AXIS J9 (PHASE 3)

HOWES LANE, BICESTER

Site-Specific Flood Risk Assessment & Drainage Strategy

Issue 4

April 2022

B A I L E Y

J O H N S O N

H A Y E S

CONSULTING ENGINEERS

SUITE 4
PHOENIX HOUSE
63 CAMPFIELD ROAD
ST ALBANS
AL1 5FL

Tel: 01727 841172
Fax: 01727 841085
Email: james.griffiths@bjh.co.uk
Email: wb@bjh.co.uk

Client – Albion Land Ltd
Project Ref – S1209 (Phase 3)

SITE SPECIFIC FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

CONTENTS

1.0 DEVELOPMENT DESCRIPTION & LOCATION

2.0 GEOLOGY, HYDROLOGY & DRAINAGE

3.0 ASSESSMENT OF EXISTING FLOOD RISKS

4.0 FLOOD RISK MITIGATION MEASURES

5.0 ASSESSMENT OF SUDS FEATURES

6.0 WATER QUALITY ASSESSMENT

7.0 DETAILED DRAINAGE PROPOSALS

8.0 CONCLUSIONS AND RECOMMENDATIONS

APPENDIX

A. Cornish Architects Site Plan Drawings

- 20019-TP-001F – Site Location Plan
- 20019-TP-002P – Proposed Site Plan

B. Topographical Survey by Blue Plan dated February 2012

C. Ground Investigation Report by Applied Geology dated January 2019

D. Environment Agency Flood Map for Planning

E. BJH Concept Drainage Scheme Drawings:

- S1209-PH3-02F – SW Drainage Layout
- S1209-PH3-03F – FW Drainage Layout
- S1209-PH3-04E – External Works & Levels

F. Axis J9 Phases 1 & 2 Drainage Plan:

- S1209-PH2-C16(0) – Full Site Scheme Drainage Layout
- S1209-PH1-C47(1) – Main Outlet Headwall Details

G. BJH Drainage Calculations - S1209 Rev 2 dated April 2022

F. SuDS Maintenance & Management Plan – S1209 Issue 5 dated April 2022

1 DEVELOPMENT DESCRIPTION AND LOCATION

1a. What type of development is proposed and where will it be located?

The 6.5 Ha Axis J9 (Phase 3) site is located adjacent to Howes Lane, Bicester. The proposed industrial/commercial development is shown on Cornish Architects Site Plan numbered 20019-TP-002P found in **Appendix A**. Currently only the western plot is to be developed which is divided into 5 Units with access road.

The total site owned by the client is in excess of 20 Ha. Phases 1 & 2 of Axis J9, which represents 70% of the development, is already constructed and fully operational for industrial and commercial use. In addition, S278 road works have been completed to provide new access to the development from Middleton Stoney Road with upgraded drainage facilities. The new on-site estate road, now known as Empire Road, will be extended to Phase 3 which is the next phase at Axis J9.

The site is currently undeveloped greenfield land with no impermeable areas. Topographical levels and details of the existing site can be found in **Appendix B**. Approximately 3.6 Ha of impermeable area is to be constructed post-development to provide buildings, access roads, service yards and car parking.

A new access road will need to be constructed in co-ordination with the Strategic Link Road (SLR) planned by Oxfordshire County Council. This will be necessary in order to connect Phases 1 & 2 to the new development in Phase 3. Detailed design of the link road drainage has been scoped out of this FRA/Drainage Strategy although a description of the concept is provided. The SLR will have independent SuDS design & likely discharge into nearby existing watercourses.

SuDS have been utilised on this site in the form of permeable car park construction where parking is not directly exposed to HGV's. Two Swales are proposed to provide online storage with Hydro-brake Manhole flow control devices to limit discharge into the wider-site drainage at Greenfield QBAR rate of 10 l/s. There are no significant areas of public open space proposed.

1b. What is its vulnerability classification?

The Scheme is classified as "less vulnerable".

1c. Is the proposed development consistent with the Local Development Documents?

The Development is consistent with the Local Development Plan.

1d. Please provide evidence that the Sequential Test or Exception Test has been applied in the selection of this site for this development type?

The Site is located in Flood Zone 1 Area and therefore the Site is appropriate.

2 GEOLOGY, HYDROLOGY AND DRAINAGE

2a. What constraints exist that must be considered for infiltration SuDS?

The ground conditions underlaying the site comprise dominant clay with subordinate hard limestone rock bands. These conditions are anticipated to be practically impermeable / of very low permeability. Hence, conventional Soakaways are not considered viable and an alternative drainage solution is recommended. Specific Soakaway or permeability testing have not been carried out on the advice of the ground investigation report produced by Applied Geology in January 2019 which can be found in **Appendix C**.

2b. What is the drainage potential of the ground?

Very low permeability.

2c. What is the potential for ground instability?

It is considered that the in-situ Cornbrash Formation strata that underlays the majority of the site is suitable to support conventional strip/trench fill or pad foundations. Given the site's relative flatness it is highly unlikely there will be any stability issues.

2d. What is the potential for deterioration of groundwater quality?

Generally, ground water has been encountered at significant depths of 7.3m to 9.5m bgl. In some areas ground water in these boreholes did rise to up to 1m above ground level, indicating artesian pressure at significant depths. Given that the majority of construction works are to be at a shallow depth and no discharge is proposed into the ground at depth there will be a negligible effect on groundwater quality from the proposed development.

2e. What flood zone is the site located in?

Flood Zone 1 as shown on the EA Flood Map for Planning in **Appendix D.**

2f. What existing watercourses exist on the site?

The site is bounded by field boundary ditches on the western, northern, and eastern boundary adjacent to Howes Lane. Flows from these ditches' outlet in the north-east corner of the site discharging into an existing culvert which runs under the Howes Lane and into nearby housing estate.

The ditches on the site remain in good working condition with regular flow.

3 ASSESSMENT OF EXISTING FLOOD RISKS

3a. What sources of flooding could affect the site?(see Annex C PPS25).

We have considered all sources of potential flooding as follows:-

Fluvial (Rivers)

- Inundation of floodplains from rivers and watercourses
- Inundation of areas outside the floodplain due to influence of bridges, embankments and other features that artificially raise water levels
- Overtopping of defences
- Breaching of defences
- Blockages of culverts
- Blockages of flood channels, or flood corridors.

Tidal

- Sea
- Estuary
- Overtopping of defences
- Breaching of defences
- Other flows (fluvial surface water) that could pond due to tide locking
- Wave action.

Surface Water

- Sheet run – off from adjacent land (urban or rural)
- Surcharged sewers (Combined, foul or surface water sewers).

Groundwater

- Water table rising after prolonged rainfall to emerge above ground level remote from a watercourse.
- Most likely to occur in low lying areas underlain by permeable rock (aquifers).
- Groundwater recovery after pumping has ceased for mining or industry.

Infrastructure Failure

- Reservoirs
- Canals
- Industrial processes
- Burst water mains
- Blocked sewers or failed pumping stations.

The site does not have a history of Flooding and only localised flooding could occur due to blocked or inadequate drainage facilities.

3b. For each identified source, describe how flooding would occur, with reference to any historic records wherever these are available.

- For fluvial flooding to occur significant inundation would need to build in the ditches discharging in north-east corner of the site. Given that the site is located at a higher level than surrounding housing areas, there is negligible risk of fluvial flooding to the site.

- There has been some recent history of the Howes Lane culvert overflowing into local gardens. In order to prevent damage to the wider housing catchment the culvert under Howes Lane will need to be upgraded.

- The site is located significantly away from the nearest sea, estuary, canal, or reservoir so flooding from all these sources is negligible risk.

- If piled foundations were used then groundwater flooding may occur due to rising artesian pressures. As described in the previous section, groundwater is of a significant depth (>7m bgl) therefore given the shallow construction and industrial use of the site, flooding from this source is low risk.

- The site benefits from falls across the site of approximately 1 in 80 towards ditches adjacent to Howes Lane. The likelihood of surface water flooding from the site is very low due to the absorbent topsoil overlaying the whole site and ditches at the low point of the site to convey flows off-site.

- There are no existing public surface water sewers on the site. In the north-east corner of the site is an existing foul water manhole. There is a risk of this becoming surcharged in extreme weather therefore risk remains low overall.

3c. What are the existing surface water drainage arrangements for the site?

Surface Water from the Site outfalls into the existing ditches along Howes Lane. See below Figure 1 for Existing Drainage Regime.

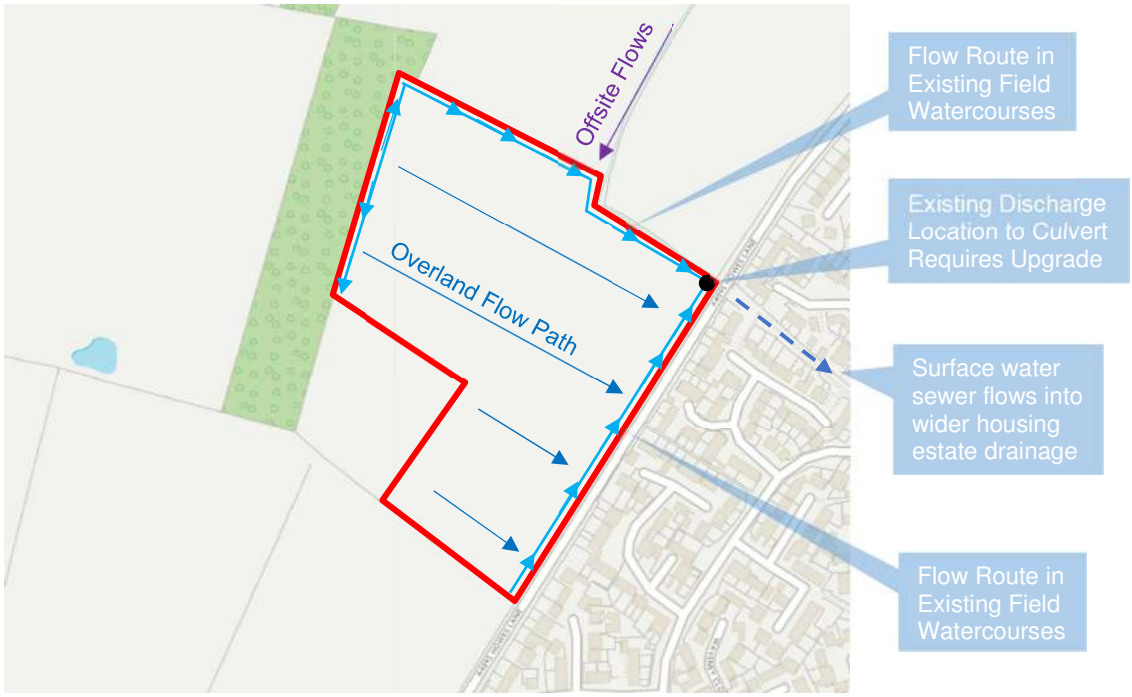


Figure 1 – Runoff Flow Routes

4 FLOOD RISK MITIGATION MEASURES

4a. How will the site be protected from flooding, including the potential impacts of climate change, over the development s lifetime?

- The existing culvert under Howes Lane is adopted. We confirm that upgrades are necessary to reduce flood risk off-site.
- Future discharge from impermeable areas is to be directed to the new formal 30 l/s hydro brake connection commissioned during Phase 1 & 2. This will result in reduced flows into the existing culvert thus minimising flood risk in the local catchment significantly.
- The on-site SuDS features are designed to cater for a 1 in 100-year + 40% Climate Change storm event, without causing flood risk to buildings. In addition, extra storage volume allowance is made for 80% of the 1 in 10-year storm event to reduce and mitigate residual risk of follow-on storms.
- As the development is to include car parks, service yards and roads where HGV's spend extended periods of time, to prevent pollution into the surface water system by-pass petrol interceptors should be provided accordingly.
- All the possible SuDS options will be assessed in order to provide the most comprehensive design for future climate change.
- Proposals to route exceedance flow through the development so that runoff does not adversely affect the development or surrounding areas.

Please see Table below summarising the Flood Risk:

Flood Source	**Potential Risk**				**Description**
	High	**Medium**	**Low**	**None**	
Fluvial/River/Sea			X		Located within Environment Agency River Flood Zone 1
Groundwater			X		No recorded history of Groundwater flooding
Canals				X	None present on or adjacent to site
Reservoirs				X	The site is outside the zone of reservoir failure risk
Sewers				X	None present on or adjacent to site.
Surface Water Runoff/Flows			X		Levels locally are at moderate falls, significant exceedance runoff velocity unlikely.
Effect of development on wider catchment			X		Exceedance flow routes directed to low areas of the site away from buildings on/off-site.

5 ASSESSMENT OF SUDS FEATURES

5a. Has the OCC SuDS Management Train been adopted for the design?

This assessment has been carried out in compliance with the Oxfordshire County Council (OCC) SuDS design guidance and The SuDS Manual C753. Axis J9 (Phase 3) is considered a major development as the development exceeds over a hectare in size.

The OCC management train has been adopted in the design process as follows:

- **Prevention** Prevention of runoff by good site design and reduction of impermeable areas.
- **Source Control** Dealing with water where and when it falls (e.g. infiltration techniques)
- **Site Control** Management of water in local area (e.g. swales, detention basins)
- **Regional Control** Management of runoff from sites (e.g. balancing ponds, wetlands).

5b. What are the proposed SuDS features for this development?

The proposed surface water system, presented by Bailey Johnson Hayes in **Appendix E** consists of the following SuDS components:

- Swales.
- Permeable Paving.
- Petrol Interceptors
- Catchpits, Gullies and Line Drains.

5c. Have calculations been provided to justify Drainage Design?

Calculations completed on MircoDrainage software are presented by Bailey Johnson Hayes in **Appendix G** consists of the following calculations:

- No above ground flooding for any conventional element of the drainage system for the critical 1 in 30-year event.
- No flooding from the drainage system to property or critical/sensitive infrastructure for the 1 in 100-year + 40% event.

5d. Is the site suitable for Infiltration/Soakaway features?

It is desirable on all sites in the UK, in the first instance that SuDS infiltration systems are considered, to reduce impermeable hard standing and treat run-off at source. Unfortunately, due to underlying clay layers to depths of greater than 5m bgl, this site is assessed to have ‘low’ permeability potential. Therefore, the use of infiltration systems such as **Soakaways** to discharge into the ground are not appropriate.

5e. Has justification for all SuDS features been provided?

Swale features have been considered for this site in order to provide a vegetated channel for the conveyance and storage of surface water. At headwall and outlet positions Riprap stones set into concrete will be introduced to reduce flows and lessen topsoil erosion near high velocity discharge and throughout the swale. The banks of the swale will be lined with approximately 300mm of topsoil with 1 in 3 slopes (max), to encourage growth of grass and local wildlife. Nominal longitudinal falls of 1 in 1000 (min) within the swales will prevent ponding of water resulting in reduced maintenance costs and increased performance.

Permeable Paving systems have been proposed for this site in order to reduce flow velocity and increase storage attenuation. Permeable paving is not appropriate in areas which are regularly trafficked by HGV's however, there is an opportunity in car parks. As there is no infiltration a 'Type C' system is to be utilised which is lined with an impermeable membrane at formation. In order to drain the permeable area, perforated pipes are provided in order to drain sub-grade layer.

Attenuation Tanks could be appropriate for this site. Care should be taken to provide appropriate cover over the tank to prevent long term damage and failure. Access points should be designed so the tanks can be maintained over its design life. As a result, tanks should not be located near buildings or HGV trafficked areas. The tank should be sealed with a welded membrane in order to prevent rising groundwater egress and reduction of storage volume. Due to the volume storage requirements being met by swales, attenuation tanks are not required.

Line Drains with **Catchpits** are recommended in the yards to meet the load requirements of HGV wheels and for easy maintenance. These features can easily be maintained to keep them free of silt and other potential contaminates over the design life. As only light contamination is expected, a Class 1 By-pass **Petrol Interceptor** is recommended for flows generated in the yards to increase water quality to acceptable levels before discharge into the site and wider-site drainage systems. See section 6 for more information on water quality.

This site is to be used predominantly for industrial storage facilities**. Rainwater Harvesting Systems** were not considered on this site due to the buildings low water demand and significant increase in maintenance cost to the end user. The height to the roof ridge is over 10m in most cases. **Green Roofs** are deemed to present an unacceptable risk to those maintaining the SuDS feature for this site. Access to the roof is to be provided for emergency roof maintenance only.

The use of **Filter Strips** or **Filter Drains** is not considered appropriate for this site due to the likelihood of HGV's regularly trafficking the yards. The run-off generated from this site is to be collected by a heavy-duty line drains and treated by petrol interceptors before discharge. The construction of gently sloping landscaped areas to drain run-off was not considered practical on this site. If spillages did occur, they could cause contamination issues in surrounding areas.

Efforts have been made to reduce impermeable area on the site, using permeable paving systems where possible as well significant ecological soft landscaping. Petrol interceptors have been provided to all yards to improve water quality discharge into the wider site. We believe that the SuDS components presented above meet the criteria set out by Oxfordshire County Council (LLFA) and Cherwell District Council (LPA) requirements. A landscaping strategy has been developed to increase biodiversity within allocated zones of this site.

6 WATER QUALITY ASSESSMENT

A Water Quality Assessment (WQA) has been undertaken below to assess the potential hazards from the site and the appropriateness of the SuDS features considered. The 'Simple Index Approach' from The SuDS Manual is used as follows:

Step 1 – Define Pollution Hazard Indices

6a. An assessment has been undertaken in Table 1 to define the potential level of hazard from different drained surfaces within the proposed development.

Table 1 – Hazard Pollution Indices for each Land Use

Land use	**Pollution hazard level**	**Total suspended solids (TSS)**	**Metals**	**Hydro-carbons**
Typical Industrial Roof	Low	0.3	0.3	0.05
Non-residential car parking e.g. offices	Low	0.5	0.4	0.4
Commercial Yard and Delivery Area and Parking	Medium	0.7	0.6	0.7
Sites with lorry parks and approaches to industrial estates	High	0.8	0.8	0.9

Note: The indices range from 0 (no pollution hazard) to 1 (high pollution hazard).

Step 2 – Determine SuDS Pollution Mitigation Indices

6b. To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type):

Total SuDS mitigation index ≥ *Pollution Hazard Index*
(for each contaminant type) (for each contaminant type)

Where the only destination of the runoff is to surface water – that is there is no infiltration from the SuDS to the groundwater – the surface water indices should be used. Where the principal destination of the runoff is to groundwater, but discharges to surface waters may occur once the infiltration capacity is exceeded, the groundwater indices should be used. The risk to surface waters will be low, as dilution will be high for large events, so treatment is not required. The table below indicates the mitigation indices of SuDS features used to discharge groundwater.

Indicative SuDS mitigation indices for discharges to surface waters:

Table 2 – Mitigation Indices for each SuDS feature

	Mitigation Indices		
Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Swale	0.5	0.6	0.6
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Proprietary treatment systems	**These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.**		

Step 3 – Conclusions and Recommendations

6c. For roof water drainage it is suggested that flows from this surface type are directed to any of the SuDS options available. Generally, low contamination is expected from the roof and therefore all proposed SuDS solutions satisfy the water quality requirements. It would be preferential to outlet into an open feature so that if any small wildlife became trapped in the system they would be able to escape more easily.

6d. Permeable paving is an option within the car parking areas. In terms of water quality, it is completely satisfied for water quality indices due to the nature of runoff filtering through the open graded stone. Thereafter, it gets a second layer of filtration as it moves into the appropriate soil. Permeable paving would be highly recommended in the car parks as it would also reduce the impermeable area of the site and mimic existing drainage.

6e. Surface water generated by yards and delivery areas is considered a 'Medium' water pollution hazard from Table 1. Runoff generated in these areas would not be adequately treated by infiltration basins or swales alone. As a result, a petrol interceptor has been specified to treat runoff to acceptable EA standard levels for each unit. This approach is considered adequate to treat runoff, subject to implementation of a certified petrol interceptors.

6f. As proposals are for general storage and distribution and details of end user requirements remain unclear an assessment has been made based on moderate future industrial use at the development. Multiple features benefiting water quality like Permeable paving, Swales and petrol interceptors have been considered for this site. If these SuDS features are provided in the final detailed design and constructed accordingly then water quality would be discharged at an acceptable quality.

7 DETAILED DRAINAGE PROPOSALS

7a. Has the drainage discharge hierarchy been followed?

The Oxfordshire County Council drainage discharge hierarchy has been followed with justification for each provided below:

1. Discharge to infiltration / Soakaway is not appropriate as the site is underlain by clay strata of very low permeability.

2. Discharge to a watercourse is achievable on this site as there are multiple accessible ditches of good quality and adequate capacity.

3. Discharge to a sewer is not possible on this site. No public surface water sewer connections exist on site.

4. Discharge to a combined sewer is not necessary on this site. Although there is an adopted foul water manhole within the site there are other more acceptable means of discharge for this development.

7b. Is evidence provided to justify discharge to an Ordinary Watercourse?

Discharge is to the wider-site drainage system which already has an approved discharge connection to a watercourse. The whole development (Inclusive of Phase 3) has been designed to discharge into a watercourse on the south-west corner of the site at no more than QBAR of 30 l/s.

Further details of the Phase 1 & 2 drainage system can be found in **Appendix F.**

7c. What are the existing rates and volumes of run-off generated by the site?

The Greenfield Run-Off for the Phase 3 Site is assessed at 10.4 l/sec for the QBAR average storm event.

7d. How is flood risk at the site likely to be affected by Climate Change?

It is accepted that climate Change is occurring however this Site is unlikely to be at risk of flooding. The risk should remain in Zone 1, i.e. 1 in 1000.The Drainage System is designed for a 100 year event + 40% for Climate Change.

7e. *How will you ensure that your proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere?*

Surface Water out-flows from the Site will be restricted to less than “Greenfield” run-off at 10 l/sec. All mitigation measures will be put in place before first occupation of the site to reduce risk to everyone on & off site.

7f. What flood-related risks will remain after you have implemented the measures to protect the site from flooding?

The flood risk on completion of the Development will be low and only related to blockages to pipework and Maintenance of SuDS features.

7g. How, and by whom, will these risks be managed over the lifetime of the development.

The Drainage Systems will be managed by the Site Management Company as per the management and maintenance plan (**See Appendix H)** for the rest of the Axis J9 development.

7h. What are the foul drainage proposals for the site?

The drainage for the site has been designed in compliance with Building Regulations Part H and recommendations in Sewers for Adoption (8th Ed.). It is anticipated that foul flows will be domestic waste only from toilets, showers and handwash basins. No provisions have been made for trade effluent. All flows are to be directed into a new independent gravity system which is to discharge to an existing foul manhole in the north-east corner of the site. Wash down foul gullies are provided to all external bin stores across the Phase 3 site.

The maximum peak flow from the Axis J9 Phases 1&2 rising main is **7.5 l/sec**. In contrast, the maximum anticipated peak flow from Phase 3 is **2.5 l/sec**. Therefore overall, the average daily flow into the Thames Water adopted sewer is 1.7 l/sec and maximum peak flow is **10 l/sec**. Please see below capacity assessment for further details of daily and peak flow estimates.

Thames Water recommended daily average flow rates:

- Warehouse = 150 l/day/100m^2
- Offices = 75 l/day/10m^2

Table 3 – Summary of Area's Assessed for Foul Flow

Building	Warehouse Area	Office Area
Units 1-3	5,250 m^2	-
Unit 4	4,500 m^2	300 m^2
Unit 5	3,500 m^2	500 m^2
Unit 6-10	2,300 m^2	-
Unit 11	650 m^2	-
Total	**16,200 m^2**	**800 m^2**

Warehouse est. daily flow = 150*(16,200/100) = 24,300 l/day (0.281 l/sec)
Office estimated daily flow = 75*(800/10) = 6,000 l/day (0.0694 l/sec)

Total Average Dry Weather Flow (DWF) = 30,300 l/day (0.35 l/sec)

Maximum Peak Flow (DWF x6 * 20% for Bin Stores) = 0.35*6*1.2 = **2.5l/sec**

8 CONCLUSIONS AND RECOMMENDATIONS

Flood Risk

The EA and Oxfordshire County Council classify the site as being located within Flood Zone 1. The site is classified as “Less Vulnerable” and therefore is compatible with for development in Flood Zone 1 as outlined in the NPPF. The site is assessed as having a low to negligible risk of flooding from all sources assessed including; fluvial, surface water, groundwater, sewer, canal, reservoir and tidal.

In order to mitigate flood risk to an acceptable level the following measures have been recommended: existing culvert under Howes Lane is to be upgraded, discharge from the site is to be limited to QBAR, on-site SuDS features are designed to cater for a 1 in 100-year + 40% Climate Change storm event, extra storage volume allowance is made for 80% of the 1 in 10-year storm event to reduce and mitigate residual risk of follow-on storms, by-pass petrol interceptors should be provided accordingly and exceedance flow through the development is to be directed so that runoff does not adversely affect the development or surrounding areas.

Surface Water Drainage - Units 1-5 + Future Development Area

A SuDS and Water Quality assessment was carried out to identify potential drainage features for use on this site. Infiltration techniques were precluded from this site due to the low permeability of underlaying clay formation. It was recommended that features such as permeable paving, swales, petrol interceptors, line drains and gullies should be used wherever possible to mimic as far as practicable the natural run off regime, improve water quality , reduce run off volume and attenuate peak flows. These are designed in accordance with the current guidance, The SuDS Manual (CIRIA C753).

Using the Oxfordshire County Council SuDS design guidance, a drainage strategy for the Axis J9 (Phase 3) development was created that includes, adequate storage up to the 1 in 100-year +40% CC event with storage distributed throughout the site. No flooding is predicted in all rainfall events. Discharge from Phase 3 has been limited to 10 l/sec overall. There is also sufficient capacity in the system to cater for potential follow-on storms. All calculations have been carried out using MircoDrainage software package using FEH rainfall data.

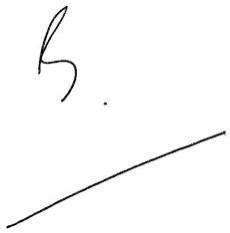
Surface Water Drainage – Strategic Link Road (Concept)

An indicative drainage strategy is presented on the Phase 3 SW Drainage Layout in Appendix E for the strategic link road (SLR). This strategy has been conceptually detailed to provide an indictive design for the SuDS used, flow routes and discharge locations which are subject to change for local authority approval. For the purposes of this report detailed design & calculation for the SLR has not been provided.

In line with the latest SLR designs provided by OCC, the new SLR is to be drained via above ground runoff to either side of the road in a crossfall or cambered arrangement. Runoff is then collected by swales on each side of the road in an environmentally friendly system. Water filters through the swales topsoil and stone filtration layers before collection by underdrain pipes or tanks. Flow will then be conveyed in a south-westerly direction to a hydro-brake manhole to limit discharge to QBAR Greenfield rate. Runoff will then be discharged into a local watercourse/ditch adjacent to Howes Lane, as per existing drainage arrangements.

Foul Water Drainage

The drainage for the site has been designed in compliance with Building Regulations Part H and recommendations in Sewers for Adoption (8th Ed.). The site is to be drained via a gravity system outletting to an adopted manhole near Howes Lane at an average daily flow of 0.35 l/sec and an estimated peak flow of 2.3 l/sec (max).



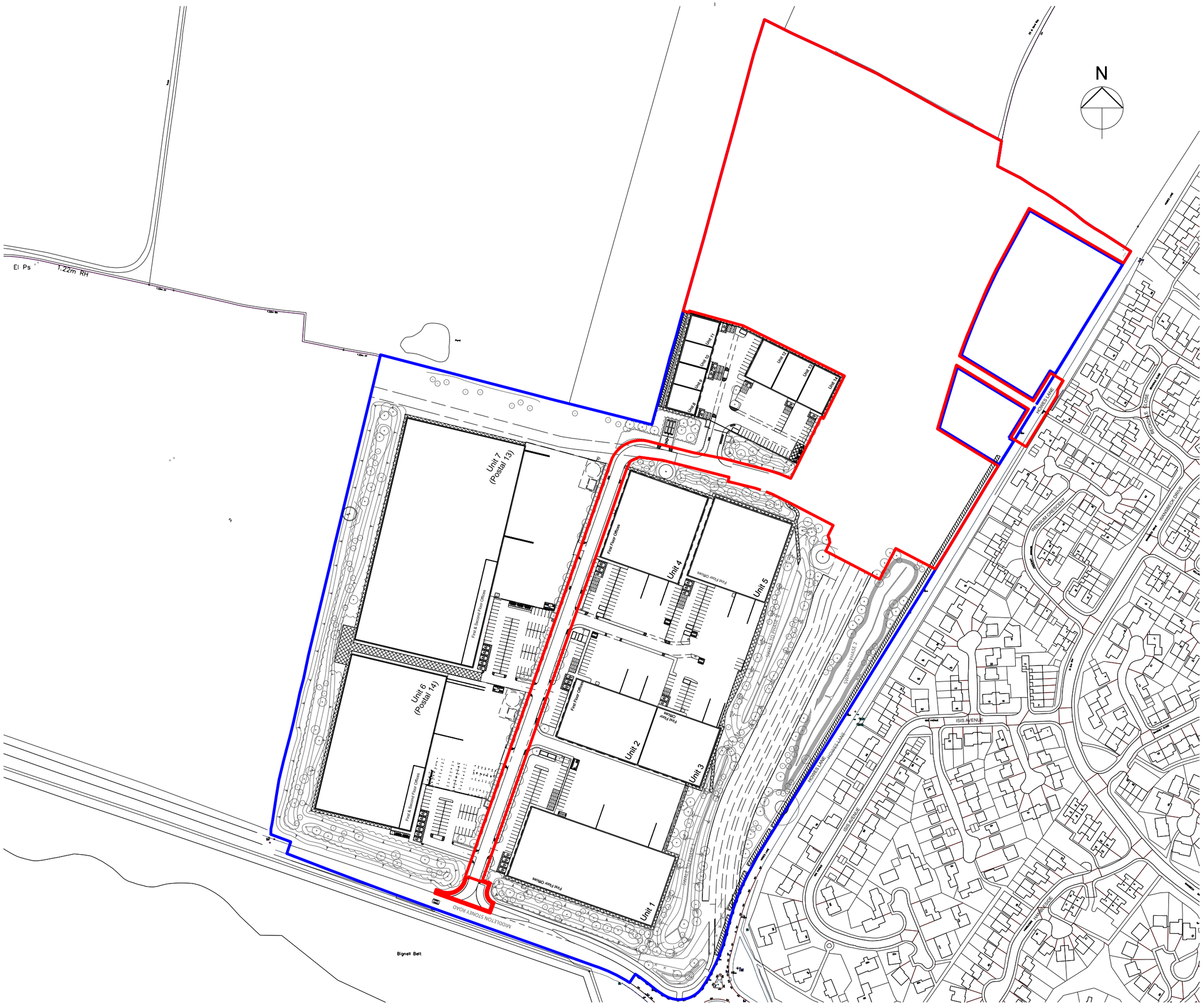
……..……
W Bailey C.Eng., F.I.Struct.E., M.I.C.E.
On behalf of Bailey Johnson Hayes

Bailey Johnson Hayes
Consulting Engineers
April 2022

APPENDIX A

Cornish Architects Plans:

20019-TP-001F – Site Location Plan
20019-TP-002P – Proposed Site Plan



NOTES

Reproduced from the Ordnance Survey map with the permission of the Controller of Her Majesty's Stationery Office, © Crown Copyright.

C A Cornish & Associates Ltd Licence no LIG0908.

Subject to Statutory Approvals.

Rev	Description	Chk	Date
F	Revision to Howes Lane crossing	CS	09/03/2022
E	Red line revised for drainage and cycle provision changes	CS	08/03/2022
D	Units 6 - 11 omitted	CS	04/03/2022
C	Site Boundary Updated	SM	02/09/2021
B	Site Boundary Updated	CS	02/09/2021
A	Site Boundary Updated	CS	31/08/2021

Peer House
8 -14 Verulam Street
London WC1X 8LZ

tel +44(0)20 7400 2120

enquiries@cornisharchitects.com
www.cornisharchitects.com

RIBA Chartered Practice

cornisharchitects

Project Title.
PHASE 3 AXIS J9 BICESTER

Drawing Title.
SITE LOCATION PLAN

Drawing Status.
TOWN PLANNING

Scale.
0 25 metres 150

Drawn By.	Scale.	Date.	Chk'd By.
S K	1:2500 @ A3	16/08/2021	C S

ALBION LAND

Drawing No.	Rev.
20019 - TP - 001	F

Schedule of approximate areas																	
UNIT	Ground Floor GEA sm	Ground Floor GEA sf	First Floor GEA sm	First Floor GEA sf	Second Floor GEA sm	Second Floor GEA sf	Total Unit GEA sm	Total Unit GEA sf	Ground Floor GIA sm	Ground Floor GIA sf	First Floor GIA sm	First Floor GIA sf	Second Floor GIA sm	Second Floor GIA sf	Total Unit GIA sm	Total Unit GIA sf	Car Parking
1	1830	19698	224	2411	0	0	**2054**	**22109**	1759	18934	195	2104	0	0	**1954**	**21038**	23
2	1665	17922	202	2174	0	0	**1867**	**20096**	1613	17362	179	1929	0	0	**1792**	**19291**	21
3	1717	18482	211	2271	0	0	**1928**	**20753**	1650	17761	183	1973	0	0	**1833**	**19734**	21
4	4412	47491	272	2928	272	2928	**4956**	**53346**	4278	46048	238	2558	238	2558	**4753**	**51165**	53
5	3552	38234	478	5145	0	0	**4030**	**43379**	3433	36953	423	4553	0	0	**3856**	**41506**	42
TOTAL	**13176**	**141826**	**1387**	**14930**	**272**	**2928**	14835	**159684**	**12733**	**137058**	**1219**	**13118**	**238**	**2558**	14189	**152734**	**160**

NOTES

Subject to Statutory Approvals.

Subject to Highways Development.

- Perameters Boundary
- Planning Site Boundary
- Ownership Boundary
- Notional Boundary
- Hedgerow Protection
- SLR License
- 2.5m high acoustic fence
- 1.5m high timber post and rail fence

Rev	Description	Chk	Date
P	Revision to Howes lane crossing	CS	09/03/2022
N	Unit 1 - 3 refuse stores relocated. Red line adjusted to allow for foul drain.cycle paths increased to 3m wide. Provisions for cycles at Howes Lane crossing	CS	08/03/2022
M	Units 6 - 11 omitted	CS	04/03/2022
L	Unit 1 Cycle parking relocated closer to the building	SM	08/02/2022
K	Planning boundary updated to include howes lane crossing	SM	04/02/2022
J	Minor adjustments to radii.	SM	01/02/2022
H	Enhanced pathway to include cycle path & crossing point to Howes Lane.	SM	25/01/2022
G	Area Schedule Corrected	SK	02/11/2021
F	Site Boundary Updated	CS	02/09/2021
E	Site Boundary updated	CS	31/08/2021
D	Acousitc fences added	SK	20/08/2021
C	Sheet number amended. Road layout updated. Areas updated.	SK	16/08/2021
B	Paving around units 1-3 yards adjusted. Acoustic fence added and landscaping adjusted between units 10 and 11.	SK	29/07/2021
A	Units 6-11 moved further into the site to acheive 10m buffer to eastern site ownership boundary	SK	16/07/2021

Peer House
8 -14 Verulam Street
London WC1X 8LZ

tel +44(0)20 7400 2120

enquiries@cornisharchitects.com
www.cornisharchitects.com

RIBA
Chartered Practice

cornisharchitects

Project Title.
PHASE 3 AXIS J9 BICESTER

Drawing Title.
PROPOSED SITE PLAN

Drawing Status.
TOWN PLANNING

Scale.
0 10 metres 80

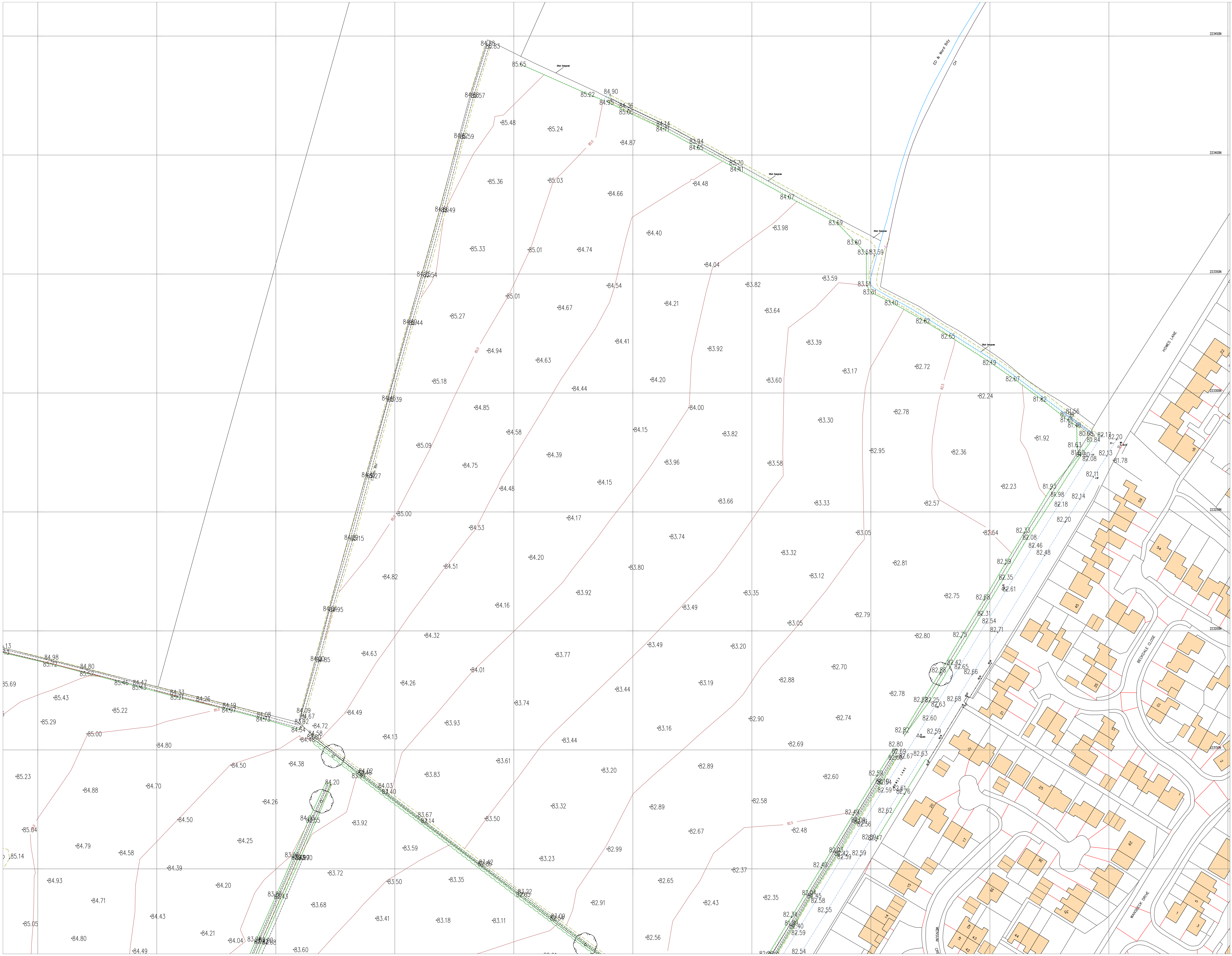
Drawn By.	Scale.	Date.	Chk'd By.
S K	1:1000 @ A1	08/07/2021	C S

ALBION LAND

Drawing No. 20019 - TP - 002 Rev. P

APPENDIX B

Topographical Survey



A0

This survey has been produced at the survey scale detailed below with its accuracy consummate with the indicated scale and should only be used for its original intended purpose. Any scaling should only be undertaken using a stable media print produced using the original data The plotted scale may differ (for presentation purposes) from the survey scale.

It is for the use only of the party to whom it has been addressed and no responsibility is accepted to any third party for the whole or part of its contents. This survey has been prepared on the basis that all information and facts, which may affect the survey, have been disclosed to BluePlan Surveys Ltd by all parties concerned and no liability, nor responsibility can be accepted, unless full disclosure has been made.

All ground features that were visible at the time of the survey have been located, however there may have been items obscured. Pipe sizes and flow direction have been visually assessed from the surface and should be considered as approximate only.

All data remains in the ownership of BluePlan Surveys Ltd and any discrepancies between this survey and any other information should be reported to BluePlan.

Abbreviations

(where applicable)

AV	Air Valve	ME	Meter Manhole
BB	Belisha Beacon	MH	Manhole
BC	Building Canopy	MK	Marker
BH	Borehole	MS	Multi-Stem (Tree)
BL	Bed Level	MY	Mercury Manhole
BM	Bench Mark	NB	Notice Board
BDY	Boundary	RNB	Road Name Board
BO	Bollard	PO	Post
BS	Bi-Stem (Tree)	PED	Pedestrian Pad
BST	Bus Stop	PI	Pipe
BT	British Telecom Manhole	PM	Parking Meter
CE	Cat's Eye	PP	Power Point
CCTV	Closed Circuit Television	RE	Rodding Eye
CR	Cycle Rack	RTW	Retaining Wall
CTV	Cable Television Manhole	RWP	Rainwater Pipe
CUL	Culvert	SP	Sign Post
DK	Drop Kerb	SDP	Stand Pipe
DP	Drain Pipe	SK	Soakaway
DPC	Damp Proof Course	SOF	Soffit Level
D	Drain	ST	Stop Tap
DCP	Dynamic Core Penetrometer	SU	Stump (Tree)
DWB	Dog Waste Bin	SV	Stop Valve
EB	Electricity Box	SVP	Soil Vent Pipe
EL	Electricity Manhole	SW	Storm Water
EP	Electricity Pole	SY	Stay (e.g. Pylon, TP)
ER	Earthing Rod	TBM	Temporary Benchmark
FFL	Finished Floor Level	TCB	Telephone Call Box
IFL	Floor Level	TH	Threshold Level
FP	Flag Pole	TL	Traffic Light
GV	Gas Valve	TW	Top of Wall
GP	Gate Post	TP	Telegraph Pole
GS	Gravestone	TPT	Trial Pit
GY	Gully	TSI	Traffic Signal Manhole
FH	Hydrant	U/B	Under Beam
IC	Inspection Chamber	UTL	Unable To Lift
IS	Information Sign	VP	Vent Pipe
IT	Intercom	WCL	Window Cill Level
JTN	Junction Box	WHL	Window Head Level
KO	Kerb Outlet	WL	Wall Level
LP	Lamp Post	WM	Water Meter

Survey Control

Grid & Datum

Survey Grid: Local Grid ☐ Nat. Grid (OSGB36) ☑ Nat. Grid (Graph. Fit) ☐ Existing Grid ☐

Survey Datum: Local Datum ☐ Nat. Grid (OSGB36) ☑ Nat. Grid (Spot Level) ☐ O.S.B.M. ☐

General Notes

Rev	Date	Description	CAD

Client

BluePlan
35/36 Iron Gate
Derby
DE1 3GA

T: 01335 367047
F: 01332 200231
E: info@blueplan.co.uk
W: www.blueplan.co.uk

Topographical Survey

Bonner Lane, Bicester

Plotted Scale: A0@1:500
NB: Survey Scale: 1:500

Surveyor: CM	CAD: CM	Checker: AR	Rev:
Date of Issue: 12.02.12		Job No. 1553	

chartered ICES

RICS

APPENDIX C

Ground Investigation Report

APPLiED GEOLOGY

REPORT ON
GROUND INVESTIGATION
AT
HOWES LANE,
BICESTER

REPORT STATUS SHEET

Client:	Albion Land Two Limited
Report Title:	Report on Ground Investigation at Howes Lane, Bicester
Report Number:	AG2873-18-AF58
Report Status:	Validated Issue 1
Date:	January 2019

		Date	Signed for and on behalf of Applied Geology Limited
Report Author	S E Treacy MSci (Hons) FGS Project Geologist	29/01/2019	
Checked	A Perks MGeol (Hons) CGeol FGS Senior Engineering Geologist	29/01/2019	
Authorised	S Day BSc (Hons) MSc CGeol FGS SiLC Director	29/01/2019	

CONTENTS

EXECUTIVE SUMMARY

1.0 INTRODUCTION 1
1.1 Objectives and Scope of Investigation 1
1.2 Report Layout 1
2.0 SITE DESCRIPTION AND PROPOSALS 2
2.1 Site Description 2
2.2 Site Proposals 2
3.0 DESK STUDY INFORMATION 3
4.0 CONCEPTUAL SITE MODEL 4
4.1 Diagrammatical Illustration 4
4.2 Sources 4
4.3 Pathways 5
4.4 Receptors 5
4.5 Source/Pathway/Receptor Linkage and Assessed Risk 5
5.0 GROUND INVESTIGATION WORKS 6
5.1 Fieldwork 6
5.2 Instrumentation and Monitoring 6
5.3 Laboratory Testing 7
6.0 GROUND CONDITIONS 8
6.1 Strata Encountered 8
6.2 Topsoil 8
6.3 Cornbrash Formation 8
6.4 Groundwater 9
6.5 Contamination 10
7.0 GEOENVIRONMENTAL ASSESSMENT 10
7.1 Human Health Risk Assessment 10
7.2 Controlled Waters Risk Assessment 11
7.3 Disposal of Soil Arisings 11
7.4 Conclusions and Recommendations of Geo-Environmental Assessment 11
8.0 GEOTECHNICAL ASSESSMENT 12
8.1 General 12
8.2 Earthworks 12
8.3 Foundation Design 14
8.4 Floor Slabs 15
8.5 Excavations 15
8.6 Pavement Design 16
8.7 Soakaways / Site Drainage 16
8.8 Buried Concrete and Services 16
8.9 Conclusions and Recommendations of Geotechnical Assessment 17

GENERAL NOTES
LIST OF REFERENCES

APPENDICES

APPENDIX A **DRAWINGS & FIGURES**

- Site Location Plan, Dwg No AG2873-18-01
- Exploratory Hole Location Plan, Dwg No AG2873-18-02 Rev 3
- Conceptual Site Model, Dwg No AG2873-18-03
- 'Phase I External Works Plan', Dwg No S1209-PH1-03E;
- 'Phase I Site Sections', Dwg No S1209-PH1-04E;
- 'Phase I Swale Details' Dwg No S1209-Ph1 – 05D;
- 'Phase I Residential Site Section' Dwg No S1209-PH1-07B.
- SPT N value v depth
- Unconfined Compressive Strength v depth
- Point Load Is_{50} v depth

APPENDIX B **DESK STUDY DATA**
APPENDIX C **EXPLORATORY HOLE LOGS**
APPENDIX D **FIELD MONITORING RESULTS**
APPENDIX E **LABORATORY TEST RESULTS & DATA SHEETS**
APPENDIX F **STANDARD FIELDWORK AND ASSESSMENT PROCEDURES**

EXECUTIVE SUMMARY

Proposed Development	Development of the existing fields for commercial and residential end use with associated landscaping/gardens, swales, access roads and infrastructure.
Site Description	The site is located off Howes Lane, approximately 1.75km west of Bicester town centre and covers an area of c.20ha comprising three fields. Adjacent agricultural fields bound the site to the north and west, Howes Lane to the east and Middleton Stoney Road to the south.
Site History	The site has comprised undeveloped fields since 1875. A drainage ditch/stream runs along the northeastern boundary flowing to the south/southeast. A quarry is indicated off the southeast corner c.25m away (1898-1966). By 1967 much of the surrounding areas have been developed and further residential development to within 100m east of site has occurred by 1976. The site itself remains three undeveloped fields to the present day.
Anticipated Geology	Published information indicates that the site is underlain by solid geology of the Cornbrash Formation with no overlying drift deposits. Made Ground is not anticipated.
Other Pertinent Desk Study Data	No surface water abstractions within 500m of the site; No current or historical records of landfills sites within 250m of the site; No recorded pollution incidents within 250m of the site; No recorded petrol/fuel sites identified within 250m; Cornbrash Formation is designated as Secondary A Aquifer; Site is not within a Source Protection Zone, no potable water abstractions within 1km; The site is outside of any floodplain; Site is not in a radon affected area, with <1% of homes above the Action Level. No radon protection measures are therefore considered necessary for new properties; No ecologically sensitive areas within 500m of the site.
Scope of Investigation	Fifty-nine machine excavated trial pits, six rotary cored boreholes, groundwater monitoring and sampling and chemical and geotechnical laboratory testing of soils.
Ground Conditions	Made Ground was not encountered. Agricultural Topsoil was encountered at surface across the site to depths of generally between 0.25m to 0.35m bgl, locally up to 0.70m bgl. Cornbrash Formation was recorded beneath the Topsoil, predominantly comprising an initial shallow limestone overlying clay, underlain by a deeper stronger limestone band. Groundwater seepages were recorded in six of the trial pits at depths of c2-2.5m bgl, deeper groundwater was recorded in four of the six boreholes during drilling at depths of between 7.3m and 9.5m bgl. There was one instance of groundwater strike rising above ground level indicating sub-artesian pressure in R4. During subsequent monitoring groundwater was recorded at generally between 1.6m and 2.6m bgl in all six of the standpipes. From a study of the reduced groundwater levels a flow direction towards the east can be inferred.
Geo-environmental Assessment	Marginal elevated concentrations of arsenic were recorded at four locations in the natural Cornbrash Formation, however since these are all from the natural Cornbrash Formation and there is no credible on-site source, these are considered to be natural background levels resident in the local geology. One concentration of sulphate from the groundwater samples slightly exceeded the UK Drinking Water Standard (DWS), however, UK DWS are not considered wholly relevant to the hydrogeological regime under the site and the marginal nature of the exceedance suggests the concentration is not of a concern to Controlled Water receptors. All other test results fall either below the relevant screening value or the laboratory limit of detection. The asbestos screening tests did not detect the presence of any (ACM). WAC testing on the natural Cornbrash Formation indicates compliance with inert criteria. Site is essentially a greenfield site and no sources of contamination were identified.
Geotechnical Assessment	Pad or trench fill foundations are considered feasible bearing within the stiff clay of the Cornbrash Formation and significant groundwater ingress is not expected in excavations. Based on a review of the existing topography and the proposed commercial unit's layouts a maximum cut in the order of c.1m from the northwest area and a corresponding maximum fill of c.1m in the centre-east of the area will be required. It will be necessary to produce a detailed specification for the earthworks detailing methods, controls and verification testing with target end performance criteria. Ground bearing floor slabs should be feasible for the commercial units provided any desiccated materials are removed and a suitably designed granular mattress is constructed. Floor slabs for the proposed houses will need to be suspended in proximity to trees or hedges or where Made Ground exceeds 0.6m depth. Ground conditions comprise impermeable/ very low permeability soils and soakaways are not considered feasible. Sulphate resisting concrete in line with DS-2 AC-2 will be required where in contact with the Cornbrash Formation. Further testing may allow this class to be downgraded to DS-1.

1.0 INTRODUCTION

1.1 Objectives and Scope of Investigation

An area of land off Howes Lane, Bicester (the site) is being considered for redevelopment by Albion Land Two Limited (the Client). The proposals for the site comprise the development of the existing fields for commercial and residential end use with associated landscaping/gardens, swales, access roads and infrastructure.

Applied Geology was appointed by Bailey Johnson Hayes consulting engineer to the Client, to undertake a desk study/Phase I assessment and preliminary Phase II ground investigation in order to:

- assess the potential for hazardous substances or conditions to exist at the site that might warrant mitigation or remediation appropriate to the intended end use proposed by the Client.
- establish geological conditions and geotechnical parameters to assist in the safe and economic engineering design of the proposed development.

The terms of reference/brief for the works were mutually developed between Bailey Johnson Hayes and Applied Geology and are outlined in our proposal and estimate reference AG18-3356-04 dated 30th May 2018.

The scope of works undertaken by Applied Geology comprised:

- A site inspection and walkover survey,
- A review of the following desk study sources:
  - GroundSure – GeoInsight & EnviroInsight environmental databases.
  - GroundSure – MapInsight historical maps.
  - British Geological Survey (BGS) - published information & on-line borehole database.
  - Multi-Agency Geographical Information for the Countryside (MAGIC) on-line database.
  - Environment Agency Web Site.
- Ground investigation together with sampling, monitoring and a programme of laboratory testing.
- Assessment and reporting of the results of the works.

Underground service plans for the site were obtained by Applied Geology on 4th July 2018. A topographic survey drawing by Blue Plan drawing No. 1553, dated 12th February 2012, was provided by Bailey Johnson Hayes.

1.2 Report Layout

This report presents a brief description of the site, the desk study data and the factual results of the intrusive investigations carried out. An interpretation of the ground conditions and a discussion/assessment of the findings is presented in the later report text sections. The main text of the report has been produced in a concise format, including the use of data tables to summarise key information where possible. The report should be read in conjunction with the general procedures detailed in Appendix

F and General Notes given at the end of the main text, which provide details of investigation techniques, assessment methodology and standards, health & safety and limitations and exceptions of the report. Drawings and factual data including exploratory hole records, laboratory testing results and desk study records are presented in the other Appendices.

2.0 SITE DESCRIPTION AND PROPOSALS

2.1 Site Description

The site is located on the western side of Howes Lane, Bicester, approximately 1.75km west of Bicester town centre. The Ordnance Survey grid reference for the centre of the site is 456381 223088 as shown on the Site Location Plan in Appendix A.

The site is approximately 'L' shaped with approximate maximum extents of 300m by 590m and covers a total area of c.20ha. The topographic survey indicates a consistent gentle slope to the east with a maximum difference in elevation of approximately 4.8m from c. 86.5mOD to 82mOD. The topographic survey forms the base of the Exploratory Hole Location Plan, Drawing No AG2873-18-02 Rev3, in Appendix A.

A site inspection/walkover was undertaken by Applied Geology on 10th August 2018. Access to the site was gained off Howes Lane, Bicester. At the time of the inspection, the site comprised three rectangular fields, all oriented approximately north-south and each comprising roughly one third of the total site area. Two of the fields formed south and west of the site and the third formed the north of the site. Both the northern and western fields were occupied by c.1-2m tall maize crops whilst the southern field was cleared of the crops. The topographic survey indicated a pond in the field adjacent to the northwest corner of the western field and a stream / drain along the northern boundary of the northern field, however due to the dense foliage these were not observed.

The site was bound to the south and east by Middleton Stoney Road (B4030) and Howes Lane respectively and to the north and west by agricultural fields. The site entrance was an opening in the hedge off Howes Lane.

There were semi mature trees along the margins of the three fields.

2.2 Site Proposals

The proposals for the site comprise a mixed commercial and residential development with associated roads and infrastructure. The outline proposals are shown on a series of drawings by Bailey Johnson Hayes dated November 2018 and comprising the following:

- 'Phase I External Works Plan' ref. S1209-PH1-03E;
- 'Phase I Site Sections' ref. S1209-PH1-04E;
- 'Phase I Swale Details' ref. S1209-Ph1 – 05D;
- 'Phase I Residential Site Section' ref. S1209-PH1-07B.

The proposed commercial development area comprises a 'Large Employment Plot' in the southern and western fields covering c. 2/3 of the whole site area with attenuation swales in the southeast and soil bunds / mounds formed along the northern, western and southern margins. The Employment Plot in the centre, south and west is to be split into two separate levels with units on the lower eastern area having proposed finished floor levels (FFL) of 83.80m OD and the unit in the west has a proposed FFL of 85.30m OD. A 'Small Business Allocation' is proposed in the centre / north (FFL of 84.80m OD) while a residential development is proposed in the north and northeast of the site with associated landscaping and 'Play Area'. The development has been split into two phases with Phase I including the lower eastern commercial development plateau, small business allocation, residential development and infrastructure. Phase II comprises the upper western plateau of the employment area.

3.0 DESK STUDY INFORMATION

The desk study findings are summarised below with the full Groundsure Report and selected Historical Ordnance Survey Maps included in Appendix B.

Site History	• **1875-1880 & 1881-1885** – Site and surrounding area is agricultural fields. A footpath transects the site from west to east. There is a drainage ditch/stream along the northeast boundary flowing south/southeast. Parker's Barn is located on the northwest boundary. King's End Farm is located to the east. A kiln, workhouse and hospital are located c.750m to the northeast. • **1898** – Bignell Park is now located to the south on the southern side of the road. A quarry is indicated off the SE corner of site on the opposite side of the crossroads. The kiln NE of the site is now a quarry. • **1919-1923** – The footpath on site is no longer shown. Parker's Barn is renamed Feoffee Barn. The quarry off the SE corner is now labelled 'Old Quarry'. Limekiln Quarry c. 750m NE of the site is now 'Old Quarry'. A limekiln and quarry c.500-600m to the north adjacent to tower and pumping station. A railway now runs east-west 750m N of the site. • **1950** – The hospital NE of the site is now Market End House. • **1966** – The Old Quarry off the SE corner of site is no longer shown on the map. A very small pond c.4m diameter now shown adjacent to the SW corner with another pond indicated along the boundary with Feoffee Barn. The road along the southern boundary is now labelled B4030. • **1967-1971** – The former Limekiln Quarry and surrounding areas have been developed into residential areas. Bicester American Elementary School has been built 250m NE of site. Limekiln and quarry to the north no longer shown. • **1976-1981** – Residential development has extended to within 100m east of site. • **1984**-**1985** – Feoffee Barn is no longer shown on the map. Residential development has expanded up to Howes Lane east of the site. Overhead power lines now transect the southwest corner of site. • **1995** – Police headquarters are located on the former Limekiln Quarry c.500m north. • No further significant changes to present day.
Anticipated Geology and Ground Conditions	• Published BGS Map indicates site underlain by solid geology of the Cornbrash Formation with no overlying drift deposits. • Nearest BGS archive borehole (64m to northeast) indicates Topsoil to 0.7m bgl overlying coarse rubbly limestone with firm to stiff clay becoming very stiff from 1.0m with coarse limestone from 2.4m. • Site is not in a radon affected area, with <1% of homes above the Action Level. No radon protection measures are therefore considered necessary for new properties.

Mining/Quarrying	• Site not indicated to be within area of underground coal or other mining. • Site not in area associated with natural cavity formation. • There are 3 no. historical surface ground workings and 1 no. current ground working (status – ceased) within 50m of site, possibly the old quarry to the southeast. • There is a former quarry and limekiln c.500-600m to the north (1919-1971 historical maps) and a former quarry and kiln c.750m to the northeast (1875-1970 historical maps).
Hydrology	• Nearest surface watercourse is a small stream along the northern boundary of the site which flows to the southeast. • No water quality data available. • There are no surface water abstractions within 500m of site. • There is 1 no. active licensed discharge consent 318m northwest of site for sewage discharges with the receiving water labelled as a tributary of Pingle Stream. • The site is outside of any floodplain.
Hydrogeology	• Cornbrash Formation underlying site is a Secondary A Aquifer. • Nearest groundwater abstraction license is 731m SE – for General Farming and Domestic. • Groundwater Vulnerability is designated as Minor Aquifer/High Leaching Potential. • Likely groundwater flow direction is to the southeast, following topography.
Other Environmental data	• There are 3 no. 'Unspecified Old Quarries' 13-18m S, 1 no.' Unspecified Quarry' 22m S and 2 no. 'Unspecified Heaps' 256-262m SE from between 1880 and 1966 which have been potentially infilled. • 1 no. Unspecified Tank c.6m to west from 1922. • There are 31 Electricity Substations between 109-444m from site predominantly to the southeast/south with 8 to the northeast. • 6 current industrial land usages within 250m. Due to the distance they are not of great significance to site. • 1 no. EA historic landfill 518m to NE at 'Gowell Farm' for inert, industrial, commercial and household waste. • No recorded petrol/fuel site within 500m. • The site is within an existing nitrate vulnerable zone. • No pollution incidents within 250m. • No environmentally sensitive ecological designations within 500m.

4.0 CONCEPTUAL SITE MODEL

4.1 Diagrammatical Illustration

The Conceptual Model for the site, showing the main elements of the surface and subsurface conditions and including the potential contaminant sources, pathways and receptors identified from the desk study information is presented in Appendix A as Drawing No AG2873-18-03. The potential sources, pathways and receptors are defined in the following sections:

4.2 Sources

The findings of the desk study have not identified any obvious sources on site with the exception of:

- Possible pesticides;
- Sulphates in cohesive layers of Cornbrash;
- Hydrocarbons are unlikely to be present, however, this would need to be confirmed by testing.

The former limestone quarry located c.25m from the southeast corner of the commercial development is of limited size (c.30m x 70m), has been infilled for at least 60 years and is not recorded as a landfill. Furthermore, the former quarry is separated from the site by the road, roundabout, associated infrastructure trenches and drainage ditches, which could inhibit the flow of any migrating ground gas. The feature is c.400m from the proposed residential development. The former quarry is therefore not considered a credible source of ground gas.

4.3 Pathways

- Human dermal contact;
- Human ingestion via soil directly or via bioavailable contaminants within vegetables grown in contaminated soils (assuming private gardens are proposed in residential areas);
- Human inhalation of dust or vapours;
- Leaching and/or migration through permeable soils (Cornbrash Formation);
- Direct contact with buried concrete/water supply services.

4.4 Receptors

- End user residents, workers, visitors, customers (Human Health);
- Cornbrash Formation – Secondary A Aquifer (Controlled Waters);
- Stream along northern boundary of site (Controlled Waters);
- Buried foundation/substructure concrete (Building Materials);
- Water supply services (Building Materials).

4.5 Source/Pathway/Receptor Linkage and Assessed Risk

Source-pathway-receptor (SPR) linkages are tabulated below together with the qualitatively assessed risk. The risk to ground workers and construction workers is not included here due to the short-term exposure times that they will be subject to and the assumption that good hygiene practices will be adopted on site and the appropriate use of relevant PPE/RPE will be adhered to when exposed to potentially contaminated soils. Comments regarding contamination issues with respect to ground workers and construction workers are included in the health and safety section of the Standard Procedures included as Appendix F.

Source	Pathway	Receptor	Risk*
Potential contaminants within Topsoil including pesticides.	Inhalation, ingestion, dermal contact.	End users	Low
	Migration and Leaching	Secondary A Aquifer/ watercourse	Low
Elevated sulphates in natural soils	Direct contact, leaching and contact with groundwater	Buried concrete	Low
Hydrocarbon contaminants within soils (not anticipated)	Direct contact	Water supply services	Low-negligible

*** Definition of Risk Categories**

Negligible - Contaminants that might have unacceptable impact on key receptors, are unlikely to be present, or, no pathway is envisaged.

Low Risk: Contaminants may be present but are unlikely to be at levels to have unacceptable impact on key receptors, or pathways are likely to be minimal.

Medium Risk: Contaminants are probably present and might have an unacceptable impact on key receptors. Pathways may also be present therefore remedial measures may be necessary to reduce the risks.
High Risk – Contaminants probably or certainly present and pathways are probably also present. Therefore, contaminants are likely to have an unacceptable impact on key receptors and remedial measures are likely to be necessary to reduce the risks to acceptable levels.

5.0 GROUND INVESTIGATION WORKS

5.1 Fieldwork

The following scope of fieldwork was undertaken:

- 6 No Rotary Cored Boreholes (ref. R1 to R6) to depths of between 6m and 12m below ground level (bgl);
- 59 No Machine Excavated Trial Pits (ref. TP1 to TP59) to depths of between 0.55m and 4.4m bgl.

The borehole and trial pit records are included in Appendix C together with the SPT calibration certificate whilst the in-situ test results are included in Appendix D.

The rotary boreholes were advanced through the stiff strength material using rotary open techniques with SPTs at approximately 1m intervals. Upon encountering hard rock strata drilling progressed via rotary methods using air mist flush and coreline obtaining core of c. 90mm diameter.

The locations of the exploratory holes were selected by Bailey Johnson Hayes, set out on site by Applied Geology and were constrained by crops in the fields and the presence of overhead services. The sampling strategy for the exploratory hole locations was to provide best overall coverage given the access constraints. In general, the trial pits were carried out on an approximate 40-60m grid.

The positions of the exploratory holes were defined by handheld GPS whilst levels were estimated from the nearest spot height /contours on the topographical survey. The locations of the exploratory holes are presented on Drawing No. AG2873-18-02 Rev 3 in Appendix A.

5.2 Instrumentation and Monitoring

On completion of boring, 50mm inside diameter HDPE standpipes were installed in all boreholes as detailed below, with further details included in the relevant borehole logs in Appendix C:

- R1, response zone 7.0 to 12.0m bgl, in Cornbrash Formation;
- R2, response zone 7.0 to 11.5m bgl, in Cornbrash Formation;
- R3, response zone 9.5 to 11.5m bgl, in Cornbrash Formation;
- R4, response zone 8.5 to 11.5m bgl, in Cornbrash Formation;
- R5, response zone 9.0 to 12.0m bgl, in Cornbrash Formation;
- R6, response zone 3.0 to 6.0m bgl, in Cornbrash Formation.

Washed quarzitic gravel (6-10mm) was used as the filter medium with a hydrated bentonite seal installed above. Each standpipe was fitted with a flush metal cover concreted in place. Monitoring visits for groundwater level were undertaken on four occasions between the 24th of August 2018 and the 19th of September 2018. The monitoring results are included in Appendix D. The standpipes were developed on

the first visit and then R1, R3, R4 and R6 were sampled using volume purge methods on the second visit with samples dispatched to the laboratory for analysis.

5.3 Laboratory Testing

Geotechnical laboratory testing was undertaken generally to BS1377 on selected samples and comprised the following:

- 26 No natural moisture content tests;
- 26 No Atterberg limit tests;
- 6 No particle size distribution test;
- 6 No particle density test;
- 6 No Moisture Content / Dry Density Relationship – 2.5 kg rammer;
- 6 No Moisture Content / Dry Density Relationship – 4.5 kg rammer;
- 10 No BRE SD1 Greenfield suite tests;
- 10 No BRE SD1 Greenfield and pyrite suite tests;
- 27 No Franklin point load tests to ISRM 1985;
- 9 No Unconfined compressive strength (UCS) to ISRM 1985.

Chemical testing was undertaken based upon the desk study, walkover and site observations during the fieldwork. 13 no. samples of the Topsoil and 17 no. samples of the Cornbrash Formation were analysed for the following suite of contaminants:

- Selected metals suite [arsenic, cadmium, chromium (total), copper, mercury, nickel, lead, zinc, selenium];
- Speciated (16 US EPA) Polycyclic Aromatic Hydrocarbons (PAH);
- pH;
- Water soluble sulphate;
- Soil organic matter.

Three samples from each field (9 no. total) were submitted for Total Petroleum Hydrocarbon (TPH) to the Criteria Working Group (CWG) methodology, together with benzene, toluene, ethylbenzene, xylene (BTEX) and methyl-tert-butyl ether (MTBE). Six samples of Topsoil and three samples of the Cornbrash were screened for the presence of asbestos containing material (ACM) within the soil. Six samples of Topsoil and six samples of the Cornbrash were tested for a targeted pesticide suite. Three samples of Cornbrash were tested for inert waste acceptance criteria (WAC).

Four water samples taken during the 2nd monitoring phase were analysed for the following suite of contaminants:

- Selected metals suite [arsenic, boron, beryllium, cadmium, chromium (total), copper, mercury, nickel, lead, zinc, selenium, vanadium];
- Speciated (16 US EPA) Polycyclic Aromatic Hydrocarbons (PAH);
- pH;
- Sulphate;
- Hardness;
- TPH (CWG speciation including BTEX + MTBE) semi-volatile organic compounds (SVOC) and volatile organic compounds (VOC).

Laboratory test results are included in Appendix E.

6.0 GROUND CONDITIONS

6.1 Strata Encountered

Topsoil was encountered from ground level across the whole site, generally to depths of 0.25m to 0.35m bgl but locally up to 0.7m bgl overlying weathered limestone of the Cornbrash Formation. The Cornbrash Formation comprised bands of limestone interbedded with clay bands. Full details of the strata encountered are given on the borehole records presented in Appendix C.

6.2 Topsoil

Agricultural soils were recorded across the site to a generally to a depth of between 0.25m and 0.35m bgl but locally to 0.70m bgl (TP15) directly overlying the in-situ natural Cornbrash Formation strata. The Topsoil comprised soft dark brown sandy silty clay with limestone and rare quartzite pebbles. Frequent rootlets and occasional roots <8mm diameter were also noted.

6.3 Cornbrash Formation

The Cornbrash Formation was recorded directly beneath the Topsoil in all of the locations across the site. The Cornbrash Formation generally comprised an initial shallow limestone band overlying clay which is underlain by a deeper limestone band. The shallower limestone was recovered as clayey sandy gravel, the clayey sandy matrix was orangish brown and the limestone was grey, light grey, and bluish and greenish grey.

Where shallow (<2m bgl) limestone was encountered, this was fully penetrated with the excavator (8T wheeled backhoe 'JCB 3CX') in 34 of the 59 trial pit locations using a toothed bucket with qualitative ease of dig noted as 'moderate' to 'hard'. However, the limestone was significantly harder to dig from shallow depth in 18 trial pits resulting in the pits being terminated at depths of between 0.55m and 1.4m bgl. The locations of the 'hard to dig' limestone at shallow depth were generally in the southwest corner (TP1, TP11 and TP12), southeast corner (TP38, TP 39 and TP40) and in the north of the site (TP31, TP32, TP46, TP47, TP's 50-53 and TP59). Where deeper limestone was encountered at depths of between 1.9m and 3.3m bgl this was also too hard to penetrate with the plant used.

Two trial pits encountered clay to depth (TP8 and TP14). Five trial pits encountered firm to stiff light brown and bluish grey sandy silty clay with rare limestone gravel overlying the deeper limestone (TP15, TP19, TP22, TP24 and TP55). The remaining thirty-four trial pits encountered the shallow limestone overlying clay.

Two of the rotary cored locations encountered clay with limestone gravel at shallow depths (R1 and R5). The remainder of the rotary cored locations encountered limestone directly below the Topsoil. The deep Cornbrash Formation encountered in the rotary cored locations from depths between 1.88m and 3.40m bgl comprised a series of interbedded stiff clay and generally 'weak', occasionally 'very weak' and 'strong' to 'medium strong' limestone horizons (strength terms from BS EN 14689-1:2003). Pyrite speckling (possible representing sulphates) was encountered only in R3 between 8.90m and 8.93m and also between 9.03m and 9.07m bgl.

The results of twenty-five Atterberg Limit tests on samples of the Cornbrash Formation have given variable results with two thirds of uncorrected Plasticity Indices within the range of 10% and 21% and the final third between 25% and 33% giving a modal average of 21%. Corrected Plasticity Indices ranged from 7.5% to 25% with two higher outliers of 28% and 31%. Liquid limits were generally between 30% and 42% with two lower values of 27% and nine higher results of between 48% and 65%.This indicates the clays to be of low to medium plasticity and low to medium shrinkability. Moisture contents of between 8.1% and 24% were also recorded.

Uncorrected SPT 'N' values in cohesive Cornbrash Formation were recorded between 39 and >50. Using the empirical relationship between SPT 'N' and undrained shear strength together with the mean Plasticity Index of 21% and corresponding f_1 value of 5.4 (after Stroud), an equivalent shear strength range of between c.200kN/m^2 and c.>270kN/m^2 (very high shear strength) is indicated. An SPT 'N' versus depth plot is included in Appendix A.

The results of five particle size distribution tests on samples from TP8, TP14, TP15, TP19 and TP22 have indicated proportions of gravel ranging from 2.1% to 52.40%,sand from 8.1% to 33.3% and fines from 27.5% to 89.8%.

The results of five light compaction (2.5kg rammer) and five heavy compaction (4.5kg rammer) tests on samples from TP8, TP14, TP15, TP19 and TP22 at depths of between 0.5m and 0.7m bgl returned maximum dry densities of between 1.56Mg/m^3 and 1.76Mg/m^3 for light compaction and 1.70Mg/m^3 and 1.94Mg/m^3 for heavy compaction respectively. Optimum moisture content results for the compaction tests were recorded at between 17% and 21% for light compaction and between 11% and 17% for heavy compaction respectively. The same five samples were also submitted for particle density determinations and recorded results of between 2.54Mg/m^3 and 2.69Mg/m^3.

Unconfined compressive strength (UCS) testing was carried out on samples of the 'hard limestone rock' from recovered core and these tests have given results of between 3.4 and 51.2MPa (corresponding generally with technical rock strengths in the range of weak to medium strong - BS EN 14689-1:2003 strength terms). A UCS Vs depth plot is included in Appendix A and this indicates a wide range of values between c. 5 and 51.2MPa between 3.5m to 6m whilst more consistent values of between 3.4 and 15MPa were recorded between 9.5m and 11m bgl.

Point load tests were also undertaken by Applied Geology on selected limestone core samples recording Is_{50} values of between 0.05 and 4.39MN/m^2 for the axial tests and 0.04 and 3.36MN/m^2 for the diametrical tests.

The UCS and Point Load results have been plotted against depth (in Appendix A) however, both plots appear to show no general trend in distribution.

6.4 Groundwater

Groundwater was encountered in four of the six boreholes during drilling (R2, R3, R4 and R5) at depths of between 7.3m and 9.5m bgl. The groundwater recorded in R4 was initially struck at 8.5m bgl and rose to 1m above ground level after 20 minutes indicating artesian pressure. During subsequent monitoring groundwater was recorded at generally between 1.60m and 2.60m bgl, with the exception of R4 (the location where sub-artesian groundwater was recorded during drilling) where levels

as shallow as 0.91m bgl were recorded and at R5 on visit 1 where a level of 1.0m bgl was recorded. The deepest groundwater was generally recorded in the north and west of the site and the shallowest groundwater was in the centre and east of the site. From a study of the reduced groundwater levels (mOD) a flow direction towards the east can be inferred generally following the topography.

6.5 Contamination

No obvious visual or olfactory evidence of contamination was observed during the field work.

7.0 GEOENVIRONMENTAL ASSESSMENT

7.1 Human Health Risk Assessment

The results of the chemical testing on soils have been assessed as described in Appendix F, with specific details as follows:

- Proposed end-use – predominantly commercial end use with residential area in the north of site;
- Assuming two datasets based on the site's history and the proposed redevelopment (1) Residential and (2) Commercial;
- Screening criteria – (1) as details of proposed developments not know both residential with and without plant uptake criteria have been used, assuming 2.5% SOM;
- Screening criteria – (2) commercial, assuming 6% SOM.

The spreadsheets summarising the laboratory results and relevant screening values for each dataset are presented in Appendix E.

Residential Dataset

In the dataset for the area allocated for residential use, the majority of the determinands were either below the limit of detection or below the relevant screening value with the exception of Arsenic where four samples of the natural Cornbrash strata (TP50, TP55, TP56 and TP57) recorded values of between 40 and 43mg/kg, which exceeds the screening value for arsenic for residential with plant uptake (37mg/kg) and also three of the samples exceed the residential without plant uptake value (40mg/kg). These exceedences are considered marginal and, as they are all from natural Cornbrash strata allied to no plausible on-site sources of arsenic, are likely to be natural background levels resident in the local geology and therefore not indicative of contamination.

The results of the hydrocarbons testing recorded values of below the laboratory limit of detection.

The results of targeted pesticide suite testing recorded results below the laboratory limit of detection.

The asbestos screening tests did not detect the presence of ACM.

Commercial Dataset

The determinands in the second dataset all fall below either the limit of detection or the corresponding screening value for a commercial end use.

The results of the hydrocarbons testing recorded values of below the laboratory limit of detection.

The asbestos screening tests did not detect the presence of any ACM.

7.2 Controlled Waters Risk Assessment

The exploratory locations did not encounter Made Ground and no visual or olfactory contamination was observed. The laboratory testing on soil samples has not recorded any concentrations of any contaminants above what could be deemed typical background concentrations and many of the determinands were recorded at less than detection limits.

Groundwater was encountered in all of the boreholes and groundwater from selected boreholes were sampled and submitted for contamination analysis for a range of commonly occurring contaminants. The spreadsheet summarising the laboratory results and relevant screening values are presented in Appendix E. The determinands typically fell below either the limit of detection or below the relevant screening value with the exception of one concentration of sulphate (310mg/l) in R3 within the natural Cornbrash Formation, which slightly exceeds the UK DWS (250mg/l). However, UK DWS are not considered wholly relevant to the hydrogeological regime beneath the site and have been used as an initial screen only and this together with the marginal nature of the exceedance suggests the concentration is not a concern to controlled waters receptors. Sulphate is mainly an issue for buried concrete design included in Section 8.0.

Based on the context of the site and the proposed redevelopment, there is considered to be a negligible risk to Controlled Waters.

7.3 Disposal of Soil Arisings

General comments regarding the procedures for the assessment of waste soil for off-site disposal purposes is included in Appendix F. As requested, waste acceptance criteria (WAC) tests were undertaken on three samples of natural soil and the results demonstrate compliance with the WAC limits for inert landfills.

It is recommended that the results are provided to the proposed landfill site for confirmation of waste classification.

7.4 Conclusions and Recommendations of Geo-Environmental Assessment

The site is essentially a greenfield site and no sources of contamination were identified. The above risk assessments have established a negligible risk to human health and controlled water receptors. It is therefore, considered that remedial actions are not warranted for this development and no further assessment is required for the commercial development areas.

Issues with respect to ground gas and potential effects of contaminants on buried concrete and water supply pipework are included in Section 8.0.

8.0 GEOTECHNICAL ASSESSMENT

8.1 General

The outline proposals provided to date indicate the commercial development in the centre and south of site comprises five portal frame units with associated parking and loading/service areas as well as roads and infrastructure. The small business development area in centre/north is currently understood to comprise seven small units. No specific details have been given about the residential area at the time of writing. There are swales indicated in the east and centre/north of site, a 'Play Area' in the centre/north and a foul water pumping station in the northeast and the south of the northern field. Landscaping and public open space areas are indicated to be included as part of the development. It is understood that a scheme of cut and fill earthworks will be required to create the required levels for the development. The cut and fill balance is not yet available, although the existing topography suggests that the west/northwest of the site will be cut with the fill placed over the east/southeast of the site.

The investigations have identified Topsoil (around 0.3m thick) underlain by the Cornbrash Formation, which is generally weathered to a clay in the upper horizons with limestone rock bands variably above at shallow depth from 0.55m and below from 4.40m. Artesian water pressure was encountered at 8.50m in R4 during drilling but subsequent monitoring showed the water level to be just below ground and slightly deeper (up to c.2.5m) in other installations. However, groundwater levels are likely to exhibit seasonal fluctuations.

8.2 Earthworks

Based upon the proposed finished floor levels of the commercial areas, and a review of the existing topography, a maximum cut in the order of 1m has been estimated from the northwest of the Phase 2 area and a corresponding maximum fill of c.1m in the southeast of the Phase 2 area (FFL of 85.30m OD) in order to create level plateaus for the proposed units. The earthworks in the Phase 1 area are estimated at up to a maximum of 0.5m of cut in the west and between 0.5m to 1.5m of fill in the east (FFL of 83.80m OD). The small business allocation in the centre / north of the site is estimated to require <0.5m of cut and up to c. 1m of fill (FFL of 84.80m OD).

Samples from the Cornbrash Formation strata encountered in areas of possible cut from the west of the site have been tested for earthworks suitability and the results of the testing are included within Appendix E.

The classification of soils has been made with respect to the general requirements given in the Manual of Contract Documents for Highway Works, Specification for Highway Works: Volume 1: 2009 [SHW] for use as Earthworks Material and BS 6031:2009 'Code of Practise for Earthworks'. It should be noted and clear reference made to the fact that the engineering performance of an earthworks material can be greatly influenced by the moisture content at time of assessment and excavation/placement and compaction. With variation in the moisture content, the end performance of a material can be both improved and reduced, and consideration should be given to the management of the moisture as a key element of any

earthworks control. With respect to this, the information included in the following sections should be used for guidance on the potential use of the material, with additional testing required prior to use to confirm acceptability.

The grading limits chosen for comparison to the results of the laboratory analysis were taken from the SHW Table 6/2, with the description of the material being referenced from SHW Table 6/1 and Table 6/2. Both light (2.5kg rammer) and heavy (4.5kg rammer) compaction tests, together with particle size distribution, plasticity index, moisture content and particle density analyses were carried out on six samples of the cohesive Cornbrash Formation strata. The results of the testing are summarised in the table below.

Particle Density (Mg/m^3)	Plastic Limit (%)	Natural moisture content (%)	Optimum moisture content (%)		Maximum dry density (Mg/m^3)		Material class (SHW Table 6/2)	SHW description (SHW Table 6/1)
2.54 – 2.75	22 – 34	14 – 24	17 – 24 (2.5kg)	11 – 17 (4.5kg)	1.56 – 1.76 (2.5kg)	1.70 – 1.94 (4.5kg)	2C (2no.) & 2B (4no.)	Stoney cohesive & Dry cohesive General Fill

It is likely that during earthworks and mass excavation materials in some areas of the site will contain a variable proportion of limestone gravel, which will likely dictate the material class (i.e. 2C or 2A/2B). It is also likely there will be some oversized limestone fragments arising from excavations on site that may require screening, segregation and/or crushing.

The results of twenty-five Atterberg limit tests indicate the cohesive Cornbrash Formation materials to have plasticity index values generally of between 20% and 33% with nine results recorded in a lower range of between 10% and 19%. Natural moisture contents for the strata ranged between 8.1% and 24%. Assessing these results in isolation from gravel content / grading analysis, half of the results (13no.) would be classified as Class 2B (Dry Cohesive), 8no. samples would be classed as 2A (Wet Cohesive) and 5no. would be borderline Class 2A/2B.

Based on the assumption that the Earthworks Specification will require a minimum 100% dry density of the 2.5kg rammer tests and less than 5% air voids, the recorded natural moisture contents indicate that 28 of the 30 results fall within the likely acceptability envelope (moisture contents of between 11.5% and 26.5%) and therefore, within an acceptable range of moisture contents for use as general fill in the cut and fill exercise. Although there is some variance in the compaction, plasticity and moisture content results. The remaining two results are slightly dry of the acceptability envelope and may require some moisture modification prior to use.

There could be an option to use lime or cement to modify the moisture content of overly wet fill or stabilise soft materials. However, should this option be chosen then careful consideration would need to be given to the recorded values of total potential sulphate within the Cornbrash Formation soils. The British Insitu Paving Association document ‘Stabilisation of Sulphate Bearing Soils – Guidelines for Best Practice’ recommends that disruption associated with sulphate expansion is greatly enhanced at Total Potential Sulphate (TPS) concentrations above 0.25%. On the basis of these test results the use of lime/cement to assist with moisture modification of the

proposed fill materials will need careful consideration and cement/lime suitability laboratory testing may be worth consideration.

It will be necessary to produce a detailed specification for the earthworks detailing methods, controls and verification testing with target end performance criteria. This could initially be based upon the guidance in the Manual of Contract Documents for Highway Works, Specification for Highway Works: Volume 1: 2009 [SHW] and BS 6031:2009. Prior to any filling, proposed formation levels should be stripped of Topsoil and any other soft, organic, desiccated, loose or otherwise unsuitable materials and proof rolled. Further laboratory testing to assess the acceptability of materials will be required prior to filling. It is recommended that validation of the earthworks is carried out by an independent party.

8.3 Foundation Design

General

It is considered that the in-situ Cornbrash Formation strata at the site are suitable to support conventional strip/trench fill or pad foundations. These must be placed below any disturbed ground and also beneath any soft or loose natural materials. It will be necessary to embed the foundations within the in-situ more competent Cornbrash Formation strata beneath these materials.

A minimum founding depth of 0.9m will also apply to the site to allow for seasonal effects, unless foundations are placed on 'solid' limestone. Further deepening will be required in the influencing area of any existing, recently felled or proposed trees/ shrubs in accordance with current guidance, such as the NHBC Chapter 4.2. In particular care will be needed to ensure that foundations are placed below any potentially desiccated soils in the areas of the existing hedgerows on the site. All foundations below 1.5m bgl will require anti-heave precautions in line with current standards and according to location.

It is possible that foundation excavations may span both clay and limestone strata and it is recommended that where this occurs light mesh reinforcement is included to mitigate the effects of any potential minor differential settlement.

If ground conditions, significantly at variance to those described herein are encountered, specialist geotechnical advice should be sought to make appropriate assessment and recommendations with regards to foundations.

Commercial Development

For industrial units (and any residential apartment blocks) strip/trench fill (up to 1m wide) and pad foundations (up to 2m x 2m) competently designed to the above requirements may adopt an allowable bearing pressure of up to 150kN/m^2. This is based on lower-bound shear strength parameters and using traditional methods of bearing capacity assessments e.g. as set out in Tomlinson 7th Edition to provide a factor of safety of 3 against bearing capacity failure whilst limiting total settlements to less than 25mm.

From a study of the existing topography it is possible that up to 2m of engineered fill will need to be placed beneath parts of some of the units. As such, where founding on engineered fill is necessary it should be possible to achieve an allowable bearing

pressure in the order of 100-125 kN/m^2 for strip/pad foundations with dimensions as assumed above, provided that an adequate Earthworks Specification is adopted. This should include requirements such as minimum compaction (100% of the 2.5kg rammer maximum dry density), minimum air voids (<5%), minimum shear strength (>50 kN/m^2) and minimum CBR (>5%).

Residential Development

It is considered that traditional housing could be supported upon strip/trench fill footings of standard dimensions supported upon the in-situ Cornbrash Formation strata. Subject to the final proposed layout the developer may wish to carry out supplementary investigation and testing to confirm specific design information for this area, particularly if houses are to be located on areas of fill.

8.4 Floor Slabs

Commercial

Following earthworks it is anticipated that formation soils will comprise a combination of Cornbrash Formation and Engineered Fill. Provided that any softened/loosened or desiccated materials (such as may be present beneath former hedgerows) are removed from beneath the cut formation, the formation is proof rolled and Engineered Fills are placed to a suitable specification and verified a ground bearing slab constructed on a granular mattress of appropriately designed thickness is considered suitable. Given that the estimated thickness of fill beneath some parts of the slabs will be less than 1.5m and provided the fill is placed to a good quality under strict control then differential settlement is expected to be small.

Residential

NHBC guidance suggests ground bearing floor slabs may be adopted where the depth of Made Ground is <0.6m and where there is no risk of ground heave. Given the presence of shrinkable soils together with hedgerows along field boundaries it is considered likely that floor slabs will need to be fully suspended over a ventilated void for plots in some areas. However, where plots are located away from hedgerows / trees and Made Ground is <0.6m thick then ground bearing slabs may be feasible according to location. Plot specific assessment would be required.

8.5 Excavations

Excavations for the foundations and service trenches are expected to be in firm to stiff Cornbrash Formation clay. Limestone bands should be expected (c. 0.3-1.1m thick) within the Cornbrash Formation strata, which may require more powerful and larger excavation plant and / or breakers. The trial pits suggest that these materials may be stable in open vertical cut in the very short term, although they may become unstable if left open for longer periods potentially leading to catastrophic sudden collapse. Trench support or the angle of batter should be designed by an appropriately qualified engineer or competent person to suit the required depth and the ground and groundwater conditions. Any trenches requiring man access will require appropriate supports and assessments in line with current guidance and legislation.

Whilst standing water levels in the standpipes were relatively shallow in places these relate potentially to sub-artesian water strikes at depth and observations of the trial pits indicated only seepages in the upper c.2-2.5m. Therefore, significant groundwater ingress is not expected, although it is recommended that some provision for obtaining sump pumping equipment is made to control any minor seepages or localised flows from limestone bands and run off in wet weather conditions.

8.6 Pavement Design

As part of the site preparation, Topsoil should be stripped from the development areas.

Based on a review of classification testing, soil type, construction conditions and reference to IAN 73/06, an equilibrium CBR value of 5% is recommended for the Cornbrash Formation clays.

An equilibrium CBR value for the proposed engineered fill will be governed by the Earthworks Specification and the quality of the compaction and moisture control of the filling operation. However, provided the filling is carried out competently and is closely controlled and validated then typically a minimum CBR value of 5% can be achieved.

Based on the measured plasticity the Cornbrash Formation materials are considered unlikely to be frost susceptible.

8.7 Soakaways / Site Drainage

The ground conditions underlying the site comprise dominant clay with subordinate hard limestone rock bands. These conditions are anticipated to be practically impermeable / of very low permeability. Hence, conventional soakaways are not considered viable and an alternate off-site drainage solution is recommended. Specific soakaway or permeability testing have, therefore, not been carried out as part of this investigation.

8.8 Buried Concrete and Services

As defined by BRE Special Digest 1, Concrete Aggressive Ground, 2005 the Design Sulphate Class and the Aggressive Chemical Environment for Concrete (ACEC) has been assessed for the Cornbrash Formation. Of the 10No. pyrite suite tests, one of the samples indicated that the Cornbrash Formation is ‘potentially pyritic’. Following the results of the geotechnical testing, the characteristic values for the Cornbrash Formation have been determined as below:

- water soluble sulphate: 350mg/l;
- total potential sulphate: 0.3%;
- pH: 7.9.

The results of the sulphate tests carried out have identified the Design Sulphate Class to be DS-2 with the Aggressive Chemical Environment for Concrete (ACEC) being AC-2 (assuming mobile groundwater) as defined by the BRE Special Digest 1, Concrete Aggressive Ground, 2005 for a Greenfield site and mobile groundwater regime. Further reference should be made to BRE Special Digest 1 for requirements

in respect of types of cement and aggregate to be used and variations in type of concrete construction.

The current sulphate assessment included 10no. total potential sulphate results, one of which is elevated, which has resulted in the DS-2 classification. However, with further sampling and testing it may be possible to statistically demonstrate that DS-1 conditions are appropriate.

The results of the laboratory testing undertaken have indicated concentrations of TPH at less than the threshold for Polyurethane pipes. Barrier supply pipes, therefore, may not be necessary on this site. It should be noted that the full suite of testing required by the UKWIR guidance has not been undertaken as part of this investigation and such testing may be required by the Water Authority once the pipeline routes are known. Further guidance on this subject is included within Appendix F.

8.9 Conclusions and Recommendations of Geotechnical Assessment

Traditional pad or trench fill foundations are considered feasible bearing within the stiff clay of the Cornbrash Formation adopting allowable bearing pressure of up to 150kN/m^2 whilst limited total settlement of <25mm.

A detailed Earthworks Specification is considered necessary for the scheme to stipulate the appropriate end performance of the fill as floor slabs, roads and potentially also foundations will bear upon the fill. In addition, local slopes to the proposed cut/fill plateaus will be composed of fill and hence the earthworks will need to be of a high standard.

Ground bearing floor slabs constructed on a granular mattress should be suitable for the commercial units provided that any softened/loosened or desiccated materials are removed, the formation is proof rolled and Engineered Fill is placed to a suitable specification.

Floor slabs for the proposed housing will need to be suspended in proximity to trees (due to the presence of shrinkable soils) in accordance with NHBC standards. Ground bearing floor slabs may be feasible for locations away from trees where Made Ground is <0.6m thick.

Gas protection measures are not considered necessary and no radon protection measures are required for either the commercial or residential areas.

The ground conditions underlying the site are anticipated to be practically impermeable/of very low permeability. Hence, conventional soakaways are not considered viable and an alternate off-site drainage solution is recommended.

Sulphate resisting concrete will be required in line with DS-2 AC-2 for foundations placed in contact with the Cornbrash Formation. Further testing may allow this class to be downgraded to DS-1 and remove the need for sulphate resisting concrete.

Applied Geology Limited
Unit 23
Abbey Park
Stareton
Kenilworth
Warwickshire
CV8 2LY

Tel: 02476 511822

APPENDIX D

EA Flood Map for Planning

Flood map for planning

Your reference	Location (easting/northing)	Created
Axis J9, P3	**456540/223265**	**25 Aug 2021 15:07**

Your selected location is in flood zone 1, an area with a low probability of flooding.

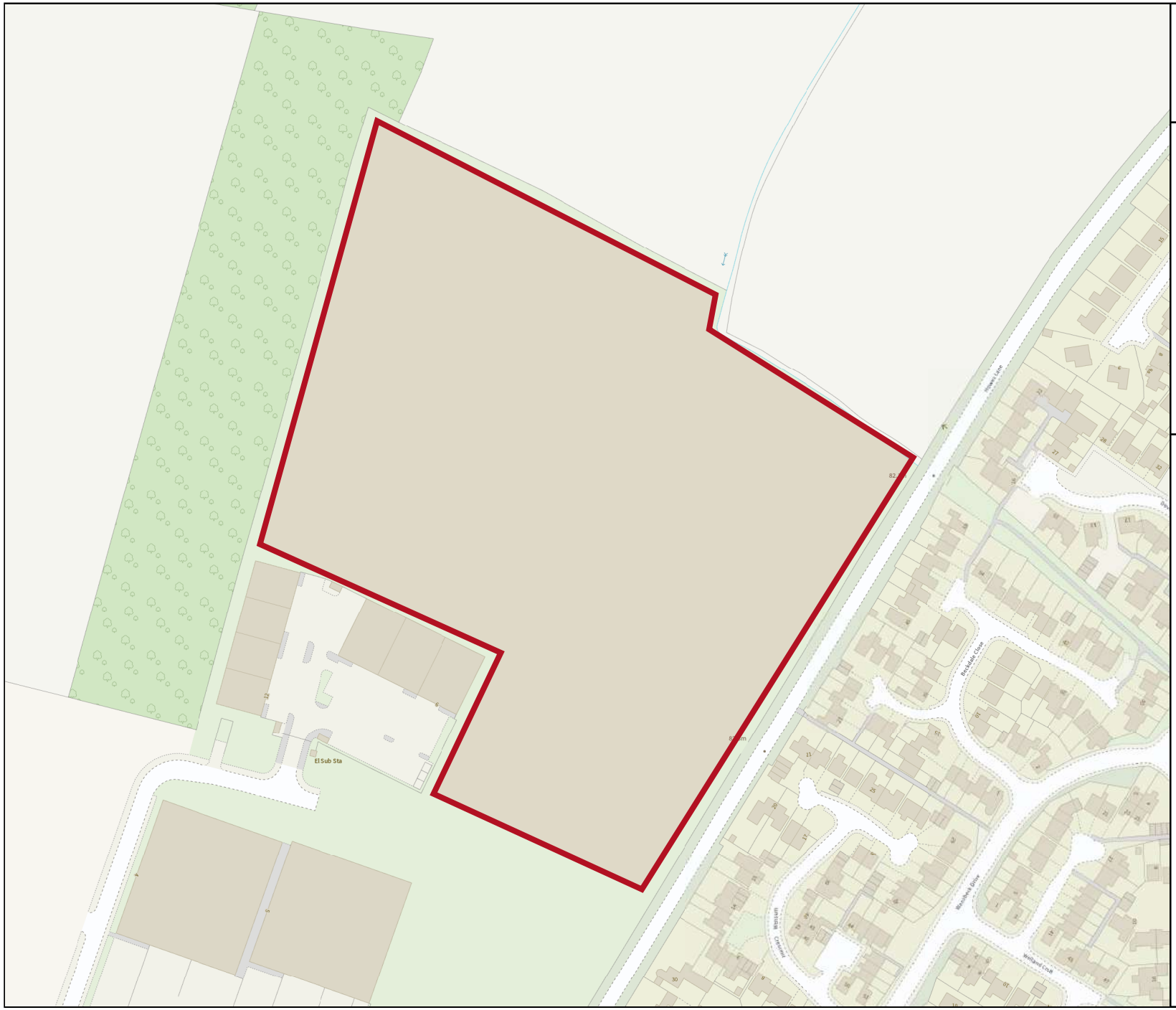
This means:

- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage problems

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.



Environment Agency

Flood map for planning

Your reference
Axis J9, P3

Location (easting/northing)
456540/223265

Scale
1:2500

Created
25 Aug 2021 15:07

- Selected area
- Flood zone 3
- Flood zone 3: areas benefitting from flood defences
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Flood storage area

0 20 40 60m

APPENDIX E

BJH Concept Drainage Plans:

S1209-PH3-02F – SW Drainage Layout
S1209-PH3-03F – FW Drainage Layout
S1209-PH3-04E – External Works & Levels

A1

SURFACE WATER MANHOLE / INSPECTION CHAMBER SCHEDULE

MH REF	CL	IL	DEPTH	DIA	OPENING	COVER	COMMENTS
S1	83.500	81.250	2250	1800	2/600x600	B125	Hydrobrake 7 l/s + Wier Overflow 82.900m
S2	84.100	81.400	2700	1800	600x600	B125	300mm Catchpit
S3	84.100	81.850	2250	1800	600x600	B125	.
S4	83.600	81.950	1650	1800	600x600	D400	.
S5	83.700	82.200	1500	1500	600x600	D400	.
S6	83.700	82.425	1275	1350	600x600	D400	.
S7	83.700	82.225	1475	1200	600x600	D400	300mm Catchpit
S8	84.100	82.450	1650	1200	600x600	B125	.
S9	84.100	83.000	1100	600	600x600	B125	600m Dia. PPIC 150mm Concrete Encased
S10	84.100	82.100	2000	1200	600x600	D400	.
S11	84.100	82.950	1150	1200	600x600	D400	.
S12	83.800	82.125	1675	1200	600x600	D400	300mm Catchpit
S13	83.800	81.975	1825	1200	600x600	D400	300mm Catchpit
S14	83.800	82.350	1450	1200	600x600	D400	300mm Catchpit
S15	83.850	81.725	2125	1350	600x600	B125	.
S16	84.100	82.100	2000	1350	600x600	B125	.
S17	84.100	82.250	1850	1350	600x600	B125	.
S18	84.100	82.425	1675	1200	600x600	B125	.
S19	84.000	82.775	1225	1200	600x600	D400	.
S20	84.000	82.050	1950	1200	600x600	D400	300mm Catchpit
S21	84.150	82.350	1800	1350	600x600	D400	.
S22	84.150	82.500	1650	1350	600x600	D400	.
S23	84.200	82.675	1525	1200	600x600	D400	.
S24	84.300	83.100	1200	1200	600x600	B125	.
S25	84.200	82.200	2000	1200	600x600	D400	300mm Catchpit
S26	84.200	82.875	1325	1200	600x600	D400	.
S27	83.000	80.950	2050	1800	2/600x600	B125	Hydrobrake 3 l/s + Wier Overflow 82.300m

PERMEABLE PAVING SCHEDULE

AREA REF	IL	LENGTH	WIDTH	AREA	DEPTH	VOLUME	COMMENTS
AREA 1	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 2	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 3	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 4	83.400 - 83.050	38.0m	32.2m	1150m2	0.4m	N/A	Perm. paving for water quality treatment only
AREA 5	83.400 - 83.000	38.0m	16.0m	608m2	0.4m	N/A	Perm. paving for water quality treatment only

NOTE: ALL RWP PIPE POSITIONS TO BE AGREED WITH ARCHITECT

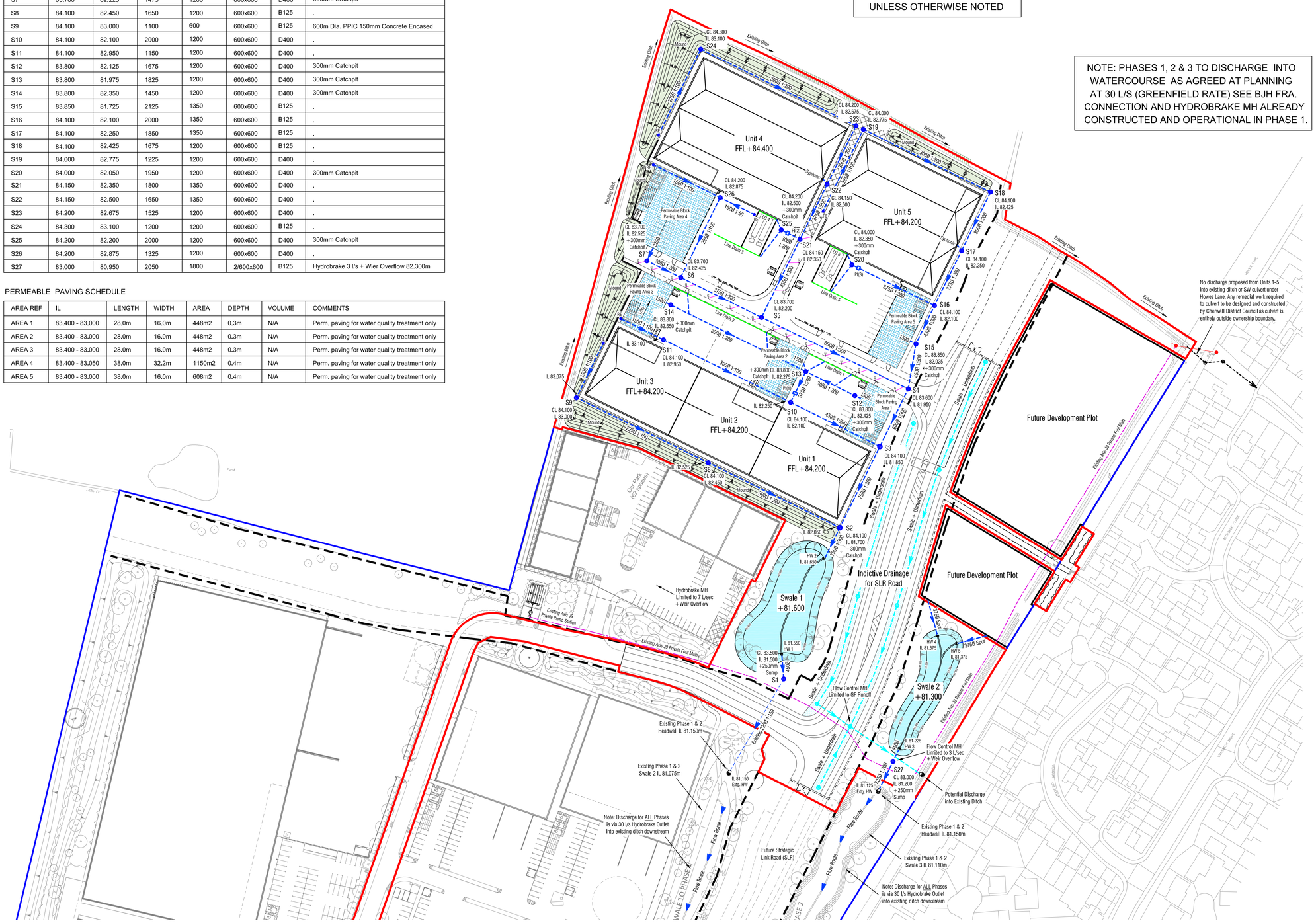
NOTE: ALL DRAINAGE IS INVERT TO INVERT MANHOLE DESIGN UNLESS OTHERWISE NOTED

DRAINED AREAS	STORAGE VOLUMES
UNITS 1-5 - 26,000 m2	SWALE 1 - 2,090 m3
FUTURE - 10,000 m2	SWALE 2 - 805 m3
TOTAL = 36,000 m2	TOTAL = 2,895 m3

MAXIMUM DISCHARGE WESTERN PLOT = 7 l/sec

MAXIMUM DISCHARGE EASTERN PLOT = 3 l/sec

NOTE: PHASES 1, 2 & 3 TO DISCHARGE INTO WATERCOURSE AS AGREED AT PLANNING AT 30 L/S (GREENFIELD RATE) SEE BJH FRA. CONNECTION AND HYDROBRAKE MH ALREADY CONSTRUCTED AND OPERATIONAL IN PHASE 1.



Phase 3 SW Drainage Layout 1:1000

20m 10m 0 20m 40m 60m

Scale 1:1000 @A1

DRAINAGE NOTES

1 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND BAILEY JOHNSON HAYES DRAWINGS AND SPECIFICATIONS.

2 DRAINS TO BE 'HEPWORTH SUPERSLEEVE' LAID IN CLASS S BEDDING TO BS 882 1983; TABLE 4, OR TO BS 8301 1985; APPENDIX D. 450 DIA DRAINS AND ABOVE TO BE HEPWORTH CONCRETE PIPES CLASS H . OR EQUAL APPROVED DRAINS WITHIN THE SITE MAY BE THERMOPLASTIC STRUCTURED WALL PIPE IN ACCORDANCE WITH CLAUSE E2.22 OF SFA 8th EDITION

3 ALL TRENCHES WITHIN TRAFFICKED AREAS TO BE BACKFILLED WITH 75 MM DOWN GRADED STONE FILL, PLACED AND COMPACTED IN 150 MM LAYERS. ALL PIPES IN ROADWAYS, SERVICE YARDS AND CARPARKS LESS THAN 1200 MM DEEP TO BE ENCASED IN CONCRETE. PROVIDE FLEXIBLE JOINTS AT 3 METRE CENTRES.

4 MANHOLES TO BE CONSTRUCTED IN PRECAST CONCRETE RINGS TO BS 5911: PART 1. RINGS TO BE BEDDED IN SEALANT STRIPS.

5 MANHOLES IN FOOTPATHS OR LANDSCAPED AREAS TO BE BACKFILLED WITH 40 MM DOWN GRADED STONE FILL, COMPACTED IN LAYERS NOT EXCEEDING 150 MM THICK. MANHOLES BENEATH ROADS AND PARKING AREAS TO BE CASED IN 150 MM CONCRETE SURROUND.

6 ALL CONNECTIONS TO RAIN WATER PIPES TO BE PROVIDED WITH RODDING ACCESS.

7 ALL ROAD GULLIES TO BE HEPWORTH ROAD GULLIES., REF RGR4, WITH 150 MM DIAMETER OUTLETS. GULLIES TO BE ENCASED IN 150 MM MINIMUM CONCRETE.

8 DRAINS UNDER BUILDING AND WITHIN 300 MM OF THE UNDERSIDE OF FLOORSLAB TO BE ENCASED IN 150 MM CONCRETE. CASING TO INCORPORATE FLEXIBLE FIBRE BOARD JOINTS AT SPACINGS AS RECOMMENDED BY THE PIPE MANUFACTURER. DRAINS UNDER BUILDINGS GENERALLY TO HAVE MIN 100 FULL GRANULAR SURROUND TO CLASS S BS8301

9 WHERE PIPES RUN THROUGH GROUND BEAMS, FLEXIBLE JOINT CASINGS AT EACH FACE OF THE GROUND BEAM ARE TO BE PROVIDED. PIPES WHICH RUN UNDER GROUND BEAMS TO BE PROTECTED WITH 50 MM MINIMUM POLYSTYRENE PLACED OVER THE CROWN OF THE PIPE.

10 ALL WORK TO EXISTING PUBLIC SEWERS TO BE IN ACCORDANCE WITH SEWERS FOR ADOPTION 8TH EDITION AND BS 8301 : CODE OF PRACTICE FOR BUILDING DRAINAGE

11 WHERE DRAINS RUN CLOSE TO BUILDINGS AND INVERT LEVELS ARE BELOW FOUNDATIONS THE DRAINS SHOULD BE ENCASED AS FOLLOWS:-

(a) WHERE THE DRAIN TRENCH IS WITHIN 1M OF THE BUILDING THE TRENCH SHOULD BE FILLED WITH CONCRETE UP TO FOUNDATION FORMATION LEVEL or

(b) WHERE THE DRAIN TRENCH IS FURTHER THAN 1M OF THE BUILDING THE TRENCH SHOULD BE FILLED WITH CONCRETE TO A LEVEL BELOW FOUNDATION FORMATION EQUAL TO THE DISTANCE FROM THE BUILDING LESS 150mm.

KEY:

- INDICATES NEW GULLIES
- INDICATES NEW SURFACE WATER MANHOLES
- INDICATES NEW PIPE RUNS
- INDICATES LINE DRAIN RUNS
- INDICATES NEW PERMEABLE PAVING
- INDICATES NEW SWALE BASINS

ALL PIPES CONNECTED DIRECTY INTO GULLIES TO BE 150MM DIAMETER (SHOWN IN MAGENTA ON PLAN)

TOWN PLANNING

Rev	Date	Revision Description
F	22.04.22	Updated to LLFA planning comments
E	07.03.22	Updated to latest planning scheme.
D	07.01.22	Updated to LLFA planning comments
C	02.09.21	Red line planning boundary adjusted
B	23.08.21	Updated to latest Architects layout, pipe sizes added & manholes scheduled
A	20.07.21	Updated Ditches, Mounds & SLR

Revision Schedule

Project Title: Axis J9 - Bicester

Client: ALBION LAND

Drawing Title: PHASE 3 SW Drainage Layout

BAILEY JOHNSON HAYES
Consulting Engineers
ST.ALBANS: Suite 4, Phoenix House, 63 Campfield Rd, ST.ALBANS, Herts AL1 5FL
MANCHESTER: Grange House, John Dalton Street, MANCHESTER, M2 6FW

Scale	1:1000 @A1
Date	23.06.21
Drawn	JNG

Drawing Number: S1209-PH3-02 F

A1

FOUL WATER MANHOLE / INSPECTION CHAMBER SCHEDULE

MH REF	CL	IL	DEPTH	DIA	OPENING	COVER	COMMENTS
F1	84.000	79.950	4050	1050	600x600	D400	.
F8	83.800	80.575	3225	1050	600x600	D400	.
F9	83.800	80.875	2925	1050	600x600	D400	.
F10	83.800	81.300	2500	1050	600x600	D400	.
F11	83.800	81.475	2325	1050	600x600	D400	.
F12	83.800	81.925	1875	1050	600x600	D400	.
F13	83.800	82.200	1600	1050	600x600	D400	.
F14	83.700	82.425	1275	1050	600x600	D400	.
F15	84.000	82.775	1225	1050	600x600	D400	.
F16	84.000	83.200	800	450	450x450	D400	450 Dia. PPIC 150mm Concrete Encased
F17	84.000	82.700	1300	450	450x450	D400	450 Dia. PPIC 150mm Concrete Encased
F18	84.000	83.000	1000	450	450x450	D400	450 Dia. PPIC 150mm Concrete Encased
F19	83.400	82.400	1000	1050	600x600	D400	.
F20	83.700	82.050	1650	1050	600x600	D400	.
F21	84.000	82.600	1400	1050	600x600	D400	.
F22	83.950	83.200	750	450	450x450	D400	450 Dia. PPIC 150mm Concrete Encased
F23	83.700	82.000	1700	1050	600x600	D400	.
F24	84.000	82.600	1400	1050	600x600	D400	.
F25	84.075	83.200	875	450	450x450	D400	450 Dia. PPIC 150mm Concrete Encased

Schedule of approximate areas								
UNIT	Ground Floor GIA sm	Ground Floor GIA sf	First Floor GIA sm	First Floor GIA sf	Second Floor GIA sm	Second Floor GIA sf	Total Unit GIA sm	Total Unit GIA sf
1	1759	18934	195	2104	0	0	**1954**	**21038**
2	1613	17362	179	1929	0	0	**1792**	**19291**
3	1650	17761	183	1973	0	0	**1833**	**19734**
4	4278	46048	238	2558	238	2558	**4753**	**51165**
5	3433	36953	423	4553	0	0	**3856**	**41506**
TOTAL	**12733**	**137058**	**1219**	**13118**	**238**	**2558**	**14189**	**152734**

NOTE: ESTIMATED PEAK FLOW FROM PHASE 3 Units 1-5 =2.3 L/S (Max)

NOTE: ALL DISCHARGE IS THROUGH GRAVITY FLOW INTO PUBLIC SEWER

NOTE: FOUL DISCHARGE IS SUBJECT TO TW AGREEMENT

FOUL WATER ASSESSMENT

Units 1-5 Ground Floor =12,733m²

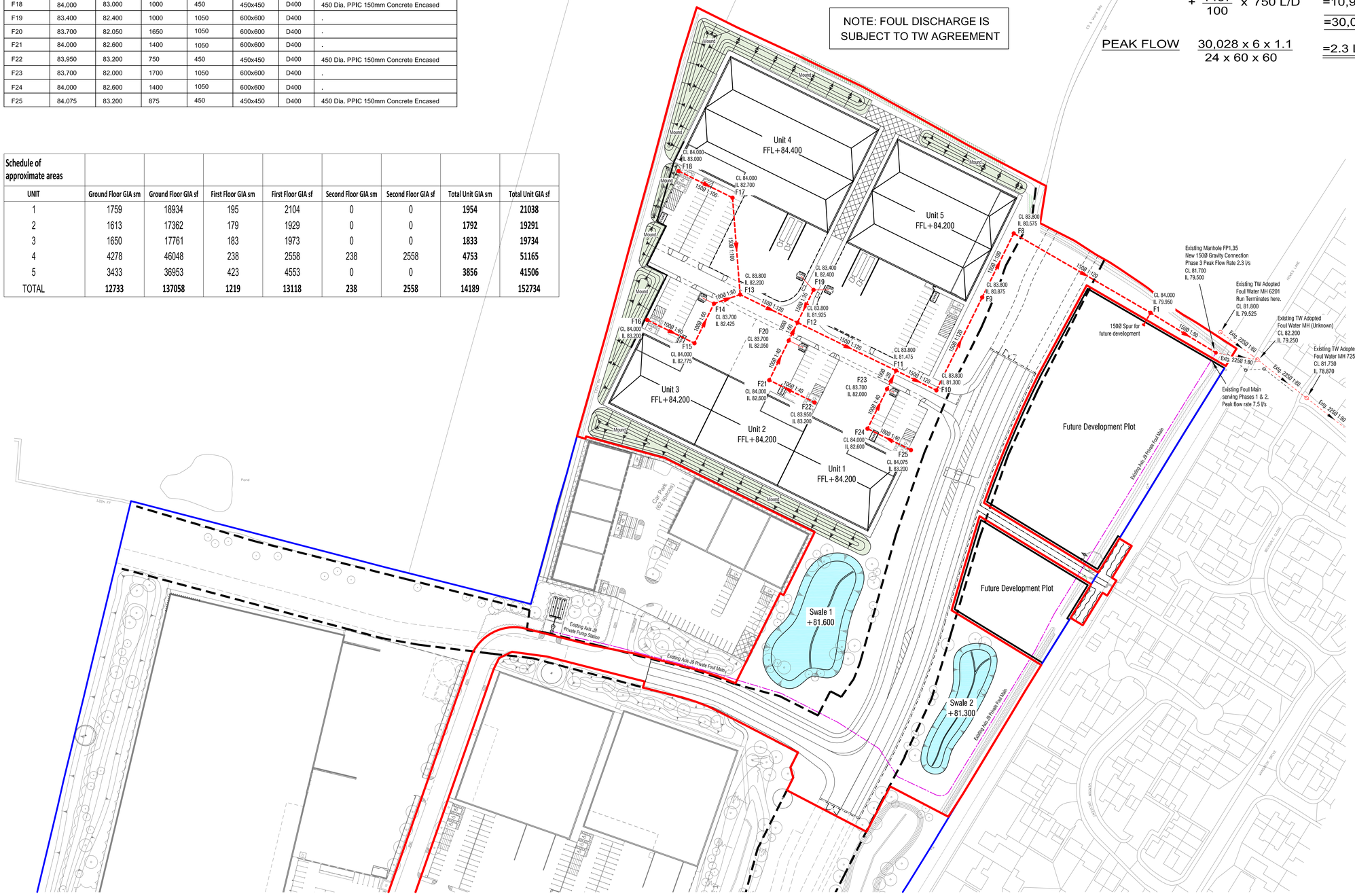
1st & 2nd Floor Offices =1,457m²

DWF $\frac{12,733}{100}$ x 150 L/D =19,100 L/D

+ $\frac{1457}{100}$ x 750 L/D =10,928 L/D

=30,028 L/D

PEAK FLOW $\frac{30,028 \times 6 \times 1.1}{24 \times 60 \times 60}$ =2.3 L/S



Application Boundary

Other Land in Control of the Applicant

Phase 3 FW Drainage Layout 1:1000

20m 10m 0 20m 40m 60m

Scale 1:1000 @A1

DRAINAGE NOTES

1 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND BAILEY JOHNSON HAYES DRAWINGS AND SPECIFICATIONS.

2 DRAINS TO BE 'HEPWORTH SUPERSLEEVE' LAID IN CLASS S BEDDING TO BS 882 1983: TABLE 4, OR TO BS 8301 1985: APPENDIX D. 450 DIA DRAINS AND ABOVE TO BE HEPWORTH CONCRETE PIPES CLASS H . OR EQUAL APPROVED DRAINS WITHIN THE SITE MAY BE THERMOPLASTIC STRUCTURED WALL PIPE IN ACCORDANCE WITH CLAUSE E2.22 OF SFA 8th EDITION

3 ALL TRENCHES WITHIN TRAFFICKED AREAS TO BE BACKFILLED WITH 75 MM DOWN GRADED STONE FILL, PLACED AND COMPACTED IN 150 MM LAYERS. ALL PIPES IN ROADWAYS, SERVICE YARDS AND CARPARKS LESS THAN 1200 MM DEEP TO BE ENCASED IN CONCRETE. PROVIDE FLEXIBLE JOINTS AT 3 METRE CENTRES.

4 MANHOLES TO BE CONSTRUCTED IN PRECAST CONCRETE RINGS TO BS 5911: PART 1. RINGS TO BE BEDDED IN SEALANT STRIPS.

5 MANHOLES IN FOOTPATHS OR LANDSCAPED AREAS TO BE BACKFILLED WITH 40 MM DOWN GRADED STONE FILL, COMPACTED IN LAYERS NOT EXCEEDING 150 MM THICK. MANHOLES BENEATH ROADS AND PARKING AREAS TO BE CASED IN 150 MM CONCRETE SURROUND.

6 ALL CONNECTIONS TO RAIN WATER PIPES TO BE PROVIDED WITH RODDING ACCESS.

7 ALL ROAD GULLIES TO BE HEPWORTH ROAD GULLIES., REF RGR4, WITH 150 MM DIAMETER OUTLETS. GULLIES TO BE ENCASED IN 150 MM MINIMUM CONCRETE.

8 DRAINS UNDER BUILDING AND WITHIN 300 MM OF THE UNDERSIDE OF FLOORSLAB TO BE ENCASED IN 150 MM CONCRETE. CASING TO INCORPORATE FLEXIBLE FIBRE BOARD JOINTS AT SPACINGS AS RECOMMENDED BY THE PIPE MANUFACTURER. DRAINS UNDER BUILDINGS GENERALLY TO HAVE MIN 100 FULL GRANULAR SURROUND TO CLASS S BS8301

9 WHERE PIPES RUN THROUGH GROUND BEAMS, FLEXIBLE JOINT CASINGS AT EACH FACE OF THE GROUND BEAM ARE TO BE PROVIDED. PIPES WHICH RUN UNDER GROUND BEAMS TO BE PROTECTED WITH 50 MM MINIMUM POLYSTYRENE PLACED OVER THE CROWN OF THE PIPE.

10 ALL WORK TO EXISTING PUBLIC SEWERS TO BE IN ACCORDANCE WITH SEWERS FOR ADOPTION 8TH EDITION AND BS 8301 : CODE OF PRACTICE FOR BUILDING DRAINAGE

11 WHERE DRAINS RUN CLOSE TO BUILDINGS AND INVERT LEVELS ARE BELOW FOUNDATIONS THE DRAINS SHOULD BE ENCASED AS FOLLOWS:-

(a) WHERE THE DRAIN TRENCH IS WITHIN 1M OF THE BUILDING THE TRENCH SHOULD BE FILLED WITH CONCRETE UP TO FOUNDATION FORMATION LEVEL or

(b) WHERE THE DRAIN TRENCH IS FURTHER THAN 1M OF THE BUILDING THE TRENCH SHOULD BE FILLED WITH CONCRETE TO A LEVEL BELOW FOUNDATION FORMATION EQUAL TO THE DISTANCE FROM THE BUILDING LESS 150mm.

KEY:

- INDICATES GULLIES
- INDICATES FOUL WATER MANHOLES
- INDICATES NEW PIPE RUNS
- INDICATES EXISTING MANHOLES

ALL PIPES CONNECTED DIRECTY INTO GULLIES TO BE 150MM DIAMETER

TOWN PLANNING

Rev	Date	Revision Description
F	22.04.22	Updated to LLFA planning comments
E	07.03.22	Updated to latest planning scheme.
D	07.01.22	Updated to LLFA planning comments
C	02.09.21	Red line planning boundary adjusted
B	23.08.21	Updated to latest Architects layout, pipe sizes added & manholes scheduled
A	20.07.21	Updated Ditches, Mounds & SLR

Revision Schedule

Project Title

Axis J9 - Bicester

Client

ALBION LAND

Drawing Title

PHASE 3
FW Drainage Layout

BAILEY JOHNSON HAYES
Consulting Engineers
ST.ALBANS: Suite 4, Phoenix House, 63 Campfield Rd, ST.ALBANS, Herts AL1 5FL
MANCHESTER: Grange House, John Dalton Street, MANCHESTER, M2 6FW

Scale	1:1000 @A1
Date	23.06.21
Drawn	JNG

Drawing Number

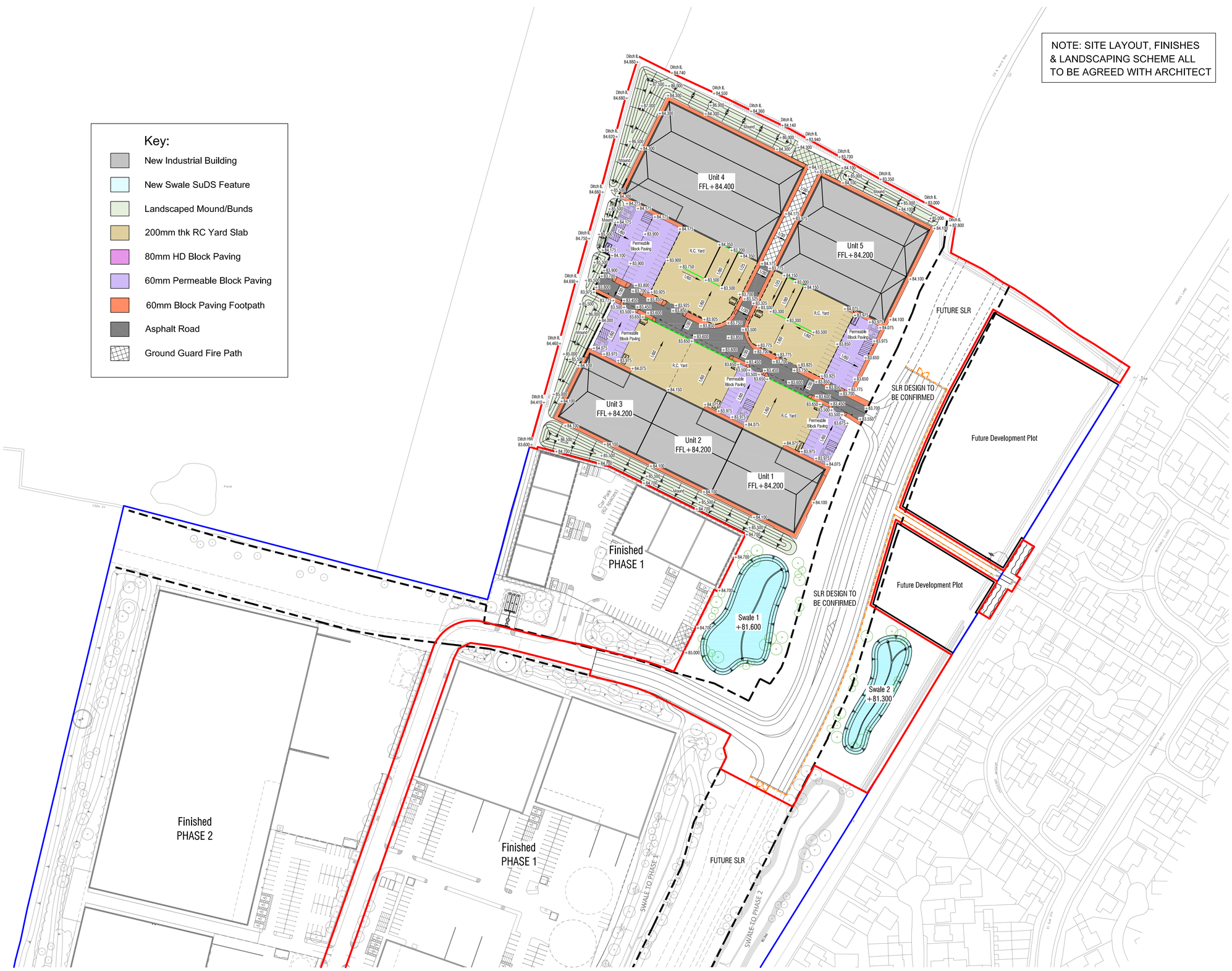
S1209-PH3-03 F

A1

Key:

- New Industrial Building
- New Swale SuDS Feature
- Landscaped Mound/Bunds
- 200mm thk RC Yard Slab
- 80mm HD Block Paving
- 60mm Permeable Block Paving
- 60mm Block Paving Footpath
- Asphalt Road
- Ground Guard Fire Path

NOTE: SITE LAYOUT, FINISHES & LANDSCAPING SCHEME ALL TO BE AGREED WITH ARCHITECT



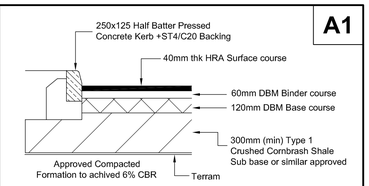
Application Boundary

Other Land in Control of the Applicant

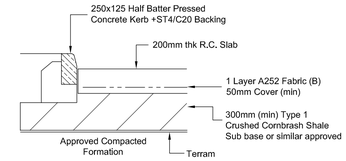
Phase 3 External Works & Levels 1:1000

20m 10m 0 20m 40m 60m

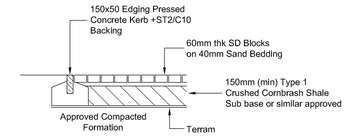
Scale 1:1000 @A1



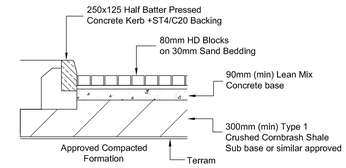
Asphalt Kerb Detail 1:25



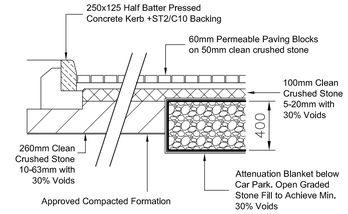
RC Yard Kerb Detail 1:25



Footpath Kerb Detail 1:25



Heavy Duty Block Paving 1:25



Permeable Block Paving 1:25

TOWN PLANNING

Rev	Date	Revision Description
E	22.04.22	Updated to LLFA planning comments
D	07.03.22	Updated to latest planning scheme.
C	07.01.22	Updated to LLFA planning comments
B	02.09.21	Red line planning boundary adjusted

Revision Schedule

Project Title

Axis J9 - Bicester

Client

ALBION LAND

Drawing Title

PHASE 3
External Works & Levels

BAILEY JOHNSON HAYES
Consulting Engineers
ST.ALBANS: Suite 4, Phoenix House, 63 Campfield Rd, ST.ALBANS, Herts AL1 5FL
MANCHESTER: Grange House, John Dalton Street, MANCHESTER, M2 6FW

Scale	1:1000, 25 @A1
Date	20.07.21
Drawn	JNG

Drawing Number

S1209-PH3-04 E

APPENDIX F

BJH Axis J9 Phase 1&2 Plans:

S1209-PH2-C16(0) – Full Site Scheme Drainage Layout
S1209-PH1-C47(1) – Main Outlet Headwall Details

20m 0 20m 40m 60m 80m 100m

1:1000 @ A1

Unit 6
FFL 85.300

Unit 7
FFL 85.300

Unit 4
FFL 83.80

Unit 2
FFL 83.80

Unit 1
FFL 83.80

Unit 3
FFL 83.80

Unit 5
FFL 83.80

Units 8-11
FFL 84.80

Units 12-14
FFL 84.80

MIDDLETON STONEY ROAD

ISIS AVENUE

WELLS LANE

SWALE 1

SWALE 2

SWALE 3

Hydrobrake 30 l/sec (Greenfield flow)

Full Site Drainage Layout 1:1000

NOTES

DRAINAGE

1 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTS & ENGINEERS DRAWINGS & SPECIFICATIONS.

2 DRAINS TO BE HEPWORTH SUPERSLEEVE OR NAYLOR DENSLEEVE: LAID ON CLASS N GRANULAR BEDDING TO BS 882: TABLE 4 OR TO BS 8301: 1985 APPENDIX D.

3 ALL TRENCHES WITHIN TRAFFICKED AREAS TO BE BACKFILLED WITH 75MM DOWNGRADED STONE FILL, PLACED & COMPACTED IN LAYERS OF 150MM. ALL PIPES IN ROADWAYS / PARKING, LESS THAN 900MM DEEP TO BE ENCASED IN CONCRETE. PROVIDE FLEXIBLE JOINTS AT 3000MM CENTRES.

4 MANHOLES TO BE CONSTRUCTED OF PRECAST CONCRETE RINGS TO BS 5911-PART 1. RINGS TO BE BEDDED IN SEALANT STRIPS.

5 MANHOLES BENEATH ROADS & PARKING AREAS TO BE CASED IN 150MM CONCRETE SURROUND.

6 ALL CONNECTIONS TO RAIN WATER PIPES TO BE PROVIDED WITH RODDING ACCESS.

7 ROAD GULLIES TO BE HEPWORTH ROAD GULLIES REF: 213 WITH 150MM DIAMETER OUTLET OR SIMILAR APPROVED. GULLIES TO BE ENCASED IN 150MM MINIMUM CONCRETE.

8 DRAWINGS TO BE ISSUED TO NRA & LOCAL AUTHORITY WELL IN ADVANCE OF COMMENCEMENT OF DRAINAGE

9 EXISTING MANHOLES IN ROADS TO HAVE INVERT LEVELS CONFIRMED PRIOR TO DRAINAGE

10 ROADS TO BE REINSTATED TO STANDARD REQUESTED BY LOCAL AUTHORITY WHERE DRAINAGE CROSSES

KEY:

- ○ INDICATES GULLIES
- INDICATES SURFACE WATER MANHOLES
- INDICATES FOUL MANHOLES
- □ INDICATES EXISTING MANHOLES
- INDICATES NEW FW PIPE RUNS
- INDICATES NEW SW PIPE RUNS
- INDICATES NEW ROOF PIPE RUNS

ALL PIPES CONNECTED DIRECTY INTO GULLIES TO BE 150MM DIAMETER

INFORMATION

Rev	Date	Revision Description
0	06.04.21	First Issue

Revision Schedule

AXIS J9 – BICESTER

Client:

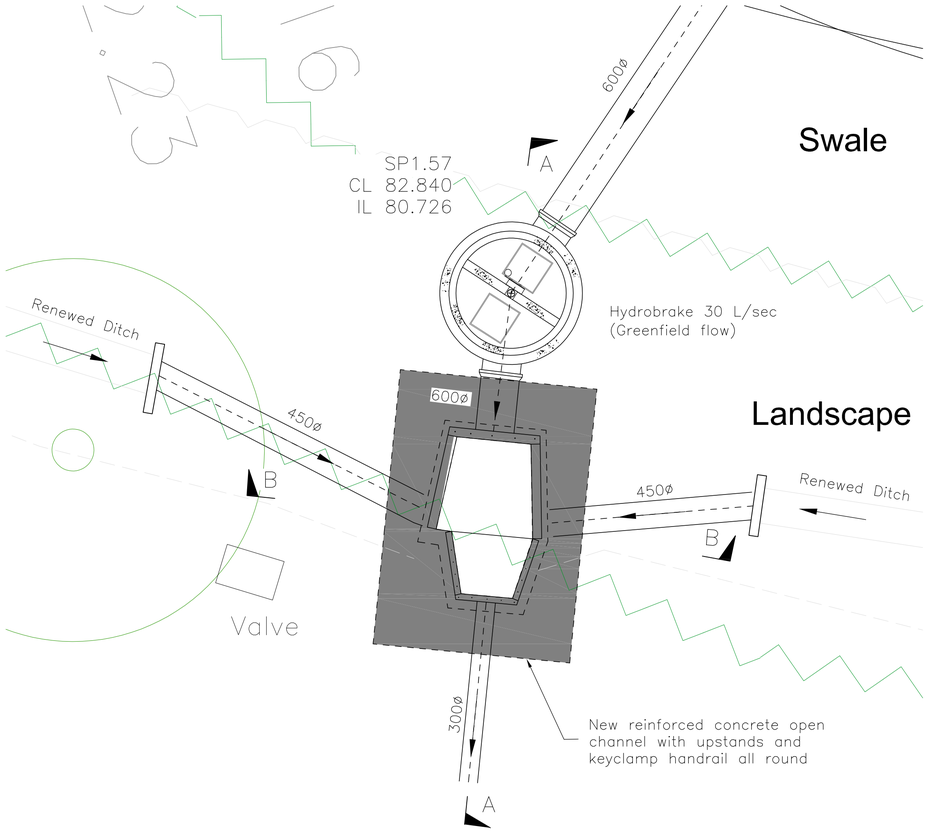
Albion Land Plc.

PHASE 2 - FULL SITE SCHEME
DRAINAGE LAYOUT PLAN

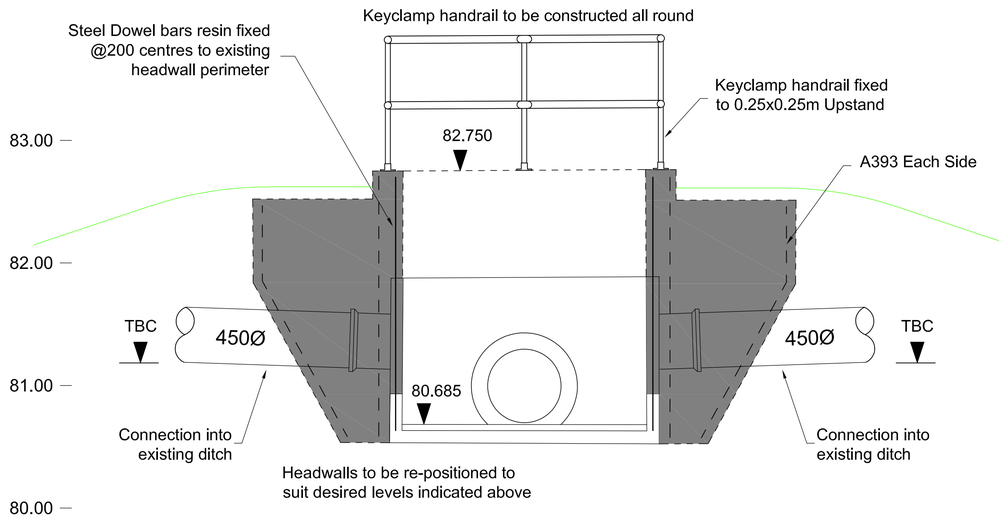
BAILEY JOHNSON HAYES
Consulting Engineers
ST.ALBANS: Suite 4, Phoenix House, 63 Campfield Rd, ST.ALBANS, Herts AL1 5FL
MANCHESTER: Grange House, John Dalton Street, MANCHESTER, M2 6FW

Scale	1:1000 @A1
Date	06.04.21
Drawn	JNG

S1209–PH2–C16(0)

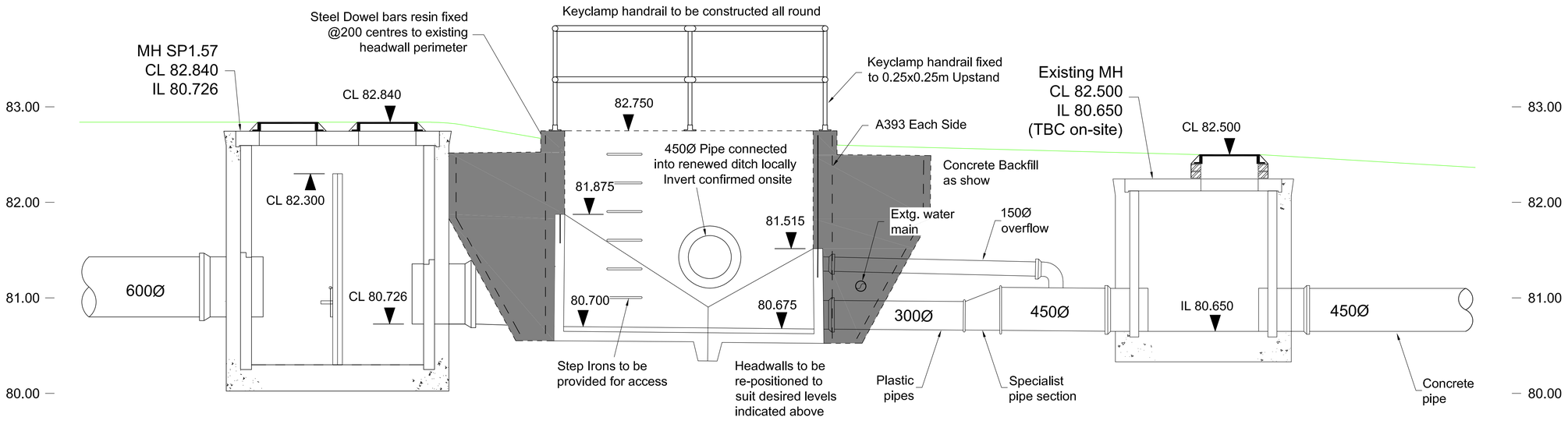


Headwall Plan (1:50)



Section B-B (1:25)

NOTE DRAWING FOR DISCUSSION ONLY
ALL LEVELS TO BE CHECKED PRIOR TO
COMMENCEMENT OF ANY WORKS



Section A-A (1:25)

NOTES

DRAINAGE

1 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTS & ENGINEERS DRAWINGS & SPECIFICATIONS.

2 DRAINS TO BE HEPWORTH SUPERSLEEVE OR NAYLOR DENSLEEVE: LAID ON CLASS N GRANULAR BEDDING TO BS 882: TABLE 4 OR TO BS 8301: 1985 APPENDIX D.

3 ALL TRENCHES WITHIN TRAFFICKED AREAS TO BE BACKFILLED WITH 75MM DOWNGRADED STONE FILL, PLACED & COMPACTED IN LAYERS OF 150MM. ALL PIPES IN ROADWAYS / PARKING, LESS THAN 900MM DEEP TO BE ENCASED IN CONCRETE. PROVIDE FLEXIBLE JOINTS AT 3000MM CENTRES.

4 MANHOLES TO BE CONSTRUCTED OF PRECAST CONCRETE RINGS TO BS 5911-PART 1. RINGS TO BE BEDDED IN SEALANT STRIPS.

5 MANHOLES BENEATH ROADS & PARKING AREAS TO BE CASED IN 150MM CONCRETE SURROUND.

6 ALL CONNECTIONS TO RAIN WATER PIPES TO BE PROVIDED WITH RODDING ACCESS.

7 ROAD GULLIES TO BE HEPWORTH ROAD GULLIES REF: 213 WITH 150MM DIAMETER OUTLET OR SIMILAR APPROVED. GULLIES TO BE ENCASED IN 150MM MINIMUM CONCRETE.

8 DRAWINGS TO BE ISSUED TO NRA & LOCAL AUTHORITY WELL IN ADVANCE OF COMMENCEMENT OF DRAINAGE

9 EXISTING MANHOLES IN ROADS TO HAVE INVERT LEVELS CONFIRMED PRIOR TO DRAINAGE

10 ROADS TO BE REINSTATED TO STANDARD REQUESTED BY LOCAL AUTHORITY WHERE DRAINAGE CROSSES

KEY:

- ○ INDICATES GULLIES
- INDICATES SURFACE WATER MANHOLES
- INDICATES FOUL MANHOLES
- ▫ INDICATES EXISTING MANHOLES
- INDICATES NEW FW PIPE RUNS
- INDICATES NEW SW PIPE RUNS
- INDICATES NEW ROOF PIPE RUNS

ALL PIPES CONNECTED DIRECTY INTO GULLIES TO BE 150MM DIAMETER

FINAL CONSTRUCTION ISSUE

Rev	Date	Revision Description
1	01.06.20	Final Construction issue
0	02.03.20	Issued for discussion

Revision Schedule

AXIS J9 – BICESTER

Client:

Albion Land Plc.

PHASE I

MAIN OUTLET HEADWALL DETAILS

BAILEY JOHNSON HAYES
Consulting Engineers
ST.ALBANS: Suite 4, Phoenix House, 63 Campfield Rd, ST.ALBANS, Herts AL1 5FL
MANCHESTER: Grange House, John Dalton Street, MANCHESTER, M2 6FW

Scale	1:50,25 @A1
Date	02.03.20
Drawn	JNG

S1209–PH1–C47(1)

APPENDIX G

BJH Drainage Calculations

BAILEY JOHNSON HAYES
CONSULTING ENGINEERS
Bailey Johnson Hayes
Suite 4, Phoenix House, 63 Campfield Road
St Albans, Hertfordshire. AL1 5FL
Tel: 01727 841172 Fax: 01727 841085
Web: www.bjh.co.uk

Project	Project No.	Sheet No.
Phase 3, Axis J9, Howes Lane, Bicester.	S1209	D-1
	Drawing No.	Rev. 2
Section: Surface Water Drainage	By: JG	Date: April 2022
	Checked: WB	Date: April 2022

Calculations

PROPOSED INDUSTRIAL DEVELOPMENT,

PHASE 3, AXIS J9, HOWES LANE, BICESTER.

SURFACE WATER DRAINAGE CALCULATIONS

1.0 INTRODUCTION

The following calculations have been prepared to justify the design of a below-ground drainage system to serve the above development. This Rev 2 of the calculations is prepared to satisfy the design of the Phase 3 drainage network in co-ordination with the existing Axis J9 Phase 1 & 2 which are now completed and fully operational.

The drainage scheme for the whole site has been developed in accordance with BJH SSFRA (Issue 1), to attenuate surface water outflows from the proposed development site to a ditch off Howes Lane to a peak figure of 30 litres/second for design rainfall up to and including 100year +CC events. For further details of the existing drainage arrangements & calculations can be found in Rev 4 of the Phase 1 & 2, Axis J9 calculations package.

2.0 DRAINAGE DESIGN OVERVIEW

Approximately 70% of the 21 Ha development has been completed at Axis J9. Phases 1&2 have been split into a series of 14 Units to accommodate industrial buildings including; associated external service yards, access roads, car parking and landscaping. Three large attenuation basins/swales have been approved by the Cherwell District Council & OCC as the LLFA and are fully operational within the landscaped areas to the southeast of the development plots.

Within the Phase 3 proposals 5 further industrial units are proposed. These have been split into two catchment areas named; Western Catchment (Units 1-5) and Eastern Catchment (Future Development Plot). Previously Phase 3 was allocated for residential development. The drainage is designed using the MircoDrainage software package and adopting FEH design rainfall.

Appended to these calculations (Appendix A) are the following drawings:

- S1209-PH3-DD01B Phases 3 Drained Areas.
- S1209-PH3-DD02B Phases 3 Network Design.
- S1209-PH3-DD03B Phase 3 Swales 1 - 2.
- S1209-PH3-DD04A Phase 3 Exceedance Flood Routes

BAILEY JOHNSON HAYES
CONSULTING ENGINEERS
Bailey Johnson Hayes
Suite 4, Phoenix House, 63 Campfield Road
St Albans, Hertfordshire. AL1 5FL
Tel: 01727 841172 Fax: 01727 841085
Web: www.bjh.co.uk

Project	Project No.	Sheet No.
Phase 3, Axis J9, Howes Lane, Bicester.	S1209	D-2
	Drawing No.	Rev. 2
Section: Surface Water Drainage	By: JG	Date: April 2022
	Checked: WB	Date: April 2022

Calculations

The below-ground drainage system is modelled in the System 1 module of MircoDrainage, and then exported into the Simulation module where the two retention basins and two Hydro brake flow control devices are included. For the purpose of drainage design zero infiltration flow has been considered, in which case the results are conservative. The Phase 3 site has two separate systems which are modelled as the Western Catchment and the Eastern Catchment for clarity.

- Proposed Drained Impermeable area for each catchment is as follows:

  Western Catchment = 1.000 Ha
  Eastern Catchment = 2.600 Ha

Overall impermeable area is 3.60 Ha and an allowance for urban creep is not applicable.

3.0 EXISTING DRAINAGE REGIME

3.1 Site Discharge

The Phase 3 site is currently undeveloped Greenfields. There is currently 0m^2 of impermeable area on the existing Phase 3 development site.

In light rainfall events precipitation is attenuated in the Topsoil upper strata and evaporated off over time. In heaver rainfall events, overland and subterrain runoff is generated which eventually is collected by an ordinary watercourse on the northern/eastern boundaries, discharging to a closed culvert under Howes Lane.

3.2 Current Runoff Rates

Using the EA/DEFRA document "Preliminary Rainfall runoff management for development (W5-074/A/TR1)" and the HR Wallingford Greenfield Runoff Estimation Tool (IH124 method) runoff rates for QBAR, 3.3% (1in30), 1% (1in100) and, 1% (1in100) plus climate change have been assessed as follows below:

The whole of the Phase 3 site is approximately 6.5 Ha.

QBAR = 10.4 l/s
1 in 30 year = 24 l/s
1 in 100 year = 33.3 l/s
1 in 100 year + 40% CC = 46.6 l/s

Calculation output from the HR Wallingford Greenfield Runoff Estimation Tool can be found in Appendix B. Soil type 2 is conservatively assumed based on the Ground Investigation Report.

BAILEY JOHNSON HAYES
CONSULTING ENGINEERS
Bailey Johnson Hayes
Suite 4, Phoenix House, 63 Campfield Road
St Albans, Hertfordshire. AL1 5FL
Tel: 01727 841172 Fax: 01727 841085
Web: www.bjh.co.uk

Project	Project No.	Sheet No.
Phase 3, Axis J9, Howes Lane, Bicester.	S1209	D-3
	Drawing No.	Rev.
		2
Section	By	Date
Surface Water Drainage	JG	April 2022
	Checked	Date
	WB	April 2022

Calculations

4.0 DRAINAGE DESIGN RESULTS

4.1 Phase 3 (Eastern Catchment)

It has been decided that an allowable discharge of 3 l/s can be used, which is approximately equal to QBAR for this catchment alone. There is no requirement from OCC to have a minimum outlet flow of 5l/s. The discharge rate from this catchment is based on engineering judgement and interpolation of existing Greenfield QBAR rates due to parts of the site remaining as soft landscaping and to reduce downstream effects on Phase 1 & 2.

MircoDrainage calculation Page 2 presents results of the Quick Storage Estimate (QSE) where it is predicted that between 775 and 1042 m^3 of attenuation volume is required for outlet of 3 l/s. The maximum volume possible in swale 2 if it was allowed to fill up to a level of 82.600m (300mm freeboard above design flood level) would have a total volume capacity of 1151 m^3.

MircoDrainage calculation Pages 3-6 present details of the drainage network input. This is followed by pages 7-9 which presents the critical summary of results for the followings return periods; 2-year, 30-year, and 100-year + 40% return periods.

Maximum Water Level Summary

Design invert level of swale 2 is 81.300m. The Cover level of the swale is 82.600m (min)
The maximum water level in swale 2 for the 2-year return period was 81.484m.
The maximum water level in swale 2 for the 30-year return period was 81.753m.
The maximum water level in swale 2 for the 100-year +40% return period was 82.218m.

Maximum Storage Volume Summary

Maximum Design volume in the system is 819 m^3. Total volume to cover level is 1151 m^3.
The maximum volume in the system for the 2-year return period was 168 m^3.
The maximum volume in the system for the 30-year return period was 376 m^3.
The maximum volume in the system for the 100-year +40% return period was 806 m^3.

Follow on Storm Check

If 80% of the 10-year event followed the 100-year +40% event 24 hours a total volume storage would be required of 806 + 200m^3 = 1006m^3 Given the system can hold 1151 m^3 therefore OK.

By inspection no surface flooding is predicted during 2, 30, 100 year + 40% design storms. The maximum water level in the Swale was 82.218m which represents a depth of 918mm. In the worst-case rainfall event, the minimum storage required for 100 year + 40% event is 806 m^3 which has been satisfied by the combination of Swale, Pipe and Manhole storage.

BAILEY JOHNSON HAYES
CONSULTING ENGINEERS
Bailey Johnson Hayes
Suite 4, Phoenix House, 63 Campfield Road
St Albans, Hertfordshire. AL1 5FL
Tel: 01727 841172 Fax: 01727 841085
Web: www.bjh.co.uk

Project	Project No.	Sheet No.
Phase 3, Axis J9, Howes Lane, Bicester.	S1209	D-4
	Drawing No.	Rev. 2
Section: Surface Water Drainage	By: JG	Date: April 2022
	Checked: WB	Date: April 2022

Calculations

4.0 DRAINAGE DESIGN RESULTS (Continued.)

4.2 Phase 3 (Western Catchment)

It has been decided that an allowable discharge of 7 l/s can be used, which is approximately equal to QBAR for this catchment. The discharge rate from this catchment based on engineering judgement and interpolation of existing Greenfield QBAR rates due to parts of the site remaining as soft landscaping and to reduce downstream effects on Phase 1 & 2.

MircoDrainage calculation Page 10 presents results of the Quick Storage Estimate (QSE) where it is predicted that between 2080 and 2769 m^3 of attenuation volume is required for outlet discharge of 7 l/s. The maximum volume possible in the system if it was allowed to fill up to a level of 83.200m (300mm freeboard above design flood level) would have a total volume capacity of 2706 m^3.

MircoDrainage calculation Pages 11-19 present details of the drainage network input. This is followed by pages 20-25 which presents the critical summary of results for the followings return periods; 2-year, 30-year, and 100-year + 40% return periods.

Maximum Water Level Summary
Design invert level of swale 1 is 81.600m.
The maximum water level in swale 1 for the 2-year return period was 81.908m.
The maximum water level in swale 1 for the 30-year return period was 82.266m.
The maximum water level in swale 1 for the 100-year +40% return period was 82.864m.

Maximum Storage Volume Summary
Maximum Design volume in the system is 2090 m^3. Total volume to cover level is 2706 m^3.
The maximum volume in the system for the 2-year return period was 450 m^3.
The maximum volume in the system for the 30-year return period was 1050 m^3.
*The maximum volume in the system for the 100-year +40% return period was 2091 m^3.
*Note – 0.6m^3 of flooding is predicted from manhole S9.

Follow on Storm Check

If 80% of the 10-year event followed the 100-year +40% event 24 hours a total volume storage would be required of 2091 + 550m^3 = 2641m^3 Given the system can hold 2706 m^3 therefore OK.

By inspection no surface flooding is predicted during 1, 30, 100 year + 40% design storms. The maximum water level in the Swale was 82.864m which represents a depth of 1264mm. In the worst-case rainfall event the minimum storage required for 100 year + 40% event is 2091 m^3 which has been satisfied by the combination of Swale, Pipe and Manhole storage.

BAILEY JOHNSON HAYES
CONSULTING ENGINEERS
Bailey Johnson Hayes
Suite 4, Phoenix House, 63 Campfield Road
St Albans, Hertfordshire. AL1 5FL
Tel: 01727 841172 Fax: 01727 841085
Web: www.bjh.co.uk

Project	Project No.	Sheet No.
Phase 3, Axis J9, Howes Lane, Bicester.	S1209	D-5
	Drawing No.	Rev. 2
Section: Surface Water Drainage	By: JG	Date: April 2022
	Checked: WB	Date: April 2022

Calculations

5.0 EXCEEDANCE FLOOD ROUTES

The buildings are elevated above the lower-lying attenuation basins and therefore safeguarded against flooding in the event of exceedance. In the event of failure of any part of the drainage system means of escape routes to nearby ditches have been shown in Appendix A.

APPENDIX A

BAILEY JOHNSON HAYES DRAWINGS

S1209-PH3-DD01B – Phase 3 Drained Areas

S1209-PH3-DD02B – Phase 3 Network Design

S1209-PH3-DD03B – Phase 3 Swales 1-2

S1209-PH3-DD04A – Phase 3 Exceedance Route

A1

SURFACE WATER MANHOLE / INSPECTION CHAMBER SCHEDULE

MH REF	CL	IL	DEPTH	DIA	OPENING	COVER	COMMENTS
S1	83.500	81.250	2250	1800	2/600x600	B125	Hydrobrake 7 l/s + Wier Overflow 82.900m
S2	84.100	81.400	2700	1800	600x600	B125	300mm Catchpit
S3	84.100	81.850	2250	1800	600x600	B125	.
S4	83.600	81.950	1650	1800	600x600	D400	.
S5	83.700	82.200	1500	1500	600x600	D400	.
S6	83.700	82.425	1275	1350	600x600	D400	.
S7	83.700	82.225	1475	1200	600x600	D400	300mm Catchpit
S8	84.100	82.450	1650	1200	600x600	B125	.
S9	84.100	83.000	1100	600	600x600	B125	600m Dia. PPIC 150mm Concrete Encased
S10	84.100	82.100	2000	1200	600x600	D400	.
S11	84.100	82.950	1150	1200	600x600	D400	.
S12	83.800	82.125	1675	1200	600x600	D400	300mm Catchpit
S13	83.800	81.975	1825	1200	600x600	D400	300mm Catchpit
S14	83.800	82.350	1450	1200	600x600	D400	300mm Catchpit
S15	83.850	81.725	2125	1350	600x600	B125	.
S16	84.100	82.100	2000	1350	600x600	B125	.
S17	84.100	82.250	1850	1350	600x600	B125	.
S18	84.100	82.425	1675	1200	600x600	B125	.
S19	84.000	82.775	1225	1200	600x600	D400	.
S20	84.000	82.050	1950	1200	600x600	D400	300mm Catchpit
S21	84.150	82.350	1800	1350	600x600	D400	.
S22	84.150	82.500	1650	1350	600x600	D400	.
S23	84.200	82.675	1525	1200	600x600	D400	.
S24	84.300	83.100	1200	1200	600x600	B125	.
S25	84.200	82.200	2000	1200	600x600	D400	300mm Catchpit
S26	84.200	82.875	1325	1200	600x600	D400	.
S27	83.000	80.950	2050	1800	2/600x600	B125	Hydrobrake 3 l/s + Wier Overflow 82.300m

PERMEABLE PAVING SCHEDULE

AREA REF	IL	LENGTH	WIDTH	AREA	DEPTH	VOLUME	COMMENTS
AREA 1	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 2	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 3	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 4	83.400 - 83.050	38.0m	32.2m	1150m2	0.4m	N/A	Perm. paving for water quality treatment only
AREA 5	83.400 - 83.000	38.0m	16.0m	608m2	0.4m	N/A	Perm. paving for water quality treatment only

NOTE: THIS SCHEME IS COMMERCIAL / INDUSTRIAL AND NO FURTHER EXPANSION IS NOT POSSIBLE, THEREFORE NO ALLOWANCE FOR URBAN CREEP IS REQUIRED

DRAINED AREAS	STORAGE VOLUMES
WEST - 26,000 m2	SWALE 1 - 2,090 m3
EAST - 10,000 m2	SWALE 2 - 810 m3
TOTAL = 36,000 m2	TOTAL = 2,900 m3

MAXIMUM DISCHARGE WESTERN PLOT = 7 l/sec

MAXIMUM DISCHARGE EASTERN PLOT = 3 l/sec

Phase 3 Drained Areas 1:1000

20m 10m 0 20m 40m 60m

Scale 1:1000 @A1

DRAINAGE NOTES

1 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND BAILEY JOHNSON HAYES DRAWINGS AND SPECIFICATIONS.

2 DRAINS TO BE 'HEPWORTH SUPERSLEEVE' LAID IN CLASS S BEDDING TO BS 882 1983: TABLE 4, OR TO BS 8301 1985: APPENDIX D. 450 DIA DRAINS AND ABOVE TO BE HEPWORTH CONCRETE PIPES CLASS H . OR EQUAL APPROVED DRAINS WITHIN THE SITE MAY BE THERMOPLASTIC STRUCTURED WALL PIPE IN ACCORDANCE WITH CLAUSE E2.22 OF SFA 8th EDITION

3 ALL TRENCHES WITHIN TRAFFICKED AREAS TO BE BACKFILLED WITH 75 MM DOWN GRADED STONE FILL, PLACED AND COMPACTED IN 150 MM LAYERS. ALL PIPES IN ROADWAYS, SERVICE YARDS AND CARPARKS LESS THAN 1200 MM DEEP TO BE ENCASED IN CONCRETE. PROVIDE FLEXIBLE JOINTS AT 3 METRE CENTRES.

4 MANHOLES TO BE CONSTRUCTED IN PRECAST CONCRETE RINGS TO BS 5911: PART 1. RINGS TO BE BEDDED IN SEALANT STRIPS.

5 MANHOLES IN FOOTPATHS OR LANDSCAPED AREAS TO BE BACKFILLED WITH 40 MM DOWN GRADED STONE FILL, COMPACTED IN LAYERS NOT EXCEEDING 150 MM THICK. MANHOLES BENEATH ROADS AND PARKING AREAS TO BE CASED IN 150 MM CONCRETE SURROUND.

6 ALL CONNECTIONS TO RAIN WATER PIPES TO BE PROVIDED WITH RODDING ACCESS.

7 ALL ROAD GULLIES TO BE HEPWORTH ROAD GULLIES., REF RGR4, WITH 150 MM DIAMETER OUTLETS. GULLIES TO BE ENCASED IN 150 MM MINIMUM CONCRETE.

8 DRAINS UNDER BUILDING AND WITHIN 300 MM OF THE UNDERSIDE OF FLOORSLAB TO BE ENCASED IN 150 MM CONCRETE. CASING TO INCORPORATE FLEXIBLE FIBRE BOARD JOINTS AT SPACINGS AS RECOMMENDED BY THE PIPE MANUFACTURER. DRAINS UNDER BUILDINGS GENERALLY TO HAVE MIN 100 FULL GRANULAR SURROUND TO CLASS S BS8301

9 WHERE PIPES RUN THROUGH GROUND BEAMS, FLEXIBLE JOINT CASINGS AT EACH FACE OF THE GROUND BEAM ARE TO BE PROVIDED. PIPES WHICH RUN UNDER GROUND BEAMS TO BE PROTECTED WITH 50 MM MINIMUM POLYSTYRENE PLACED OVER THE CROWN OF THE PIPE.

10 ALL WORK TO EXISTING PUBLIC SEWERS TO BE IN ACCORDANCE WITH SEWERS FOR ADOPTION 8TH EDITION AND BS 8301 : CODE OF PRACTICE FOR BUILDING DRAINAGE

11 WHERE DRAINS RUN CLOSE TO BUILDINGS AND INVERT LEVELS ARE BELOW FOUNDATIONS THE DRAINS SHOULD BE ENCASED AS FOLLOWS:-

(a) WHERE THE DRAIN TRENCH IS WITHIN 1M OF THE BUILDING THE TRENCH SHOULD BE FILLED WITH CONCRETE UP TO FOUNDATION FORMATION LEVEL or

(b) WHERE THE DRAIN TRENCH IS FURTHER THAN 1M OF THE BUILDING THE TRENCH SHOULD BE FILLED WITH CONCRETE TO A LEVEL BELOW FOUNDATION FORMATION EQUAL TO THE DISTANCE FROM THE BUILDING LESS 150mm.

KEY:

- INDICATES NEW GULLIES
- INDICATES NEW SURFACE WATER MANHOLES
- INDICATES NEW PIPE RUNS
- INDICATES LINE DRAIN RUNS
- WESTERN SUB-CATCHMENT AREA
- EASTERN SUB-CATCHMENT AREA

ALL PIPES CONNECTED DIRECTY INTO GULLIES TO BE 150MM DIAMETER (SHOWN IN MAGENTA ON PLAN)

CALCULATION

Rev	Date	Revision Description
B	22.04.22	Updated to LLFA planning comments
A	07.01.22	Updated to LLFA planning comments

Revision Schedule

Project Title

Axis J9 - Bicester

Client

ALBION LAND

Drawing Title

PHASE 3
Drained Areas

BAILEY JOHNSON HAYES
Consulting Engineers
ST.ALBANS: Suite 4, Phoenix House, 63 Campfield Rd, ST.ALBANS, Herts AL1 5FL
MANCHESTER: Grange House, John Dalton Street, MANCHESTER, M2 6FW

Scale	1:1000 @A1
Date	23.08.21
Drawn	JNG

Drawing Number

S1209-PH3-DD01 B

A1

SURFACE WATER MANHOLE / INSPECTION CHAMBER SCHEDULE

MH REF	CL	IL	DEPTH	DIA	OPENING	COVER	COMMENTS
S1	83.500	81.250	2250	1800	2/600x600	B125	Hydrobrake 7 l/s + Wier Overflow 82.900m
S2	84.100	81.400	2700	1800	600x600	B125	300mm Catchpit
S3	84.100	81.850	2250	1800	600x600	B125	.
S4	83.600	81.950	1650	1800	600x600	D400	.
S5	83.700	82.200	1500	1500	600x600	D400	.
S6	83.700	82.425	1275	1350	600x600	D400	.
S7	83.700	82.225	1475	1200	600x600	D400	300mm Catchpit
S8	84.100	82.450	1650	1200	600x600	B125	.
S9	84.100	83.000	1100	600	600x600	B125	600m Dia. PPIC 150mm Concrete Encased
S10	84.100	82.100	2000	1200	600x600	D400	.
S11	84.100	82.950	1150	1200	600x600	D400	.
S12	83.800	82.125	1675	1200	600x600	D400	300mm Catchpit
S13	83.800	81.975	1825	1200	600x600	D400	300mm Catchpit
S14	83.800	82.350	1450	1200	600x600	D400	300mm Catchpit
S15	83.850	81.725	2125	1350	600x600	B125	.
S16	84.100	82.100	2000	1350	600x600	B125	.
S17	84.100	82.250	1850	1350	600x600	B125	.
S18	84.100	82.425	1675	1200	600x600	B125	.
S19	84.000	82.775	1225	1200	600x600	D400	.
S20	84.000	82.050	1950	1200	600x600	D400	300mm Catchpit
S21	84.150	82.350	1800	1350	600x600	D400	.
S22	84.150	82.500	1650	1350	600x600	D400	.
S23	84.200	82.675	1525	1200	600x600	D400	.
S24	84.300	83.100	1200	1200	600x600	B125	.
S25	84.200	82.200	2000	1200	600x600	D400	300mm Catchpit
S26	84.200	82.875	1325	1200	600x600	D400	.
S27	83.000	80.950	2050	1800	2/600x600	B125	Hydrobrake 3 l/s + Wier Overflow 82.300m

PERMEABLE PAVING SCHEDULE

AREA REF	IL	LENGTH	WIDTH	AREA	DEPTH	VOLUME	COMMENTS
AREA 1	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 2	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 3	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 4	83.400 - 83.050	38.0m	32.2m	1150m2	0.4m	N/A	Perm. paving for water quality treatment only
AREA 5	83.400 - 83.000	38.0m	16.0m	608m2	0.4m	N/A	Perm. paving for water quality treatment only

NOTE: ALL RWP PIPE POSITIONS TO BE AGREED WITH ARCHITECT

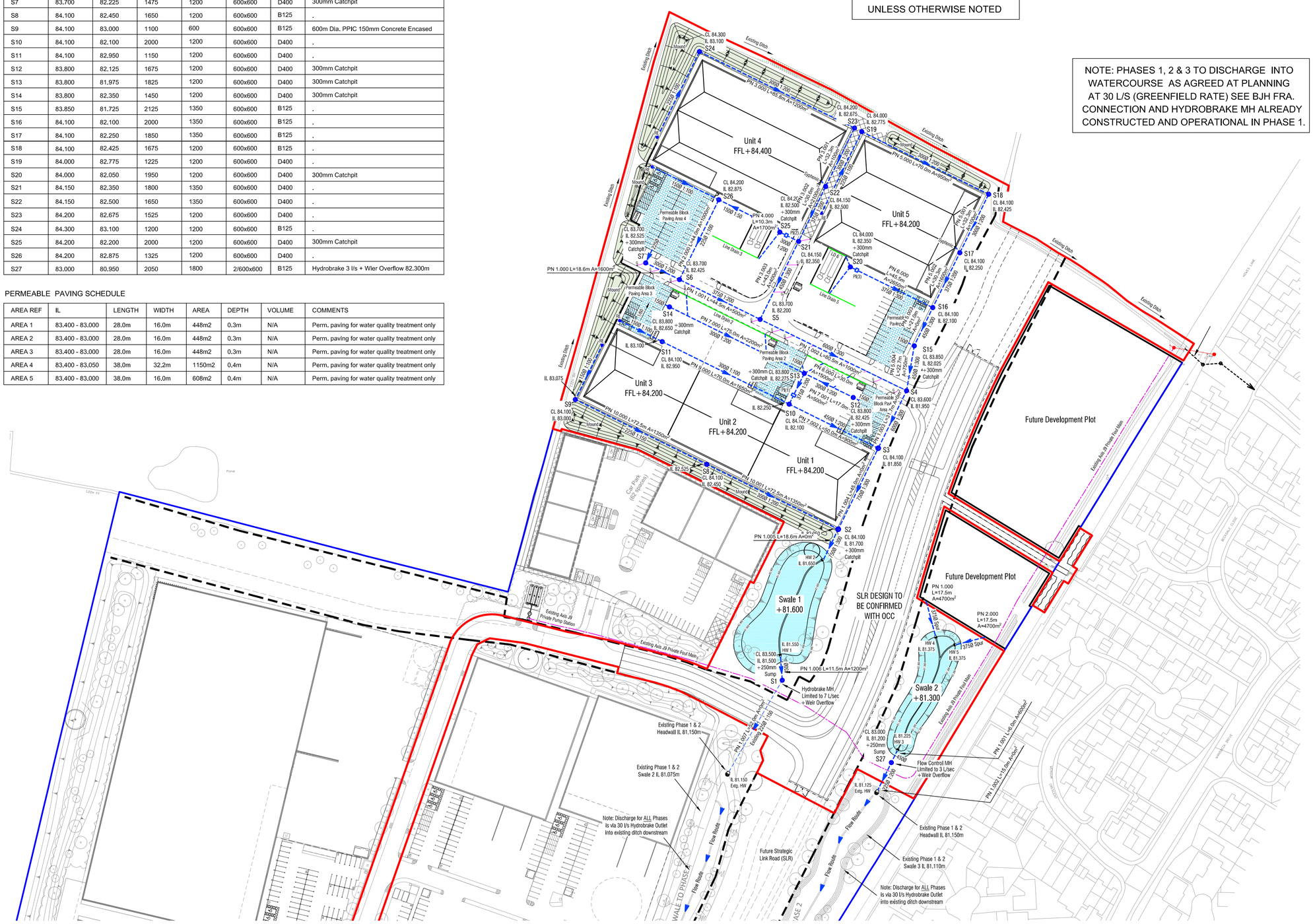
NOTE: ALL DRAINAGE IS INVERT TO INVERT MANHOLE DESIGN UNLESS OTHERWISE NOTED

DRAINED AREAS	STORAGE VOLUMES
UNITS 1-5 - 26,000 m2	SWALE 1 - 2,090 m3
FUTURE - 10,000 m2	SWALE 2 - 810 m3
TOTAL = 36,000 m2	TOTAL = 2,900 m3

MAXIMUM DISCHARGE WESTERN PLOT = 7 l/sec

MAXIMUM DISCHARGE EASTERN PLOT = 3 l/sec

NOTE: PHASES 1, 2 & 3 TO DISCHARGE INTO WATERCOURSE AS AGREED AT PLANNING AT 30 L/S (GREENFIELD RATE) SEE BJH FRA. CONNECTION AND HYDROBRAKE MH ALREADY CONSTRUCTED AND OPERATIONAL IN PHASE 1.



MicroDrainage Network Design 1:1000

20m 10m 0 20m 40m 60m

Scale 1:1000 @A1

DRAINAGE NOTES

1 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND BAILEY JOHNSON HAYES DRAWINGS AND SPECIFICATIONS.

2 DRAINS TO BE 'HEPWORTH SUPERSLEEVE' LAID IN CLASS S BEDDING TO BS 882 1983: TABLE 4, OR TO BS 8301 1985: APPENDIX D. 450 DIA DRAINS AND ABOVE TO BE HEPWORTH CONCRETE PIPES CLASS H . OR EQUAL APPROVED DRAINS WITHIN THE SITE MAY BE THERMOPLASTIC STRUCTURED WALL PIPE IN ACCORDANCE WITH CLAUSE E2.22 OF SFA 8th EDITION

3 ALL TRENCHES WITHIN TRAFFICKED AREAS TO BE BACKFILLED WITH 75 MM DOWN GRADED STONE FILL, PLACED AND COMPACTED IN 150 MM LAYERS. ALL PIPES IN ROADWAYS, SERVICE YARDS AND CARPARKS LESS THAN 1200 MM DEEP TO BE ENCASED IN CONCRETE. PROVIDE FLEXIBLE JOINTS AT 3 METRE CENTRES.

4 MANHOLES TO BE CONSTRUCTED IN PRECAST CONCRETE RINGS TO BS 5911: PART 1. RINGS TO BE BEDDED IN SEALANT STRIPS.

5 MANHOLES IN FOOTPATHS OR LANDSCAPED AREAS TO BE BACKFILLED WITH 40 MM DOWN GRADED STONE FILL, COMPACTED IN LAYERS NOT EXCEEDING 150 MM THICK. MANHOLES BENEATH ROADS AND PARKING AREAS TO BE CASED IN 150 MM CONCRETE SURROUND.

6 ALL CONNECTIONS TO RAIN WATER PIPES TO BE PROVIDED WITH RODDING ACCESS.

7 ALL ROAD GULLIES TO BE HEPWORTH ROAD GULLIES., REF RGR4, WITH 150 MM DIAMETER OUTLETS. GULLIES TO BE ENCASED IN 150 MM MINIMUM CONCRETE.

8 DRAINS UNDER BUILDING AND WITHIN 300 MM OF THE UNDERSIDE OF FLOORSLAB TO BE ENCASED IN 150 MM CONCRETE. CASING TO INCORPORATE FLEXIBLE FIBRE BOARD JOINTS AT SPACINGS AS RECOMMENDED BY THE PIPE MANUFACTURER. DRAINS UNDER BUILDINGS GENERALLY TO HAVE MIN 100 FULL GRANULAR SURROUND TO CLASS S BS8301

9 WHERE PIPES RUN THROUGH GROUND BEAMS, FLEXIBLE JOINT CASINGS AT EACH FACE OF THE GROUND BEAM ARE TO BE PROVIDED. PIPES WHICH RUN UNDER GROUND BEAMS TO BE PROTECTED WITH 50 MM MINIMUM POLYSTYRENE PLACED OVER THE CROWN OF THE PIPE.

10 ALL WORK TO EXISTING PUBLIC SEWERS TO BE IN ACCORDANCE WITH SEWERS FOR ADOPTION 8TH EDITION AND BS 8301 : CODE OF PRACTICE FOR BUILDING DRAINAGE

11 WHERE DRAINS RUN CLOSE TO BUILDINGS AND INVERT LEVELS ARE BELOW FOUNDATIONS THE DRAINS SHOULD BE ENCASED AS FOLLOWS:-

(a) WHERE THE DRAIN TRENCH IS WITHIN 1M OF THE BUILDING THE TRENCH SHOULD BE FILLED WITH CONCRETE UP TO FOUNDATION FORMATION LEVEL or

(b) WHERE THE DRAIN TRENCH IS FURTHER THAN 1M OF THE BUILDING THE TRENCH SHOULD BE FILLED WITH CONCRETE TO A LEVEL BELOW FOUNDATION FORMATION EQUAL TO THE DISTANCE FROM THE BUILDING LESS 150mm.

KEY:

- INDICATES NEW GULLIES
- INDICATES NEW SURFACE WATER MANHOLES
- INDICATES NEW PIPE RUNS
- INDICATES LINE DRAIN RUNS
- INDICATES NEW PERMEABLE PAVING
- INDICATES NEW SWALE BASINS

ALL PIPES CONNECTED DIRECTY INTO GULLIES TO BE 150MM DIAMETER (SHOWN IN MAGENTA ON PLAN)

CALCULATION

Rev	Date	Revision Description
B	22.04.22	Updated to LLFA planning comments
A	07.01.22	Updated to LLFA planning comments

Revision Schedule

Project Title: Axis J9 - Bicester

Client: ALBION LAND

Drawing Title: PHASE 3 MicroDrainage Network Design

BAILEY JOHNSON HAYES
Consulting Engineers
ST.ALBANS: Suite 4, Phoenix House, 63 Campfield Rd, ST.ALBANS, Herts AL1 5FL
MANCHESTER: Grange House, John Dalton Street, MANCHESTER, M2 6FW

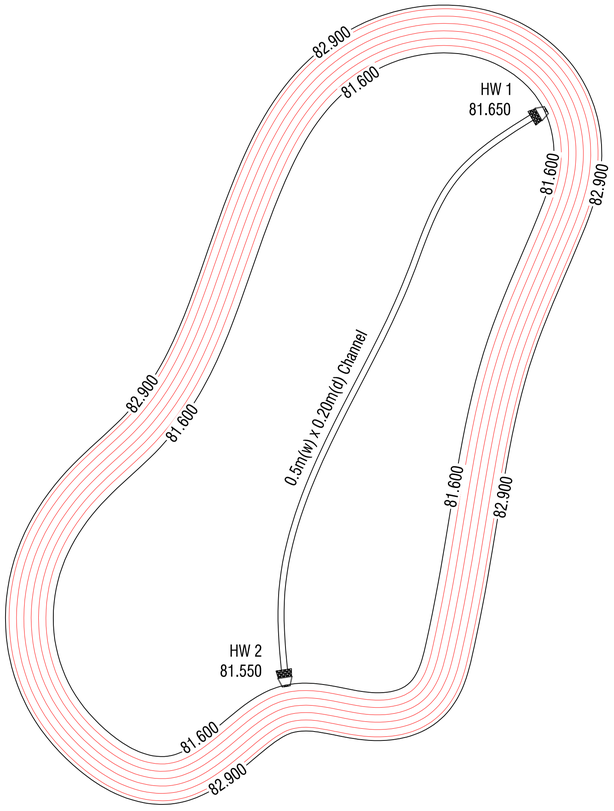
Scale	1:1000 @A1
Date	23.08.21
Drawn	JNG

Drawing Number: S1209-PH3-DD02 B

A1

Swale 1 IL=81.600m

Depth = 0 Area = 1283m2
Depth = 0.2 Area = 1377m2
Depth = 0.4 Area = 1474m2
Depth = 0.6 Area = 1573m2
Depth = 0.8 Area = 1674m2
Depth = 1.0 Area = 1777m2
Depth = 1.2 Area = 1883m2
Depth = 1.3 Area = 1935m2

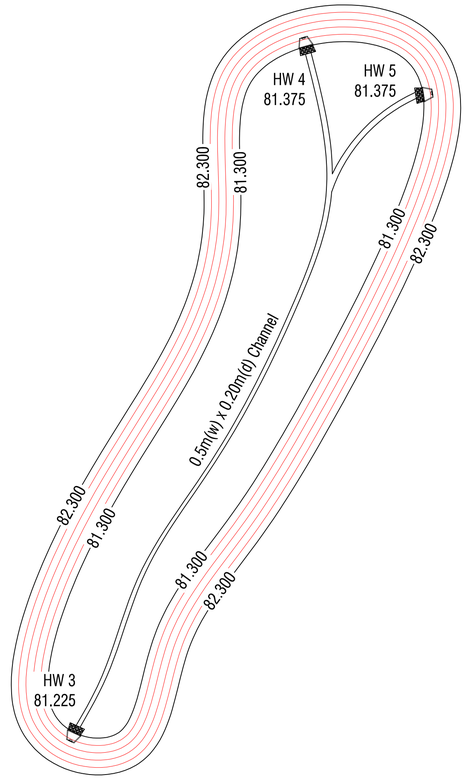


VOLUMES

Depth = 0 Volume = 0m3
Depth = 0.2 Volume = 266m3
Depth = 0.4 Volume = 551m3
Depth = 0.6 Volume = 857m3
Depth = 0.8 Volume= 1183m3
Depth = 1.0 Volume = 1530m3
Depth = 1.2 Area = 1900m3
Depth = 1.3 Area = 2090m3

Swale 2 IL=81.300m

Depth = 0 Area = 594m2
Depth = 0.2 Area = 677m2
Depth = 0.4 Area = 763m2
Depth = 0.6 Area = 861m2
Depth = 0.8 Area = 941m2
Depth = 1.0 Area = 1033m2



VOLUMES

Depth = 0 Volume = 0m3
Depth = 0.2 Volume = 127m3
Depth = 0.4 Volume = 271m3
Depth = 0.6 Volume = 437m3
Depth = 0.8 Volume= 614m3
Depth = 1.0 Volume = 810m3

Swale 1 & 2 Plan 1:250

CALCULATION

Rev	Date	Revision Description
B	22.04.22	Updated to LLFA planning comments
A	07.01.22	Updated to LLFA planning comments

Revision Schedule

Project Title
Axis J9 - Bicester

Client
ALBION LAND

Drawing Title
PHASE 3
Swale 1 & 2

BAILEY JOHNSON HAYES
Consulting Engineers
ST.ALBANS: Suite 4, Phoenix House, 63 Campfield Rd, ST.ALBANS, Herts AL1 5FL
MANCHESTER: Grange House, John Dalton Street, MANCHESTER, M2 6FW

Scale	1:1000 @A1
Date	23.08.21
Drawn	JNG

Drawing Number
S1209-PH3-DD03 B

A1

SURFACE WATER MANHOLE / INSPECTION CHAMBER SCHEDULE

MH REF	CL	IL	DEPTH	DIA	OPENING	COVER	COMMENTS
S1	83.500	81.250	2250	1800	2/600x600	B125	Hydrobrake 7 l/s + Wier Overflow 82.900m
S2	84.100	81.400	2700	1800	600x600	B125	300mm Catchpit
S3	84.100	81.850	2250	1800	600x600	B125	.
S4	83.600	81.950	1650	1800	600x600	D400	.
S5	83.700	82.200	1500	1500	600x600	D400	.
S6	83.700	82.425	1275	1350	600x600	D400	.
S7	83.700	82.225	1475	1200	600x600	D400	300mm Catchpit
S8	84.100	82.450	1650	1200	600x600	B125	.
S9	84.100	83.000	1100	600	600x600	B125	600m Dia. PPIC 150mm Concrete Encased
S10	84.100	82.100	2000	1200	600x600	D400	.
S11	84.100	82.950	1150	1200	600x600	D400	.
S12	83.800	82.125	1675	1200	600x600	D400	300mm Catchpit
S13	83.800	81.975	1825	1200	600x600	D400	300mm Catchpit
S14	83.800	82.350	1450	1200	600x600	D400	300mm Catchpit
S15	83.850	81.725	2125	1350	600x600	B125	.
S16	84.100	82.100	2000	1350	600x600	B125	.
S17	84.100	82.250	1850	1350	600x600	B125	.
S18	84.100	82.425	1675	1200	600x600	B125	.
S19	84.000	82.775	1225	1200	600x600	D400	.
S20	84.000	82.050	1950	1200	600x600	D400	300mm Catchpit
S21	84.150	82.350	1800	1350	600x600	D400	.
S22	84.150	82.500	1650	1350	600x600	D400	.
S23	84.200	82.675	1525	1200	600x600	D400	.
S24	84.300	83.100	1200	1200	600x600	B125	.
S25	84.200	82.200	2000	1200	600x600	D400	300mm Catchpit
S26	84.200	82.875	1325	1200	600x600	D400	.
S27	83.000	80.950	2050	1800	2/600x600	B125	Hydrobrake 3 l/s + Wier Overflow 82.300m

PERMEABLE PAVING SCHEDULE

AREA REF	IL	LENGTH	WIDTH	AREA	DEPTH	VOLUME	COMMENTS
AREA 1	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 2	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 3	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 4	83.400 - 83.050	38.0m	32.2m	1150m2	0.4m	N/A	Perm. paving for water quality treatment only
AREA 5	83.400 - 83.000	38.0m	16.0m	608m2	0.4m	N/A	Perm. paving for water quality treatment only

NOTE: ALL RWP PIPE POSITIONS TO BE AGREED WITH ARCHITECT

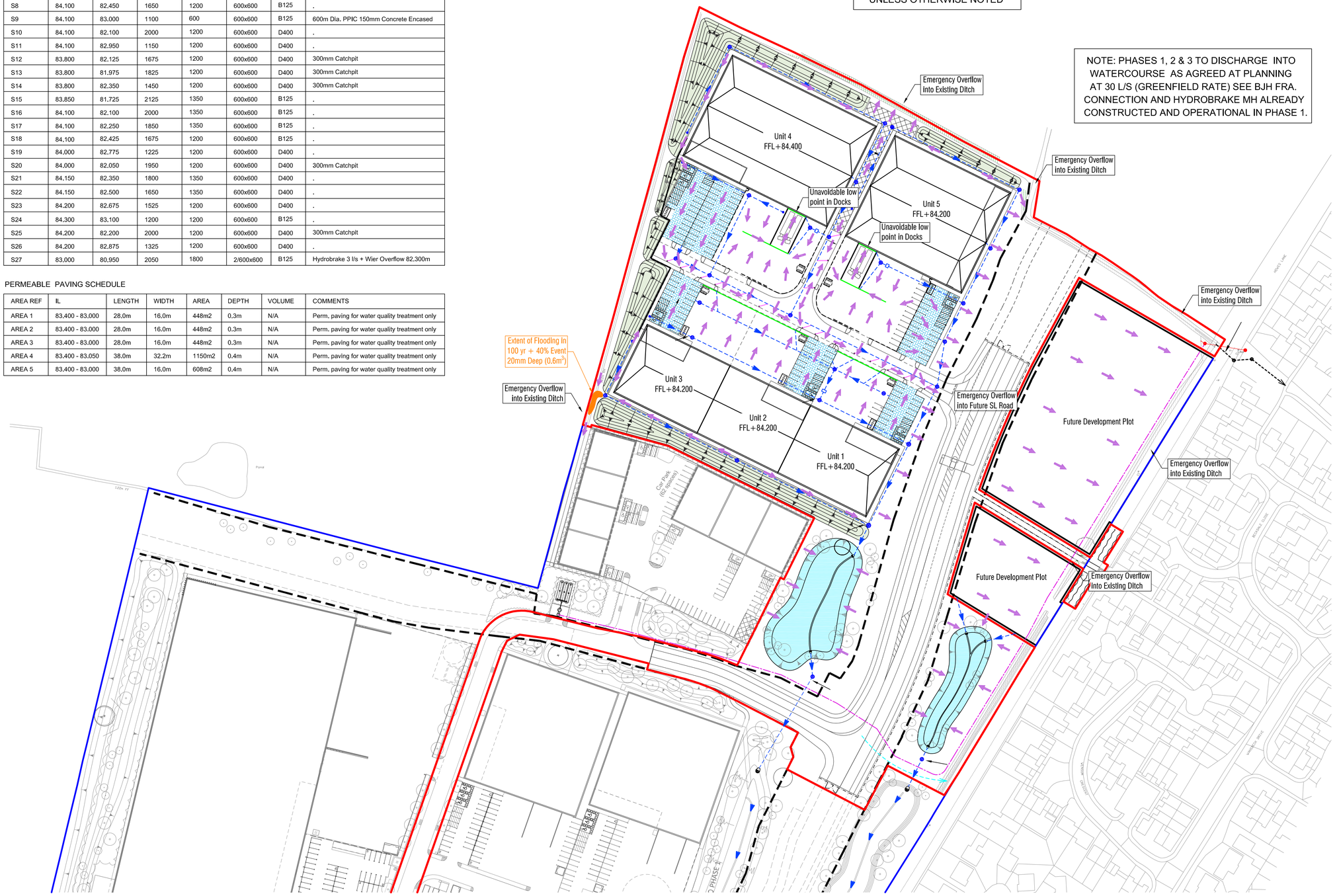
NOTE: ALL DRAINAGE IS INVERT TO INVERT MANHOLE DESIGN UNLESS OTHERWISE NOTED

NOTE: PHASES 1, 2 & 3 TO DISCHARGE INTO WATERCOURSE AS AGREED AT PLANNING AT 30 L/S (GREENFIELD RATE) SEE BJH FRA. CONNECTION AND HYDROBRAKE MH ALREADY CONSTRUCTED AND OPERATIONAL IN PHASE 1.

DRAINED AREAS	STORAGE VOLUMES
UNITS 1-5 - 26,000 m2	SWALE 1 - 2,090 m3
FUTURE - 10,000 m2	SWALE 2 - 805 m3
TOTAL = 36,000 m2	TOTAL = 2,895 m3

MAXIMUM DISCHARGE WESTERN PLOT = 7 l/sec

MAXIMUM DISCHARGE EASTERN PLOT = 3 l/sec



DRAINAGE NOTES

1 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND BAILEY JOHNSON HAYES DRAWINGS AND SPECIFICATIONS.

2 DRAINS TO BE 'HEPWORTH SUPERSLEEVE' LAID IN CLASS S BEDDING TO BS 882 1983; TABLE 4, OR TO BS 8301 1985; APPENDIX D. 450 DIA DRAINS AND ABOVE TO BE HEPWORTH CONCRETE PIPES CLASS H . OR EQUAL APPROVED DRAINS WITHIN THE SITE MAY BE THERMOPLASTIC STRUCTURED WALL PIPE IN ACCORDANCE WITH CLAUSE E2.22 OF SFA 8th EDITION

3 ALL TRENCHES WITHIN TRAFFICKED AREAS TO BE BACKFILLED WITH 75 MM DOWN GRADED STONE FILL, PLACED AND COMPACTED IN 150 MM LAYERS. ALL PIPES IN ROADWAYS, SERVICE YARDS AND CARPARKS LESS THAN 1200 MM DEEP TO BE ENCASED IN CONCRETE. PROVIDE FLEXIBLE JOINTS AT 3 METRE CENTRES.

4 MANHOLES TO BE CONSTRUCTED IN PRECAST CONCRETE RINGS TO BS 5911: PART 1. RINGS TO BE BEDDED IN SEALANT STRIPS.

5 MANHOLES IN FOOTPATHS OR LANDSCAPED AREAS TO BE BACKFILLED WITH 40 MM DOWN GRADED STONE FILL, COMPACTED IN LAYERS NOT EXCEEDING 150 MM THICK. MANHOLES BENEATH ROADS AND PARKING AREAS TO BE CASED IN 150 MM CONCRETE SURROUND.

6 ALL CONNECTIONS TO RAIN WATER PIPES TO BE PROVIDED WITH RODDING ACCESS.

7 ALL ROAD GULLIES TO BE HEPWORTH ROAD GULLIES., REF RGR4, WITH 150 MM DIAMETER OUTLETS. GULLIES TO BE ENCASED IN 150 MM MINIMUM CONCRETE.

8 DRAINS UNDER BUILDING AND WITHIN 300 MM OF THE UNDERSIDE OF FLOORSLAB TO BE ENCASED IN 150 MM CONCRETE. CASING TO INCORPORATE FLEXIBLE FIBRE BOARD JOINTS AT SPACINGS AS RECOMMENDED BY THE PIPE MANUFACTURER. DRAINS UNDER BUILDINGS GENERALLY TO HAVE MIN 100 FULL GRANULAR SURROUND TO CLASS S BS8301

9 WHERE PIPES RUN THROUGH GROUND BEAMS, FLEXIBLE JOINT CASINGS AT EACH FACE OF THE GROUND BEAM ARE TO BE PROVIDED. PIPES WHICH RUN UNDER GROUND BEAMS TO BE PROTECTED WITH 50 MM MINIMUM POLYSTYRENE PLACED OVER THE CROWN OF THE PIPE.

10 ALL WORK TO EXISTING PUBLIC SEWERS TO BE IN ACCORDANCE WITH SEWERS FOR ADOPTION 8TH EDITION AND BS 8301 : CODE OF PRACTICE FOR BUILDING DRAINAGE

11 WHERE DRAINS RUN CLOSE TO BUILDINGS AND INVERT LEVELS ARE BELOW FOUNDATIONS THE DRAINS SHOULD BE ENCASED AS FOLLOWS:-

(a) WHERE THE DRAIN TRENCH IS WITHIN 1M OF THE BUILDING THE TRENCH SHOULD BE FILLED WITH CONCRETE UP TO FOUNDATION FORMATION LEVEL or

(b) WHERE THE DRAIN TRENCH IS FURTHER THAN 1M OF THE BUILDING THE TRENCH SHOULD BE FILLED WITH CONCRETE TO A LEVEL BELOW FOUNDATION FORMATION EQUAL TO THE DISTANCE FROM THE BUILDING LESS 150mm.

KEY:

- INDICATES NEW GULLIES
- INDICATES NEW SURFACE WATER MANHOLES
- INDICATES NEW PIPE RUNS
- INDICATES LINE DRAIN RUNS
- INDICATES NEW PERMEABLE PAVING
- INDICATES NEW SWALE BASINS
- INDICATES PREDICTED FLOODING
- INDICATES DIRECTION OF OVERLAND FLOWS

ALL PIPES CONNECTED DIRECTY INTO GULLIES TO BE 150MM DIAMETER (SHOWN IN MAGENTA ON PLAN)

CALCULATION

Rev	Date	Revision Description
A	22.04.22	Updated to LLFA planning comments

Revision Schedule

Project Title: Axis J9 - Bicester

Client: ALBION LAND

Drawing Title: PHASE 3 Exceedance Flood Route

BAILEY JOHNSON HAYES
Consulting Engineers
ST.ALBANS: Suite 4, Phoenix House, 63 Campfield Rd, ST.ALBANS, Herts AL1 5FL
MANCHESTER: Grange House, John Dalton Street, MANCHESTER, M2 6FW

Scale	1:1000 @A1
Date	07.01.22
Drawn	JNG

Drawing Number: S1209-PH3-DD04 A

APPENDIX B

MICRODRAINAGE CALCULATIONS PHASE 3

Page 1 – Existing Greenfield Runoff Estimate

Pages 2 – Quick Storage Estimate (East)

Pages 3-9 – MircoDrainage Calculations (East)

Pages 10 – Quick Storage Estimate (West)

Pages 11-25 – MircoDrainage Calculations (West)

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	James Griffiths
Site name:	Axis J9 - Phase 3
Site location:	Bicester

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.

Site Details

Latitude:	51.90408° N
Longitude:	1.18047° W
Reference:	779462308
Date:	Jan 07 2022 10:20

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 6.5

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics	Default	Edited
SOIL type:	1	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.1	0.3

Hydrological characteristics	Default	Edited
SAAR (mm):	628	628
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

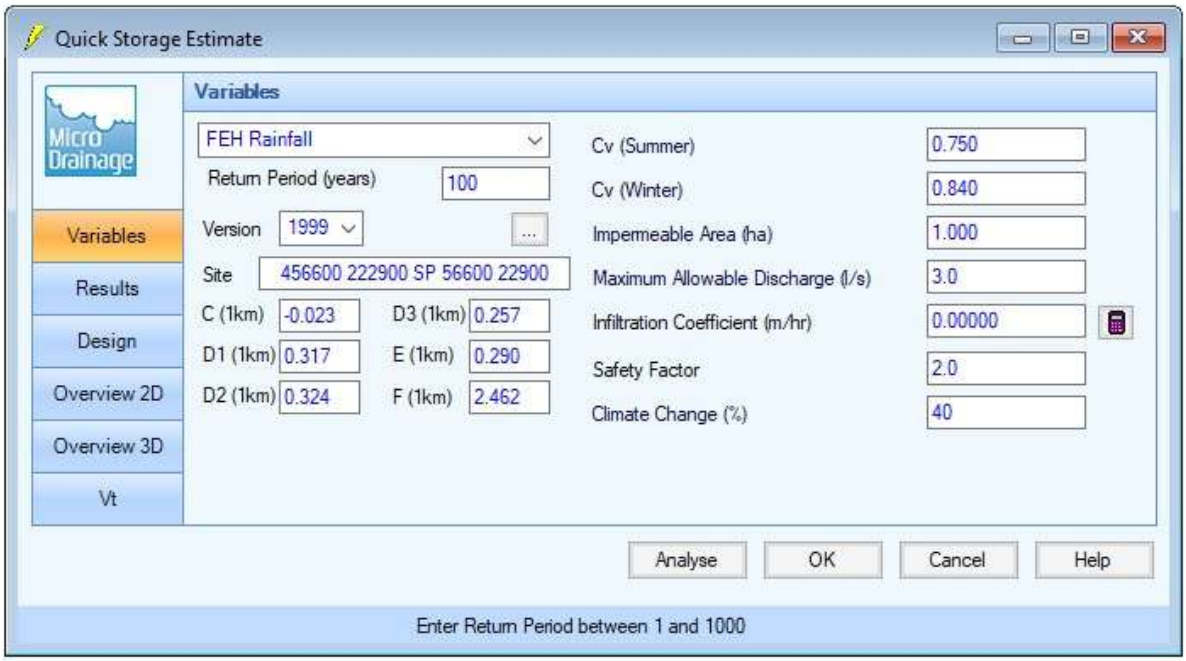
Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

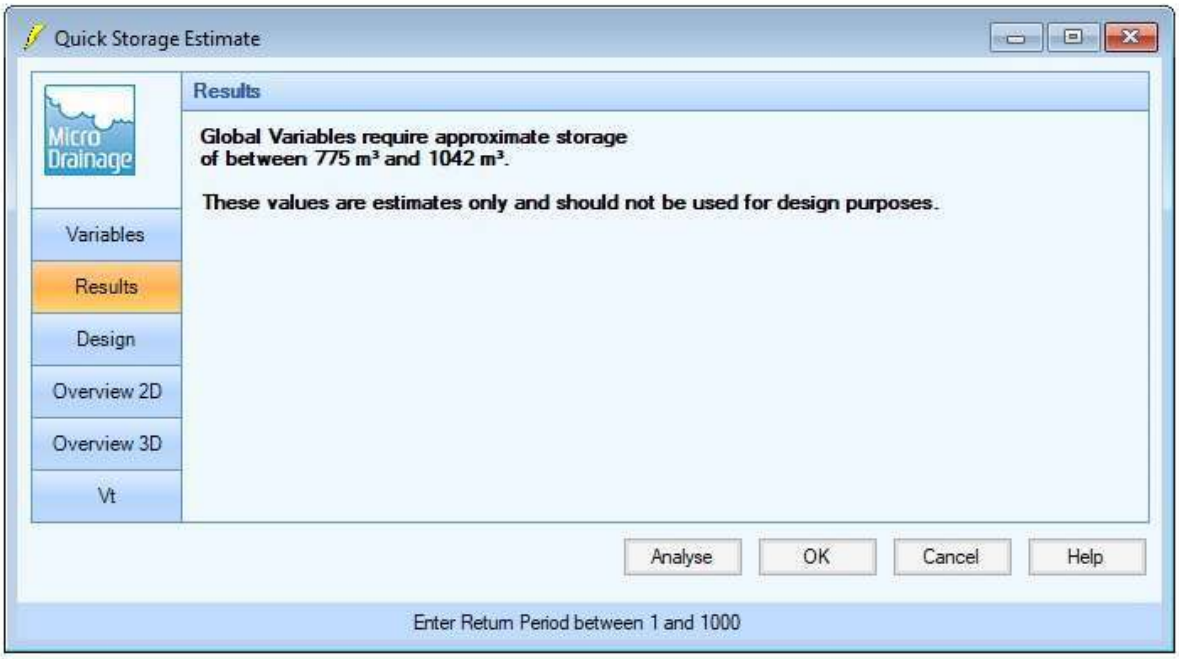
(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	0.96	10.43
1 in 1 year (l/s):	0.82	8.87
1 in 30 years (l/s):	2.21	24
1 in 100 year (l/s):	3.07	33.28
1 in 200 years (l/s):	3.6	39.02

East Site Sub-Catchment – Quick Storage Estimates
100-year + 40% Initial Calculations





STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	17.500	0.058	300.0	0.470	15.00	0.0	0.600	o	375	Pipe/Conduit	
2.000	17.500	0.058	301.7	0.470	15.00	0.0	0.600	o	375	Pipe/Conduit	
1.001	6.000	0.025	240.0	0.060	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.002	15.000	0.075	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	88.60	15.28	81.433	0.470	0.0	0.0	0.0	1.04	115.0	112.8
2.000	88.59	15.28	81.433	0.470	0.0	0.0	0.0	1.04	114.6	112.8
1.001	88.26	15.36	81.225	1.000	0.0	0.0	0.0	1.31	208.0«	239.0
1.002	87.09	15.63	81.200	1.000	0.0	0.0	0.0	0.92	36.6«	239.0

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	375	Spur 1	83.000	81.433	1.192	Open Manhole	1350
2.000	o	375	Spur 2	83.000	81.433	1.192	Open Manhole	1350
1.001	o	450	Swale 2	83.000	81.225	1.325	Open Manhole	1350
1.002	o	225	S27	83.000	81.200	1.575	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	17.500	300.0	Swale 2	83.000	81.375	1.250	Open Manhole	1350
2.000	17.500	301.7	Swale 2	83.000	81.375	1.250	Open Manhole	1350
1.001	6.000	240.0	S27	83.000	81.200	1.350	Open Manhole	1350
1.002	15.000	200.0	Existing Swale	82.800	81.125	1.450	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002	Existing Swale	82.800	81.125	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	E (1km)	0.290
Return Period (years)	30	F (1km)	2.462
FEH Rainfall Version	1999	Summer Storms	Yes
Site Location	456600 222900 SP 56600 22900	Winter Storms	Yes
C (1km)	-0.023	Cv (Summer)	0.750
D1 (1km)	0.317	Cv (Winter)	0.840
D2 (1km)	0.324	Storm Duration (mins)	30
D3 (1km)	0.257		

Online Controls for Storm

Complex Manhole: S27, DS/PN: 1.002, Volume (m³): 3.3

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0081-3000-1100-3000
Design Head (m)	1.100
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	81
Invert Level (m)	81.200
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.100	3.0	Kick-Flo®	0.682	2.4
Flush-Flo™	0.333	3.0	Mean Flow over Head Range	-	2.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.4	1.200	3.1	3.000	4.8	7.000	7.1
0.200	2.9	1.400	3.4	3.500	5.1	7.500	7.3
0.300	3.0	1.600	3.6	4.000	5.5	8.000	7.6
0.400	3.0	1.800	3.8	4.500	5.8	8.500	7.8
0.500	2.9	2.000	4.0	5.000	6.1	9.000	8.0
0.600	2.7	2.200	4.1	5.500	6.3	9.500	8.2
0.800	2.6	2.400	4.3	6.000	6.6		
1.000	2.9	2.600	4.5	6.500	6.9		

Weir

Discharge Coef 0.544 Width (m) 1.800 Invert Level (m) 82.300

Storage Structures for Storm

Tank or Pond Manhole: Swale 2, DS/PN: 1.001

Invert Level (m) 81.225

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	594.0	1.000	1034.0	1.001	0.0

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	Spur 1	2.243	1.933	0.000	4.176
2.000	Spur 2	2.243	1.933	0.000	4.176
1.001	Swale 2	2.541	0.954	804.247	807.742
1.002	S27	2.576	0.596	0.000	3.173
Total		9.603	5.416	804.247	819.266

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.257
FEH Rainfall Version	1999	E (1km)	0.290
Site Location	456600 222900 SP 56600 22900	F (1km)	2.462
C (1km)	-0.023	Cv (Summer)	0.750
D1 (1km)	0.317	Cv (Winter)	0.840
D2 (1km)	0.324		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flooded Volume (m³)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
1.000	Spur 1	15 minute 2 year Winter I+0%	83.000	81.606	0.000	0.241	41.2	OK
2.000	Spur 2	15 minute 2 year Winter I+0%	83.000	81.606	0.000	0.241	41.2	OK
1.001	Swale 2	960 minute 2 year Winter I+0%	83.000	81.484	0.000	167.465	3.4	OK
1.002	S27	960 minute 2 year Winter I+0%	83.000	81.489	0.000	0.805	3.0	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.257
FEH Rainfall Version	1999	E (1km)	0.290
Site Location	456600 222900 SP 56600 22900	F (1km)	2.462
C (1km)	-0.023	Cv (Summer)	0.750
D1 (1km)	0.317	Cv (Winter)	0.840
D2 (1km)	0.324		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flooded Volume (m³)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
1.000	Spur 1	15 minute 30 year Winter I+0%	83.000	81.792	0.000	0.507	94.5	OK
2.000	Spur 2	15 minute 30 year Winter I+0%	83.000	81.798	0.000	0.516	94.2	OK
1.001	Swale 2	960 minute 30 year Winter I+0%	83.000	81.753	0.000	373.799	3.8	SURCHARGED
1.002	S27	960 minute 30 year Winter I+0%	83.000	81.784	0.000	1.567	3.0	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

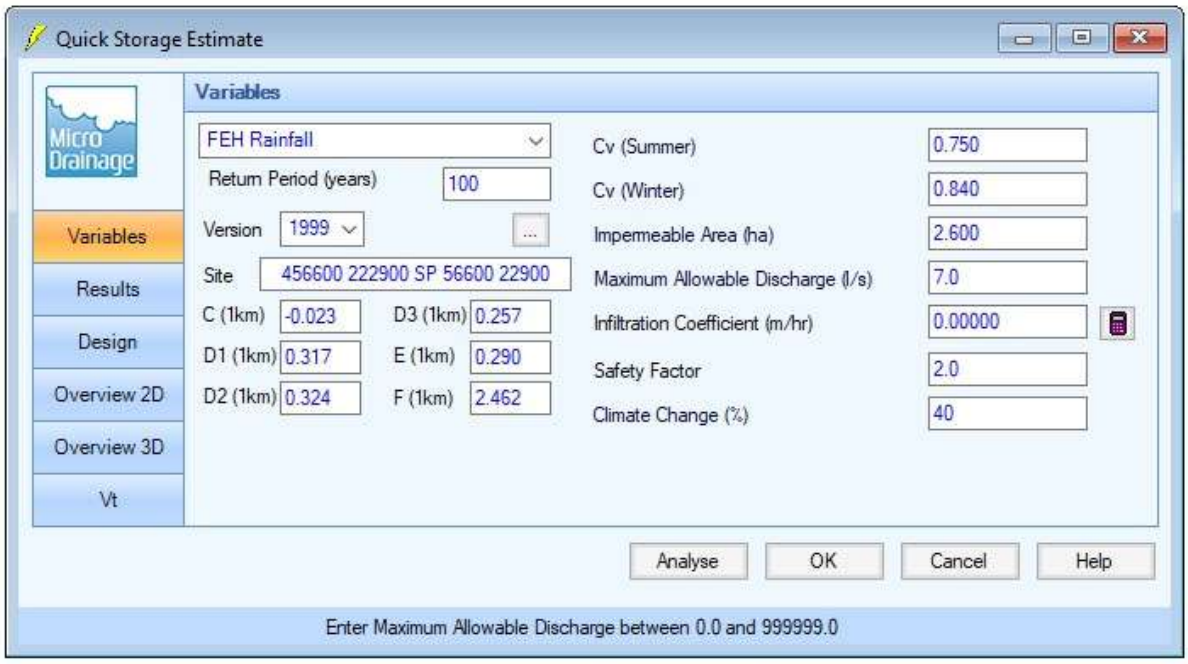
Rainfall Model	FEH	D3 (1km)	0.257
FEH Rainfall Version	1999	E (1km)	0.290
Site Location	456600 222900 SP 56600 22900	F (1km)	2.462
C (1km)	-0.023	Cv (Summer)	0.750
D1 (1km)	0.317	Cv (Winter)	0.840
D2 (1km)	0.324		

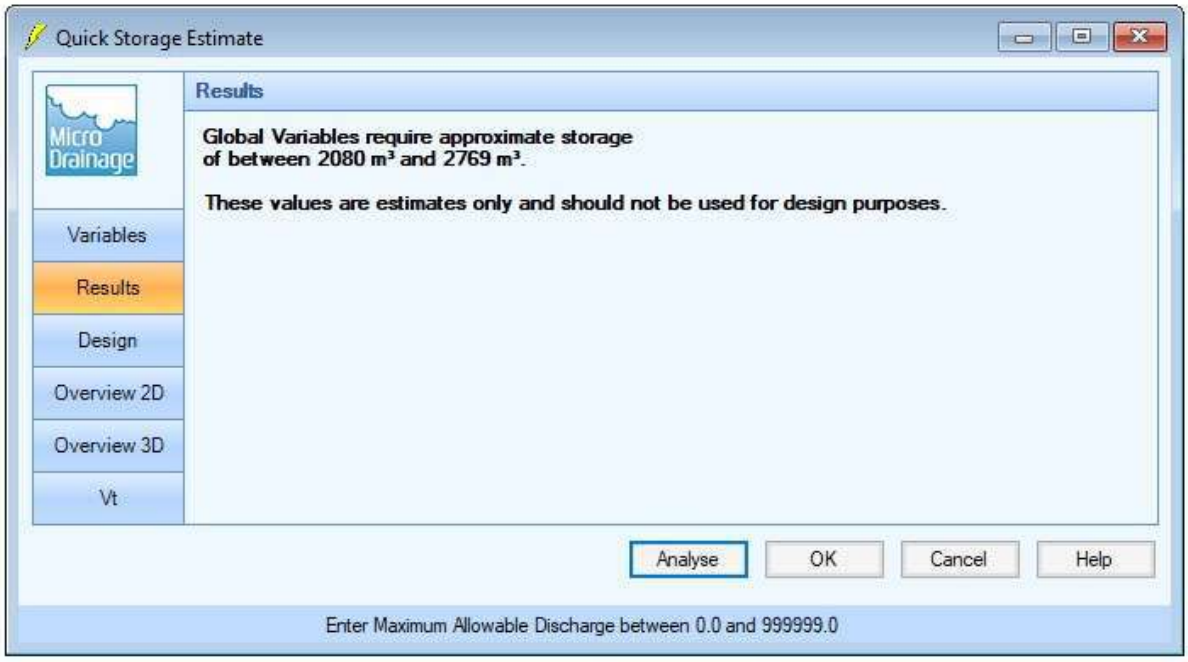
Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flooded Volume (m³)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
1.000	Spur 1	1440 minute 100 year Winter I+40%	83.000	82.219	0.000	1.118	14.2	SURCHARGED
2.000	Spur 2	1440 minute 100 year Winter I+40%	83.000	82.219	0.000	1.118	14.2	SURCHARGED
1.001	Swale 2	1440 minute 100 year Winter I+40%	83.000	82.218	0.000	801.727	3.9	SURCHARGED
1.002	S27	1440 minute 100 year Winter I+40%	83.000	82.250	0.000	2.235	3.0	SURCHARGED

West Site Sub-Catchment – Quick Storage Estimates
100-year + 40% Initial Calculations





STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	20.000	0.100	200.0	0.160	15.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	45.000	0.450	100.0	0.100	15.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	45.000	0.225	200.0	0.050	0.00	0.0	0.600	o	375	Pipe/Conduit	
3.000	85.800	0.425	201.9	0.120	15.00	0.0	0.600	o	300	Pipe/Conduit	
3.001	32.300	0.175	184.6	0.010	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.002	30.600	0.150	204.0	0.210	0.00	0.0	0.600	o	375	Pipe/Conduit	
4.000	10.300	0.150	68.7	0.170	15.00	0.0	0.600	o	300	Pipe/Conduit	
3.003	43.000	0.150	286.7	0.040	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.002	80.500	0.250	322.0	0.100	0.00	0.0	0.600	o	600	Pipe/Conduit	
5.000	70.000	0.350	200.0	0.095	15.00	0.0	0.600	o	300	Pipe/Conduit	
5.001	32.300	0.175	184.6	0.010	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.002	30.000	0.150	200.0	0.160	0.00	0.0	0.600	o	375	Pipe/Conduit	
6.000	45.000	0.150	300.0	0.265	15.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	88.51	15.30	82.525	0.160	0.0	0.0	0.0	1.11	78.3	38.4
2.000	87.33	15.57	82.875	0.100	0.0	0.0	0.0	1.31	52.0	23.6
1.001	84.90	16.16	82.425	0.310	0.0	0.0	0.0	1.28	141.1	71.3
3.000	84.36	16.30	83.100	0.120	0.0	0.0	0.0	1.10	78.0	27.4
3.001	82.57	16.76	82.675	0.130	0.0	0.0	0.0	1.15	81.6	29.1
3.002	81.09	17.17	82.500	0.340	0.0	0.0	0.0	1.26	139.7	74.7
4.000	89.44	15.09	82.500	0.170	0.0	0.0	0.0	1.90	134.3	41.2
3.003	79.00	17.77	82.350	0.550	0.0	0.0	0.0	1.20	190.2	117.7
1.002	75.80	18.76	82.200	0.960	0.0	0.0	0.0	1.35	382.2	197.1
5.000	85.33	16.05	82.775	0.095	0.0	0.0	0.0	1.11	78.3	22.0
5.001	83.49	16.52	82.425	0.105	0.0	0.0	0.0	1.15	81.6	23.7
5.002	82.02	16.91	82.250	0.265	0.0	0.0	0.0	1.28	141.1	58.9
6.000	86.70	15.72	82.250	0.265	0.0	0.0	0.0	1.04	115.0	62.2

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
5.003	21.000	0.075	280.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.004	22.700	0.075	302.7	0.075	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.003	31.700	0.100	317.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
7.000	75.000	0.375	200.0	0.220	15.00	0.0	0.600	o	300	Pipe/Conduit	
8.000	30.000	0.150	200.0	0.150	15.00	0.0	0.600	o	300	Pipe/Conduit	
7.001	17.000	0.175	97.1	0.050	0.00	0.0	0.600	o	375	Pipe/Conduit	
9.000	70.000	0.450	155.6	0.165	15.00	0.0	0.600	o	300	Pipe/Conduit	
7.002	50.000	0.250	200.0	0.093	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.004	45.000	0.150	300.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
10.000	72.500	0.475	152.6	0.135	15.00	0.0	0.600	o	225	Pipe/Conduit	
10.001	72.500	0.400	181.3	0.135	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	18.600	0.050	372.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.006	11.500	0.050	230.0	0.120	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.007	52.000	0.350	148.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
5.003	80.97	17.20	82.100	0.530	0.0	0.0	0.0	1.21	192.4	116.2
5.004	79.82	17.53	82.025	0.605	0.0	0.0	0.0	1.16	185.0	130.8
1.003	74.63	19.15	81.950	1.565	0.0	0.0	0.0	1.36	385.2	316.3
7.000	85.03	16.13	82.650	0.220	0.0	0.0	0.0	1.11	78.3	50.7
8.000	87.85	15.45	82.425	0.150	0.0	0.0	0.0	1.11	78.3	35.7
7.001	84.42	16.28	82.275	0.420	0.0	0.0	0.0	1.84	203.1	96.0
9.000	85.85	15.93	82.550	0.165	0.0	0.0	0.0	1.26	88.9	38.4
7.002	82.20	16.86	82.100	0.678	0.0	0.0	0.0	1.43	228.1	150.9
1.004	73.28	19.61	81.850	2.243	0.0	0.0	0.0	1.61	711.5	445.1
10.000	84.97	16.14	83.000	0.135	0.0	0.0	0.0	1.06	42.0	31.1
10.001	81.03	17.18	82.450	0.270	0.0	0.0	0.0	1.16	82.3	59.3
1.005	72.67	19.83	81.700	2.513	0.0	0.0	0.0	1.44	638.4	494.6
1.006	72.27	19.97	81.550	2.633	0.0	0.0	0.0	1.34	212.5«	515.4
1.007	70.12	20.78	81.500	2.633	0.0	0.0	0.0	1.07	42.6«	515.4

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	300	S7	83.700	82.525	0.875	Open Manhole	1200
2.000	o	225	S26	84.200	82.875	1.100	Open Manhole	1200
1.001	o	375	S6	83.700	82.425	0.900	Open Manhole	1350
3.000	o	300	S24	84.300	83.100	0.900	Open Manhole	1200
3.001	o	300	S23	84.200	82.675	1.225	Open Manhole	1200
3.002	o	375	S22	84.150	82.500	1.275	Open Manhole	1350
4.000	o	300	S25	84.200	82.500	1.400	Open Manhole	1200
3.003	o	450	S21	84.150	82.350	1.350	Open Manhole	1350
1.002	o	600	S5	83.700	82.200	0.900	Open Manhole	1500
5.000	o	300	S19	84.000	82.775	0.925	Open Manhole	1200
5.001	o	300	S18	84.100	82.425	1.375	Open Manhole	1200
5.002	o	375	S17	84.100	82.250	1.475	Open Manhole	1350
6.000	o	375	S20	84.000	82.250	1.375	Open Manhole	1350
5.003	o	450	S16	84.100	82.100	1.550	Open Manhole	1350
5.004	o	450	S15	83.850	82.025	1.375	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	20.000	200.0	S6	83.700	82.425	0.975	Open Manhole	1350
2.000	45.000	100.0	S6	83.700	82.425	1.050	Open Manhole	1350
1.001	45.000	200.0	S5	83.700	82.200	1.125	Open Manhole	1500
3.000	85.800	201.9	S23	84.200	82.675	1.225	Open Manhole	1200
3.001	32.300	184.6	S22	84.150	82.500	1.350	Open Manhole	1350
3.002	30.600	204.0	S21	84.150	82.350	1.425	Open Manhole	1350
4.000	10.300	68.7	S21	84.150	82.350	1.500	Open Manhole	1350
3.003	43.000	286.7	S5	83.700	82.200	1.050	Open Manhole	1500
1.002	80.500	322.0	S4	83.600	81.950	1.050	Open Manhole	1500
5.000	70.000	200.0	S18	84.100	82.425	1.375	Open Manhole	1200
5.001	32.300	184.6	S17	84.100	82.250	1.550	Open Manhole	1350
5.002	30.000	200.0	S16	84.100	82.100	1.625	Open Manhole	1350
6.000	45.000	300.0	S16	84.100	82.100	1.625	Open Manhole	1350
5.003	21.000	280.0	S15	83.850	82.025	1.375	Open Manhole	1350
5.004	22.700	302.7	S4	83.600	81.950	1.200	Open Manhole	1500

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.003	o	600	S4	83.600	81.950	1.050	Open Manhole	1500
7.000	o	300	S14	83.800	82.650	0.850	Open Manhole	1200
8.000	o	300	S12	83.800	82.425	1.075	Open Manhole	1200
7.001	o	375	S13	83.800	82.275	1.150	Open Manhole	1350
9.000	o	300	S11	84.100	82.550	1.250	Open Manhole	1200
7.002	o	450	S10	84.100	82.100	1.550	Open Manhole	1350
1.004	o	750	S3	84.100	81.850	1.500	Open Manhole	1800
10.000	o	225	S9	84.100	83.000	0.875	Open Manhole	1200
10.001	o	300	S8	84.100	82.450	1.350	Open Manhole	1200
1.005	o	750	S2	84.100	81.700	1.650	Open Manhole	1800
1.006	o	450	SWALE	83.500	81.550	1.500	Open Manhole	1800
1.007	o	225	S1	83.500	81.500	1.775	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.003	31.700	317.0	S3	84.100	81.850	1.650	Open Manhole	1800
7.000	75.000	200.0	S13	83.800	82.275	1.225	Open Manhole	1350
8.000	30.000	200.0	S13	83.800	82.275	1.225	Open Manhole	1350
7.001	17.000	97.1	S10	84.100	82.100	1.625	Open Manhole	1350
9.000	70.000	155.6	S10	84.100	82.100	1.700	Open Manhole	1350
7.002	50.000	200.0	S3	84.100	81.850	1.800	Open Manhole	1800
1.004	45.000	300.0	S2	84.100	81.700	1.650	Open Manhole	1800
10.000	72.500	152.6	S8	84.100	82.525	1.350	Open Manhole	1200
10.001	72.500	181.3	S2	84.100	82.050	1.750	Open Manhole	1800
1.005	18.600	372.0	SWALE	83.500	81.650	1.100	Open Manhole	1800
1.006	11.500	230.0	S1	83.500	81.500	1.550	Open Manhole	1350
1.007	52.000	148.6	Existing Swale	82.800	81.150	1.425	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.007	Existing Swale	82.800	81.150	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	E (1km)	0.290
Return Period (years)	5	F (1km)	2.462
FEH Rainfall Version	1999	Summer Storms	Yes
Site Location	456600 222900 SP 56600 22900	Winter Storms	Yes
C (1km)	-0.023	Cv (Summer)	0.750
D1 (1km)	0.317	Cv (Winter)	0.840
D2 (1km)	0.324	Storm Duration (mins)	30
D3 (1km)	0.257		

Online Controls for Storm

Complex Manhole: S1, DS/PN: 1.007, Volume (m³): 4.4

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0118-7000-1400-7000
Design Head (m)	1.400
Design Flow (l/s)	7.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	118
Invert Level (m)	81.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	7.0	Kick-Flo®	0.868	5.6
Flush-Flo™	0.415	7.0	Mean Flow over Head Range	-	6.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.2	1.200	6.5	3.000	10.0	7.000	15.0
0.200	6.4	1.400	7.0	3.500	10.8	7.500	15.5
0.300	6.9	1.600	7.4	4.000	11.5	8.000	16.0
0.400	7.0	1.800	7.9	4.500	12.1	8.500	16.5
0.500	7.0	2.000	8.3	5.000	12.8	9.000	16.9
0.600	6.8	2.200	8.7	5.500	13.4	9.500	17.4
0.800	6.1	2.400	9.0	6.000	13.9		
1.000	6.0	2.600	9.4	6.500	14.5		

Weir

Discharge Coef 0.544 Width (m) 1.800 Invert Level (m) 82.900

Storage Structures for Storm

Porous Car Park Manhole: S7, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	25.0
Membrane Percolation (mm/hr)	1000	Length (m)	38.0
Max Percolation (l/s)	263.9	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	83.000	Cap Volume Depth (m)	0.400

Porous Car Park Manhole: S15, DS/PN: 5.004

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	16.0
Membrane Percolation (mm/hr)	1000	Length (m)	38.0
Max Percolation (l/s)	168.9	Slope (1:X)	100.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	83.000	Membrane Depth (mm)	0

Porous Car Park Manhole: S14, DS/PN: 7.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	16.0
Membrane Percolation (mm/hr)	1000	Length (m)	28.0
Max Percolation (l/s)	124.4	Slope (1:X)	60.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	83.000	Membrane Depth (mm)	0

Porous Car Park Manhole: S12, DS/PN: 8.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	16.0
Membrane Percolation (mm/hr)	1000	Length (m)	28.0
Max Percolation (l/s)	124.4	Slope (1:X)	60.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	83.000	Cap Volume Depth (m)	0.300

Porous Car Park Manhole: S13, DS/PN: 7.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	16.0
Membrane Percolation (mm/hr)	1000	Length (m)	28.0
Max Percolation (l/s)	124.4	Slope (1:X)	60.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	83.000	Membrane Depth (mm)	0

Tank or Pond Manhole: SWALE, DS/PN: 1.006

Invert Level (m) 81.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1282.0	1.300	1935.0	1.301	0.0

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	S7	1.329	1.414	111.600	114.343
2.000	S26	1.499	1.789	0.000	3.288
1.001	S6	1.825	4.970	0.000	6.795
3.000	S24	1.357	6.065	0.000	7.422
3.001	S23	1.725	2.283	0.000	4.008
3.002	S22	2.362	3.380	0.000	5.741
4.000	S25	1.923	0.728	0.000	2.651
3.003	S21	2.576	6.839	0.000	9.415
1.002	S5	2.651	22.761	0.000	25.412
5.000	S19	1.385	4.948	0.000	6.333
5.001	S18	1.894	2.283	0.000	4.178
5.002	S17	2.648	3.313	0.000	5.961
6.000	S20	2.505	4.970	0.000	7.475
5.003	S16	2.863	3.340	0.000	6.203
5.004	S15	2.612	3.610	120.384	126.607
1.003	S4	2.916	8.963	0.000	11.879
7.000	S14	1.301	5.301	76.160	82.762
8.000	S12	1.555	2.121	40.320	43.996
7.001	S13	2.183	1.878	76.160	80.220
9.000	S11	1.753	4.948	0.000	6.701
7.002	S10	2.863	7.952	0.000	10.815
1.004	S3	5.726	19.880	0.000	25.606
10.000	S9	1.244	2.883	0.000	4.127
10.001	S8	1.866	5.125	0.000	6.991
1.005	S2	6.107	8.217	0.000	14.324
1.006	SWALE	4.962	1.829	2077.185	2083.976
1.007	S1	2.863	2.068	0.000	4.930
Total		66.492	143.858	2501.809	2712.158

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	S7	1.329	1.324	111.600	114.252
2.000	S26	1.499	1.739	0.000	3.237
1.001	S6	1.825	4.813	0.000	6.638
3.000	S24	1.357	5.980	0.000	7.337
3.001	S23	1.725	2.193	0.000	3.918
3.002	S22	2.362	3.231	0.000	5.592
4.000	S25	1.923	0.638	0.000	2.561
3.003	S21	2.576	6.612	0.000	9.189
1.002	S5	2.651	22.337	0.000	24.987
5.000	S19	1.385	4.863	0.000	6.249
5.001	S18	1.894	2.193	0.000	4.087
5.002	S17	2.648	3.164	0.000	5.812
6.000	S20	2.505	4.821	0.000	7.326
5.003	S16	2.863	3.125	0.000	5.988
5.004	S15	2.612	3.384	120.384	126.380
1.003	S4	2.916	8.496	0.000	11.412
7.000	S14	1.301	5.211	76.160	82.672
8.000	S12	1.555	2.030	40.320	43.906
7.001	S13	2.183	1.728	76.160	80.071
9.000	S11	1.753	4.858	0.000	6.611
7.002	S10	2.863	7.702	0.000	10.564
1.004	S3	5.726	19.085	0.000	24.811
10.000	S9	1.244	2.835	0.000	4.079
10.001	S8	1.866	5.019	0.000	6.885
1.005	S2	6.107	7.422	0.000	13.529
1.006	SWALE	4.962	1.579	2077.185	2083.725
1.007	S1	2.863	2.041	0.000	4.903
Total		66.492	138.422	2501.809	2706.722

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.257
FEH Rainfall Version	1999	E (1km)	0.290
Site Location	456600 222900 SP 56600 22900	F (1km)	2.462
C (1km)	-0.023	Cv (Summer)	0.750
D1 (1km)	0.317	Cv (Winter)	0.840
D2 (1km)	0.324		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flooded Volume (m³)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
1.000	S7	15 minute 2 year Winter I+0%	83.700	82.617	0.000	0.099	14.0	OK
2.000	S26	15 minute 2 year Winter I+0%	84.200	82.938	0.000	0.066	8.7	OK
1.001	S6	30 minute 2 year Winter I+0%	83.700	82.540	0.000	0.464	26.3	OK
3.000	S24	15 minute 2 year Winter I+0%	84.300	83.174	0.000	0.079	10.4	OK
3.001	S23	15 minute 2 year Winter I+0%	84.200	82.751	0.000	0.202	10.9	OK
3.002	S22	15 minute 2 year Winter I+0%	84.150	82.642	0.000	0.581	37.5	OK
4.000	S25	15 minute 2 year Winter I+0%	84.200	82.578	0.000	0.083	14.9	OK
3.003	S21	15 minute 2 year Winter I+0%	84.150	82.527	0.000	1.195	55.6	OK
1.002	S5	30 minute 2 year Winter I+0%	83.700	82.399	0.000	2.746	82.8	OK
5.000	S19	15 minute 2 year Winter I+0%	84.000	82.841	0.000	0.070	8.3	OK
5.001	S18	15 minute 2 year Winter I+0%	84.100	82.494	0.000	0.179	8.9	OK
5.002	S17	15 minute 2 year Winter I+0%	84.100	82.374	0.000	0.440	29.3	OK
6.000	S20	15 minute 2 year Winter I+0%	84.000	82.373	0.000	0.169	23.1	OK
5.003	S16	30 minute 2 year Winter I+0%	84.100	82.299	0.000	2.539	44.7	OK
5.004	S15	30 minute 2 year Winter I+0%	83.850	82.269	0.000	1.637	50.1	OK
1.003	S4	30 minute 2 year Winter I+0%	83.600	82.239	0.000	7.403	128.0	OK
7.000	S14	15 minute 2 year Winter I+0%	83.800	82.753	0.000	0.111	19.1	OK
8.000	S12	15 minute 2 year Winter I+0%	83.800	82.512	0.000	0.093	13.1	OK
7.001	S13	15 minute 2 year Winter I+0%	83.800	82.393	0.000	0.674	35.7	OK
9.000	S11	15 minute 2 year Winter I+0%	84.100	82.633	0.000	0.088	14.4	OK
7.002	S10	15 minute 2 year Winter I+0%	84.100	82.263	0.000	0.966	57.8	OK
1.004	S3	30 minute 2 year Winter I+0%	84.100	82.162	0.000	7.044	181.9	OK
10.000	S9	15 minute 2 year Winter I+0%	84.100	83.083	0.000	0.088	11.7	OK

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flooded Volume (m^3)	Maximum Vol (m^3)	Pipe Flow (l/s)	Status
10.001	S8	15 minute 2 year Winter I+0%	84.100	82.574	0.000	0.173	28.0	OK
1.005	S2	30 minute 2 year Winter I+0%	84.100	82.055	0.000	7.284	201.4	OK
1.006	SWALE	600 minute 2 year Winter I+0%	83.500	81.908	0.000	418.776	7.0	OK
1.007	S1	600 minute 2 year Winter I+0%	83.500	81.905	0.000	1.905	6.8	SURCHARGED

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.257
FEH Rainfall Version	1999	E (1km)	0.290
Site Location	456600 222900 SP 56600 22900	F (1km)	2.462
C (1km)	-0.023	Cv (Summer)	0.750
D1 (1km)	0.317	Cv (Winter)	0.840
D2 (1km)	0.324		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flooded Volume (m³)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
1.000	S7	15 minute 30 year Winter I+0%	83.700	82.677	0.000	0.167	33.4	OK
2.000	S26	15 minute 30 year Winter I+0%	84.200	82.977	0.000	0.109	20.8	OK
1.001	S6	15 minute 30 year Winter I+0%	83.700	82.625	0.000	1.242	60.7	OK
3.000	S24	15 minute 30 year Winter I+0%	84.300	83.219	0.000	0.129	24.6	OK
3.001	S23	15 minute 30 year Winter I+0%	84.200	82.808	0.000	0.513	25.2	OK
3.002	S22	15 minute 30 year Winter I+0%	84.150	82.780	0.000	1.804	102.0	OK
4.000	S25	15 minute 30 year Winter I+0%	84.200	82.701	0.000	0.222	36.4	OK
3.003	S21	15 minute 30 year Winter I+0%	84.150	82.673	0.000	3.155	144.8	OK
1.002	S5	15 minute 30 year Winter I+0%	83.700	82.564	0.000	8.224	214.8	OK
5.000	S19	15 minute 30 year Winter I+0%	84.000	82.880	0.000	0.113	19.6	OK
5.001	S18	30 minute 30 year Winter I+0%	84.100	82.764	0.000	2.925	20.3	SURCHARGED
5.002	S17	30 minute 30 year Winter I+0%	84.100	82.740	0.000	2.876	57.9	SURCHARGED
6.000	S20	15 minute 30 year Winter I+0%	84.000	82.739	0.000	0.693	53.5	SURCHARGED
5.003	S16	15 minute 30 year Winter I+0%	84.100	82.645	0.000	8.749	99.0	SURCHARGED
5.004	S15	15 minute 30 year Winter I+0%	83.850	82.549	0.000	3.848	117.9	SURCHARGED
1.003	S4	15 minute 30 year Winter I+0%	83.600	82.467	0.000	19.319	280.6	OK
7.000	S14	15 minute 30 year Winter I+0%	83.800	82.820	0.000	0.187	45.3	OK
8.000	S12	15 minute 30 year Winter I+0%	83.800	82.569	0.000	0.158	31.1	OK
7.001	S13	15 minute 30 year Winter I+0%	83.800	82.513	0.000	2.665	80.5	OK
9.000	S11	15 minute 30 year Winter I+0%	84.100	82.683	0.000	0.144	34.2	OK
7.002	S10	15 minute 30 year Winter I+0%	84.100	82.468	0.000	4.138	127.2	OK
1.004	S3	15 minute 30 year Winter I+0%	84.100	82.386	0.000	15.285	393.4	OK
10.000	S9	15 minute 30 year Winter I+0%	84.100	83.138	0.000	0.151	27.8	OK

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flooded Volume (m³)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
10.001	S8	15 minute 30 year Winter I+0%	84.100	82.687	0.000	0.603	74.8	OK
1.005	S2	15 minute 30 year Winter I+0%	84.100	82.295	0.000	16.627	437.4	OK
1.006	SWALE	960 minute 30 year Winter I+0%	83.500	82.266	0.000	965.109	8.0	SURCHARGED
1.007	S1	960 minute 30 year Winter I+0%	83.500	82.283	0.000	2.692	6.8	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.257
FEH Rainfall Version	1999	E (1km)	0.290
Site Location	456600 222900 SP 56600 22900	F (1km)	2.462
C (1km)	-0.023	Cv (Summer)	0.750
D1 (1km)	0.317	Cv (Winter)	0.840
D2 (1km)	0.324		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flooded Volume (m³)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
1.000	S7	15 minute 100 year Winter I+40%	83.700	83.304	0.000	35.555	68.0	SURCHARGED
2.000	S26	15 minute 100 year Winter I+40%	84.200	83.629	0.000	0.847	43.5	SURCHARGED
1.001	S6	15 minute 100 year Winter I+40%	83.700	83.307	0.000	4.317	107.1	SURCHARGED
3.000	S24	15 minute 100 year Winter I+40%	84.300	84.062	0.000	1.083	55.2	FLOOD RISK
3.001	S23	15 minute 100 year Winter I+40%	84.200	83.933	0.000	7.397	57.6	FLOOD RISK
3.002	S22	15 minute 100 year Winter I+40%	84.150	83.845	0.000	4.111	160.6	SURCHARGED
4.000	S25	15 minute 100 year Winter I+40%	84.200	83.697	0.000	1.349	78.1	SURCHARGED
3.003	S21	15 minute 100 year Winter I+40%	84.150	83.578	0.000	5.619	239.1	SURCHARGED
1.002	S5	15 minute 100 year Winter I+40%	83.700	83.281	0.000	13.327	333.3	SURCHARGED
5.000	S19	15 minute 100 year Winter I+40%	84.000	83.629	0.000	0.960	41.2	SURCHARGED
5.001	S18	15 minute 100 year Winter I+40%	84.100	83.531	0.000	6.109	42.7	SURCHARGED
5.002	S17	15 minute 100 year Winter I+40%	84.100	83.431	0.000	3.877	121.4	SURCHARGED
6.000	S20	15 minute 100 year Winter I+40%	84.000	83.486	0.000	1.762	115.1	SURCHARGED
5.003	S16	15 minute 100 year Winter I+40%	84.100	83.318	0.000	9.722	200.3	SURCHARGED
5.004	S15	15 minute 100 year Winter I+40%	83.850	83.199	0.000	14.272	221.6	SURCHARGED
1.003	S4	15 minute 100 year Winter I+40%	83.600	83.062	0.000	27.676	501.1	SURCHARGED
7.000	S14	15 minute 100 year Winter I+40%	83.800	83.391	0.000	22.836	73.8	SURCHARGED
8.000	S12	15 minute 100 year Winter I+40%	83.800	83.233	0.000	8.720	59.2	SURCHARGED
7.001	S13	15 minute 100 year Winter I+40%	83.800	83.139	0.000	11.242	132.4	SURCHARGED
9.000	S11	15 minute 100 year Winter I+40%	84.100	83.309	0.000	0.853	70.4	SURCHARGED
7.002	S10	15 minute 100 year Winter I+40%	84.100	83.039	0.000	7.924	193.9	SURCHARGED
1.004	S3	1440 minute 100 year Winter I+40%	84.100	82.865	0.000	18.769	64.4	SURCHARGED

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Flooded Volume (m³)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
10.000	S9	15 minute 100 year Winter I+40%	84.100	84.101	0.599	1.832	61.7	FLOOD
10.001	S8	15 minute 100 year Winter I+40%	84.100	83.600	0.000	4.130	125.6	SURCHARGED
1.005	S2	1440 minute 100 year Winter I+40%	84.100	82.864	0.000	27.049	71.2	SURCHARGED
1.006	SWALE	1440 minute 100 year Winter I+40%	83.500	82.864	0.000	2017.500	10.5	SURCHARGED
1.007	S1	1440 minute 100 year Winter I+40%	83.500	82.883	0.000	3.551	6.9	SURCHARGED

APPENDIX H

SuDS Maintenance Plan

S1209/220422/WB/LDD

BAILEY
JOHNSON
HAYES
CONSULTING ENGINEERS

AXIS J9, HOWES LANE, BICESTER

SCHEDULE OF MAINTENANCE WORKS REQUIRED FOR SITE DRAINAGE & SuDS FEATURES

Bailey Johnson Hayes
Consulting Engineers

Tel: 01727 841172
Fax: 01727 841085
Email: wb@bjh.co.uk

S1209/April 2022
Issue 5

S1209/220422/WB/LDD

BAILEY JOHNSON HAYES CONSULTING ENGINEERS

AXIS J9, HOWES LANE, BICESTER

SCHEDULE OF MAINTENANCE WORKS REQUIRED FOR SITE DRAINAGE & SuDS FEATURES

1.0 INTRODUCTION TO SuDS

SuDS are a new environmentally friendly approach to managing rainfall that uses landscape features to deal with surface water. SuDS aim to:

- Control the flow, volume and frequency of water leaving a development area;
- Prevent pollution by intercepting silt and cleaning runoff from hard surfaces;
- Provide attractive surroundings for the community;
- Create opportunities for wildlife.

2.0 MANAGING THE SuDS

The SuDS at Howes Lane have been designed for easy maintenance to comprise:

- Regular day to day care – litter collection, grass cutting and checking the inlets and outlets where water enters or leaves a SuDS feature;
- Occasional tasks – managing pond vegetation and removing any silt that builds up in the SuDS features;
- Remedial work – repairing damage where necessary.

3.0 SUMMARY OF DRAINAGE DESIGN/FEATURES

3.1 Surface Water

A new gravity system will be constructed and outlet at greenfield rates to an existing ditch adjacent to Howes Lane will be restricted by use of large attenuation swales/pipes.

The SuDS features currently adopted on this site include:

- Swales (Attenuation Basins)
- Permeable Paving
- Petrol Interceptors

The system is designed to cater for 1 in 100 year + Climate Change Storm Conditions.

In order to ensure that no contamination enters the Water Courses Permeable Paving, Silt Traps and Petrol Interceptors are provided at appropriate positions.

In designing the System due reference has been given to the DEFRA CIRIA SuDS Manual.

3.2 Foul Drainage

A gravity system will be constructed to outfall to an on-Site Pumping Station with appropriate 'off-line' storage to cater for emergency breakdown of Pumps. The Foul Water is then pumped to the adopted Thames Water Sewer adjacent to Howes Lane.

4.0 SCHEDULE OF TRADITIONAL DRAINAGE FEATURE MAINTENANCE

4.1 Gullies - Inspect and de-sludge at least once a year.

4.2 Line Drains – Inspect and de-sludge silt boxes as necessary but at least once a year.

4.3 Catch Pits - Inspect and de-sludge at least once a year.

4.4 Petrol Interceptors – Maintain strictly in accordance with the Manufacturer's Instructions but at least once each year. Major refurbishment should be considered on a 15-year cycle.

4.5 Pipe Works – Inspect and jet clean as necessary but at least once each year.

4.6 Head Walls/Outlets – These must be inspected and cleaned as necessary but at least twice each year. All gratings/screens and fixings should be checked and secured as necessary.

4.7 Hydrobrakes – These must be inspected and cleaned as necessary but at least twice each year. All orifices, overflow doors and fixings should be checked and secured as necessary.

4.8 Landscaping to Swale Area – The landscaping is to be planted/managed/maintained as attached Re-Form Management & Maintenance Plan – Feb 2019, as agreed with Oxfordshire County Council and attached.

5.0 SCHEDULE OF PERMEABLE PAVING MAINTENANCE

Permeable surfaces such as permeable block paving, porous Asphalt, gravel, or free draining soils that allow rain to percolate through the surface into underlying drainage layers. They must be protected from silt, sand, compost, mulch, etc. Many of the specific maintenance activities can be undertaken as part of a general site cleaning contract.

Generally, pervious pavements require less frequent gritting in winter to prevent ice formation. There is also less risk of ice formation after snow melt, as the melt water drains directly into the underlying sub-base. A slight frost might occur on block paving.

Maintenance schedule	Required action	Typical frequency
Regular Maintenance	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequency's	Annually
	Monitor inspection chambers	Annually
	Brushing and vacuuming (Standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced based on manufacturers recommendations – pay particular attention to areas where water runs onto pervious surface from nearby impervious area as this area is most likely to collect the most sediment
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosphate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised within 50mm of the level of paving	As required
	Remedial work to depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)

6.0 SCHEDULE OF SWALE / ATTENUATION BASIN MAINTENANCE

Swales are linear, flat bottomed grassed or vegetated channels that convey water from one place to another which can also store water and allow it to soak into the ground. Maintenance of swales is relatively straightforward for landscape contractors. Adequate access is provided in the design of the swales for appropriate equipment and vehicles.

The major maintenance requirement for dry swales is mowing. Mowing should ideally retain grass lengths of 75-150mm across the main "treatment" surface, to assist in filtering pollutants and retaining sediments. However, longer vegetation lengths, where appropriate, are not considered to pose a significant risk.

Maintenance schedule	Required action	Typical frequency
Regular Maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly, or as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding > 48 hours	Monthly, or as required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish silt removal prog.	Half yearly
Occasional Maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required, or if bare soil if exposed over 10% of swale area
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

7.0 MANAGEMENT COMPANY

Appointed Management Company will be fully responsible for all maintenance works. The Management Company will appoint a Professional Management Surveying Company to ensure all infrastructure and SuDS are properly maintained and managed.

APPENDIX

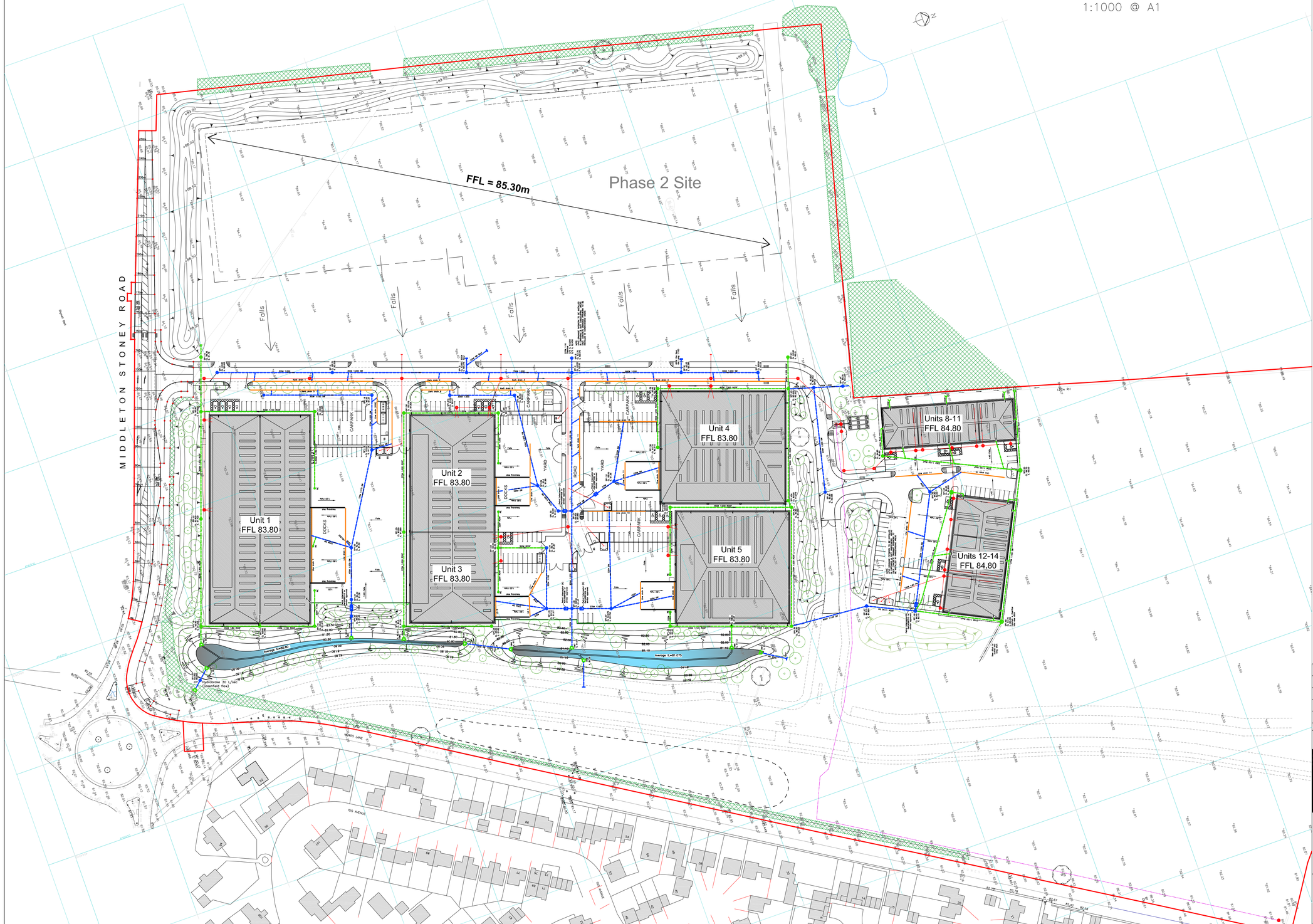
1. BJH SW Drainage Plan S1209 - PH1 - C01(4). (Phase 1)
2. BJH SW Drainage Plan S1209 - PH2 - C01(14). (Phase 2)
3. BJH SW Drainage Plan S1209 - PH3 – 02F. (Phase 3)
4. Re-Form Landscape Architecture Management & Maintenance Plan RFM-XX-00-RP-L-0001-PL02.

Bailey Johnson Hayes
Consulting Engineers

S1209 – 22nd April 2022

20m 0 20m 40m 60m 80m 100m

1:1000 @ A1



Phase 1 SW Drainage Layout 1:1000

NOTES

DRAINAGE

1 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTS & ENGINEERS DRAWINGS & SPECIFICATIONS.

2 DRAINS TO BE HEPWORTH SUPERSLEEVE OR NAYLOR DENSLEEVE: LAID ON CLASS N GRANULAR BEDDING TO BS 882: TABLE 4 OR TO BS 8301: 1985 APPENDIX D.

3 ALL TRENCHES WITHIN TRAFFICKED AREAS TO BE BACKFILLED WITH 75MM DOWNGRADED STONE FILL, PLACED & COMPACTED IN LAYERS OF 150MM. ALL PIPES IN ROADWAYS / PARKING, LESS THAN 900MM DEEP TO BE ENCASED IN CONCRETE. PROVIDE FLEXIBLE JOINTS AT 3000MM CENTRES.

4 MANHOLES TO BE CONSTRUCTED OF PRECAST CONCRETE RINGS TO BS 5911-PART 1. RINGS TO BE BEDDED IN SEALANT STRIPS.

5 MANHOLES BENEATH ROADS & PARKING AREAS TO BE CASED IN 150MM CONCRETE SURROUND.

6 ALL CONNECTIONS TO RAIN WATER PIPES TO BE PROVIDED WITH RODDING ACCESS.

7 ROAD GULLIES TO BE HEPWORTH ROAD GULLIES REF: 213 WITH 150MM DIAMETER OUTLET OR SIMILAR APPROVED. GULLIES TO BE ENCASED IN 150MM MINIMUM CONCRETE.

8 DRAWINGS TO BE ISSUED TO NRA & LOCAL AUTHORITY WELL IN ADVANCE OF COMMENCEMENT OF DRAINAGE

9 EXISTING MANHOLES IN ROADS TO HAVE INVERT LEVELS CONFIRMED PRIOR TO DRAINAGE

10 ROADS TO BE REINSTATED TO STANDARD REQUESTED BY LOCAL AUTHORITY WHERE DRAINAGE CROSSES

KEY:

- ○ INDICATES GULLIES
- INDICATES SURFACE WATER MANHOLES
- INDICATES FOUL MANHOLES
- □ INDICATES EXISTING MANHOLES
- INDICATES NEW FW PIPE RUNS
- INDICATES NEW SW PIPE RUNS
- INDICATES NEW ROOF PIPE RUNS

ALL PIPES CONNECTED DIRECTY INTO GULLIES TO BE 150MM DIAMETER

FINAL CONSTRUCTION ISSUE

Rev	Date	Revision Description
4	01.06.20	Final Construction issue
3	21.04.19	Units 8–14 SW updated
2	01.10.19	Construction issue
1	15.08.19	Minor setting out update
0	22.07.19	Contract Issue

Revision Schedule

AXIS J9 – BICESTER

Client:

Albion Land Plc.

PHASE 1 - RMA 2

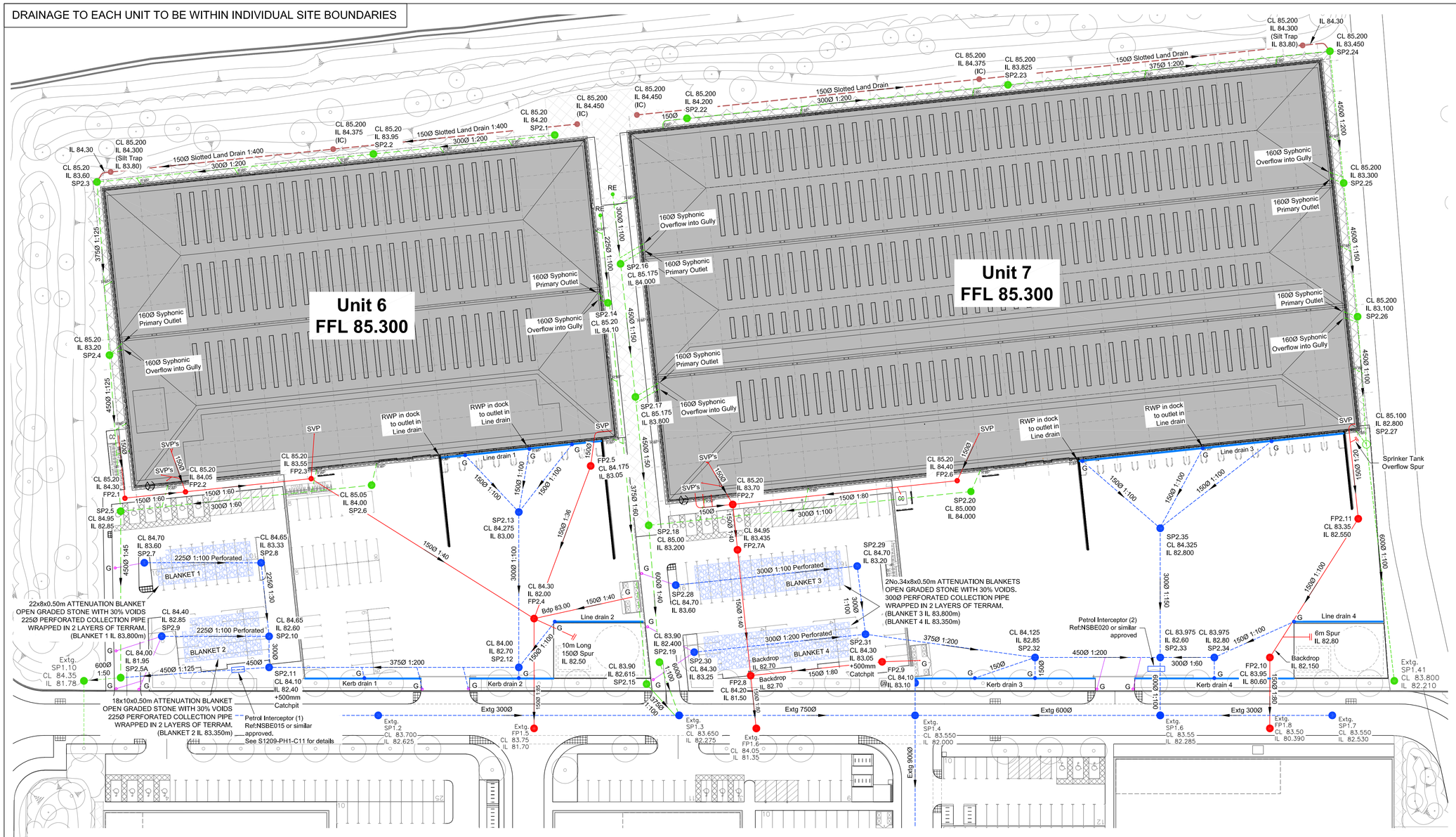
SURFACE WATER DRAINAGE PLAN

BAILEY JOHNSON HAYES
Consulting Engineers
ST.ALBANS: Suite 4, Phoenix House, 63 Campfield Rd, ST.ALBANS, Herts AL1 5FL
MANCHESTER: Grange House, John Dalton Street, MANCHESTER, M2 6FW

Scale	1:1000 @A1
Date	15.11.18
Drawn	DJC

S1209–PH1–C01(4)

DRAINAGE TO EACH UNIT TO BE WITHIN INDIVIDUAL SITE BOUNDARIES



UNIT 6-7 Drainage Layout 1:500

10m 5m 0 10m 20m 30m 40m

Scale 1:500 @A1

NOTES

DRAINAGE

1 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTS & ENGINEERS DRAWINGS & SPECIFICATIONS.

2 DRAINS TO BE HEPWORTH SUPERSLEEVE OR NAYLOR DENSLEEVE: LAID ON CLASS N GRANULAR BEDDING TO BS 882: TABLE 4 OR TO BS 8301: 1985 APPENDIX D.

3 ALL TRENCHES WITHIN TRAFFICKED AREAS TO BE BACKFILLED WITH 75MM DOWNGRADED STONE FILL, PLACED & COMPACTED IN LAYERS OF 150MM. ALL PIPES IN ROADWAYS / PARKING, LESS THAN 900MM DEEP TO BE ENCASED IN CONCRETE. PROVIDE FLEXIBLE JOINTS AT 3000MM CENTRES.

4 MANHOLES TO BE CONSTRUCTED OF PRECAST CONCRETE RINGS TO BS 5911-PART 1. RINGS TO BE BEDDED IN SEALANT STRIPS.

5 MANHOLES BENEATH ROADS & PARKING AREAS TO BE CASED IN 150MM CONCRETE SURROUND.

6 ALL CONNECTIONS TO RAIN WATER PIPES TO BE PROVIDED WITH RODDING ACCESS.

7 ROAD GULLIES TO BE HEPWORTH ROAD GULLIES REF: 213 WITH 150MM DIAMETER OUTLET OR SIMILAR APPROVED. GULLIES TO BE ENCASED IN 150MM MINIMUM CONCRETE.

8 DRAWINGS TO BE ISSUED TO NRA & LOCAL AUTHORITY WELL IN ADVANCE OF COMMENCEMENT OF DRAINAGE

9 EXISTING MANHOLES IN ROADS TO HAVE INVERT LEVELS CONFIRMED PRIOR TO DRAINAGE

10 ROADS TO BE REINSTATED TO STANDARD REQUESTED BY LOCAL AUTHORITY WHERE DRAINAGE CROSSES

KEY:

- INDICATES GULLIES
- INDICATES SURFACE WATER MANHOLES
- INDICATES FOUL MANHOLES
- INDICATES EXISTING MANHOLES
- INDICATES NEW FW PIPE RUNS
- INDICATES NEW SW PIPE RUNS
- INDICATES NEW ROOF PIPE RUNS
- INDICATES NEW LINE DRAIN RUNS

ALL PIPES CONNECTED DIRECTY INTO GULLIES TO BE 150MM DIAMETER

CONSTRUCTION

Rev	Date	Revision Description
14	01.07.21	Unit 6 RWP positions updated
13	30.06.21	Manhole SP2.21 Omitted
12	15.04.21	Drainage updated to Architects demise
11	23.02.21	Minor Revs
10	19.02.21	CONSTRUCTION ISSUE
9	11.02.21	Unit 7 FW drainage minor revs
8	04.02.21	Updated to latest site layout + revs
7	11.11.20	Unit 7 Car-Park gully outlets altered
6	09.11.20	Line Drains outlets clarified (blue)
5	03.11.20	Dock leveller added, wing walls extended
4	13.10.20	Updated to latest Architects Layout
3	01.09.20	Minor revs
2	25.08.20	Minor revs to pipe sizes
1	19.08.20	Updated to latest Architects Layout

Revision Schedule

AXIS J9 – BICESTER

Client:

Albion Land Plc.

PHASE 2 - UNITS 6-7
DRAINAGE LAYOUT PLAN

BAILEY JOHNSON HAYES
Consulting Engineers
ST.ALBANS: Suite 4, Phoenix House, 63 Campfield Rd, ST.ALBANS, Herts AL1 5FL
MANCHESTER: Grange House, John Dalton Street, MANCHESTER, M2 6FW

Scale	1:500 @A1
Date	14.08.20
Drawn	JNG

S1209-PH2-C01(14)

SURFACE WATER MANHOLES / INSPECTION CHAMBERS

MH REF	CL	IL	DEPTH	DIA	OPENING	COVER	COMMENTS
SP2.1	85.200	84.200	1000	1200	600x600	D400	.
SP2.2	85.200	83.950	1250	1200	600x600	D400	.
SP2.3	85.200	83.600	1600	1350	600x600	D400	.
SP2.4	85.200	83.200	2000	1500	600x600	D400	Vented Cover
SP2.5	84.950	82.850	2100	1500	600x600	D400	.
SP2.5A	84.000	81.950	2050	1500	600x600	D400	.
SP2.6	85.050	84.000	1050	1200	600x600	D400	.
SP2.7	84.700	83.600	1100	1200	600x600	D400	.
SP2.8	84.650	83.330	1320	1200	600x600	D400	.
SP2.9	84.400	82.850	1550	1200	600x600	D400	.
SP2.10	84.650	82.600	2050	1200	600x600	D400	.
SP2.11	84.100	81.900	2200	1350	600x600	D400	500mm Catchpit Manhole
SP2.12	84.000	82.700	1300	1350	600x600	D400	.
SP2.13	84.275	83.000	1275	1200	600x600	D400	.
SP2.14	85.200	84.100	1100	1350	600x600	D400	Vented Cover
SP2.15	83.900	82.615	1285	1350	600x600	D400	.
SP2.16	85.175	84.000	1175	1500	600x600	D400	Vented Cover

SURFACE WATER MANHOLES / INSPECTION CHAMBERS

MH REF	CL	IL	DEPTH	DIA	OPENING	COVER	COMMENTS
SP2.17	85.175	83.800	1375	1500	600x600	D400	Vented Cover
SP2.18	85.000	83.200	1800	1800	600x600	D400	.
SP2.19	83.900	82.400	1500	1500	600x600	D400	.
SP2.20	85.000	84.000	1000	1200	600x600	D400	.
SP2.21	.	.	.	.	.	.	Omitted
SP2.22	85.200	84.200	1000	1200	600x600	D400	.
SP2.23	85.200	83.825	1375	1200	600x600	D400	.
SP2.24	85.200	83.450	1750	1350	600x600	D400	.
SP2.25	85.200	83.300	1900	1500	600x600	D400	Vented Cover
SP2.26	85.200	83.100	2100	1500	600x600	D400	Vented Cover
SP2.27	85.100	82.800	2300	1500	600x600	D400	.
SP2.28	84.700	83.600	1100	1200	600x600	D400	.
SP2.29	84.700	83.200	1500	1200	600x600	D400	.
SP2.30	84.300	83.250	1050	1200	600x600	D400	.
SP2.31	84.300	82.550	1750	1350	600x600	D400	500mm Catchpit Manhole
SP2.32	84.125	82.850	1300	1500	600x600	D400	.
SP2.33	83.975	82.600	1375	1500	600x600	D400	.

SURFACE WATER MANHOLES / INSPECTION CHAMBERS

MH REF	CL	IL	DEPTH	DIA	OPENING	COVER	COMMENTS
SP2.34	83.975	82.800	1175	1200	600x600	D400	.
SP2.35	84.325	82.800	1525	1200	600x600	D400	.

FOUL WATER MANHOLES

MH REF	CL	IL	DEPTH	DIA	OPENING	COVER	COMMENTS
FP2.1	85.200	84.300	900	450	450x450	D400	PPIC 150 (Concrete Encased)
FP2.2	85.200	84.050	1150	450	450x450	D400	PPIC 150 (Concrete Encased)
FP2.3	85.200	83.550	1650	1050	600x600	D400	.
FP2.4	84.300	82.000	2300	1350	600x600	D400	Backdrop Inlet 83.000m
FP2.5	84.175	83.050	1125	1050	600x600	D400	.
FP2.6	85.200	84.400	800	450	450x450	D400	PPIC 150 (Concrete Encased)
FP2.7	85.200	83.700	1500	1050	600x600	D400	.
FP2.7A	84.950	83.435	1515	1050	600x600	D400	.
FP2.8	84.200	81.500	2700	1200	600x600	D400	2No. Backdrop Inlet(s) 82.700m
FP2.9	84.100	83.100	1000	450	450x450	D400	PPIC 150 (Concrete Encased)
FP2.10	83.950	80.600	3350	1200	600x600	D400	Backdrop Inlet 82.150m
FP2.11	83.350	82.550	800	1050	600x600	D400	.

A1

SURFACE WATER MANHOLE / INSPECTION CHAMBER SCHEDULE

MH REF	CL	IL	DEPTH	DIA	OPENING	COVER	COMMENTS
S1	83.500	81.250	2250	1800	2/600x600	B125	Hydrobrake 7 l/s + Wier Overflow 82.900m
S2	84.100	81.400	2700	1800	600x600	B125	300mm Catchpit
S3	84.100	81.850	2250	1800	600x600	B125	.
S4	83.600	81.950	1650	1800	600x600	D400	.
S5	83.700	82.200	1500	1500	600x600	D400	.
S6	83.700	82.425	1275	1350	600x600	D400	.
S7	83.700	82.225	1475	1200	600x600	D400	300mm Catchpit
S8	84.100	82.450	1650	1200	600x600	B125	.
S9	84.100	83.000	1100	600	600x600	B125	600m Dia. PPIC 150mm Concrete Encased
S10	84.100	82.100	2000	1200	600x600	D400	.
S11	84.100	82.950	1150	1200	600x600	D400	.
S12	83.800	82.125	1675	1200	600x600	D400	300mm Catchpit
S13	83.800	81.975	1825	1200	600x600	D400	300mm Catchpit
S14	83.800	82.350	1450	1200	600x600	D400	300mm Catchpit
S15	83.850	81.725	2125	1350	600x600	B125	.
S16	84.100	82.100	2000	1350	600x600	B125	.
S17	84.100	82.250	1850	1350	600x600	B125	.
S18	84.100	82.425	1675	1200	600x600	B125	.
S19	84.000	82.775	1225	1200	600x600	D400	.
S20	84.000	82.050	1950	1200	600x600	D400	300mm Catchpit
S21	84.150	82.350	1800	1350	600x600	D400	.
S22	84.150	82.500	1650	1350	600x600	D400	.
S23	84.200	82.675	1525	1200	600x600	D400	.
S24	84.300	83.100	1200	1200	600x600	B125	.
S25	84.200	82.200	2000	1200	600x600	D400	300mm Catchpit
S26	84.200	82.875	1325	1200	600x600	D400	.
S27	83.000	80.950	2050	1800	2/600x600	B125	Hydrobrake 3 l/s + Wier Overflow 82.300m

PERMEABLE PAVING SCHEDULE

AREA REF	IL	LENGTH	WIDTH	AREA	DEPTH	VOLUME	COMMENTS
AREA 1	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 2	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 3	83.400 - 83.000	28.0m	16.0m	448m2	0.3m	N/A	Perm. paving for water quality treatment only
AREA 4	83.400 - 83.050	38.0m	32.2m	1150m2	0.4m	N/A	Perm. paving for water quality treatment only
AREA 5	83.400 - 83.000	38.0m	16.0m	608m2	0.4m	N/A	Perm. paving for water quality treatment only

NOTE: ALL RWP PIPE POSITIONS TO BE AGREED WITH ARCHITECT

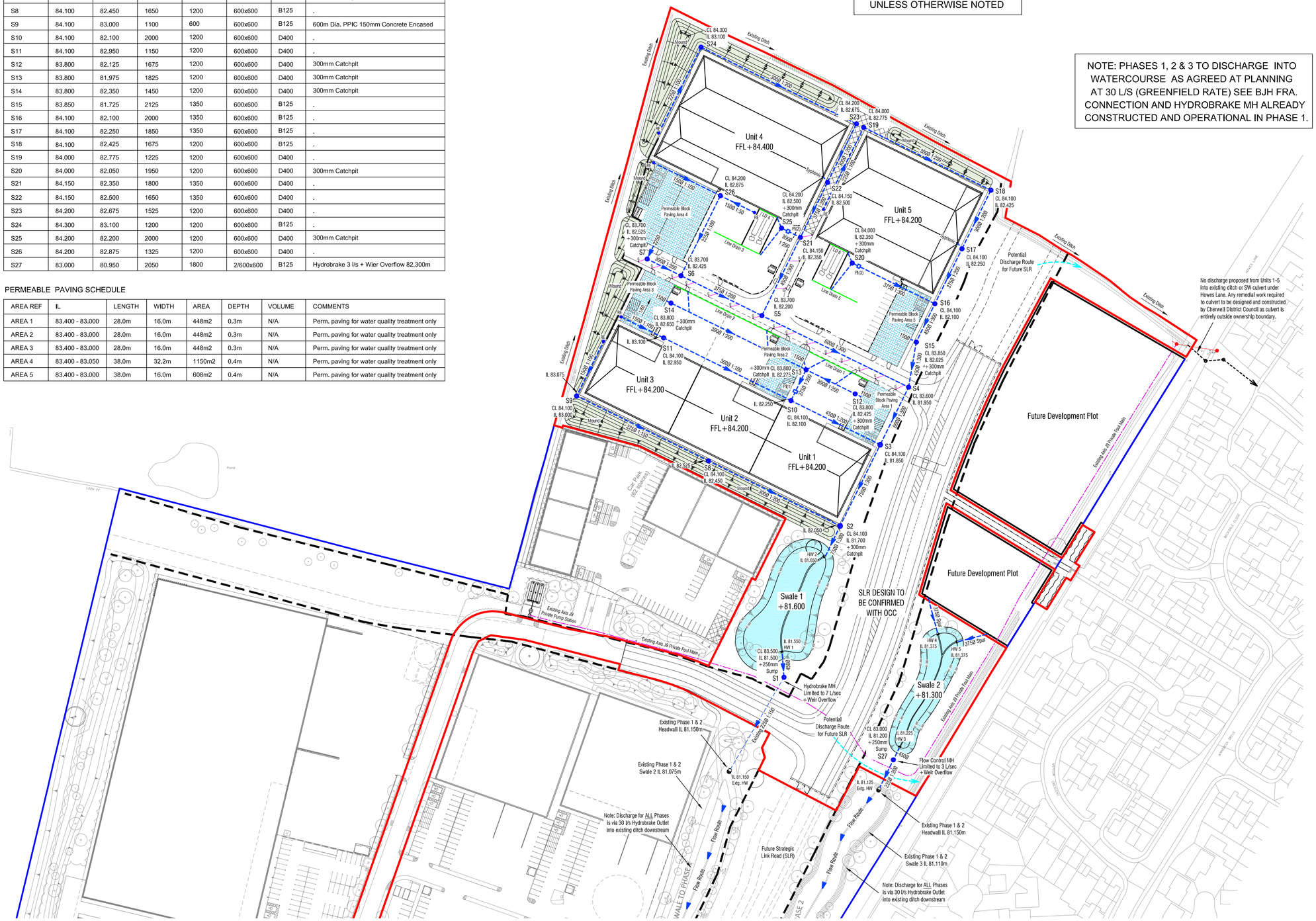
NOTE: ALL DRAINAGE IS INVERT TO INVERT MANHOLE DESIGN UNLESS OTHERWISE NOTED

DRAINED AREAS	STORAGE VOLUMES
UNITS 1-5 - 26,000 m2	SWALE 1 - 2,090 m3
FUTURE - 10,000 m2	SWALE 2 - 805 m3
TOTAL = 36,000 m2	TOTAL = 2,895 m3

MAXIMUM DISCHARGE WESTERN PLOT = 7 l/sec

MAXIMUM DISCHARGE EASTERN PLOT = 3 l/sec

NOTE: PHASES 1, 2 & 3 TO DISCHARGE INTO WATERCOURSE AS AGREED AT PLANNING AT 30 L/S (GREENFIELD RATE) SEE BJH FRA. CONNECTION AND HYDROBRAKE MH ALREADY CONSTRUCTED AND OPERATIONAL IN PHASE 1.



DRAINAGE NOTES

1 THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND BAILEY JOHNSON HAYES DRAWINGS AND SPECIFICATIONS.

2 DRAINS TO BE 'HEPWORTH SUPERSLEEVE' LAID IN CLASS S BEDDING TO BS 882 1983: TABLE 4, OR TO BS 8301 1985: APPENDIX D. 450 DIA DRAINS AND ABOVE TO BE HEPWORTH CONCRETE PIPES CLASS H . OR EQUAL APPROVED DRAINS WITHIN THE SITE MAY BE THERMOPLASTIC STRUCTURED WALL PIPE IN ACCORDANCE WITH CLAUSE E2.22 OF SFA 8th EDITION

3 ALL TRENCHES WITHIN TRAFFICKED AREAS TO BE BACKFILLED WITH 75 MM DOWN GRADED STONE FILL, PLACED AND COMPACTED IN 150 MM LAYERS. ALL PIPES IN ROADWAYS, SERVICE YARDS AND CARPARKS LESS THAN 1200 MM DEEP TO BE ENCASED IN CONCRETE. PROVIDE FLEXIBLE JOINTS AT 3 METRE CENTRES.

4 MANHOLES TO BE CONSTRUCTED IN PRECAST CONCRETE RINGS TO BS 5911: PART 1. RINGS TO BE BEDDED IN SEALANT STRIPS.

5 MANHOLES IN FOOTPATHS OR LANDSCAPED AREAS TO BE BACKFILLED WITH 40 MM DOWN GRADED STONE FILL, COMPACTED IN LAYERS NOT EXCEEDING 150 MM THICK. MANHOLES BENEATH ROADS AND PARKING AREAS TO BE CASED IN 150 MM CONCRETE SURROUND.

6 ALL CONNECTIONS TO RAIN WATER PIPES TO BE PROVIDED WITH RODDING ACCESS.

7 ALL ROAD GULLIES TO BE HEPWORTH ROAD GULLIES., REF RGR4, WITH 150 MM DIAMETER OUTLETS. GULLIES TO BE ENCASED IN 150 MM MINIMUM CONCRETE.

8 DRAINS UNDER BUILDING AND WITHIN 300 MM OF THE UNDERSIDE OF FLOORSLAB TO BE ENCASED IN 150 MM CONCRETE. CASING TO INCORPORATE FLEXIBLE FIBRE BOARD JOINTS AT SPACINGS AS RECOMMENDED BY THE PIPE MANUFACTURER. DRAINS UNDER BUILDINGS GENERALLY TO HAVE MIN 100 FULL GRANULAR SURROUND TO CLASS S BS8301

9 WHERE PIPES RUN THROUGH GROUND BEAMS, FLEXIBLE JOINT CASINGS AT EACH FACE OF THE GROUND BEAM ARE TO BE PROVIDED. PIPES WHICH RUN UNDER GROUND BEAMS TO BE PROTECTED WITH 50 MM MINIMUM POLYSTYRENE PLACED OVER THE CROWN OF THE PIPE.

10 ALL WORK TO EXISTING PUBLIC SEWERS TO BE IN ACCORDANCE WITH SEWERS FOR ADOPTION 8TH EDITION AND BS 8301 : CODE OF PRACTICE FOR BUILDING DRAINAGE

11 WHERE DRAINS RUN CLOSE TO BUILDINGS AND INVERT LEVELS ARE BELOW FOUNDATIONS THE DRAINS SHOULD BE ENCASED AS FOLLOWS:-

(a) WHERE THE DRAIN TRENCH IS WITHIN 1M OF THE BUILDING THE TRENCH SHOULD BE FILLED WITH CONCRETE UP TO FOUNDATION FORMATION LEVEL or

(b) WHERE THE DRAIN TRENCH IS FURTHER THAN 1M OF THE BUILDING THE TRENCH SHOULD BE FILLED WITH CONCRETE TO A LEVEL BELOW FOUNDATION FORMATION EQUAL TO THE DISTANCE FROM THE BUILDING LESS 150mm.

KEY:

- INDICATES NEW GULLIES
- INDICATES NEW SURFACE WATER MANHOLES
- INDICATES NEW PIPE RUNS
- INDICATES LINE DRAIN RUNS
- INDICATES NEW PERMEABLE PAVING
- INDICATES NEW SWALE BASINS

ALL PIPES CONNECTED DIRECTY INTO GULLIES TO BE 150MM DIAMETER (SHOWN IN MAGENTA ON PLAN)

TOWN PLANNING

Rev	Date	Revision Description
F	22.04.22	Updated to LLFA planning comments
E	07.03.22	Updated to latest planning scheme.
D	07.01.22	Updated to LLFA planning comments
C	02.09.21	Red line planning boundary adjusted
B	23.08.21	Updated to latest Architects layout, pipe sizes added & manholes scheduled
A	20.07.21	Updated Ditches, Mounds & SLR

Revision Schedule

Project Title: Axis J9 - Bicester

Client: ALBION LAND

Drawing Title: PHASE 3 SW Drainage Layout

BAILEY JOHNSON HAYES
Consulting Engineers
ST.ALBANS: Suite 4, Phoenix House, 63 Campfield Rd, ST.ALBANS, Herts AL1 5FL
MANCHESTER: Grange House, John Dalton Street, MANCHESTER, M2 6FW

Scale	1:1000 @A1
Date	23.06.21
Drawn	JNG

Drawing Number: S1209-PH3-02 F

Landscape Management & Maintenance Plan

AXIS J9, Bicester

for Albion Land
February 2019

RFM-XX-00-RP-L-0001-PL02

re-form
landscape architecture

T 0113 245 4695
E info@re-formlandscape.com
www.re-formlandscape.com
Tower Works |Globe Road | Leeds | LS11 5QG

1. Introduction

1.1. This Landscape Management Plan sets out the management and maintenance requirements for the first phase of the site on Middleton Stoney Road in North West Bicester known as AXIS J9. The purpose of this management plan is to aid the efficient and effective management of the site, to ensure the healthy establishment of all planting types and to preserve the design intent for the first five years after planting.

2. Site description

2.1. The development site is located on the western edge of Bicester, Oxfordshire. The A4095 (Howes Lane) runs along the eastern boundary of the site, and Middleton Stoney Road to the south. The site is approximately 20 hectares.

2.2. The site is currently used for arable crops and comprises of three fields separated with native hedgerow and incidental tree planting. The frontage to Howes Lane comprises grass verges and native hedgerow with occasional tree planting. To the west and north of the site is open pasture and farmland, bounded by hedgerows and occasional mature tree planting. A rectangular shaped plantation of young trees is located to the north of the site.

2.3. To the east of the site is a suburban residential area which is fronted along Howes Lane with a mixture of hedgerow, tree planting, and close-boarded fencing to rear gardens. To the south east of the site is Kingsmere, a housing development located on Middleton Stoney Road which is currently under construction. To the south of the site, beyond Middleton Stoney Road is Bignell Park landscape garden and house.

3. Objectives

3.1. The aims of the management plan are:

- Provide a quality landscape setting to the new development
- Conserve and enhance ecology and biodiversity
- Ensure healthy establishment of the proposed planting
- Establish important areas of green infrastructure within the new development

3.2 All maintenance operations are to be in accordance with BS7370-4: 1993 *Grounds Maintenance: recommendations for maintenance of soft landscape* other than amenity turf.

4. Phasing

4.1. The site will be delivered in phases, including an initial enabling phase. This management plan covers landscape management planting for Phase 1 as per re-form Landscape Architecture's Planting Plan RFM-XX-00-DR-L-0001.

4.2. The 'Enabling Phase' allows for the removal of existing trees and hedgerows to facilitate the start of the construction works. Refer to RFM-XX-00-DR-L-0002 'Tree removal and retention plan' for details. All existing trees and hedgerows will be protected according to BS 5837:2012 'Trees in relation to construction'.

5. Soft Landscaping & planting

5.1. This management plan is to be read in conjunction with the following drawings by re-form Landscape architecture:

- RFM-XX-00-DR-L-0001 Soft Landscape and Planting Plan
- RFM-XX-00-DR-L-0002 Tree removal and retention plan
- RFM-XX-00-DR-L-0003/4 Landscape Sections
- RFM-XX-00-DR-L-0005 Planting schedule
- RFM-XX-00-DR-L-0006 Soil Profiles

5.2. All maintenance operations are to be in accordance with BS7370-4: 1993 *Grounds Maintenance: recommendations for maintenance of soft landscape* other than amenity turf.

5.3. The proposed soft landscape will augment and enhance existing green infrastructure to the site. The proposed soft landscape and planting consists of:

- General tree planting:
  Native tree species in a range of sizes: semi mature (15% of mix), extra heavy standard (35%) and standard trees (50%). This will include deciduous and evergreen species. Tree species will be spread evenly throughout the woodland planting area to achieve desired coverage and instant impact. Trees will be planted in and around the swales to the east of the proposed development to create a layered effect to assist with screening and maximise cover for visual mitigation.

- General native woodland planting:
  In conjunction with larger trees, a native woodland mix of transplants and whips shall be provided at an average rate of 1 plant/1.5m2. This will form bands of native vegetation comprising both tree and shrub species, including deciduous and evergreen species. Native transplant and whip species will be spread evenly throughout the woodland planting area to maximize cover for visual mitigation and amenity.

- Native understory planting:
  Within more open naturalistic areas around the swale, generously spaced trees are located within areas of native woodland shrubs planted in swathes of 3-5 species at 1500mm centres.

- Native hedgerow planting:
  Hedgerow planting shall consist of trees at 3m centres and native whips (tree & shrub species) at 0.5m centres throughout the planting zone.

- Planting associated with seasonally wet swale feature:
  Swales features to be planted to be base and slopes with a moisture-tolerant species-rich grass seed mix.

- Meadow grassland:

Wildflower meadow grass is used across the site. The majority will be a wildflower mixed meadow with a variation appropriate for seasonally wet soils in the swales. There is a two strand approach to maintenance of the meadow with some areas to be left to grow longer to increase both visual amenity and species diversity across the open areas of grassland.
Some areas of amenity grass will be provided for the 'grassroad' emergency access routes adjacent to the buildings.

- General amenity shrub planting:
  This will comprise a variety of robust & hardy groundcover and low level (below 1.2m mature height with some specimen/accent plants, all requiring minimal maintenance. There will be a predominance of amenity shrub planting with a high proportion of evergreen and flowering species to give year round structure and interest

- Soils:
  Suitable quality topsoil shall be provided to the following depths:
  Native woodland planting (transplants & whips) Planted areas – 300mm
  Meadow grass to swale – 100mm low nutrient
  Amenity shrubs – 400mm
  Species rich/wildflower grass – 100mm low nutrient or as per supplier's recommendations

6. Management Plan

6.1. General preamble

- Duration of plan:
  There will be a provision of 25 years for plant establishment, maintenance and replacement. The duration of the management plan is be confirmed within a detailed Management Plan to be provided by the client following practical completion of the landscape works.

- Area:
  The management plan applies to all external areas within the site boundary as shown on drawing RFM-XX-00-DR-L-0001 Soft Landscape and Planting Plan.

- Visits:
  The contractor shall notify the Client 48 hours prior to any visits to confirm suitability of time and works to be undertaken to avoid disruption to the Client's activities.

- Specification and planting stock:
  Any replacement planting required during the period of the management plan should be undertaken in accordance with the Landscape Specification as part of the building works. All plant stock should comply as follows:

6.1..1. All plants are to be supplied in accordance with Horticultural Trade Association's National Plant Specification and from a HTA certified nursery. All plants and trees to be planted in accordance with BS3936. Delivery and backfilling of all plant material to be in accordance with BS4428:1989 'Code of practice for general landscape operations' and CPSE Code of Practice for 'Handling and Establishing Landscape Plants, Parts I, II and III'.

6.1..2. The supply and aftercare of trees will be in accordance with BS8545:2014

6.1..3. All excavated areas to be backfilled with either topsoil from site or imported to be BS3882 – General purpose grade. All topsoiled areas to be clear of rocks and rubble larger than 50mm diameter and any other debris that may interfere with the establishment of plants.

6.1..4. Existing trees and hedgerows to be retained shall be protected in accordance with BS5837, from commencement to completion of all works on site.

6.2. Machinery and Tools

Use only machines and tools suitable for the site conditions and the work to be carried out. Use hand tools around trees, plants and in confined spaces where it is impracticable to use machinery. The use of strimmers is not permitted around tree stems below 8-10cm in girth.

6.3. Chemicals

- Legislation

  Pesticides include herbicides, insecticides, fungicides and plant growth regulators. The use of pesticides is governed by legislation. The Landscape Contractor must comply with the 'The Control of Pesticides Regulations 1986' made under the 'Food and the Environment Protection Act 1985', 'The Control of Substances Hazardous to Health Regulations 1988' made under the 'Health and Safety at Work Act 1974' and any other legislation enacted during the contract period.

  All pesticides must be products on the current list of Agricultural Chemicals Approval Scheme. All pesticide users shall comply with the conditions of approval relating to use clearly stated on the product label.

  The Contractor must comply with all relevant Codes of Practice issued by DeFRA. In particular, where work is near water, comply with the 'Code of Practice for the Use of Herbicides on Weeds in Watercourses and Lakes'. Written approval from the Environment Agency should be obtained prior to the use of pesticides within these areas.

Wherever practical, other non-chemical means of plant removal should be used in consultation with the Environment Agency.

- Use of pesticides

  The Contractor shall keep a written logbook detailing all uses and pesticide applications carried out.

  The Contractor is required to notify the public of any pesticide application. A warning sign shall be posted on the railing to any public routes. Where contained solely within planting beds the sign shall be placed adjacent to edges in noticeable positions. Details of the application and a contact person shall be indicated on the sign.

  The Contractor shall in accordance with COSHH Regulations protect employees and other persons, including the public, who may be exposed to substances hazardous to health.

6.4. General planting maintenance (1 to 25 years)

- Failures of planting: general

  Any trees/shrubs/plants that have died or failed to thrive (not developing full foliage throughout all branches) within the period of this maintenance plan should be replaced.

  Years 1 – 3:
  Replacements must match the size of adjacent or nearby plants of the same species or should match the original specification, whichever is the greater.

  Years 4 – 25:
  Replacements to be as original specification. Replacements of tree species left to grow to maturity, after thinning at years 7 – 10 must be to original specification.

- Watering: general

  The contractor shall make due allowance in his rates for carrying out these tasks outside normal working hours when necessary to avoid premature evaporation or leaf damage caused through watering in bright sunlight.

  The contractor is to allow for the provision of water, water carts or hoses with a fine hose attachment or sprinklers at normal mains pressure. The contractor is to include and state in his tender the cost of compliance with this clause so that the cost of visits can be deducted in whole or in part if not required to be used.

  Drought Conditions:

Should emergency legislation restricting the use of water during drought conditions be imposed, the contractor will be required to ascertain — before operations — the availability and cost of, and arrange to collect and apply second class water by bowser or other means from an approved sewage works, deliver to site and apply as specified. When required by the Architect, the contractor shall arrange for tests of this water to be carried out in accordance with BS 6068:2000 Water Quality.

- Pests and Diseases: general

  Maintenance shall include the control of insects, fungus and disease by spraying with an approved insecticide or fungicide.

- Litter Collection: general

  The contractor shall at all times keep the site clean, tidy and free from litter and carry out a litter collection at each maintenance visit.

  'Litter' is anything whatsoever that is thrown down, dropped or otherwise deposited in onto or from any place in the open air to which the public are permitted to have access without payment.

  'Fly tipping': large items such as discarded furniture that require two or more people to lift or are in excess of 0.5m3 will be treated as fly tipping and not litter. The contractor should provide a cost for removal and depositing for fly tipping on each and every occasion.

  The contractor shall take care to avoid any spillage of fuel, oil, chemicals or other materials toxic to plant life. Plants or soil contaminated by such material must be removed off site and replaced.

- Cleanliness: general

  At completion and at each visit, remove soil and other debris from all hard surfaces and grassed areas and leave the works in a clean and tidy condition.

- Leaf Clearance: general

  The contractor is responsible for the clearance of leaves, twigs, etc from all areas of the grounds including planting beds, lawns, paths, channels, drains, car park steps and other areas specified by the Client, from leaf fall (normally October until end December). The Client will instruct the contractor when to begin.

  The clearance shall be carried out with hand raking or sweeping, or using machinery appropriate and approved by the Client.

All collected leaves to be removed from site and should not be left in piles awaiting removal but cleared immediately.

Leaves should not be left on ground for more than a week. The contractor shall schedule operations to achieve this standard.

- Management of proposed tree planting

  General Health of Trees, Years 1, 3 and 5:
  Check general health of all trees by qualified arboriculturalist. Recommendations will be made for replacements and remedial works as required.

  In order to ensure that trees do not become hazardous, the condition of all trees at the site should be checked annually. Trees should also be checked following storms, where there may be damage from wind throw.

  Deciduous trees are often vulnerable to diseases caused by pathogens, fungi, bacteria and viruses. Trees should be monitored for signs of diseases, which may include visible mushrooms and patchy and discoloured leaves. Where it is suspected that a tree may be suffering from a disease advice should be sought from an Arboriculturalist.

  Hazardous branches or mature trees that are to be removed must be surveyed for potential birds' nests or bat roosts prior to felling. Trees and hazardous branches should only be removed outside the bird-breeding season, between March and August for most species, unless a suitably qualified ecologist undertakes a survey of the affected area.

  All tree surgery works should be undertaken by a professional tree surgeon who should work in accordance with BS 3998:1989 'Recommendations for Tree Work'.

  Inspection of trees:
  Arboricultural inspections and works are to continue up to the 25 years and beyond. They will address wind damage, disease, dead wooding and tackling windblown trees.

- Newly Planted Trees

  Watering: Year 1and 2 – Establishment
  Between May and September all newly planted trees shall be watered at a rate of 50 litres per visit.

  Mulching and weeding: Years 1-3
  Maintain a mulched, weed-free area 800mm radius around each tree. Mulch should be maintained at a depth of 75mm deep. Weeding within this zone should be hand-weeding which should be done as often as required or through the use of biodegradable mulch.

Inspection of stakes, ties etc. Years 1-3
Twice a year check condition of stakes, ties, guys and guards.

Redundant ties: Check for excessive movement at ground level by pulling on tree at shoulder height. If most of movement is in the bending of the stem then it is likely that the root system is providing adequate support and stakes and ties can be removed.

Adjustment and/or replacement of ties:
Trees should be able to move approximately 50mm (2") in all directions when staked properly. Too little movement may result in poor root structure and inability to withstand wind loading. Too much movement may cause rocking and damage of new root growth. Ties should not rub bark. Ties should be loosened, tightened or replaced as required.

Stakes to be removed after the third winter from time of planting, unless further tree stabilisation is required.

Re-firming Trees and Specimen Shrubs:
Re-firming Trees and Shrubs – shall be carried out after strong winds, frost heave and other disturbances. To re-firm the Contractor should tread around the base until firmly bedded. Any collars in the soil at the base of tree stems, created by tree movement should be broken up by fork, avoiding damage to roots. The voids should be backfilled with topsoil and re-firmed.

- Pruning newly planted trees: Years 1 onwards

Prune at appropriate times, to remove dead, dying, damaged and diseased wood along with crossing branches (where branches are rubbing together) in accordance with BS 3998: 1989, to promote healthy growth and natural shape. Trees should be allowed to grow to their natural mature height. Pruning shall only be carried out to remove dead, diseased or dying branches.

All trees shall be cut using sharp shears, reciprocating hand held cutters or secateurs.

All cuts shall be clean and any ragged edges shall be removed using a sharp knife or secateurs. Keep wounds as small as possible, cut cleanly back to sound wood leaving a smooth surface, and angled so that water will not collect on the cut area.

All arisings shall be collected immediately following cutting or at the end of each work period and taken to the designated location for disposal.

The Contractor shall ensure that trees do not present a hazard or obstruction to pedestrians, pavements, roads or signs at any time.

Once commenced, the cutting operation shall continue and be completed without delay.

The Contractor shall avoid cutting/pruning in March to June to cause minimum disturbance to nesting birds and wildlife, in compliance with the Wildlife and Countryside Act.

- Disease of fungus
  Give notice if detected. Do not apply fungicide or sealant unless instructed.

- Watering

  Water throughout the growing season in line with the maintenance schedules.

- Thinning Out

  The object of the native woodland planting is to encourage full woodland growth to encourage the screening of large units. Trees shall be checked from 3 years to ensure healthy growth. Vigorous deciduous trees in the native woodland mix shall be thinned out after 7 to 10 years to allow slower growing species to reach their full height.

  The following species are to be allowed to grow onto maturity:

  Acer campestre
  Pinus sylvestris
  Prunus avium
  Quercus robur

  These species are to be spread evenly throughout the woodland to achieve desired coverage as set out in the planting matrix. Trees that are over shadowing these species shall be selected and removed to the base. Any encroaching vegetation adjacent to public rights of way will be thinned out in order to maintain width and sightlines.

- Mulching
  All mulch beds to tree planting to be topped up in line with the maintenance programme

- Protection
  All planting shall be suitably supported during the establishment period and protected from damage caused by animals e.g. rabbits

6.5. Management of hedgerow planting

- Watering

  Water as necessary through the growing season in line with the maintenance schedules.

- Cutting back/foliage removal

  Hedgerow should be cut twice a year in the spring and summer to promote healthy growth and maintain a neat, dense form, and to maintain clear access and sightlines to adjacent public rights of way.

6.6. Management of native shrub mix

- Watering

  Water as necessary through the growing season in line with the maintenance schedules.

- Cutting back/foliage removal

  Native shrubs to be maintained at maximum 1.8m height. Plants should be cut twice a year in the spring and summer to promote healthy growth and maintain a neat, dense form.

6.7. Management of grasslands

- Mowing

  For first year of management mow regularly throughout the first year of establishment to a height of 40-60mm, removing cuttings if dense. This will control annual weeds and help maintain balance between faster growing grasses and slower developing wild flowers.

  For future years:

  Short meadow:
  Grass to be cut back three times a year in early spring, summer and autumn. The summer cut to be after flowering in July or August as a 'hay cut': cut back to c 50mm. Leave the 'hay' to dry and shed seed for 1-7 days then remove from site.
  For the spring and autumn cut; cut back to c 60mm and remove arisings.

  Care should be taken if the swale is holding water and on steeper sides of the swale. Only grass that can be safely accessed should be cut back in such conditions.

  Long meadow:
  Grass to be cut back once a year in late August and early September, left for a minimum of 3 days and then arisings removed, thus allowing the majority of the grassland plants to bloom and set seed.

  Amenity grass to 'Grassroad':
  Grass to be cut to height of 50mm monthly during growing season with arisings to be removed.

- Weeding

  Weeds, over 100mm in height in late May, that do not form part of the seed mix should be removed from site.

- Re-seeding

  Bare patches to be re-seeded annually in September as per the original specification. If bare patches appear, do not top dress with topsoil and do not apply fertiliser. Add grass seed as per original specification.

6.8. Amenity planting: shrub and ground cover planting

- Watering: Year 1 – Establishment
  Between May and September of the first year shrub beds will be watered on each visit if there has been no rainfall for a period of seven days. Shrub areas should be watered at a rate of 15 litres per square metre. During subsequent years watering should be undertaken as necessary.

- Weeding and mulching: Years 1-25
  Shrub beds should be weeded monthly during the growing season, March to October inclusive, utilizing the following methods:

  Ornamental shrub & perennial areas - Hand pulling only
  General amenity shrub areas - Hand pulling or herbicide spot treatment

  Use only an approved herbicide in accordance with manufacturer's instructions. Care should be taken not to spray the green parts of shrubs or low ground cover planting. All weeds are to be removed from site once they have died down.

  Remulch as necessary the whole surface of shrub beds to ensure a depth of 75mm. Ensure that the soil is thoroughly moistened prior to remulching, applying water where necessary.

- Fertiliser: Years 1-3
  Annual application of a slow release organic fertilizer in accordance with manufacturer's instructions.

- Protective fencing: Year 1
  Where newly planted areas are protected with Chestnut Paling fencing. Maintain fencing until end of Defects period then remove and reinstate ground. Make good any damage to planting until area is accepted. The fencing will remain the property of the Contractor.

- Pruning: Years 1-25
  Shrub plants should be pruned at appropriate times, to remove dead or dying and diseased shoots or branches, to promote healthy growth and natural shape. Prune

overgrowing specimens to avoid suppression of adjacent species, overgrowth onto grass or paving etc. Ensure that shrubs are maintained at a maximum of waist height.

All shrubs shall be cut using sharp shears, reciprocating hand held cutters or secateurs. Large leafed species such as Prunus should only be pruned using secateurs or similar approved equipment. All cuts shall be clean and any ragged edges shall be removed using a sharp knife or secateurs.

All arisings shall be collected immediately following cutting or at the end of each work period and taken to the designated location for disposal off site by the contractor. This includes trimmings hung up in shrubs and the sweeping of adjacent hard surfaces.

Once commenced, the cutting operation shall continue and be completed without delay.

- Maintenance of shrub area base

  The Contractor shall be required to leave the base of the shrub beds clean, tidy and weed free on every occasion that maintenance operations are carried out, and this shall include the removal of all litter,' leaves, debris and other such deleterious matter. The site shall be left clean and tidy.

  All beds and bare areas shall be maintained free of litter and weeds at all times.

  Bed soil shall be pushed back and left at a 45 degree angle from the bed edge, starting slightly below surrounding levels.

7. Maintenance schedule

On following page.

All landscape maintenance operations will be carried out in accordance with Landscape Services' Technical Specifications, as a requirement of the 106 Agreement. This is to ensure that the appropriate standard of landscape maintenance is achieved.

RF16-375

AXIS J9, BICESTER

Maintenance Schedule (Planting - Years 1-5)

re-form landscape architecture

This maintenance schedule details when maintenance work items are to be carried out. In each identified month, the number in the shaded box details the number of times per month when a work item is to be carried out. Where a number "1" is indicated, the maintenance work item must be carried out once a month at the beginning of the month. Where a number "2" is indicated, the maintenance work item must be carried out twice in the month, once at the beginning of the month and the second occurence mid-way through the month.

Item	Description	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1.0	**Tree Planting**												
1.1	Cut back broken, diseased or dying branches. Prune trees to maintain a desirable shape in the first three years after planting.	1	1	1									
1.2	Check for general health in line with good horticultural practice. Any signs of disease or decreasing health to be reported to site management.	1	1	1	1	1	1	1	1	1	1	1	1
1.3	Top up mulch to base of trees in soft areas.						1		1				
1.4	Apply general tree fertiliser			1									
1.5	Check stakes and ties twice a year. Any broken or damaged stakes will be replaced and ties re-fixed at a slightly lower position, allowing for growth since planting. Stakes to be removed after the third winter from time of planting, unless further tree stabilisation is required.			1						1			
1.6	Water trees during summer months as necessary, minimum 2 x per month in first two years.						2	2	2	2			
1.7	To reduce excessive competition, retain a weed free area around all trees to a diameter of 1m around the base of the trees using glyphosate spray twice a year. Newly planted trees will require refirming as required during the first three years.			1							1		
2.0	**Hedgerow (Existing and proposed) and native shrub mix**												
2.1	(Proposed only) Water during summer months as necessary, minimum 2 x per month in first two years.					2	2	2	2	2	2		
2.2	(Existing and proposed) PLants should be cut twice a year in the spring and summer to promote healthy growth and maintain a neat, dense form				1				1				
3.0	**Amenity grass to 'Grassroad**												
3.1	Mow fortnightly throughout May - October to maintain a length of 35-50mm (12 visits)					2	2	2	2	2	2		
3.2	Cultivate and re-seed areas of bare ground (as necessary during spring)using exact same seed mix as originally sown.			1	1								
3.3	Weed control will include spot treatment using selective herbicide of noxious weeds such as docks, thistles, nettles, ragwort and willowherb. (one visit in spring, one visit in early autumn)			1							1		
4.0	**Meadow grassland**												
4.1	For first year of management mow regularly throughout the first year of establishment to a height of 40-60mm, removing cuttings if dense. This will control annual weeds and help maintain balance between faster growing grasses and slower developing wild flowers.				1	1	1	1	1	1			
4.1	Short meadow: Grass to be cut back three times a year in early spring, summer and autumn. The summer cut to be after flowering in July or August as a 'hay cut': cut back to c 50mm. Leave the 'hay' to dry and shed seed for 1-7 days then remove from site. For the spring and autumn cut; cut back to c 60mm and remove arisings.				1			1			1		
4.1	Long meadow: Grass to be cut back once a year in late August and early September, left for a minimum of 3 days and then arisings removed, thus allowing the majority of the grassland plants to bloom and set seed.									1			
4.1	Removal of any devleoping young scrub . Cut material should be chipped and left on site in a compost area, followed by direct treatment of stems to stop regrowth.									1			
4.1	Weed control will include spot treatment using selective herbicide of noxious weeds such as docks, thistles, nettles, ragwort and willowherb. (one visit in spring, one visit in early autumn)			1							1		
4.1	Cultivate and re-seed areas of bare ground (as necessary during spring) using exact same seed mix as originally sown.			1	1								
5.0	**Amenity Planting**												
5.1	Watering: Year 1 – Establishment Between May and September of the first year shrub beds will be watered on each visit if there has been no rainfall for a period of seven days. Shrub areas should be watered at a rate of 15 litres per square metre. During subsequent years watering should be undertaken as necessary.					1	1	1	1	1	1		
5.2	Shrub beds should be weeded monthly during the growing season, March to October Remulch as necessary			1	1	1	1	1	1	1	1		
5.3	Pruning: Shrub plants should be pruned at appropriate times, to remove dead or dying and diseased shoots or branches, to promote healthy growth and natural shape.			1	1	1	1	1	1	1	1		
5.4	All beds and bare areas shall be maintained free of litter and weeds at all times.	1	1	1	1	1	1	1	1	1	1	1	1
5.5	Fertiliser: Years 1-3 Annual application of a slow release organic fertilizer in accordance with manufacturer's instructions.				1								