Proposed Flood Mitigation Plan 1:1000

Outlet at Greenfield rate of 4 litres per second. Non-return valves to prevent flood water entering soakaway.

Outlet at Greenfield rate of 12 litres per second. Non-return valves to prevent flood water entering soakaway.

Bank to only allow water in at 0.35m with non-return valve to allow water to drain back into watercourse at 0.35m.

PUBLIC LANDSCAPE BRIEF ZONE
LEVELS TO BE RE-GRADED FOR INCREASED SW RUN OFF. ADDITIONAL LANDSCAPING TO BE PROVIDED FOR BENEFIT OF WILD LIFE.
PUBLIC ACCESS GATES PROVIDED FOR MAINTENANCE & EMERGENCY ACCESS ONLY.

64.150 Contour
1% AEP (+35%)
Promised Land Farm
Bicester

Client:
Albion Land PLC

Flood Compensation - Slice
63.150m-63.350m

BAILEY JOHNSON HAYES
Consulting Engineers

Scale
Date
Drn Chkd

Project Ref. Drawing No. Rev.

3D 63.150m - 63.350m
### Flood Compensation - Slice 63.550m-63.750m

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<td>64.800</td>
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<td>1 in 20 year (17% AEP)</td>
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<td>1 in 100 year (1% AEP)</td>
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<tr>
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</tr>
<tr>
<td>1 in 100 year + 0.66% CC (1% AEP + 0.66% CC)</td>
<td>66.350</td>
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**Client:** Albion Land PLC  
**Location:** Bicester  

---

**Revision Schedule**

- **Date:** 06/21/19  
- **Drawn:** BJH  
- **Checked:** BJH

---

**Diagram Image:**

3D 63.550m - 63.750m
Promised Land Farm
Bicester

Client:
Albion Land PLC

Flood Compensation - Slice 63.750m-63.950m

BAILEY JOHNSON HAYES
Consulting Engineers

S1358 3D-013
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<th>Difference (Gain) M³</th>
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Option 8

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1.0 INTRODUCTION

The following calculations are prepared to justify the principles for design of below-ground surface water drainage systems for the above development.

The development plot has an area of 9.7 ha and exhibits a gentle gradient from west to east. With the exception of a chicken farm in the southwestern corner, the site is presently undeveloped and comprises of open fields used as arable land. The proposed scheme is to develop the site with new roads, buildings and external yard hardstanding areas for B1(c), B2, and B8 use classes, and a Leisure Club.

The site presently drains naturally in an easterly direction towards Langford Brook which forms the eastern site boundary. Ground levels within the site boundary shall be adjusted by local raising levels in the northern sector to create a plateau for building development, with associated lowering of levels within the western and southern sectors to provide flood compensation. Details of the flood compensation scheme are appended to the BJH site-specific flood risk assessment.

The surface water drainage strategy for the developed site is to maintain the existing outfall arrangements and limit flows to existing greenfield values by utilising substantial retention swales and/or below-ground...
Calculations

attenuation storage, and incorporating flow control devices to the drainage network. The design for the site drainage shall include an allowance for climate change.

2.0 GROUND CONDITIONS

The published BGS geology map indicates Alluvium across the majority of the site. The Alluvium is absent in the northwest and the southwest of the site, where River Terrace deposits are shown. Solid geology of the Kellaways Formation is anticipated below, comprising interbedded sandstone and siltstone of the Kellaways Sand Member, underlain by mudstone interbedded with siltstone and sandstone of the Kellaways Clay Member. Kellaways Sand is shown to be absent in the north of the site. The Kellaways Formation is anticipated to be underlain by limestone of the Cornbrash Formation.

A series of 18 trial pits have been excavated by Applied Geology on behalf of Albion Land Ltd. Topsoil and subsoil was encountered at surface across the site and was underlain by Superficial Deposits comprising Alluvium and River Terrace Deposits, which in turn was underlain by the Kellaways Formation, predominantly comprising clay, with initial horizons of sand in the southeast of the site. This is broadly consistent with the published geological records. Groundwater was recorded as seepages in all trial pits, with the exception of TP12 (no River Terrace Deposits present) within the River Terrace Deposits at depths of between 0.5m and 1.3m bgl.

3.0 DESIGN

3.1 Greenfield Runoff Estimate

Greenfield runoff estimation is undertaken using the UK SuDS Tools Website using the Institute of Hydrology Report 124 methodology. Based upon soils information for the development site obtained from the Cranfield Soil and AgriFood Institute Soilscape Viewer.
Calculations

and the ground conditions established during the trial pitting exercise undertaken by Applied Geology, the SOIL is conservatively considered to be type 3 for the purpose of greenfield runoff estimation. The default value of SOIL type 1 (sandy highly permeable material), allocated by the UK SuDS Tools Website for the subject site, is considered inappropriate and is therefore edited within the input data.

Greenfield runoff is calculated using the Institute of Hydrology Report 124 methodology; the appended calculation sheet confirms the 1:1 greenfield runoff rate = \( 20.43 \text{ litres/sec} \).

3.2 Quick Storage Estimate

For the purpose of initial sizing of flood storage requirements it shall be assumed that the outflow from the whole site shall be restricted to 20.4 l/sec for all rainfall events up to and including the 1 in 100 year event, inclusive of an allowance of 40% for climate change in accordance with government guidance.

Drainage design is undertaken using the Source Control module of Microdrainage Windes software. The surface water drainage shall be split into two systems; Units 10-13 shall drain into Swale 1, and Units 1-9 shall drain into Swale 2. Both swales shall discharge to existing field ditches which in turn outfall to Langford Brook to the east. The total permissible outflow rates are apportioned at 8 l/sec from Swale 1, and 12 l/sec from Swale 2. Input data and results of Quick Storage Estimates are presented on the following sheets nos 1 and 39. For 1 in 100 year +40% storm events (using FEH design rainfall) the software predicts storage volumes between 1869 m\(^3\) and 2553 m\(^3\) will be required for Swale 1, and between 5179 m\(^3\) and 6702 m\(^3\) will be required for Swale 1.

3.3 Drainage Layouts

The attached BJH drawings M1358-DD01, DD02 & DD03 illustrate the hard surfaced drained site areas, pipe design references and lengths, and the layout of principal below-ground drainage runs respectively. The Leisure Centre plot has dedicated surface water attenuation provisions by virtue of private below-ground storage and an hydrobrake flow control to restrict flows to 60 l/sec at the outfall manhole connecting to the shared system constructed through the industrial plot. This information is input to the Windes software and modelled in the Simulation module.

3.4 Units 10-13 – Swale 1

In order to establish the critical storm event a simple model is created within the Source Control module of Windes using a Swale fitted with an Hydrobrake flow control device to restrict outflows to 8 l/sec. Microdrainage pages 2-4 indicate that the critical storm is a 1440 minute winter event. Swale 1 dimensions are shown on the attached BJH drawing M1358-DD04.

3.4.1 Simulation 100yr+40%CC Winter Storms

Design storms from 2160minute duration to 15min duration are modelled in Simulation, to include the critical 1440 minute design storm.
Microdrainage pages 5-14 include complete details of the network i.e. online controls and storage provisions for a 2160 minute winter design storm. The water level in Swale 1 is 63.995; discharge to outfall is 8 l/sec.

Microdrainage pages 15-16 include simulation criteria and results for a 1440 minute winter design storm. The water level in Swale 1 is 64.004; discharge to outfall is 8 l/sec.

Microdrainage pages 17-18 include simulation criteria and results for a 960 minute winter design storm. The water level in Swale 1 is 63.995; discharge to outfall is 8 l/sec.

Microdrainage pages 19-20 include simulation criteria and results for a 720 minute winter design storm. The water level in Swale 1 is 63.980; discharge to outfall is 8 l/sec.

Microdrainage pages 21-22 include simulation criteria and results for a 600 minute winter design storm. The water level in Swale 1 is 63.967; discharge to outfall is 8 l/sec.

Microdrainage pages 23-24 include simulation criteria and results for a 480 minute winter design storm. The water level in Swale 1 is 63.947; discharge to outfall is 8 l/sec.

Microdrainage pages 25-26 include simulation criteria and results for a 360 minute winter design storm. The water level in Swale 1 is 63.918; discharge to outfall is 8 l/sec.

Microdrainage pages 27-28 include simulation criteria and results for a 240 minute winter design storm. The water level in Swale 1 is 63.871; discharge to outfall is 8 l/sec.

Microdrainage pages 29-30 include simulation criteria and results for a 180 minute winter design storm. The water level in Swale 1 is 63.839; discharge to outfall is 8 l/sec.

Microdrainage pages 31-32 include simulation criteria and results for a 120 minute winter design storm. The water level in Swale 1 is 63.795; discharge to outfall is 8 l/sec.

Microdrainage pages 33-34 include simulation criteria and results for a 60 minute winter design storm. The water level in Swale 1 is 63.722; discharge to outfall is 8 l/sec.

Microdrainage pages 35-36 include simulation criteria and results for a 30 minute winter design storm. The water level in Swale 1 is 63.657; discharge to outfall is 8 l/sec.

Microdrainage pages 37-38 include simulation criteria and results for a 15 minute winter design storm. The water level in Swale 1 is 63.599; discharge to outfall is 8 l/sec. In this extreme design case isolated surface flooding up to 2m³ is predicted to occur within the service yard between Units 10 and 12, and the access road between Units 10 and 11; the water not threaten the buildings and will be temporarily held as ponding on the pavement surface until the storm abates.
### Calculations

For 100yr+40%CC design storms the peak water level in Swale 1 is 64.004 (depth 0.804m) for an outflow restriction of 8 l/sec.

3.5 Units 1-9 – Swale 2

3.5.1 Simulation 100yr+40%CC Winter Storms

The detailed calculations for the drainage network serving Units 1-9 -Swale 2 confirm that the 2880 minute winter storm is the critical design case. Design storms from 4320 minute duration to 15 min duration are modelled in Simulation, to include the critical 2880 minute design storm.

Microdrainage pages 40-54 include complete details of the network i.e. online controls and storage provisions for a 4320 minute winter design storm. The water level in Swale 2 is 63.862; discharge to outfall is 12 l/sec.

Microdrainage pages 55-57 include simulation criteria and results for a 2880 minute winter design storm. The water level in Swale 2 is 63.904; discharge to outfall is 12 l/sec.

Microdrainage pages 58-60 include simulation criteria and results for a 2160 minute winter design storm. The water level in Swale 2 is 63.896; discharge to outfall is 12 l/sec.

Microdrainage pages 61-63 include simulation criteria and results for a 1440 minute winter design storm. The water level in Swale 2 is 63.867; discharge to outfall is 12 l/sec.

Microdrainage pages 64-66 include simulation criteria and results for a 960 minute winter design storm. The water level in Swale 2 is 63.822; discharge to outfall is 12 l/sec.

Microdrainage pages 67-69 include simulation criteria and results for a 720 minute winter design storm. The water level in Swale 2 is 63.783; discharge to outfall is 12 l/sec.

Microdrainage pages 70-72 include simulation criteria and results for a 600 minute winter design storm. The water level in Swale 2 is 63.756; discharge to outfall is 12 l/sec.

Microdrainage pages 73-75 include simulation criteria and results for a 480 minute winter design storm. The water level in Swale 2 is 63.723; discharge to outfall is 12 l/sec.

Microdrainage pages 76-78 include simulation criteria and results for a 360 minute winter design storm. The water level in Swale 2 is 63.681; discharge to outfall is 12 l/sec.

Microdrainage pages 79-81 include simulation criteria and results for a 240 minute winter design storm. The water level in Swale 2 is 63.623; discharge to outfall is 12 l/sec.

Microdrainage pages 82-84 include simulation criteria and results for a 180 minute winter design storm. The water level in Swale 2 is 63.576; discharge to outfall is 12 l/sec.
Microdrainage pages 85-87 include simulation criteria and results for a 120 minute winter design storm. The water level in Swale 2 is 63.502; discharge to outfall is 12 l/sec.

Microdrainage pages 88-90 include simulation criteria and results for a 60 minute winter design storm. The water level in Swale 2 is 63.380; discharge to outfall is 12 l/sec.

Microdrainage pages 91-93 include simulation criteria and results for a 30 minute winter design storm. The water level in Swale 2 is 63.286; discharge to outfall is 12 l/sec.

Microdrainage pages 94-96 include simulation criteria and results for a 15 minute winter design storm. The water level in Swale 2 is 63.238; discharge to outfall is 8 l/sec. In this extreme design case isolated surface flooding up to 7.5m³ is predicted to occur within the service yard between Units 6 and 8; the water not threaten the buildings and will be temporarily held as ponding on the pavement surface until the storm abates.

For 100yr+40%CC design storms the peak water level in Swale 2 is 63.904 (depth 1.004m) for an outflow restriction of 12 l/sec.

4.0 EXCEEDANCE EVENTS

Site levels will arranged to ensure that overland flow routes are created to encourage any build-up of surface water to flow in an easterly direction towards Langford Brook. Similarly the bunding to the Swale will be constructed to ensure that there is facility for overspill to occur in an easterly direction away from the development land.
GREENFIELD RUNOFF ESTIMATE
This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at http://uksuds.com/terms-and-conditions.htm. The outputs from this tool have been used to estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for use of this data in the design or operational characteristics of any drainage scheme.

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance “Preliminary rainfall runoff management for developments”, W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site name: Promised Land Farm
Site location: Bicester

Methodology

<table>
<thead>
<tr>
<th>Methodology</th>
<th>IH124</th>
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### Site characteristics

| Total site area (ha) | 9.7 |

### Methodology

#### Qbar estimation method
- Calculate from SPR and SAAR

#### SPR estimation method
- Calculate from SOIL type

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<th>SOIL type</th>
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### Hydrological characteristics

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<td>Growth curve factor: 100 year</td>
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</table>

### Notes:

1. Is $Q_{\text{BAR}} < 2.0$ l/s/ha?
   - Normally limiting discharge rates which are less than 2.0 l/s/ha 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 consents are usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be 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 may be a requirement for disposal of surface water runoff.

### Greenfield runoff rates

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<tr>
<td>1 in 100 years (l/s)</td>
<td>4.48</td>
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This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at http://uksuds.com/terms-and-conditions.htm. The outputs from this tool have been used to estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for use of this data in the design or operational characteristics of any drainage scheme.
APPENDIX B

BAILEY JOHNSON HAYES DRAWINGS

S1358-DD01A – Drained Areas
S1358-DD02A – SW drainage design refs
S1358-DD03A – Proposed SW Drainage
S1358-DD04A – Proposed Swales