

GWK STRUCTURAL SOLUTIONS LTD

CONSULTING ENGINEERS

Drainage Strategy Report

PROJECT REFERENCE:

- **Project No:** GK5191
- **Project Location:** Land to Rear of 220 Ainsworth Road, Bury, BL8 2LR.
- **Client:** Mr C Hames

				APPROVALS	
Issue	Date	Pages	Issue Description	By	Check
A	26.06.25		Issued to Support Planning Application	PG	GWK
B	14.07.25		Site Plan Updated	PG	GWK
☒ Entire Report Issued this Revision			Report Issued for:		
			☐ In-house Review	☐ Purchase	
☐ Revised Pages Only Issued this Revision			☐ Client Approval	☐ Construction	
			☐ Inquiry	☒ Planning	

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Executive Summary

Item	Brief Description
Development Proposed	Construction of a detached dwelling with garden and driveway on land to the rear of 220 Ainsworth Road, Bury, BL8 2LR.
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 Glacial Till / Devensian, comprised of clays and silts. The bedrock is identified as the Pennine Lower Coal Measures Formation - Mudstone, siltstone and sandstone. In light of these findings infiltration as a means of draining the site has been discounted.
Infiltration Rate	No Phase 2 Site Investigation has been completed. Based on the underlying cohesive ground, infiltration as a means of draining the site has been discounted.
Nearest Watercourses	The nearest watercourse in close proximity to the site is the Elton Brook located approximately 300m north, flowing easterly.
Nearest Adopted Sewers and Private onsite Drainage	The United Utilities (UU) sewer records have been reviewed. This has identified a 600mm diameter combined water sewer flowing south within Elton Vale Road. This then merges with a combined sewer in Ainsworth Road and flows easterly. No surface water sewer has been identified in close proximity. The current site is undeveloped, and no positive drainage has been identified.
Existing Discharge Rate	Existing site is classes as greenfield. With the area being relatively small, the greenfield rates have not been defined.
Surface Water Drainage Outfall and SuDS Hierarchal Approach	With infiltration not being feasible and no watercourse or surface water sewer in close proximity, connection will be made to the combined water sewer in Elton Vale Road.
Proposed Discharge Rate	Discharge rate to satisfy local and national guidance, with a maximum discharge rate of 2l/s to reduce the risk of blockage.
Climate Change Allowance	45% - based on a residential > 100-year design life to 'the 2100's' Upper end Allowance.
SuDS features	Water butts, permeable surfacing and flow controls.
Maintenance Responsibility	Development owner.
Foul Drainage Outfall	Reuse existing connection to the combined sewer.

1.0 Introduction

GWK Structural Solutions Limited (GWK) has been appointed by Mr C Hames to prepare this Drainage Strategy Report to support a planning application for the construction of a detached dwelling with associated gardens and parking, to the rear of 220 Ainsworth Road, Bury, BL8 2LR.

The assessment has been undertaken in line with Section 14 of the 2024 'National Planning Policy Framework' plus the accompanying Technical Guidance on Flood Risk.

The outline Site Master Plan as indicated in Appendix A provides details of the proposed development intent.

This report has been commissioned by Mr C Hames and is specific to his interests in the development proposals as described by the Architectural plan in Appendix A.

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.
- Assess local and national policy in relation to the inclusion of SuDS.
- 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 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	220 Ainsworth Road
Site address and location	Land to the rear of 220 Ainsworth Road, Bury, BL8 2LR.
Council Area	Bury Metropolitan Borough Council (BMBC)
Approximate Grid Reference	OS: 378481, 410662
General Locality	The site is located some 2km to the west of Bury Town Centre.

Figure 1: Site Referencing Information

2.2 Existing Site Description

The development site (Red Line Boundary) is irregular in plan shape, encompassing an area of unmade land / garden with 2 outbuildings, to the rear of No. 220 Ainsworth Road, Bury, BL8 2LR. The remaining boundaries are made up of shrubbery and mature trees to the north and west.

The site is located in a predominantly residential area with a sports club to the north by approximately 100m known as Elton Vale Sports Club and further residential dwellings on all other sides. As 220 Ainsworth Road is located on a corner plot, the new access to the site will be from Elton Vale Road located to the east of the proposed plot boundary.

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 topographical survey has been completed at the site. This has indicated no 220 Ainsworth road to hold a level of 111.48m AOD. The land encompassing the proposed dwelling then falls in a northerly direction down to circa 110.60m AOD.

3.0 Fluvial Flood Risk Review

Figure 3 below locates the site on the Environment Agency's indicative floodplain 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 2024 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.

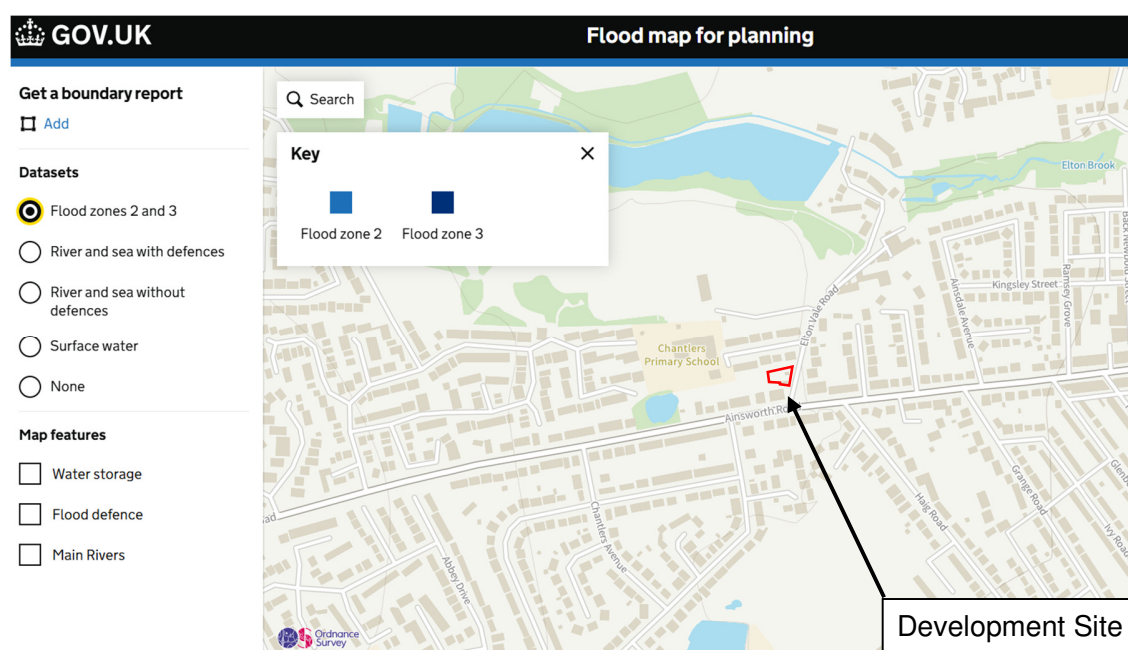


Figure 3: EA Indicative Flood Maps

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 External Consultation

GWK have not at this time been in contact with United Utilities via a predevelopment drainage enquiry for the development site. However, based on previous experience it would be anticipated that their considered response would advise that evidence should be provided that the SuDS Hierarchy has been assessed. Should this assessment confirm that infiltration is not feasible they would then allow connection to the 600mm diameter combined water sewer in Elton Vale Road at a peak rate not exceeding 5l/s. Foul water can discharge unrestricted to the combined water sewer.

4.2 Existing Drainage

The United Utilities (UU) sewer records have been reviewed. This has identified a 600mm diameter combined water sewer flowing south within Elton Vale Road. This then merges with a combined sewer in Ainsworth Road and flows easterly. No surface water sewer has been identified in close proximity. Refer to Figure 4 below for details.

The current site is undeveloped, and no positive drainage has been identified.

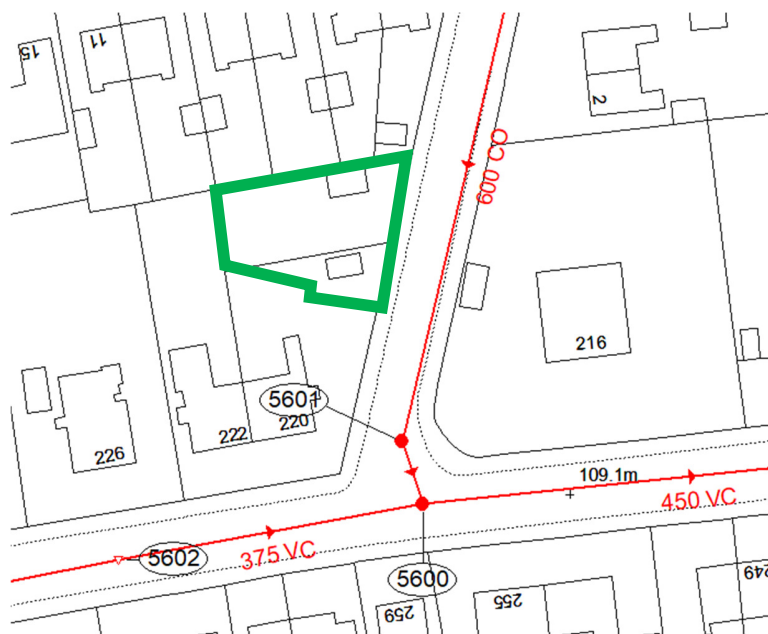


Figure 4: Existing United Utilities Sewer Records

4.3 Existing Runoff

The existing site is fully undeveloped and thus classed as greenfield.

With the area being relatively small, the Greenfield runoff rates have not been defined.

4.4 Geology

No formal site investigation has been undertaken at this time. According to the British Geological Survey (BGS), the superficial deposits encompass Glacial Till / Devensian, comprised of clays and silts. The bedrock is identified as the Pennine Lower Coal Measures Formation - Mudstone, siltstone and sandstone. In light of these findings infiltration as a means of draining the site has been discounted.

4.5 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 the site is the Elton Brook located approximately 300m north.

4.6 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 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 restricts the potential range of prevention, source control and site control SuDS devices to be considered.
- *Site Characteristics:* Based on BGS mapping, infiltration is unlikely to be suitable but will be confirmed following future infiltration testing.
- *Catchment Characteristics:* The site is currently classed for drainage purposes as 'Greenfield'.
- *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 for all future users is paramount and so the 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

Figures 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 promote evaporation and local biodiversity.	<u>Not suitable:</u> Architectural proposals are for pitched roofs that would not be viable for Green Roofs.
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 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 a severe effect on the 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.

Method	Comment	Suitability for Development
Infiltration Options	Reduces total run off volume from the development.	<u>Not Suitable:</u> Initial investigation would indicate that the underlying ground is not suitable for infiltration.
Permeable Surfacing (Infiltration)	- Reduces total run off volume from the development. - Can be used to enhance water quality.	<u>Not Suitable:</u> Initial investigation would indicate that the underlying ground is not suitable for infiltration.
Permeable Surfacing (Standard)	- Can be used to enhance the 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> Private parking bays have the potential to attenuate and filter surface water flows through the use of permeable surfacing (subject to confirmation of surface finishes).
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 a residential care home, 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. - Infiltration options viable.

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> • More suited for larger residential developments with adopted highways and sewers.

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	Initial assessment has determined that the underlying ground would not be suitable for infiltration-based options. Further investigation to be undertaken to fully confirm.
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	Reuse existing connection to the combined sewer at restricted rates.

Figure 7: SuDS Hierarchal Approach

SuDS Design Philosophy

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

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.
- Prevention measures in the form of Water butts at the base of rainwater pipes.
- Source control measures in the form of permeable surfacing to the driveway.
- Site control in the form of a flow control device restricting the offsite flow to 2l/s.

4.7 The Non-Statutory Technical Standards for SuDS

It is best practice to develop drainage strategies to the DEFRA document 'The Non-Statutory Technical Standards for SuDS'. The Bury Metropolitan Borough Council SuDS document also follows the principles of this document.

The DEFRA document advises the following with respect to 'Peak Flow Control' (S2) and 'Volume Control' (S4 & S6) for Greenfield sites such as this:

- **S2** *For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100-year rainfall event should never exceed the peak greenfield runoff rate for the same event.*
- **S4** *Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100-year, 6-hour rainfall event should never exceed the greenfield runoff volume for the same event.*
- **S6** *Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.*

As noted above, and in line with policy, it is intended that surface water discharge rates will be restricted as close to the respective greenfield runoff rates for all rainfall events in accordance with standard **S2** and to comply with the peak volume requirements as per **S4** and **S6**. However, also taking due regard to a minimum orifice size to prevent blockage, a maximum discharge rate of 2.0l/s will be applied to the flow control.

It should be noted that these rates are indicative only and based on the anticipated measured impermeable areas from the development masterplan. The final discharge rate will be confirmed at detailed design stage and agreed with the LLFA through a reserved matters or condition discharge application.

4.8 Climate Change

In May 2022, the Environment Agency released updated climate change allowances for peak rainfall intensities which should be applied to new developments. Rather than nationwide allowances, each area will have its own peak rainfall allowances. In the case of the Bury Area, this is the Irwell Management Catchment peak rainfall allowances.

Based on the nature of development, a lifespan of circa 100 years is anticipated. Therefore, the potential climate change allowance for the 2070's Upper End Allowance for residential developments is 45%, which will be included in the hydraulic calculations.

4.9 Outline Surface Water Drainage Strategy

The general principle of the surface water drainage strategy is to collect the runoff from the roof of the new residential dwelling and direct it to a new below ground surface water drainage network. This will then pass through a flow control device before connecting to the combined water sewer within Elton Vale road via an existing connection. Runoff will be restricted to a maximum of 2.0l/s for the 100-year storm event plus a 45% allowance for climate change. Due to the relatively small roof area, no attenuation measures are required.

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.

Although it is envisaged that Prevention and Source Controls measures could be included in the final scheme, this strategy will assume for outline calculations purposes that only Site Control methods are incorporated. A fully detailed hydraulic surface water network has been simulated in the Causeway Flow Hydraulic Design Software. This takes into account the flow control of 2l/s and assumes no prevention measures are incorporated.

Drawing GK5191-C-001 in Appendix C indicates the Drainage Strategy based on the Architects masterplan intent, with the hydraulic calculations in Appendix D.

4.10 Volume Control

The impermeable area of the application site will be increased as a result of the development and therefore the volume of run-off in the 100-year 6-hour storm event will be increased above the pre-development greenfield level. The management of the additional volume through infiltration or re-use is not considered reasonably practicable for the development and therefore the rate of runoff will be restricted to a maximum of 2l/s, for all storm events, in order to prevent an adverse effect on flood risk.

4.11 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 residential parking bays are considered a low hazard in terms of contamination and pass through the permeable paving.

4.12 Maintenance

The long-term maintenance of the new drainage infrastructure will be with the property owner. 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 9 below.

Future Maintenance of the Drainage System			
Responsibility	Feature	Maintenance	Frequency
Owner	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.
	Permeable Paving	Brushing and Vacuuming, removal of weeds	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

4.13 Foul Water Drainage

Foul drainage generated from the new development will connect to a new below ground foul water network that outfalls via the same existing connection to the existing combined sewer in Elton Vale Road.

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

NOTES:

This drawing is the property of Equilibrium Architects and copyright is reserved by them. This drawing is not to be copied or disclosed by or to any unauthorised persons without the prior written consent of Equilibrium Architects.

Do not scale from this drawing.

All dimensions are to be checked on site prior to construction, manufacture of any components and ordering of materials and equipment.

Any discrepancies are to be reported to the architect for clarification.

All materials and workmanship to be in accordance with the current British Standards and codes of practice.

This drawing is to be read in conjunction with all relevant Architectural, Structural Engineers, Mechanical Engineers, Electrical Engineers and Specialists drawings and specifications.

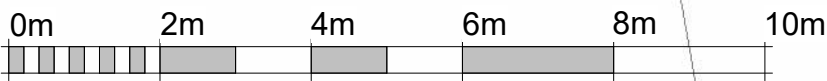
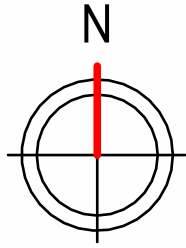
As with all construction projects the CDM 2015 regulations apply and the work on this project may require both the issue of a notification to the HSE (because of the duration of the works on site) and the client may also need to appoint a Principal Designer because there may be more than one contractor working on site.

The Principal Designer will be able to coordinate the pre-construction information and also ensure that all duty holders under CDM comply with their relevant duties.

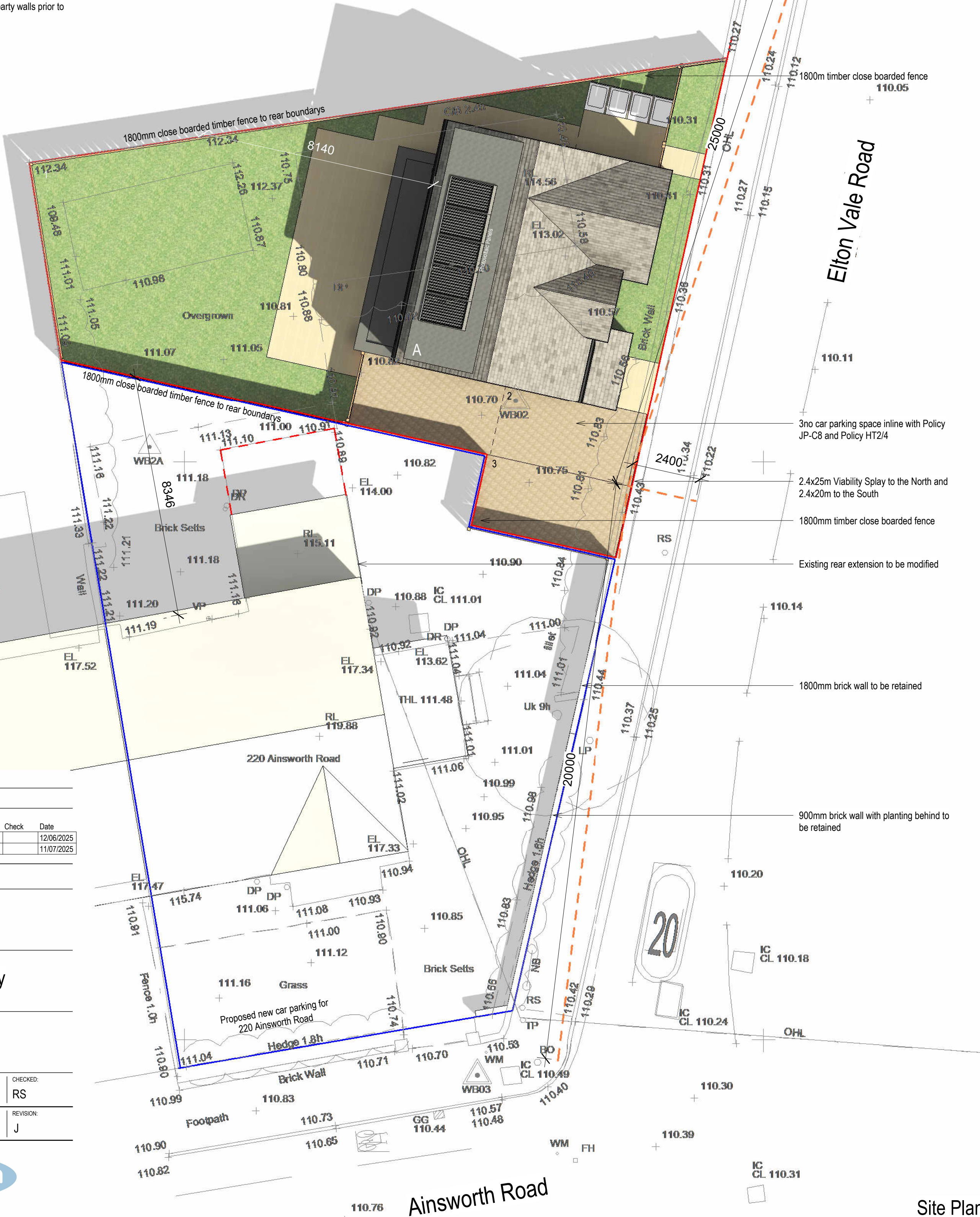
The building owner is to serve a Party Wall Act Notice as applicable to adjoining property owners as outlined in The Party Wall Act 1996. The Building Contractor is to verify the thickness of the party walls prior to commencement of the proposed works.

House Type A

4B7P
137.15sqm - 1476.27sqft



VISUAL SCALE 1:100 @ A2



DRAWING STATUS:			
Rev	Description	Check	Date
H	Topographical added		12/06/2025
J	Notes amended		11/07/2025

CLIENT:
Mr C. Hames

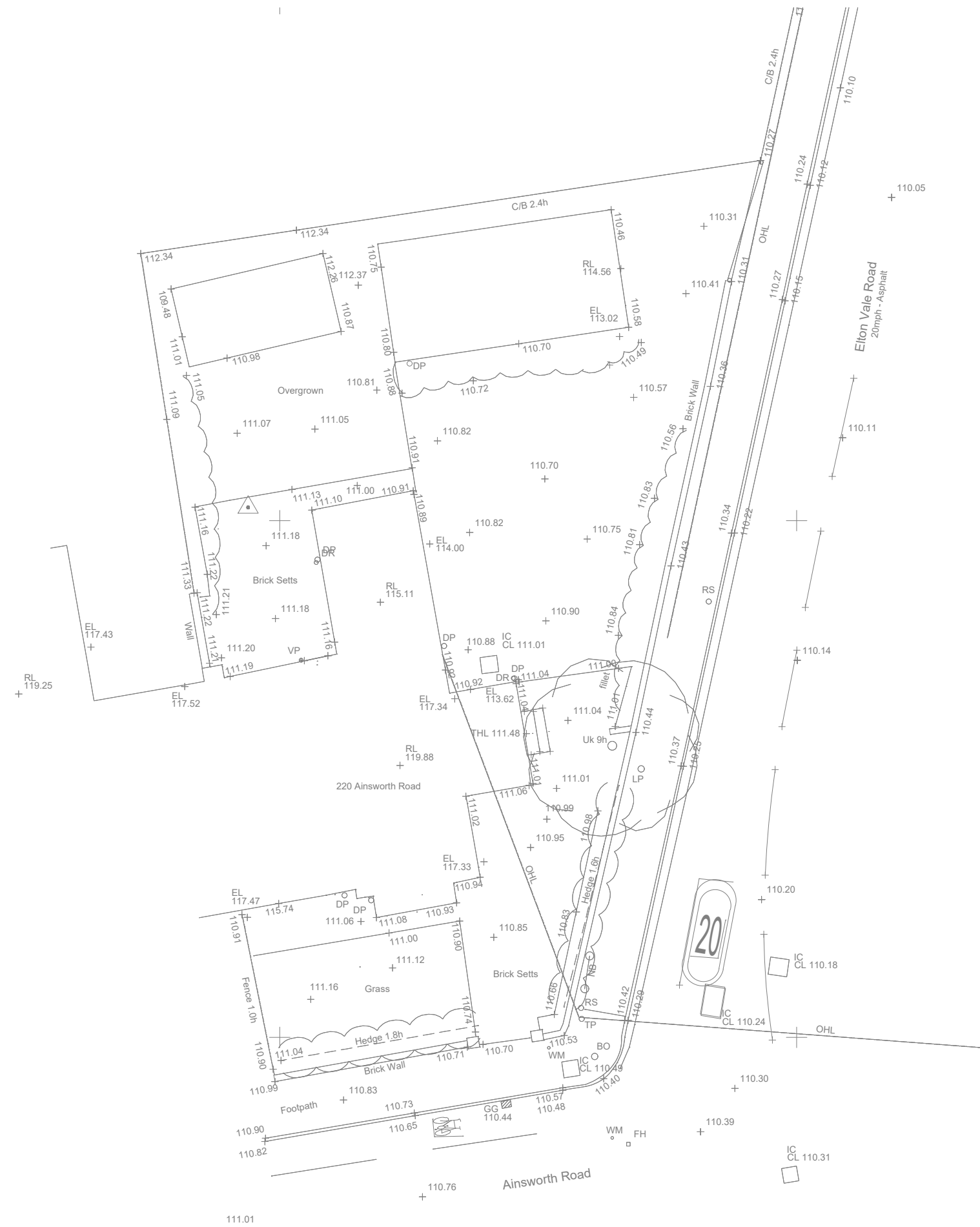
PROJECT:
220 Ainsworth Road, Bury

DRAWING:
Proposed Site Layout

SCALE at A2:	DATE:	DRAWN:	CHECKED:
1 : 100	03/12/2024	KS	RS
DRAWING NO:	CAD REFERENCE NO:	REVISION:	
R0819-01		J	



Appendix B – Topographical Survey



Appendix C - GWK Design Drawings

SURFACE WATER DRAINAGE

CONSIDERATION HAS BEEN GIVEN TO THE HIERARCHY OF DRAINAGE OPTIONS FOR THE SITE AS FOLLOWS:

- DISCHARGE INTO GROUND – DESK TOP INFORMATION WOULD INDICATE THAT THE UNDERLYING GROUND WILL NOT BE SUITABLE FOR INFILTRATION BASED OPTIONS.
- DISCHARGE TO SURFACE WATER BODY – NO ACCESSIBLE WATERCOURSE IN CLOSE PROXIMITY.
- DISCHARGE TO SURFACE WATER SEWER, HIGHWAY DRAIN OR OTHER DRAINAGE SYSTEM – NO SUITABLE SURFACE WATER SEWER IN CLOSE PROXIMITY.
- DISCHARGE TO COMBINED WATER SEWER – REUSE EXISTING CONNECTION TO THE COMBINED SEWER AT A PEAK RATE OF 2L/S.

SUDS TO ENCOMPASS:

- WATER BUTTS
- PERMEABLE SURFACING
- FLOW CONTROL

SUMMARY

IMPERMEABLE AREA: 80m² (TOTAL)
OUTFALL LOCATION: COMBINED SEWER
PEAK DISCHARGE RATE: 2L/S (100YR+ 45% CC)

FOUL WATER DRAINAGE

FOUL WATER GENERATED BY THE NEW DEVELOPMENT WILL DISCHARGE UNRESTRICTED TO THE COMBINED WATER SEWER VIA AN EXISTING CONNECTION.

NOTES: –

- ALL LEVELS ARE IN METRES.
- ALL DIMENSIONS ARE IN MILLIMETRES.
- 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.
- THE CONTRACTOR SHALL ENSURE ALL NECESSARY PRECAUTIONS ARE TAKEN TO PROTECT EXISTING SERVICES DURING THE WORKS.

KEY

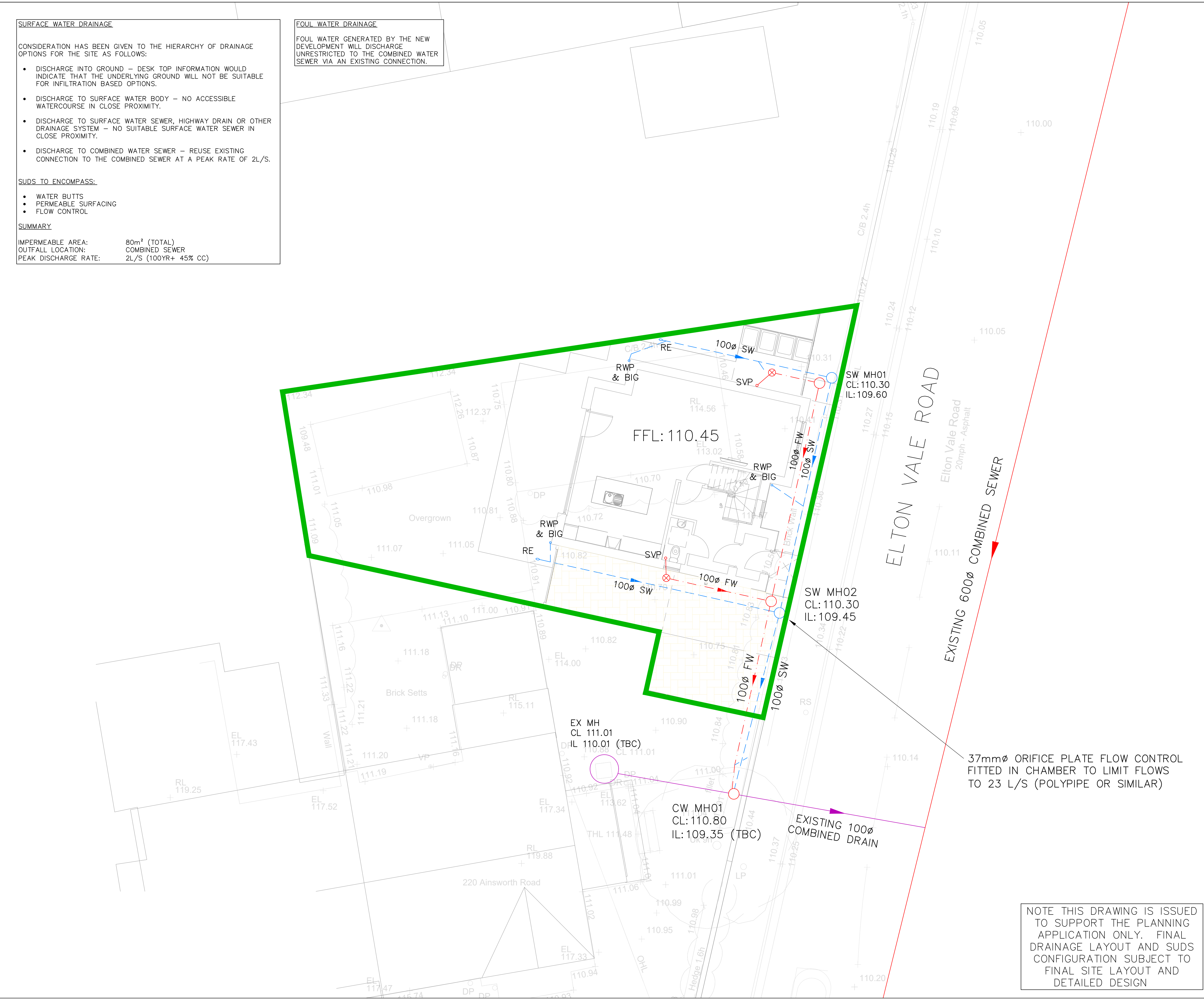
- EXISTING COMBINED WATER SEWER
- EXISTING COMBINED WATER DRAIN
- PROPOSED FOUL WATER DRAINAGE
- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED 450Ø PPIC
- PROPOSED 300Ø MINI PPIC (MAX 600 DP)
- RAINWATER PIPE
- SOIL VENT PIPE
- BACK INLET GULLY
- ROAD GULLY
- RODDING EYE
- PROPOSED PERMEABLE SURFACING
-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

A	25.06.25	PG	GWK	ISSUED FOR INFORMATION
No	DATE	DRAWN	REV'D ENG.	AMENDMENT



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CLIENT	MR C HAMES		
PROJECT	220 AINSWORTH ROAD, BURY		
DRAFTER	PG	ENGINEER	GWK
TITLE	DRAINAGE STRATEGY PLAN		
SCALE	DRAWING No	DATE	AMDT
1:75	GK5191-C-001	25.06.25	A



37mmØ ORIFICE PLATE FLOW CONTROL
FITTED IN CHAMBER TO LIMIT FLOWS
TO 23 L/S (POLYPIPE OR SIMILAR)

NOTE THIS DRAWING IS ISSUED
TO SUPPORT THE PLANNING
APPLICATION ONLY. FINAL
DRAINAGE LAYOUT AND SUDS
CONFIGURATION SUBJECT TO
FINAL SITE LAYOUT AND
DETAILED DESIGN

Appendix D - GWK Hydraulic Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	10	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Adoptable Manhole Type

Max Width (mm)	Diameter (mm)	Max Width (mm)	Diameter (mm)
374	1200	749	1500
499	1350	900	1800

>900 Link+900 mm

Max Depth (m)	Diameter (mm)	Max Depth (m)	Diameter (mm)
1.500	1050	99.999	1200

Circular Link Type

Template	Freeform Carrier	Auto Increment (mm)	75
Shape	Circular	Follow Ground	x
Barrels	1		

Available Diameters (mm)

100 | 150

twin Link Type Group

Link Type	Minimum size (mm)	Maximum size (mm)	Link Type	Minimum size (mm)	Maximum size (mm)
Circular			culvert 600	600	1200

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
RE01	0.004	5.00	110.300	100	0.600
SW01			110.300	450	0.700
RE02	0.004	5.00	110.300	100	0.700
SW02			110.300	450	0.850
CW01			110.800	450	1.450

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	RE01	SW01	7.500	0.600	109.700	109.600	0.100	75.0	100	5.14	50.0
1.001	SW01	SW02	10.000	0.600	109.600	109.450	0.150	66.7	100	5.32	50.0
2.000	RE02	SW02	10.500	0.600	109.600	109.450	0.150	70.0	100	5.19	50.0
1.002	SW02	CW01	7.000	0.600	109.450	109.350	0.100	70.0	100	5.44	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.889	7.0	0.5	0.500	0.600	0.004	0.0	19	0.528
1.001	0.944	7.4	0.5	0.600	0.750	0.004	0.0	18	0.547
2.000	0.921	7.2	0.5	0.600	0.750	0.004	0.0	18	0.533
1.002	0.921	7.2	1.1	0.750	1.350	0.008	0.0	26	0.661

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	7.500	75.0	100	Circular	110.300	109.700	0.500	110.300	109.600	0.600
1.001	10.000	66.7	100	Circular	110.300	109.600	0.600	110.300	109.450	0.750
2.000	10.500	70.0	100	Circular	110.300	109.600	0.600	110.300	109.450	0.750
1.002	7.000	70.0	100	Circular	110.300	109.450	0.750	110.800	109.350	1.350

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	RE01	100	Manhole	Adoptable	SW01	450	Manhole	Adoptable
1.001	SW01	450	Manhole	Adoptable	SW02	450	Manhole	Adoptable
2.000	RE02	100	Manhole	Adoptable	SW02	450	Manhole	Adoptable
1.002	SW02	450	Manhole	Adoptable	CW01	450	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
RE01	42.893	89.831	110.300	0.600	100				
						0	1.000	109.700	100
SW01	73.062	71.186	110.300	0.700	450		1	1.000	109.600
						0	1.001	109.600	100
RE02	26.791	66.949	110.300	0.700	100				
						0	2.000	109.600	100
SW02	55.774	45.424	110.300	0.850	450		1	2.000	109.450
						2	1.001	109.450	100
						0	1.002	109.450	100
CW01	41.876	20.678	110.800	1.450	450		1	1.002	109.350

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
Rainfall Events	Singular	Skip Steady State	x
FSR Region	England and Wales	Drain Down Time (mins)	240
M5-60 (mm)	20.000	Additional Storage (m³/ha)	20.0
Ratio-R	0.400	Starting Level (m)	
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	45	0	0

Node SW02 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	2.0		
Invert Level (m)	109.450	Diameter (m)	0.037		

Approval Settings

Node Size	✓	Minimum Full Bore Velocity (m/s)	
Node Losses	✓	Maximum Full Bore Velocity (m/s)	3.000
Link Size	✓	Proportional Velocity	✓
Minimum Diameter (mm)	150	Return Period (years)	
Link Length	✓	Minimum Proportional Velocity (m/s)	0.750
Maximum Length (m)	100.000	Maximum Proportional Velocity (m/s)	3.000
Coordinates	✓	Surcharged Depth	✓
Accuracy (m)	1.000	Return Period (years)	
Crossings	✓	Maximum Surcharged Depth (m)	0.100
Cover Depth	✓	Flooding	✓
Minimum Cover Depth (m)		Return Period (years)	30
Maximum Cover Depth (m)	3.000	Time to Half Empty	x
Backdrops	✓	Discharge Rates	✓
Minimum Backdrop Height (m)		Discharge Volume	✓
Maximum Backdrop Height (m)	1.500	100 year 360 minute (m³)	
Full Bore Velocity	✓		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	109.521	30.991	1 year 180 minute summer	23.233	5.979
1 year 15 minute winter	76.857	30.991	1 year 180 minute winter	15.102	5.979
1 year 30 minute summer	71.439	20.215	1 year 240 minute summer	18.475	4.882
1 year 30 minute winter	50.133	20.215	1 year 240 minute winter	12.274	4.882
1 year 60 minute summer	48.435	12.800	1 year 360 minute summer	14.169	3.646
1 year 60 minute winter	32.179	12.800	1 year 360 minute winter	9.210	3.646
1 year 120 minute summer	30.053	7.942	1 year 480 minute summer	11.185	2.956
1 year 120 minute winter	19.966	7.942	1 year 480 minute winter	7.431	2.956

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 600 minute summer	9.182	2.511	30 year 960 minute summer	14.215	3.743
1 year 600 minute winter	6.274	2.511	30 year 960 minute winter	9.416	3.743
1 year 720 minute summer	8.203	2.199	30 year 1440 minute summer	10.161	2.723
1 year 720 minute winter	5.513	2.199	30 year 1440 minute winter	6.829	2.723
1 year 960 minute summer	6.768	1.782	100 year +45% CC 15 minute summer	505.670	143.087
1 year 960 minute winter	4.483	1.782	100 year +45% CC 15 minute winter	354.856	143.087
1 year 1440 minute summer	4.949	1.326	100 year +45% CC 30 minute summer	332.000	93.944
1 year 1440 minute winter	3.326	1.326	100 year +45% CC 30 minute winter	232.982	93.944
30 year 15 minute summer	268.706	76.035	100 year +45% CC 60 minute summer	222.268	58.739
30 year 15 minute winter	188.566	76.035	100 year +45% CC 60 minute winter	147.669	58.739
30 year 30 minute summer	174.929	49.499	100 year +45% CC 120 minute summer	134.215	35.469
30 year 30 minute winter	122.757	49.499	100 year +45% CC 120 minute winter	89.169	35.469
30 year 60 minute summer	116.589	30.811	100 year +45% CC 180 minute summer	101.219	26.047
30 year 60 minute winter	77.459	30.811	100 year +45% CC 180 minute winter	65.795	26.047
30 year 120 minute summer	70.438	18.615	100 year +45% CC 240 minute summer	78.690	20.795
30 year 120 minute winter	46.797	18.615	100 year +45% CC 240 minute winter	52.280	20.795
30 year 180 minute summer	53.298	13.715	100 year +45% CC 360 minute summer	58.701	15.106
30 year 180 minute winter	34.645	13.715	100 year +45% CC 360 minute winter	38.157	15.106
30 year 240 minute summer	41.604	10.995	100 year +45% CC 480 minute summer	45.550	12.038
30 year 240 minute winter	27.641	10.995	100 year +45% CC 480 minute winter	30.262	12.038
30 year 360 minute summer	31.221	8.034	100 year +45% CC 600 minute summer	36.875	10.086
30 year 360 minute winter	20.295	8.034	100 year +45% CC 600 minute winter	25.195	10.086
30 year 480 minute summer	24.324	6.428	100 year +45% CC 720 minute summer	32.556	8.725
30 year 480 minute winter	16.160	6.428	100 year +45% CC 720 minute winter	21.879	8.725
30 year 600 minute summer	19.756	5.404	100 year +45% CC 960 minute summer	26.340	6.936
30 year 600 minute winter	13.498	5.404	100 year +45% CC 960 minute winter	17.448	6.936
30 year 720 minute summer	17.490	4.687	100 year +45% CC 1440 minute summer	18.700	5.012
30 year 720 minute winter	11.754	4.687	100 year +45% CC 1440 minute winter	12.567	5.012

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	RE01	10	109.720	0.020	0.6	0.0028	0.0000	OK
15 minute winter	SW01	11	109.619	0.019	0.6	0.0030	0.0000	OK
15 minute winter	RE02	10	109.619	0.019	0.6	0.0023	0.0000	OK
15 minute winter	SW02	12	109.561	0.111	1.1	0.0177	0.0000	SURCHARGED
15 minute winter	CW01	13	109.373	0.023	0.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	RE01	1.000	SW01	0.6	0.542	0.081	0.0078	
15 minute winter	SW01	1.001	SW02	0.6	0.221	0.075	0.0441	
15 minute winter	RE02	2.000	SW02	0.6	0.432	0.078	0.0462	
15 minute winter	SW02	1.002	CW01	0.8	0.607	0.117	0.0097	0.5

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	RE01	10	109.730	0.030	1.4	0.0042	0.0000	OK
15 minute winter	SW01	14	109.729	0.129	1.4	0.0204	0.0000	SURCHARGED
15 minute winter	RE02	13	109.729	0.129	1.4	0.0158	0.0000	SURCHARGED
15 minute winter	SW02	13	109.727	0.277	2.0	0.0440	0.0000	SURCHARGED
15 minute winter	CW01	14	109.380	0.030	1.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	RE01	1.000	SW01	1.4	0.639	0.197	0.0365	
15 minute winter	SW01	1.001	SW02	0.9	0.244	0.127	0.0782	
15 minute winter	RE02	2.000	SW02	1.0	0.489	0.140	0.0822	
15 minute winter	SW02	1.002	CW01	1.4	0.700	0.196	0.0142	1.3

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	RE01	14	109.922	0.222	2.6	0.0313	0.0000	SURCHARGED
15 minute winter	SW01	14	109.920	0.320	2.4	0.0508	0.0000	SURCHARGED
15 minute winter	RE02	14	109.920	0.320	2.6	0.0390	0.0000	SURCHARGED
15 minute winter	SW02	14	109.917	0.467	2.6	0.0742	0.0000	SURCHARGED
15 minute winter	CW01	15	109.385	0.035	1.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	RE01	1.000	SW01	2.4	0.693	0.337	0.0587	
15 minute winter	SW01	1.001	SW02	1.2	0.241	0.165	0.0782	
15 minute winter	RE02	2.000	SW02	1.8	0.495	0.255	0.0822	
15 minute winter	SW02	1.002	CW01	1.9	0.754	0.259	0.0174	2.4