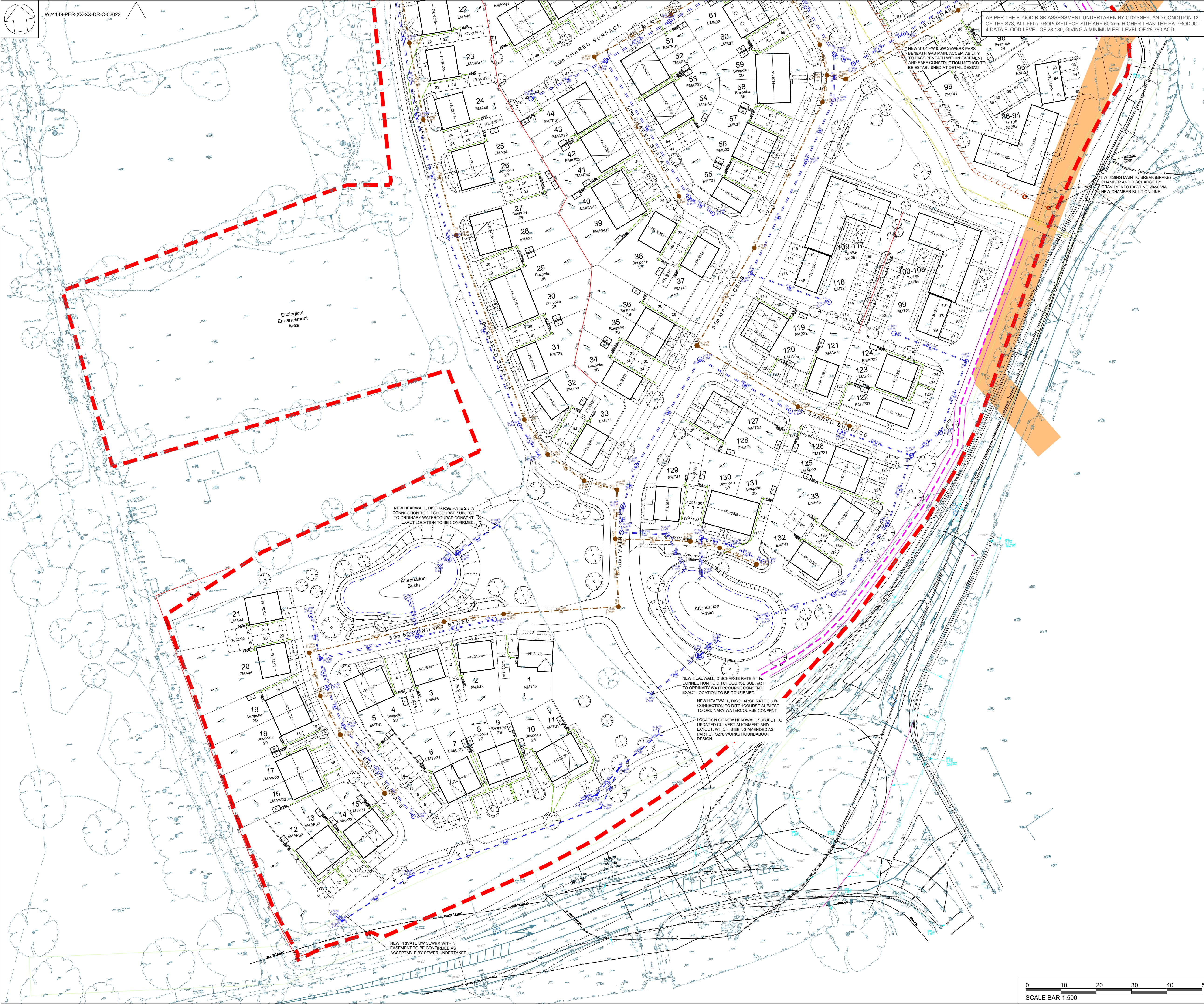


## **Appendix D**

### Proposed Drainage Strategy



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### SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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

**CONSTRUCTION**

1. SAFE CONSTRUCTION METHOD OF SW & FW SEWER ADJACENT TO THE EXISTING GAS AND EXISTING SEWER UTILITIES ON SITE.

**MAINTENANCE**

1. ANY EXCAVATION WORKS NEAR THE HIGH PRESSURE GAS PIPELINE TO BE UNDERTAKEN UNDER PERMIT TO WORK AND NEED TO NOTIFY THE UTILITY COMPANY.

**DEMOLITION**

1. CARE TO BE TAKEN DURING SITE CLEARANCE AND SITE STRIP WORKS AROUND EXISTING UTILITIES

ALL WORKS TO BE CARRIED OUT BY A COMPETENT CONTRACTOR, WORKING (WHERE APPROPRIATE) TO AN APPROVED METHOD STATEMENT

**THIS DRAWING SHOULD NOT BE USED FOR CONSTRUCTION UNLESS THE DRAWING STATUS IS "CONSTRUCTION"**

- ### GENERAL NOTES:
- THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL THE RELEVANT ARCHITECTS, ENGINEERS' AND SERVICE ENGINEERS DRAWINGS & SPECIFICATIONS.
  - ALL UNITS IN MILLIMETERS U.N.O. ON THE DRAWING.
  - DO NOT SCALE OFF THE DRAWING.
  - THE WORKS DESCRIBED AND SPECIFIED ON THIS DRAWING AND ASSOCIATED DRGS SHALL BE UNDERTAKEN IN ACCORDANCE WITH ALL CURRENT HEALTH AND SAFETY LEGISLATION AND THE PROJECT HEALTH & SAFETY PLAN, PREPARED BY THE PLANNING SUPERVISOR FOR THE PROJECT.
  - WHERE NOTES AND INFORMATION ON THIS DRG DIFFER FROM THE SPECIFICATION, CLARIFICATION SHOULD BE SOUGHT FROM THE ENGINEER.

### LEGEND

- S104 SW SEWER
- S104 SW MANHOLE
- S104 FW RISING MAIN
- S104 FW SEWER
- HIGH PRESSURE GAS MAIN (6m EASEMENT EITHER SIDE)
- S104 FW MANHOLE
- PROPOSED ACOUSTIC FENCE LAYOUT
- DEVELOPMENT SITE BOUNDARY
- NEW HIGHWAY GULLY
- EXISTING FW DRAINAGE EASEMENT (5m EITHER SIDE)
- EXISTING FW DRAINAGE EASEMENT (5m EITHER SIDE)

AS PER THE FLOOD RISK ASSESSMENT UNDERTAKEN BY ODYSSEY, AND CONDITION 12 OF THE S73, ALL FFLs PROPOSED FOR SITE ARE 600mm HIGHER THAN THE EA PRODUCT 4 DATA FLOOD LEVEL OF 28.180m, GIVING A MINIMUM FFL LEVEL OF 28.780m AOD.

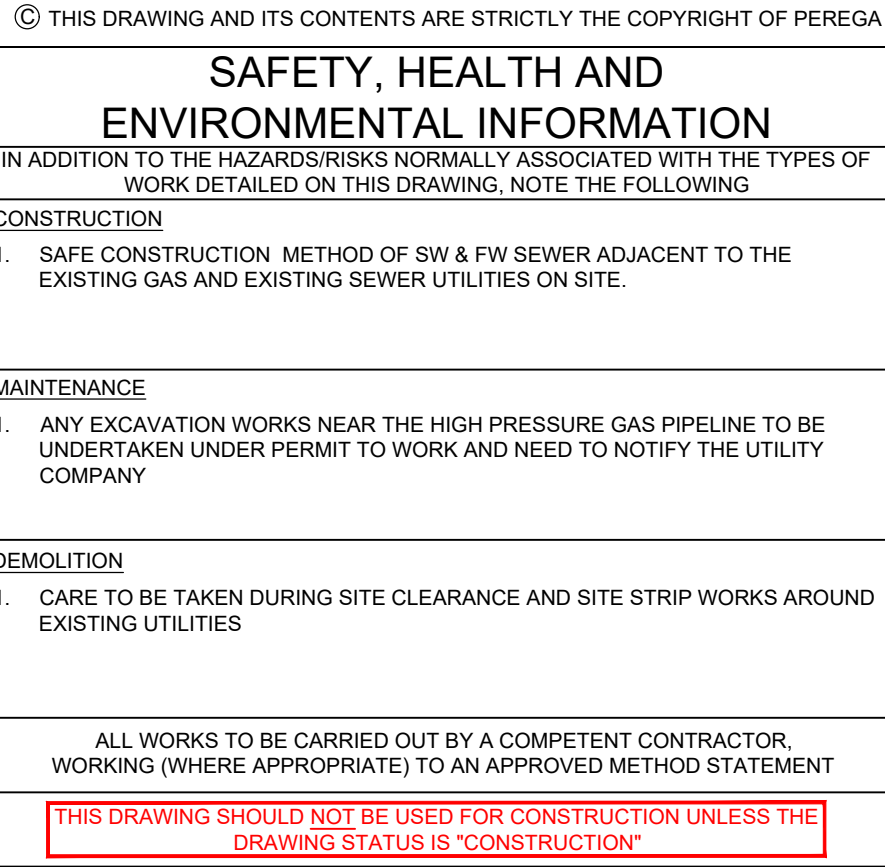
|     |                                                                                                          |     |            |      |
|-----|----------------------------------------------------------------------------------------------------------|-----|------------|------|
| P4  | UPDATED DRAINAGE TO SUIT TO LATEST SITE PLAN PROVIDED. ADDED FOOTPATH PLOT #, ADDED NOTE REGARDING FFLs. | RGM | 30/03/2026 | GS   |
| P3  | UPDATED DRAINAGE TO SUIT TO LATEST SITE PLAN PROVIDED.                                                   | RGM | 24/03/2026 | GS   |
| P2  | UPDATED DRAINAGE/PONDS TO LATEST SITE PLAN PROVIDED.                                                     | RGM | 10/03/2026 | GS   |
| P1  | ISSUED FOR INFORMATION                                                                                   | RGM | 24/02/2026 | GS   |
| Rev | Description                                                                                              | By  | Date       | Chkd |

Quarry Court, Lime Quarry Mews, Guildford, GU1 2RD  
Client

Project  
**BROADBRIDGE FARM  
HORSHAM**

Title  
**DRAINAGE STRATEGY  
SHEET 1 OF 2**

|                    |        |            |             |          |    |       |    |       |       |      |   |             |       |
|--------------------|--------|------------|-------------|----------|----|-------|----|-------|-------|------|---|-------------|-------|
| Perega Project No. | W24149 | Checked    | GS          | Passed   | -  | Size  | A1 | Scale | 1:500 |      |   |             |       |
| Project Code       | W24149 | Originator | PER         | Zone     | XX | Level | XX | Type  | DR    | Role | C | Drawing No. | 02021 |
| Suitability Code   | S2     | Status     | PRELIMINARY | Revision | P4 |       |    |       |       |      |   |             |       |



THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL THE RELEVANT ARCHITECTS, ENGINEERS' AND SERVICE ENGINEERS DRAWINGS & SPECIFICATIONS.

ALL UNITS IN MILLIMETERS UNLESS OTHERWISE SPECIFIED ON THE DRAWING.

DO NOT SCALE OFF THE DRAWING.

THE WORKS DESCRIBED AND SPECIFIED ON THIS DRAWING AND ASSOCIATED DGRS SHALL BE UNDERTAKEN IN ACCORDANCE WITH ALL CURRENT HEALTH AND SAFETY LEGISLATION AND THE PROJECT HEALTH & SAFETY PLAN.

PREPARED BY THE PLANNING SUPERVISOR FOR THE PROJECT.

WHERE NOTES AND INFORMATION ON THIS DGR DIFFER FROM THE SPECIFICATION, CLARIFICATION SHOULD BE SOUGHT FROM THE ENGINEER.

Legend:

- S104 SW SEWER
- S104 SW MANHOLE
- S104 FW RISING MAIN
- S104 FW SEWER
- HIGH PRESSURE GAS MAIN (6m EASEMENT EITHER SIDE)
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- PROPOSED ACOUSTIC FENCE LAYOUT
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- EXISTING FW DRAINAGE EASEMENT (5m EITHER SIDE)
- EXISTING FW DRAINAGE EASEMENT (5m EITHER SIDE)

AS PER THE FLOOD RISK ASSESSMENT UNDERTAKEN BY ODYSSEY,  
AND CONDITION 12 OF THE S73, ALL FFLs PROPOSED FOR SITE ARE  
600mm HIGHER THAN THE EA PRODUCT 4 DATA FLOOD LEVEL OF  
28.180m, GIVING A MINIMUM FFL LEVEL OF 28.780m AOD.

|     |                                                                                                          |     |            |      |
|-----|----------------------------------------------------------------------------------------------------------|-----|------------|------|
| P4  | UPDATED DRAINAGE TO SUIT TO LATEST SITE PLAN PROVIDED, ADDED FOOTPATH PLOT #, ADDED NOTE REGARDING FFLs. | RGM | 30/03/2026 | GS   |
| P3  | UPDATED DRAINAGE TO SUIT TO LATEST SITE PLAN PROVIDED                                                    | RGM | 24/03/2026 | GS   |
| P2  | UPDATED DRAINAGE/PONDS TO LATEST SITE PLAN PROVIDED                                                      | RGM | 10/03/2026 | GS   |
| P1  | ISSUED FOR INFORMATION                                                                                   | RGM | 24/02/2026 | GS   |
| Rev | Description                                                                                              | By  | Date       | Chkd |

PEREGA

Quarry Court, Lime Quarry Mews, Guildford, GU1 2RD 01483 565 886

Client

**Taylor Wimpey**

Project  
BROADBRIDGE FARM  
HORSHAM

---

Title  
DRAINAGE STRATEGY  
SHEET 2 OF 2

|                    |            |      |             |        |      |             |
|--------------------|------------|------|-------------|--------|------|-------------|
| Peraga Project No. |            |      | Checked     | Passed | Size | Scale       |
| W24149             |            |      | GS          | -      | A1   | 1:500       |
| Project Code       | Originator | Zone | Level       | Type   | Role | Drawing No. |
| W24149             | PER        | XX   | XX          | DR     | C    | 02022       |
| Suitability Code   |            |      | Status      |        |      | Revision    |
| S2                 |            |      | PRELIMINARY |        |      | P4          |

## **Appendix E**

### Greenfield Runoff Rate Calculations

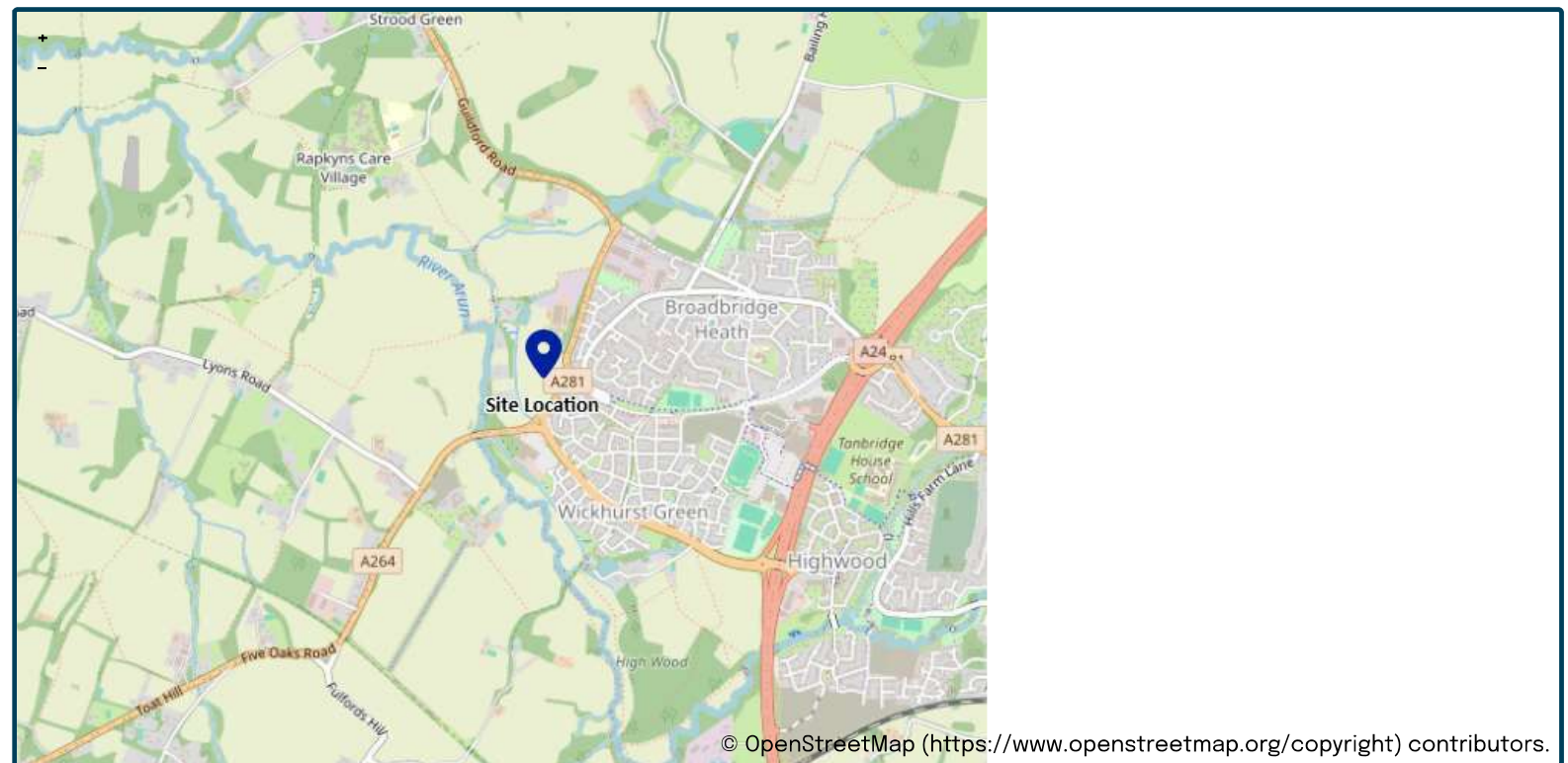
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

## Project details

|               |                                         |
|---------------|-----------------------------------------|
| Date          | <input type="text" value="23/02/2026"/> |
| Calculated by | <input type="text" value="RGM"/>        |
| Reference     | <input type="text" value="W24149"/>     |
| Model version | <input type="text" value="2.2.3"/>      |

## Location

|               |                                                     |
|---------------|-----------------------------------------------------|
| Site name     | <input type="text" value="Lower Broadbridge Farm"/> |
| Site location | <input type="text" value="Horsham"/>                |



|                                       |                                     |
|---------------------------------------|-------------------------------------|
| Site easting (British National Grid)  | <input type="text" value="514206"/> |
| Site northing (British National Grid) | <input type="text" value="131070"/> |

## Site details

|                      |                                |    |
|----------------------|--------------------------------|----|
| Total site area (ha) | <input type="text" value="7"/> | ha |
|----------------------|--------------------------------|----|

# Greenfield runoff

## Method

|        |       |
|--------|-------|
| Method | IH124 |
|--------|-------|

## IH124

|                            |                                          |                                  |                  |
|----------------------------|------------------------------------------|----------------------------------|------------------|
|                            | <u>My value</u>                          |                                  | <u>Map value</u> |
| SAAR (mm)                  | <div><div>775</div><div>mm</div></div>   | <input checked="" type="radio"/> | <div>775</div>   |
| How should SPR be derived? | <div>WRAP soil type</div>                |                                  |                  |
| WRAP soil type             | <div><div>4</div></div>                  | <input checked="" type="radio"/> | <div>4</div>     |
| SPR                        | <div><div>0.47</div><div></div></div>    |                                  |                  |
| QBar (IH124) (l/s)         | <div><div>38.1</div><div>l/s</div></div> |                                  |                  |

## Growth curve factors

|                        |                                       |                                  |                  |
|------------------------|---------------------------------------|----------------------------------|------------------|
|                        | <u>My value</u>                       |                                  | <u>Map value</u> |
| Hydrological region    | <div><div>7</div></div>               | <input checked="" type="radio"/> | <div>7</div>     |
| 1 year growth factor   | <div><div>0.85</div><div></div></div> |                                  |                  |
| 2 year growth factor   | <div><div>0.88</div><div></div></div> |                                  |                  |
| 10 year growth factor  | <div><div>1.62</div><div></div></div> |                                  |                  |
| 30 year growth factor  | <div><div>2.3</div><div></div></div>  |                                  |                  |
| 100 year growth factor | <div><div>3.19</div><div></div></div> |                                  |                  |
| 200 year growth factor | <div><div>3.74</div><div></div></div> |                                  |                  |

# Results

|                           |       |     |
|---------------------------|-------|-----|
| Method                    | IH124 |     |
| Flow rate 1 year (l/s)    | 32.4  | l/s |
| Flow rate 2 year (l/s)    | 33.5  | l/s |
| Flow rate 10 years (l/s)  | 61.7  | l/s |
| Flow rate 30 years (l/s)  | 87.6  | l/s |
| Flow rate 100 years (l/s) | 121.4 | l/s |
| Flow rate 200 years (l/s) | 142.4 | l/s |

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent ‘zero’ figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

## Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.2.3) developed by HR Wallingford and available at [uksuds.com](https://www.uksuds.com) (<https://www.uksuds.com/>). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at [uksuds.com/terms-conditions](https://www.uksuds.com/terms-conditions) (<https://www.uksuds.com/terms-conditions>). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

## **Appendix F**

### Drainage Calculations

### Nodes

| Name            | Area<br>(ha) | T of E<br>(mins) | Cover<br>Level<br>(m) | Diameter<br>(mm) | Easting<br>(m) | Northing<br>(m) | Depth<br>(m) |
|-----------------|--------------|------------------|-----------------------|------------------|----------------|-----------------|--------------|
| S103            | 0.087        | 5.00             | 30.409                | 1200             | 514069.206     | 130980.114      | 1.509        |
| S126            | 0.015        | 5.00             | 30.564                | 1200             | 514052.499     | 131007.955      | 1.839        |
| S104            | 0.011        | 5.00             | 30.585                | 1200             | 514049.206     | 131019.470      | 1.935        |
| S121            | 0.040        | 5.00             | 30.356                | 1350             | 514047.114     | 131040.139      | 1.356        |
| S105            | 0.046        | 5.00             | 30.490                | 1200             | 514048.185     | 131027.814      | 1.965        |
| S122            | 0.048        | 5.00             | 29.959                | 1350             | 514098.643     | 131032.903      | 1.359        |
| S106            | 0.020        | 5.00             | 30.195                | 1350             | 514076.597     | 131030.615      | 1.845        |
| S107 Headwall   |              |                  | 29.750                |                  | 514075.340     | 131041.293      | 1.460        |
| S108 Basin 1 SW |              | 5.00             | 29.750                |                  | 514085.140     | 131049.859      | 1.500        |
| S109 FCC        |              |                  | 29.750                | 1500             | 514090.653     | 131052.853      | 1.525        |
| S110 Headwall   |              |                  | 28.650                |                  | 514102.832     | 131059.467      | 0.525        |

### Simulation Settings

|                      |          |                        |        |                                         |     |                        |   |
|----------------------|----------|------------------------|--------|-----------------------------------------|-----|------------------------|---|
| Rainfall Methodology | FEH-22   | Analysis Speed         | Normal | Additional Storage (m <sup>3</sup> /ha) | 0.0 | Check Discharge Volume | x |
| Rainfall Events      | Singular | Skip Steady State      | x      | Starting Level (m)                      |     |                        |   |
| Summer CV            | 1.000    | Drain Down Time (mins) | 1440   | Check Discharge Rate(s)                 | x   |                        |   |

### Storm Durations

30 | 60 | 120 | 240 | 360 | 480 | 720 | 960 | 1440

| Return Period<br>(years) | Climate Change<br>(CC %) | Additional Area<br>(A %) | Additional Flow<br>(Q %) | Return Period<br>(years) | Climate Change<br>(CC %) | Additional Area<br>(A %) | Additional Flow<br>(Q %) |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 30                       | 0                        | 0                        | 0                        | 100                      | 45                       | 0                        | 0                        |

### Node S109 FCC Online Hydro-Brake® Control

|                          |        |                         |                                |
|--------------------------|--------|-------------------------|--------------------------------|
| Flap Valve               | x      | Objective               | (HE) Minimise upstream storage |
| Replaces Downstream Link | x      | Sump Available          | ✓                              |
| Invert Level (m)         | 28.225 | Product Number          | CTL-SHE-0075-2800-1300-2800    |
| Design Depth (m)         | 1.300  | Min Outlet Diameter (m) | 0.100                          |
| Design Flow (l/s)        | 2.8    | Min Node Diameter (mm)  | 1200                           |

**Node S108 Basin 1 SW Flow through Pond Storage Structure**

|                             |         |                           |        |                          |        |
|-----------------------------|---------|---------------------------|--------|--------------------------|--------|
| Base Inf Coefficient (m/hr) | 0.00000 | Porosity                  | 1.00   | Main Channel Length (m)  | 10.000 |
| Side Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 28.250 | Main Channel Slope (1:X) | 250.0  |
| Safety Factor               | 1.0     | Time to half empty (mins) | 744    | Main Channel n           | 0.025  |

**Inlets**  
S107 Headwall

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|-----------|-----------|---------------|-----------|-----------|---------------|-----------|-----------|---------------|-----------|-----------|---------------|-----------|-----------|---------------|-----------|-----------|---------------|
| 0.000     | 92.0      | 0.0           | 0.300     | 137.3     | 0.0           | 0.600     | 191.7     | 0.0           | 0.900     | 255.1     | 0.0           | 1.200     | 327.6     | 0.0           | 1.500     | 409.1     | 0.0           |
| 0.100     | 106.1     | 0.0           | 0.400     | 154.4     | 0.0           | 0.700     | 211.8     | 0.0           | 1.000     | 278.3     | 0.0           | 1.300     | 353.8     | 0.0           |           |           |               |
| 0.200     | 121.2     | 0.0           | 0.500     | 172.6     | 0.0           | 0.800     | 233.0     | 0.0           | 1.100     | 302.4     | 0.0           | 1.400     | 380.9     | 0.0           |           |           |               |

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

| Node Event        | US Node         | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status     |
|-------------------|-----------------|-------------|-----------|-----------|--------------|---------------|------------|------------|
| 30 minute summer  | S103            | 18          | 29.049    | 0.149     | 37.9         | 0.1682        | 0.0000     | OK         |
| 240 minute summer | S126            | 240         | 28.909    | 0.184     | 13.2         | 0.2086        | 0.0000     | OK         |
| 240 minute summer | S104            | 244         | 28.909    | 0.259     | 14.5         | 0.2934        | 0.0000     | OK         |
| 30 minute summer  | S121            | 18          | 29.073    | 0.073     | 17.3         | 0.1048        | 0.0000     | OK         |
| 240 minute summer | S105            | 244         | 28.909    | 0.384     | 25.6         | 0.4348        | 0.0000     | SURCHARGED |
| 240 minute summer | S122            | 244         | 28.909    | 0.309     | 6.3          | 0.4429        | 0.0000     | SURCHARGED |
| 240 minute summer | S106            | 244         | 28.910    | 0.560     | 31.9         | 0.8007        | 0.0000     | SURCHARGED |
| 240 minute summer | S107 Headwall   | 244         | 28.910    | 0.620     | 29.9         | 0.0000        | 0.0000     | OK         |
| 240 minute summer | S108 Basin 1 SW | 244         | 28.909    | 0.659     | 16.4         | 0.0000        | 0.0000     | SURCHARGED |
| 240 minute summer | S109 FCC        | 244         | 28.910    | 0.685     | 2.9          | 1.2096        | 0.0000     | SURCHARGED |
| 60 minute summer  | S110 Headwall   | 33          | 28.167    | 0.042     | 2.6          | 0.0000        | 0.0000     | OK         |

| Link Event (Upstream Depth) | US Node         | Link              | DS Node         | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|-----------------------------|-----------------|-------------------|-----------------|---------------|----------------|----------|---------------|--------------------|
| 30 minute summer            | S103            | 1.000             | S126            | 38.0          | 0.978          | 0.467    | 1.2598        |                    |
| 240 minute summer           | S126            | 1.001             | S104            | 13.1          | 0.779          | 0.150    | 0.6597        |                    |
| 240 minute summer           | S104            | 1.002             | S105            | 14.5          | 0.867          | 0.169    | 0.5681        |                    |
| 30 minute summer            | S121            | 2.000             | S105            | 17.3          | 1.614          | 0.205    | 0.1326        |                    |
| 240 minute summer           | S105            | 1.003             | S106            | 24.4          | 0.602          | 0.156    | 3.1490        |                    |
| 240 minute summer           | S122            | 3.000             | S106            | 5.8           | 0.604          | 0.059    | 1.5608        |                    |
| 240 minute summer           | S106            | 1.004             | S107 Headwall   | 29.9          | 0.575          | 0.220    | 1.1859        |                    |
| 240 minute summer           | S107 Headwall   | Flow through Pond | S108 Basin 1 SW | 16.4          | 0.045          | 0.000    | 91.1831       |                    |
| 240 minute summer           | S108 Basin 1 SW | 1.006             | S109 FCC        | 2.9           | 0.303          | 0.041    | 0.4418        |                    |
| 240 minute summer           | S109 FCC        | 1.007             | S110 Headwall   | 2.6           | 0.636          | 0.171    | 0.0561        | 132.2              |

**Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.88%**

| Node Event        | US Node         | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status     |
|-------------------|-----------------|-------------|-----------|-----------|--------------|---------------|------------|------------|
| 30 minute summer  | S103            | 19          | 29.432    | 0.532     | 69.9         | 0.6011        | 0.0000     | SURCHARGED |
| 480 minute summer | S126            | 488         | 29.324    | 0.599     | 13.8         | 0.6777        | 0.0000     | SURCHARGED |
| 360 minute summer | S104            | 360         | 29.324    | 0.674     | 18.1         | 0.7622        | 0.0000     | SURCHARGED |
| 480 minute summer | S121            | 480         | 29.324    | 0.324     | 5.4          | 0.4643        | 0.0000     | SURCHARGED |
| 360 minute summer | S105            | 360         | 29.325    | 0.800     | 32.6         | 0.9043        | 0.0000     | SURCHARGED |
| 480 minute summer | S122            | 480         | 29.325    | 0.725     | 6.5          | 1.0370        | 0.0000     | SURCHARGED |
| 360 minute summer | S106            | 360         | 29.324    | 0.974     | 43.9         | 1.3937        | 0.0000     | SURCHARGED |
| 480 minute summer | S107 Headwall   | 480         | 29.324    | 1.034     | 33.9         | 0.0000        | 0.0000     | OK         |
| 480 minute summer | S108 Basin 1 SW | 480         | 29.324    | 1.074     | 18.3         | 0.0000        | 0.0000     | SURCHARGED |
| 480 minute summer | S109 FCC        | 480         | 29.324    | 1.099     | 2.7          | 1.9428        | 0.0000     | SURCHARGED |
| 60 minute summer  | S110 Headwall   | 28          | 28.167    | 0.042     | 2.6          | 0.0000        | 0.0000     | OK         |

| Link Event (Upstream Depth) | US Node         | Link              | DS Node         | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|-----------------------------|-----------------|-------------------|-----------------|---------------|----------------|----------|---------------|--------------------|
| 30 minute summer            | S103            | 1.000             | S126            | 67.3          | 1.061          | 0.827    | 2.2864        |                    |
| 480 minute summer           | S126            | 1.001             | S104            | 12.5          | 0.699          | 0.143    | 0.8434        |                    |
| 360 minute summer           | S104            | 1.002             | S105            | 17.7          | 0.763          | 0.206    | 0.5919        |                    |
| 480 minute summer           | S121            | 2.000             | S105            | 5.4           | 1.028          | 0.064    | 0.4920        |                    |
| 360 minute summer           | S105            | 1.003             | S106            | 32.2          | 0.528          | 0.206    | 3.1490        |                    |
| 480 minute summer           | S122            | 3.000             | S106            | 6.3           | 0.464          | 0.064    | 1.5608        |                    |
| 360 minute summer           | S106            | 1.004             | S107 Headwall   | 43.6          | 0.575          | 0.321    | 1.1859        |                    |
| 480 minute summer           | S107 Headwall   | Flow through Pond | S108 Basin 1 SW | 18.3          | 0.036          | 0.000    | 192.5105      |                    |
| 480 minute summer           | S108 Basin 1 SW | 1.006             | S109 FCC        | 2.7           | 0.338          | 0.039    | 0.4418        |                    |
| 480 minute summer           | S109 FCC        | 1.007             | S110 Headwall   | 2.6           | 0.636          | 0.171    | 0.0561        | 268.2              |

### Nodes

| Name           | Area<br>(ha) | T of E<br>(mins) | Cover<br>Level<br>(m) | Diameter<br>(mm) | Easting<br>(m) | Northing<br>(m) | Depth<br>(m) |
|----------------|--------------|------------------|-----------------------|------------------|----------------|-----------------|--------------|
| S41            | 0.067        | 5.00             | 31.345                | 1350             | 514221.120     | 131100.066      | 1.245        |
| S130           | 0.032        | 5.00             | 31.814                | 1200             | 514240.540     | 131089.771      | 1.914        |
| S42            | 0.021        | 5.00             | 31.582                | 1200             | 514230.853     | 131070.599      | 1.832        |
| S127           | 0.034        | 5.00             | 31.061                | 1350             | 514202.548     | 131074.297      | 1.261        |
| S128           | 0.006        | 5.00             | 31.452                | 1200             | 514224.322     | 131065.839      | 1.902        |
| S43            | 0.018        | 5.00             | 31.173                | 1200             | 514212.778     | 131046.328      | 1.823        |
| S44            |              |                  | 30.756                | 1350             | 514195.302     | 131028.552      | 1.631        |
| S45 Headwall   |              |                  | 30.250                |                  | 514172.654     | 131024.097      | 1.440        |
| S60            | 0.034        | 5.00             | 30.543                | 1350             | 514179.841     | 131037.888      | 1.443        |
| S61            | 0.030        | 5.00             | 30.376                | 1350             | 514167.485     | 131046.021      | 1.401        |
| S62            |              |                  | 30.279                | 1350             | 514159.829     | 131048.940      | 1.369        |
| S63 Headwall   |              |                  | 30.250                |                  | 514158.711     | 131037.981      | 1.440        |
| S31            | 0.037        | 5.00             | 30.799                | 1350             | 514189.243     | 131081.700      | 1.299        |
| S32            | 0.081        | 5.00             | 30.338                | 1350             | 514165.470     | 131099.344      | 1.078        |
| S33            | 0.007        | 5.00             | 30.586                | 1350             | 514143.996     | 131071.477      | 1.516        |
| S34            | 0.049        | 5.00             | 30.461                | 1350             | 514138.809     | 131060.458      | 1.461        |
| S35            |              |                  | 30.384                | 1350             | 514137.501     | 131053.138      | 1.434        |
| S36            | 0.027        | 5.00             | 30.419                | 1350             | 514150.423     | 131051.098      | 1.519        |
| S40 Headwall   |              |                  | 30.250                |                  | 514153.932     | 131040.411      | 1.440        |
| S49 Basin 2 SE |              | 5.00             | 30.250                |                  | 514161.186     | 131019.464      | 1.500        |
| S50 FCC        |              |                  | 30.150                | 2400             | 514155.415     | 131015.894      | 1.500        |
| S51 Headwall   |              |                  | 29.700                |                  | 514140.307     | 131006.549      | 1.350        |

### Simulation Settings

|                      |          |                        |          |                            |     |                        |   |
|----------------------|----------|------------------------|----------|----------------------------|-----|------------------------|---|
| Rainfall Methodology | FEH-22   | Analysis Speed         | Detailed | Additional Storage (m³/ha) | 0.0 | Check Discharge Volume | x |
| Rainfall Events      | Singular | Skip Steady State      | x        | Starting Level (m)         |     |                        |   |
| Summer CV            | 1.000    | Drain Down Time (mins) | 1440     | Check Discharge Rate(s)    | x   |                        |   |

### Storm Durations

30 | 60 | 120 | 240 | 360 | 480 | 720 | 960 | 1440

| Return Period<br>(years) | Climate Change<br>(CC %) | Additional Area<br>(A %) | Additional Flow<br>(Q %) | Return Period<br>(years) | Climate Change<br>(CC %) | Additional Area<br>(A %) | Additional Flow<br>(Q %) |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 30                       | 0                        | 0                        | 0                        | 100                      | 45                       | 0                        | 0                        |

**Node S50 FCC Online Hydro-Brake® Control**

|                          |        |                         |                                |
|--------------------------|--------|-------------------------|--------------------------------|
| Flap Valve               | x      | Objective               | (HE) Minimise upstream storage |
| Replaces Downstream Link | x      | Sump Available          | ✓                              |
| Invert Level (m)         | 28.650 | Product Number          | CTL-SHE-0080-3100-1250-3100    |
| Design Depth (m)         | 1.250  | Min Outlet Diameter (m) | 0.100                          |
| Design Flow (l/s)        | 3.1    | Min Node Diameter (mm)  | 1200                           |

**Node S49 Basin 2 SE Flow through Pond Storage Structure**

|                             |         |                           |        |                          |        |
|-----------------------------|---------|---------------------------|--------|--------------------------|--------|
| Base Inf Coefficient (m/hr) | 0.00000 | Porosity                  | 1.00   | Main Channel Length (m)  | 15.000 |
| Side Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 28.750 | Main Channel Slope (1:X) | 250.0  |
| Safety Factor               | 1.0     | Time to half empty (mins) | 1155   | Main Channel n           | 0.025  |

**Inlets**

S40 Headwall | S63 Headwall | S45 Headwall

| Depth<br>(m) | Area<br>(m²) | Inf Area<br>(m²) | Depth<br>(m) | Area<br>(m²) | Inf Area<br>(m²) | Depth<br>(m) | Area<br>(m²) | Inf Area<br>(m²) | Depth<br>(m) | Area<br>(m²) | Inf Area<br>(m²) | Depth<br>(m) | Area<br>(m²) | Inf Area<br>(m²) | Depth<br>(m) | Area<br>(m²) | Inf Area<br>(m²) |
|--------------|--------------|------------------|--------------|--------------|------------------|--------------|--------------|------------------|--------------|--------------|------------------|--------------|--------------|------------------|--------------|--------------|------------------|
| 0.000        | 206.8        | 0.0              | 0.300        | 263.5        | 0.0              | 0.600        | 325.7        | 0.0              | 0.900        | 393.0        | 0.0              | 1.200        | 465.4        | 0.0              | 1.500        | 612.1        | 0.0              |
| 0.100        | 224.9        | 0.0              | 0.400        | 283.7        | 0.0              | 0.700        | 347.6        | 0.0              | 1.000        | 416.5        | 0.0              | 1.300        | 490.6        | 0.0              |              |              |                  |
| 0.200        | 243.9        | 0.0              | 0.500        | 304.4        | 0.0              | 0.800        | 370.0        | 0.0              | 1.100        | 440.7        | 0.0              | 1.400        | 516.4        | 0.0              |              |              |                  |

**Results for 30 year Critical Storm Duration. Lowest mass balance: 99.59%**

| Node Event        | US Node      | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status     |
|-------------------|--------------|-------------|-----------|-----------|--------------|---------------|------------|------------|
| 30 minute summer  | S41          | 17          | 30.224    | 0.124     | 29.1         | 0.1773        | 0.0000     | OK         |
| 30 minute summer  | S130         | 18          | 30.102    | 0.202     | 43.0         | 0.2290        | 0.0000     | OK         |
| 30 minute summer  | S42          | 18          | 29.930    | 0.180     | 52.1         | 0.2039        | 0.0000     | OK         |
| 30 minute summer  | S127         | 18          | 29.885    | 0.085     | 14.7         | 0.1212        | 0.0000     | OK         |
| 30 minute summer  | S128         | 18          | 29.746    | 0.196     | 69.1         | 0.2218        | 0.0000     | OK         |
| 30 minute summer  | S43          | 18          | 29.556    | 0.206     | 76.8         | 0.2324        | 0.0000     | OK         |
| 240 minute summer | S44          | 244         | 29.398    | 0.273     | 22.6         | 0.3903        | 0.0000     | OK         |
| 360 minute summer | S45 Headwall | 368         | 29.399    | 0.589     | 16.9         | 0.0000        | 0.0000     | OK         |
| 360 minute summer | S60          | 368         | 29.397    | 0.297     | 3.3          | 0.4245        | 0.0000     | SURCHARGED |
| 360 minute summer | S61          | 368         | 29.396    | 0.421     | 6.2          | 0.6029        | 0.0000     | SURCHARGED |
| 360 minute summer | S62          | 368         | 29.396    | 0.486     | 5.7          | 0.6951        | 0.0000     | SURCHARGED |
| 360 minute summer | S63 Headwall | 360         | 29.397    | 0.587     | 5.4          | 0.0000        | 0.0000     | OK         |
| 30 minute summer  | S31          | 18          | 29.580    | 0.080     | 15.9         | 0.1147        | 0.0000     | OK         |
| 30 minute summer  | S32          | 19          | 29.437    | 0.177     | 51.0         | 0.2535        | 0.0000     | OK         |
| 360 minute summer | S33          | 360         | 29.396    | 0.326     | 11.9         | 0.4671        | 0.0000     | SURCHARGED |

| Link Event (Upstream Depth) | US Node      | Link              | DS Node        | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|-----------------------------|--------------|-------------------|----------------|---------------|----------------|----------|---------------|--------------------|
| 30 minute summer            | S41          | 1.000             | S130           | 29.1          | 0.964          | 0.588    | 0.6574        |                    |
| 30 minute summer            | S130         | 1.001             | S42            | 42.9          | 1.192          | 0.989    | 0.7708        |                    |
| 30 minute summer            | S42          | 1.002             | S128           | 51.9          | 1.658          | 0.802    | 0.2523        |                    |
| 30 minute summer            | S127         | 2.000             | S128           | 14.7          | 0.796          | 0.306    | 0.4781        |                    |
| 30 minute summer            | S128         | 1.003             | S43            | 68.8          | 1.373          | 0.660    | 1.1361        |                    |
| 30 minute summer            | S43          | 1.004             | S44            | 76.2          | 1.518          | 0.722    | 1.2527        |                    |
| 240 minute summer           | S44          | 1.005             | S45 Headwall   | 22.5          | 1.005          | 0.218    | 1.5890        |                    |
| 360 minute summer           | S45 Headwall | Flow through Pond | S49 Basin 2 SE | 29.0          | 0.054          | 0.001    | 163.8952      |                    |
| 360 minute summer           | S60          | 4.000             | S61            | 3.3           | 0.488          | 0.069    | 0.5883        |                    |
| 360 minute summer           | S61          | 4.001             | S62            | 5.7           | 0.626          | 0.123    | 0.3259        |                    |
| 360 minute summer           | S62          | 4.002             | S63 Headwall   | 5.4           | 0.476          | 0.118    | 0.4381        |                    |
| 360 minute summer           | S63 Headwall | Flow through Pond | S49 Basin 2 SE | 29.0          | 0.054          | 0.001    | 163.8952      |                    |
| 30 minute summer            | S31          | 5.000             | S32            | 15.9          | 0.567          | 0.159    | 0.8537        |                    |
| 30 minute summer            | S32          | 5.001             | S33            | 51.8          | 1.005          | 0.636    | 2.0004        |                    |
| 360 minute summer           | S33          | 5.002             | S34            | 11.7          | 0.640          | 0.139    | 0.8576        |                    |

**Results for 30 year Critical Storm Duration. Lowest mass balance: 99.59%**

| Node Event        | US<br>Node     | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|-------------------|----------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 360 minute summer | S34            | 360            | 29.396       | 0.396        | 16.5            | 0.5669           | 0.0000        | SURCHARGED |
| 360 minute summer | S35            | 360            | 29.396       | 0.446        | 16.0            | 0.6382           | 0.0000        | SURCHARGED |
| 360 minute summer | S36            | 360            | 29.396       | 0.496        | 18.0            | 0.7092           | 0.0000        | SURCHARGED |
| 360 minute summer | S40 Headwall   | 360            | 29.397       | 0.587        | 17.4            | 0.0000           | 0.0000        | OK         |
| 360 minute summer | S49 Basin 2 SE | 360            | 29.396       | 0.646        | 29.0            | 0.0000           | 0.0000        | SURCHARGED |
| 360 minute summer | S50 FCC        | 360            | 29.396       | 0.746        | 18.8            | 3.3732           | 0.0000        | SURCHARGED |
| 120 minute summer | S51 Headwall   | 60             | 28.380       | 0.030        | 3.0             | 0.0000           | 0.0000        | OK         |

| Link Event<br>(Upstream Depth) | US<br>Node     | Link              | DS<br>Node     | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|--------------------------------|----------------|-------------------|----------------|------------------|-------------------|----------|------------------|-----------------------|
| 360 minute summer              | S34            | 5.003             | S35            | 16.0             | 0.709             | 0.176    | 0.5236           |                       |
| 360 minute summer              | S35            | 5.004             | S36            | 15.4             | 0.611             | 0.225    | 0.9212           |                       |
| 360 minute summer              | S36            | 5.005             | S40 Headwall   | 17.4             | 0.624             | 0.236    | 0.7921           |                       |
| 360 minute summer              | S40 Headwall   | Flow through Pond | S49 Basin 2 SE | 29.0             | 0.054             | 0.001    | 163.8952         |                       |
| 360 minute summer              | S49 Basin 2 SE | 1.007             | S50 FCC        | 18.8             | 0.564             | 0.139    | 0.4779           |                       |
| 360 minute summer              | S50 FCC        | 1.008             | S51 Headwall   | 3.0              | 0.825             | 0.021    | 0.0644           | 236.3                 |

**Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.72%**

| Node Event        | US Node      | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status     |
|-------------------|--------------|-------------|-----------|-----------|--------------|---------------|------------|------------|
| 30 minute summer  | S41          | 19          | 31.311    | 1.211     | 53.6         | 1.7325        | 0.0000     | FLOOD RISK |
| 30 minute summer  | S130         | 19          | 31.083    | 1.183     | 73.4         | 1.3381        | 0.0000     | SURCHARGED |
| 30 minute summer  | S42          | 19          | 30.603    | 0.853     | 85.7         | 0.9646        | 0.0000     | SURCHARGED |
| 30 minute summer  | S127         | 19          | 30.328    | 0.528     | 27.2         | 0.7556        | 0.0000     | SURCHARGED |
| 30 minute summer  | S128         | 20          | 30.278    | 0.728     | 110.7        | 0.8233        | 0.0000     | SURCHARGED |
| 30 minute summer  | S43          | 20          | 30.002    | 0.652     | 122.7        | 0.7376        | 0.0000     | SURCHARGED |
| 720 minute summer | S44          | 720         | 29.862    | 0.737     | 17.1         | 1.0551        | 0.0000     | SURCHARGED |
| 720 minute summer | S45 Headwall | 720         | 29.864    | 1.054     | 16.3         | 0.0000        | 0.0000     | OK         |
| 720 minute summer | S60          | 720         | 29.860    | 0.760     | 3.3          | 1.0881        | 0.0000     | SURCHARGED |
| 720 minute summer | S61          | 720         | 29.860    | 0.885     | 6.0          | 1.2668        | 0.0000     | SURCHARGED |
| 720 minute summer | S62          | 720         | 29.860    | 0.950     | 5.9          | 1.3598        | 0.0000     | SURCHARGED |
| 720 minute summer | S63 Headwall | 720         | 29.861    | 1.051     | 5.7          | 0.0000        | 0.0000     | OK         |
| 30 minute summer  | S31          | 18          | 30.388    | 0.888     | 29.3         | 1.2706        | 0.0000     | SURCHARGED |
| 30 minute summer  | S32          | 18          | 30.338    | 1.078     | 91.3         | 1.5426        | 1.8046     | FLOOD      |
| 30 minute summer  | S33          | 19          | 30.171    | 1.101     | 84.8         | 1.5760        | 0.0000     | SURCHARGED |

| Link Event (Upstream Depth) | US Node      | Link              | DS Node        | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|-----------------------------|--------------|-------------------|----------------|---------------|----------------|----------|---------------|--------------------|
| 30 minute summer            | S41          | 1.000             | S130           | 47.8          | 1.202          | 0.964    | 0.8742        |                    |
| 30 minute summer            | S130         | 1.001             | S42            | 69.5          | 1.748          | 1.604    | 0.8543        |                    |
| 30 minute summer            | S42          | 1.002             | S128           | 83.5          | 2.100          | 1.289    | 0.3214        |                    |
| 30 minute summer            | S127         | 2.000             | S128           | 23.8          | 0.807          | 0.494    | 0.9290        |                    |
| 30 minute summer            | S128         | 1.003             | S43            | 109.2         | 1.551          | 1.047    | 1.5964        |                    |
| 30 minute summer            | S43          | 1.004             | S44            | 121.3         | 1.722          | 1.149    | 1.7554        |                    |
| 720 minute summer           | S44          | 1.005             | S45 Headwall   | 16.3          | 0.714          | 0.158    | 1.6254        |                    |
| 720 minute summer           | S45 Headwall | Flow through Pond | S49 Basin 2 SE | 27.4          | 0.036          | 0.001    | 340.9837      |                    |
| 720 minute summer           | S60          | 4.000             | S61            | 3.1           | 0.386          | 0.066    | 0.5883        |                    |
| 720 minute summer           | S61          | 4.001             | S62            | 5.9           | 0.502          | 0.128    | 0.3259        |                    |
| 720 minute summer           | S62          | 4.002             | S63 Headwall   | 5.7           | 0.419          | 0.126    | 0.4381        |                    |
| 720 minute summer           | S63 Headwall | Flow through Pond | S49 Basin 2 SE | 27.4          | 0.036          | 0.001    | 340.9837      |                    |
| 30 minute summer            | S31          | 5.000             | S32            | 28.0          | 0.586          | 0.281    | 2.0848        |                    |
| 30 minute summer            | S32          | 5.001             | S33            | 78.8          | 1.119          | 0.968    | 2.4774        |                    |
| 30 minute summer            | S33          | 5.002             | S34            | 81.4          | 1.155          | 0.968    | 0.8576        |                    |

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.72%

| Node Event        | US Node        | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status     |
|-------------------|----------------|-------------|-----------|-----------|--------------|---------------|------------|------------|
| 30 minute summer  | S34            | 19          | 30.086    | 1.086     | 121.0        | 1.5534        | 0.0000     | SURCHARGED |
| 30 minute summer  | S35            | 19          | 29.946    | 0.996     | 116.2        | 1.4249        | 0.0000     | SURCHARGED |
| 720 minute summer | S36            | 720         | 29.860    | 0.960     | 17.8         | 1.3744        | 0.0000     | SURCHARGED |
| 720 minute summer | S40 Headwall   | 720         | 29.861    | 1.051     | 17.6         | 0.0000        | 0.0000     | OK         |
| 720 minute summer | S49 Basin 2 SE | 720         | 29.860    | 1.110     | 27.4         | 0.0000        | 0.0000     | SURCHARGED |
| 720 minute summer | S50 FCC        | 720         | 29.860    | 1.210     | 15.0         | 5.4742        | 0.0000     | FLOOD RISK |
| 720 minute summer | S51 Headwall   | 720         | 28.380    | 0.030     | 3.0          | 0.0000        | 0.0000     | OK         |

| Link Event<br>(Upstream Depth) | US Node        | Link              | DS Node        | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|--------------------------------|----------------|-------------------|----------------|---------------|----------------|----------|---------------|--------------------|
| 30 minute summer               | S34            | 5.003             | S35            | 116.2         | 1.650          | 1.277    | 0.5236        |                    |
| 30 minute summer               | S35            | 5.004             | S36            | 111.5         | 1.583          | 1.631    | 0.9212        |                    |
| 720 minute summer              | S36            | 5.005             | S40 Headwall   | 17.6          | 0.511          | 0.239    | 0.7921        |                    |
| 720 minute summer              | S40 Headwall   | Flow through Pond | S49 Basin 2 SE | 27.4          | 0.036          | 0.001    | 340.9837      |                    |
| 720 minute summer              | S49 Basin 2 SE | 1.007             | S50 FCC        | 15.0          | 0.503          | 0.111    | 0.4779        |                    |
| 720 minute summer              | S50 FCC        | 1.008             | S51 Headwall   | 3.0           | 0.827          | 0.021    | 0.0649        | 350.9              |

Nodes

| Name          | Area<br>(ha) | T of E<br>(mins) | Cover<br>Level<br>(m) | Diameter<br>(mm) | Easting<br>(m) | Northing<br>(m) | Depth<br>(m) |
|---------------|--------------|------------------|-----------------------|------------------|----------------|-----------------|--------------|
| S501          | 0.063        | 5.00             | 32.230                | 1200             | 514281.785     | 131159.851      | 1.980        |
| S502          | 0.030        | 5.00             | 32.420                | 1200             | 514285.480     | 131179.356      | 2.470        |
| S503          | 0.046        | 5.00             | 32.114                | 1350             | 514236.478     | 131215.602      | 1.584        |
| S540          |              |                  | 31.836                | 1200             | 514271.510     | 131231.418      | 2.312        |
| S541          |              |                  | 32.103                | 1200             | 514274.999     | 131206.704      | 3.144        |
| S504          | 0.073        | 5.00             | 32.245                | 1200             | 514270.678     | 131201.186      | 3.445        |
| S508          | 0.044        | 5.00             | 31.314                | 1200             | 514233.893     | 131184.198      | 3.014        |
| S509          | 0.012        | 5.00             | 30.932                | 1200             | 514218.763     | 131177.449      | 2.882        |
| S510          |              | 5.00             | 30.761                | 1350             | 514203.871     | 131111.083      | 1.611        |
| S511          | 0.130        | 5.00             | 30.415                | 1350             | 514182.633     | 131121.736      | 1.615        |
| S512          | 0.026        | 5.00             | 30.794                | 1200             | 514202.138     | 131151.562      | 2.444        |
| S513          | 0.036        | 5.00             | 30.946                | 1200             | 514211.941     | 131167.947      | 2.846        |
| S514          | 0.034        | 5.00             | 30.804                | 1350             | 514213.726     | 131180.766      | 2.954        |
| S515          | 0.016        | 5.00             | 30.490                | 1200             | 514174.038     | 131140.073      | 1.500        |
| S516          | 0.112        | 5.00             | 30.394                | 1350             | 514167.800     | 131145.451      | 1.579        |
| S517          | 0.040        | 5.00             | 29.571                | 1350             | 514126.659     | 131178.527      | 1.246        |
| S519          | 0.081        | 5.00             | 29.863                | 1350             | 514148.950     | 131186.788      | 1.688        |
| S520          |              |                  | 30.239                | 1200             | 514168.267     | 131195.584      | 2.214        |
| S521          | 0.066        | 5.00             | 30.465                | 1350             | 514200.917     | 131210.042      | 2.815        |
| S522          | 0.044        | 5.00             | 31.710                | 1350             | 514264.417     | 131242.271      | 1.610        |
| S523          | 0.015        | 5.00             | 31.243                | 1350             | 514239.301     | 131251.845      | 1.493        |
| S524          | 0.082        | 5.00             | 30.975                | 1350             | 514228.060     | 131249.042      | 1.550        |
| S525          | 0.107        | 5.00             | 30.162                | 1350             | 514190.794     | 131232.255      | 2.737        |
| S526          | 0.036        | 5.00             | 29.360                | 1350             | 514170.626     | 131277.148      | 2.210        |
| S527          | 0.021        | 5.00             | 29.150                | 1350             | 514152.924     | 131268.323      | 2.150        |
| S528 Headwall |              |                  | 28.250                |                  | 514140.121     | 131274.335      | 1.420        |
| S529          | 0.011        | 5.00             | 30.144                | 1200             | 514116.868     | 131077.439      | 2.044        |
| S530          | 0.090        | 5.00             | 30.036                | 1200             | 514112.423     | 131086.893      | 2.006        |
| S531          | 0.066        | 5.00             | 29.433                | 1200             | 514098.547     | 131142.324      | 1.808        |
| S532          | 0.033        | 5.00             | 28.969                | 1350             | 514093.729     | 131177.588      | 1.619        |
| S533          | 0.029        | 5.00             | 28.739                | 1350             | 514092.664     | 131199.776      | 1.589        |
| S534          |              |                  | 28.250                | 1350             | 514090.415     | 131241.616      | 1.325        |

### Nodes

| Name           | Area<br>(ha) | T of E<br>(mins) | Cover<br>Level<br>(m) | Diameter<br>(mm) | Easting<br>(m) | Northing<br>(m) | Depth<br>(m) |
|----------------|--------------|------------------|-----------------------|------------------|----------------|-----------------|--------------|
| S535           | 0.075        | 5.00             | 28.989                | 1350             | 514139.169     | 131262.013      | 1.639        |
| S536           | 0.029        | 5.00             | 28.658                | 1350             | 514113.590     | 131244.002      | 1.558        |
| S537 Headwall  |              |                  | 28.250                |                  | 514103.331     | 131255.371      | 1.420        |
| S538 Basin 3 N |              | 5.00             | 28.250                |                  | 514097.675     | 131268.505      | 1.500        |
| S539 FCC       |              |                  | 28.250                | 2400             | 514090.905     | 131271.317      | 1.600        |
| S540 Outfall   |              |                  | 27.250                |                  | 514084.858     | 131273.795      | 0.690        |

### Simulation Settings

|                      |          |                        |          |                            |     |                        |   |
|----------------------|----------|------------------------|----------|----------------------------|-----|------------------------|---|
| Rainfall Methodology | FEH-22   | Analysis Speed         | Detailed | Additional Storage (m³/ha) | 0.0 | Check Discharge Volume | x |
| Rainfall Events      | Singular | Skip Steady State      | x        | Starting Level (m)         |     |                        |   |
| Summer CV            | 1.000    | Drain Down Time (mins) | 1440     | Check Discharge Rate(s)    | x   |                        |   |

### Storm Durations

30 | 60 | 120 | 240 | 360 | 480 | 720 | 960 | 1440

| Return Period<br>(years) | Climate Change<br>(CC %) | Additional Area<br>(A %) | Additional Flow<br>(Q %) | Return Period<br>(years) | Climate Change<br>(CC %) | Additional Area<br>(A %) | Additional Flow<br>(Q %) |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 30                       | 0                        | 0                        | 0                        | 100                      | 45                       | 0                        | 0                        |

### Node S539 FCC Online Hydro-Brake® Control

|                          |        |                         |                                |
|--------------------------|--------|-------------------------|--------------------------------|
| Flap Valve               | x      | Objective               | (HE) Minimise upstream storage |
| Replaces Downstream Link | x      | Sump Available          | ✓                              |
| Invert Level (m)         | 26.650 | Product Number          | CTL-SHE-0068-2400-1400-2400    |
| Design Depth (m)         | 1.400  | Min Outlet Diameter (m) | 0.100                          |
| Design Flow (l/s)        | 2.4    | Min Node Diameter (mm)  | 1200                           |

**Node S538 Basin 3 N Flow through Pond Storage Structure**

|                             |         |                           |        |                          |        |
|-----------------------------|---------|---------------------------|--------|--------------------------|--------|
| Base Inf Coefficient (m/hr) | 0.00000 | Porosity                  | 1.00   | Main Channel Length (m)  | 20.000 |
| Side Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 26.750 | Main Channel Slope (1:X) | 250.0  |
| Safety Factor               | 1.0     | Time to half empty (mins) |        | Main Channel n           | 0.025  |

**Inlets**

S528 Headwall      S537 Headwall

| Depth<br>(m) | Area<br>(m²) | Inf Area<br>(m²) | Depth<br>(m) | Area<br>(m²) | Inf Area<br>(m²) | Depth<br>(m) | Area<br>(m²) | Inf Area<br>(m²) | Depth<br>(m) | Area<br>(m²) | Inf Area<br>(m²) | Depth<br>(m) | Area<br>(m²) | Inf Area<br>(m²) | Depth<br>(m) | Area<br>(m²) | Inf Area<br>(m²) |
|--------------|--------------|------------------|--------------|--------------|------------------|--------------|--------------|------------------|--------------|--------------|------------------|--------------|--------------|------------------|--------------|--------------|------------------|
| 0.000        | 1016.7       | 0.0              | 0.300        | 1132.9       | 0.0              | 0.600        | 1255.1       | 0.0              | 0.900        | 1382.3       | 0.0              | 1.200        | 1514.6       | 0.0              | 1.500        | 1652.0       | 0.0              |
| 0.100        | 1054.3       | 0.0              | 0.400        | 1173.1       | 0.0              | 0.700        | 1296.9       | 0.0              | 1.000        | 1425.8       | 0.0              | 1.300        | 1559.8       | 0.0              |              |              |                  |
| 0.200        | 1093.4       | 0.0              | 0.500        | 1213.8       | 0.0              | 0.800        | 1339.3       | 0.0              | 1.100        | 1469.9       | 0.0              | 1.400        | 1605.6       | 0.0              |              |              |                  |

**Results for 30 year Critical Storm Duration. Lowest mass balance: 94.68%**

| Node Event                     | US Node | Peak (mins) | Level (m) | Depth (m)     | Inflow (l/s)   | Node Vol (m³) | Flood (m³)    | Status             |
|--------------------------------|---------|-------------|-----------|---------------|----------------|---------------|---------------|--------------------|
| 30 minute summer               | S501    | 18          | 30.365    | 0.115         | 27.5           | 0.1304        | 0.0000        | OK                 |
| 30 minute summer               | S502    | 18          | 30.047    | 0.096         | 40.7           | 0.1091        | 0.0000        | OK                 |
| 30 minute summer               | S503    | 18          | 30.605    | 0.075         | 19.8           | 0.1074        | 0.0000        | OK                 |
| 30 minute summer               | S540    | 18          | 29.601    | 0.077         | 19.8           | 0.0867        | 0.0000        | OK                 |
| 30 minute summer               | S541    | 19          | 29.191    | 0.232         | 19.8           | 0.2623        | 0.0000        | SURCHARGED         |
| 30 minute summer               | S504    | 19          | 29.174    | 0.374         | 89.8           | 0.4230        | 0.0000        | SURCHARGED         |
| 30 minute summer               | S508    | 19          | 28.882    | 0.582         | 106.4          | 0.6584        | 0.0000        | SURCHARGED         |
| 30 minute summer               | S509    | 19          | 28.680    | 0.630         | 109.2          | 0.7126        | 0.0000        | SURCHARGED         |
| 30 minute summer               | S510    | 1           | 29.150    | 0.000         | 0.0            | 0.0000        | 0.0000        | OK                 |
| 30 minute summer               | S511    | 18          | 28.944    | 0.144         | 56.5           | 0.2062        | 0.0000        | OK                 |
| 30 minute summer               | S512    | 19          | 28.716    | 0.366         | 68.3           | 0.4134        | 0.0000        | SURCHARGED         |
| 30 minute summer               | S513    | 19          | 28.645    | 0.545         | 80.9           | 0.6159        | 0.0000        | SURCHARGED         |
| 30 minute summer               | S514    | 19          | 28.562    | 0.712         | 190.3          | 1.0188        | 0.0000        | SURCHARGED         |
| 30 minute summer               | S515    | 18          | 29.042    | 0.052         | 7.1            | 0.0583        | 0.0000        | OK                 |
| 30 minute summer               | S516    | 18          | 28.937    | 0.122         | 55.6           | 0.1743        | 0.0000        | OK                 |
| Link Event<br>(Upstream Depth) | US Node | Link        | DS Node   | Outflow (l/s) | Velocity (m/s) | Flow/Cap      | Link Vol (m³) | Discharge Vol (m³) |
| 30 minute summer               | S501    | 1.000       | S502      | 27.5          | 1.400          | 0.473         | 0.3900        |                    |
| 30 minute summer               | S502    | 1.001       | S504      | 40.7          | 1.707          | 0.386         | 0.7388        |                    |
| 30 minute summer               | S503    | 2.000       | S540      | 19.8          | 1.686          | 0.235         | 0.4515        |                    |
| 30 minute summer               | S540    | 2.001       | S541      | 19.8          | 1.436          | 0.252         | 0.6411        |                    |
| 30 minute summer               | S541    | 2.002       | S504      | 21.0          | 0.540          | 0.267         | 0.2787        |                    |
| 30 minute summer               | S504    | 1.002       | S508      | 88.8          | 1.293          | 1.319         | 2.6151        |                    |
| 30 minute summer               | S508    | 1.003       | S509      | 104.4         | 1.482          | 0.763         | 1.1666        |                    |
| 30 minute summer               | S509    | 1.004       | S514      | 107.2         | 1.523          | 1.061         | 0.4247        |                    |
| 30 minute summer               | S510    | 4.000       | S511      | 0.0           | 0.000          | 0.000         | 0.1227        |                    |
| 30 minute summer               | S511    | 4.001       | S512      | 57.0          | 1.480          | 0.456         | 1.7983        |                    |
| 30 minute summer               | S512    | 4.002       | S513      | 65.4          | 1.276          | 0.514         | 1.3446        |                    |
| 30 minute summer               | S513    | 4.003       | S514      | 74.5          | 1.391          | 0.764         | 0.9114        |                    |
| 30 minute summer               | S514    | 1.005       | S521      | 190.7         | 1.203          | 0.747         | 5.0632        |                    |
| 30 minute summer               | S515    | 5.000       | S516      | 7.1           | 0.920          | 0.058         | 0.0636        |                    |
| 30 minute summer               | S516    | 5.001       | S519      | 55.6          | 1.081          | 0.234         | 3.0445        |                    |

**Results for 30 year Critical Storm Duration. Lowest mass balance: 94.68%**

| Node Event         | US<br>Node    | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|--------------------|---------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 30 minute summer   | S517          | 20             | 28.542       | 0.217        | 17.4            | 0.3107           | 0.0000        | OK         |
| 30 minute summer   | S519          | 20             | 28.532       | 0.357        | 106.9           | 0.5108           | 0.0000        | OK         |
| 30 minute summer   | S520          | 20             | 28.478       | 0.453        | 104.2           | 0.5122           | 0.0000        | SURCHARGED |
| 30 minute summer   | S521          | 19             | 28.400       | 0.750        | 295.4           | 1.0733           | 0.0000        | SURCHARGED |
| 30 minute summer   | S522          | 18             | 30.190       | 0.090        | 19.2            | 0.1283           | 0.0000        | OK         |
| 30 minute summer   | S523          | 18             | 29.847       | 0.097        | 25.5            | 0.1389           | 0.0000        | OK         |
| 30 minute summer   | S524          | 18             | 29.529       | 0.104        | 61.1            | 0.1490           | 0.0000        | OK         |
| 30 minute summer   | S525          | 19             | 28.119       | 0.694        | 389.4           | 0.9933           | 0.0000        | SURCHARGED |
| 30 minute summer   | S526          | 19             | 27.723       | 0.573        | 399.8           | 0.8194           | 0.0000        | SURCHARGED |
| 30 minute summer   | S527          | 19             | 27.503       | 0.503        | 407.1           | 0.7192           | 0.0000        | OK         |
| 1440 minute summer | S528 Headwall | 1500           | 27.522       | 0.692        | 33.5            | 0.0000           | 0.0000        | OK         |
| 30 minute summer   | S529          | 19             | 28.242       | 0.142        | 4.7             | 0.1608           | 0.0000        | OK         |
| 30 minute summer   | S530          | 19             | 28.241       | 0.211        | 43.4            | 0.2389           | 0.0000        | OK         |
| 30 minute summer   | S531          | 18             | 27.846       | 0.221        | 69.6            | 0.2498           | 0.0000        | OK         |
| 30 minute summer   | S532          | 18             | 27.563       | 0.213        | 82.8            | 0.3047           | 0.0000        | OK         |

| Link Event<br>(Upstream Depth) | US<br>Node    | Link              | DS<br>Node     | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|--------------------------------|---------------|-------------------|----------------|------------------|-------------------|----------|------------------|-----------------------|
| 30 minute summer               | S517          | 6.000             | S519           | 17.0             | 0.394             | 0.107    | 2.0735           |                       |
| 30 minute summer               | S519          | 5.002             | S520           | 104.2            | 1.567             | 0.620    | 2.3201           |                       |
| 30 minute summer               | S520          | 5.003             | S521           | 109.7            | 1.090             | 0.598    | 3.9385           |                       |
| 30 minute summer               | S521          | 1.006             | S525           | 296.7            | 1.873             | 1.173    | 3.8678           |                       |
| 30 minute summer               | S522          | 7.000             | S523           | 19.2             | 1.234             | 0.323    | 0.4182           |                       |
| 30 minute summer               | S523          | 7.001             | S524           | 25.5             | 1.649             | 0.333    | 0.1793           |                       |
| 30 minute summer               | S524          | 7.002             | S525           | 61.1             | 2.215             | 0.263    | 1.8827           |                       |
| 30 minute summer               | S525          | 1.007             | S526           | 385.6            | 1.785             | 1.066    | 10.6321          |                       |
| 30 minute summer               | S526          | 1.008             | S527           | 398.9            | 1.847             | 0.946    | 4.2412           |                       |
| 30 minute summer               | S527          | 1.009             | S528 Headwall  | 406.5            | 1.953             | 0.998    | 2.9424           |                       |
| 1440 minute summer             | S528 Headwall | Flow through Pond | S538 Basin 3 N | 30.5             | 0.016             | 0.000    | 822.3242         |                       |
| 30 minute summer               | S529          | 9.000             | S530           | 4.5              | 0.189             | 0.107    | 0.3404           |                       |
| 30 minute summer               | S530          | 9.001             | S531           | 41.4             | 1.166             | 1.051    | 2.0291           |                       |
| 30 minute summer               | S531          | 9.002             | S532           | 68.7             | 1.291             | 0.827    | 1.8973           |                       |
| 30 minute summer               | S532          | 9.003             | S533           | 82.5             | 1.349             | 0.551    | 1.3583           |                       |

**Results for 30 year Critical Storm Duration. Lowest mass balance: 94.68%**

| Node Event         | US Node        | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status     |
|--------------------|----------------|-------------|-----------|-----------|--------------|---------------|------------|------------|
| 1440 minute summer | S533           | 1440        | 27.503    | 0.353     | 7.0          | 0.5045        | 0.0000     | OK         |
| 1440 minute summer | S534           | 1470        | 27.501    | 0.576     | 7.0          | 0.8246        | 0.0000     | SURCHARGED |
| 1440 minute summer | S535           | 1470        | 27.500    | 0.150     | 2.3          | 0.2147        | 0.0000     | OK         |
| 1440 minute summer | S536           | 1440        | 27.502    | 0.402     | 3.2          | 0.5754        | 0.0000     | SURCHARGED |
| 1440 minute summer | S537 Headwall  | 1410        | 27.506    | 0.676     | 16.4         | 0.0000        | 0.0000     | OK         |
| 1440 minute summer | S538 Basin 3 N | 1470        | 27.501    | 0.751     | 36.5         | 0.0000        | 0.0000     | SURCHARGED |
| 1440 minute summer | S539 FCC       | 1470        | 27.501    | 0.851     | 13.2         | 3.8480        | 0.0000     | SURCHARGED |
| 960 minute summer  | S540 Outfall   | 420         | 26.592    | 0.032     | 2.0          | 0.0000        | 0.0000     | OK         |

| Link Event<br>(Upstream Depth) | US Node        | Link              | DS Node        | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|--------------------------------|----------------|-------------------|----------------|---------------|----------------|----------|---------------|--------------------|
| 1440 minute summer             | S533           | 9.004             | S534           | 7.0           | 0.512          | 0.030    | 6.1105        |                    |
| 1440 minute summer             | S534           | 9.005             | S537 Headwall  | 6.5           | 0.392          | 0.032    | 2.9895        |                    |
| 1440 minute summer             | S535           | 10.000            | S536           | 2.3           | 0.583          | 0.050    | 1.0619        |                    |
| 1440 minute summer             | S536           | 10.001            | S537 Headwall  | 3.2           | 0.554          | 0.057    | 0.6091        |                    |
| 1440 minute summer             | S537 Headwall  | Flow through Pond | S538 Basin 3 N | 30.5          | 0.016          | 0.000    | 822.3242      |                    |
| 1440 minute summer             | S538 Basin 3 N | 1.011             | S539 FCC       | 13.2          | 0.408          | 0.102    | 0.5162        |                    |
| 1440 minute summer             | S539 FCC       | 1.012             | S540 Outfall   | 2.0           | 0.744          | 0.098    | 0.0179        | 308.2              |

**Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 96.73%**

| Node Event       | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status     |
|------------------|---------|-------------|-----------|-----------|--------------|---------------|------------|------------|
| 30 minute summer | S501    | 20          | 31.796    | 1.546     | 50.7         | 1.7483        | 0.0000     | SURCHARGED |
| 30 minute summer | S502    | 20          | 31.661    | 1.711     | 65.8         | 1.9351        | 0.0000     | SURCHARGED |
| 30 minute summer | S503    | 20          | 31.507    | 0.977     | 36.6         | 1.3982        | 0.0000     | SURCHARGED |
| 30 minute summer | S540    | 20          | 31.393    | 1.869     | 36.1         | 2.1137        | 0.0000     | SURCHARGED |
| 30 minute summer | S541    | 20          | 31.310    | 2.351     | 40.1         | 2.6595        | 0.0000     | SURCHARGED |
| 30 minute summer | S504    | 20          | 31.278    | 2.478     | 125.9        | 2.8021        | 0.0000     | SURCHARGED |
| 30 minute summer | S508    | 20          | 30.640    | 2.340     | 152.6        | 2.6462        | 0.0000     | SURCHARGED |
| 30 minute summer | S509    | 19          | 30.204    | 2.154     | 161.5        | 2.4356        | 0.0000     | SURCHARGED |
| 30 minute summer | S510    | 18          | 30.487    | 1.337     | 25.5         | 1.9138        | 0.0000     | FLOOD RISK |
| 30 minute summer | S511    | 18          | 30.415    | 1.615     | 104.1        | 2.3111        | 3.8319     | FLOOD      |
| 30 minute summer | S512    | 19          | 30.284    | 1.934     | 89.5         | 2.1868        | 0.0000     | SURCHARGED |
| 30 minute summer | S513    | 19          | 30.149    | 2.049     | 114.9        | 2.3169        | 0.0000     | SURCHARGED |
| 30 minute summer | S514    | 19          | 29.969    | 2.119     | 289.7        | 3.0323        | 0.0000     | SURCHARGED |
| 30 minute summer | S515    | 18          | 29.794    | 0.804     | 13.1         | 0.9096        | 0.0000     | SURCHARGED |
| 30 minute summer | S516    | 19          | 29.802    | 0.987     | 100.1        | 1.4129        | 0.0000     | SURCHARGED |

| Link Event<br>(Upstream Depth) | US Node | Link  | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|--------------------------------|---------|-------|---------|---------------|----------------|----------|---------------|--------------------|
| 30 minute summer               | S501    | 1.000 | S502    | 43.8          | 1.531          | 0.752    | 0.7895        |                    |
| 30 minute summer               | S502    | 1.001 | S504    | 59.8          | 1.672          | 0.567    | 1.0490        |                    |
| 30 minute summer               | S503    | 2.000 | S540    | 36.1          | 1.887          | 0.427    | 1.5287        |                    |
| 30 minute summer               | S540    | 2.001 | S541    | 40.1          | 1.433          | 0.511    | 0.9926        |                    |
| 30 minute summer               | S541    | 2.002 | S504    | 53.7          | 1.349          | 0.683    | 0.2787        |                    |
| 30 minute summer               | S504    | 1.002 | S508    | 127.7         | 1.814          | 1.899    | 2.8532        |                    |
| 30 minute summer               | S508    | 1.003 | S509    | 154.4         | 2.193          | 1.130    | 1.1666        |                    |
| 30 minute summer               | S509    | 1.004 | S514    | 163.6         | 2.323          | 1.618    | 0.4247        |                    |
| 30 minute summer               | S510    | 4.000 | S511    | -25.5         | -0.640         | -0.455   | 0.9450        |                    |
| 30 minute summer               | S511    | 4.001 | S512    | 71.2          | 1.556          | 0.569    | 2.5096        |                    |
| 30 minute summer               | S512    | 4.002 | S513    | 86.7          | 1.276          | 0.681    | 1.3446        |                    |
| 30 minute summer               | S513    | 4.003 | S514    | 109.0         | 1.549          | 1.118    | 0.9114        |                    |
| 30 minute summer               | S514    | 1.005 | S521    | 292.4         | 1.846          | 1.145    | 5.0632        |                    |
| 30 minute summer               | S515    | 5.000 | S516    | 14.1          | 0.896          | 0.115    | 0.5800        |                    |
| 30 minute summer               | S516    | 5.001 | S519    | 100.1         | 1.176          | 0.421    | 5.0109        |                    |

**Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 96.73%**

| Node Event         | US Node       | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status     |
|--------------------|---------------|-------------|-----------|-----------|--------------|---------------|------------|------------|
| 30 minute summer   | S517          | 18          | 29.571    | 1.246     | 143.2        | 1.7830        | 25.3507    | FLOOD      |
| 30 minute summer   | S519          | 19          | 29.671    | 1.496     | 165.3        | 2.1410        | 0.0000     | FLOOD RISK |
| 30 minute summer   | S520          | 19          | 29.665    | 1.640     | 118.8        | 1.8546        | 0.0000     | SURCHARGED |
| 30 minute summer   | S521          | 19          | 29.640    | 1.990     | 389.7        | 2.8481        | 0.0000     | SURCHARGED |
| 30 minute summer   | S522          | 18          | 30.230    | 0.130     | 35.4         | 0.1861        | 0.0000     | OK         |
| 30 minute summer   | S523          | 18          | 29.894    | 0.144     | 47.1         | 0.2057        | 0.0000     | OK         |
| 30 minute summer   | S524          | 18          | 29.633    | 0.208     | 112.9        | 0.2983        | 0.0000     | OK         |
| 30 minute summer   | S525          | 19          | 29.168    | 1.743     | 568.9        | 2.4936        | 0.0000     | SURCHARGED |
| 30 minute summer   | S526          | 19          | 28.339    | 1.189     | 587.5        | 1.7018        | 0.0000     | SURCHARGED |
| 1440 minute summer | S527          | 1470        | 28.062    | 1.062     | 61.8         | 1.5204        | 0.0000     | SURCHARGED |
| 1440 minute summer | S528 Headwall | 1440        | 28.068    | 1.238     | 67.6         | 0.0000        | 0.0000     | OK         |
| 30 minute summer   | S529          | 19          | 29.530    | 1.430     | 11.2         | 1.6172        | 0.0000     | SURCHARGED |
| 30 minute summer   | S530          | 19          | 29.524    | 1.494     | 76.0         | 1.6902        | 0.0000     | SURCHARGED |
| 30 minute summer   | S531          | 19          | 28.192    | 0.567     | 124.8        | 0.6411        | 0.0000     | SURCHARGED |
| 1440 minute summer | S532          | 1440        | 28.065    | 0.715     | 11.2         | 1.0236        | 0.0000     | SURCHARGED |

| Link Event (Upstream Depth) | US Node       | Link              | DS Node        | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|-----------------------------|---------------|-------------------|----------------|---------------|----------------|----------|---------------|--------------------|
| 30 minute summer            | S517          | 6.000             | S519           | -113.9        | -1.033         | -0.718   | 2.6221        |                    |
| 30 minute summer            | S519          | 5.002             | S520           | 118.8         | 1.552          | 0.707    | 2.3411        |                    |
| 30 minute summer            | S520          | 5.003             | S521           | 113.4         | 1.085          | 0.619    | 3.9385        |                    |
| 30 minute summer            | S521          | 1.006             | S525           | 395.8         | 2.498          | 1.565    | 3.8678        |                    |
| 30 minute summer            | S522          | 7.000             | S523           | 35.4          | 1.400          | 0.596    | 0.6792        |                    |
| 30 minute summer            | S523          | 7.001             | S524           | 47.2          | 1.872          | 0.616    | 0.2972        |                    |
| 30 minute summer            | S524          | 7.002             | S525           | 109.5         | 2.248          | 0.471    | 2.5070        |                    |
| 30 minute summer            | S525          | 1.007             | S526           | 561.2         | 2.598          | 1.552    | 10.6321       |                    |
| 30 minute summer            | S526          | 1.008             | S527           | 588.0         | 2.722          | 1.394    | 4.2731        |                    |
| 1440 minute summer          | S527          | 1.009             | S528 Headwall  | 61.2          | 0.802          | 0.150    | 3.0556        |                    |
| 1440 minute summer          | S528 Headwall | Flow through Pond | S538 Basin 3 N | 39.1          | 0.015          | 0.000    | 1625.9680     |                    |
| 30 minute summer            | S529          | 9.000             | S530           | 14.4          | 0.361          | 0.338    | 0.4155        |                    |
| 30 minute summer            | S530          | 9.001             | S531           | 74.8          | 1.882          | 1.900    | 2.2726        |                    |
| 30 minute summer            | S531          | 9.002             | S532           | 124.0         | 1.763          | 1.493    | 2.4322        |                    |
| 1440 minute summer          | S532          | 9.003             | S533           | 10.8          | 0.713          | 0.072    | 2.4501        |                    |

**Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 96.73%**

| Node Event         | US<br>Node     | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|--------------------|----------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 1440 minute summer | S533           | 1470           | 28.067       | 0.917        | 12.4            | 1.3122           | 0.0000        | SURCHARGED |
| 1440 minute summer | S534           | 1440           | 28.068       | 1.143        | 11.6            | 1.6355           | 0.0000        | FLOOD RISK |
| 30 minute summer   | S535           | 18             | 28.193       | 0.843        | 60.5            | 1.2060           | 0.0000        | SURCHARGED |
| 1440 minute summer | S536           | 1440           | 28.066       | 0.966        | 5.6             | 1.3828           | 0.0000        | SURCHARGED |
| 1440 minute summer | S537 Headwall  | 1470           | 28.075       | 1.245        | 23.7            | 0.0000           | 0.0000        | OK         |
| 1440 minute summer | S538 Basin 3 N | 1470           | 28.065       | 1.315        | 39.1            | 0.0000           | 0.0000        | FLOOD RISK |
| 1440 minute summer | S539 FCC       | 1470           | 28.065       | 1.415        | 13.3            | 6.4015           | 0.0000        | FLOOD RISK |
| 1440 minute summer | S540 Outfall   | 1470           | 26.594       | 0.034        | 2.4             | 0.0000           | 0.0000        | OK         |

| Link Event<br>(Upstream Depth) | US<br>Node     | Link              | DS<br>Node     | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|--------------------------------|----------------|-------------------|----------------|------------------|-------------------|----------|------------------|-----------------------|
| 1440 minute summer             | S533           | 9.004             | S534           | 11.6             | 0.445             | 0.049    | 6.6388           |                       |
| 1440 minute summer             | S534           | 9.005             | S537 Headwall  | 11.8             | 0.403             | 0.058    | 2.9895           |                       |
| 30 minute summer               | S535           | 10.000            | S536           | 58.3             | 1.466             | 1.256    | 1.2442           |                       |
| 1440 minute summer             | S536           | 10.001            | S537 Headwall  | 5.6              | 0.504             | 0.100    | 0.6091           |                       |
| 1440 minute summer             | S537 Headwall  | Flow through Pond | S538 Basin 3 N | 39.1             | 0.015             | 0.000    | 1625.9680        |                       |
| 1440 minute summer             | S538 Basin 3 N | 1.011             | S539 FCC       | 13.3             | 0.417             | 0.102    | 0.5162           |                       |
| 1440 minute summer             | S539 FCC       | 1.012             | S540 Outfall   | 2.4              | 0.778             | 0.115    | 0.0201           | 375.9                 |

### Nodes

| Name          | Area<br>(ha) | T of E<br>(mins) | Cover<br>Level<br>(m) | Diameter<br>(mm) | Easting<br>(m) | Northing<br>(m) | Depth<br>(m) |
|---------------|--------------|------------------|-----------------------|------------------|----------------|-----------------|--------------|
| S900 Paving   | 0.022        | 5.00             | 29.726                | 150              | 514040.489     | 130956.584      | 0.676        |
| S908 Paving   | 0.026        | 5.00             | 29.809                | 150              | 514046.196     | 130955.608      | 0.659        |
| S901 FCC      |              |                  | 29.807                | 600              | 514047.128     | 130953.687      | 0.857        |
| S902          |              |                  | 30.561                | 1200             | 514083.726     | 130966.016      | 1.836        |
| S903          |              |                  | 29.456                | 450              | 514122.379     | 130978.231      | 1.006        |
| S904 Paving   | 0.072        | 5.00             | 29.639                | 150              | 514116.854     | 130978.853      | 0.919        |
| S905 FCC      |              |                  | 29.650                | 600              | 514121.675     | 130980.040      | 1.150        |
| S906          |              |                  | 29.100                | 450              | 514128.787     | 130986.709      | 0.750        |
| S907 Headwall |              |                  | 29.270                |                  | 514141.326     | 130995.105      | 1.070        |

### Simulation Settings

|                      |          |                        |          |                            |     |                        |   |
|----------------------|----------|------------------------|----------|----------------------------|-----|------------------------|---|
| Rainfall Methodology | FEH-22   | Analysis Speed         | Detailed | Additional Storage (m³/ha) | 0.0 | Check Discharge Volume | x |
| Rainfall Events      | Singular | Skip Steady State      | x        | Starting Level (m)         |     |                        |   |
| Summer CV            | 1.000    | Drain Down Time (mins) | 1440     | Check Discharge Rate(s)    | x   |                        |   |

### Storm Durations

30 | 60 | 120 | 240 | 360 | 480 | 720 | 960 | 1440

| Return Period<br>(years) | Climate Change<br>(CC %) | Additional Area<br>(A %) | Additional Flow<br>(Q %) | Return Period<br>(years) | Climate Change<br>(CC %) | Additional Area<br>(A %) | Additional Flow<br>(Q %) |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 30                       | 0                        | 0                        | 0                        | 100                      | 45                       | 0                        | 0                        |

### Node S905 FCC Online Orifice Control

|                          |   |                  |        |                   |       |                       |       |
|--------------------------|---|------------------|--------|-------------------|-------|-----------------------|-------|
| Flap Valve               | x | Invert Level (m) | 28.500 | Design Flow (l/s) | 2.5   | Discharge Coefficient | 0.600 |
| Replaces Downstream Link | x | Design Depth (m) | 1.100  | Diameter (m)      | 0.033 |                       |       |

### Node S901 FCC Online Orifice Control

|                          |   |                  |        |                   |       |                       |       |
|--------------------------|---|------------------|--------|-------------------|-------|-----------------------|-------|
| Flap Valve               | x | Invert Level (m) | 28.950 | Design Flow (l/s) | 1.0   | Discharge Coefficient | 0.600 |
| Replaces Downstream Link | x | Design Depth (m) | 0.676  | Diameter (m)      | 0.024 |                       |       |

**Node S900 Paving Carpark Storage Structure**

|                             |         |                           |        |             |        |               |
|-----------------------------|---------|---------------------------|--------|-------------|--------|---------------|
| Base Inf Coefficient (m/hr) | 0.00000 | Porosity                  | 0.30   | Width (m)   | 5.000  | Depth (m)     |
| Side Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 29.050 | Length (m)  | 22.500 | Inf Depth (m) |
| Safety Factor               | 1.0     | Time to half empty (mins) | 352    | Slope (1:X) | 96.0   |               |

**Node S908 Paving Carpark Storage Structure**

|                             |         |                           |        |             |        |               |
|-----------------------------|---------|---------------------------|--------|-------------|--------|---------------|
| Base Inf Coefficient (m/hr) | 0.00000 | Porosity                  | 0.30   | Width (m)   | 8.000  | Depth (m)     |
| Side Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 29.150 | Length (m)  | 17.500 | Inf Depth (m) |
| Safety Factor               | 1.0     | Time to half empty (mins) | 240    | Slope (1:X) | 50.0   |               |

**Node S904 Paving Carpark Storage Structure**

|                             |         |                           |        |             |        |               |
|-----------------------------|---------|---------------------------|--------|-------------|--------|---------------|
| Base Inf Coefficient (m/hr) | 0.00000 | Porosity                  | 0.30   | Width (m)   | 5.500  | Depth (m)     |
| Side Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 28.720 | Length (m)  | 40.000 | Inf Depth (m) |
| Safety Factor               | 1.0     | Time to half empty (mins) | 132    | Slope (1:X) | 50.0   |               |

**Node S904 Paving Depth/Area Storage Structure**

|                             |         |               |      |                           |        |
|-----------------------------|---------|---------------|------|---------------------------|--------|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 1.0  | Invert Level (m)          | 28.720 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity      | 0.95 | Time to half empty (mins) | 42     |

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|-----------|-----------|---------------|-----------|-----------|---------------|-----------|-----------|---------------|-----------|-----------|---------------|
| 0.000     | 20.0      | 20.0          | 0.200     | 20.0      | 23.2          | 0.201     | 0.0       | 23.2          | 0.919     | 0.0       | 23.2          |

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

| Node Event        | US<br>Node    | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|-------------------|---------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 120 minute summer | S900 Paving   | 120            | 29.445       | 0.395        | 5.6             | 9.3898           | 0.0000        | FLOOD RISK |
| 120 minute summer | S908 Paving   | 120            | 29.445       | 0.295        | 5.4             | 5.2454           | 0.0000        | SURCHARGED |
| 120 minute summer | S901 FCC      | 120            | 29.445       | 0.495        | 2.7             | 0.1401           | 0.0000        | SURCHARGED |
| 120 minute summer | S902          | 122            | 28.750       | 0.025        | 0.8             | 0.0279           | 0.0000        | OK         |
| 120 minute summer | S903          | 122            | 28.472       | 0.022        | 0.8             | 0.0035           | 0.0000        | OK         |
| 120 minute summer | S904 Paving   | 98             | 29.323       | 0.603        | 15.2            | 18.8580          | 0.0000        | SURCHARGED |
| 120 minute summer | S905 FCC      | 98             | 29.322       | 0.822        | 2.5             | 0.2326           | 0.0000        | SURCHARGED |
| 120 minute summer | S906          | 102            | 28.391       | 0.041        | 2.8             | 0.0065           | 0.0000        | OK         |
| 120 minute summer | S907 Headwall | 102            | 28.241       | 0.041        | 2.8             | 0.0000           | 0.0000        | OK         |

| Link Event<br>(Upstream Depth) | US<br>Node  | Link  | DS<br>Node    | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|--------------------------------|-------------|-------|---------------|------------------|-------------------|----------|------------------|-----------------------|
| 120 minute summer              | S900 Paving | 1.000 | S901 FCC      | -1.2             | 0.164             | -0.056   | 0.1275           |                       |
| 120 minute summer              | S908 Paving | 2.000 | S901 FCC      | 2.7              | 0.252             | 0.049    | 0.0376           |                       |
| 120 minute summer              | S901 FCC    | 1.001 | S902          | 0.8              | 0.431             | 0.061    | 0.0742           |                       |
| 120 minute summer              | S902        | 1.002 | S903          | 0.8              | 0.469             | 0.057    | 0.0713           |                       |
| 120 minute summer              | S903        | 1.003 | S906          | 0.8              | 0.465             | 0.048    | 0.0294           |                       |
| 120 minute summer              | S904 Paving | 3.000 | S905 FCC      | 2.5              | 0.450             | 0.068    | 0.0874           |                       |
| 120 minute summer              | S905 FCC    | 3.001 | S906          | 2.0              | 0.627             | 0.092    | 0.0316           |                       |
| 120 minute summer              | S906        | 1.004 | S907 Headwall | 2.8              | 0.734             | 0.161    | 0.0585           | 50.2                  |

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

| Node Event        | US<br>Node    | Peak<br>(mins) | Level<br>(m) | Depth<br>(m) | Inflow<br>(l/s) | Node<br>Vol (m³) | Flood<br>(m³) | Status     |
|-------------------|---------------|----------------|--------------|--------------|-----------------|------------------|---------------|------------|
| 240 minute summer | S900 Paving   | 236            | 29.658       | 0.608        | 5.1             | 16.5771          | 0.0000        | FLOOD RISK |
| 240 minute summer | S908 Paving   | 236            | 29.658       | 0.508        | 6.1             | 14.0120          | 0.0000        | FLOOD RISK |
| 240 minute summer | S901 FCC      | 236            | 29.658       | 0.708        | 2.3             | 0.2003           | 0.0000        | FLOOD RISK |
| 240 minute summer | S902          | 240            | 28.752       | 0.027        | 1.0             | 0.0305           | 0.0000        | OK         |
| 240 minute summer | S903          | 240            | 28.474       | 0.024        | 1.0             | 0.0039           | 0.0000        | OK         |
| 120 minute summer | S904 Paving   | 86             | 29.639       | 0.919        | 27.7            | 38.1199          | 2.3322        | FLOOD      |
| 60 minute summer  | S905 FCC      | 57             | 29.638       | 1.138        | 3.4             | 0.3219           | 0.0000        | FLOOD RISK |
| 120 minute summer | S906          | 122            | 28.395       | 0.045        | 3.4             | 0.0071           | 0.0000        | OK         |
| 120 minute summer | S907 Headwall | 122            | 28.244       | 0.044        | 3.4             | 0.0000           | 0.0000        | OK         |

| Link Event<br>(Upstream Depth) | US<br>Node  | Link  | DS<br>Node    | Outflow<br>(l/s) | Velocity<br>(m/s) | Flow/Cap | Link<br>Vol (m³) | Discharge<br>Vol (m³) |
|--------------------------------|-------------|-------|---------------|------------------|-------------------|----------|------------------|-----------------------|
| 240 minute summer              | S900 Paving | 1.000 | S901 FCC      | 0.6              | 0.063             | 0.029    | 0.1275           |                       |
| 240 minute summer              | S908 Paving | 2.000 | S901 FCC      | 1.9              | 0.132             | 0.035    | 0.0376           |                       |
| 240 minute summer              | S901 FCC    | 1.001 | S902          | 1.0              | 0.453             | 0.073    | 0.0846           |                       |
| 240 minute summer              | S902        | 1.002 | S903          | 1.0              | 0.495             | 0.068    | 0.0812           |                       |
| 240 minute summer              | S903        | 1.003 | S906          | 1.0              | 0.489             | 0.058    | 0.0334           |                       |
| 120 minute summer              | S904 Paving | 3.000 | S905 FCC      | 3.0              | 0.659             | 0.080    | 0.0874           |                       |
| 60 minute summer               | S905 FCC    | 3.001 | S906          | 2.4              | 0.658             | 0.108    | 0.0356           |                       |
| 120 minute summer              | S906        | 1.004 | S907 Headwall | 3.4              | 0.770             | 0.191    | 0.0662           | 89.1                  |

## **Appendix G**

### Site Investigation

## A Phase II Geoenvironmental and Geotechnical Report for Gleeson Land.

**Address:** Lower Broadbridge Heath Farm, Broadbridge Heath, West Sussex, RH13 0QN.

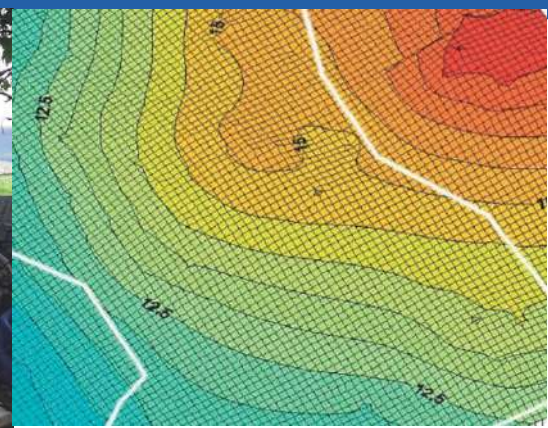
**Date:** 13<sup>th</sup> April 2022

**Reference:** ES0007 Rev1

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## Executive Summary

The site comprises a series of agricultural fields to the west, north and south of Lower Broadbridge Heath Farm, which is now occupied by the Horsham Stone Reclamation Yard and Bury Hill Landscaping Supplies. The total site area is approximately 22ha, the majority of which comprises open arable fields.

The buildings, which formerly comprised Lower Broadbridge Heath Farm, were found to be metal and concrete framed barns, with asbestos cement cladding, downpipes and guttering. The barns had a solid concrete floor and were found to be used for storing soils, bark and a range of equipment. Two small above ground plastic bunded fuel tanks were observed in the Bury Hill Landscaping Yard, each of which were in good condition and were situated on concrete slabs.

It is proposed to redevelop the site with a mixture of residential properties and mixed commercial properties with areas of landscaping.

Geological records indicate the site to be underlain by the Weald Clay (Unproductive Aquifer), with pockets of Horsham Stone off site in the surrounding area. Along the far western boundary Alluvium (Secondary A aquifer) deposits are mapped, which run along the route of the River Arun. The site is not situated within a groundwater source protection zone.

Historical records show that the site had in essence remained unaltered up to the present day, with the area of fields remaining unaltered from the 1880 maps. The buildings around Lower Broadbridge Heath Farm have been redeveloped on several occasions, which could lead to the presence of reworked made ground soils beneath the footprint of the existing buildings.

Potential sources of onsite contamination that have been identified comprise made ground soils around the farmyard, the presence of asbestos containing materials on the existing buildings and the presence of both historical and present above ground fuel tanks.

During the site investigation works, the soils encountered comprised TOPSOIL (-0.20/0.50m) or MADE GROUND (-0.20/0.40m) over gravelly CLAY (-0.50/2.70m) over MUDSTONE (-3.30m+).

On the basis of the investigations carried out to date, and subject to final layout, traditional strip or trench fill foundations are recommended for this site. All loadings should be transferred beneath any topsoil and softer subsoil and be placed within the underlying firm becoming firm to stiff clay.

For reinforced foundations placed into the CLAY, to a minimum depth of 1.0m, an allowable bearing capacity of 100kPa is applicable, and NHBC high Volume Change Potential precautions will apply. Should foundation deepening expose the underlying MUDSTONE, and an appropriate toe depth is achieved, any further deepening can be ceased. It is recommended that foundations are inspected by a suitably qualified engineer. Piled foundations may be required subject to engineers review.

Suspended floor slabs, incorporating land gas protection measures, are applicable for all buildings.

Concrete Design Sulphate Class of DS-2 should be assumed, on the basis of the test results, with ACEC site classification of AC-2.

There is a limited Made Ground encountered within the farm yard buildings, and the samples analysed of this were generally free from significant contamination, however, some BaP exceedances were recorded, along with some isolated asbestos fibres. Some basic remediation is necessary. CS2 Gas protection measures are also proposed.

The contamination screening values used are valid at the time of writing but may be subject to change and any such changes will have implications for the assessments based upon them. Their validity should be confirmed at the time of site development.

## 1 Introduction and Site Location

The CDS Group have been requested by Kirsty Miller of Gleeson Land to undertake a Phase I Desk Study Assessment/Walkover Survey of the proposed development site to ascertain the historical nature of the site and any potential geotechnical and/or geoenvironmental issues which could impact on the development of the site.

The proposed development area, which comprises land to the east of Lower Broadbridge Heath Farm, Broadbridge Heath, West Sussex, RH13 0QN, has been assessed on a 1km area of influence: grid reference 514129, 131484 and the nearest postcode is RH13 0QN. The site is calculated as being approximately 22 ha.



Figure 1. OS map of the site (boundary indicated in red)



Figure 2. Aerial Image of the site (boundary indicated in red)

## 2 Development Proposals

The site is currently at master planning stage and as such definitive development proposals have not been put forward. However, the details shown on the illustrative master plan drawing provided to us shows that the proposal at the time of writing comprises 8.4ha of residential properties and 13.9ha of open public space.

The residential development areas are predominantly situated in the southern part of the site and the north-eastern/eastern part of the site. The western/north-western areas of the site a proposed to be public open space. Therefore, in accordance with published guidance (CLEA Model 2009/C4SL Report 2014), the developable areas of the site would be classified as Residential with homegrown produce.

CIRIA Guidance C665 classifies the residential development area as High gas sensitivity.

### 3 Geological Assessment

The report utilises third party information from providers such as Envirocheck, British Geological Survey and Cranfield University, whilst the information is deemed to be professionally reliable, CDS do not guarantee the accuracy of third party information.

The full reports of the referenced documents are attached in Appendix F.

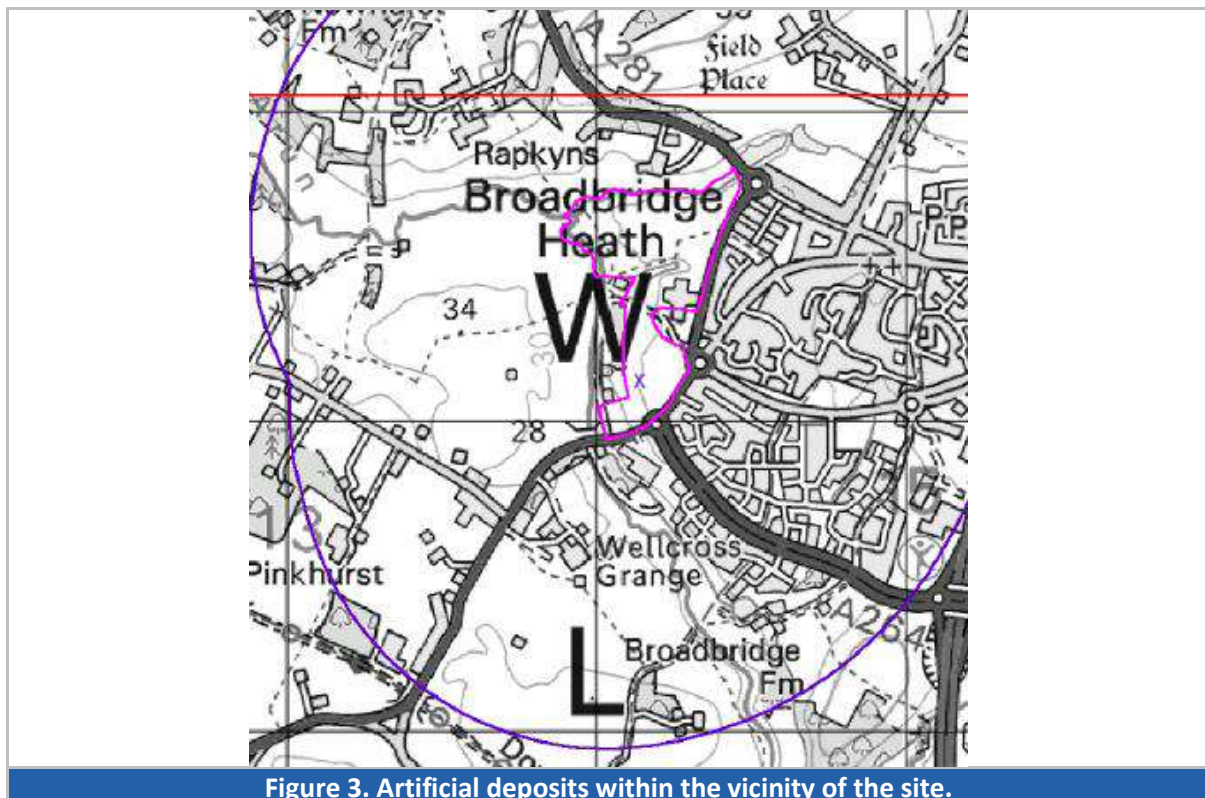
#### 3.1 Geology

The following headings cover the aspects of geology of the immediate area of the proposed development.

##### 3.1.1 Artificial Ground

This is ground at or near the surface that has been modified by man. It includes ground that has been deposited (Made Ground), landscaped, disturbed, excavated (Worked Ground) or some combination of these.

As can be seen in Figure 3 below, there are no mapped artificial ground deposits beneath the site or within the immediate vicinity.



### 3.1.2 Superficial Deposits

These are relatively young geological deposits formerly known as 'Drift', which lie on the bedrock in many areas. They include deposits such as unconsolidated sands and gravels formed by rivers and clayey tills formed by glacial action. They may be overlain by landslide deposits, by artificial deposits or both.

As can be seen in Figure 4 below, there are no mapped superficial deposits across the majority of the site. Along the far western boundary, where the River Arun is situated, there are Alluvial deposits, however these soils are only mapped along the far site boundary and are therefore not expected to be encountered during the redevelopment of the site based on the current development plans.

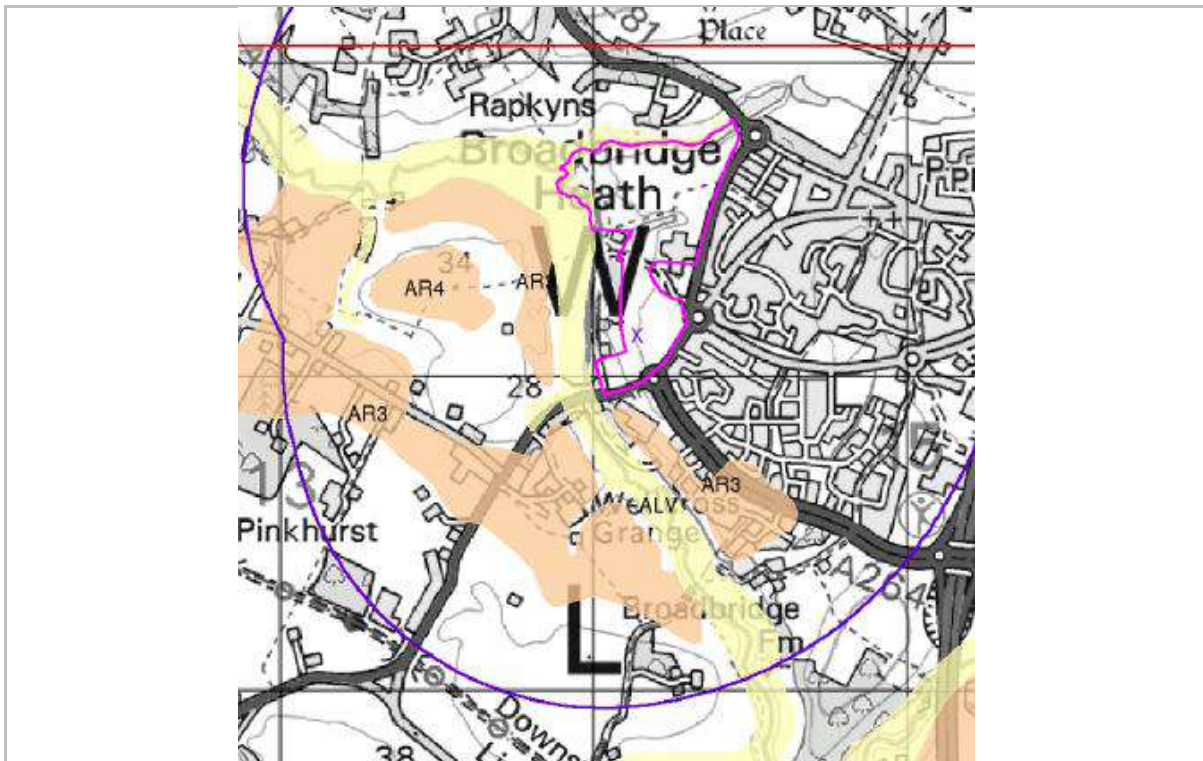


Figure 4. Superficial deposits within the vicinity of the site.

#### Superficial Geology

| Map Colour                                                                          | Lex Code | Rock Name                                                                                         | Rock Type                   | Min and Max Age           |
|-------------------------------------------------------------------------------------|----------|---------------------------------------------------------------------------------------------------|-----------------------------|---------------------------|
|  | ALV      | Alluvium                                                                                          | Clay, Silt, Sand and Gravel | Not Supplied - Holocene   |
|  | AR3      | Arun Terrace Deposits, 3 Member                                                                   | Sand and Gravel             | Not Supplied - Wolstonian |
|  | AR4      | Arun Terrace Deposits, 4 Member                                                                   | Sand and Gravel             | Not Supplied - Anglian    |
|  | AR3T4    | Arun River Terrace Deposits, 3 Member And Arun River Terrace Deposits, 4 Member, Undifferentiated | Sand and Gravel             | Not Supplied - Quaternary |

### 3.1.3 Bedrock Geology

Bedrock forms the ground underlying the whole of an area, commonly overlain by superficial deposits, landslide deposits or artificial deposits, in any combination.

As can be seen in Figure 5 below, the site is underlain in its entirety by the Weald Clay Formation, which generally comprises dark grey shales, mudstones and subordinate bands of siltstone, sandstone shelly limestones and clay ironstones. At the surface the Weald Clay weathers to a plastic Clay with variable mudstone lithorelic content and bands of red clay can also be encountered where the Horsham Stone is situated. Weald Clay is also known to contain pyrite, which can have implications with regards to the grade of concrete used.

Pockets of Horsham Stone are shown off site to the west and therefore there is potential that outliers of Horsham Stone could be encountered on the subject site.

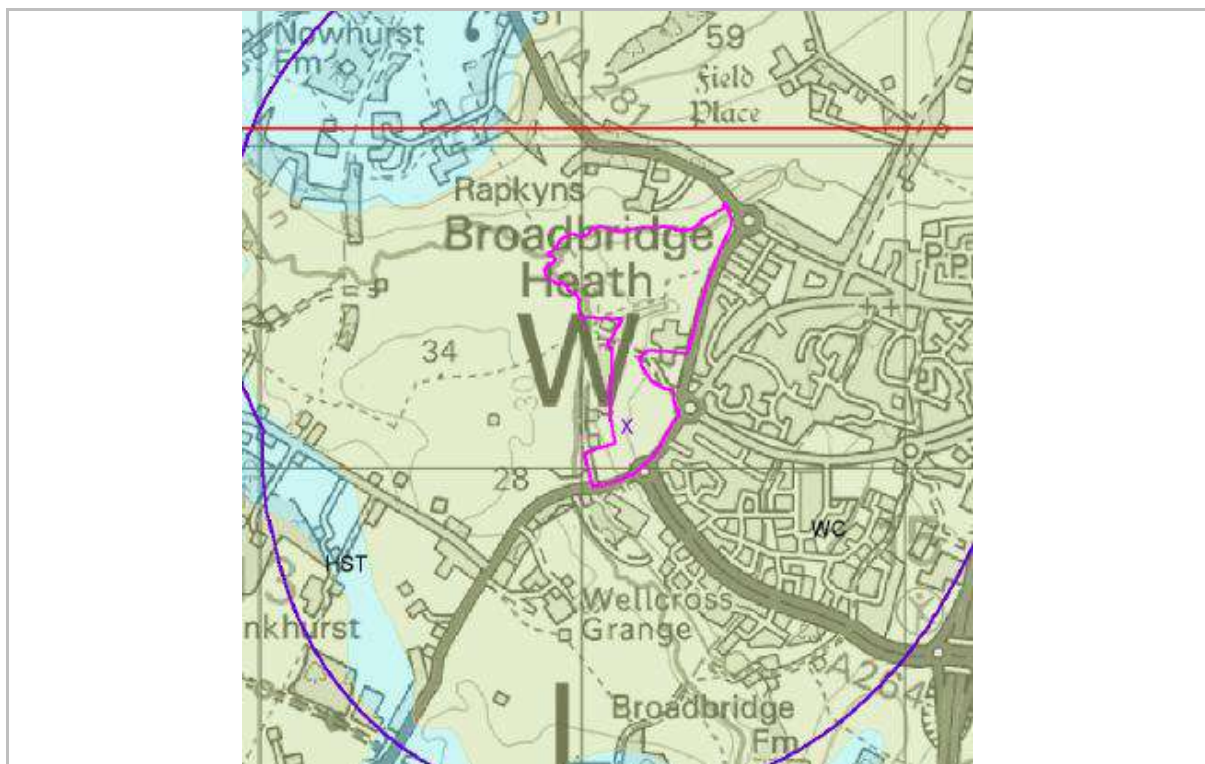


Figure 5. Bedrock Geology within the vicinity of the site.

#### Bedrock and Faults

| Map Colour                                                                          | Lex Code | Rock Name                  | Rock Type                            | Min and Max Age            |
|-------------------------------------------------------------------------------------|----------|----------------------------|--------------------------------------|----------------------------|
|  | WC       | Weald Clay Formation       | Mudstone                             | Not Supplied - Hauterivian |
|  | HST      | Horsham Stone Member       | Sandstone                            | Not Supplied - Hauterivian |
|  | UTW      | UPPER TUNBRIDGE WELLS SAND | Sandstone and Siltstone, Interbedded | Not Supplied - Valanginian |
|  | UTW      | UPPER TUNBRIDGE WELLS SAND | Sandstone and Mudstone               | Not Supplied - Valanginian |

### 3.2 Agricultural Land Classification

As the proposed parcel of land comprises agricultural land, a detailed Agricultural Land Classification Report will be required to support any future planning application in line with government requirements (<https://www.gov.uk/government/publications/agricultural-land-assess-proposals-for-development/guide-to-assessing-development-proposals-on-agricultural-land>). A review of the published 1:250,000 scale maps, as shown below in Figure 6 below, indicates that the site appears to fall into either Grade III (Good to Moderate) or Grade IV (Poor land). It should be noted that these maps do not show the subdivisions of the Grade III land into 3a and 3b, this would need to be defined during a detailed assessment of the site.

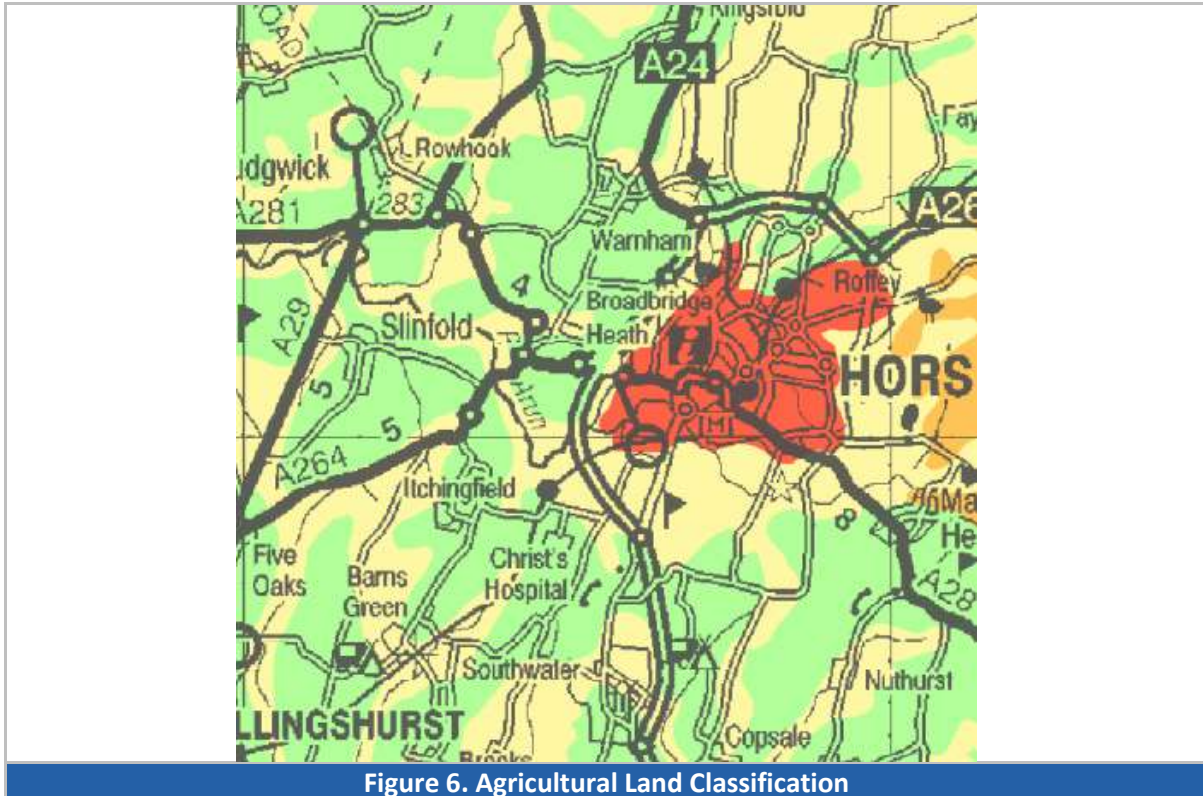


Figure 6. Agricultural Land Classification

### 3.3 Additional Geological Considerations

A summary of the potential geological hazards which could be found on site are explained in Table 1 below. This data is obtained from the BGS and the Envirocheck Report and should not be considered site specific.

Table 1. Onsite Geological Hazards

| Geological hazard                                 | May be significant within site area (Yes/No)? | Comments                                                                                                                                                                     |
|---------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Potential Natural Ground Stability Hazards</b> |                                               |                                                                                                                                                                              |
| <b>Shrink-Swell</b>                               | Yes                                           | The mapped geology on the site predominantly comprises the Weald Clay. Whilst the unweathered Weald Clay is not considered to be plastic, the upper weathered profile is and |

| Geological hazard                     | May be significant within site area (Yes/No)? | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                       |                                               | swelling and shrinkage, especially in close proximity to mature trees, is considered to be a risk on this site.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Landslides (slope instability)</b> | No                                            | The site is generally flat and level and as such there is no significant risk associated with landslides.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Soluble Rocks (dissolution)</b>    | No                                            | The site is not situated on a geology which is susceptible to dissolution and as such there is very low risk.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Compressible Ground</b>            | No                                            | The site is not situated on a geology which is susceptible to compression and as such there is no risk. If Alluvial soils were however encountered on site then these soils would be considered a moderate to high risk.                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Collapsible Deposits</b>           | No                                            | The site is not situated on a geology which is susceptible to collapse and as such there is very low risk.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Running Sand</b>                   | No                                            | Based on the mapped geology of Weald Clay the site is not considered to be at risk from encountering running sands.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Other Potential Hazards</b>        |                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Mining</b>                         | No                                            | <p>The site is not in an area at high risk of mining.</p> <p>No historical evidence of mining was observed on site or on the historical maps, however small scale/piecemeal excavations in the Weald Clay are often encountered and a careful watch for any infilled features should be made during investigation works and subsequent development.</p> <p>There was some limited evidence of quarrying off site to the northeast of the site on the early maps, which could potentially be a stone quarry for the excavation of Horsham Stone.</p>                                                                                                            |
| <b>Flooding*</b>                      | Yes                                           | <p>The majority of the site is classed as Flood Zone 1 and is at low risk of flooding from rivers or sea and as such is suitable for use as a residential development</p> <p>The majority of the site is at a very low risk of pluvial (surface) flooding, however there are areas associated with the ponds and ditch lines that are mapped as high risk areas and therefore development should allow for a suitable buffer between these features.</p> <p><i>* This section is for information only, this report does not constitute a formal flood risk assessment and specialist advice should be sought in relation to potential flooding issues.</i></p> |
| <b>Natural Land Gas</b>               |                                               | There are a number of small scale historical pits in the immediate vicinity of the site, however these appear to have been left as                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

| Geological hazard | May be significant within site area (Yes/No)? | Comments                                                                                                                                                                                                                                  |
|-------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   | No                                            | open excavations and subsequently filled with water, therefore the risk is negligible.<br><br>There are also some limited alluvial deposits mapped to the west of the site, which could act as a potential source of land gas generation. |
| <b>Radon</b>      | No                                            | The site is situated in a lower probability radon area (less than 1% of homes estimated to be at or above the action level). On this basis, no radon protective measures are required in the construction of new dwellings or properties. |

## 4 Hydrogeological Assessment

In lowland areas of the UK with little topographic variation, groundwater is likely to be found at shallow depths of only a few metres. Water table fluctuations will be small as they will be constrained by the ground surface and the base level of the local perennial streams and rivers. In upland areas, precipitation is usually high and the dominantly metamorphic and igneous rocks often have relatively shallow groundwater levels.

This is due to preferential groundwater storage in near-surface weathered and fractured zones with limited drainage into the underlying un-weathered lower permeability rock. Exceptions can occur where higher permeability rocks, such as sandstone or limestone, allow faster throughflow of groundwater towards the nearest stream or other discharge point.

Perched water tables occur where a less permeable horizon (e.g. a clay layer) in an otherwise permeable sequence retains a body of groundwater above the level of the regional water table. They usually occur at shallow depths in alluvial and glacial sediments and can be difficult to identify or to delimit.

An aquifer becomes confined when it is overlain by a less permeable horizon that restricts the upward movement of groundwater. When this less permeable horizon is penetrated (e.g. by drilling), the groundwater level rises above where struck to a level controlled by the hydrostatic pressure. If this is above ground level, overflowing artesian conditions will be encountered. Confined conditions should be anticipated, where possible, in order to plan for the problems they can generate.

Individual sites will always require more detailed assessments to determine the specific impact on groundwater resources. The maps represent conditions only at the ground surface. Where the soil and/or underlying formations have been disturbed or removed the vulnerability class may have been changed and site-specific data will be required. Sites in urban areas and restored or current mineral workings are classified as having high (urban) soil leaching potential until proved otherwise.

Table 2. Hydrogeology summary

| Geological unit | Groundwater potential                                                                                                                                                                             | Water level and strikes                                                                                                                                                                                                       | Groundwater vulnerability classification                     |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| Alluvium        | Mixed permeability of moderate to high due to the presence of organic silty clays and potentially bands of sand and gravel.                                                                       | Likely to be close to the water level in the River Arun to the west of the site, therefore we would expect to encounter water strikes within 1-3m bgl depending on the time of year.                                          | Secondary A Superficial aquifer with moderate vulnerability. |
| Weald Clay      | Negligible permeability through the clay soils, with some potential fissure flow. Where bands of rock are encountered then the potential to encounter perched water is considered to be moderate. | Nearby borehole records to the east indicate multiple water strikes within the underlying Tunbridge Wells Sand which were artesian in nature.<br><br>No records of shallow water strikes within the Weald Clay were observed. | Unproductive Aquifer                                         |

#### 4.1 Groundwater Vulnerability

This section reviews all components of hydrology, geology and topsoil surface water drainage to assess risk notably to groundwater.

##### 4.1.1 Source Protection Zones

The position of the site relevant to current groundwater protection zones is shown in Figure 7. The proposed development site lies outside of any groundwater source protection zones.

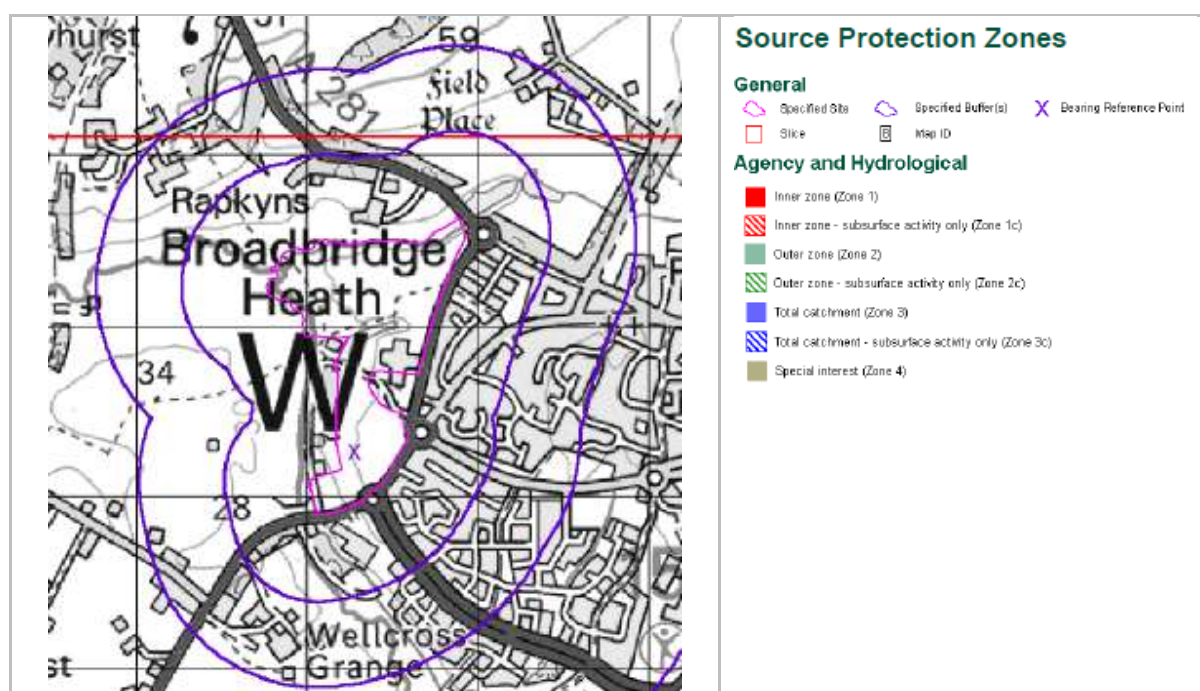


Figure 7. Groundwater Source Protection Zones associated with the site.

Source Protection Zones (SPZs) provide an indication of the risk to groundwater supplies that may result from potentially polluting activities and accidental releases of pollutants. Generally, the closer the activity or release is to a groundwater source the greater the risk. Three zones (an inner, outer and total catchment) are usually defined although a fourth zone (zone of special interest) is occasionally defined.

The Agency has subdivided groundwater source catchments into four zones. Two of these are determined by the travel time of potential pollutants, the third by the source catchment area itself and the fourth is a "Zone of Special Interest". This fourth zone highlights areas where known local conditions mean that potentially polluting activities could impact on a groundwater source even though the area is outside the normal catchment of that source.

- *Zone I (Inner Protection Zone)* - This zone is defined by a travel time of 50-days or less from any point within the zone at, or below, the water table. Additionally, the zone has, as a minimum, a 50-meter radius. It is based principally on biological decay criteria and is designed to protect against the transmission of toxic chemicals and water-borne disease.
- *Zone II (Outer Protection Zone)* - This zone is defined by the 400-day travel time, or 25% of the source catchment area, whichever is larger. The travel time is derived from consideration of the minimum time required to provide delay, dilution and attenuation of slowly degrading pollutants.
- *Zone III (Total catchment)* - This zone is defined as the total area needed to support the abstraction or discharge from the protected groundwater source.
- *Zone of Special Interest* - For some groundwater sources an additional Zone of Special Interest may be defined. These zones highlight areas (mainly on non-aquifers) where known local conditions mean that potentially polluting activities could impact on a groundwater source even though the area is outside the normal catchment of that source.

The discharge of clean roof water to ground is acceptable within an SPZ1, provided that all roof water down-pipes are sealed against pollutants entering the system from surface run-off, effluent disposal or other forms of discharge. The method of discharge must not create new pathways for pollutants to groundwater or mobilise contaminants already in the ground. No environmental permit is required, if the above criteria can be met.

#### **4.1.2 Aquifer Vulnerability**

The Groundwater Vulnerability maps are produced at a 1:100,000 scale. They show, by means of colour coding, those areas of the country where water-bearing rocks (aquifers) are present. They also show the vulnerability of groundwater to pollution. The aquifers are classified into Principal, Secondary and unproductive aquifers according to their physical properties and their consequent value as a resource.

The classification of the land surface reflects the ability of contaminants to leach through the covering soils and pose a potential risk to groundwater at depth. The maps also indicate areas where the presence of low permeability drift may provide additional groundwater protection.

These maps can therefore be used for an initial screening assessment of the vulnerability of groundwater to contaminants applied to the surface of the ground. They do not provide all information relevant to the determination of vulnerability, such as the depth to water table or nature of the drift deposits. Site-specific information would always be needed for a detailed assessment of vulnerability at a given location. The original groundwater vulnerability maps were produced some time ago.

Groundwater Vulnerability Maps provide information on how significant the ground waters are likely to be and if they are vulnerable to pollution occurring at the land surface. The maps have descriptions on them to explain the different aquifer and soil types.

Areas shown as principal aquifers have strategic significance for water resource; they often support large abstractions for the public water supply.

Secondary aquifers have a more localised significance to domestic, agricultural and industrial users (although they may still be used for drinking water). Unproductive aquifers do not store significant amounts of groundwater. However, in some areas they can support local supplies: e.g. small springs feeding individual properties.

#### 4.1.3 Superficial Aquifer

As shown in Figure 8 below, the majority of the site is not situated on a designated superficial aquifer due to the absence of superficial geology onsite. Along the western site boundary, where the Alluvial soils are mapped, a Secondary A aquifer is mapped.

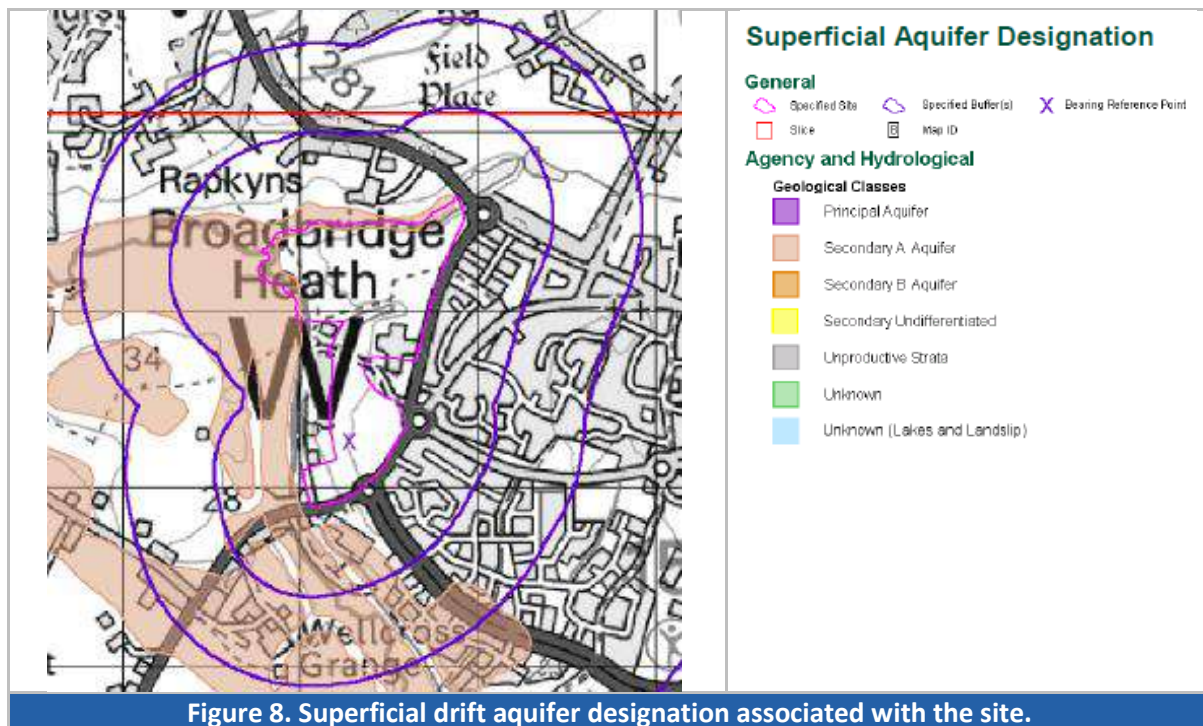


Figure 8. Superficial drift aquifer designation associated with the site.

#### 4.1.4 Bedrock Aquifer

As shown in Figure 9 below, the site is situated on an unproductive bedrock aquifer.

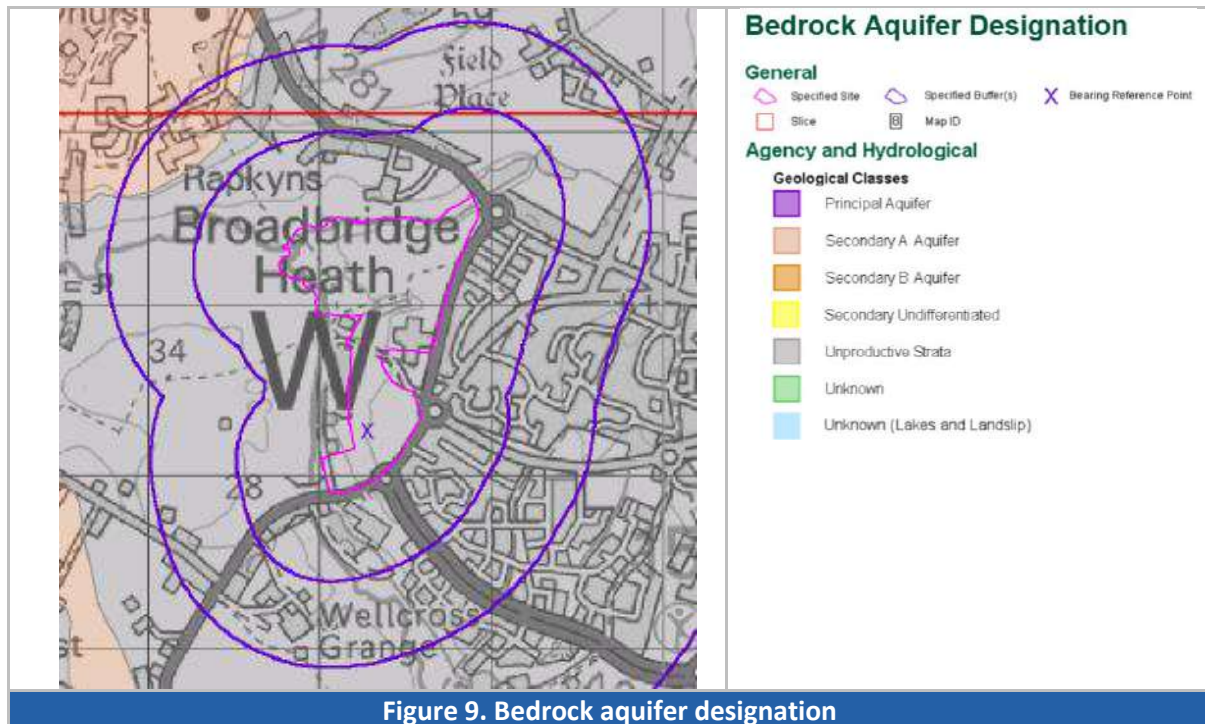


Figure 9. Bedrock aquifer designation

#### 4.1.5 Groundwater Vulnerability Classification

As shown in Figure 10 below, the site is situated on an unproductive aquifer.

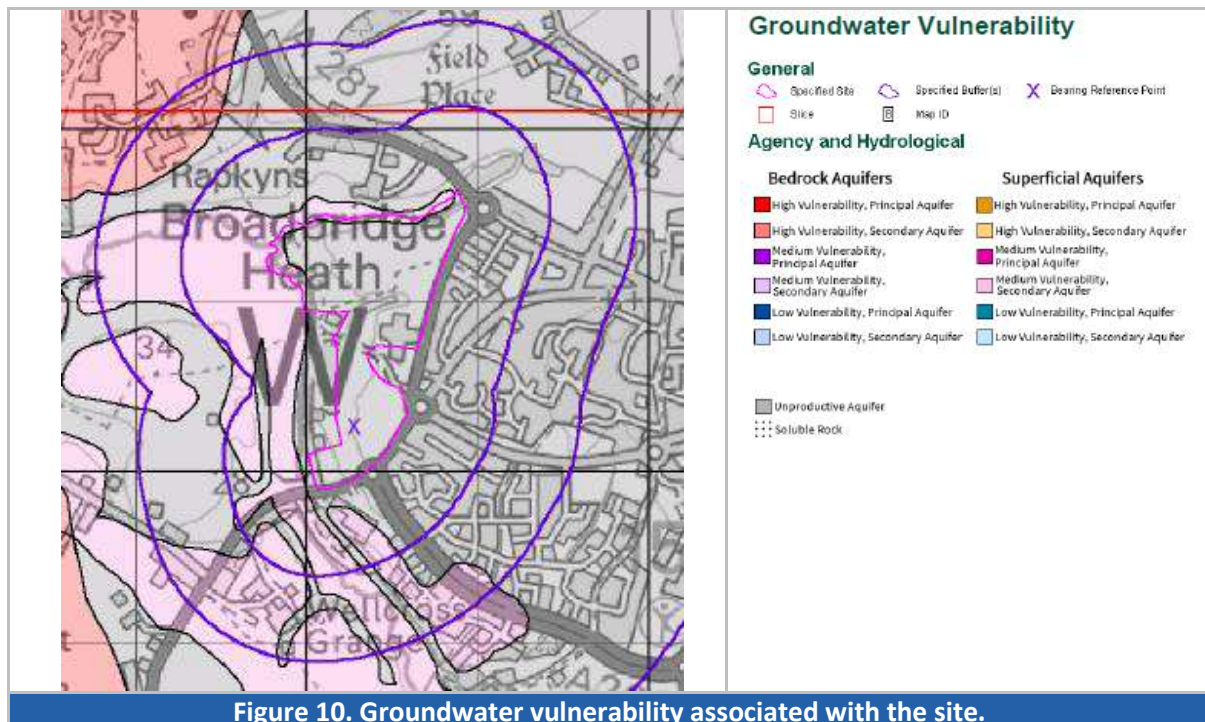


Figure 10. Groundwater vulnerability associated with the site.

#### 4.1.6 Flood Risk

The majority of the site is within Flood Zone 1 land which is at low risk- less than 1 in 1,000 in any given year (Figure 11). From this respect, the land is suitable for residential development. Along the far western boundary, adjacent to the ditches and the River Arun, both Flood Zone II and Zone III land is mapped. However these areas are not due to be developed and therefore these flood zones will not have a significant impact on the proposed site redevelopment.

If areas of impermeable surfaces such as buildings, roads etc. are constructed on a greenfield site, a surface water management system designed in accordance with the principles of Sustainable Urban Drainage Schemes (SUDS) will be required.

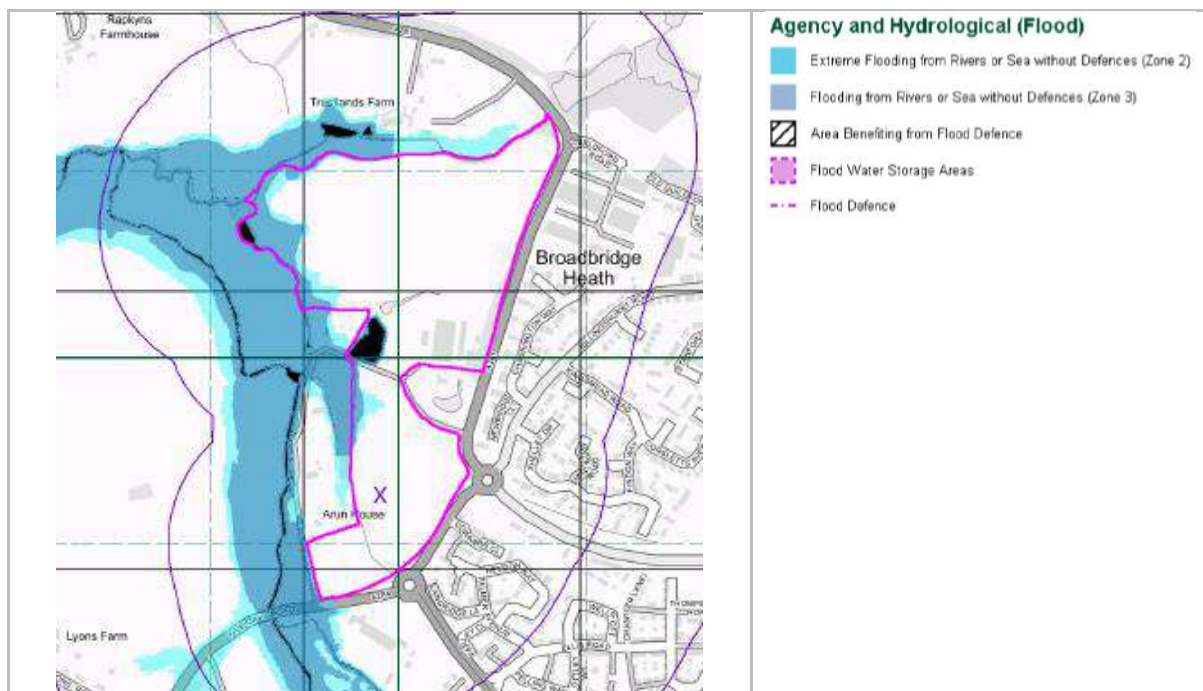
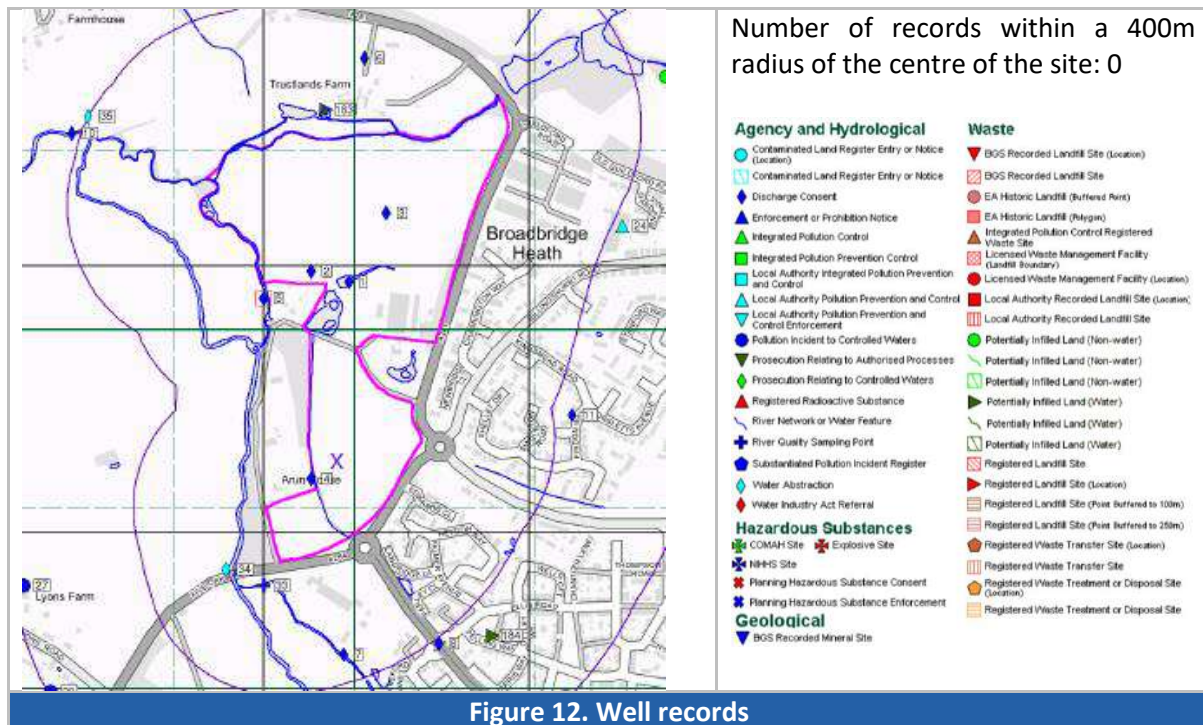


Figure 11. Map of Flood Risk Zones

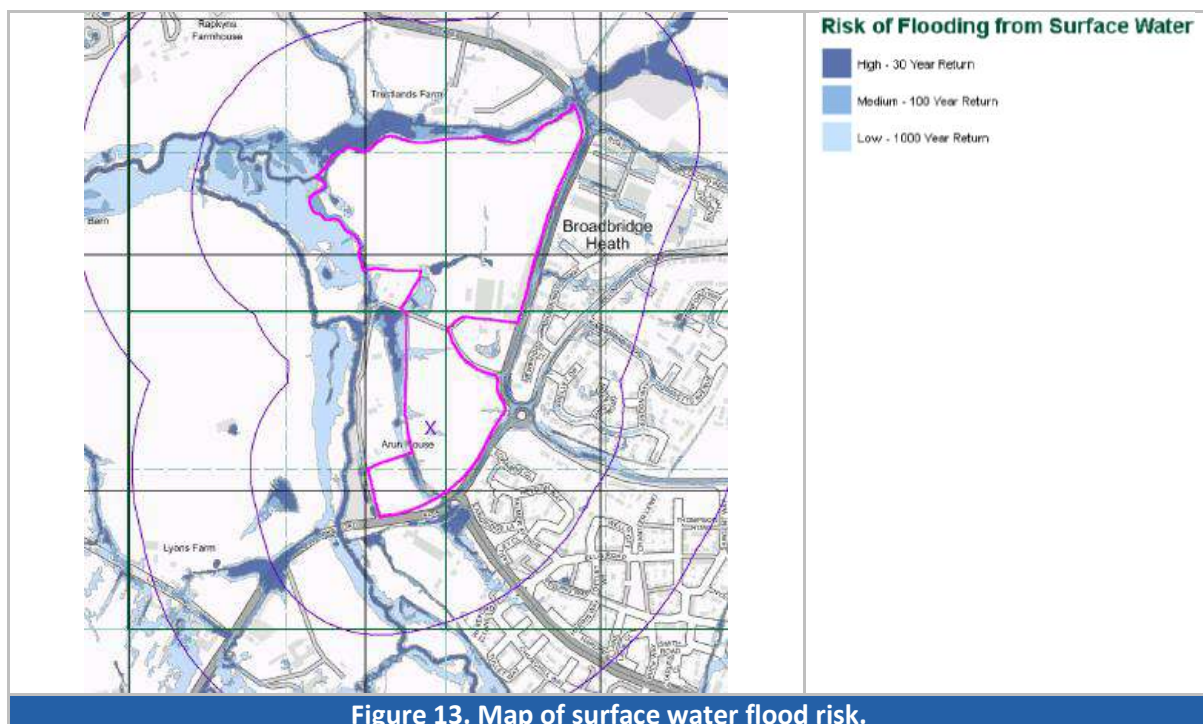
#### 4.1.7 Wells in the vicinity of the site

As can be seen in Figure 12 below, there are two groundwater abstractions mapped within 250m of the site. The first is mapped off site to the southwest and the second is mapped off site to the northwest.



## 4.2 Surface Water Issues

The western boundary of the site is shown to be at low to high risk of surface water flooding. This is associated with a ditch line and overgrown boggy/wetland area which is fed from the pond overflow to the north. This ditch line is in places culverted under entrances across fields and these should be inspected and potentially upgraded to reduce the risk of surface water flooding exceedances. If any of the proposed redevelopment works increase the risk of downstream flooding or onsite flooding, these risks would need to be assessed and mitigated against using a suitable SUDS compliant approach.



---

## 5 Desk Study and Walkover Assessment

### 5.1 Introduction

Due to the size of site and the different uses of the current land within the site itself, the description of the site and the historical map assessment of the site has been broken down into six distinct areas. These areas comprise:

- The Northern Fields (pale green)
- Bury Hill Landscape Supplies (pale brown)
- Horsham Stone Reclamation Yard (pale yellow)
- Southern Fields (pale blue)
- Wetland/Marsh Area (pale red)
- Pond Area (pale orange)

These areas are generally indicated on Figure 14 below for reference and photograph locations and view directions are highlighted on the drawing in Appendix A.

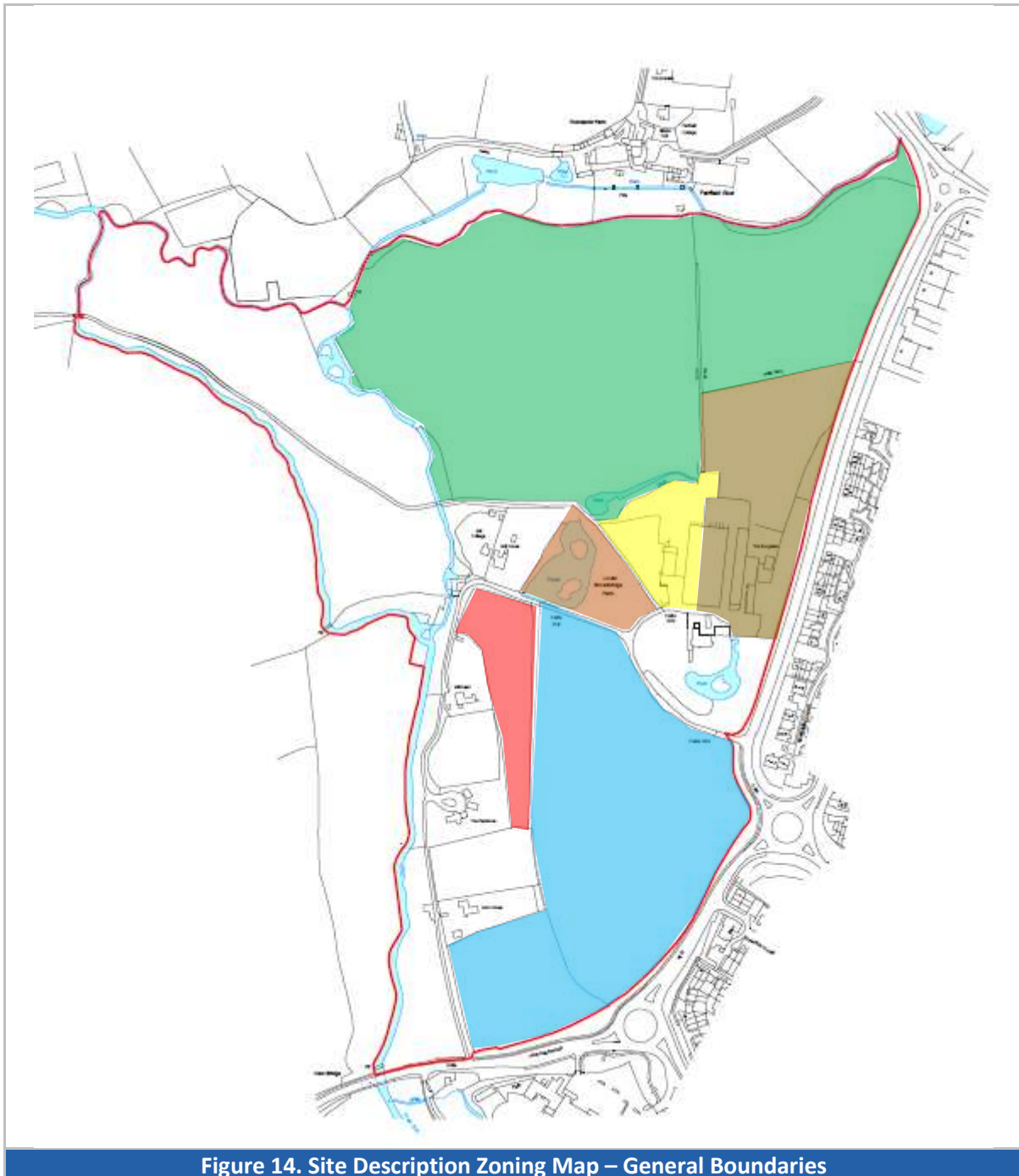


Figure 14. Site Description Zoning Map – General Boundaries

## 5.2 General Site Description

### 5.2.1 Northern Fields (Walkover Images 35-50 in Appendix B)

The northern fields comprise two parcels of agricultural land, which are subdivided by discontinuous hedgerows and mature oak trees into four parcels of land and also has a concrete access road which splits the fields to a small eastern field and a large western field. The land at the time of our walkover survey had been recently cultivated ready for seeding of the winter crop (corn/winter wheat) in the coming weeks. The site generally fell broadly towards to the north and to the west at a gentle slope.

The northern fields are bounded to the east by the A281, to the north and to the west by a ditch/stream, which flows initially to the west and then to the south and is situated approximately 1-2m below the general level of the site (deeper in the north-eastern corner and becoming more progressively shallow to the west). The southern boundary of the northern fields comprises a mixed boundary, to the east the boundary is with the Bury Hill Landscaping Supplies and comprises a mixed hedgerow with mature oak trees and recently formed shallow soil bunds. The central part of the boundary is against a ditch line which drains water from the Horsham Stone Yard and Farm Buildings away to the pond to the south. The western most part of the southern boundary is against gardens of the two residential properties Mill Cottage and Mill House.

Other than a few pieces of abandoned farm machinery along the concrete access road and a small soil bund in the far north-eastern corner, no obvious signs of potential on site contamination was identified.

### **5.2.2 Bury Hill Landscape Supplies (Walkover Images 51-68 in Appendix B)**

The Bury Hill Landscape Supplies business is a recent addition to the site and appears to have opened between 2018-2020, with a further extension into the fields taking place in 2021. The owner of the business and the current landowner informed us that the topsoil and subsoil of the former field area was scrapped back and forms the mound, which runs along the eastern boundary of this part of the site. The land was then partially covered in crushed concrete/compacted hardcore to form a stable base for machinery and vehicular movement.

At the time of our walkover survey, the northern half of this part of the site comprised a series of soil mounds, comprising sand, organics, topsoil, nutrient depleted sand and reject material which is being used to form a bund along the northern boundary under license (images 51-54).

The central part of the site (images 55-61) comprised a more open working area, with a crushed concrete/hardcore base. This area contained modular concrete storage yards/bins for segregated materials and two small, modern plastic bunded fuel/oil tanks (images 59 and 61).

The southern part of the site (images 62-68) comprises a series of former agricultural barns which were formally used to house livestock. The buildings comprised a solid concrete floor and are a mixture of concrete and steel frames with half height concrete walls. The buildings are clad on the upper portion and roofed with asbestos cement sheeting and evidence of asbestos cement guttering and downpipes were also observed. At the time of our walkover survey, the barns were being used for the storage of graded soils, bark and other landscaping products as well as storage of equipment and maintenance products such as fuel/oils etc.

**Given the presence of asbestos sheeting on the existing buildings, it is recommended that an Asbestos Survey is undertaken and that all materials are carefully removed from site by a licensed contractor.**

### **5.2.3 Horsham Stone Reclamation Yard (Walkover Images 69-79 in Appendix B)**

The Horsham Stone Reclamation yard appears to have developed on site around 2001 and slowly extended its operations to the north towards the boundary with a ditch by the 2005 map, with potential land raising/levelling having taken place.

At the time of our walkover survey the Horsham Stone Reclamation yard comprised a small single storey building with asbestos cement sheeting on the roof, small portacabin style buildings and the western half of the barns as described in the Bury Hill Landscape walkover description.

In the northern part of this area, stockpiles of stone and brick were observed along with a soil mound to the west which comprises the subsoil/topsoil which was stripped as part of the extension of the yard. Along the northern boundary and the eastern boundary stockpiles of what appears to be inert waste (rubble, wood and reject stone) were observed which contained some plastic and metal. The ditch along the northern boundary receives uncontrolled drainage from the yard, with no flow controls or pollution control measures in place.

The northern part of this parcel of land appears to have been built up by between 0.5m to 1.0m of made ground, as observed in image 77. As such, these made ground soils will require investigation for potential contamination and will likely require removal from site during the redevelopment works.

**Given the presence of asbestos sheeting on the existing buildings, it is recommended that an Asbestos Survey is undertaken and that all materials are carefully removed from site by a licensed contractor.**

#### **5.2.4 Southern Fields (Walkover Images 8-24 in Appendix B)**

The southern fields comprise two parcels of agricultural land, which are divided by a ditch line and mature hedgerow. The access point from the larger eastern field to the smaller western field (image 18) comprises a field entrance which crosses the ditch line which runs along the western field boundary. The ditch is culverted under the crossing by a ~150mm twin-walled plastic pipe, and was partially obstructed with silt and vegetation (image 19).

The land at the time of our walkover survey had been recently cultivated ready for seeding of the winter crop (corn/winter wheat) in the coming weeks. The site generally fell broadly towards to the south and to the west at a gentle slope. An overhead power cable cuts across the larger field from the A281 to the residential properties to the west and two gas marker posts were observed along the southwestern field boundary (images 14 and 15).

The fields are bounded by the site entrance route to the north, by the A281 to the east, by the A264 to the south and by an access road to the west which provided access to a series of residential properties along the western boundary. Also along the far western boundary the River Arun is mapped which flows to the north before turning west and used to have an old corn mill at the location of the location of Mill Cottage.

No obvious signs of potential on site contamination was identified in this part of the site.

#### **5.2.5 Wetland/Marsh Area**

Access into this area was not possible during our walkover survey as it was wet underfoot and heavily overgrown. This area, known as the Withey, takes the overflow from the pond to the north through a culvert pipe under the access track and eventually joins the ditch line to the south where the water flows down to join the River Arun.

### **5.2.6 Pond Area (Walkover Images 1, 2, 6 and 7 in Appendix B)**

The pond area comprises a small section of open land laid to grass at the time of our walkover survey. The pond comprises a large feature with a small island in the centre, and has a high level overflow on the southern boundary which discharges into the wetland area to the south.

The pond is bounded by existing residential properties to the west and by fields to the north and south.

## **5.3 Historical Map Assessment**

Historical maps are attached in Appendix F for reference. Due to the scale of the site, the historical assessment below has been undertaken using the 1:10000 scale maps, however more detailed 1:2500 maps are also included.

### **5.3.1 Onsite Features**

The site is first shown on the 1880 map to comprise predominantly open agricultural land. Lower Broadbridge Heath Farm is mapped in the centre of the site along the eastern boundary and comprises a farmhouse and series of external buildings assumed to be the farmyard. Directly west of the farm is a small section of orchards, beyond which a pond is mapped.

By the 1898 map, the only change of note onsite comprises the construction of additional buildings in and around the Lower Broadbridge Heath farmyard. Further redevelopment of the farmyard was also shown by the 1912-1913 map, which also includes the mapping of a well to the west of the farm buildings.

The site has remained essentially unchanged up to the 1981-1983 map when the buildings associated with Lower Broadbridge Heath Farm appear to have been redeveloped in their entirety with the exception of the original farmhouse. The buildings now appear to comprise one large barn, one narrow barn and a smaller outbuilding.

The site has remained essentially unchanged up to the latest map dated 2021. The map however does not show the development of the Horsham Stone yard or the Bury Hill Landscape Supplies yard which were described in detail as part of the walkover survey above.

### **5.3.2 Off Site Features**

The 1880 map shows that the surrounding area is predominantly open rural land, with numerous farmsteads mapped in the surrounding area. Directly off site to the west, Sleafold Flour Mill is mapped on the River Arun along with a small residential property. Along the western site boundary an area of marshland is also mapped. Off site to the northeast, a series of fishponds are mapped which appear to be situated in former quarries as the maps clearly show quarry boundaries.

By the 1912-1913 map, Sleafold Mill to the west has now been mapped as disused and off site to the east the village of Broadbridge Heath has started to develop, with new houses constructed, St Johns Church built along with schools, smithies, and recreation grounds. By the 1932-1933 map, Broadbridge Heath to the east has continued to expand, and to the south of the site a water treatment works including filter beds has been developed along Mill Stream, which joins into the River Arun.

On the 1938 map, two residential properties have been developed along the western site boundary and by the 1961 map, an additional property was constructed along the western boundary.

By the 1981-1983 map, the village of Broadbridge Heath to the east has continued to grow, with many new roads, residential estates and sports centres developed, which are adjacent to the A24 which was constructed at some point between the 1960's and the 1980's. Directly south of the southern most part of the site, Newbridge Nurseries is now also mapped.

At some point between the 1981-1983 map and the 1999-2000 map, the village of Broadbridge Heath to the east has undergone significant development. Housing and industrial units now directly bound the subject site to the east. The final map dated 2021 shows further significant development, with the village of Broadbridge Heath expanding to the south and almost doubling in size. As part of the extensive development a new bypass has been developed for the A264, so that traffic goes around Broadbridge Heath to the A24 rather than directly through it. Newbridge nurseries which was situated to the south of the site has been redeveloped into Greenacres Nurseries.

#### 5.4 Environmental Database Assessment

The Envirocheck Report, which is included in full in Appendix F, summarises a range of historical and current land uses in close proximity to the site, as well as a range of other important information.

The following table provides a review of the features and entries listed within 500m of the boundary of the site.

**Table 3. Environmental Database Summary**

| Environmental Database                | Distance (m) and Direction | Significant Hazard to/from the site (Yes/No)? | Notes                                                                                                                                                                      |
|---------------------------------------|----------------------------|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Contemporary Trade Directories</b> | 27m NE                     | No                                            | Bury Hill Builders Merchants – Active                                                                                                                                      |
|                                       | 28m NE                     | No                                            | Antique Stone Company – Inactive                                                                                                                                           |
|                                       | 47m NE                     | No                                            | Ax Distribution Services – Inactive                                                                                                                                        |
|                                       | 47m NE                     | No                                            | Aerco – Electronic Manufacturers – Inactive                                                                                                                                |
|                                       | 50m NE                     | No                                            | Charlie'S Products – Animal By products – Inactive                                                                                                                         |
|                                       | 63m E                      | No                                            | K D Autos – Garage Services - Inactive                                                                                                                                     |
|                                       | 70m NE                     | No                                            | Preco – Radio Communication Equipment – Inactive                                                                                                                           |
|                                       |                            |                                               | A further 34 entries are listed within 250m of the site, however none are considered to pose a significant risk.                                                           |
| <b>Fuel Sites</b>                     | 270m NE                    | No                                            | Evans Halshaw – Obsolete.                                                                                                                                                  |
|                                       | 783m E                     | No                                            | Tesco's Horsham - Active                                                                                                                                                   |
| <b>Pollution Incidents</b>            | -                          | No                                            | None listed within 450m of the site.<br>The nearest is listed as 496m southwest of the site and related to a spillage of oil into groundwater – Category 3 Minor Incident. |
| <b>Water Abstractions</b>             | 102m SW                    | No                                            | Abstraction for spray irrigation.                                                                                                                                          |
|                                       | 243m NW                    | No                                            | Abstraction for spray irrigation.                                                                                                                                          |
| <b>Discharge Consents</b>             | 0m E                       | No                                            | Sewage Discharge – Treated Domestic to watercourse.                                                                                                                        |
|                                       | 0m W                       | No                                            | Sewage Discharge – Treated Domestic to watercourse.                                                                                                                        |
|                                       | 0m W                       | No                                            | Sewage Discharge – Treated Domestic to watercourse.                                                                                                                        |

| Environmental Database           | Distance (m) and Direction | Significant Hazard to/from the site (Yes/No)? | Notes                                                                                                                                                                                                                                                      |
|----------------------------------|----------------------------|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  | 6m W                       | No                                            | Sewage Discharge – Treated Domestic to watercourse.<br><br>Multiple other domestic treated sewage discharges are listed within 150m of the site. However, none of these licensed discharge are considered to pose a risk to the redevelopment of the site. |
| <b>Infilled Land (Non-Water)</b> | -                          | -                                             | None listed on site.<br>The nearest listed feature is mapped 308m to the northeast of the site from the 1981 map.                                                                                                                                          |
| <b>Infilled Land (Water)</b>     | -                          | -                                             | None listed on site.<br>The nearest listed feature is mapped 57m to the north of the site from the 1961 map.                                                                                                                                               |
| <b>Historical Landfills</b>      | -                          | -                                             | None listed within 500m of the site.                                                                                                                                                                                                                       |
| <b>Recorded Landfill Sites</b>   | -                          | -                                             | None listed within 500m of the site.                                                                                                                                                                                                                       |

## 6 Conceptual Model

### 6.1 On site Sources of Contamination

#### 6.1.1 Pesticides/Herbicides

The majority of the site has been used as arable land since the earliest historical maps. The only potential source of onsite contamination associated with this land use would be the build up of pesticides/herbicides in the topsoil, coupled with potential heavy metal build up associated with the compounds used.

As such we would recommend some initial pesticide screening tests to be undertaken to assess the level of risk posed.

#### 6.1.2 Demolition / Construction Materials

The continuous redevelopment of the Lower Broadbridge Heath Farm buildings poses the greatest onsite risk due to the potential to encounter variable made ground soils. There also remains a risk that residual contamination associated with the former buildings may remain on site if redevelopment works excluded the removal of any below ground substructures.

In addition, evidence of imported made ground was observed in both the Horsham Stone Yard and the Bury Hill Landscape Yard, which could potentially contain variable contamination sources.

As such, the following contaminants may be encountered in this area of the site and should therefore form part of the contamination assessment in the Phase II investigation:

- Heavy Metals, PAH's, Asbestos, Hydrocarbons.

### 6.1.3 Fuel Tanks

Two small, banded plastic fuel tanks were observed during our walkover survey within the Bury Hill Landscape yard. These tanks appeared in good condition and were situated on solid concrete bases and as such the risk of contamination is considered to be low.

Historical tanks associated with the former buildings may have been situated on site, however the locations of these is now unknown. Therefore there remains a risk that residual pockets of hydrocarbons may be encountered across the former farmyard area. Given the soils low permeability these are likely to be isolated hotspots rather than widespread contamination and would be more easily remediated as hotspots during the demolition of the existing farm buildings.

As such, the following contaminants may be encountered in this area of the site:

- Hydrocarbons.

## 6.2 Off site Sources of Contamination

No significant sources of offsite contamination have been identified which would have an impact on the proposed redevelopment of the site.

## 6.3 Pollutant Linkage Model

The identified pollutant linkages based on the desk study assessment have been summarised below in the Site Specific Pollutant Linkage table:

**Table 4. Site Specific Pollutant Linkages**

| Source                                                           | Pathway                                                         | Receptor           | Assessment<br>(Calculated Risk)                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------------------|-----------------------------------------------------------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Onsite contamination arising from current of historical land use | Direct ingestion, direct contact & inhalation of dust/ vapours. | Future Site users. | <p>The calculated risk is deemed to be low in the areas of the site which are currently arable land.</p> <p>The area of the site where the former farmyard was situated and where the existing buildings and commercial operations are based to the current day is considered to be a moderate risk.</p> <p>Remedial works based on the identified contamination would be required to reduce/remove the risk to future end users in line with the sites end use (residential with plant uptake).</p> |

| Source | Pathway                                    | Receptor                            | Assessment<br>(Calculated Risk)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------|--------------------------------------------|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|        |                                            | Construction workers.               | <p>The calculated risk is deemed to be low in the areas of the site which are currently arable land.</p> <p>The area of the site where the former farmyard was situated and where the existing buildings and commercial operations are based to the current day is considered to be a moderate risk.</p> <p>The provision of suitable PPE/RPE during the demolition/construction phase along with detailed method statements and risk assessments would be required to reduce/remove the risk to construction workers to appropriate levels.</p> |
|        | Leaching and vertical & lateral migration  | Controlled waters                   | The calculated risk is deemed to be low in general across the site given the limited number of potential contamination sources and the negligible permeability of the underlying geology which restrict vertical and lateral migration.                                                                                                                                                                                                                                                                                                          |
|        | Direct infiltration in water supply pipes. | Service conduits.                   | <p>The calculated risk is deemed to be low in the areas of the site which are currently arable land.</p> <p>The area of the site where the former farmyard was situated and where the existing buildings and commercial operations are based to the current day is considered to be a moderate risk.</p> <p>Services and incoming pipework will need to be designed in accordance with the suppliers specifications based on the level of identified contamination on site.</p>                                                                  |
|        | Plant uptake.                              | Vegetation within landscaped areas. | <p>The calculated risk is deemed to be low in the areas of the site which are currently arable land.</p> <p>The area of the site where the former farmyard was situated and where the existing buildings and commercial operations are based to the current day is considered to be a moderate risk.</p>                                                                                                                                                                                                                                         |
|        | Lateral migration through groundwater      | Off-Site neighbouring properties.   | The calculated risk is deemed to be low in general across the site given the limited number of potential contamination sources and the negligible permeability of the underlying geology which restrict vertical and lateral migration.                                                                                                                                                                                                                                                                                                          |

| Source                                                   | Pathway                                                         | Receptor                         | Assessment<br>(Calculated Risk)                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------|-----------------------------------------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Potentially contaminated groundwater (onsite or offsite) | Direct ingestion, direct contact & inhalation of dust/ vapours. | Future Site users.               | <p>The calculated risk is deemed to be low in general across the site given the limited number of potential contamination sources and the negligible permeability of the underlying geology which restrict vertical and lateral migration.</p> <p>Remedial works based on the identified contamination would be required to reduce/remove the risk to offsite receptors subject to consent and approval.</p> |
|                                                          | Leaching and vertical & lateral migration                       | Controlled waters (watercourses) | <p>The calculated risk is deemed to be low in general across the site given the limited number of potential contamination sources and the negligible permeability of the underlying geology which restrict vertical and lateral migration.</p> <p>Remedial works based on the identified contamination would be required to reduce/remove the risk to offsite receptors subject to consent and approval.</p> |
| Potential for ground gas                                 | Vertical and lateral migration                                  | Human Health and buildings       | The calculated risk is deemed to be low in general across the site given the limited number of potential contamination sources. Furthermore, the clay based geology encountered across the site would restrict the lateral migration of land gases away from the source.                                                                                                                                     |

## 7 Site Investigation

### 7.1 Site Topography

The site appears to be generally flat at approximately 30m AOD, whilst the surrounding area appears to gently slope to the west.

### 7.2 Site Investigation

Given the size of the site and in order to keep the impact to the recent sown winter crop, our intrusive site investigation was split into two separate phases.

The first phase was undertaken between the 3<sup>rd</sup> and 4<sup>th</sup> November 2021 and comprised a total of thirteen windowless sampler boreholes across the site, to a maximum depth of 3.30m bgl (refusal on underlying weak mudstone). The aim of the investigation was to allow for the construction of a series of groundwater / gas monitoring wells across the site, and to allow for initial investigation to be undertaken within the commercial working area whilst minimising disturbance.

The second phase of the investigation was undertaken between the 30<sup>th</sup> November and the 3<sup>rd</sup> December 2021 and comprised a total of twenty-five mechanically excavated trial pits using a 8T tracked machine. The pits were dug to a maximum depth of 3.20m bgl. In addition to the trial pits 3 No. BRE365 soakage tests were undertaken at the proposed location of the attenuation basins to assess on site soakage potential. The trial pits were all located, at the behest of the landowner, near field boundaries and along tram lines to minimise crop damage. A fourth soakage test had been planned but given the requirement to keep wheeled traffic off the fields, this test had to be cancelled.

The trial pits and windowless sampler boreholes were sunk at the approximate locations shown below in Figure 3. The locations were distributed across the entire site to assess soil variability and depth to groundwater, and were positioned due to access restrictions by way of under / above ground services, structures and obstacles onsite.

Some of the originally proposed locations had to be moved due to the requests of the land owner.

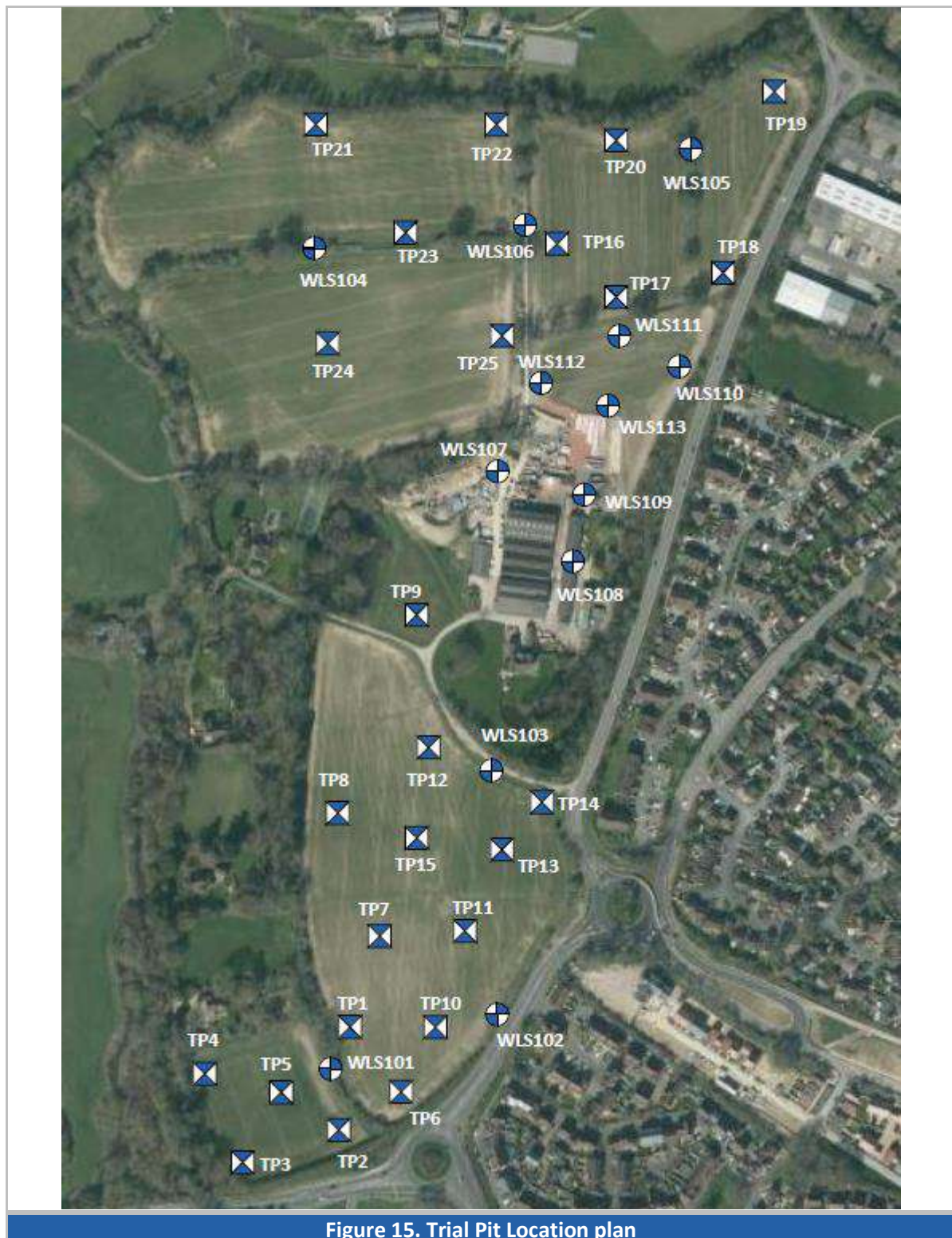


Figure 15. Trial Pit Location plan

### 7.3 Soils as Found

The soils encountered are described in detail on the attached exploratory hole logs in Appendix A, but in general comprised a covering of TOPSOIL over gravelly CLAY, which transitioned into MUDSTONE at depth. A limited thickness of MADE GROUND was encountered within the stone reclamation yard and topsoil processing centre. The following table provides a general summary of the soils as found on site.

Table 5. Soils as Found

| Depth m bgl<br>(Top to Base) | Soil Type        | Description                                                                                                                                                                                                                                                                                                          |
|------------------------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| G.L to<br>0.20m/0.50m        | Topsoil          | Brown silty clayey TOPSOIL with rootlets.                                                                                                                                                                                                                                                                            |
| G.L to<br>0.20m/0.40m        | Made<br>Ground   | Concrete over flint sub-base / crushed brick and concrete<br>Over<br><br>Dirty brown very gravelly SAND with abundant brick, concrete,<br>glass and blacktop fragments. Whole bricks<br>Or<br><br>Dark brown sandy gravelly CLAY with brick and concrete fragments<br>[only encountered in WLS107 to 113]            |
| -0.50m/2.70m                 | Gravelly<br>CLAY | Firm grey/orange-brown silty CLAY with black flecks and rae fine<br>rootlets.<br>Over<br><br>Stiff becoming hard, orange-brown mottled grey silty CLAY with<br>abundant fine to coarse randomly orientated, becoming<br>subhorizontally oriented mudstone lithorelics.<br><br>[some layers absent between locations] |
| -3.30m +                     | MUDSTONE         | Very weak to weak orange-brown/grey friable MUDSTONE with<br>some laminated structure and ironstone staining. Occasional very<br>stiff clay lenses.                                                                                                                                                                  |

## 7.4 Groundwater

A limited number of groundwater strikes were encountered within particular sandy lenses encountered, details of which are included within the logs attached (Appendix A).

Groundwater monitoring has been undertaken as part of the fortnightly gas monitoring visits and are reported in the table below. It is likely that the reported values represents build up of water seepages and potential surface water ingress within the monitoring wells rather than representing the true depth to groundwater. Additional monthly groundwater monitoring visits are scheduled until April 2022.

Table 6. Groundwater Monitoring

| Groundwater Levels m bgl |          |          |          |          |          |          |          |          |          |
|--------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
|                          | 09.11.21 | 23.11.21 | 15.12.21 | 21.12.21 | 06.01.22 | 20.01.22 | 16.02.22 | 17.03.22 | 12.04.22 |
| BH101                    | 0.52     | 0.56     | 0.34     | 0.40     | 0.39     | 0.36     | 0.31     | 0.42     | 0.32     |
| BH102                    | 1.78     | 1.93     | 1.93     | 1.91     | 1.96     | 1.59     | 1.85     | 1.80     | 0.82     |
| BH103                    | 0.84     | 1.19     | 0.74     | 0.60     | 0.41     | 0.32     | 1.54     | 0.93     | 0.80     |
| BH104                    | 0.65     | 0.84     | 0.75     | 0.80     | 0.71     | 0.85     | 1.35     | 0.84     | 0.82     |
| BH105                    | 0.94     | 1.10     | 0.72     | 0.80     | 0.43     | 0.52     | 0.52     | 0.78     | 0.75     |
| BH106                    | DRY      | 1.68     | 1.22     | 1.18     | 1.08     | 1.95     | 1.84     | 1.01     | 0.78     |
| BH107                    | 1.48     | 1.81     | 1.42     | 1.72     | 1.15     | 1.16     | 1.84     | N/a*     | N/a*     |
| BH109                    | 1.91     | 1.81     | 1.62     | 1.73     | 1.46     | 1.38     | 1.69     | 1.12     | 1.09     |

\*BH107 had been destroyed and the well could not be accessed.

## 7.5 Trench Stability

It was observed during our intrusive works, that the underlying cohesive soils tended to be generally stable in the short term, with no evidence of any significant trench stability observed.

As with any excavations where personnel are required to enter, some form of close lateral support and allowances for dewatering is always recommended.

## 8 Geotechnical Assessment

### 8.1 Laboratory Results

During our first phase of investigation, eleven Atterberg Limit tests were undertaken, with Plasticity Index's recorded in these samples ranged from 13% - 53%.

An additional eighteen Atterberg Limit tests were undertaken during the second phase of our investigation, with Plasticity Index's recorded in these samples ranged from 4.5% - 57%, following percentage passing modification.

Based on the results of both phases of testing, the cohesive substrates in general should therefore be considered to be shrinkable, and of HIGH volume change potential with respect to NHBC Chapter 4.2 Building Near Trees, for the design of new foundations/floor slabs.

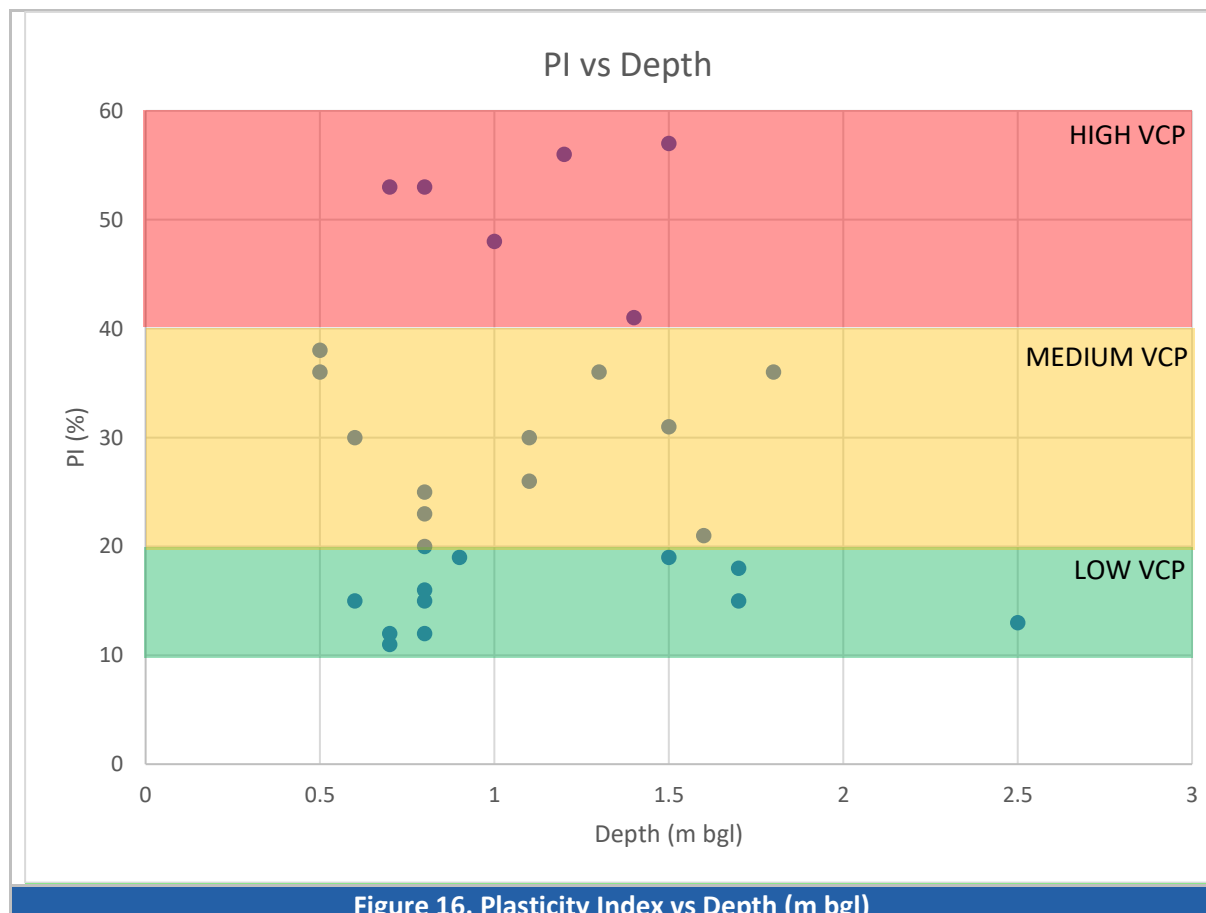


Figure 16. Plasticity Index vs Depth (m bgl)

There does not appear to be any evidence of zoning, either by area or substrate. Therefore, the worst-case situation should be assumed – HIGH VCP. The underlying mudstone should however be regarded as non-shrinkable.

## 8.2 Groundwater Levels

Scattered and limited water strikes were observed within particularly sandy lenses encountered during our intrusive investigation. In addition, shallow water levels were also recorded within the installed boreholes. However, given the cohesive nature of the soils encountered, and the limited number of water strikes recorded during both the boreholes and pitting exercises, the groundwater recorded within the monitoring wells is not thought to represent a true groundwater level across the site, but perched groundwater entering the boreholes, from the boundaries between the topsoil / made ground and clay subgrades.

Water ingress and trench instability did not appear to have obvious zoning across the site.

Groundwater levels may vary from season to season and year to year with levels potentially rising near surface in wet or winter periods. Groundworks should make allowances for encountering the localised groundwater pockets and dewatering from sumps within the main excavations should be allowed for at this stage.

## 8.3 Soakaways

A total of three BRE 365 soakage tests were undertaken in close proximity to the proposed attenuation ponds. The fourth planned location was not undertaken, due to access restrictions imposed by the landowner.

The results of the soakage tests were negligible, with the water levels not dropping significantly over a four hour period.

**Table 7. Soakage Results**

| Location                                          | Depth | Soakage Rate              |                                         |
|---------------------------------------------------|-------|---------------------------|-----------------------------------------|
|                                                   | m bgl | Litre/m <sup>2</sup> /min | m/sec                                   |
| TP1                                               | 2.24m | 0.026                     | $4.31 \times 10^{-7}$                   |
| TP9                                               | 2.00m | N/a                       | N/a                                     |
| TP16                                              | 2.40m | 0.0048                    | $8.07 \times 10^{-8}$                   |
| <b>Mean Value of All Calculated Soakage Rates</b> |       | <b>0.015</b>              | <b><math>2.56 \times 10^{-8}</math></b> |

Where three fillings have not been carried out, a reduction factor should be applied to the result to provide a design infiltration rate.

Typically, a minimum soakage rate of 0.1 l/m<sup>2</sup>/min is required for conventional soakaways to meet the BRE365 requirement of a soakaway half empty time of less than 24 hours. Based upon the results obtained, conventional chamber soakaways would not prove feasible for this site.

Discharge to sewers where possible or to the ditches/rivers along the site boundaries at greenfield run off should generally be pursued for the site. Attenuation basins should be assumed to be impermeable and should be design in accordance with a 1:100 year storm +30% for climate change.

## 8.4 Sulphates and Acidity

Twenty two BRE SD1 suites were undertaken across the two site investigations. The oxidisable sulphates did exceed 0.3% in two of the samples, inferring that pyrite is present.

The samples tested recorded pH values in the range of 5.6 – 10.7, which are slight acidic through to slightly alkaline in reaction. The elevated pH in some of the samples could be attributed to the crushed concrete encountered in the farmyard area.

Given the potential for the presence of pyrite, the Total Potential Sulphate has been used to classify the concrete design. Based upon these a concrete classification of **DS-2, and mobile groundwater AC-2** should be assumed for the site.

The result from WLS107 @ 0.2m did indicate a classification of DS-3, but given that this was within the crushed concrete made ground recovered the result has been ignored.

## 8.5 Foundation Design

### 8.5.1 Shallow Foundations

On the basis of the investigations carried out to date, and subject to final layout, traditional strip or trench fill foundations are recommended for this site. All loadings should be transferred beneath any topsoil and softer subsoil and be placed within the underlying firm becoming firm to stiff clay.

For reinforced foundations placed into the CLAY, to a minimum depth of 1.0m, an allowable bearing capacity of 100kPa is applicable, and NHBC HIGH Volume Change Potential precautions will apply. Should foundation deepening expose the underlying MUDSTONE, and an appropriate toe depth is achieved, any further deepening can be ceased. It is recommended that foundations, especially where under the influence of trees are inspected by a suitably qualified engineer.

The designer should be aware that precautions regarding swelling and shrinkage are applicable and, in this respect, NHBC precautions provide a helpful guide with respect to minimum foundation depths and deepening, particularly within the zone of influence of trees hedgerows or shrubs; existing, proposed or removed.

Subject to the Engineers final design, excessive foundation deepening may be required where plots are in close proximity to mature trees. Based on NHBC guidance, foundations below 2.5m must be designed individually by an engineer on an individual property basis taking into account soil desiccation, heave, lateral pressure, trench stability and workmanship. At depths in excess of 2.5m, a piled foundation is usually the most appropriate foundation option. However, as stated above, if the foundations are toed into non plastic Mudstone at depths shallower than 2.5m bgl, foundation deepening should not be required.

Allowance should be made for nominal mesh reinforcement in all foundations to cater for differential movement where they span differing materials.

Provisional allowances (extra-dig, over-break etc) are always recommended, and abnormal foundations cannot be ruled out entirely should deepening for existing service runs (water pipes and gas pipes) that traverse the site be required; such disturbed ground should be 'bottomed out'.

### **8.5.2 Piled Foundations**

Given anticipated tree influence along the site boundaries and in some area of the site and HIGH shrinkable clays, there is the potential for foundation deepening to exceed 2.5m in certain locations, therefore a piled foundation solution would prove a potential option. Deeper boreholes would be required to progress with this option.

However, as stated above, if the foundations are toed into non plastic Mudstone at depths shallower than 2.5m bgl, foundation deepening should not be required.

### **8.6 Floor Slabs**

Given the immediate sub-grades are locally clayey and may be prone to influence from existing and proposed vegetation, we would recommend allowance be made for a fully suspended block and beam type floor slabs throughout.

### **8.7 Settlement**

For foundations constructed as discussed above, and assuming site levels are to remain approximately as per existing, then settlements are anticipated to be within standard construction tolerances (<25mm).

### **8.8 Excavations and trenching**

Statutory support will be required in all excavations where personnel must work.

The clay materials will be prone to instability in open excavations during wet weather, or where seepages are encountered, and will soften rapidly if exposed to moisture or the elements. The sand lenses will run and be highly unstable in excavations or boring operations below the water table.

Where excavation is proposed in close proximity to existing structures, care will need to be taken to avoid undermining existing foundations.

Hard ground may be encountered, such as mudstone, and, where necessary, allowance should be made for breaking these using hydraulic hammers or the like mounted on the excavation plant, to facilitate excavation.

Seepage of groundwater into excavations should be anticipated, especially from the superficial soils. However, these should be managed with simple pumping methods from within the main excavation.

An allowance should be made for breaking out and re-routing sub-surface obstructions such as buried services and potentially larger concrete and brickwork obstructions.

### **8.9 Road Construction**

It is anticipated that proposed pavement areas will be formed in the firm CLAY. The results of in-situ DCP CBR testing generally indicated CBR values in the range of 1.7% to 2.9% from 0.3m to 1.0m bgl.

The results of Atterberg Limit tests form the initial phase of work on the clay materials indicate plasticity indices in the range of 13% to 53 %, with an average value of 24%.

For preliminary design purposes, a CBR value of 2.5% can be assumed for pavement design. However, given that the soils are likely to be disturbed by heavy plant during demolition and construction, it may be prudent to reassess the CBR value as construction progresses.

The most important element of any road construction is drainage and attention must be given not only to the drainage of the subsoil, but to the various layers of construction. To this end, the formation should be shaped to a camber or crossfall to allow water movement out of the sub-base. Silty soils soften extremely quickly if allowed to become wet, or if they are excavated below the water table, and this softening can give rise to a very substantial increase in costs.

Sub-base and coarse capping materials tend to segregate during placing operations, particularly when end-tipped. On soft clay sub-grades this can lead to punching and softening of the formation. The use of a layer of sand or geo-fabric will minimise the problem.

The formation should be proof rolled and any soft spots found should be excavated and replaced with compacted granular material. The surface of the formation should then be compacted, prior to laying the road sub-base.

Construction traffic should be kept off formations and it is often advisable to leave a protective layer of soil above formation level until the last moment before placing the sub-base.

**The formation should be considered potentially frost-susceptible.**

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## 9 Preliminary Environmental Assessment

### 9.1 Analytical Assessment Criteria

CDS have undertaken the contamination assessment based on the Source – Pathway – Receptor risk assessment methodology.

Soil screening values have been utilised where possible from the CLEA model (Updated Technical Background to the CLEA Model, 2009), which utilises toxicological data to calculate a Soil Guidance Value or SGV, which can be used as a screening value based on the proposed end use of the site (i.e residential/commercial/industrial).

Where an SGV is not available for a given substance, a screening value is derived based on guidance including the LQM/CIEH S4UL's for Human Health Risk Assessment (2014) and The EIC/AGS/CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment (2009).

Screening values for the identified contaminants are valid at the time of writing and any assessment of on site contamination is made against these published figures at the time of writing. Any changes to the proposed end use or published changes to screening values dated after the issue of this report would invalidate any assessment and recommendations made here within.

### 9.2 Environmental Sampling

The aim of this investigation and subsequent sampling was to provide general high level coverage across the site.

### 9.3 Environmental Testing

Our preliminary conceptual model identified that the majority of site has had an agricultural history, with the area around the main farm buildings being more industrial/commercial in nature.

Potential sources of onsite contamination in the form of unknown made ground soil was identified which could contain a wide range of contaminants including Asbestos, Heavy Metals, Hydrocarbons and PAHS. Additionally herbicide / pesticide contamination was considered within the larger fields.

The following tests were undertaken on made ground soils to assess the potential presence of onsite contamination.

- Heavy Metal Screen - (40 topsoil / made ground / natural samples)
- PAH's -USEPA 16 - (10 topsoil / made ground / natural samples)
- Asbestos Screen- (10 topsoil / made ground / natural samples)
- Hydrocarbon Testing TPH CWG - (10 topsoil / made ground / natural soil samples)
- WAC analysis – (9 made ground / natural samples)
- Herbicide/Pesticide Screens – (10 topsoil / natural samples)

### 9.4 Environmental Test Result Analysis – Heavy Metals, PAH's and Asbestos

#### 9.4.1 Soil Type – Made Ground

A total of five samples of made ground from around the existing stone reclamation and topsoil processing centre were sampled and screened for the range of contaminants identified above. The full results are included in Appendix D and are summarised in the table below:

**Table 8. Made Ground – Contamination Results**

| Determinand         | Unit  | Number of Samples | Mean  | Range                                               | Screening Values (Residential with veg) |
|---------------------|-------|-------------------|-------|-----------------------------------------------------|-----------------------------------------|
| <b>Heavy Metals</b> |       |                   |       |                                                     |                                         |
| Arsenic             | mg/kg | 5                 | 10    | <1.0-16                                             | 37                                      |
| Cadmium             | mg/kg | 5                 | 0.31  | <0.10-0.39                                          | 11                                      |
| Chromium III        | mg/kg | 5                 | 15    | 12-17                                               | 910                                     |
| Chromium VI         | mg/kg | 5                 | <0.50 | <0.50                                               | 6                                       |
| Copper              | mg/kg | 5                 | 58    | 29-110                                              | 200                                     |
| Lead                | mg/kg | 5                 | 25    | 8.3-51                                              | 200                                     |
| Mercury             | mg/kg | 5                 | <0.10 | <0.10                                               | 7.6                                     |
| Nickel              | mg/kg | 5                 | 11    | 9.5-13                                              | 110                                     |
| Selenium            | mg/kg | 5                 | 0.23  | <0.20-0.23                                          | 250                                     |
| Zinc                | mg/kg | 5                 | 52    | 32-94                                               | 300                                     |
|                     |       |                   |       |                                                     |                                         |
| Naphthalene         | mg/kg | 5                 | 0.86  | <0.10-0.86                                          | 2.3                                     |
| Benzo[a]pyrene      | mg/kg | 5                 | 11.7  | <0.10-33                                            | 1.7                                     |
|                     |       |                   |       | WLS109 @ 0.20 – 33mg/kg<br>WLS110 @ 0.20 – 1.3mg/kg |                                         |
| Total PAH's         | mg/kg | 5                 | 201   | <2.0-570                                            | //                                      |
|                     |       |                   |       |                                                     |                                         |
| Asbestos Screen     | -     | 5                 | -     | WLS109 @ 0.20m – Chrysotile Fibres / clumps         | -                                       |

The majority of the results from the contamination testing of the made ground have identified no elevated concentrations of heavy metals, PAH's or asbestos above the site specific screening values for Residential with homegrown produce. However, there were two exceedances for Benzo[a]pyrene, along with some isolated asbestos encountered (discussed more in section 9.5).

As such, based on the results from the soils tested to date, there will be a requirement for remedial measures as part of the redevelopment of the site, which would include importation of clean cover, combined with reduced dig and removal. This would be required within the proposed rear gardens and soft landscaping areas to mitigate any risk to the end users; the contractors will need to review this report for their own health and safety assessment although, on the basis of the results to date, the use to use standard PPE and good site practices should be sufficient to mitigate any risk to the work force.

Given the operational nature of the site, additional investigation once the site has been vacated would be prudent to confirm the contamination risk and to identify and further potential sources.

#### 9.4.2 Soil Type – Topsoil

A total of twenty-one samples of topsoil from around the proposed development area were sampled and screened for the range of contaminants identified above. The full results are included in Appendix D and are summarised in the table below:

**Table 9. Topsoil – Contamination Results**

| Determinand         | Unit  | Number of Samples | Mean  | Range              | Screening Values (Residential with veg) |
|---------------------|-------|-------------------|-------|--------------------|-----------------------------------------|
| <b>Heavy Metals</b> |       |                   |       |                    |                                         |
| Arsenic             | mg/kg | 21                | 10.1  | 5.5-18             | 37                                      |
| Cadmium             | mg/kg | 21                | 0.27  | <0.10-0.71         | 11                                      |
| Chromium III        | mg/kg | 21                | 22    | 13-40              | 910                                     |
| Chromium VI         | mg/kg | 21                | <0.50 | <0.50              | 6                                       |
| Copper              | mg/kg | 21                | 41    | 9.1-140            | 200                                     |
| Lead                | mg/kg | 21                | 38    | 14-61              | 200                                     |
| Mercury             | mg/kg | 21                | <0.10 | <0.10              | 7.6                                     |
| Nickel              | mg/kg | 21                | 15    | 7.9-25             | 110                                     |
| Selenium            | mg/kg | 21                | 0.28  | <0.20-0.45         | 250                                     |
| Zinc                | mg/kg | 21                | 60    | 25-94              | 300                                     |
|                     |       |                   |       |                    |                                         |
| Naphthalene         | mg/kg | 1                 | <0.10 | <0.10              | 2.3                                     |
| Benzo[a]pyrene      | mg/kg | 1                 | <0.10 | <0.10              | 1.7                                     |
| Total PAH's         | mg/kg | 1                 | <2.0  | <2.0               | //                                      |
|                     |       |                   |       |                    |                                         |
| Asbestos Screen     | -     | 1                 | -     | None detected (ND) | -                                       |

The results from the contamination testing of the topsoil have identified no elevated concentrations of heavy metals, PAH's or asbestos above the site specific screening values for Residential with homegrown produce. Therefore as long as the topsoil is stripped and stored correctly, it should prove suitable for re-use.

### 9.4.3 Soil Type – Natural

A total of sixteen samples of natural soils from around the proposed development area were sampled and screened for the range of contaminants identified above. The full results are included in Appendix D and are summarised in the table below:

**Table 10. Natural – Contamination Results**

| Determinand         | Unit  | Number of Samples | Mean  | Range              | Screening Values (Residential with veg) |
|---------------------|-------|-------------------|-------|--------------------|-----------------------------------------|
| <b>Heavy Metals</b> |       |                   |       |                    |                                         |
| Arsenic             | mg/kg | 16                | 10    | 1.8-37             | 37                                      |
| Cadmium             | mg/kg | 16                | 0.34  | <0.10-1.1          | 11                                      |
| Chromium III        | mg/kg | 16                | 24    | 8.5-60             | 910                                     |
| Chromium IV         | mg/kg | 16                | <0.50 | <0.50              | 6                                       |
| Copper              | mg/kg | 16                | 51    | 9.6-200            | 200                                     |
| Lead                | mg/kg | 16                | 22    | 6.2-74             | 200                                     |
| Mercury             | mg/kg | 16                | 0.10  | <0.10-0.10         | 7.6                                     |
| Nickel              | mg/kg | 16                | 13    | 4.0-30             | 110                                     |
| Selenium            | mg/kg | 16                | 0.31  | <0.20-0.55         | 250                                     |
| Zinc                | mg/kg | 16                | 48    | 16-120             | 300                                     |
| <b>PAH's</b>        |       |                   |       |                    |                                         |
| Naphthalene         | mg/kg | 6                 | 0.34  | <0.10-0.34         | 2.3                                     |
| Benzo[a]pyrene      | mg/kg | 6                 | 0.38  | <0.10-0.38         | 1.7                                     |
| Total PAH's         | mg/kg | 6                 | 6.6   | <2.0-6.6           | //                                      |
| <b>Other</b>        |       |                   |       |                    |                                         |
| Asbestos Screen     | -     | 6                 | -     | None detected (ND) | -                                       |

The results of the contamination testing have identified no elevated concentrations of heavy metals, PAH's or asbestos above the site-specific screening values for Residential with homegrown produce. Therefore, the natural samples analysed appeared to be free from significant levels of contamination. This concurs with the visual and olfactory evidence on site.

### 9.5 Asbestos Containing Materials

Only one single asbestos result was recorded at WLS109 @ 0.20m (further quantification recorded <0.001%). However, it should be noted that some potential ACM boarding was noted during the site walkover, mainly on the existing structures as noted in our walkover survey. There is always the potential for pockets of asbestos or for asbestos containing materials to be present, which have not been detected in the sampling. This is particularly true on old commercial sites, such as this, where fill has been encountered.

It is also our experience that asbestos containing materials are quite often encountered in buried pockets and beneath slabs (sometimes adhering to the concrete) on older sites. A watching brief should be put in place should any unforeseen pockets of asbestos be encountered.

## 9.6 Environmental Test Result Analysis – Hydrocarbons

Relatively low levels of longer chain aromatic and aliphatic compounds were recorded for most of the samples analysed, but these were well below the LQM/CIEH S4UL's guideline level for the corresponding hydrocarbon band, in terms of Residential with homegrown produce. The concentrations of BTEX compounds were also recorded below the laboratory detection limits. This concurs with the visual and olfactory evidence on site.

## 9.7 Pesticides / Herbicides

Due to the majority of the site comprising fields' which are associated with long term agricultural use over a prolonged period, a range of pesticides and herbicides were screened for as a precaution in selected samples of topsoil. Organo Nitrate, Organo Phosphate and Organochlorine pesticides and Acid Herbicides were all screened for in selected samples, and no residual impact was detected within the samples analysed.

No further assessment is considered necessary in this regard.

# 10 Land Gas Monitoring

## 10.1 Gas Monitoring

The sensitivity of the proposed development is rated high (residential), however, with the exception of the made ground soils round the farmyard, the generation potential is considered to be low.

An initial six gas readings over a period of three-month period have been proposed to assess the risk of land gas generation.

The results of the land gas monitoring to date are given in full in Appendix E and are summarised in the table below.

**Table 11. Gas Monitoring Results**

| Borehole Gas Monitoring Results          |           |          |           |           |           |           |
|------------------------------------------|-----------|----------|-----------|-----------|-----------|-----------|
| Location                                 | BH101     | BH102    | BH103     | BH104     | BH105     | BH106     |
| Evidence of contamination                | None      | None     | None      | None      | None      | None      |
| No. of Monitoring Events                 | 6         | 6        | 6         | 6         | 6         | 6         |
| Methane range CH <sub>4</sub> (%)        | 0.0-0.1   | 0.0-0.1  | 0.0       | 0.0-0.1   | 0.0-0.3   | 0.0-0.1   |
| Carbon dioxide range CO <sub>2</sub> (%) | 1.4-3.1   | 1.7-5.1  | 2.2-6.0   | 0.7-7.1   | 1.7-5.1   | 1.8-4.2   |
| Oxygen range O <sub>2</sub> (%)          | 19.8-22.3 | 7.4-20.9 | 16.0-19.0 | 19.6-21.9 | 13.8-20.7 | 10.9-16.4 |

| Borehole Gas Monitoring Results             |           |                                         |                                         |           |           |                                         |
|---------------------------------------------|-----------|-----------------------------------------|-----------------------------------------|-----------|-----------|-----------------------------------------|
| Location                                    | BH101     | BH102                                   | BH103                                   | BH104     | BH105     | BH106                                   |
| Flow rate range l/hr                        | -3.0-0.0  | -0.1-0.5<br>steady<br>4.5 peak recorded | -3.9-0.4<br>steady<br>8.5 peak recorded | 0.1-0.0   | -0.2-0.0  | -0.1-0.2<br>steady<br>3.6 peak recorded |
| Water level (m bgl)                         | 0.34-0.56 | 1.59-1.96                               | 0.32-1.19                               | 0.65-0.85 | 0.43-1.1  | 1.08-DRY                                |
| Atmospheric pressure during monitoring (mb) | 1018-1030 | 1017-1031                               | 1017-1032                               | 1017-1034 | 1016-1033 | 1016-1032                               |

| Borehole Gas Monitoring Results             |                                      |                     |
|---------------------------------------------|--------------------------------------|---------------------|
| Location                                    | BH107                                | BH109               |
| Evidence of contamination                   | Shallow Made Ground                  | Shallow Made Ground |
| No. of Monitoring Events                    | 6                                    | 6                   |
| Methane range CH4 (%)                       | 0.0-0.1                              | 0.0-0.1             |
| Carbon dioxide range CO2 (%)                | 0.7- <b>15.0</b>                     | 1.2- <b>10.1</b>    |
| Oxygen range O2 (%)                         | 14.6-21.3                            | 6.5-21.2            |
| Flow rate range l/hr                        | -0.2-0.0 steady<br>3.9 peak recorded | -3.1-0.0            |
| Water level (m bgl)                         | 1.15-1.81                            | 1.15-1.91           |
| Atmospheric pressure during monitoring (mb) | 1014-1032                            | 1014-1031           |

The monitoring visits to date were undertaken at times of generally high atmospheric pressure (1014-1032mb). It should be noted that a visit during falling or low pressure (>1000mb) was not achieved during the three month monitoring period.

The levels of carbon dioxide measured at a number of locations were generally around and above the 5% threshold, whilst the results recorded for methane generally were generally below 0.1%. Some isolated flow was also recorded, albeit larger peak values were recorded, which reduced to <0.1l/hr after a five-minute period. The increased flow could potentially be attributed to changing water levels within the boreholes rather than land gas generation given the lack of an identifiable source either on site or in the surrounding area.

At the location of WLS107 and WLS109, within the made ground soil there is evidence of significant gas generation in the form of elevation Carbon Dioxide concentrations, with a maximum concentration of 15% recorded. It would be prudent as part of the future development to remove the made ground soils from this part of the site and hence the source of the land gas generation would be also removed.

#### **10.1.1 Identified Gas Regime**

A worse case flow rate of 0.5l/hr (steady flow used rather than peak) has been assumed, along with the maximum CO<sub>2</sub> reading of 15%. This yields a gas screening value (GSV) of 0.075 for the site. This corresponds to Characteristic Situation 2 (CS2) of the modified Wilson and Card classification.

It should be noted however that this is an overall site classification, parcel specific monitoring is recommended to finalise any ground gas protection requirements. Subject to the parcel specific investigation, a reduced characteristic situation (CS1) may be achievable in some parts of the site.

We would recommend that at least one further land gas monitoring visits is undertaken to coincide with a low pressure event in order to collect the 'worst case' levels.

#### **10.2 Summary of Results**

On the basis of the investigation to date, some elevated concentrations of Benzo (a)pyrene & asbestos and PAH's were identified within the made ground samples analysed within the farmyard buildings. This poses a risk to the contractors, end users and the service pipes and may impact the waste classification of arisings.

In addition, some ground gas protection measures will be required due to the recorded elevated carbon dioxide concentrations. Further monitoring and installation of additional ground gas monitoring wells may enable the site to be zoned subject to further analysis and agreement from the regulatory bodies.

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### **11 Revised Conceptual Model**

Based on the results of the investigation and subsequent contamination testing the initial site conceptual model, undertake by others, has been reviewed and revised to reflect the findings of the investigation.

Table 12. Revised Conceptual Model

| Source                                                                    | Pathway                                                         | Receptor                            | Calculated Risk                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------|-----------------------------------------------------------------|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Onsite/Offsite contamination arising from current and historical land use | Direct ingestion, direct contact & inhalation of dust/ vapours. | Future Site users.                  | The calculated risk is deemed to be MODERATE within the farmyard buildings, whilst LOW across the rest of the site based on the onsite contamination to be encountered. Some remedial action will be required.                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                                                                           |                                                                 | Construction workers.               | <p>The calculated risk is deemed to be MODERATE within the farmyard buildings, whilst LOW across the rest of the site based on the potential for onsite contamination to be encountered especially during any excavation.</p> <p>The provision of suitable PPE/RPE during the demolition/construction phase along with detailed method statements and risk assessments would be required to reduce/remove the risk to construction workers to appropriate levels.</p> <p>A discovery strategy should be put in place should any currently un-discovered contamination be encountered. Phase III works are recommended below the existing buildings.</p> |
|                                                                           | Leaching and vertical & lateral migration                       | Controlled waters                   | The calculated risk is deemed to be LOW based on the potential for onsite contamination to be encountered.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                                                                           | Direct infiltration in water supply pipes.                      | Service conduits                    | <p>The calculated risk is deemed to be MODERATE based on the potential for onsite contamination to be encountered.</p> <p>Services and incoming pipework will need to be designed in accordance with the suppliers specifications based on the level of identified contamination on site.</p>                                                                                                                                                                                                                                                                                                                                                           |
|                                                                           | Plant uptake.                                                   | Vegetation within landscaped areas. | <p>The calculated risk is deemed to be LOW to MODERATE based on the potential for onsite contamination to be encountered.</p> <p>Some remedial action will be required.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                                                           | Lateral migration through groundwater                           | Off-Site neighbouring properties.   | The calculated risk is deemed to be LOW based on the potential for onsite contamination to be encountered.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

|                          |                                |                            |                                                                                                                                                                         |
|--------------------------|--------------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Potential for ground gas | Vertical and lateral migration | Human Health and buildings | The calculated risk is MODERATE given the elevated CO2 encountered. Some basic gas protection will be required based on the results of the preliminary testing to date. |
|--------------------------|--------------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### 11.1 Revised Relevant Pollutant Linkages

A number of Relevant Pollutant Linkages, some of which are possible, for which remedial action will be required have been identified in the revised conceptual model, as follows.

**Table 13. Pollutant linkages**

| Contaminant / Source              | Pathways                                              | Receptor                                         |
|-----------------------------------|-------------------------------------------------------|--------------------------------------------------|
| PAH's and Asbestos in Made Ground | Ingestion/inhalation/dermal contact<br>Direct Contact | End Users and construction Workers<br>Structures |
| Land Gas                          | Inhalation                                            | End Users                                        |

## 12 Discussions and Conclusions

Phase III investigations are recommended within the farmyard buildings, stone reclamation and topsoil manufacturing centre once these have been vacated and ideally demolished along with the removal of the floor slabs. Parcel specific gas monitoring is recommended to potentially reduce the characteristic gas situation in areas of the site.

Appropriate health and safety measures should be adopted during all ground works in respect of the presence of PAHs and asbestos identified in the made ground, with precautions taken to minimise the potential for dust release and inhalation. It would be sensible to wear dusk masks that have a P3 filter when digging through the made ground, and to ensure that exposed soils are damped down during dry weather, to prevent dust generation. This would also afford some protection should more significant quantities be present in place.

For the majority of the site, any new areas of gardens/soft landscaping, it would be prudent to allow for a minimum of 150mm of site-won certified clean topsoil to allow for a growing medium. The landscape gardener contractor, may request a more significant depth of topsoil, depending on the planting requirements. This should be confirmed.

Where the proposed residential gardens coincide with Made Ground, some removal will be necessary (unless levels are raised significantly) and replacement with 600mm of certified clean subsoil and topsoil. As the depth of fill often exceeded 600mm an 'alert membrane' should be placed at the base of 600mm of clean cover to act as a physical barrier to any remaining made ground present which is impacted with PAHs and asbestos. This could be reduced to 300mm within less sensitive communal soft landscaping areas. This is subject to the comment and approval of the regulators.

If any topsoil needs to be imported for new soft landscaped/garden areas, this material should be from a reliable source and certified clean; in addition, depending upon the source and local authority requirements, testing may also be required following importation. The existing topsoil onsite, could also be re-used, depending on the quantities required. This should be stripped and stockpiled at an early part of the works to protect this resource. The material should also be managed properly.

Any new pipes for drinking water may need to be upgraded to Protecta Line or similar. This should be checked with the suppliers.

Based upon the preliminary land gas monitoring results to date the site falls within CS2. This corresponds to a gas protection score of 3.5, assuming a residential building classification, and appropriate protection systems will need to allow for this.

As with any site, areas of contamination not identified during site investigation works may come to light in the course of redevelopment. Accordingly, a discovery strategy must be in place during the redevelopment to ensure that any hitherto unknown contamination is identified and dealt with in an appropriate manner. Depending on the nature of any such contamination, it may prove necessary to reassess the remedial strategy for the site.

A formal remediation strategy and verification plan should be agreed with the regulatory authorities prior to commencement of any remedial works.

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## 13 Waste Disposal

If arisings from earthworks are intended for disposal, then there is a requirement to determine prior to disposal whether these would classify as:

- Hazardous or;
- Non hazardous

### 13.1 Waste Classification and Waste Acceptance Criteria (WAC)

The current relevant waste legislation and technical guidance (WM3 1st edition version 1.1, 2018) on the assessment and classification of hazardous waste, sets out the requirement for classification and provides the basis for the methodology employed to ensure compliance with the regulations. This report sets out to fulfil the requirements of basic characterisation.

Waste classification indicates whether the material is hazardous or non-hazardous. If material is classified as non-hazardous, there is a choice of sending the material to a non-hazardous or an inert landfill (subject to meeting inert waste acceptance levels based on WAC analysis). Where the waste is classified as hazardous, WAC analysis will be required to demonstrate that the concentrations meet the acceptance levels for hazardous landfill or stable non-reactive hazardous (SNRH) landfill.

The List of Wastes (England) Regulations 2005 shows those wastes that are absolute entries (i.e. hazardous waste regardless of their concentration) and mirror entries (hazardous waste only if hazardous substances are present above the specified threshold concentrations).

Section 17 of the List of Wastes relates to Construction and Demolition Wastes (including Excavated Soil from Contaminated Sites, stones and dredging spoil). Contaminated soil is a “mirror entry” and is not automatically assigned a hazardous or non-hazardous nature. Instead, an assessment of the composition of the soil is undertaken to determine the concentrations of hazardous substances, and the waste classified accordingly. The assessment of contaminated soil to determine whether it is hazardous waste is dependent on the presence of “hazardous substances” exceeding particular thresholds.

### 13.2 Waste Classification Assessment

The waste classification assessment has been undertaken using the results of the chemical analyses on the samples analysed, including some analysis of the samples recovered during the previous site investigation. The classification of the materials was conducted using the concentrations of each identified substance attributed to its 'worst-case' compound (where relevant), as per Environment Agency (EA) document WM3 (2018) and The Classification, Labelling and Packaging of Substances and Mixtures Regulation 1272/2008 (CLP). The assessment was carried out using the HazWaste Online Toolkit together with Tables 3.1 and 3.2 of CLP Regulation. The details of the waste classification are presented in Appendix D.

A summary of the assessment results is presented in the table below:

**Table 14. Waste Classification Assessment**

| Sample ID      | Strata  | Classification | EWC      | Hazardous Substance | Hazardous Properties |
|----------------|---------|----------------|----------|---------------------|----------------------|
| TP1 @ 0.90m    | Natural | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP2 @ 0.10m    | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP3 @ 0.10m    | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP3 @ 1.40m    | Natural | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP4 @ 0.10m    | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP5 @ 2.10m    | Natural | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP6 @ 0.20m    | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP6 @ 0.60m    | Natural | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP8 @ 0.10m    | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP8 @ 0.40m    | Natural | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP9 @ 0.20m    | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP11 @ 0.10m   | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP11 @ 0.40m   | Natural | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP13 @ 0.20m   | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP13 @ 1.30m   | Natural | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP14 @ 0.10m   | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP16 @ 0.10m   | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP17 @ 0.40m   | Natural | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP18 @ 0.10m   | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP20 @ 0.10m   | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP23 @ 1.00m   | Natural | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP24 @ 0.10m   | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP25 @ 0.10m   | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| TP25 @ 1.30m   | Natural | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS101 @ 0.10m | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS101 @ 0.40m | Natural | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS102 @ 0.20m | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS102 @ 0.90m | Natural | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS103 @ 0.10m | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS103 @ 1.20m | Natural | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS104 @ 0.10m | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS104 @ 0.30m | Natural | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS105 @ 0.10m | Topsoil | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |

| Sample ID      | Strata      | Classification | EWC      | Hazardous Substance | Hazardous Properties |
|----------------|-------------|----------------|----------|---------------------|----------------------|
| WLS106 @ 0.10m | Topsoil     | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS107 @ 0.20m | Made Ground | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS107 @ 0.50m | Natural     | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS109 @ 0.20m | Made Ground | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS110 @ 0.20m | Natural     | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS111 @ 0.30m | Natural     | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |
| WLS113 @ 0.30m | Made Ground | Non-Hazardous  | 17 05 04 | n/a                 | n/a                  |

The TPH (C6 to C40) petroleum group results indicated that the samples could be potentially Hazardous, however, these can be discounted as this material is a solid waste, and does not have a free draining liquid phase. In addition, during the sampling exercise no vapour or liquid element was noted within the exploratory logs or samples. The asbestos encountered in WLS109 @ 0.20m was recorded as <0.001%, below the 0.1% hazardous threshold.

Based upon the results of the chemical analysis, the topsoil, made ground and natural soils could be classified as Non-Hazardous with EWC Code 17 05 04.

### 13.3 Waste Acceptance Criteria (WAC) Analysis

WAC analysis was only undertaken on three samples (1 x Made Ground, 8 x Natural) collected during both phases of site investigation.

#### Topsoil

No WAC testing was undertaken on the topsoil recovered, however, by default, topsoil is not considered to be inert due to presence of generally high organic matter. The recovered topsoil materials have been described as containing organic matter (roots). On the basis of the above, any surplus topsoil from the site cannot be disposed of as inert. It can however, be accepted into NON-HAZARDOUS landfill.

#### Made Ground (WLS107 @ 0.20m)

The results from the WAC testing indicate for the majority of the determinands that the made ground material could be disposed of as INERT. However, the inert threshold is exceeded for sulphates, but given the high volume of crushed concrete encountered in the made ground, this is not thought to pose a risk to the waste classification. The inclusion of asbestos fibres in the crushed demolition materials means that the made ground material would need to be disposed of as NON-HAZARDOUS. The results should be forwarded to the receiving facility of their final approval.

#### Natural (WLS102 @ 0.90m, WLS107 @ 0.50m, WLS110 @ 0.20m, TP1 @ 0.90m, TP13 @ 1.30m, TP17 @ 0.40m, TP23 @ 1.00m and TP25 @ 1.30m)

As long as the materials can be kept separate, the underlying natural soils can be disposed of as INERT.

### 13.4 Recommendations

The chemical analyses undertaken in the course of this investigation have been used to carry out a preliminary waste classification of the materials on site. This report should be forwarded to waste receiving sites for their final decision. Additional testing and Waste Acceptance Criteria (WAC) testing may be needed for confirmation of the material's classification.

If more significant contamination is encountered during the construction works, this may affect the waste classification.

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## **14    Reporting Details**

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Date: 13<sup>th</sup> April 2022

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