

3421 57 River Road, Littlehampton
Drainage Assessment
February 2025

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Revision	Date	Status
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Approved by:	David Purcell	

1 Introduction

AKT II have been commissioned to undertake a foul and surface water drainage strategy in support of the proposed redevelopment of 57 River Road, Littlehampton on behalf of 'the Client', Brownfield Estates.

The site area is approximately 475 m² and consists of an auto repair unit as existing, which will be redeveloped to form 9 residential units as proposed.

The site is located at 57 River Road, Littlehampton and the Northings and Eastings for the development land are 102109, 502371 respectively.

The topography of the development land is broadly flat with the maximum level difference approximately 0.1 m. The average ground surface level on site is approximately 3.40 m AOD.

This report is intended to cover only the aspects of drainage design and provide the guidelines and parameters for the detailed design at later /more advanced stages of the project

This report has been prepared in accordance with the guidance contained in the National Policy Framework (NPPF) and the accompanying Planning Practice guidance and a more detailed explanation of the requirements nationally and locally are laid out in Section 2 of this report.

The following drainage report and strategy will need to be approved by the Lead Local Flood Authority (LLFA) to obtain planning approval and satisfy the relevant consultees (the local Water Authority and the Environment Agency, where relevant)



Figure 1.1 Site

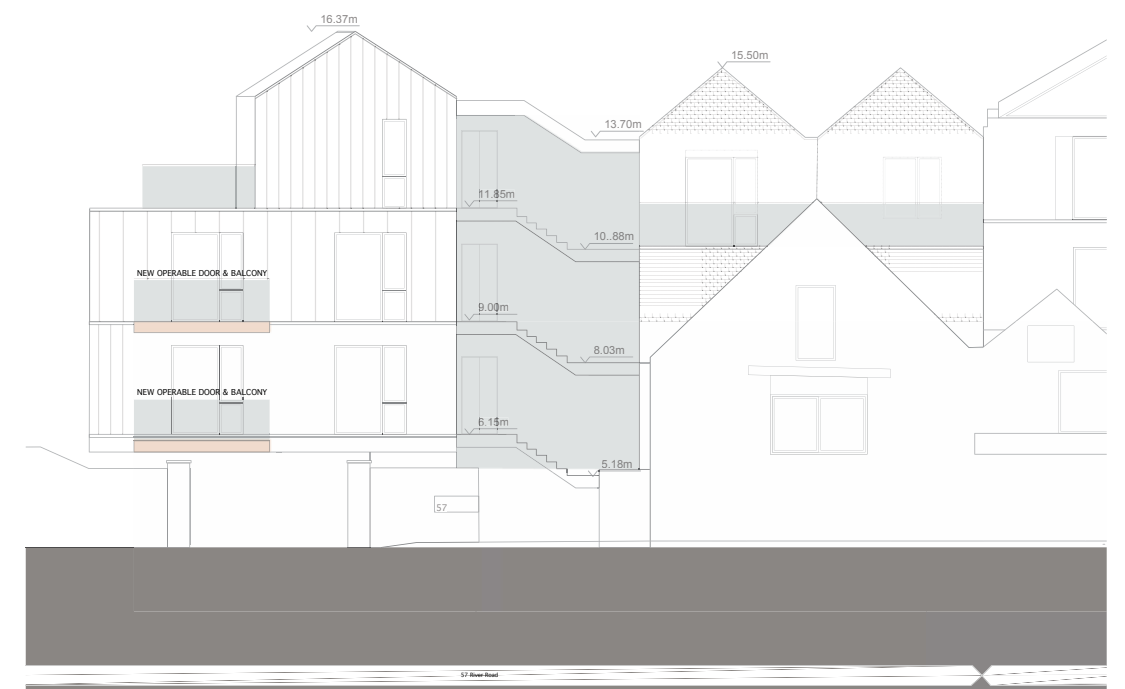


Figure 1.2 Site

2 Executive Summary

	SCOPE
Purpose of the report	To highlight the drainage proposals for the site.
Current Site status	Location of Riverside Autos workshop and yard
Future Site end-use	Residential
Development Proposal	Demolish and rebuild
	SITE INFORMATION
National Grid Reference	502371 E, 102109 N
Site Area	Approximately 475 m²
Geology	The superficial geology map indicates that the Site is underlain by Raised Beach Deposits, 1 - Sand and gravel and the bedrock geology map indicates the Site is underlain by Lewes Nodular Chalk, Seaford Chalk, Newhaven Chalk, Culver Chalk and Portsdown Chalk Formations - Chalk.
Hydrogeology	The Environment Agency’s new aquifer designation map indicates that the superficial Raised Beach Deposits are classified as a Secondary A Aquifer and the Lewes Nodular Chalk Formation is classified as a Principal Aquifer. The site is not located within an Environment Agency designated source protection zone (SPZ). The groundwater level will be confirmed during a site-specific ground investigation.
Hydrology	The nearest water feature is the River Arun.
	SURFACE WATER DRAINAGE DESIGN
Conceptual scheme design	Surface water from the roof areas will discharge to the public sewer at an attenuated rate of 1.7 litres/sec. Surface water from the car park areas will drain to the river Arun through conduits provided by the Environment Agency as part of their flood defence improvement works.
	FOUL WATER DRAINAGE DESIGN
Conceptual scheme design	Foul water will drain to the public sewer in River Road.

3 The Site

3.1 Site Location

The Site is located at River Road, Littlehampton and is bounded to the north east by River Road, to the north west by 47 River Road, to the south east by 49 River Road and to the south west by the River Arun.

The Site is located within Flood Zone 3a (land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year).

The Site is not located within a conservation area and there are no listed buildings in close proximity to the Site.

The National Grid Reference for the site is TQ 02371 02109 and the nearest postcode is BN17 5DB.

Figures 3.1 to 3.3 below show the location of the proposed development.



Figure 3.1 Site Location (StreetMap)

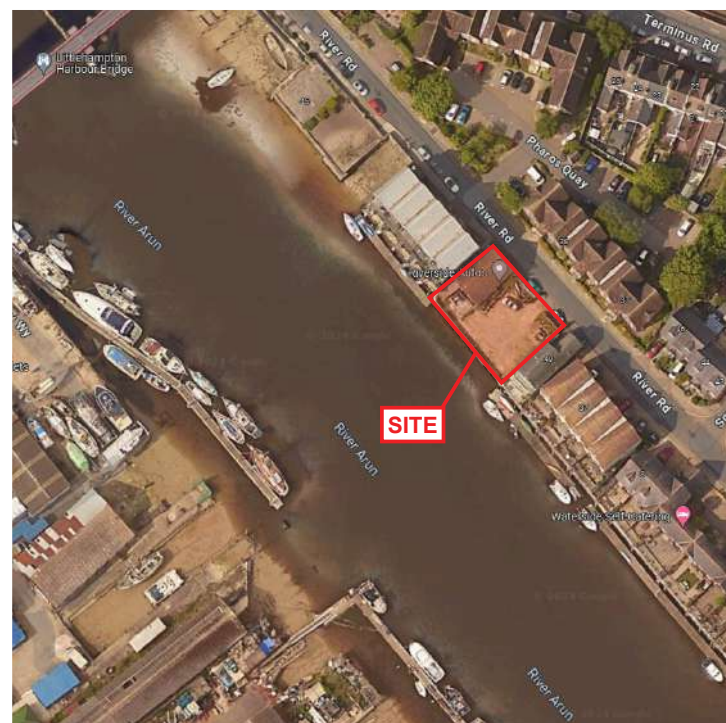


Figure 3.2 Site Location (Google Earth)

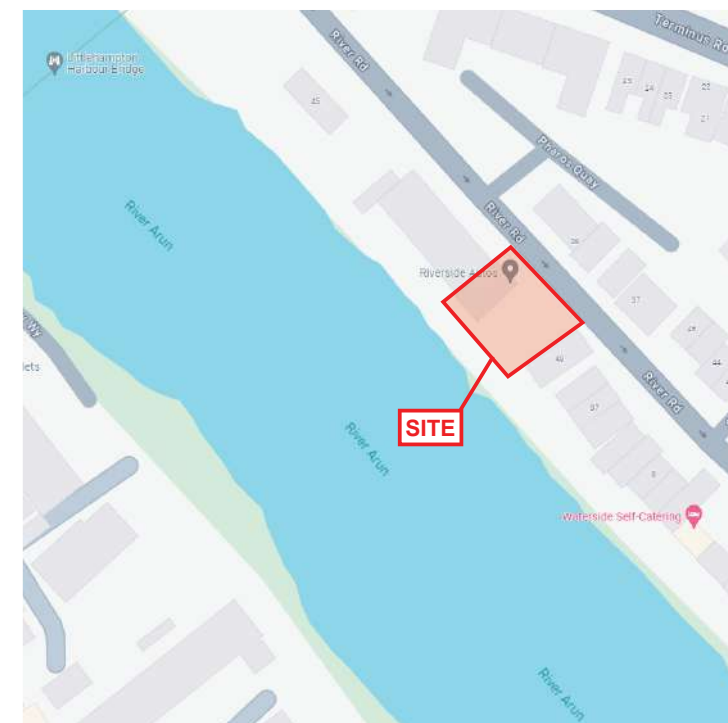


Figure 3.3 Site Location (Google Maps)

3.2 Site Description

The adjacent recently developed site, 47 River Road, is the first property on the eastern bank of Littlehampton's Arun riverside just after entering the town from the A258 across a bridge. It was developed originally in the early 19th Century as home to a small blacksmith's shop and warehouses and in recent years was used as a car repair workshop. The current site, 57 River Road, is a further workshop building associated with the garage and the yard area that serves it.

3.2.1 Topography

The site occupies an area of approximately 475 m² and is fairly flat with the maximum level difference approximately 0.1 m. The average ground surface level on site is approximately 3.40 m AOD. A site specific topographical survey for 55-57 River Road has been included in Appendix 1 for reference.

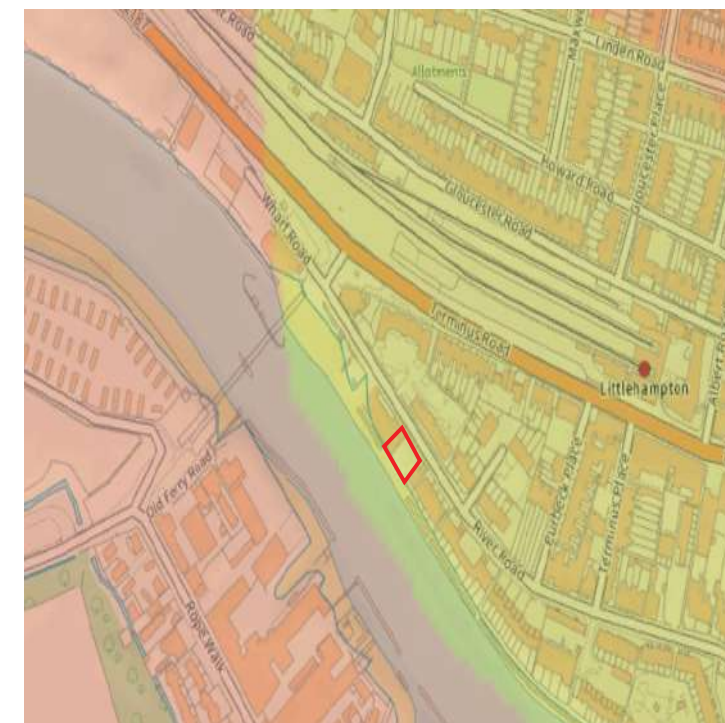


Figure 3.4 BGS Combined Geology Map

3.2.2 Geology

The following maps related to the Site's geology were received by Envirocheck:

- BGS Superficial Geology Map
- BGS Bedrock Geology Map
- BGS Combined Geology Map (Figure 3.4 below)

The superficial geology map indicates that the Site is underlain by Raised Beach Deposits, 1 - Sand and gravel and the bedrock geology map indicates the Site is underlain by Lewes Nodular Chalk, Seaford Chalk, Newhaven Chalk, Culver Chalk and Portsdown Chalk Formations - Chalk.

Published British Geological Survey maps and borehole records indicate that the geology underlying the Site comprises Made Ground, loose clayey to very clayey gravelly sand and structureless chalk.

The superficial Raised Beach Deposits are classified as a Secondary A Aquifer. Secondary A aquifers comprise permeable layers that can support local water supplies, and may form an important source of base flow to rivers

The Lewes Nodular Chalk Formation is classified as a Principal Aquifer, as per the Bedrock Aquifer map (Figure 3.5). Principal aquifers provide significant quantities of drinking water, and water for business needs. They may also support rivers, lakes and wetlands.

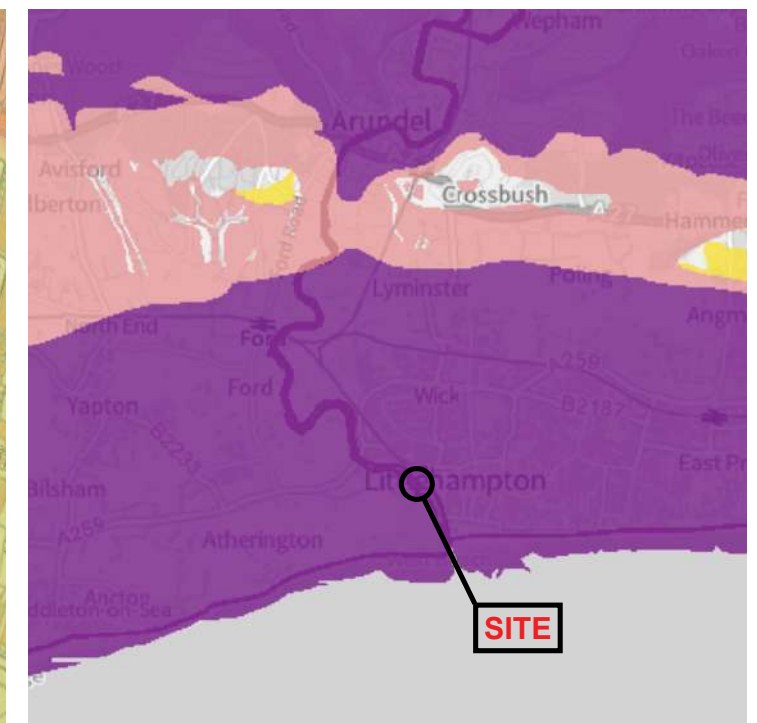


Figure 3.5 Bedrock Aquifer Map

3.2.3 Groundwater

The closest BGS borehole to the site is located within the existing yard area and recorded a groundwater level 4.25m below ground level (approximately -1.0m AOD).

3.2.4 Source Protection zones

The site is not located within a Source Protection Zone (Figure 3.6).

3.3 Development Proposals

It is proposed to redevelop the site for residential purposes in a similar manner to the adjacent site 47 River Road which is owned by the same developer and has already received planning permission.

The ground floor level will consist of communal car parking, bicycle parking, bin store areas and residential space and the three upper floors will provide the habitable residential space.

Nine apartments are proposed with each apartment ranging from two to three bedrooms.

All habitable space has a finished floor level above 5.18m.

The proposed plans are shown in Figures 3.7 to 3.10 for reference.

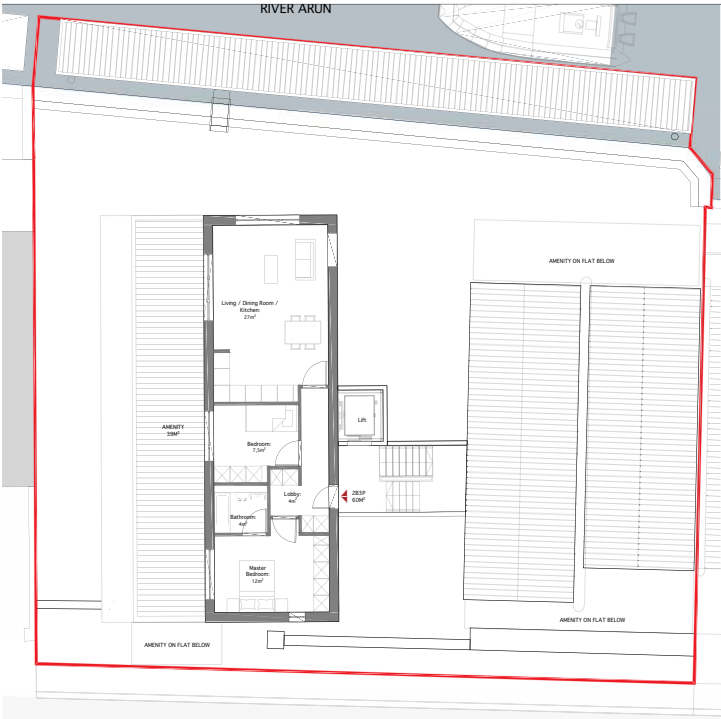


Figure 3.10 Proposals - Third Floor



Figure 3.6 Source Protection Zone Map

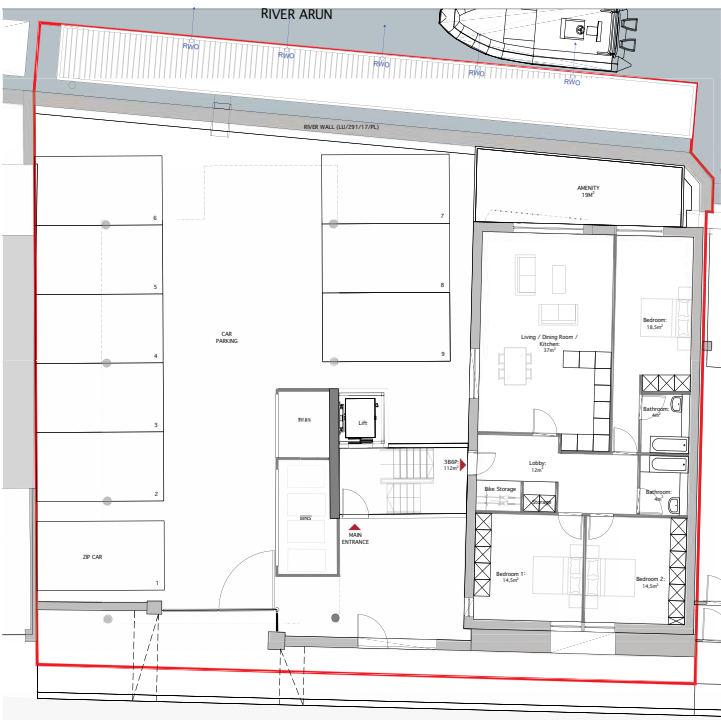


Figure 3.7 Proposals - Ground Floor

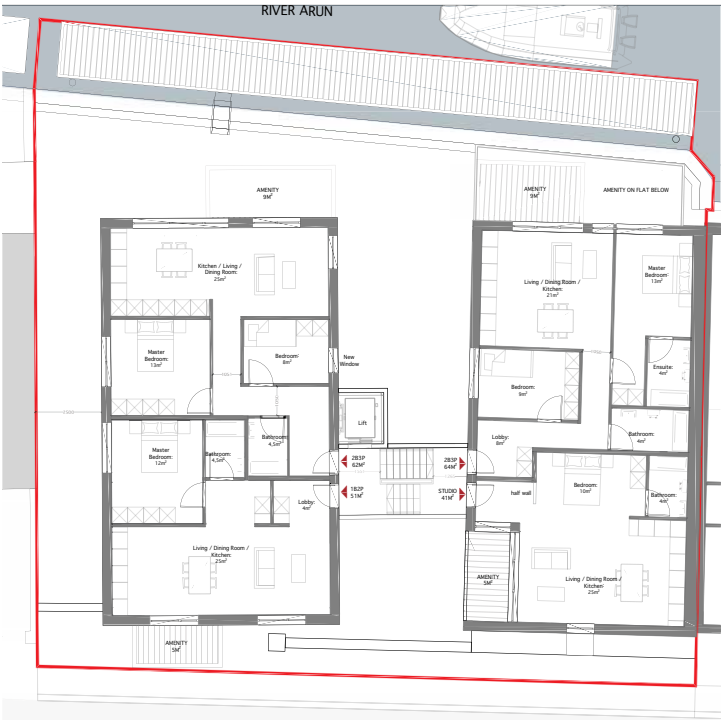


Figure 3.8 Proposals - First Floor

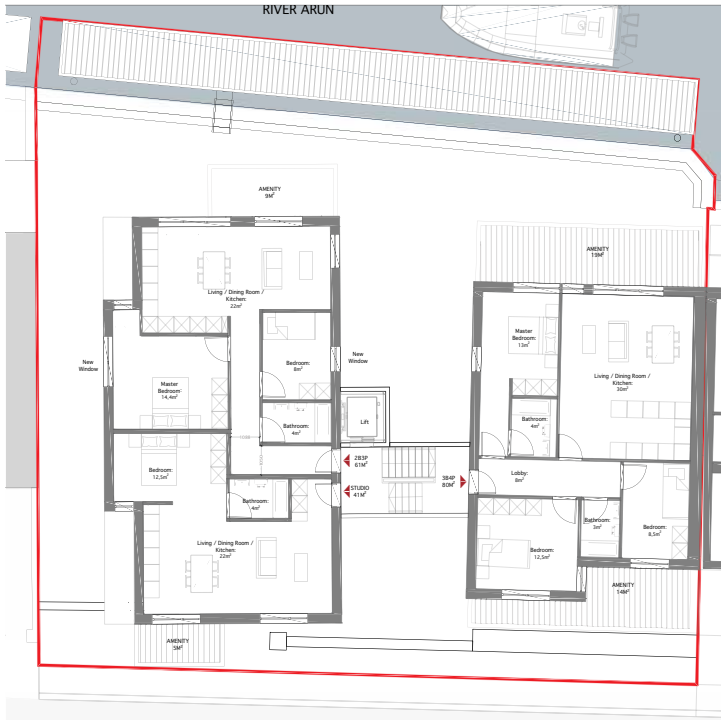


Figure 3.9 Proposals - Second Floor

4 Design Standards

4.1 National Standards

The following guides and current British Standards will be used for the design of the drainage elements on this project:

- BS EN 752:2017 Drain and Sewer Systems Outside Buildings. Sewer System Management
- BS EN 12056 Gravity Drainage Systems Inside Buildings: Part 2
- Building Regulations 2010 Part H1 – Foul Water Drainage (2015 Edition)
- Building Regulations 2010 Part H2 – Wastewater Treatment Systems and Cesspools (2015 Edition)
- Building Regulations 2010 Part H3 – Rainwater Drainage (2015 Edition)
- Building Regulations 2010 Part H4 – Building Over Sewers (2015 Edition)
- Building Regulations 2010 Part H5 – Separate Systems of Drainage (2015 Edition)
- Building Regulations 2010 Part H6 – Solid Waste Storage (2015 Edition)
- Environment Agency “Control of Runoff from New Developments Interim Regional Guidance”
- National Planning Policy Framework Planning Practice Guidance

4.2 National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) superseded Planning Policy Statement 25 “Development and Flood Risk” (PPS 25) although the requirements and goals remain essentially the same:

- The susceptibility of land to flooding is a material planning consideration;
- The Environment Agency has the lead role in providing advice on flood issues, at a strategic level and in relation to planning applications;
- Planning decisions should apply the precautionary principle to the issue of flood risk, using a risk-based search sequence to avoid inappropriate development on undeveloped and undefended flood plains etc;
- Developers should fund flood defences and warning measures required because of the development;
- Planning policies and decisions should recognise that the consideration of flood risk and its management needs to be applied on a whole-catchment basis and not only be restricted to flood plains.

With regard to the NPPF, those proposing particular developments are responsible for:

- Providing an assessment of whether any proposed development is likely to be affected by flooding and whether it will increase flood risk elsewhere and the measures proposed to deal with these effects and risks and;
- Satisfying the local planning authority that any flood risk to the development or additional risk arising from the proposal will be successfully managed with the minimum environmental effect thus ensuring the safe development and secure future occupancy of the site.

After this has been addressed, it is then the local planning authority’s responsibility (advised as necessary by the Environment Agency on fluvial and tidal flood risk, and the LLFA on surface water flood risk) to determine an application for planning permission after taking into account all material considerations, including the issue of flood risk and how it might be managed or mitigated. Local planning authorities are required to adopt a risk-based approach to proposals for development in flood risk areas.

5 Surface water drainage

5.1 Existing scheme

It is believed that until the recent upgrade of the flood wall along the edge of the site, all surface water from the existing building and yard area discharged directly to the public sewer in River Road without any form of attenuation. As part of the upgrade works, rainwater outlets were provided along the wall to allow part of the exisitng yard to drain to the river.

5.1.1 Site Characteristics

- Total site area = 475 m²
- Existing impermeable area = 475 m²
- Percentage Impermeable (PIMP) = 100%
- M5-60min = 19 mm
- Ratio r = 0.35
- IH 124 Soil Type = 2

Detailed calculations are contained in Appendix B for reference. The discharge rates and volumes are summarised below.

Return Period	Existing peak runoff rate¹	Greenfield Run Off Rate²	Existing Discharge Volume³
1 year	5.4 litres/sec	0.08 litres/sec	1.11 m³
30 year	11.2 litres/sec	0.22 litres/sec	2.31 m³
100 year	14.5 litres/sec	0.29 litres/sec	3.00 m³
100 year (+40%)	20.3 litres/sec	0.32 litres/sec	4.19 m³

¹ The existing run off rates were determined by the Wallingford Rational Method with a rainstorm of 15 minutes duration

² Calculated based on EA "Rainfall runoff management for developments"

³ Based on BS 8582 Section 9.8

5.2 Proposed scheme

The philosophy for the proposed SUDS strategy is to provide an attenuation tank with a flow control to limit the discharge rate to 1.7 litres/sec (50% of the existing 1 in 1 year rate for the roof area).

The proposed drainage strategy drawings are contained in Appendix D for reference.

The SuDS selection process undertaken is outlined in detail in Appendix C and the proposed SuDS devices are summarised in Figure 5.3 below.

5.2.1 Design criteria and modelling results

- Proposed impermeable area = 475 m²
- Percentage Impermeable (PIMP) = 100%
- Climate change allowance = 40% ("Upper Limit" of the DEFRA guidance (refer to Figure 5.4 below)
- Standard Annual Average Rainfall (SAAR) = 700 mm
- Volumetric runoff coefficient C_v (summer) = 0.95
- Volumetric runoff coefficient C_v (winter) = 0.95
- Hydrological Growth Curve Region = 6/7 (South East England)

The InfoDrainage results demonstrate that all water is contained within the proposed drainage system for every event up to and including the 1 in 100 year plus 40% climate change allowance event.

Detailed calculations for the proposed run off rates and discharge volumes are contained in Appendix B for reference and are summarised below.

Return Period	Existing Peak run off rate ¹ (litres/sec)	Proposed scheme unattenuated peak run off rate (litres/sec)	Greenfield run off rate (litres/sec)	Proposed Design Peak run off rate (litres/sec)	Existing Discharge Volume (m ³)	Proposed Discharge Volume (m ³)
1 in 1 year	5.4	5.4	0.08	0.8	1.11	0.71
1 in 30 years	11.2	11.2	0.22	1.3	2.31	1.48
1 in 100 years	14.5	14.5	0.29	1.6	3.00	1.92
1 in 100 years (+40%)	20.3	20.3	0.32	1.7	4.19	2.69

¹ The existing run off rates were determined by the Wallingford Rational Method with a rainstorm of 15 minutes duration and an assumed runoff of 100% for impermeable areas and 0% for permeable areas

5.2.2 Water quality and quantity

The proposed uses of the site along with the SuDS measures proposed will ensure that water leaving the site through the piped system to the sewer will be of good quality.

The proposed drainage strategy will provide a reduction in the peak flow rate and volume of surface water leaving the site and will therefore reduce the potential risk to the site itself and also the surrounding area from overland flow or sewer flooding.

Element	Management stage	Water quantity	Water quality	Amenity & biodiversity	Proposed in scheme
Rainwater harvesting	Prevention	✓	✗	✗	✗
Green/brown / blue roof	Source control	✓	✓	✓	✗
Raingardens	Source control	✓	✓	✓	✗
Bio-retention	Source control	✓	✓	✓	✗
Permeable surfacing	Source control	✓	✓	✗	✗
Swales	Source control	✓	✓	✓	✗
Detention basin / ponds	Source control	✓	✓	✓	✗
Discharge to tidal river / dock / canals	Site control	✓	✗	✗	✓
Storage tanks / Geocellular storage	Site control	✓	✗	✗	✓
Oversized piping	Site control	✓	✗	✗	✗
Design for exceedance	Site control	✓	✗	✗	✗

Figure 5.1 Summary of proposed SuDS devices

Range	Total potential change anticipated for 2010-2039	Total potential change anticipated for 2040-2059	Total potential change anticipated for 2060-2115
Upper end	10%	20%	40%
Central	5%	10%	20%

Figure 5.2 Peak rainfall intensity climate change allowance

6 Foul water drainage

6.1 Existing scheme

It is believed that all foul water from the existing building currently discharges directly to the public sewer in River Road.

As floor plans are not available for the existing building it has not been possible to accurately assess the current foul water discharge rate from the site. A rate of 5 litres/sec has been estimated based on the current use.

6.2 Proposed scheme

The proposed foul water discharge rate from the site has been calculated as **3.91 litres/sec** (detailed calculations are contained in Section B.2 of Appendix B for reference).

Although it has not been possible to make an assessment of the existing foul water flow, it is believed that it will be comparable to the proposed rates.

It is assumed that the new foul water drainage from ground floor level and above will be drained by gravity to the public sewer in River Road mimicking the existing situation.

- The developer must ensure that all warning and evacuation plans are in place.
- Surface water from the proposed development can drain to the River Arun through a single outlet
- Any surface water from car park areas should be passed through oil-trapped gullies prior to discharge to the river.
- An appropriately sized tank will be required to store any backup of surface water caused by the outfall being tide-locked due to high water levels in the river.
- Therefore, the proposed redevelopment has an acceptable flood risk within the terms and requirements of the National Planning Policy Framework.



Figure 7.1 Environment Agency indicative flood map

8 Maintenance and operation

Before cleaning, final testing and immediately before handover the Contractor will:

- Lift covers to manholes, inspection chambers and access points. Remove mortar droppings, debris and loose wrappings.
- Thoroughly flush pipelines with water to remove silt and check for blockages. Rod pipelines between access points if there is any indication that they may be obstructed.
- Carry out a CCTV of the pipework to ensure that it is free of silt and blockages.

The End User shall then follow the “Waste Management, The Duty of Care – A Code of Practice (Revised 1996)” and shall ensure that their waste does not escape from their control and is transferred only to a registered waste carrier to be sent for recycling or disposal at a suitably licensed facility.

All waste arising from the maintenance of the drains and sewers shall be handled, stored and disposed of correctly to avoid pollution. Waste may be designated as hazardous / special waste and, as such, the End User shall ensure that they comply with the Hazardous Waste (England and Wales) Regulations 2005.

Reference shall be made to CIRIA publication C753 - The SuDS Manual by the Contractor and the End User. A suitable maintenance schedule must be developed, maintained, followed and updated as required to reflect observed performance. The following items are highlighted for guidance.

8.1 General drainage

The below ground drainage network has been designed in accordance with the requirements of the Building Regulations whilst acknowledging the need to limit the number of inspection chambers within “front of house” areas. To this end, all main runs have rodding eyes, manholes or inspection chambers at the head of the run and at all changes of direction to provide access to rod or jet the main pipework.

Where possible, connections from stacks or gullies have been made directly to these manholes or inspection chambers to allow the connection to be rodded or jetted from the downstream end. Where this is not possible, each stack has been detailed to have an access hatch provided just above floor level (see Figure 5.1) to allow the connection to be rodded or jetted from the upstream end. Similarly, the gullies have a rodding access provided within their body allowing the pipework to be rodded or jetted from the gully downstream.

Gullies and channels have been specified with silt buckets and silt trap manholes have been provided upstream of all tanks and infiltration structures to prevent the ingress of silts into the drainage network and impairing the performance of the system.

Maintenance schedule	Required action	Recorded frequency
Regular maintenance	Inspect and identify areas that are not operating correctly. If required, take remedial action.	Monthly for the first three months then six-monthly
	Remove sediment from pre-treatment structures (e.g. gullies, channels, silt traps).	Six-monthly or as required
Occasional maintenance	Debris removal from catchment surface where this may cause risks to performance.	Monthly
Remedial actions	Repair / rehabilitation of inlets, outlets, overflows and vents.	As required
Monitoring	Inspect all manholes, inspection chambers, inlets, outlets, overflows and vents to ensure they are in good condition and operating as designed.	Annually and after large storms

8.2 Attenuation tanks

By aligning AquaCell Plus units end-to-end,full length viewing channels have been created within the base of the attenuation tank allowing for CCTV inspection if required. CCTV inspection of the tank is recommended at six-monthly intervals and after every major storm. Should the CCTV reveal a build up of silt in the base of the tank these channels also allow for jetting of the tank structure to clear the system.

Silt traps prior to inlet pipework should be routinely inspected and cleaned out to minimise debris reaching the tank. It is important to prevent construction silt from entering the AquaCell structure.

The table below provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/ or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

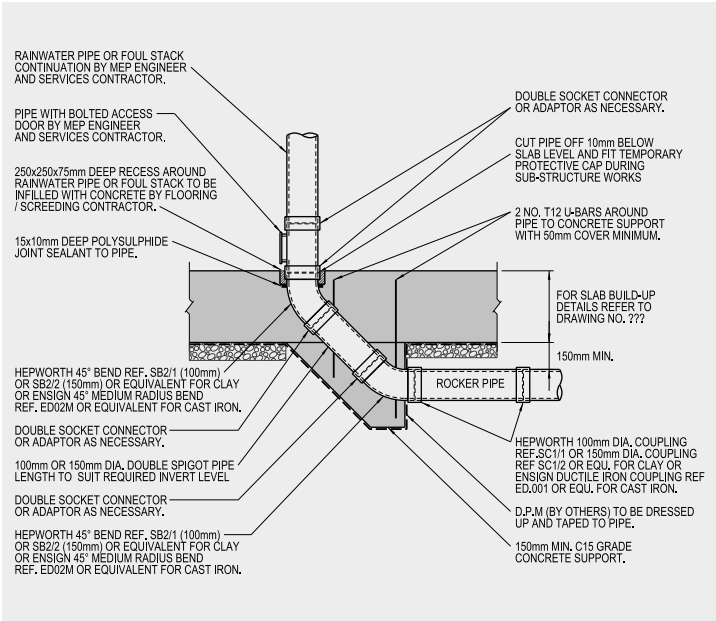
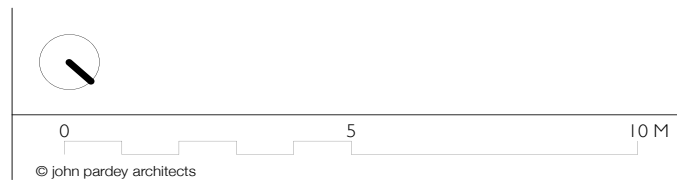


Figure 8.1 Rodding/jetting access detail

Appendix A

Topographic survey





STATUS:	PLANNING
SCALE:	1:125 @ A3
DATE:	SEPTEMBER 2020

DRAWING NO:	1908_P_150
TITLE:	TOPOGRAPHIC SURVEY
PROJECT:	57 RIVER ROAD, LITTLEHAMPTON

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Appendix B

Calculations



B.1 Climate Change Allowance

In the following calculations, a climate change allowance of 40% has been made which corresponds with the “Upper Limit” of the DEFRA guidance (refer to the table below):

Range	Total potential change anticipated for 2010-2039	Total potential change anticipated for 2040-2059	Total potential change anticipated for 2060-2115
Upper end	10%	20%	40%
Central	5%	10%	20%

B.2 Existing site surface water runoff rates

The development site occupies a total area of 475 m² which is currently entirely hardstanding.

In accordance with the Modified Rational Method, the peak existing run-off from the site is calculated from the formula:

$$Q = 3.61 \times C_v \times A \times i$$

where C_v is the volumetric runoff coefficient, A is the catchment area in hectares and i is the peak rainfall intensity in mm /hr.

For this site, the following site characteristics have been used in the calculation:

- M5-6omin = 19 mm
- Ratio r = 0.35
- Peak run off rates have been based on a 15 minute rainfall event
- Impermeable Area Factor = 1.00
- Permeable Area Factor = 0.00
- C_v = 0.95

For the peak return period storm events this gives existing discharge rates from the site of:

$$Q_1 = 3.61 \times 0.95 \times 0.0475 \times 33.3 = \textbf{5.4 litres/sec}$$

$$Q_{30} = 3.61 \times 0.95 \times 0.0475 \times 68.8 = \textbf{11.2 litres/sec}$$

$$Q_{100} = 3.61 \times 0.95 \times 0.0475 \times 89.0 = \textbf{14.5 litres/sec}$$

$$Q_{100+cc} = 3.61 \times 0.95 \times 0.0475 \times 124.6 = \textbf{20.3 litres/sec}$$

Splitting these proportionately between the proposed roof and car park areas gives:

Return Period	Roof	Car Park
1 year	3.47 litres/sec	1.93 litres/sec
30 year	7.19 litres/sec	4.01 litres/sec
100 year	9.31 litres/sec	5.19 litres/sec
100 year (+40%)	13.03 litres/sec	7.27 litres/sec

B.3 Existing Discharge Volumes

The existing discharge volumes have been calculated in accordance with BS 8582 which requires the volume for the 6 hour storm event to be considered. The volume discharged during the storm event is calculated from the formula:

$$Vol_x = A \times i \times 6 \text{ hrs}$$

where A is the existing hardstanding area in hectares and i is the X-year, 6 hour event rainfall intensity in mm /hr.

$$Vol_1 = 0.0475 \times 3.90 \times 6 = \textbf{1.11 m³}$$

$$Vol_{30} = 0.0475 \times 8.11 \times 6 = \textbf{2.31 m³}$$

$$Vol_{100} = 0.0475 \times 10.51 \times 6 = \textbf{3.00 m³}$$

$$Vol_{100+cc} = 0.0475 \times 14.71 \times 6 = \textbf{4.19 m³}$$

B.4 Existing Runoff Summary

The existing runoff values are summarised below:

Return Period	Existing peak runoff rate	Existing Discharge Volume
1 year	20.6 litres/sec	48.4 m³
30 year	43.1 litres/sec	100.9 m³
100 year	65.6 litres/sec	130.8 m³
100 year (+40%)	78.3 litres/sec	183.2 m³

B.5 Greenfield Runoff Rates

In accordance with the method outlined in the Institute of Hydrology Report 124, the Greenfield runoff for the site is calculated from the formula:

$$Q_{BAR} = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$$

where AREA is the site area in km² (pro rata of 50 ha if the site is less than 50 ha), SAAR is the Standard Average Annual Rainfall in mm and SOIL is the Soil Index. For this site, the following site characteristics have been used in the calculation:

- IH 124 Soil Type = 2, therefore, SOIL = 0.3
- Standard Annual Average Rainfall (SAAR) = 700 mm
- Hydrological Growth Curve Region = 6/7 (South East England)

For a 50 ha site this gives a greenfield runoff rate of:

$$Q_{BAR} = 0.00108 \times 0.5^{0.89} \times 700^{1.17} \times 0.30^{2.17} = \textbf{91.1 litres/sec}$$

Scaling this for the actual site area gives:

$$Q_{BAR} = (91.1 \times 0.0475) \div 50 = \textbf{0.09 litres/sec}$$

Using the Hydrological Growth Curve for south east England, gives:

$$Q_1 = 0.850 \times 0.09 = \textbf{0.08 litres/sec}$$

$$Q_{30} = 2.400 \times 0.09 = \textbf{0.22 litres/sec}$$

$$Q_{100} = 3.190 \times 0.09 = \textbf{0.29 litres/sec}$$

$$Q_{100+cc} = 3.61 \times 0.09 = \textbf{0.32 litres/sec}$$

B.6 Proposed Unattenuated Surface Water Runoff Rates

The proposed development will also be 100% hardstanding. Again using the Modified Rational Method, the proposed (unattenuated) peak run-off from the site for the 1-in-1-year return period storm would be:

$$Q_1 = 3.61 \times 0.95 \times 0.0475 \times 33.3 = \textbf{5.4 litres/sec}$$

$$Q_{30} = 3.61 \times 0.95 \times 0.0475 \times 68.8 = \textbf{11.2 litres/sec}$$

$$Q_{100} = 3.61 \times 0.95 \times 0.0475 \times 89.0 = \textbf{14.5 litres/sec}$$

$$Q_{100+cc} = 3.61 \times 0.95 \times 0.0475 \times 124.6 = \textbf{20.3 litres/sec}$$

B.7 Proposed Attenuated Surface Water Runoff Rates

In accordance with the Environment Agency’s guidelines, the Building Regulations and the Water Authority’s advice, the preferred means of surface water drainage for any new development is into a suitable soakaway or infiltration drainage system. Sustainable Urban Drainage Systems (SuDS) can reduce the impact of urbanisation on watercourse flows, ensure the protection and enhancement of water quality and encourage recharging of groundwater in a manner which mimics nature.

In addition to this, the National Planning Policy Framework requires that surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic surface water flows arising from the site prior to the proposed development, whilst reducing flood risk to the site itself and elsewhere, taking climate change into account.

Therefore, as an absolute minimum, the proposed site discharge under the 1-in-100-year storm plus climate change should be no greater than the existing 1-in-100-year storm discharge (i.e. mitigate the impact of climate change and any increase in the area of hardstanding). In this case, this would mean that, rather than discharging **20.3 litres/sec**, the maximum permissible discharge from the site would be **14.5 litres/sec**.

Further to the above, the London Plan’s Policy SI 13 states that “Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible”. The Environment Agency (EA) suggests that Developers should aim to achieve greenfield run off from their site.

However, Clause 17 of the DEFRA /EA publication ‘Rainfall runoff management for developments’ states that “A practicable minimum limit on the discharge rate from a flow attenuation device is often a compromise between attenuating to a satisfactorily low flow rate while keeping the risk of blockage to an acceptable level.

Return Period	Existing Peak run off rate² (litres/sec)	Proposed scheme unattenuated peak run off rate (litres/sec)	Greenfield run off rate (litres/sec)	Proposed Design Peak run off rate (litres/sec)	Existing Discharge Volume (m³)	Proposed Discharge Volume (m³)
1 in 1 year	5.4	5.4	0.08	0.8	1.11	0.71
1 in 30 years	11.2	11.2	0.22	1.3	2.31	1.48
1 in 100 years	14.5	14.5	0.29	1.6	3.00	1.92
1 in 100 years (+40%)	20.3	20.3	0.32	1.7	4.19	2.69

This limit is set at 5 litres per second, using an appropriate vortex or other flow control device. Where sedimentation could be an issue, the minimum size of orifice for controlling flow from an attenuation device should normally be 150 mm laid at a gradient not flatter than 1 in 150, which meets the requirements of Sewers for Adoption 7th Edition”.

Based on the above considerations, it is proposed to limit the post-development runoff rate from the roof area to a maximum of 1.7 litres/sec (50% of the existing 1 in 1 year rate for the roof proportion of the site) as any less than this is considered impractical to implement. These rates are summarised below:

$$Q_1 = \textbf{0.8 litres/sec}$$

$$Q_{30} = \textbf{1.3 litres/sec}$$

$$Q_{100} = \textbf{1.6 litres/sec}$$

$$Q_{100+cc} = \textbf{1.7 litres/sec}$$

The car park area will drain to the river through the conduits provided as part of the Environment Agency’s improvement works to the flood defence wall (refer to section C.3.9 of Appendix C).

B.8 Proposed Discharge Volumes

The existing discharge volumes have been calculated in accordance with BS 8582 which requires the volume for the 6 hour storm event to be considered. The volume discharged during the storm event is calculated from the formula:

$$Vol_x = A \times i \times 6 \text{ hrs}$$

where A is the existing hardstanding area in hectares and i is the X-year, 6 hour event rainfall intensity in mm /hr.

$$Vol_1 = 0.0305 \times 3.90 \times 6 = \textbf{0.71 m³}$$

$$Vol_{30} = 0.0305 \times 8.11 \times 6 = \textbf{1.48 m³}$$

$$Vol_{100} = 0.0305 \times 10.51 \times 6 = \textbf{1.92 m³}$$

$$Vol_{100+cc} = 0.0305 \times 14.71 \times 6 = \textbf{2.69 m³}$$

B.9 Network Design

The InfoDrainage results contained on the following pages demonstrate that all water is contained within the proposed drainage system for every event up to and including the 1 in 100 year plus 40% climate change allowance event.

B.10 Summary

The proposed and existing runoff values are summarised below:

Project: 57 River Road Littlehampton	Date: 03/02/2025			
	Designed by: MJD	Checked by:	Approved By:	
Report Details: Type: Inflows Storm Phase: Phase			Company Address: AKT II, White Collar Factory 1 Old Street Yard London EC1Y 8AF	



Catchment Area

Type : Catchment Area

Area (ha)	0.031
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Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.950
Winter Volumetric Runoff	0.950
Time of Concentration (mins)	5
Percentage Impervious (%)	100

Project: 57 River Road Littlehampton	Date: 03/02/2025			
	Designed by: MJD	Checked by:	Approved By:	
Report Details: Type: Stormwater Controls Storm Phase: Phase			Company Address: AKT II, White Collar Factory 1 Old Street Yard London EC1Y 8AF	



Attenuation Tank

Type : Tank

Dimensions

Exceedance Level (m)	3.400
Depth (m)	1.500
Base Level (m)	1.900
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	0.00
Total Volume (m³)	13.850

Depth (m)	Area (m²)	Volume (m³)
0.000	20.00	0.000
0.650	20.00	13.000

Inlets

Inlet

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area
Bypass Destination	(None)
Capacity Type	No Restriction

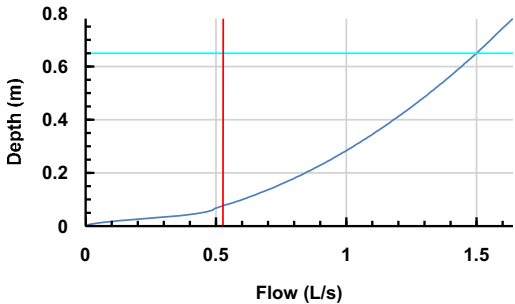
Outlets

Outlet

Outgoing Connection	(None)
Outlet Type	Hydro-Brake®

Invert Level (m)	1.900
Design Depth (m)	0.650
Design Flow (L/s)	1.5
Objective	Linear Discharge Profile
Application	Surface Water Only
Sump Available	☐

Unit Reference	CCU-0043-1500-0650-1500
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Advanced

Perimeter	Circular
Length (m)	3.370

Project: 57 River Road Littlehampton	Date: 03/02/2025			
	Designed by: MJD	Checked by:	Approved By:	
Report Details: Type: Network Design Criteria Storm Phase: Phase			Company Address: AKT II, White Collar Factory 1 Old Street Yard London EC1Y 8AF	

Flow Options

Peak Flow Calculation	(UK) Modified Rational Method
Min. Time of Entry (mins)	5
Max. Travel Time (mins)	30

Pipe Options

Lock Slope Options	None
Design Options	Minimise Excavation
Design Level	Level Soffits
Min. Cover Depth (m)	1.200
Min. Slope (1:X)	500.00
Max. Slope (1:X)	40.00
Min. Velocity (m/s)	1.0
Max. Velocity (m/s)	3.0
Use Flow Restriction	☐
Reduce Channel Depths	☐

Manhole Options

Apply Offset	☐
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Project: 57 River Road Littlehampton	Date: 03/02/2025			
	Designed by: MJD	Checked by:	Approved By:	
Report Title: Rainfall Analysis Criteria			Company Address: AKT II, White Collar Factory 1 Old Street Yard London EC1Y 8AF	

Runoff Type	Dynamic
Output Interval (mins)	5
Time Step	Default
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Rainfall

FSR

Type: FSR

Region	England And Wales
M5-60 (mm)	19.0
Ratio R	0.350
Summer	☒
Winter	☒

Return Period

Return Period (years)	Increase Rainfall (%)
1.0	40.000
30.0	40.000
100.0	40.000

Storm Durations

Duration (mins)	Run Time (mins)
15	30
30	60
60	120
120	240
180	360
240	480
360	720
480	960
600	1200

Project: 57 River Road Littlehampton	Date: 03/02/2025		
	Designed by: MJD	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address: AKT II, White Collar Factory 1 Old Street Yard London EC1Y 8AF		





FSR: 1 years: Increase Rainfall (%): +40: Summary Results for Attenuation Tank: Rank By: Max. US Depth

Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Percentage Available (%)	Status
FSR: 1 years: +40 %: 15 mins: Summer	2.022	2.022	0.122	0.122	6.4	2.452	0.000	0.000	0.7	0.838	82.299	OK
FSR: 1 years: +40 %: 15 mins: Winter	2.022	2.022	0.122	0.122	6.1	2.451	0.000	0.000	0.7	0.842	82.302	OK
FSR: 1 years: +40 %: 30 mins: Summer	2.051	2.051	0.151	0.151	4.4	3.026	0.000	0.000	0.7	1.904	78.154	OK
FSR: 1 years: +40 %: 30 mins: Winter	2.051	2.051	0.151	0.151	4.2	3.017	0.000	0.000	0.7	1.907	78.213	OK
FSR: 1 years: +40 %: 60 mins: Summer	2.070	2.070	0.170	0.170	4.0	3.410	0.000	0.000	0.8	3.857	75.381	OK
FSR: 1 years: +40 %: 60 mins: Winter	2.069	2.069	0.169	0.169	3.2	3.390	0.000	0.000	0.8	3.865	75.526	OK
FSR: 1 years: +40 %: 120 mins: Summer	2.080	2.080	0.180	0.180	3.0	3.595	0.000	0.000	0.8	6.088	74.044	OK
FSR: 1 years: +40 %: 120 mins: Winter	2.073	2.073	0.173	0.173	2.2	3.471	0.000	0.000	0.8	6.101	74.940	OK
FSR: 1 years: +40 %: 180 mins: Summer	2.078	2.078	0.178	0.178	2.4	3.557	0.000	0.000	0.8	7.164	74.317	OK
FSR: 1 years: +40 %: 180 mins: Winter	2.065	2.065	0.165	0.165	1.7	3.308	0.000	0.000	0.8	7.165	76.119	OK
FSR: 1 years: +40 %: 240 mins: Summer	2.072	2.072	0.172	0.172	2.1	3.439	0.000	0.000	0.8	7.958	75.171	OK
FSR: 1 years: +40 %: 240 mins: Winter	2.055	2.055	0.155	0.155	1.4	3.096	0.000	0.000	0.7	7.959	77.643	OK
FSR: 1 years: +40 %: 360 mins: Summer	2.056	2.056	0.156	0.156	1.6	3.123	0.000	0.000	0.7	9.093	77.453	OK
FSR: 1 years: +40 %: 360 mins: Winter	2.032	2.032	0.132	0.132	1.1	2.634	0.000	0.000	0.7	9.105	80.985	OK
FSR: 1 years: +40 %: 480 mins: Summer	2.041	2.041	0.141	0.141	1.4	2.822	0.000	0.000	0.7	9.943	79.622	OK
FSR: 1 years: +40 %: 480 mins: Winter	2.012	2.012	0.112	0.112	0.9	2.236	0.000	0.000	0.6	9.931	83.852	OK
FSR: 1 years: +40 %: 600 mins: Summer	2.028	2.028	0.128	0.128	1.2	2.553	0.000	0.000	0.7	10.648	81.563	OK
FSR: 1 years: +40 %: 600 mins: Winter	1.995	1.995	0.095	0.095	0.8	1.902	0.000	0.000	0.6	10.636	86.269	OK

Project: 57 River Road Littlehampton	Date: 03/02/2025		
	Designed by: MJD	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	Company Address: AKT II, White Collar Factory 1 Old Street Yard London EC1Y 8AF		





FSR: 30 years: Increase Rainfall (%): +40: Summary Results for Attenuation Tank: Rank By: Max. US Depth

Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Percentage Available (%)	Status
FSR: 30 years: +40 %: 15 mins: Summer	2.218	2.218	0.318	0.318	15.7	6.362	0.000	0.000	1.1	1.375	54.067	OK
FSR: 30 years: +40 %: 15 mins: Winter	2.217	2.217	0.317	0.317	14.8	6.352	0.000	0.000	1.1	1.381	54.135	OK
FSR: 30 years: +40 %: 30 mins: Summer	2.299	2.299	0.399	0.399	10.9	7.959	0.000	0.000	1.2	3.194	42.534	OK
FSR: 30 years: +40 %: 30 mins: Winter	2.298	2.298	0.398	0.398	10.2	7.952	0.000	0.000	1.2	3.198	42.584	OK
FSR: 30 years: +40 %: 60 mins: Summer	2.357	2.357	0.457	0.457	9.7	9.137	0.000	0.000	1.3	6.784	34.026	OK
FSR: 30 years: +40 %: 60 mins: Winter	2.358	2.358	0.458	0.458	7.8	9.157	0.000	0.000	1.3	6.784	33.882	OK
FSR: 30 years: +40 %: 120 mins: Summer	2.382	2.382	0.482	0.482	7.1	9.644	0.000	0.000	1.3	12.711	30.370	OK
FSR: 30 years: +40 %: 120 mins: Winter	2.378	2.378	0.478	0.478	5.1	9.563	0.000	0.000	1.3	12.718	30.953	OK
FSR: 30 years: +40 %: 180 mins: Summer	2.379	2.379	0.479	0.479	5.6	9.576	0.000	0.000	1.3	16.341	30.861	OK
FSR: 30 years: +40 %: 180 mins: Winter	2.367	2.367	0.467	0.467	3.9	9.335	0.000	0.000	1.3	16.354	32.598	OK
FSR: 30 years: +40 %: 240 mins: Summer	2.365	2.365	0.465	0.465	4.7	9.295	0.000	0.000	1.3	17.912	32.891	OK
FSR: 30 years: +40 %: 240 mins: Winter	2.344	2.344	0.444	0.444	3.2	8.881	0.000	0.000	1.2	17.924	35.874	OK
FSR: 30 years: +40 %: 360 mins: Summer	2.331	2.331	0.431	0.431	3.5	8.627	0.000	0.000	1.2	20.005	37.715	OK
FSR: 30 years: +40 %: 360 mins: Winter	2.295	2.295	0.395	0.395	2.3	7.890	0.000	0.000	1.2	20.011	43.031	OK
FSR: 30 years: +40 %: 480 mins: Summer	2.298	2.298	0.398	0.398	2.9	7.969	0.000	0.000	1.2	21.591	42.464	OK
FSR: 30 years: +40 %: 480 mins: Winter	2.249	2.249	0.349	0.349	1.9	6.981	0.000	0.000	1.1	21.567	49.594	OK
FSR: 30 years: +40 %: 600 mins: Summer	2.267	2.267	0.367	0.367	2.5	7.349	0.000	0.000	1.1	22.834	46.937	OK
FSR: 30 years: +40 %: 600 mins: Winter	2.209	2.209	0.309	0.309	1.6	6.180	0.000	0.000	1.0	22.834	55.377	OK

Project: 57 River Road Littlehampton		Date: 03/02/2025			
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase		Designed by: MJD	Checked by:		Approved By:
		Company Address: AKT II, White Collar Factory 1 Old Street Yard London EC1Y 8AF			



FSR: 100 years: Increase Rainfall (%): +40: Summary Results for Attenuation Tank: Rank By:
Max. US Depth

Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Percentage Available (%)	Status
FSR: 100 years: +40 %: 15 mins: Summer	2.316	2.316	0.416	0.416	20.4	8.328	0.000	0.000	1.2	1.575	39.870	OK
FSR: 100 years: +40 %: 15 mins: Winter	2.315	2.315	0.415	0.415	19.2	8.321	0.000	0.000	1.2	1.582	39.923	OK
FSR: 100 years: +40 %: 30 mins: Summer	2.429	2.429	0.529	0.529	14.2	10.597	0.000	0.000	1.4	3.705	23.486	OK
FSR: 100 years: +40 %: 30 mins: Winter	2.429	2.429	0.529	0.529	13.4	10.593	0.000	0.000	1.4	3.709	23.519	OK
FSR: 100 years: +40 %: 60 mins: Summer	2.520	2.520	0.620	0.620	12.7	12.401	0.000	0.000	1.5	7.976	10.462	OK
FSR: 100 years: +40 %: 60 mins: Winter	2.522	2.522	0.622	0.622	10.2	12.449	0.000	0.000	1.5	7.980	10.116	OK
FSR: 100 years: +40 %: 120 mins: Summer	2.689	2.689	0.789	0.789	9.3	13.147	0.000	0.000	1.6	15.447	5.077	OK
FSR: 100 years: +40 %: 120 mins: Winter	2.656	2.656	0.756	0.756	6.7	13.114	0.000	0.000	1.6	15.430	5.316	OK
FSR: 100 years: +40 %: 180 mins: Summer	2.678	2.678	0.778	0.778	7.3	13.135	0.000	0.000	1.6	20.712	5.160	OK
FSR: 100 years: +40 %: 180 mins: Winter	2.548	2.548	0.648	0.648	5.1	12.952	0.000	0.000	1.5	20.699	6.482	OK
FSR: 100 years: +40 %: 240 mins: Summer	2.543	2.543	0.643	0.643	6.1	12.862	0.000	0.000	1.5	23.335	7.132	OK
FSR: 100 years: +40 %: 240 mins: Winter	2.521	2.521	0.621	0.621	4.1	12.416	0.000	0.000	1.5	23.330	10.355	OK
FSR: 100 years: +40 %: 360 mins: Summer	2.499	2.499	0.599	0.599	4.6	11.982	0.000	0.000	1.4	25.928	13.486	OK
FSR: 100 years: +40 %: 360 mins: Winter	2.458	2.458	0.558	0.558	3.0	11.165	0.000	0.000	1.4	25.946	19.389	OK
FSR: 100 years: +40 %: 480 mins: Summer	2.456	2.456	0.556	0.556	3.8	11.117	0.000	0.000	1.4	27.803	19.733	OK
FSR: 100 years: +40 %: 480 mins: Winter	2.399	2.399	0.499	0.499	2.4	9.979	0.000	0.000	1.3	27.857	27.949	OK
FSR: 100 years: +40 %: 600 mins: Summer	2.416	2.416	0.516	0.516	3.2	10.316	0.000	0.000	1.3	29.355	25.518	OK
FSR: 100 years: +40 %: 600 mins: Winter	2.346	2.346	0.446	0.446	2.1	8.925	0.000	0.000	1.3	29.343	35.561	OK

B.11 Foul Water Flows

One method of calculating the peak foul flow is to use the statistical or “discharge unit” method outlined in BS 12056. This method of design is based on probability theory to estimate the maximum peak flows from appliances. It assumes that only a proportion of appliances will be in use at any one time and that appliances on a factory, school, etc. would be used more frequently than in domestic installations. For this reason discharge units (DU) are given higher values in congested and commercial use than they are for domestic.

Alternatively, foul flows can be computed using the “population method”. This method calculates a daily discharge volume from typical figures of discharge per person, per day. It then factors it evenly over the day, to calculate base flow. A peaking factor is then applied (conservatively 6 or a variable factor based upon population such as the Babbitt Formula) to determine peak flow.

Estimates can also be based on internal floor area, which can also be arrived at as a product of an assumed population density and daily discharge per person.

As to which method is the more appropriate, typically, outside the building and at the street and city scale, the population method is considered more accurate and is the preferred method utilised by sewer companies. For sizing pipes inside the building, and in drains near to the point of discharge from the building, the statistical method should be used. Consideration of high peak flows from pump stations is also required.

BS 16933-2 recommends that the statistical method can be used for the design of gravity drains and sewers where the population is less than 1000 and the population method can be used where the population is greater than 500.

B.12 Existing Foul Water

There are currently no record drawings available for the existing building in order to estimate the number of foul appliances. However, the existing use as an auto repair facility would likely generate a discharge of around **5 litres/sec**.

B.13 Proposed Foul Water

Discharge Unit Method

The architectural layouts have been used to estimate the number of foul appliances in the proposed office space. Using the guidelines for commercial developments given in BS EN 12056-2:2000 - “Gravity Drainage Systems Inside Buildings - Part 2: Sanitary Pipework, layout and calculation”, the proposed foul flow is calculated from the formula:

$$Q = K \times \sqrt{DU}$$

For ‘intermittent use’ (representing dwellings, offices, etc.) K has a value of 0.5 giving:

Appliance	No.	Discharge units per appliance	Total number of discharge units
Wash hand basin	12	0.5	6.0
Bath	12	0.8	9.6
Sinks	9	0.8	7.2
Dishwasher	9	0.8	7.2
Washing machine	9	0.8	7.2
WC	12	2.0	24.0
Total discharge units for site =			61.2
Therefore, total flow from site =			3.91 litres/sec

This is likely to be comparable to the existing flow rates and therefore should not represent an increase in discharge to the public sewer.

Appendix C

SuDS Option Selection



Disposal methods

C.1 SuDS management train

A useful concept used in the development of sustainable drainage systems is the SuDS management train (sometimes referred to as the treatment train). Just as in a natural catchment, drainage techniques can be used in series to change flow and quality characteristics of the runoff in stages. There are a variety of measures that can be implemented to achieve these goals:

C.1.1 Site management / Prevention

Site management procedures are used to limit or prevent runoff and pollution and include:

- Minimising the hardened areas within the site
- Frequent maintenance of impermeable surfaces
- Minimising the use of de-icing products

C.1.2 Source control

Source control techniques will be used where possible as they control runoff at source in smaller catchments. They can also provide effective pollution control and treatment, thereby improving the quality of the effluent discharged to the receiving waters.

C.1.3 Site control

Where source control techniques do not provide adequate protection to the receiving watercourses in terms of flood protection and pollution control, site control may be required.

C.1.4 Regional control

Where large areas of public space are available regional control can be incorporated to provide additional 'communal' storage and treatment to runoff from a number of sites. However, in this case, all storage and treatment will be implemented on site.

C.2 Drainage hierarchy

Based on the above and in line with the London Plan and the Sustainable Drainage Manual published by CIRIA, the following drainage hierarchy will therefore need to be considered when preparing the surface water disposal strategy:

1. Rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)
2. Rainwater infiltration to ground at or close to source
3. Rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)
4. Rainwater discharge direct to a watercourse (unless not appropriate)
5. Controlled rainwater discharge to a surface water sewer or drain
6. Controlled rainwater discharge to a combined sewer

C.3 Assessment of SuDS techniques

C.3.1 Rainwater harvesting

This involves the capture of rainwater into a tank for re-use (usually non-potable) such as irrigation, toilet flushing or vehicle cleaning. Systems are now available which combine rain water harvesting with tanked attenuation. This means that water is stored during dry periods for re-use but released ahead of predicted storms in order to ensure that the full attenuation capacity remains available when it is needed.

As the proposed development has a small plan area, it does not appear to be practical to install a rainwater harvesting system as the actual roof area available would not generate sufficient water yield to make the system viable.

C.3.2 Green / brown / blue roofs

These are used on flat or shallow pitched roofs to provide a durable roof covering which also provides thermal insulation, amenity space, biodiversity habitat as well as attenuation of rainwater. Depending on the design, these roofs can attenuate differing volumes of rainwater. The term 'blue roof' is reserved for those roofs designed to maximise water retention. This is a relatively recent area of increased focus and can involve effectively an attenuation tank at roof level which reduces (or avoids) the need for pumping of basement tanks.

The pitched roofs proposed on the scheme do not lend themselves to implementing blue or green roofs.

C.3.3 Raingardens

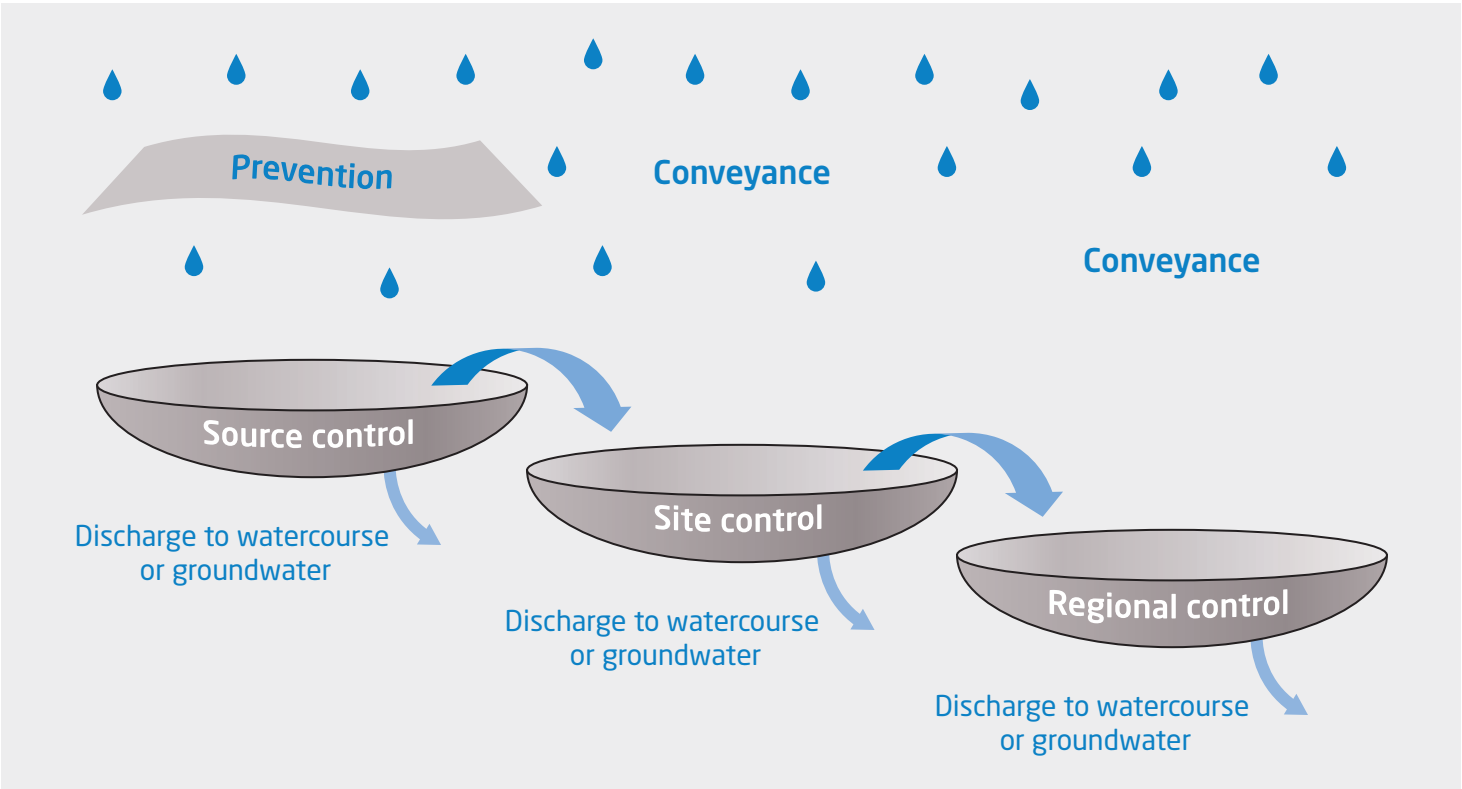
Raingardens are planted areas (usually close to buildings but not immediately adjacent) that allow the diversion of a portion of rainwater from either downpipes or the surrounding paved surfaces. These techniques can be incorporated into the landscaping plans for a site and are most effective where the landscaping regime is designed with the aim of capturing as much rainfall as possible. They can either allow infiltration into the ground or have tanked systems for water retention, depending on the site and soil conditions. There are also a number of vertical raingardens attached to building walls with rainwater downpipes diverted through a stacked series of planters.

Raingardens cannot be incorporated into the scheme due to the lack of available external space.

C.3.4 Bio-retention

This refers to a chain of landscaped features, potentially including reed beds, filter drains, etc. designed to hold and treat surface water. They are often used where there is a high risk of low-level pollution, for example from road run-off. However, it does require areas of open space. The design of a bio-retention system can vary widely depending on site conditions and available space. At a small scale this could include flow through planters or tree pits.

Bio-retention cannot be incorporated into the scheme due to the lack of available external space.



SuDS management train

C.3.5 Infiltration

There are many different types of drainage component that can be used to facilitate infiltration. These include soakaways, infiltration trenches, infiltration blankets and infiltration basins.

Infiltration can contribute to reducing runoff rates and volumes while supporting baseflow and groundwater recharge processes. The rate at which water can be infiltrated depends on the infiltration capacity (permeability) of the surrounding soils.

The available borehole information suggests there may be limited porosity in the underlying soil. However, as there is no available external space and the building covers the full site footprint, it is not possible to locate infiltration devices that comply with Building Regulations. Also, there would be a risk of undermining the Environment Agency flood wall due to it's proximity to any soakaway that would be proposed. Therefore, disposal by infiltration will not be possible.

C.3.6 Permeable surfacing

Permeable hard surfaces which work in much the same way as traditional impermeable surfaces apart from the ability to allow rainwater to pass through. Permeable blocks are traditionally used but there are now a range of permeable asphalt and resin bound gravel pavings being used increasingly commonly. Permeable surfaces can either allow infiltration into the ground or have tanked systems for water retention, depending on the site and soil conditions. They are suitable in even the most densely built-up development. However, they're not well suited to roads carrying heavy or fast motor traffic.

As there are no external areas proposed as part of the scheme it will not be possible to implement permeable surfacing.

C.3.7 Swales

These are dry ditches used as landscape features to allow the storage, carriage and infiltration of rainwater and are often used as linear features alongside roads, footpaths or rail lines. They can also be integrated into the design of many open spaces.

Swales cannot be incorporated into the scheme due to the lack of available external space.

C.3.8 Detention basin / ponds

Landscape features designed to store and in some cases infiltrate rainwater. Detentions basins are usually dry, whereas a pond should retain water. These features need areas of open space but can often be combined with other sustainable drainage techniques.

As the site is heavily developed with limited external areas there is insufficient space to provide a basin or pond.

C.3.9 Discharge to tidal river / dock / canals

Discharging clean rainwater directly to tidal rivers, canals or docks isn't normally a sustainable drainage technique. Other more productive techniques should be used first. However, it is generally more sustainable than discharging to the combined or surface drainage systems. Residual surface water can be discharged to tidal/large waterbodies, in some cases with no limitation on volumes. Some storage may be required to allow for outfalls becoming tide locked. Care is needed to prevent scour in the receiving waterbody and potentially to prevent pollution. Consent from the Environment Agency, the asset owner and where applicable the Canal and River Trust is required.

The River Arun is immediately adjacent to the site and as part of the Environment Agency's improvements to the flood defences a new section of flood wall has been implemented along the site frontage (Planning Ref. LU/291/17/PL). This included the provision of a series of drainage conduits through the capping beam to drain the Riverside Autos site yard to the river. It is therefore proposed that the ground level parking surface will drain unattenuated to the river through these conduits as agreed as part of these improvement works.

C.3.10 Storage tanks / geocellular storage

Storage tanks are single GRP units usually located (but not necessarily) below ground level which attenuate rainwater for later slow release back into the drainage system but do not provide the wider benefits of green infrastructure sustainable drainage. They can also have the disadvantage that pumping may be required to empty the tank into the drainage system - especially if the tank is located at or below basement level. Where tanks are designed for large storm events, care is needed to ensure that they still perform a useful sustainable drainage function for low order storms.

Geocellular storage tanks are similar to storage tanks except that the volume is made up from multiple units rather than a single tank meaning they can be more flexible in terms of shape to suit constrained sites.

It is believed that this is the most feasibly disposal option for the roof proportion of the site and a storage volume of 13 m³ should be provided in order to limit the discharge from the site to 1.7 litres/sec (50% of the pre-development 1 in 1 year rate).

The attenuation tank should be located at a high enough level so as to allow a connection to be made to the public sewer by gravity. Locating the tank below this level would result in a pumped surface water system which is both unsustainable and uneconomic.

C.3.11 Oversized piping

Using larger than necessary pipework creates more room to store rainwater. Potentially more sustainable than storage tanks / geocellular storage if the pipes drain by gravity and do not require pumping. However, lacks the wider benefits of the green infrastructure based techniques.

Due to the restricted nature of the site the pipework would become impractically large to provide the volume of storage required to achieve the required run-off rate.

C.4 Summary of the proposed SuDS strategy

An attenuation tank of 13 m³ is proposed which will reduce the peak discharge rate from the site to 1.7 litres/sec (50% of the existing 1 in 1 year rate for the roof proportion of the site).

The outfall from the site will connect to the existing public sewer either with a new connection or, preferably, by reusing the existing connection.

The car park area will drain to the River Arun through the existing conduits provided by the Environment Agency for this purpose as part of their improvements to the flood defence wall adjacent to the site.

A schematic SuDS layout is contained in Appendix D for reference.

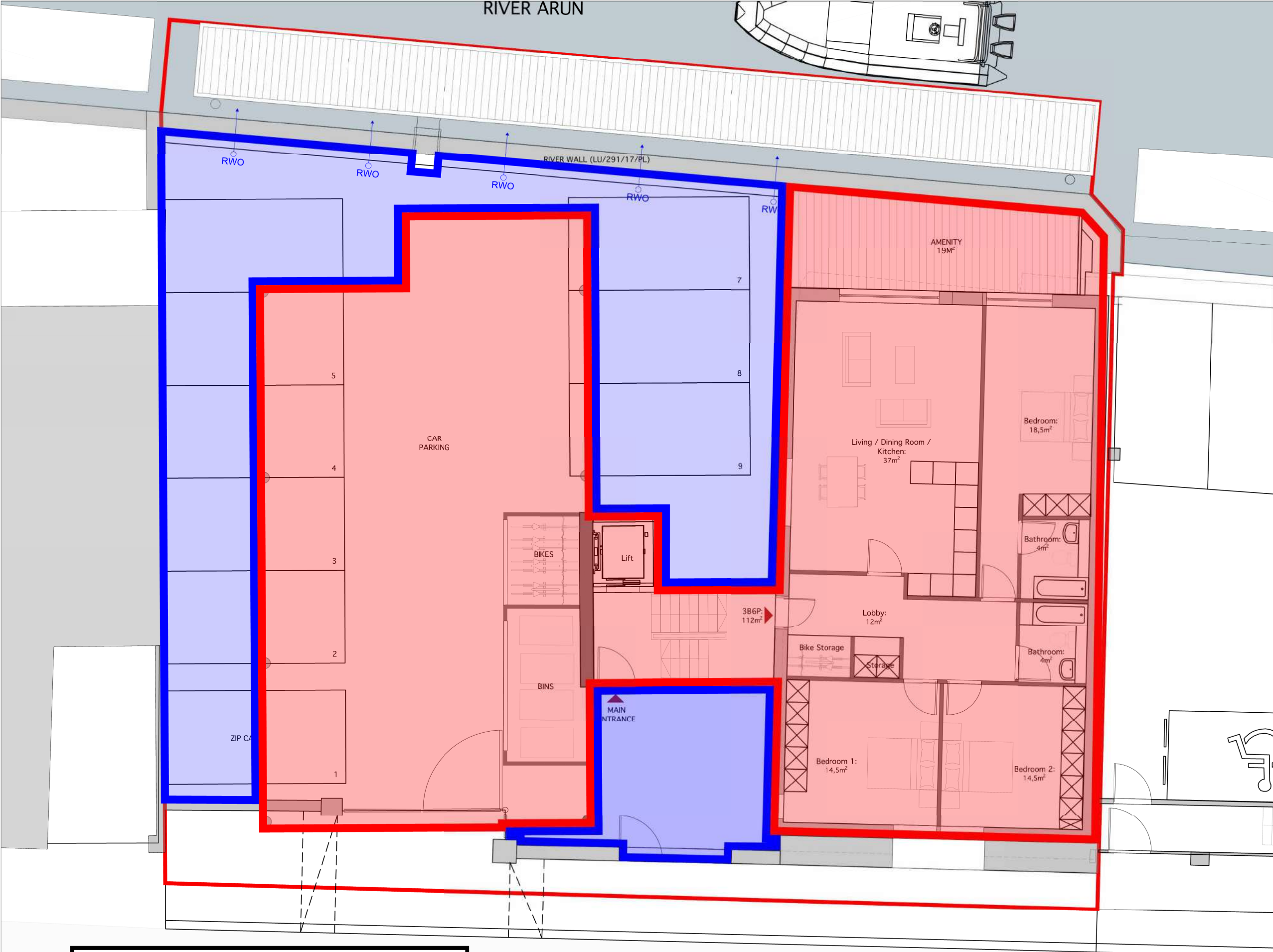
Element	Management stage	Water quantity	Water quality	Amenity & biodiversity	Proposed in scheme
Rainwater harvesting	Prevention	✓	✗	✗	✗
Green / brown / blue roof	Source control	✓	✓	✓	✗
Raingardens	Source control	✓	✓	✓	✗
Bio-retention	Source control	✓	✓	✓	✗
Permeable surfacing	Source control	✓	✓	✗	✗
Swales	Source control	✓	✓	✓	✗
Detention basin / ponds	Source control	✓	✓	✓	✗
Discharge to tidal river / dock / canals	Site control	✓	✗	✗	✓
Storage tanks / Geocellular storage	Site control	✓	✗	✗	✓
Oversized piping	Site control	✓	✗	✗	✗
Design for exceedance	Site control	✓	✗	✗	✗

Figure C.1 Summary of proposed SuDS devices

Appendix D

Proposed Drawings





- Notes
- Any variations between stated dimensions and site dimensions should be reported to the Architect prior to work being executed
 - All work to be carried out in accordance with the requirements of the building regulations and the statutory authority regulations in force and British Standards.
 - Do not scale from this drawing.
 - Verify relevant dimensions at the job before commencing work or preparing shop drawings.
 - This drawing is copyright.
 - All drawings are to be read in conjunction with existing survey drawings.
 - Structural elements, including slabs and foundations, that are visible in this drawing are the design responsibility of the structural engineer and require further detailed coordination.
 - Health & Safety: All works are to be carried out strictly in accordance with the project health & safety construction plan.

Revision Schedule		
Rev	Date	Description
P_01		
T_01		
T_02		
C_01		
C_02		



Project 47 River Rd, Littlehampton
BN17 5BF

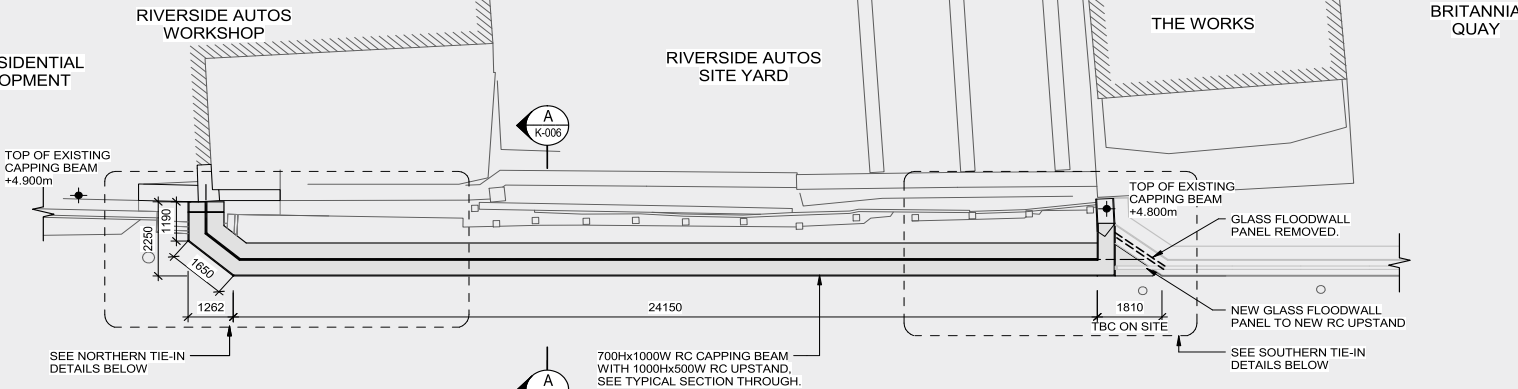
Drawing Title		Drawing Number	
PROPOSED GROUND FLOOR PLAN		A_101	
Scale	1:100 @ A3	Date	26/04/2024
Status	PLANNING	Revision	P_01

Roof Area to sewer = 305 m²
Parking Area to river = 170 m²

RIVER ROAD

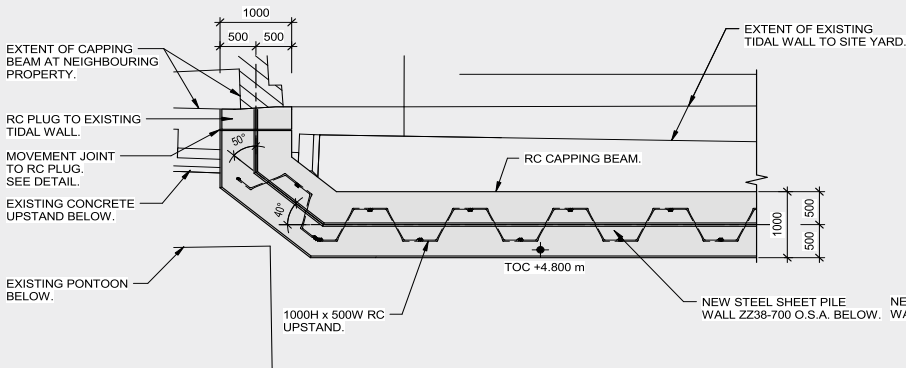


remi c.t.
studio



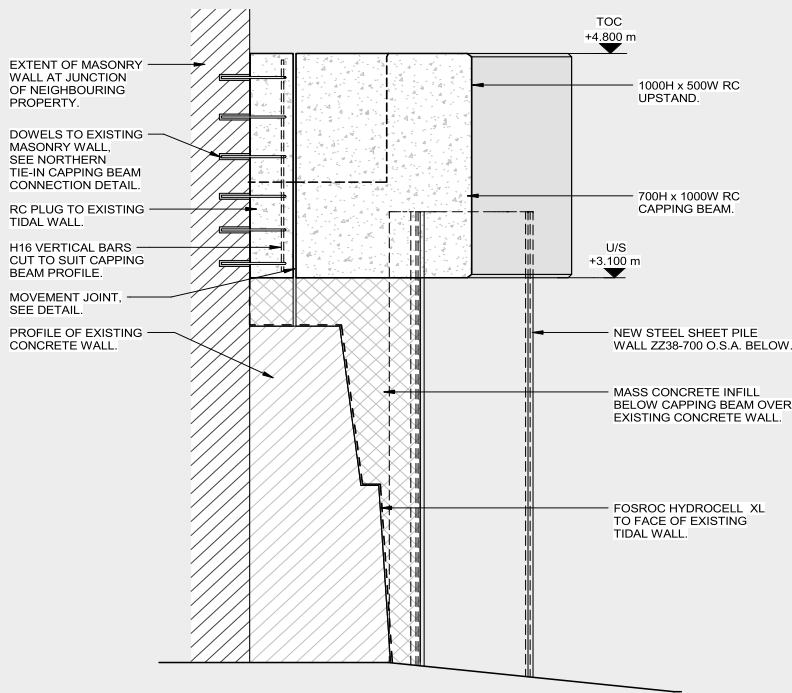
PLAN ON REACH 4 CAPPING BEAM

SCALE 1: 100



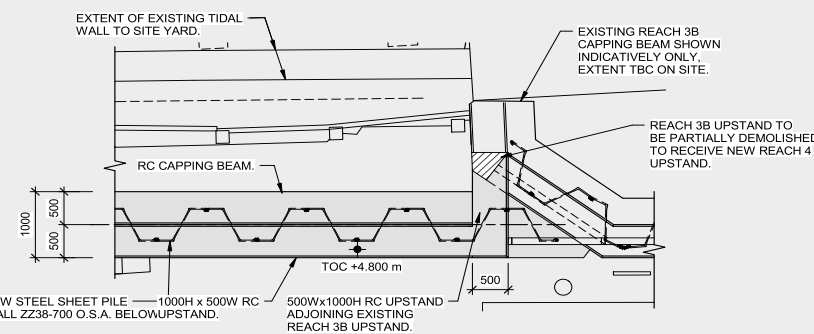
NORTHERN TIE-IN - CAPPING BEAM

SCALE 1: 50



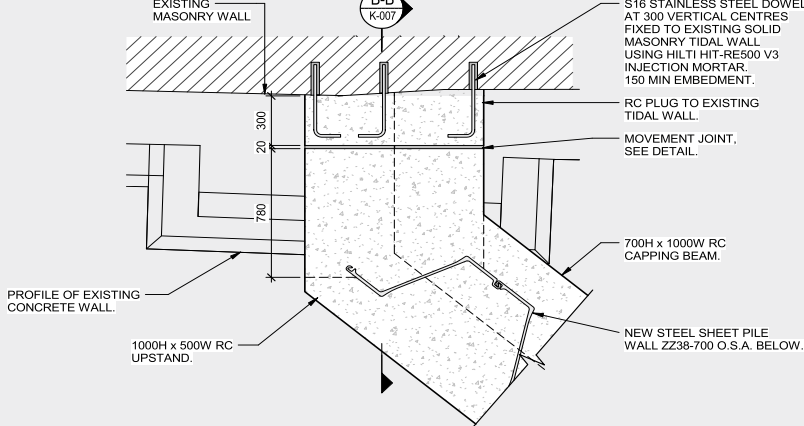
CAPPING BEAM - SECTION B-B

SCALE 1: 25



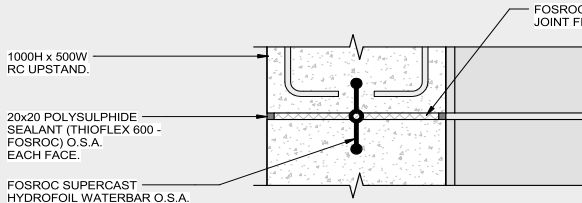
SOUTHERN TIE-IN - CAPPING BEAM

SCALE 1: 50



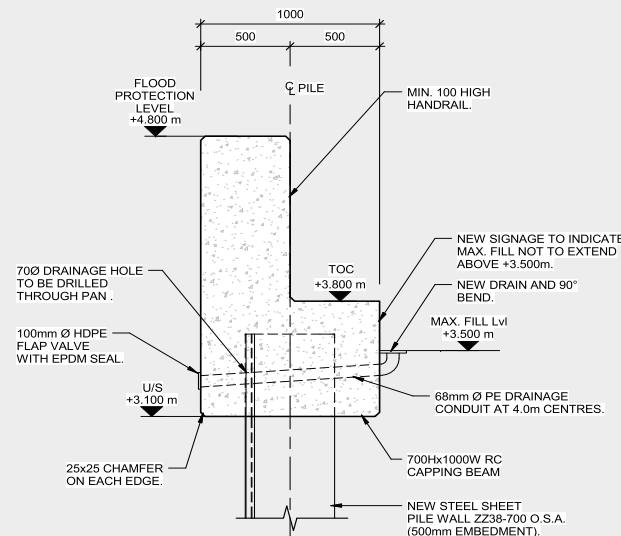
NORTHERN TIE-IN - CAPPING BEAM CONNECTION DETAIL

SCALE 1: 20



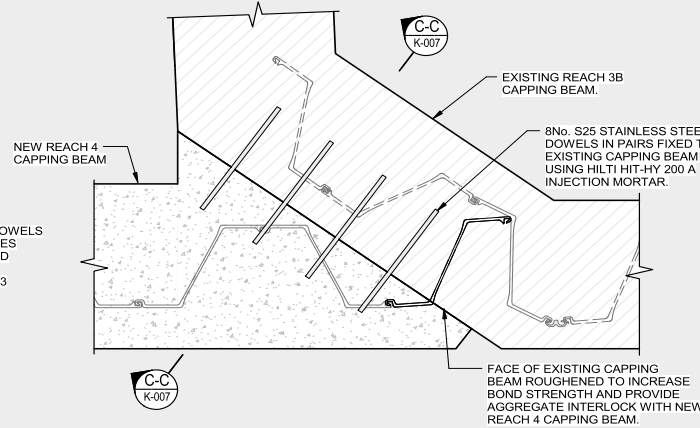
MOVEMENT JOINT DETAIL

SCALE 1: 10



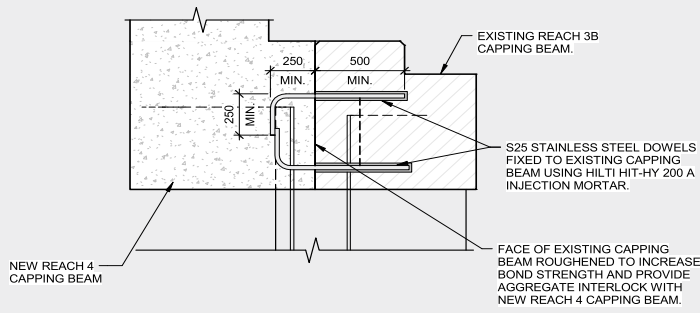
SECTION A-A THRU' CAPPING BEAM (TYP.)

SCALE 1: 20



SOUTHERN TIE-IN - CAPPING BEAM DOWELLED CONNECTION

SCALE 1: 20



CAPPING BEAM - SECTION C-C

SCALE 1: 20

- GENERAL:
- DO NOT SCALE FROM THIS DRAWING.
 - ALL DIMENSIONS ARE IN MILLIMETRES (mm) & ALL LEVELS ARE IN METRES (m) AOD, UNLESS STATED OTHERWISE.
 - ALL DIMENSIONS & LEVELS TO BE CHECKED ON SITE AND ANY DISCREPANCIES SHOULD BE REPORTED TO GHD.
 - THIS DOCUMENT IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT PROJECT STANDARDS AND SPECIFICATIONS.
 - NOMINAL PILE LENGTH TO BE PROVIDED IS 13.3m (INCLUDES 500mm ALLOWANCE FOR OVER DRIVE DUE TO VARIABLE GROUND CONDITIONS).
 - FOR CONCRETE SPECIFICATION REFER TO DRAWING No. 66-00009-K-008.

SAFETY, HEALTH & ENVIRONMENTAL (SHE) INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:

CONSTRUCTION

- EXISTING TIDAL WALL UNSTABLE.
- EXISTING CONCRETE CAPPING BEAM HAS HISTORY OF INSTABILITY.
- HIGH TIDAL FLOW IN RIVER.
- WORKING OVER WATER FROM MARINE PLANT/BARGE.
- CUTTING OFF PILE TOPS.
- EXISTING SERVICES.
- REMOVAL OF EXISTING PONTOONS DUE TO EXISTING CONDITION.
- MOVEMENT OF CARGO VESSELS IN RIVER.
- HAZARD TO THE RESIDENTS DUE TO THE PROXIMITY OF THE WORKS TO RESIDENTIAL PROPERTIES.
- WORKS ARE WITHIN THE RIVER ROAD CONSERVATION AREA.
- POLLUTION OF WATER COURSE FROM WORKS.

MAINTENANCE/CLEANING

- NO SIGNIFICANT RISK.

DECOMMISSIONING/DEMOLITION

- NO SIGNIFICANT RISK.

No	Revision	Drawn	Job Manager	Project Director	Date
P3	ISSUED FOR REVIEW	CC	ME	GB	09.10.17
P2	ISSUED FOR INFORMATION	CC	ME	GB	27.09.17
P1	ISSUED FOR INFORMATION	CC	ME	GB	18.08.17

Note: * indicates signatures on original issue of drawing or last revision of drawing

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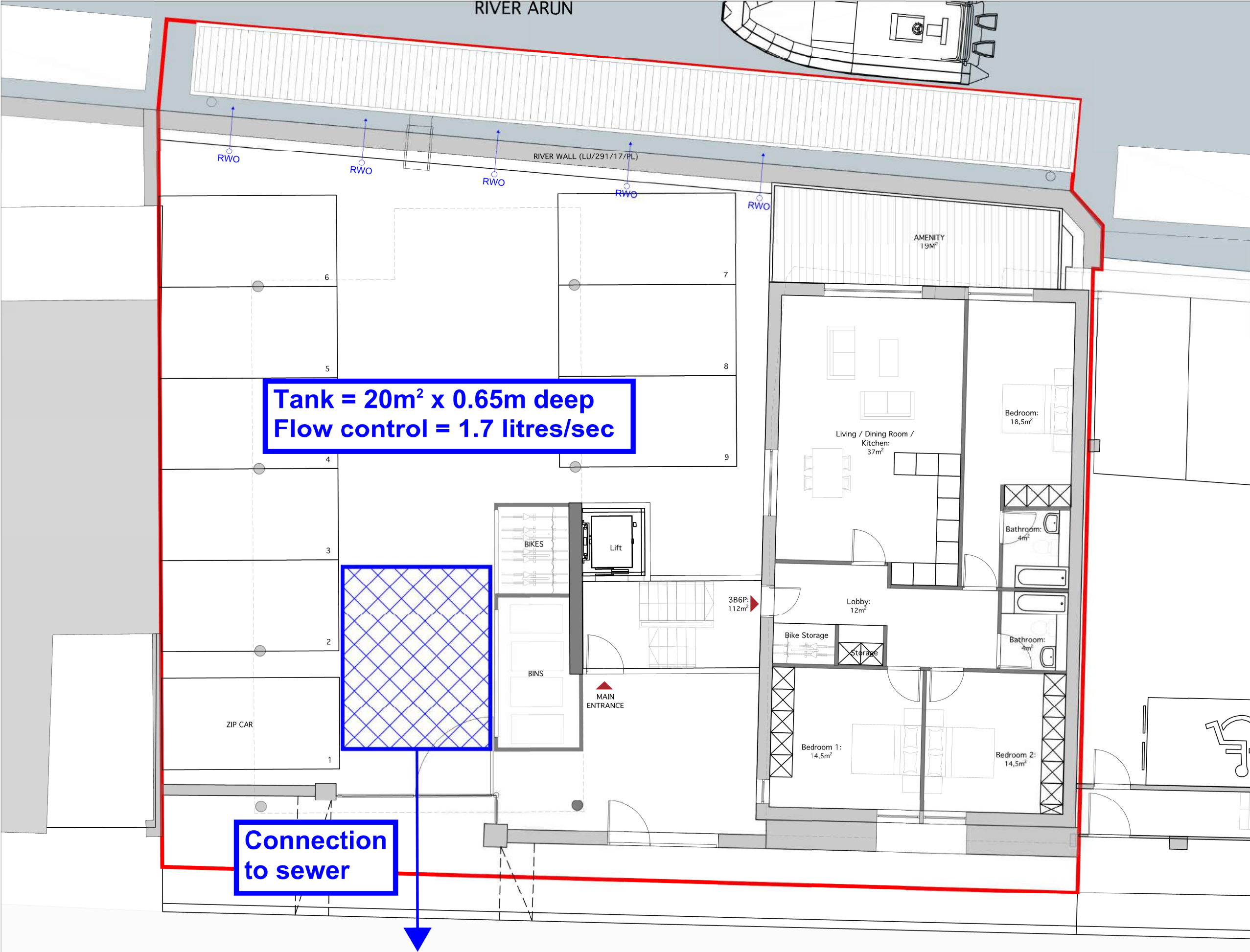
Client **JT MACKLEY & CO LTD**

Project **LITTLEHAMPTON FLOOD DEFENCE**
Title **EAST BANK REACH 4 CAPPING BEAM GENERAL ARRANGEMENT**

Scale	As indicated	DO NOT SCALE
Drawn	CC	Designer DS
Drafting	AS	Design Check ME
Approved	GB	(Project Director)

This Drawing must not be used for Construction unless signed as Approved
Drawing No: **66-00009-K-007**
Original Size: **A1**
Rev: **P3**

FOR REVIEW



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Revision Schedule		
Rev	Date	Description
P_01		
T_01		
T_02		
C_01		
C_02		

North Arrow

North

Project	47 River Rd, Littlehampton BN17 5BF	
Drawing Title	PROPOSED GROUND FLOOR PLAN	Drawing Number A_101
Scale	1:100 @ A3	Date 26/04/2024
Status	PLANNING	Revision P_01