Project Title

Drainage Strategy Report

At

Clarence Road

Longsight

Manchester

M13 0NN

For

Wing On Foods Ltd

14 Birch Lane

Longsight

Manchester

M13 0NN

PG Consulting
108 Ack Lane West
Cheadle Hulme
Cheshire
SK8 7ES

Tel: 07710 758971
Mail: Paul@pgcl.co.uk
Paul Graveney Consulting Ltd Trading as PG Consulting
Company Registration 11238546

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CONTENTS

Executive Summary **2**

1. Introduction **3**

2. Development Description and Location **4**

2.1 Site Location 4
2.2 Existing Site Description and Walk Over 4
2.3 Topography 5
2.4 Hydrology 5

3. Fluvial Flood Risk Review **6**

4. Planning Policy **7**

4.1 Strategic Flood Risk Assessment (SFRA) 7
4.2 Local SuDS Strategy 7

5. Outline Drainage Strategy **9**

5.1 Existing Drainage 9
5.2 Existing Runoff 9
5.3 Hydrological Assessment 9
5.4 Geology 9
5.5 Sustainable Drainage Systems (SuDS) Assessment 10
5.6 The Non-Statutory Technical Standards for SuDS 13
5.7 Climate Change 14
5.8 Outline Surface Water Drainage Strategy 14
5.9 Volume Control 15
5.10 Pollution Control 15
5.11 Maintenance 15
5.12 Foul Water Drainage 16

Appendix A: Architects Drawings
Appendix B: Topographical Survey
Appendix C: PGC Drawings
Appendix D: Outline Hydraulic Calculations

Executive Summary

Figure 1: Flood Risk and Drainage Strategy Summary

Item	Brief Description
Development Proposed	Extension to retained warehouse within existing service yard, situated off Clarence Road, Longsight, Manchester, M13 0NN.
Flood Zone Classification	Flood Zone 1 – Low Risk.
Geology	No formal site investigation has been undertaken at this time. A review of the BGS online Geology Viewer has identified that the development area encompasses a concrete slab over Till / Diamicton, comprising clays & silts, over the Manchester Marls Formation - Mudstone to depth.
Infiltration Rate	Due to the presence of the cohesive Glacial Till, infiltration is not considered a viable means of draining the development area.
Nearest Watercourses	A review of local maps confirmed that the closest identified watercourse is the Culverted Gore Brook, located approximately 0.5km to the south of the site.
Nearest Adopted Sewers and Private Drainage	Within Clarence Road to the west of the site and flowing north is a United Utilities (UU) adopted 300mm diameter combined water sewer. The current service yard is served by a single road gully located in the centre. This connects via a private drainage network to the combined sewer. There are no surface water sewers in close proximity.
Existing Discharge Rate	For the purpose of this assessment the site will be classed as brownfield with the brownfield discharge rates defined below based on a site area of 0.055ha: 1yr – 4.6l/s (30mm/hr) 30yr – 9.9l/s (65mm/hr) 100yr – 14.5l/s (95mm/hr)
Surface Water Drainage Outfall and SuDS Hierarchal Approach	Due to the cohesive glacial till, infiltration is not deemed suitable. Outflow to existing combined sewer via the existing connection at a maximum flow rate of 5l/s to suit UU and MCC SuDS Policy.
Proposed Discharge Rate	5l/s, considered the minimum orifice size to prevent blockage.
Allowance for Climate Change	45% - based on a commercial > 60-year design life to 'the 2070's'.
SuDS features	Geocellular storage.
Maintenance Responsibility	Development owner.
Foul Drainage Strategy	n/a as no new foul drainage proposed.

1. Introduction

1.1 Paul Graveney Consulting Ltd (PGC) has been appointed by Wing on Foods Ltd to prepare this Drainage & Sustainable Drainage Systems (SuDS) Strategy to support a planning application for a construction of an extension to their existing warehouse within the service yard, situated on land off Clarence Road. The Site Masterplan as indicated in Appendix A provides details of the proposed development intent.

1.2 The assessment has been undertaken in line with Section 10 of the 2021 'National Planning Policy Framework', plus the accompanying Technical Guidance on Flood Risk and any local policies.

1.3 This report has been commissioned by Wing On Food Ltd and is specific to their interests in the development proposals as described by the Architectural plan in Appendix A.

1.4 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 for climate change.
- Devise an appropriate outline foul water drainage strategy.

2. Development Description and Location

2.1 Site Location

The site is referenced in Figure 2, and a site location map is provided in Appendix A.

Item	Brief Description
Project name	Clarence Road, Manchester.
Site address and location	Clarence Road, Longsight, Manchester, M13 0NN
Council Area	Manchester City Council
Approximate Grid Reference	OS: 386437, 395796
General Locality	The site is located approximately 3km south east of Manchester City Centre in a predominantly commercial and residential led area.

Figure 2: Site Referencing Information

2.2 Existing Site Description and Walk Over

2.2.1 The development site (Red Line Boundaries) is predominantly rectangular in plan shape and currently encompasses a service yard area with a number of container storage units. Masonry boundary walls are located along the northern, southern and western boundaries with a vehicular gate leading onto Clarence Road. The retained warehouse is located to the eastern boundary.

2.2.2 The site is located off Clarence Road in a predominantly commercial and residential led area.

2.2.3 Figure 3 identifies the overall site location details. Further details of the existing layout can be seen on the Red Line Site Plans in Appendix A.

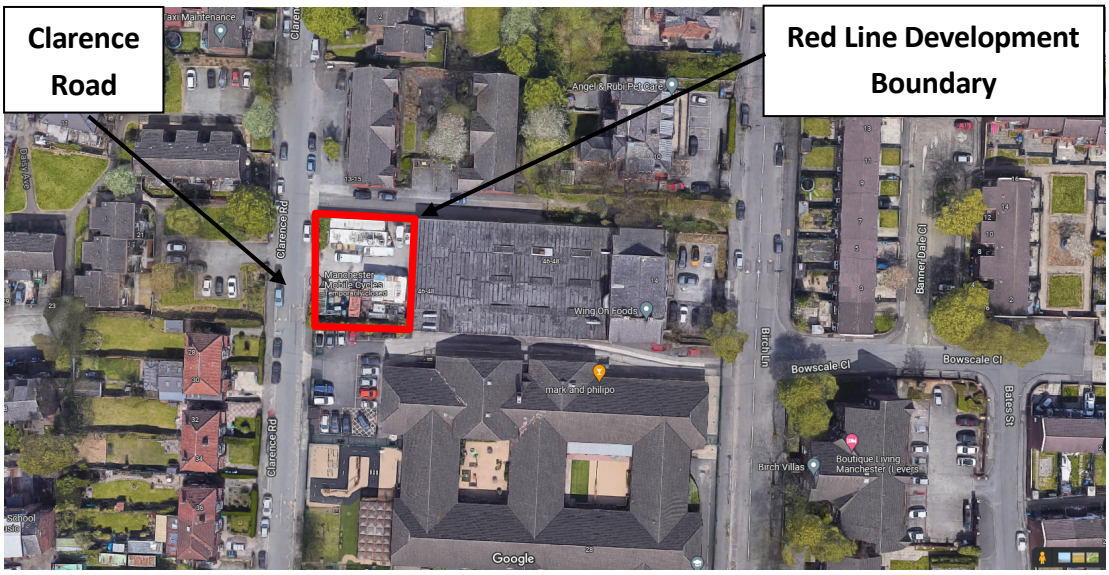


Figure 3: Location Plan as taken from Google Maps (2021)

2.3 Topography

2.3.1 A formal topographical survey has been completed. The site area is generally flat at 49.70m AOD with a nominal fall to a road gully in the centre at 49.50m AOD.

2.4 Hydrology

2.4.1 A review of local maps confirmed that the closest identified watercourse is the culverted Gore Brook, located approximately 0.5km to the south of the site.

3. Fluvial Flood Risk Review

3.1 Figure 4 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 2021 National Planning Policy Framework (NPPF) Flood Risk Guidance Notes, i.e. probability of annual fluvial flooding significantly less than 1 in 1000 in any one year (<0.1%). The risk from fluvial flood water is diminished to acceptable levels, removing the requirement for further investigation and assessment of the fluvial flood regime.

Figure 4: EA Indicative Flood Maps

3.2 In addition, the development application boundary is less that 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 that 1ha and in Flood Zone 1.

4. Planning Policy

4.1 Strategic Flood Risk Assessment (SFRA)

4.1.1 SFRA's assess the risk associated with all types of flooding and provide the information required to identify the amount of development permitted in an area, how drainage systems in the area should function and also how risks in vulnerable areas can be reduced and/or mitigated. The NPPF states that regional planning bodies (RPB's) or Local Planning Authorities should prepare SFRA's in consultation with the EA.

4.1.2 The building sits within the coverage of the Manchester, Salford and Trafford Council's Level 2 SFRA Final Report dated March 2011. The published SFRA identifies current and future broad scale flood related issues within the area that includes the development boundary. The purpose of the SFRA is to assess and map all known sources of flood risk including fluvial, surface water, sewer, groundwater and all impounded water bodies, taking into account future climate change predictions.

4.1.3 A summary of the main elements from the SFRA associated with the district is detailed below. The full report can be obtained from the Manchester City Council website.

- SFRA provides a detailed understanding of flood risks across all three Council's from all sources.
- Surface water flooding is deemed a low flood risk, following the natural topography and watercourse routes.
- Development should be designed so that there is no flooding to the development in a 1 in 30-year event and so that there is no property flooding in a 1 in 100 year plus climate change event.
- For all sites, development proposals should look at opportunities to incorporate SuDS to reduce the risk of surface water flooding.
- All proposed developments must ensure that foul and surface water are kept separate.
- Full sequential and exception tests to be carried out (where applicable).
- Follow all local and national policy.
- Flood Resilient construction to be used where applicable.
- Safe dry access and egress to be assured.

4.2 Local SuDS Strategy

4.2.1 In consultation with many other local councils in the region, Manchester City Council prepared the United Utilities Combined Authority Sustainable Drainage Systems Guidance document with the aim to guide developers in the design of surface water drainage systems and how SuDS can be integrated into the fabric of development starting at the planning stage and leading through the concept, outline and detailed design stages.

4.2.2 The main principles of the report that affect this development are:

- Detailed SuDS management train approach to be incorporated throughout the scheme with appropriate measures from prevention, source control through to site control.
- The DEFRA document 'The Non-Statutory Technical Standards for SuDS' to be followed.
- Post development runoff rates for Greenfield sites to be as per the calculated greenfield runoff rates.
- Detailed design via hydraulic modelling to be undertaken of the existing drainage network to define the predevelopment peak discharge rates. Post development to encompass a 50% reduction on Brownfield sites.
- Post development runoff rates as close to Qbar where the volume of runoff cannot equal the greenfield volumes.
- Detailed SuDS management train approach to be incorporated throughout the scheme with appropriate measures from prevention, source control through to site control.
- 45% climate change allowance where the design life exceeds 50 years. Though this is expected to now be superseded by recent EA site specific guidance.
- Exceedance flows beyond the 30-year event can be incorporated as long as the water is managed and does not flow off site or cause flood risk to the development building.
- Outline plans and hydraulic calculations to be provided at planning stage.

5. Outline Drainage Strategy

5.1 Existing Drainage

5.1.1 The United Utilities sewer records have been reviewed and confirm that a 300mm diameter combined sewer flows north within Clarence Road to the west of the site at circa 2.5m depth.

5.1.2 The current service yard is drained by a single road gully in the centre. This connects to the combined sewer via a private connection.

5.2 Existing Runoff

5.2.1 For the purpose of this assessment the site will be classed as fully Brownfield with an unrestricted outfall to the public sewer. As such the brownfield discharge rates defined below.

Area (Ha)	Brownfield Runoff Rates (l/s)		
	1 Year (30mm/hr)	30 Year (65mm/hr)	100 year (95mm/hr)
0.055	4.6l/s	9.9l/s	14.5l/s

Figure 5: Existing Greenfield Runoff Rates

5.2.2 To comply with the Manchester CC policy in post development discharge rates, a 50% reduction will be applied to the above flow rates. Though to reduce the risk of blockage a 5l/s rate will be used in the final design for all events.

5.3 Hydrological Assessment

5.3.1 As discussed in previous sections, a review of the topographical survey, OS Maps and Environment Agency maps would indicate the closest surface water feature to be the culverted Gore Brook, located approximately 0.5km to the south of the site.

5.4 Geology

5.4.1 No formal site investigation has been undertaken at this time. A review of the BGS online Geology Viewer has identified that the development area encompasses a concrete slab over Till / Diamicton, comprising clays & silts, over the Manchester Marls Formation - Mudstone to depth. The cohesive nature of the underlying geology precludes the use of soakaways on the site.

5.5 Sustainable Drainage Systems (SuDS) Assessment

5.5.1 SuDS Objectives

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

5.5.2 SuDS Design Themes

5.5.2.1 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.

5.5.3 SuDS Site Constraints

5.5.3.1 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 type of development allows the range of prevention, source control and site control SuDS devices to be considered.
- *Site Characteristics:* No Phase 2 intrusive site investigation has been carried out at the site. However, based on the cohesive underlying geology, it is not considered at this time that infiltration-based options would be possible.
- *Catchment Characteristics:* The site is currently classed for drainage purposes as 'Brownfield'.
- *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 project where feasible. Maintenance plans will be prepared for all SuDS devices that are included.

5.5.4 SuDS Methods

5.5.4.1 Figure 6 and 7 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 & 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 commercial development.

Method	Comment	Suitability for Development
Green Roofs	• Can be used on suitable low-rise buildings to provide retention, attenuation and treatment of rainwater. Promotes evaporation and local biodiversity.	*Not suitable*: • The extension is a prefabricated unit which could not include the additional loading of a green roof.
Water Butts	• Plastic tanks placed at the base of rainwater down pipes to collect rainwater runoff from the roof areas for reuse by the property owners.	*Not suitable*: • No end use due the development boundary being a service yard area only.
Rainwater Harvesting	• Rainwater harvesting reduces the total runoff volume from the developed site by reusing as 'Grey' water. Also reduces treated water consumption.	*Not suitable*: • No end use of the water. • Very small roof area.
Infiltration Options	• Reduces total run off volume from the development by allowing water to infiltrate to suitable sub strata.	*Not Suitable*: • Presence of cohesive underlying geology mean infiltration options are not viable for use on the site.
Permeable Surfacing (Infiltration)	• Reduces total run off volume from the development by allowing water to infiltrate to suitable sub strata. • Can be used to enhance water quality.	*Not Suitable*: • Presence of cohesive underlying geology mean infiltration options are not viable for use on the site. • Service yard requiring a concrete slab.
Permeable Surfacing (Standard)	• Can be used to enhance quality of runoff water. • Sub-base provides 'source' storage and reduces the volume of storage downstream with selection of stone fill or use of plastic box stems. • Impermeable membrane at base of construction to prevent impact on pavement stability.	*Not Suitable*: • Presence of cohesive underlying geology mean infiltration options are not viable for use on the site. • Service yard requiring a concrete slab.
Bio-Retention	• Collect and retain run-off within tree pits or above ground planers to help improve water quality, prior to discharge in piped system or infiltration.	*Not suitable*: • No end use of the water. • Very small roof area.
Swales, basins and ponds	• Provide areas for above ground surface runoff storage. • Swales also improve water quality through filtration.	*Not Suitable*: • Not sufficient space or suitable development type to include for swales and ponds.

Table 6: 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.	*Suitable:* • Subject to detailed design and drainage layout to be used to attenuate the peak flows.
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 (e.g. United Utilities).	*Not Suitable:* • The use of oversized pipes is more suited to large residential schemes.

Table 7: Sub-Surface SuDS Methods

5.5.5 SuDS Hierarchal Approach

Based on the SuDS assessment in Tables 6 & 7, 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	A review of the BGS website and local boreholes have indicated that the underlying cohesive Glacial Till would not be suitable for infiltration-based options.
Connection to Watercourse	No	No watercourse identified in close proximity
Connection to Surface Water Sewer	No	No surface water sewers identified within close proximity.
Connection to a Combined Sewer	Yes	Reuse existing connection to the combined water sewer at restricted rates.

Table 8: SuDS Hierarchal Approach

5.5.6 SuDS Design Philosophy

5.5.6.1 SuDS assessment and hierarchal approach discussed in Figure 6, 7 and 8 above has defined the overall SuDS strategy. Thus, the SuDS philosophy for the development site is the promotion of site control techniques with discharge to the adjacent combined sewer at a restricted rate.

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.
- Site control in the form of a flow control and geocellular storage.
- Aim to limit where possible the impermeable fraction of development.

5.6 The Non-Statutory Technical Standards for SuDS

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

5.6.2 The DEFRA document advises the following with respect to 'Peak Flow Control' (S3) and 'Volume Control' (S5) for Brownfield sites such as this:

- ***S3*** *For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.*
- ***S5*** *Where reasonably practicable, for developments which have been previously developed, 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 must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that 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* ***S5*** *above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.*

5.6.3 As noted above, and in line with policy, it is intended that surface water discharge rates will be restricted close to the respective brownfield runoff rates for all rainfall events in accordance with standard **S3** and to comply with the peak volume requirements as per **S5** and **S6**. To also comply with the MCC policy of a 50% reduction in pre development rates. A Maximum rate of 5.0l/s will therefore be applied to the flow control to satisfy these constraints and also a rate that reduces the risk of blockage.

5.6.4 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.

5.7 Climate Change

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

5.7.2 Based on the nature of the development, a lifespan of circa 60 years is anticipated. Therefore, the potential climate change allowance for the 2070's is 45% for the upper end allowance, which will be included into the peak rainfall intensity within the hydraulic calculations.

5.8 Outline Surface Water Drainage Strategy

5.8.1 The general principal of the surface water drainage strategy is to collect the runoff from the roof area of the small extension and direct it to a new geocellular storage tank located beneath the existing service yard. The existing retained gully serving the service yard will also be reconnected through the tank. The tank will then outfall into the combined sewer via an existing connection at a controlled rate of 5l/s.

5.8.2 The proposed drainage layout for the new development site will be designed in accordance with BS EN 752: 2008 and Building Regulations Part H guidance, i.e. up to the 30-year storm return period criterion and tested for the 1 in 100-year return period including a 45% increase to account for climate change to confirm that there is no flood risk to the properties.

5.8.3 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. Guidance states that development should be protected against flooding from extreme events (1 in 30 year) and that flood pathways are identified when the drainage system is exceeded.

5.8.4 In the case of this development, exceedance flows will be all those over and above the 30-year design criterion set by guidance. Using storage within the low-lying external areas would be achievable and would direct flood water away from the existing building, with flows directed back into the surface water drainage network as water levels in the drainage network receded. The exceedance flows and volumes can be calculated for the new development drainage layout.

5.8.5 This strategy will assume for outline calculations purposes that only Site Control methods are incorporated. A source control attenuation assessment has been simulated in the Microdrainage Design Software. This takes into account the 5l/s discharge rate for all events. It is noted that these rates and volumes are preliminary for this outline assessment and are likely to alter at detailed design stage when more site-specific information is made available.

5.8.6 Figure 9 below defines the outline attenuation volumes based on the attenuation tank.

Plot Area	SuDS Component	Impermeable Area (ha)	Peak Runoff Rate	Outline Attenuation Volumes for the 30 Year Event	Outline Attenuation Volumes for the 100 Year + 45% climate Change Event
Service Yard	Geocellular storage	0.055	5.0l/s	4.2m^3	13.0m^3

Figure 9: Outline Attenuation Volumes

5.8.7 Drawing PGC656-C-001 in Appendix C indicates the Drainage Strategy based on the Architects masterplan intent, with the outline hydraulic calculations in Appendix D.

5.9 Volume Control

5.9.1 The impermeable area of the application site will remain the same post development. Thus the volume of run-off in the 100-year 6-hour storm event will also remain unchanged.

5.10 Pollution Control

5.10.1 Runoff from roofs is generally considered to be clean and will be discharged directly into the surface water network. Runoff from the small service yard area will pass through the gully which will collect any silts and debris.

5.11 Maintenance

5.11.1 The long-term maintenance of the new drainage will be with the owner of the development in line with best practice guidance. Annual inspections will need to be carried out and clearing of gullies, channel drains and catchpits.

Typically, the maintenance regime will be in line with Figure 10 below.

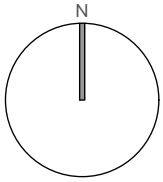
Future Maintenance of the Drainage System			
Responsibility	**Feature**	**Maintenance**	**Frequency**
Owner / Occupier	Drainage Channel.	Regular maintenance / removal of blockages and silts.	Ad-hoc flushing/jetting and emptying of silt traps required.
	Rainwater gutters, downpipes and above ground drainage.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

Figure 10: Outline Management and Maintenance Strategy

5.12 Foul Water Drainage

5.12.1 No new foul drainage is proposed as part of this development.

Appendix A – Architects Drawings



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Revision Notes

Rev	Date	Revision Description	Drawn	Checked
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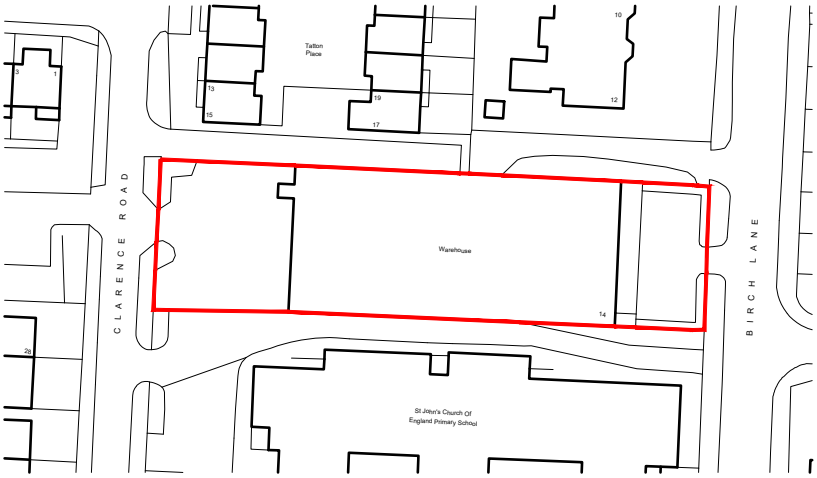

Project Name
Longsight Clarence Road

Drawing Title
Location Plan

Drawing Number
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T1129	A3 Planning	P1

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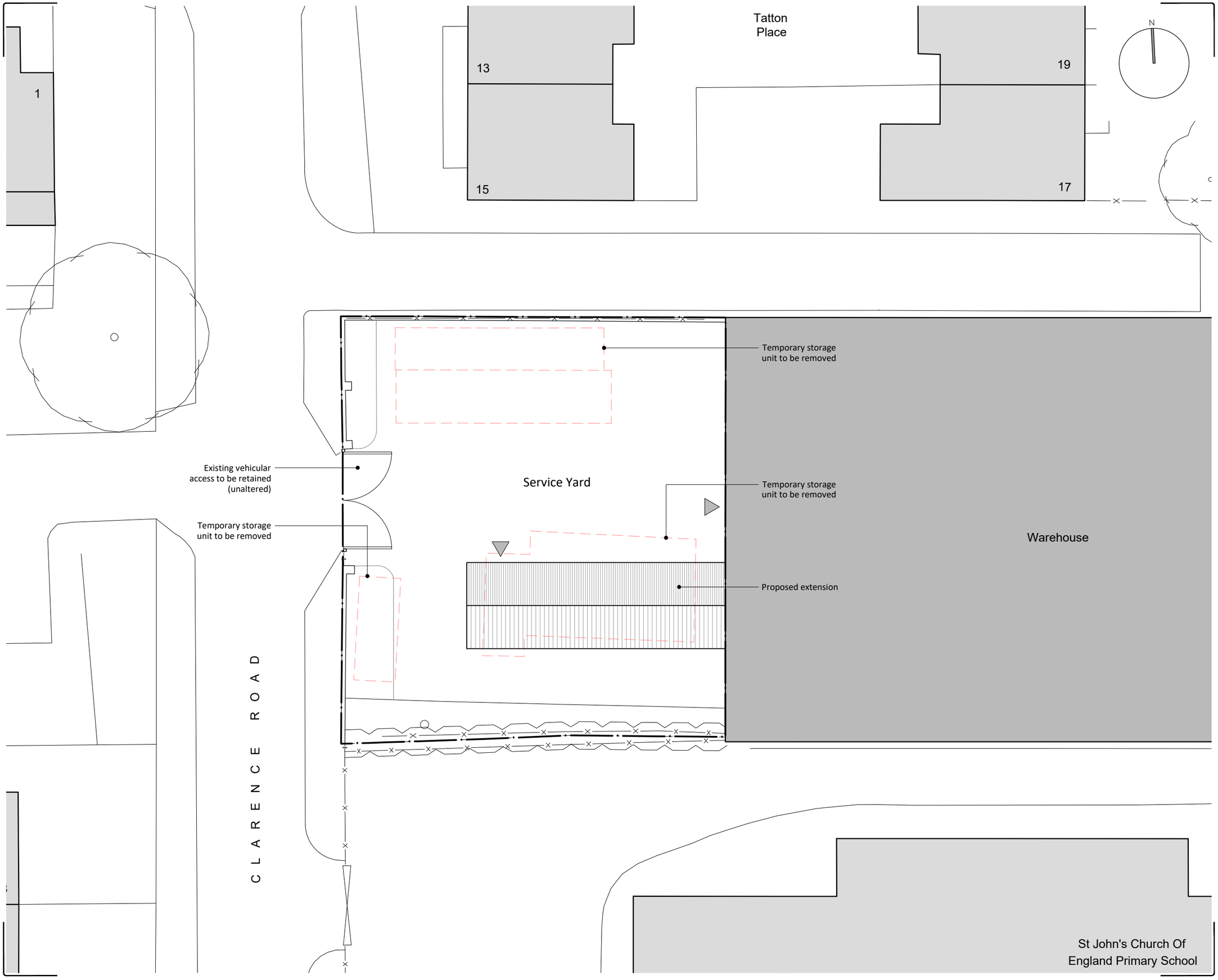
Studio KMA

Clarence Arcade | Stamford Street | Ashton-under-Lyne | OL6 7PT
T: 01457 873163

E: info@studiokma.co.uk www.studiokma.co.uk



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This drawing is to be read in conjunction with the relevant Fire Safety Strategy drawings.

Please note that the use of any quantification data is done so at the users own risk.

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Revision Notes

Rev	Date	Revision Description	Drawn	Checked
P1	15.12.22	Initial Issue	CTW	AT

Project Name
Longsight Clarence Road

Drawing Title
Proposed Site Plan

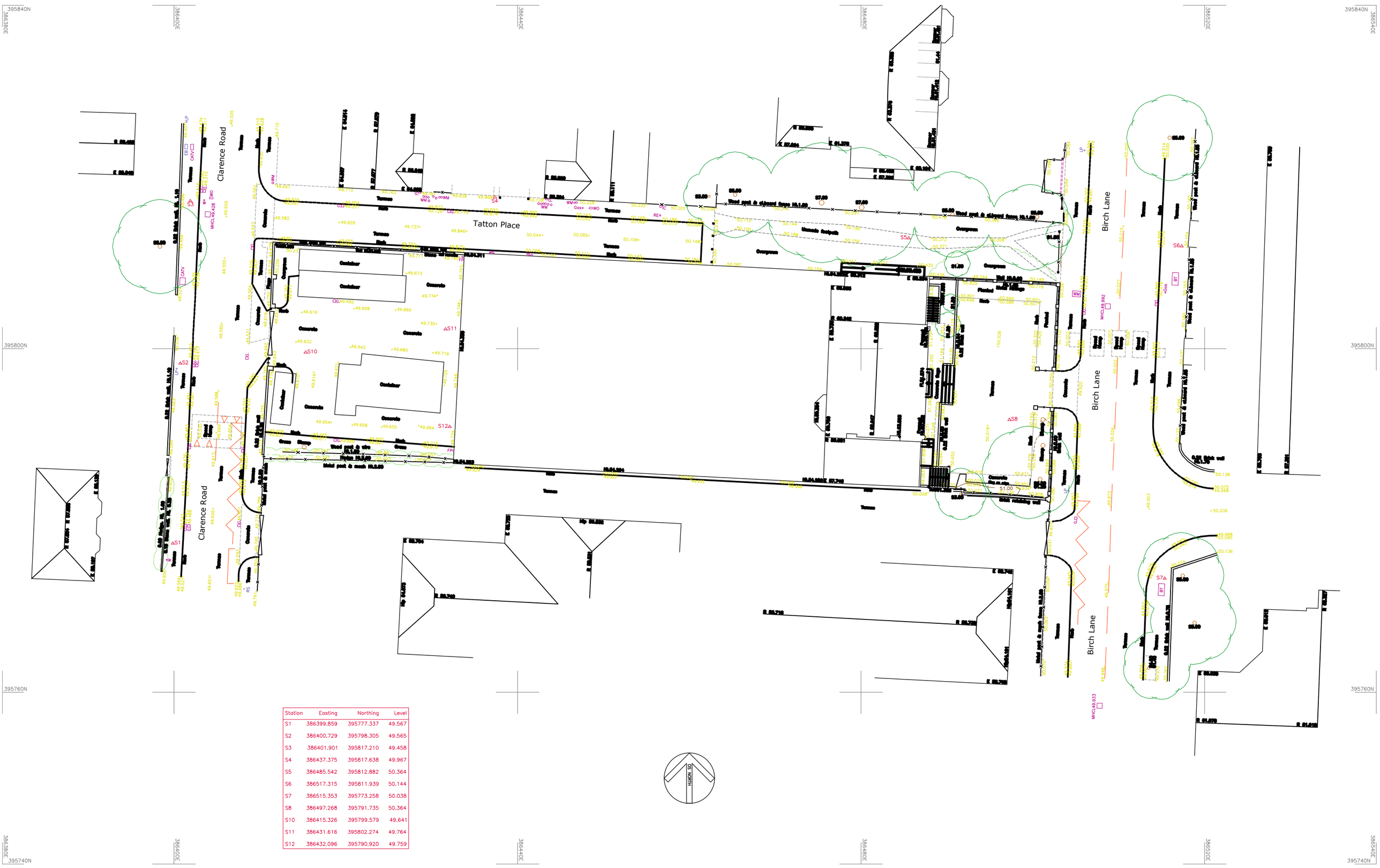
Drawing Number
LCR-KMA-XX-XX-DR-A-7002

Project Number	Status	Revision
T1129	A3 Planning	P1

Drawn by	Authorised by	Date
CTW	AT	15.12.22

Studio KMA
Clarence Arcade | Stamford Street | Ashton-under-Lyne | OL6 7PT
T: 01457 873163
E: info@studiokma.co.uk www.studiokma.co.uk

Appendix B – Topographical Survey



Station	Easting	Northing	Level
S1	386399.859	395777.337	49.567
S2	386400.729	395798.305	49.565
S3	386401.901	395817.210	49.458
S4	386437.375	395817.638	49.967
S5	386485.542	395812.882	50.364
S6	386517.315	395811.939	50.144
S7	386515.353	395773.258	50.038
S8	386497.268	395791.735	50.364
S10	386415.326	395799.579	49.641
S11	386431.616	395802.274	49.764
S12	386432.096	395790.920	49.759

Haycock+Todd
Land Survey Consultants Architectural Surveyors
The Hollies, 43 Church Street, Royston, Barnsley, S71 4QU. T:01226 709630
E:info@land-surveying.co.uk W:land-surveying.co.uk

LEGEND

Manhole shown thus — MH
Inspection Cover — IC
Lamp post — LP
Gully — G
Lampost — LP
Telegraph Post — TP
Electricity Poles — EP
Road Traffic Signs — RS
Traffic Lights — TL
British Telecom — BT
Post Office Telephones — PO
Fire Hydrant — FH
Safety Valve — SV
Stop tap Water — W
Stopcock Gas — Gas
Unknown Service — Ser

Spot Level — +123.562
Kerb Line
Fence Line — Wood post & rail
Hedge Line
Contours 1m Interval — 105.0
Contours 0.5m Interval — 33.0
Tree Spread — S5.00
Girth — G1.30
Cover Level — CL 112.335
Invert Level — IL 111.733
Foul Drain
Surface Water
Survey Station — S3

Floor Level — FL 10.907
Height floor to ceiling — C 2.22
Height floor to struct soffit — SO 2.87
Height floor to false ceiling — FC 2.22
Height floor to sill — SO.67
Height sill to window head — W1.23
Height of Door — D1.98
Height floor to underside — US 3.61
Ceiling Slopes Up — CRU
Height floor to Arch — Ar2.99
Height floor to Arch Spring — Sp2.87
Vent — VP
Fall Pipe — FP
Sky Light — SL
Water Closet — WC
Sink — S
Boxed Column — B

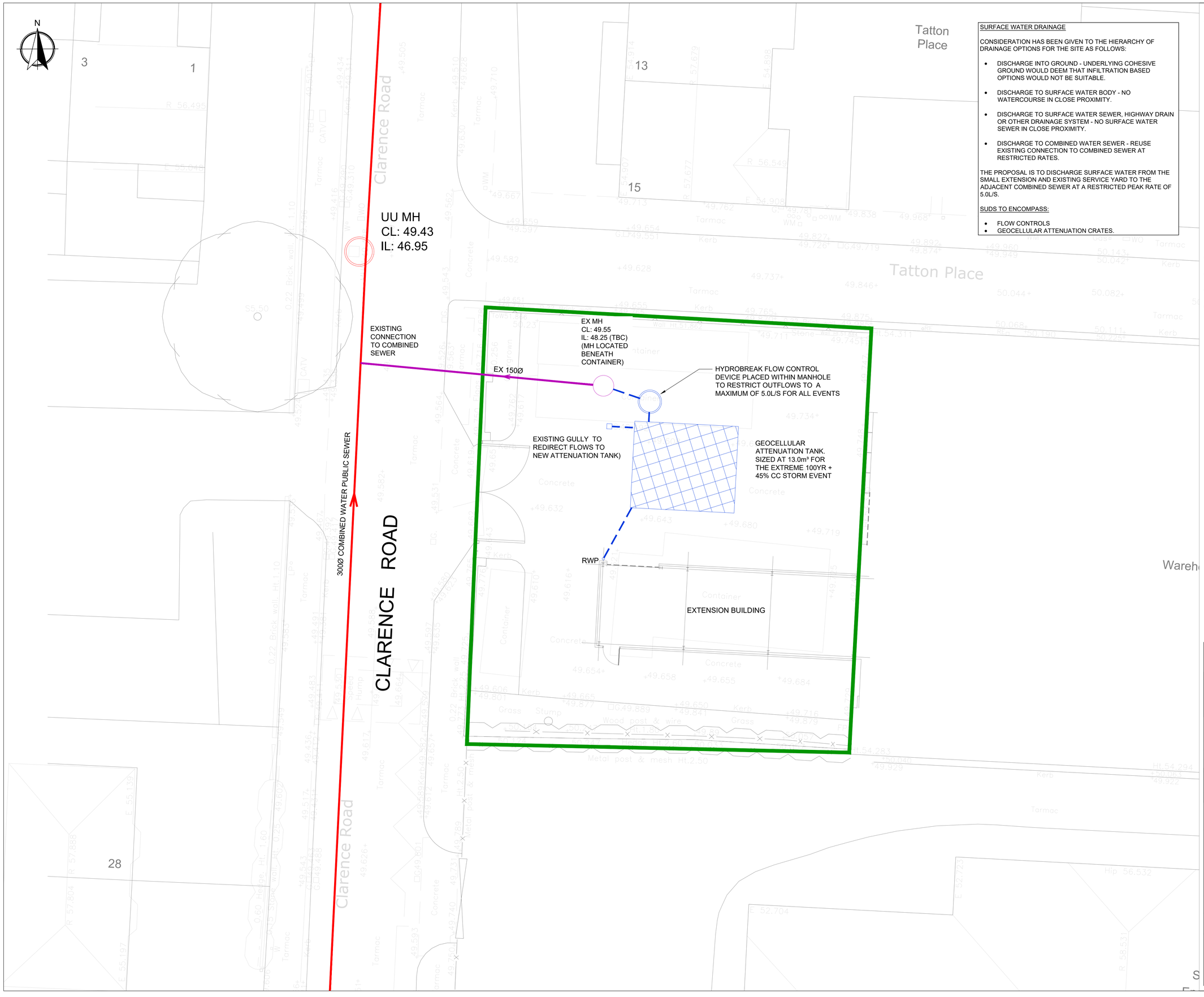
SITE SURVEY

CLARENCE ROAD
LONGSIGHT
MANCHESTER

Sheet Diagram

Datum	Sheet 1 of 1	Survey Job No. S10455	Scale 1/200
GRID– Related to Ordnance Survey using One Point Localisation on Station S6. Orientation at OS Grid North.	Surveyed by DR	Date of Survey December 2022	S10455
	Drawn by DR		
	Checked by PBT		
LEVEL– Related to Ordnance Survey by connection to the OS Active Network by G.P.S			

Appendix C – PGC Drawings



SURFACE WATER DRAINAGE

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

- DISCHARGE INTO GROUND - UNDERLYING COHESIVE GROUND WOULD DEEM THAT INFILTRATION BASED OPTIONS WOULD NOT BE SUITABLE.
- DISCHARGE TO SURFACE WATER BODY - NO WATERCOURSE IN CLOSE PROXIMITY.
- DISCHARGE TO SURFACE WATER SEWER, HIGHWAY DRAIN OR OTHER DRAINAGE SYSTEM - NO SURFACE WATER SEWER IN CLOSE PROXIMITY.
- DISCHARGE TO COMBINED WATER SEWER - REUSE EXISTING CONNECTION TO COMBINED SEWER AT RESTRICTED RATES.

THE PROPOSAL IS TO DISCHARGE SURFACE WATER FROM THE SMALL EXTENSION AND EXISTING SERVICE YARD TO THE ADJACENT COMBINED SEWER AT A RESTRICTED PEAK RATE OF 5.0L/S.

SUDS TO ENCOMPASS:

- FLOW CONTROLS
- GEOCELLULAR ATTENUATION CRATES.

GENERAL NOTES

1. DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL RELEVANT SPECIFICATIONS, ENGINEERS, ARCHITECTS & SERVICES DRAWINGS, INCLUDING APPROVED BUILDERS WORK DRAWINGS. CONTRACTOR TO NOTIFY ENGINEER OF DISCREPANCIES BETWEEN STRUCTURAL DRAWINGS AND SPECIFICATIONS OR OTHER DRAWINGS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. DETAILS OF EXISTING SEWERS SHALL BE CONFIRMED BY THE CONTRACTOR ON SITE PRIOR TO THE COMMENCEMENT OF WORKS. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY. THE CONTRACTOR SHOULD CHECK THE LEVELS OF ALL NEW OUT FALLS IN RELATION TO EXISTING SEWERS PRIOR TO ANY CONSTRUCTION TO ENSURE THE PROPOSED DESIGN CAN BE ACHIEVED.
4. DO NOT SCALE FROM THIS DRAWN, WORK TO DIMENSIONS OR COORDINATES PROVIDED. ALL LEVELS ARE IN MILLIMETRES, UNLESS OTHERWISE NOTED. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER IMMEDIATELY.

KEY

- EXISTING COMBINED WATER PUBLIC SEWER
- EXISTING COMBINED WATER DRAINAGE
- PROPOSED SURFACE WATER DRAINAGE
- SITE BOUNDARY

REV	DATE	DRAWN	REV'D ENG.	NOTES
P2	01.02.24	PG	PG	45% CC APPLIED. TANK INCREASED
P1	04.01.23	PG	PG	PRELIMINARY ISSUE

CLIENT
WING ON FOODS LTD

PROJECT
CLARENCE ROAD, MANCHESTER

DRAWING TITLE
DRAINAGE STRATEGY PLAN

DRAWING STATUS
INFORMATION

SCALE	DRAWN BY	ENGINEER	SHEET
1:100	PG	PG	A1

DRAWING No	REVISION
PGC656-C-001	P2

PG Consulting
Civil & Infrastructure Engineers
108 Ack Lane West,
Cheadle Hulme,
Cheshire,
SK8 7ES
Tel: 07710 758971
Email: paul@pgcl.co.uk

Appendix D – Outline Hydraulic Calculations

	Clarence Road, Manchester 30yr Attenuation
Date 04/01/2023 File Clarence Road - 30yr.SRCX	Designed by paulg Checked by
Innovyze	Source Control 2017.1.2

Summary of Results for 30 year Return Period

Half Drain Time : 10 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	48.420	0.120	0.0	4.7	4.7	3.0	O K
30 min Summer	48.448	0.148	0.0	5.0	5.0	3.6	O K
60 min Summer	48.451	0.151	0.0	5.0	5.0	3.7	O K
120 min Summer	48.426	0.126	0.0	4.9	4.9	3.1	O K
180 min Summer	48.409	0.109	0.0	4.3	4.3	2.7	O K
240 min Summer	48.397	0.097	0.0	3.8	3.8	2.4	O K
360 min Summer	48.382	0.082	0.0	3.0	3.0	2.0	O K
480 min Summer	48.373	0.073	0.0	2.5	2.5	1.8	O K
600 min Summer	48.367	0.067	0.0	2.2	2.2	1.7	O K
720 min Summer	48.362	0.062	0.0	1.9	1.9	1.5	O K
960 min Summer	48.356	0.056	0.0	1.6	1.6	1.4	O K
1440 min Summer	48.347	0.047	0.0	1.2	1.2	1.2	O K
2160 min Summer	48.340	0.040	0.0	0.9	0.9	1.0	O K
2880 min Summer	48.336	0.036	0.0	0.7	0.7	0.9	O K
4320 min Summer	48.330	0.030	0.0	0.5	0.5	0.7	O K
5760 min Summer	48.327	0.027	0.0	0.4	0.4	0.7	O K
7200 min Summer	48.325	0.025	0.0	0.4	0.4	0.6	O K
8640 min Summer	48.323	0.023	0.0	0.3	0.3	0.6	O K
10080 min Summer	48.322	0.022	0.0	0.3	0.3	0.5	O K
15 min Winter	48.436	0.136	0.0	4.9	4.9	3.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	65.808	0.0	6.8	21
30 min Summer	43.570	0.0	9.0	31
60 min Summer	27.653	0.0	11.4	46
120 min Summer	17.064	0.0	14.1	76
180 min Summer	12.735	0.0	15.7	104
240 min Summer	10.303	0.0	17.0	134
360 min Summer	7.597	0.0	18.8	194
480 min Summer	6.121	0.0	20.2	254
600 min Summer	5.173	0.0	21.3	314
720 min Summer	4.507	0.0	22.3	374
960 min Summer	3.624	0.0	23.9	496
1440 min Summer	2.661	0.0	26.3	736
2160 min Summer	1.952	0.0	29.0	1104
2880 min Summer	1.565	0.0	31.0	1468
4320 min Summer	1.145	0.0	34.0	2200
5760 min Summer	0.917	0.0	36.3	2936
7200 min Summer	0.772	0.0	38.2	3592
8640 min Summer	0.670	0.0	39.8	4344
10080 min Summer	0.594	0.0	41.2	5040
15 min Winter	65.808	0.0	7.6	22

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	Clarence Road, Manchester 30yr Attenuation
Date 04/01/2023 File Clarence Road - 30yr.SRCX	Designed by paulg Checked by
Innovyze	Source Control 2017.1.2

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	48.472	0.172	0.0	5.0	5.0	4.2	O K
60 min Winter	48.463	0.163	0.0	5.0	5.0	4.0	O K
120 min Winter	48.418	0.118	0.0	4.7	4.7	2.9	O K
180 min Winter	48.397	0.097	0.0	3.8	3.8	2.4	O K
240 min Winter	48.385	0.085	0.0	3.2	3.2	2.1	O K
360 min Winter	48.371	0.071	0.0	2.4	2.4	1.8	O K
480 min Winter	48.363	0.063	0.0	2.0	2.0	1.5	O K
600 min Winter	48.357	0.057	0.0	1.7	1.7	1.4	O K
720 min Winter	48.353	0.053	0.0	1.4	1.4	1.3	O K
960 min Winter	48.347	0.047	0.0	1.2	1.2	1.2	O K
1440 min Winter	48.340	0.040	0.0	0.9	0.9	1.0	O K
2160 min Winter	48.334	0.034	0.0	0.6	0.6	0.8	O K
2880 min Winter	48.330	0.030	0.0	0.5	0.5	0.7	O K
4320 min Winter	48.326	0.026	0.0	0.4	0.4	0.6	O K
5760 min Winter	48.323	0.023	0.0	0.3	0.3	0.6	O K
7200 min Winter	48.321	0.021	0.0	0.3	0.3	0.5	O K
8640 min Winter	48.319	0.019	0.0	0.2	0.2	0.5	O K
10080 min Winter	48.318	0.018	0.0	0.2	0.2	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	43.570	0.0	10.1	32
60 min Winter	27.653	0.0	12.8	48
120 min Winter	17.064	0.0	15.8	76
180 min Winter	12.735	0.0	17.6	106
240 min Winter	10.303	0.0	19.0	136
360 min Winter	7.597	0.0	21.0	196
480 min Winter	6.121	0.0	22.6	254
600 min Winter	5.173	0.0	23.9	314
720 min Winter	4.507	0.0	25.0	376
960 min Winter	3.624	0.0	26.8	498
1440 min Winter	2.661	0.0	29.5	734
2160 min Winter	1.952	0.0	32.5	1096
2880 min Winter	1.565	0.0	34.7	1480
4320 min Winter	1.145	0.0	38.1	2192
5760 min Winter	0.917	0.0	40.7	2880
7200 min Winter	0.772	0.0	42.8	3632
8640 min Winter	0.670	0.0	44.6	4336
10080 min Winter	0.594	0.0	46.1	5120

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	Clarence Road, Manchester 30yr Attenuation
Date 04/01/2023 File Clarence Road - 30yr.SRCX	Designed by paulg Checked by
Innovyze	Source Control 2017.1.2

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.363	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.055

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.010	8	12	0.010	16	20	0.005
4	8	0.020	12	16	0.010			

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	Clarence Road, Manchester 30yr Attenuation	
Date 04/01/2023 File Clarence Road - 30yr.SRCX	Designed by paulg Checked by	
Innovyze	Source Control 2017.1.2	

Model Details

Storage is Online Cover Level (m) 49.500

Cellular Storage Structure

Invert Level (m) 48.300 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	26.0	26.0	2.600	0.0	34.2
0.200	26.0	30.1	2.800	0.0	34.2
0.400	26.0	34.2	3.000	0.0	34.2
0.401	0.0	34.2	3.200	0.0	34.2
0.800	0.0	34.2	3.400	0.0	34.2
1.000	0.0	34.2	3.600	0.0	34.2
1.200	0.0	34.2	3.800	0.0	34.2
1.400	0.0	34.2	4.000	0.0	34.2
1.600	0.0	34.2	4.200	0.0	34.2
1.800	0.0	34.2	4.400	0.0	34.2
2.000	0.0	34.2	4.600	0.0	34.2
2.200	0.0	34.2	4.800	0.0	34.2
2.400	0.0	34.2	5.000	0.0	34.2

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0113-5000-0500-5000
Design Head (m)	0.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	113
Invert Level (m)	48.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	5.0
Flush-Flo™	0.179	5.0
Kick-Flo®	0.372	4.4
Mean Flow over Head Range	-	4.1

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

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	Clarence Road, Manchester 30yr Attenuation
Date 04/01/2023 File Clarence Road - 30yr.SRCX	Designed by paulg Checked by
Innovyze	Source Control 2017.1.2

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	7.5	3.000	11.6	7.000	17.4
0.200	5.0	1.400	8.1	3.500	12.5	7.500	18.1
0.300	4.8	1.600	8.6	4.000	13.3	8.000	18.7
0.400	4.5	1.800	9.1	4.500	14.1	8.500	19.2
0.500	5.0	2.000	9.6	5.000	14.8	9.000	19.8
0.600	5.4	2.200	10.0	5.500	15.4	9.500	20.3
0.800	6.2	2.400	10.4	6.000	16.1		
1.000	6.9	2.600	10.8	6.500	16.8		

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	Clarence Road, Manchester 100yr + 45% CC Attenuation
Date 01/02/2024 File Clarence Road - 100yr +...	Designed by paulg Checked by
Innovyze	Source Control 2017.1.2

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 25 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	48.521	0.221	0.0	5.0	5.0	7.6	O K
30 min Summer	48.600	0.300	0.0	5.0	5.0	10.2	O K
60 min Summer	48.627	0.327	0.0	5.0	5.0	11.2	O K
120 min Summer	48.597	0.297	0.0	5.0	5.0	10.2	O K
180 min Summer	48.550	0.250	0.0	5.0	5.0	8.5	O K
240 min Summer	48.505	0.205	0.0	5.0	5.0	7.0	O K
360 min Summer	48.441	0.141	0.0	4.9	4.9	4.8	O K
480 min Summer	48.415	0.115	0.0	4.6	4.6	3.9	O K
600 min Summer	48.402	0.102	0.0	4.0	4.0	3.5	O K
720 min Summer	48.392	0.092	0.0	3.5	3.5	3.2	O K
960 min Summer	48.380	0.080	0.0	2.9	2.9	2.8	O K
1440 min Summer	48.367	0.067	0.0	2.2	2.2	2.3	O K
2160 min Summer	48.356	0.056	0.0	1.6	1.6	1.9	O K
2880 min Summer	48.349	0.049	0.0	1.3	1.3	1.7	O K
4320 min Summer	48.341	0.041	0.0	0.9	0.9	1.4	O K
5760 min Summer	48.337	0.037	0.0	0.7	0.7	1.3	O K
7200 min Summer	48.333	0.033	0.0	0.6	0.6	1.1	O K
8640 min Summer	48.331	0.031	0.0	0.5	0.5	1.0	O K
10080 min Summer	48.329	0.029	0.0	0.5	0.5	1.0	O K
15 min Winter	48.560	0.260	0.0	5.0	5.0	8.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	123.207	0.0	12.7	25
30 min Summer	82.373	0.0	17.0	35
60 min Summer	52.627	0.0	21.7	52
120 min Summer	32.545	0.0	26.8	84
180 min Summer	24.251	0.0	30.0	116
240 min Summer	19.566	0.0	32.3	146
360 min Summer	14.331	0.0	35.5	202
480 min Summer	11.497	0.0	37.9	258
600 min Summer	9.684	0.0	39.9	318
720 min Summer	8.412	0.0	41.6	376
960 min Summer	6.731	0.0	44.4	496
1440 min Summer	4.907	0.0	48.6	738
2160 min Summer	3.570	0.0	53.0	1104
2880 min Summer	2.846	0.0	56.3	1452
4320 min Summer	2.064	0.0	61.3	2172
5760 min Summer	1.641	0.0	65.0	2936
7200 min Summer	1.373	0.0	67.9	3608
8640 min Summer	1.186	0.0	70.4	4288
10080 min Summer	1.048	0.0	72.6	5064
15 min Winter	123.207	0.0	14.2	26

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	Clarence Road, Manchester 100yr + 45% CC Attenuation	
Date 01/02/2024 File Clarence Road - 100yr +...	Designed by paulg Checked by	
Innovyze	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	48.649	0.349	0.0	5.0	5.0	11.9	O K
60 min Winter	48.677	0.377	0.0	5.0	5.0	12.9	O K
120 min Winter	48.614	0.314	0.0	5.0	5.0	10.7	O K
180 min Winter	48.533	0.233	0.0	5.0	5.0	8.0	O K
240 min Winter	48.468	0.168	0.0	5.0	5.0	5.7	O K
360 min Winter	48.412	0.112	0.0	4.4	4.4	3.8	O K
480 min Winter	48.394	0.094	0.0	3.6	3.6	3.2	O K
600 min Winter	48.384	0.084	0.0	3.1	3.1	2.9	O K
720 min Winter	48.376	0.076	0.0	2.7	2.7	2.6	O K
960 min Winter	48.367	0.067	0.0	2.2	2.2	2.3	O K
1440 min Winter	48.356	0.056	0.0	1.6	1.6	1.9	O K
2160 min Winter	48.347	0.047	0.0	1.2	1.2	1.6	O K
2880 min Winter	48.341	0.041	0.0	0.9	0.9	1.4	O K
4320 min Winter	48.335	0.035	0.0	0.7	0.7	1.2	O K
5760 min Winter	48.331	0.031	0.0	0.5	0.5	1.0	O K
7200 min Winter	48.328	0.028	0.0	0.5	0.5	1.0	O K
8640 min Winter	48.326	0.026	0.0	0.4	0.4	0.9	O K
10080 min Winter	48.324	0.024	0.0	0.3	0.3	0.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	82.373	0.0	19.0	36
60 min Winter	52.627	0.0	24.3	56
120 min Winter	32.545	0.0	30.1	90
180 min Winter	24.251	0.0	33.6	120
240 min Winter	19.566	0.0	36.1	148
360 min Winter	14.331	0.0	39.7	200
480 min Winter	11.497	0.0	42.5	258
600 min Winter	9.684	0.0	44.7	318
720 min Winter	8.412	0.0	46.6	380
960 min Winter	6.731	0.0	49.7	498
1440 min Winter	4.907	0.0	54.4	738
2160 min Winter	3.570	0.0	59.4	1092
2880 min Winter	2.846	0.0	63.1	1452
4320 min Winter	2.064	0.0	68.6	2164
5760 min Winter	1.641	0.0	72.8	2888
7200 min Winter	1.373	0.0	76.1	3624
8640 min Winter	1.186	0.0	78.9	4384
10080 min Winter	1.048	0.0	81.3	5040

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Shortest Storm (mins)	15
Ratio R	0.363	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.055

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.010	8	12	0.010	16	20	0.005
4	8	0.020	12	16	0.010			

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Model Details

Storage is Online Cover Level (m) 49.500

Cellular Storage Structure

Invert Level (m) 48.300 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	36.0	36.0	2.600	0.0	45.6
0.200	36.0	40.8	2.800	0.0	45.6
0.400	36.0	45.6	3.000	0.0	45.6
0.401	0.0	45.6	3.200	0.0	45.6
0.800	0.0	45.6	3.400	0.0	45.6
1.000	0.0	45.6	3.600	0.0	45.6
1.200	0.0	45.6	3.800	0.0	45.6
1.400	0.0	45.6	4.000	0.0	45.6
1.600	0.0	45.6	4.200	0.0	45.6
1.800	0.0	45.6	4.400	0.0	45.6
2.000	0.0	45.6	4.600	0.0	45.6
2.200	0.0	45.6	4.800	0.0	45.6
2.400	0.0	45.6	5.000	0.0	45.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0113-5000-0500-5000
Design Head (m)	0.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	113
Invert Level (m)	48.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	5.0
Flush-Flo™	0.179	5.0
Kick-Flo®	0.372	4.4
Mean Flow over Head Range	-	4.1

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

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Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	7.5	3.000	11.6	7.000	17.4
0.200	5.0	1.400	8.1	3.500	12.5	7.500	18.1
0.300	4.8	1.600	8.6	4.000	13.3	8.000	18.7
0.400	4.5	1.800	9.1	4.500	14.1	8.500	19.2
0.500	5.0	2.000	9.6	5.000	14.8	9.000	19.8
0.600	5.4	2.200	10.0	5.500	15.4	9.500	20.3
0.800	6.2	2.400	10.4	6.000	16.1		
1.000	6.9	2.600	10.8	6.500	16.8		

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