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## Surface Water and SuDS Assessment Rev0

Queens Road,  
Manchester,  
M8 0RX

21 February 2023

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## Appendices

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| Prepared by               | Checked by                | Date             |
|---------------------------|---------------------------|------------------|
| Carina Hassall BSc (Hons) | Peter Kinsella BSc (Hons) | 21 February 2023 |

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## **1. Introduction**

This Surface Water and SuDS Assessment has been prepared to support the planning application for the proposed development on land off Queens Road, Manchester.

### **Existing Site Description**

The existing site is currently occupied by areas of concrete hardstanding, and grass and brambles. The existing layout is shown on the topographic survey in **Appendix A**.

### **Development Proposals**

Proposals are for a 'trade counter' style warehouse with associated car parking. A copy of the proposed site layout plans is provided in **Appendix B**.

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## **2. Planning Policy**

### **Manchester Council**

#### **Core Strategy**

Policy EN 14 Flood Risk states:

All new development should minimise surface water run-off, including through Sustainable Drainage Systems (SUDS) and the appropriate use of Green Infrastructure. Developers should have regard to the surface water run-off rates in the SFRA User Guide. In CDAs, evidence to justify the surface water run-off approach / rates will be required.

12.84 The main ways in which Local Authorities can influence water quality are by: encouraging the use of sustainable drainage systems (SUDS) as a way to reduce water run-off; not all types of SUDS are appropriate for all urban areas; in some parts of Manchester there are brownfield sites which have issues of contamination where the use of some types of SUDS would be problematic, causing transfer of contaminants to receptor sites (the Strategic Flood Risk Assessment provides further guidance on this); where appropriate, above-ground SUDS such as retention ponds, ponds and swales are preferred to underground options because they have greater landscape and biodiversity value; in densely built-up urban areas such as Manchester where there is limited open space, there is also a role for innovative SUDS solutions including green roofs and green walls.

#### **Non-Statutory Technical Standards for SuDS**

The Non-Statutory Technical Standards for SuDS, (and accompanying Local Authority SuDS Officer Organisation (LASOO) Practice Guidance) sets out the details which should be addressed within a SuDS Report, including:

- Flood Risk Outside of the Development
- Peak Flow Control and Volume Control
- Flood Risk Within the Development
- Runoff Destinations

- 
- Structural Integrity
  - Designing for Maintenance Considerations
  - Construction

### **3. Surface Water and SuDS**

The whole site comprises approximately 400m<sup>2</sup> (0.04ha).

The **ICP SuDS** method within Micro Drainage has been used to calculate flow rates from the total site (as detailed in **Appendix D** and shown in **Table 1**).

**Table 1 – ICP SuDS – Proposed Greenfield Runoff Rates (l/s)**

| Return Period        | Flow Rate for 400m <sup>2</sup> (0.04ha) (l/s) |
|----------------------|------------------------------------------------|
| <b>QBAR</b>          | 0.2                                            |
| <b>1 in 30 year</b>  | 0.4                                            |
| <b>1 in 100 year</b> | 0.5                                            |

Following redevelopment of the site, the areas will be made up as follows:

- Roof areas ~200m<sup>2</sup>
- Hardstanding ~200m<sup>2</sup>

#### **SuDS Approach**

When choosing and designing SuDS for a development, it is important to recognise the constraints associated with the type of SuDS to be installed, including the size of the site and the underlying ground conditions. Most Councils set out a strategic approach for the disposal of surface water runoff, which mirrors the hierarchy set out in Building Regulations Approved Document Part H<sup>1</sup>. In general, these are as follows:

<sup>1</sup> Building Regulations Approved Document H Section 3 page 45

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### Infiltration

The Soilsapes Maps provided by the National Soil Resources Institute at Cranfield University indicate that the soils at the site and surrounding areas are comprised of '*Freely draining slightly acid loamy soils*'.

The British Geological Survey geology maps indicate that the site is underlain by Devensian Till. The underlying bedrock is shown to be comprised of Pennine Middle Coal Measures Formation - Mudstone, siltstone and sandstone.

In order to investigate the underlying ground conditions further, reference has been made to the BGS borehole records; there nearest record is from Bury Electric Railways on Queens Road (**Appendix D**). The record confirms that the underlying ground is sandy and stoney loam, underlain by clay, quicksand and loam.

Given the presence of clay, we would not recommend a strategy based on infiltration.

### Discharge to a watercourse

There are no watercourses in the immediate vicinity of the site.

### Discharge to a surface water sewer

It is understood that surface water runoff currently connects into the public sewer system. Therefore, it is recommended that surface water continues to drain as existing, with SuDS to manage flows from the site.

### SuDS Strategy

SuDS aim to mimic natural drainage and can achieve multiple objectives such as removing pollutants from urban runoff at source, controlling surface water runoff from developments, ensuring that flood risk is not increased further downstream and combining water management with green space which can increase amenity and biodiversity value. When selecting SuDS, consideration needs to be given to a range of factors including the ground conditions, type of proposals, and the constraints of the site.

Based on the desktop study of underlying ground condition, and recognising the scale and nature of the proposals, in this instance it is suggested that surface water continues to drain into the public sewer system, via attenuation storage with a controlled outlet set at 5ls.

As shown in **Appendix E**, a total storage volume of 9m<sup>3</sup> would be required. The storage has been designed at a depth of 1.5m, filling to 1.0m and with a 0.5m freeboard provided, should any excess flows be received.

United Utilities will be consulted to confirm capacity and agree the flow rates will be undertaken once planning permission has been granted. Detailed drainage drawings will be submitted at detailed drainage design stage.

*The SuDS strategy has been put together based on our understanding of the ground conditions and site layout. Building Control will need to be consulted on the siting of the SuDS, and the recommendations and advice of the SuDS manufacturer / installer should always be followed.*

### **SuDS Maintenance**

Schedules are provided below (taken from Ciria C753 The SuDS Manual); these, or similar should be followed.

#### **Attenuation Storage**

| Maintenance Schedule       | Required Action                                                                                    | Typical Frequency                   |
|----------------------------|----------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>Regular Maintenance</b> | 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                             |
|                            | Remove sediment from pre-treatment structures and/or internal forebays                             | Annually, or as required            |

|                         |                                                                                                                             |                                  |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| <b>Remedial Actions</b> | Repair/ rehabilitate inlets, outlet, overflow, and vents                                                                    | As required                      |
| <b>Monitoring</b>       | 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 five years, or as required |

## Pipe System

| Maintenance Schedule       | Required Action                                                                                                               | Typical Frequency                  |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| <b>Regular Maintenance</b> | 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                            |
|                            | Remove sediment from pre-treatment inlet structures and inspection chambers.                                                  | Annually or as required            |
|                            | Maintain vegetation to designed limits within the vicinity of below ground drainage pipes and tanks to avoid damage to system | Monthly or as required             |
| <b>Remedial Actions</b>    | Repair physical damage if necessary                                                                                           | As required                        |
| <b>Monitoring</b>          | Inspect all inlets, outlets and vents to ensure that they are in good condition and operating as designed.                    | Annually                           |
|                            | Survey inside of pipe runs for sediment build up and remove if necessary.                                                     | Every 5 years or as required       |

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## Hydrobrake

### Hydro International Warranty, Maintenance Statement

The following has been provided by Hydro International:

*Normally, little maintenance is required as there are no moving parts within the Flow Control. Experience has shown that if blockages occur they do so at the intake, and the cause on such occasions has been due to a lack of attention to engineering detail such as approach velocities being too low, inadequate benching, or the use of units below the minimum recommended size.*

*The Flow Control (where applicable) is fitted with a pivoting bypass door, which allows the manhole chamber to be drained down should blockage occur. The smaller conical units, below the minimum recommended size, are also supplied with rodding facilities or vortex suppressor pipes as standard.*

*Following installation of the Flow Control it is vitally important that any extraneous material i.e. building materials are removed from the unit and the chamber.*

*After the system is made live, and assuming that the chamber design is satisfactory, it is recommended that each unit be inspected monthly for three months and thereafter at six monthly intervals with hose down if required.*

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#### **4. Conclusions**

This Surface Water and SuDS Assessment has been prepared to support the planning application for the proposed development on land off Queens Road, Manchester.

The existing site is currently occupied by areas of concrete hardstanding, and grass and brambles.

Proposals are for a 'trade counter' style warehouse with associated car parking.

Based on the desktop study of underlying ground condition, and recognising the scale and nature of the proposals, in this instance it is suggested that surface water continues to drain into the public sewer system, via attenuation storage with a controlled outlet set at 5ls.

On this basis a total storage volume of 9m<sup>3</sup> would be required. The storage has been designed at a depth of 1.5m, filling to 1.0m and with a 0.5m freeboard provided, should any excess flows be received.

United Utilities will be consulted to confirm capacity and agree the flow rates will be undertaken once planning permission has been granted. Detailed drainage drawings will be submitted at detailed drainage design stage.

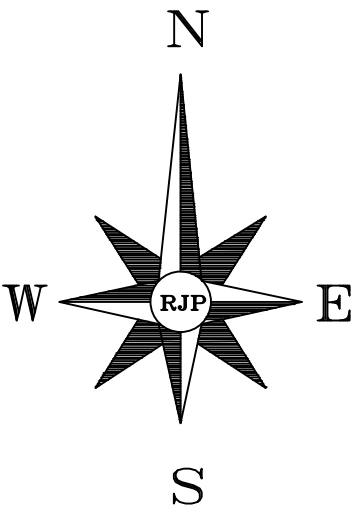
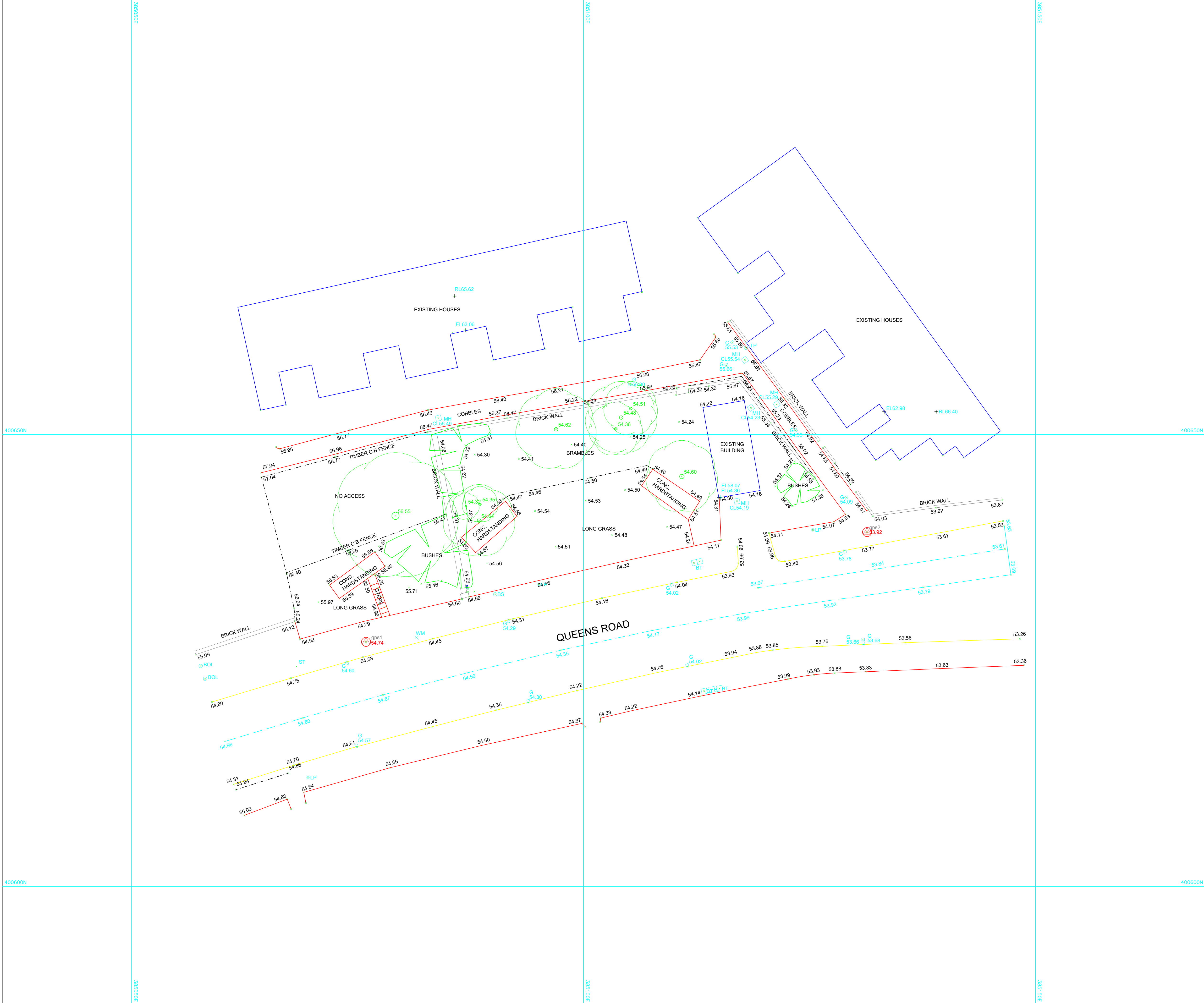
*The SuDS strategy has been put together based on our understanding of the ground conditions and site layout. Building Control will need to be consulted on the siting of the SuDS, and the recommendations and advice of the SuDS manufacturer / installer should always be followed.*

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Appendices

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**Appendix A** - Topographic Survey



| COORDINATED STATIONS |            |            |           |
|----------------------|------------|------------|-----------|
| STATION              | EASTING    | NORTHING   | LEVEL (m) |
| 1                    | 385075.931 | 400627.057 | 54.742    |
| 2                    | 385131.369 | 400639.205 | 53.922    |

ABBREVIATIONS

|     |                  |     |                     |
|-----|------------------|-----|---------------------|
| AV  | AIR VALVE/VENT   | IC  | INSPECT CHAMBER     |
| BOL | BOLLARD          | IL  | INVERT LEVEL        |
| BB  | BELISHA BEACON   | JKW | JAPANESE KNOTT WEED |
| BM  | BENCH MARK       | LH  | LAMP HOLE           |
| BL  | BED LEVEL        | LP  | LAMP POST           |
| BS  | BUS STOP         | NP  | NAME PLATE          |
| BT  | BRITISH TELECOM  | NH  | MANHOLE             |
| CL  | COVER LEVEL      | PS  | POST/SIGN POST      |
| DRI | DILAPIDATED      | PB  | POST BOX            |
| Ds  | DISUSED          | PX  | UNKNOWN SERVICE     |
| EL  | EAVES LEVEL      | RE  | RODDING EYE         |
| ELE | ELEC. JUNCT. BOX | RL  | RIDGE LEVEL         |
| EP  | ELECTRICITY POLE | RS  | ROAD SIGN           |
| FH  | FIRE HYDRANT     | ST  | STOP TAP            |
| FL  | FLOOR LEVEL      | TH  | TRIAL HOLE          |
| FOS | FULL OF SEDIMENT | TL  | TRAFFIC LIGHT       |
| FP  | FLAG POLE        | TP  | TELEGRAPH POLE      |
| GM  | GULLY            | TV  | CABLE TV BOX        |
| G   | GAS METER        | UH  | UNABLE TO LIFT      |
| GV  | GAS VALVE        | WM  | WATER METER         |

SYMBOLS

|  |                |  |            |
|--|----------------|--|------------|
|  | SURVEY STATION |  | TREE       |
|  | O/H ELEC CABLE |  | BENCH MARK |
|  | O/H PHONE LINE |  | TRIAL PIT  |
|  | CANOPY/HEDGE   |  | BOREHOLE   |

NOTES

- A) ONLY MANHOLES AND SERVICES VISIBLE AT TIME OF SURVEY SHOWN
- B) O/S GRID USED AND ORIENTATED TO TRUE NORTH
- C) LEVELS IN METRES RELATED TO G.P.S.
- D) DRAINAGE INFORMATION MUST BE CHECKED PRIOR TO WORK COMMENCING

| Rev                                              | Description | Date         |
|--------------------------------------------------|-------------|--------------|
| PROPOSED DEVELOPMENT AT QUEENS RD, CHEETHAM HILL |             |              |
| SEED ARCHITECTS                                  |             |              |
| TOPOGRAPHICAL SURVEY                             |             |              |
| SD008/T00                                        | Surveyed    | A. BAYBUTT   |
|                                                  | Drawn       | I. GREEN     |
|                                                  | Date        | JANUARY 2023 |
|                                                  | Scale       | 1:200 @ A1   |

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**Appendix B -** Proposed Site Layout Plan



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**Appendix C** - Greenfield Runoff

|                                                |                                                    |                                                                                     |
|------------------------------------------------|----------------------------------------------------|-------------------------------------------------------------------------------------|
| Base Energy Services Limited                   |                                                    | Page 1                                                                              |
| 44 Canal Street<br>Bootle<br>Liverpool L20 8QU | Queens Road<br>Manchester<br>Total Site Greenfield |  |
| Date 21/02/2023<br>File F - Attenuation.SRCX   | Designed by CC<br>Checked by PK                    |                                                                                     |
| Micro Drainage Source Control 2020.1.3         |                                                    |                                                                                     |

ICP SUDS Mean Annual Flood

Input

|                       |       |               |           |
|-----------------------|-------|---------------|-----------|
| Return Period (years) | 100   | Soil          | 0.450     |
| Area (ha)             | 0.040 | Urban         | 0.000     |
| SAAR (mm)             | 860   | Region Number | Region 10 |

**Results 1/s**

|            |     |
|------------|-----|
| QBAR Rural | 0.2 |
| QBAR Urban | 0.2 |
| Q100 years | 0.5 |
| Q1 year    | 0.2 |
| Q30 years  | 0.4 |
| Q100 years | 0.5 |

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**Appendix D** - British Geological Survey Borehole Records

SD 80 SE 84-11.85

(R10008) Wt.5086-S111-2,000 6/25 Gp.160. O.A.

SECTION OF L. & Y. Boreholes at Cleetham Hill & Grumpsall  
made for the building of the new electric railway Manchester - Bury.

Maps: One-inch 85. Six-inch 104 N. E. W County Lancashire.

Height above O.D. Below Latitude — Longitude —

Communicated by L. & Y. R. Date of Sinking —

Made by District Engineer's Office Dip of Strata —  
Hunt & Bury, Manchester  
All on present line of electric railway. Other holes in this series on 96 S.W.

| No. 11.<br>No. 1. | 85 | Queen's Road. 180 ft. O.D.       | Thickness. |   | Depth from Surface. |      |
|-------------------|----|----------------------------------|------------|---|---------------------|------|
|                   |    |                                  |            |   | metres              |      |
|                   |    | Sandy loam                       | 10         | — | 3.05                | 10 — |
|                   |    | Strong loam                      | 13         | 6 | 7.16                | 23 6 |
| <hr/>             |    |                                  |            |   |                     |      |
| No. 10<br>No. 4.  | 84 | N. of Queen's Road. 198 ft. O.D. |            |   |                     |      |
|                   |    | Clay                             | 1          | 6 | 0.46                | 1 6  |
|                   |    | Quicksand                        | 16         | — | 5.33                | 17 6 |
|                   |    | Loam                             | 5          | 6 | 7.01                | 23 — |
|                   |    | Marl                             | 11         | — | 10.36               | 34 — |

British Geological Survey

British Geological Survey

British Geological Survey

British Geological Survey

British Geological Survey

British Geological Survey

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**Appendix E -** Micro Drainage Storage Calculations

|                                                             |                     |                                              |                             |                       |                                                                                     |  |
|-------------------------------------------------------------|---------------------|----------------------------------------------|-----------------------------|-----------------------|-------------------------------------------------------------------------------------|--|
| Base Energy Services Limited                                |                     |                                              |                             |                       | Page 1                                                                              |  |
| 44 Canal Street<br>Bootle<br>Liverpool L20 8QU              |                     | Queens Road<br>Attenuation<br>100yr 40Cc 5ls |                             |                       |  |  |
| Date 21/02/2023<br>File 100yr 40CC.SRCX                     |                     | Designed by CC<br>Checked by PK              |                             |                       |                                                                                     |  |
| Micro Drainage                                              |                     | Source Control 2020.1.3                      |                             |                       |                                                                                     |  |
| <u>Summary of Results for 100 year Return Period (+40%)</u> |                     |                                              |                             |                       |                                                                                     |  |
| Storm<br>Event                                              | Max<br>Level<br>(m) | Max<br>Depth<br>(m)                          | Max<br>Control<br>(l/s)     | Max<br>Volume<br>(m³) | Status                                                                              |  |
| 15 min Summer                                               | 0.669               | 0.669                                        | 5.0                         | 6.7                   | O K                                                                                 |  |
| 30 min Summer                                               | 0.774               | 0.774                                        | 5.0                         | 7.7                   | O K                                                                                 |  |
| 60 min Summer                                               | 0.714               | 0.714                                        | 5.0                         | 7.1                   | O K                                                                                 |  |
| 120 min Summer                                              | 0.498               | 0.498                                        | 5.0                         | 5.0                   | O K                                                                                 |  |
| 180 min Summer                                              | 0.323               | 0.323                                        | 5.0                         | 3.2                   | O K                                                                                 |  |
| 240 min Summer                                              | 0.213               | 0.213                                        | 4.9                         | 2.1                   | O K                                                                                 |  |
| 360 min Summer                                              | 0.122               | 0.122                                        | 4.3                         | 1.2                   | O K                                                                                 |  |
| 480 min Summer                                              | 0.099               | 0.099                                        | 3.5                         | 1.0                   | O K                                                                                 |  |
| 600 min Summer                                              | 0.086               | 0.086                                        | 3.0                         | 0.9                   | O K                                                                                 |  |
| 720 min Summer                                              | 0.078               | 0.078                                        | 2.6                         | 0.8                   | O K                                                                                 |  |
| 960 min Summer                                              | 0.067               | 0.067                                        | 2.1                         | 0.7                   | O K                                                                                 |  |
| 1440 min Summer                                             | 0.055               | 0.055                                        | 1.5                         | 0.6                   | O K                                                                                 |  |
| 2160 min Summer                                             | 0.046               | 0.046                                        | 1.1                         | 0.5                   | O K                                                                                 |  |
| 2880 min Summer                                             | 0.040               | 0.040                                        | 0.8                         | 0.4                   | O K                                                                                 |  |
| 4320 min Summer                                             | 0.033               | 0.033                                        | 0.6                         | 0.3                   | O K                                                                                 |  |
| 5760 min Summer                                             | 0.029               | 0.029                                        | 0.5                         | 0.3                   | O K                                                                                 |  |
| 7200 min Summer                                             | 0.027               | 0.027                                        | 0.4                         | 0.3                   | O K                                                                                 |  |
| 8640 min Summer                                             | 0.025               | 0.025                                        | 0.3                         | 0.2                   | O K                                                                                 |  |
| 10080 min Summer                                            | 0.023               | 0.023                                        | 0.3                         | 0.2                   | O K                                                                                 |  |
| 15 min Winter                                               | 0.783               | 0.783                                        | 5.0                         | 7.8                   | O K                                                                                 |  |
| 30 min Winter                                               | 0.898               | 0.898                                        | 5.0                         | 9.0                   | O K                                                                                 |  |
| Storm<br>Event                                              | Rain<br>(mm/hr)     | Flooded<br>Volume<br>(m³)                    | Discharge<br>Volume<br>(m³) | Time-Peak<br>(mins)   |                                                                                     |  |
| 15 min Summer                                               | 147.106             | 0.0                                          | 11.0                        | 21                    |                                                                                     |  |
| 30 min Summer                                               | 94.613              | 0.0                                          | 14.2                        | 30                    |                                                                                     |  |
| 60 min Summer                                               | 57.877              | 0.0                                          | 17.4                        | 48                    |                                                                                     |  |
| 120 min Summer                                              | 34.225              | 0.0                                          | 20.5                        | 78                    |                                                                                     |  |
| 180 min Summer                                              | 24.863              | 0.0                                          | 22.4                        | 108                   |                                                                                     |  |
| 240 min Summer                                              | 19.719              | 0.0                                          | 23.7                        | 134                   |                                                                                     |  |
| 360 min Summer                                              | 14.165              | 0.0                                          | 25.5                        | 190                   |                                                                                     |  |
| 480 min Summer                                              | 11.206              | 0.0                                          | 26.9                        | 250                   |                                                                                     |  |
| 600 min Summer                                              | 9.338               | 0.0                                          | 28.0                        | 308                   |                                                                                     |  |
| 720 min Summer                                              | 8.042               | 0.0                                          | 28.9                        | 368                   |                                                                                     |  |
| 960 min Summer                                              | 6.349               | 0.0                                          | 30.5                        | 488                   |                                                                                     |  |
| 1440 min Summer                                             | 4.545               | 0.0                                          | 32.7                        | 734                   |                                                                                     |  |
| 2160 min Summer                                             | 3.249               | 0.0                                          | 35.1                        | 1088                  |                                                                                     |  |
| 2880 min Summer                                             | 2.558               | 0.0                                          | 36.8                        | 1456                  |                                                                                     |  |
| 4320 min Summer                                             | 1.825               | 0.0                                          | 39.4                        | 2136                  |                                                                                     |  |
| 5760 min Summer                                             | 1.435               | 0.0                                          | 41.3                        | 2936                  |                                                                                     |  |
| 7200 min Summer                                             | 1.190               | 0.0                                          | 42.8                        | 3664                  |                                                                                     |  |
| 8640 min Summer                                             | 1.021               | 0.0                                          | 44.1                        | 4392                  |                                                                                     |  |
| 10080 min Summer                                            | 0.897               | 0.0                                          | 45.2                        | 5072                  |                                                                                     |  |
| 15 min Winter                                               | 147.106             | 0.0                                          | 12.4                        | 21                    |                                                                                     |  |
| 30 min Winter                                               | 94.613              | 0.0                                          | 15.9                        | 31                    |                                                                                     |  |
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|                                                             |                     |                                              |                             |                       |                                                                                     |
|-------------------------------------------------------------|---------------------|----------------------------------------------|-----------------------------|-----------------------|-------------------------------------------------------------------------------------|
| Base Energy Services Limited                                |                     |                                              |                             |                       | Page 2                                                                              |
| 44 Canal Street<br>Bootle<br>Liverpool L20 8QU              |                     | Queens Road<br>Attenuation<br>100yr 40Cc 5ls |                             |                       |  |
| Date 21/02/2023<br>File 100yr 40CC.SRCX                     |                     | Designed by CC<br>Checked by PK              |                             |                       |                                                                                     |
| Micro Drainage                                              |                     | Source Control 2020.1.3                      |                             |                       |                                                                                     |
| <u>Summary of Results for 100 year Return Period (+40%)</u> |                     |                                              |                             |                       |                                                                                     |
| Storm<br>Event                                              | Max<br>Level<br>(m) | Max<br>Depth<br>(m)                          | Max<br>Control<br>(l/s)     | Max<br>Volume<br>(m³) | Status                                                                              |
| 60 min Winter                                               | 0.804               | 0.804                                        | 5.0                         | 8.0                   | O K                                                                                 |
| 120 min Winter                                              | 0.462               | 0.462                                        | 5.0                         | 4.6                   | O K                                                                                 |
| 180 min Winter                                              | 0.227               | 0.227                                        | 4.9                         | 2.3                   | O K                                                                                 |
| 240 min Winter                                              | 0.130               | 0.130                                        | 4.5                         | 1.3                   | O K                                                                                 |
| 360 min Winter                                              | 0.093               | 0.093                                        | 3.3                         | 0.9                   | O K                                                                                 |
| 480 min Winter                                              | 0.079               | 0.079                                        | 2.6                         | 0.8                   | O K                                                                                 |
| 600 min Winter                                              | 0.070               | 0.070                                        | 2.2                         | 0.7                   | O K                                                                                 |
| 720 min Winter                                              | 0.064               | 0.064                                        | 1.9                         | 0.6                   | O K                                                                                 |
| 960 min Winter                                              | 0.055               | 0.055                                        | 1.5                         | 0.6                   | O K                                                                                 |
| 1440 min Winter                                             | 0.046               | 0.046                                        | 1.1                         | 0.5                   | O K                                                                                 |
| 2160 min Winter                                             | 0.038               | 0.038                                        | 0.8                         | 0.4                   | O K                                                                                 |
| 2880 min Winter                                             | 0.034               | 0.034                                        | 0.6                         | 0.3                   | O K                                                                                 |
| 4320 min Winter                                             | 0.028               | 0.028                                        | 0.4                         | 0.3                   | O K                                                                                 |
| 5760 min Winter                                             | 0.025               | 0.025                                        | 0.3                         | 0.2                   | O K                                                                                 |
| 7200 min Winter                                             | 0.023               | 0.023                                        | 0.3                         | 0.2                   | O K                                                                                 |
| 8640 min Winter                                             | 0.021               | 0.021                                        | 0.2                         | 0.2                   | O K                                                                                 |
| 10080 min Winter                                            | 0.020               | 0.020                                        | 0.2                         | 0.2                   | O K                                                                                 |
| Storm<br>Event                                              | Rain<br>(mm/hr)     | Flooded<br>Volume<br>(m³)                    | Discharge<br>Volume<br>(m³) | Time-Peak<br>(mins)   |                                                                                     |
| 60 min Winter                                               | 57.877              | 0.0                                          | 19.4                        | 50                    |                                                                                     |
| 120 min Winter                                              | 34.225              | 0.0                                          | 23.0                        | 82                    |                                                                                     |
| 180 min Winter                                              | 24.863              | 0.0                                          | 25.1                        | 108                   |                                                                                     |
| 240 min Winter                                              | 19.719              | 0.0                                          | 26.5                        | 132                   |                                                                                     |
| 360 min Winter                                              | 14.165              | 0.0                                          | 28.6                        | 190                   |                                                                                     |
| 480 min Winter                                              | 11.206              | 0.0                                          | 30.1                        | 248                   |                                                                                     |
| 600 min Winter                                              | 9.338               | 0.0                                          | 31.4                        | 308                   |                                                                                     |
| 720 min Winter                                              | 8.042               | 0.0                                          | 32.4                        | 366                   |                                                                                     |
| 960 min Winter                                              | 6.349               | 0.0                                          | 34.1                        | 492                   |                                                                                     |
| 1440 min Winter                                             | 4.545               | 0.0                                          | 36.6                        | 736                   |                                                                                     |
| 2160 min Winter                                             | 3.249               | 0.0                                          | 39.3                        | 1100                  |                                                                                     |
| 2880 min Winter                                             | 2.558               | 0.0                                          | 41.3                        | 1436                  |                                                                                     |
| 4320 min Winter                                             | 1.825               | 0.0                                          | 44.1                        | 2212                  |                                                                                     |
| 5760 min Winter                                             | 1.435               | 0.0                                          | 46.3                        | 2936                  |                                                                                     |
| 7200 min Winter                                             | 1.190               | 0.0                                          | 48.0                        | 3608                  |                                                                                     |
| 8640 min Winter                                             | 1.021               | 0.0                                          | 49.4                        | 4272                  |                                                                                     |
| 10080 min Winter                                            | 0.897               | 0.0                                          | 50.6                        | 5056                  |                                                                                     |
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|                                                |                                              |                                                                                     |
|------------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------|
| Base Energy Services Limited                   |                                              | Page 3                                                                              |
| 44 Canal Street<br>Bootle<br>Liverpool L20 8QU | Queens Road<br>Attenuation<br>100yr 40Cc 5ls |  |
| Date 21/02/2023<br>File 100yr 40CC.SRCX        | Designed by CC<br>Checked by PK              |                                                                                     |
| Micro Drainage Source Control 2020.1.3         |                                              |                                                                                     |

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)            | 20.400            | Shortest Storm (mins) | 15    |
| Ratio R               | 0.450             | Longest Storm (mins)  | 10080 |
| Summer Storms         | Yes               | Climate Change %      | +40   |

Time Area Diagram

Total Area (ha) 0.040

| Time (mins) | Area  | Time (mins) | Area  | Time (mins) | Area  |
|-------------|-------|-------------|-------|-------------|-------|
| From: To:   | (ha)  | From: To:   | (ha)  | From: To:   | (ha)  |
| 0 4         | 0.013 | 4 8         | 0.013 | 8 12        | 0.013 |

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|                                                |                                              |                                                                                     |
|------------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------|
| Base Energy Services Limited                   |                                              | Page 4                                                                              |
| 44 Canal Street<br>Bootle<br>Liverpool L20 8QU | Queens Road<br>Attenuation<br>100yr 40Cc 5ls |  |
| Date 21/02/2023<br>File 100yr 40CC.SRCX        | Designed by CC<br>Checked by PK              |                                                                                     |
| Micro Drainage Source Control 2020.1.3         |                                              |                                                                                     |

Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.000

| Depth (m) | Area (m <sup>2</sup> ) | Depth (m) | Area (m <sup>2</sup> ) | Depth (m) | Area (m <sup>2</sup> ) | Depth (m) | Area (m <sup>2</sup> ) |
|-----------|------------------------|-----------|------------------------|-----------|------------------------|-----------|------------------------|
| 0.000     | 10.0                   | 0.700     | 10.0                   | 1.400     | 10.0                   | 2.100     | 10.0                   |
| 0.100     | 10.0                   | 0.800     | 10.0                   | 1.500     | 10.0                   | 2.200     | 10.0                   |
| 0.200     | 10.0                   | 0.900     | 10.0                   | 1.600     | 10.0                   | 2.300     | 10.0                   |
| 0.300     | 10.0                   | 1.000     | 10.0                   | 1.700     | 10.0                   | 2.400     | 10.0                   |
| 0.400     | 10.0                   | 1.100     | 10.0                   | 1.800     | 10.0                   | 2.500     | 10.0                   |
| 0.500     | 10.0                   | 1.200     | 10.0                   | 1.900     | 10.0                   |           |                        |
| 0.600     | 10.0                   | 1.300     | 10.0                   | 2.000     | 10.0                   |           |                        |

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0105-5000-1000-5000

Design Head (m) 1.000

Design Flow (l/s) 5.0

Flush-Flo™ Calculated

Objective Minimise upstream storage

Application Surface

Sump Available Yes

Diameter (mm) 105

Invert Level (m) 0.000

Minimum Outlet Pipe Diameter (mm) 150

Suggested Manhole Diameter (mm) 1200

| Control Points            | Head (m) | Flow (l/s) |
|---------------------------|----------|------------|
| Design Point (Calculated) | 1.000    | 5.0        |
| Flush-Flo™                | 0.296    | 5.0        |
| Kick-Flo®                 | 0.637    | 4.1        |
| Mean Flow over Head Range | -        | 4.3        |

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

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
| 0.100     | 3.6        | 1.200     | 5.4        | 3.000     | 8.4        | 7.000     | 12.5       |
| 0.200     | 4.8        | 1.400     | 5.8        | 3.500     | 9.0        | 7.500     | 12.9       |
| 0.300     | 5.0        | 1.600     | 6.2        | 4.000     | 9.6        | 8.000     | 13.3       |
| 0.400     | 4.9        | 1.800     | 6.6        | 4.500     | 10.1       | 8.500     | 13.7       |
| 0.500     | 4.7        | 2.000     | 6.9        | 5.000     | 10.6       | 9.000     | 14.1       |
| 0.600     | 4.3        | 2.200     | 7.2        | 5.500     | 11.1       | 9.500     | 14.5       |
| 0.800     | 4.5        | 2.400     | 7.5        | 6.000     | 11.6       |           |            |
| 1.000     | 5.0        | 2.600     | 7.8        | 6.500     | 12.1       |           |            |

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