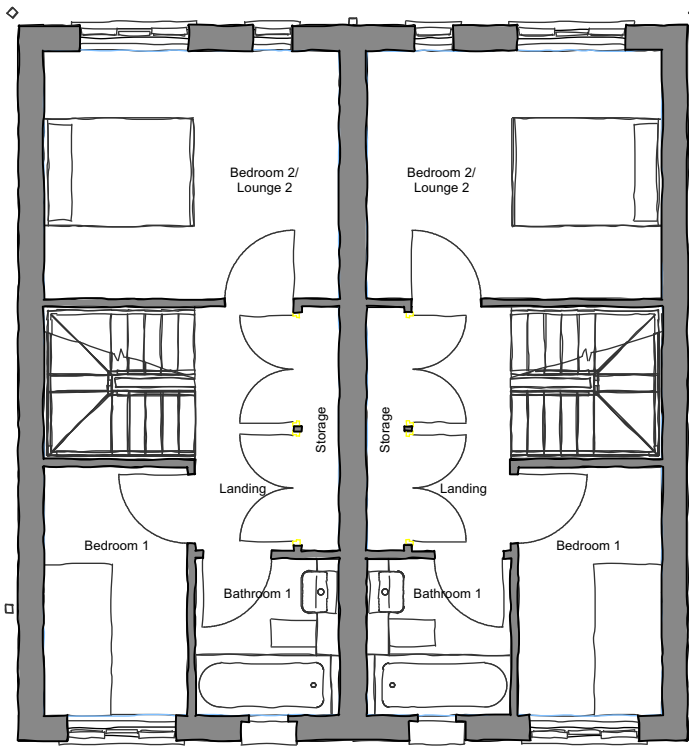
PROPOSED WEST ELEVATION 1:100 @ A1

IMPORTANT
THE CONTRACTOR WILL BE RESPONSIBLE FOR SETTING OUT THE WORK.
ALL DIMENSIONS MUST BE OBTAINED FROM OR CHECKED ON SITE. FIGURED
DIMENSIONS TO BE USED IN PREFERENCE TO SCALE.

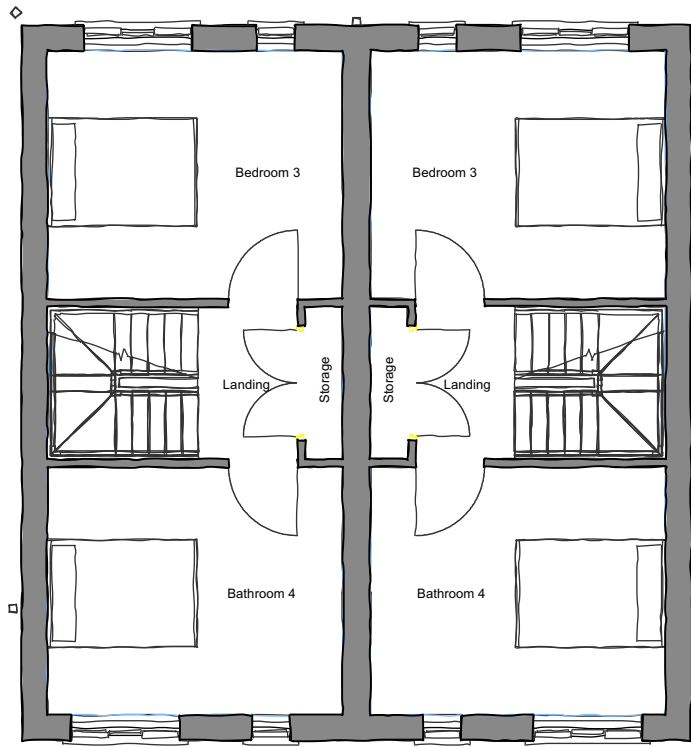
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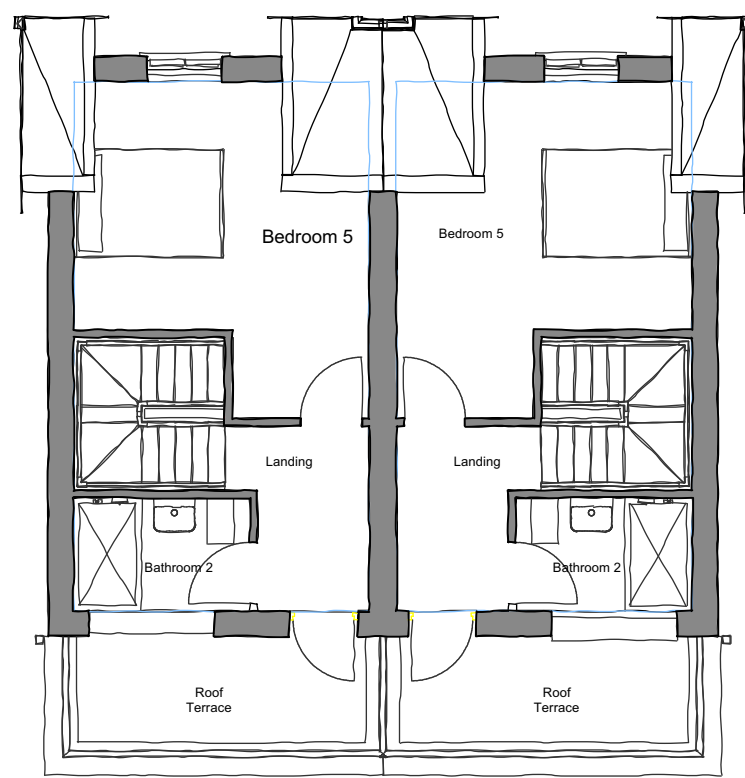
00-6F-UNIT TYPE PLAN
1:100 @ A1



01- 1st FLOOR -UNIT TYPE PLAN
1:100 @ A1



02- 2nd FLOOR -UNIT TYPE PLAN
1:100 @ A1



03- 3rd FLOOR -UNIT TYPE PLAN
1:100 @ A1



VIEW FROM BUCKLEY STREET

IW DESIGN

Architectural design • Surveying services

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Project
FORMER BAPTIST CHURCH
WEST STREET
ROCHDALE

Title
HOUSING SCHEME PROPOSAL

Drawn
IAW

Scale
1:100 @ A1

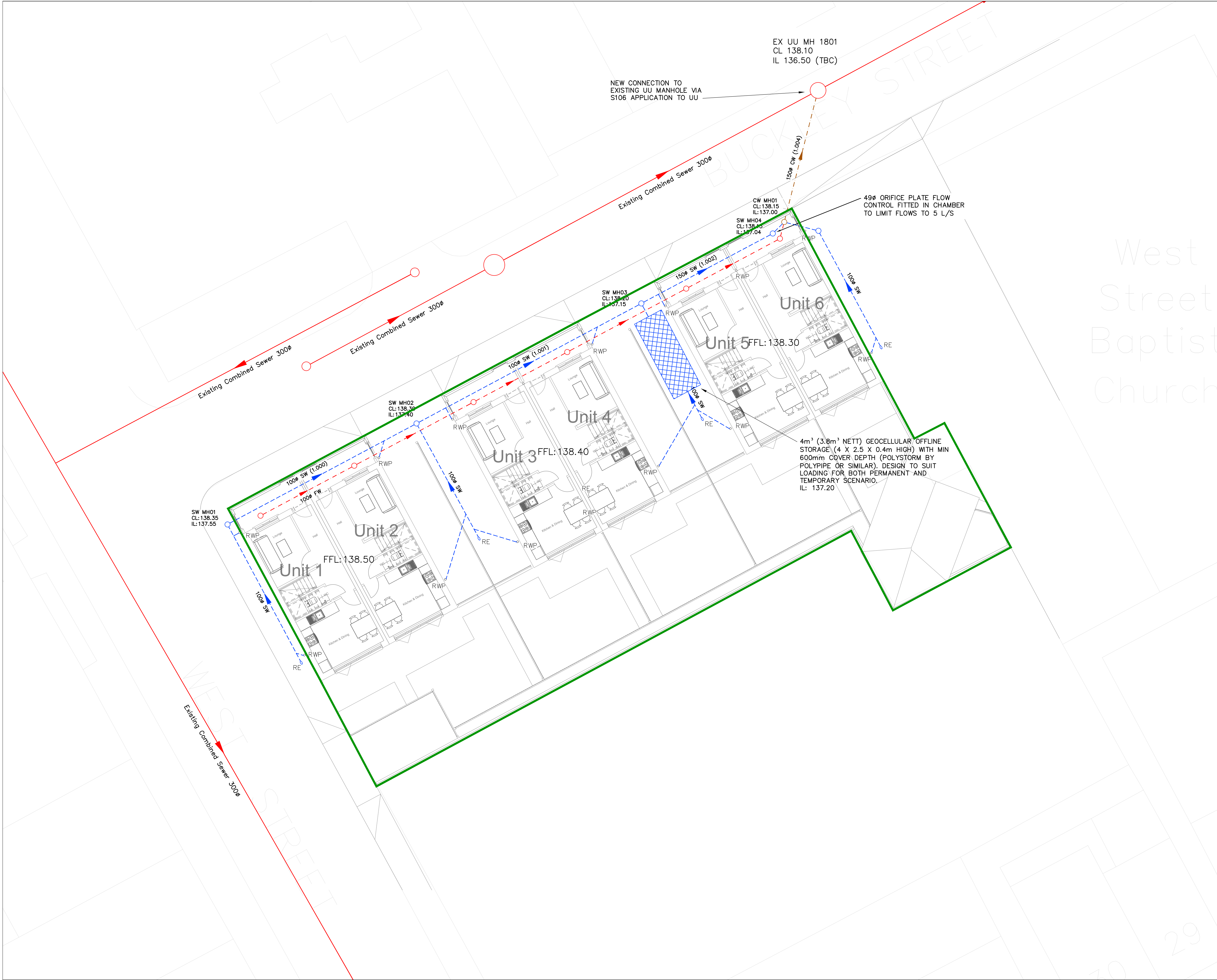
Date
Apr 2022

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FBC/012

Appendix B – Topographical Survey



Appendix C - GWK Design Drawings



NOTES

NOTES:-

1. ALL LEVELS ARE IN METRES.
2. ALL DIMENSIONS ARE IN MILLIMETRES.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE ACCURACY OF ALL DIMENSIONS AND LEVELS AND FOR THE CORRECT SETTING OUT OF THE WORK ON SITE UNLESS NOTED OTHERWISE.
4. THE CONTRACTOR SHALL ENSURE ALL NECESSARY PRECAUTIONS ARE TAKEN TO PROTECT EXISTING SERVICES DURING THE WORKS.

KEY

- EXISTING COMBINED SEWER
- PROPOSED COMBINED WATER DRAINAGE
- PROPOSED FOUL WATER DRAINAGE
- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED 450mm PPIC
- PROPOSED 300mm MINI PPIC (MAX 600 DP)
- RAINWATER PIPE
- SOIL VENT PIPE
- BACK INLET GULLY
- ROAD GULLY
- YARD GULLY
- RODDING EYE
- SITE BOUNDARY

NOTE:

ALL DRAINAGE PIPES SIZES TO BE 100mm UNLESS NOTED OTHERWISE

EXTENT AND ROUTES OF EXISTING DRAINAGE TO BE DETERMINED AND PROVIDED TO ENGINEER TO COMPLETE DRAINAGE DESIGN

RECESSED MANHOLES COVERS TO BE FITTED TO FEATURE PAVING AREAS

EXTERNAL LEVELS TO BE CONFIRMED BY OTHERS

SVP AND RWP DROP LOCATIONS TO BE CONFIRMED BY OTHERS

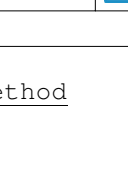
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CLIENT	MRS S SNAPE		
PROJECT	FORMER BAPTIST CHURCH, WEST STREET, ROCHDALE		
DRAFTER	PG	ENGINEER	GWK
TITLE	DRAINAGE STRATEGY PLAN		
SCALE	DRAWING No	DATE	AMDT
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Appendix D - GWK Hydraulic Calculations

	West Street, Rochdale SW Network	Page 1
Date 06/07/2022	Designed by paulg	
File West Street - SW Networ...	Checked by	
Innovyze	Network 2017.1.2	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.261	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.034	4-8	0.006

Total Area Contributing (ha) = 0.040

Total Pipe Volume (m³) = 0.734

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	12.000	0.150	80.0	0.007	4.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	14.000	0.200	70.0	0.015	0.00	0.0	0.600	o	100	Pipe/Conduit	
2.000	3.000	0.025	120.0	0.000	4.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	9.000	0.110	81.8	0.013	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	3.000	0.040	75.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	4.23	137.550	0.007	0.0	0.0	0.0	0.86	6.8	0.9
1.001	50.00	4.49	137.400	0.022	0.0	0.0	0.0	0.92	7.2	3.0
2.000	50.00	4.05	137.200	0.000	0.0	0.0	0.0	0.92	16.2	0.0
1.002	50.00	4.62	137.150	0.035	0.0	0.0	0.0	1.11	19.7	4.7
1.003	50.00	4.66	137.040	0.035	0.0	0.0	0.0	1.16	20.5	4.7

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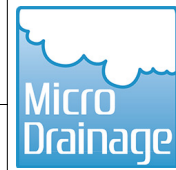
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PIPELINE SCHEDULES for Storm Upstream Manhole <table><tr><th>PN</th><th>Hyd Sect</th><th>Diam (mm)</th><th>MH Name</th><th>C.Level (m)</th><th>I.Level (m)</th><th>D.Depth (m)</th><th>MH Connection</th><th>MH DIAM., L*W (mm)</th></tr><tr><td>1.000</td><td>o</td><td>100</td><td>SW01</td><td>138.350</td><td>137.550</td><td>0.700</td><td>Open Manhole</td><td>600</td></tr><tr><td>1.001</td><td>o</td><td>100</td><td>SW02</td><td>138.300</td><td>137.400</td><td>0.800</td><td>Open Manhole</td><td>600</td></tr><tr><td>2.000</td><td>o</td><td>150</td><td>tank</td><td>138.150</td><td>137.200</td><td>0.800</td><td>Open Manhole</td><td>1200</td></tr><tr><td>1.002</td><td>o</td><td>150</td><td>SW03</td><td>138.200</td><td>137.150</td><td>0.900</td><td>Open Manhole</td><td>600</td></tr><tr><td>1.003</td><td>o</td><td>150</td><td>SW04</td><td>138.150</td><td>137.040</td><td>0.960</td><td>Open Manhole</td><td>600</td></tr><tr><td>1.004</td><td>o</td><td>150</td><td>CW01</td><td>138.150</td><td>137.000</td><td>1.000</td><td>Open Manhole</td><td>600</td></tr></table> Downstream Manhole <table><tr><th>PN</th><th>Length (m)</th><th>Slope (1:X)</th><th>MH Name</th><th>C.Level (m)</th><th>I.Level (m)</th><th>D.Depth (m)</th><th>MH Connection</th><th>MH DIAM., L*W (mm)</th></tr><tr><td>1.000</td><td>12.000</td><td>80.0</td><td>SW02</td><td>138.300</td><td>137.400</td><td>0.800</td><td>Open Manhole</td><td>600</td></tr><tr><td>1.001</td><td>14.000</td><td>70.0</td><td>SW03</td><td>138.200</td><td>137.200</td><td>0.900</td><td>Open Manhole</td><td>600</td></tr><tr><td>2.000</td><td>3.000</td><td>120.0</td><td>SW03</td><td>138.200</td><td>137.175</td><td>0.875</td><td>Open Manhole</td><td>600</td></tr><tr><td>1.002</td><td>9.000</td><td>81.8</td><td>SW04</td><td>138.150</td><td>137.040</td><td>0.960</td><td>Open Manhole</td><td>600</td></tr><tr><td>1.003</td><td>3.000</td><td>75.0</td><td>CW01</td><td>138.150</td><td>137.000</td><td>1.000</td><td>Open Manhole</td><td>600</td></tr><tr><td>1.004</td><td>15.000</td><td>78.9</td><td>sewer</td><td>138.100</td><td>136.810</td><td>1.140</td><td>Open Manhole</td><td>0</td></tr></table> Free Flowing Outfall Details for Storm <table><tr><th>Outfall Pipe Number</th><th>Outfall Name</th><th>C. 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Date 06/07/2022 File West Street - SW Networ...	Designed by paulg Checked by																					
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<u>Synthetic Rainfall Details</u> <table> <tr> <td>Rainfall Model</td> <td>FSR</td> <td>Profile Type</td> <td>Summer</td> </tr> <tr> <td>Return Period (years)</td> <td>2</td> <td>Cv (Summer)</td> <td>0.750</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> <td>Cv (Winter)</td> <td>0.840</td> </tr> <tr> <td>M5-60 (mm)</td> <td>19.000</td> <td>Storm Duration (mins)</td> <td>30</td> </tr> <tr> <td>Ratio R</td> <td>0.261</td> <td></td> <td></td> </tr> </table>			Rainfall Model	FSR	Profile Type	Summer	Return Period (years)	2	Cv (Summer)	0.750	Region	England and Wales	Cv (Winter)	0.840	M5-60 (mm)	19.000	Storm Duration (mins)	30	Ratio R	0.261		
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<u>Online Controls for Storm</u> <u>Orifice Manhole: SW04, DS/PN: 1.003, Volume (m³): 0.5</u> Diameter (m) 0.049 Discharge Coefficient 0.600 Invert Level (m) 137.040		
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Storage Structures for Storm Cellular Storage Manhole: tank, DS/PN: 2.000 Invert Level (m) 137.200 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>10.0</td><td>10.0</td><td>2.600</td><td>0.0</td><td>15.1</td></tr><tr><td>0.200</td><td>10.0</td><td>12.5</td><td>2.800</td><td>0.0</td><td>15.1</td></tr><tr><td>0.400</td><td>10.0</td><td>15.1</td><td>3.000</td><td>0.0</td><td>15.1</td></tr><tr><td>0.401</td><td>0.0</td><td>15.1</td><td>3.200</td><td>0.0</td><td>15.1</td></tr><tr><td>0.800</td><td>0.0</td><td>15.1</td><td>3.400</td><td>0.0</td><td>15.1</td></tr><tr><td>1.000</td><td>0.0</td><td>15.1</td><td>3.600</td><td>0.0</td><td>15.1</td></tr><tr><td>1.200</td><td>0.0</td><td>15.1</td><td>3.800</td><td>0.0</td><td>15.1</td></tr><tr><td>1.400</td><td>0.0</td><td>15.1</td><td>4.000</td><td>0.0</td><td>15.1</td></tr><tr><td>1.600</td><td>0.0</td><td>15.1</td><td>4.200</td><td>0.0</td><td>15.1</td></tr><tr><td>1.800</td><td>0.0</td><td>15.1</td><td>4.400</td><td>0.0</td><td>15.1</td></tr><tr><td>2.000</td><td>0.0</td><td>15.1</td><td>4.600</td><td>0.0</td><td>15.1</td></tr><tr><td>2.200</td><td>0.0</td><td>15.1</td><td>4.800</td><td>0.0</td><td>15.1</td></tr><tr><td>2.400</td><td>0.0</td><td>15.1</td><td>5.000</td><td>0.0</td><td>15.1</td></tr></tbody></table>			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	10.0	10.0	2.600	0.0	15.1	0.200	10.0	12.5	2.800	0.0	15.1	0.400	10.0	15.1	3.000	0.0	15.1	0.401	0.0	15.1	3.200	0.0	15.1	0.800	0.0	15.1	3.400	0.0	15.1	1.000	0.0	15.1	3.600	0.0	15.1	1.200	0.0	15.1	3.800	0.0	15.1	1.400	0.0	15.1	4.000	0.0	15.1	1.600	0.0	15.1	4.200	0.0	15.1	1.800	0.0	15.1	4.400	0.0	15.1	2.000	0.0	15.1	4.600	0.0	15.1	2.200	0.0	15.1	4.800	0.0	15.1	2.400	0.0	15.1	5.000	0.0	15.1
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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.261
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

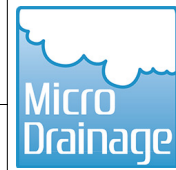
Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

									Water
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)
1.000	SW01	15	Winter	1	+0%	100/15	Summer		137.574
1.001	SW02	15	Winter	1	+0%	30/15	Summer		137.440
2.000	tank	15	Winter	1	+0%	30/15	Summer		137.223
1.002	SW03	15	Winter	1	+0%	30/15	Summer		137.284
1.003	SW04	15	Winter	1	+0%	1/15	Summer		137.276
1.004	CW01	15	Winter	1	+0%				137.039

PN	US/MH Name	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)			Flow (l/s)		
1.000	SW01	-0.076	0.000	0.14		0.9		OK
1.001	SW02	-0.060	0.000	0.34		2.3		OK
2.000	tank	-0.127	0.000	0.04		0.5		OK
1.002	SW03	-0.016	0.000	0.16		2.7		OK
1.003	SW04	0.086	0.000	0.18		2.3	SURCHARGED	
1.004	CW01	-0.111	0.000	0.15		2.7		OK

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.261
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

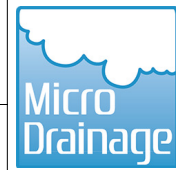
Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

									Water
	US/MH			Return Climate	First (X)	First (Y)	First (Z)	Overflow	Level
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)
1.000	SW01	15 Winter	30	+0%	100/15 Summer				137.589
1.001	SW02	15 Winter	30	+0%	30/15 Summer				137.555
2.000	tank	30 Winter	30	+0%	30/15 Summer				137.434
1.002	SW03	30 Winter	30	+0%	30/15 Summer				137.436
1.003	SW04	30 Winter	30	+0%	1/15 Summer				137.428
1.004	CW01	15 Winter	30	+0%					137.047

PN	US/MH Name	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)			Flow (l/s)		
1.000	SW01	-0.061	0.000	0.33		2.1		OK
1.001	SW02	0.055	0.000	0.92		6.3	SURCHARGED	
2.000	tank	0.084	0.000	0.23		2.4	SURCHARGED	
1.002	SW03	0.136	0.000	0.16		2.8	SURCHARGED	
1.003	SW04	0.238	0.000	0.22		2.8	SURCHARGED	
1.004	CW01	-0.103	0.000	0.21		3.9		OK

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SW Network



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Designed by paulg

File West Street - SW Networ...

Checked by

Innovyze

Network 2017.1.2

100 year Return Period Summary of Critical Results by Maximum Level (Rank
1) for Storm

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.261
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

										Water
	US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
PN	Name	Storm		Period	Change	Surcharge	Flood	Overflow	Act.	(m)
1.000	SW01	60	Winter	100	+40%	100/15	Summer			138.177
1.001	SW02	60	Winter	100	+40%	30/15	Summer			138.169
2.000	tank	60	Winter	100	+40%	30/15	Summer			138.126
1.002	SW03	60	Winter	100	+40%	30/15	Summer			138.127
1.003	SW04	60	Winter	100	+40%	1/15	Summer			138.110
1.004	CW01	30	Winter	100	+40%					137.058

PN	US/MH Name	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)			Flow (l/s)		
1.000	SW01	0.527	0.000	0.30		1.9	FLOOD	RISK
1.001	SW02	0.669	0.000	0.88		6.0	FLOOD	RISK
2.000	tank	0.776	0.000	0.28		3.0	FLOOD	RISK
1.002	SW03	0.827	0.000	0.29		5.0	FLOOD	RISK
1.003	SW04	0.920	0.000	0.39		4.9	FLOOD	RISK
1.004	CW01	-0.092	0.000	0.31		5.7		OK