

Doc Ref: **2772**
Date: **28th April 2023**
Rev: **A**

Client

**Elle R Leisure Ltd
2 Castle Street
Manchester
M3 4LZ**

Site Address

**Proposed Albert's Restaurant
Edenfield Road
Norden
Rochdale
OL12 7TT**

Document Title

Drainage Strategy Report



Oak House
2 Gatley Road
Cheadle
Cheshire
SK8 1PY

www.brennanconsult.com
0161 428 2880

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Revision History

Issue	Date	Status	Prepared By	Signature
O	24.03.22	First Issue	Lee Meadowcroft BSc (Hons) PgDip MScCHE CEng MStructE MICE IHBC	
A	28.04.23	Updated to Suit New Application	Lee Meadowcroft BSc (Hons) PgDip MScCHE CEng MStructE MICE IHBC	

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Executive Summary

Item	Brief Description
Development Proposed	The internal reconfiguration, minor extension and new terracing to an existing restaurant into an Albert's Restaurant on land off Edenfield Road, Norden, Rochdale. Car park and access road remain unchanged.
Flood Zone Classification	Flood Zone 1 – Low Risk
Geology	A Phase 2 Site Investigation has been undertaken and found made ground to a maximum depth of 2.0m, over soft gravelly clay.
Infiltration Rate	Based on the made ground and clay substrata, infiltration is not deemed possible.
Nearest Watercourses	The Mill Croft Brook is located some 100m to the west of the site boundary beyond 3 rd party land.
Nearest Adopted Sewers and Drainage Networks	225mm diameter combined water sewer in Edenfield Road, approximately 0.6km to the southeast of the site. Current restaurant and car park drain unrestricted into this sewer via a private connection. No surface water sewers in close proximity.
Surface Water Drainage Outfall and SuDS Hierarchical Approach	Reuse existing connection to the combined sewer with a reduced discharge rate for the area of extension and terracing only. Car park area remains unchanged and thus not included in the calculations.
Existing Discharge Rate	Brownfield roof area of extension – 250m ² (Modified rational method) 1yr (30mm/hr) – 2.1 l/s Qbar (35mm/hr - 2.3yr mean annual) – 2.4l/s. 30yr (65mm/hr) – 4.5l/s 100yr (95mm/hr) – 6.6l/s
Proposed Discharge Rate	50% reduction in the Qbar brownfield rate @ 1.2l/s
Allowance for Climate Change	20% - based on a commercial > 25-year design life to 'the 2050's'.
Proposed Attenuation Method and Volume	Offline Geocellular attenuation, 9.2m ³ for the 100yr + 20% CC event.
SuDS features	Geocellular attenuation / permeable surfacing to the overspill car park.
Maintenance Responsibility	Restaurant Owner
Foul Drainage Outfall	Reuse existing connections to combined drainage network.

Figure 1: Flood Risk and Drainage Strategy Summary

1.0 Introduction

- 1.1 Brennan Consult has been appointed by Elle R Leisure Ltd to prepare this Drainage Strategy Report to support a planning submission for a proposed redevelopment of an existing restaurant into a new Albert's Restaurant off Edenfield Road, Norden, Rochdale. The assessment has been undertaken in line with Section 10 of the 'National Planning Policy Framework' plus the accompanying Technical Guidance on Flood Risk.
- 1.2 This Drainage Strategy Report has been commissioned by Elle R Leisure Ltd and is specific to their interests in the development proposals as described by the Architectural plan in Appendix A. This report may not be assigned.
- 1.3 The report has been commissioned to identify any drainage related issues associated with the proposed development and any likely constraints that could be imposed. The following issues have been addressed within this report;
- Determine any the current surface water drainage regime and assess any potential increase in surface water runoff as a result of the proposed development.
 - Discuss Sustainable Drainage Systems (SuDS) as an option for reducing surface water flood risk and devise an outline Drainage layout.
 - Devise an appropriate outline surface water drainage strategy (including calculation where appropriate) to deal with any potential increase in surface water runoff and include for climate change. Include for a reduction in predevelopment discharge rates where possible.
 - Devise an appropriate outline foul water drainage strategy.

2.0 Development Description and Location

2.1 Site Location

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

Item	Brief Description
Project name	Alberts, Norden.
Site address and location	Land off Edenfield Road, Norden, Rochdale, OL12 7TT.
Council Area	Rochdale Borough Council
Approximate Grid Reference	OS: 384710 , 415068
General Locality	The site is located some 5km to the northwest of Rochdale Town Centre in the suburb of Norden.

Figure 2 Site Referencing Information

2.2 Existing Site Description

2.2.1 The development site is irregular in plan shape and currently encompasses the former Nutters Restaurant and car park, with a grassed area to the south and a large number of trees around the boundaries. The site is situated to the north of Edenfield Road with a farm and associated buildings, storage areas and fields to the north and west. To the east are further fields and dwellings in the form of two detached properties, with Edenfield Road beyond. The site will retain the existing access from Edenfield Road.

2.2.2 Figure 3 identifies the overall site location details.



Figure 3 Site Location plan

2.3 Topography

- 2.3.1 A topographical survey has been undertaken. This has identified the current building to hold a level of 235.5m AOD. This is set above the level of the car park which generally falls in a southerly direction towards the Edenfield Road. Further details can be identified on the Topographical survey in Appendix B.

2.4 Hydrology

- 2.4.1 The closest known watercourse is the Mill Croft Brook located some 100m to the west of the site boundary beyond 3rd party land.

2.5 Development Proposals

- 2.5.1 As discussed in the earlier sections, the report is prepared to support a planning application for the internal reconfiguration, small new extension and increased terracing of the existing Nutters restaurant into an Albert's Restaurant. The car parking area will remain unchanged. Vehicular access will continue to be off Edenfield Road.
- 2.5.2 The outline Site Master Plan as indicated in Appendix A provides details of the proposed development intent.

3.0 Flood Risk Review

3.1 Fluvial Flood Risk Review

3.1.1 Figure 4 below locates the site on the Environment Agency's indicative flood plain map. It is clear from this that the red line boundary sits outside of a fluvial generator of flood water from any identified water body or river. It is considered therefore that the site lays outside of the active 100-year and extreme event floodplains, thus lying within 'Flood Zone 1 Classification' in accordance with the National Planning Policy Framework (NPPF) Flood Risk Guidance Notes, i.e. probability of annual fluvial flooding significantly less than 1 in 1000 in any one year (<0.1%). The risk from fluvial flood water is diminished to acceptable levels.



Figure 4 EA Indicative Flood Maps

3.1.2 In addition, the development application boundary is less than 1ha in plan area. In line with criteria set within the NPPF a Flood Risk Assessment is not required to support a planning application if the development is less than 1ha and in Flood Zone 1.

4.0 Drainage Strategy

4.1 Existing Drainage

4.1.1 United Utilities

The United Utilities sewer records have been reviewed (refer to Figure 5 below) and confirms that there is a 225mm diameter combined sewer in Edenfield Road to the southeast of the site, flowing in a south easterly direction. There are no surface water sewers in close proximity that are accessible.

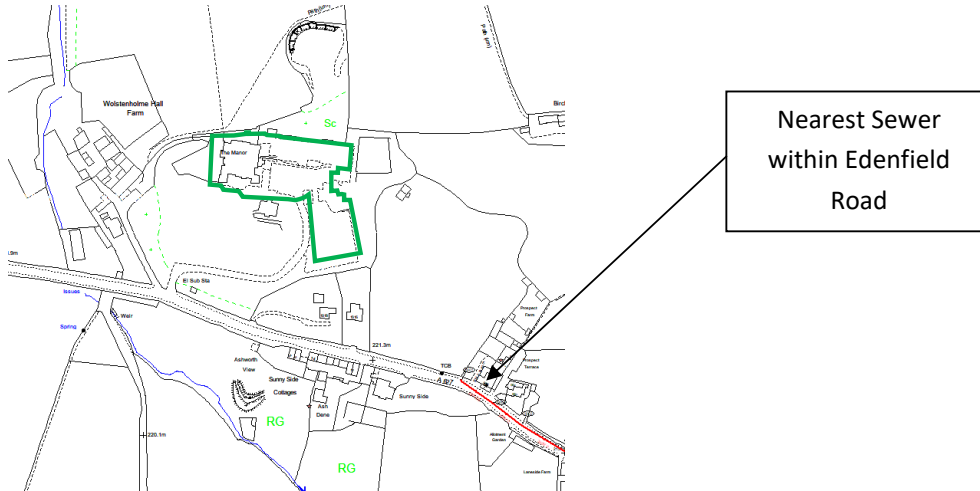


Figure 5 United Utilities Water Sewer Records

4.1.2 Private Drainage

4.2 The current restaurant building and car park is served by a network of foul and surface water drains that combine at a manhole situated within the access road and which outfalls unrestricted to the combined sewer in Edenfield Road.

4.2 Existing Runoff

4.2.1 The current site can be classed as predominantly Brownfield. Figure 6 below defines the existing Brownfield runoff rates for the new extension and terracing area based on the respective rainfall intensities and an impermeable area of 0.025ha. The existing car parking area will remain unchanged and therefore is excluded from any attenuation requirements.

Existing Permeable Area to the Restaurant Building (ha)	1yr Brownfield Rate (30mm/hr)	Qbar Brownfield Rate (35mm/hr)	30yr Brownfield Rate (65mm/hr)	100yr Brownfield Rate (95mm/hr)
0.025	2.1 l/s	2.4 l/s	4.5 l/s	6.6 l/s

Figure 6 Existing Brownfield Runoff Rates

4.3 Geology

- 4.3.1 A Phase 2 intrusive investigation has been carried out at the site. A number of trial pits and window samples carried out in the development area identified made ground to a maximum depth of 2m, over soft gravelly clay.

4.4 Hydrological Assessment

- 4.4.1 As discussed in previous sections, a review of the topographical survey, OS Maps and Environment Agency maps would indicate the closest watercourse to be located over 0.1 km to the west beyond 3rd party land ownership.

4.5 Sustainable Drainage Systems (SuDS) Assessment

4.5.1 SuDS Objectives

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

4.5.2 SuDS Design Themes

- 4.3 The 'Management Train Approach' should be central to the surface water drainage strategy of the proposed site. The main objective is treatment and control of runoff as near to the source as possible protecting downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:

- i. **Prevention** – The use of good site design and housekeeping measures to prevent runoff and pollution and includes the use of rainwater reuse / harvesting.
- ii. **Source Controls** – Control of runoff at source or as close to source as possible (e.g. soakaways, green roofs, pervious pavements).
- iii. **Site Control** – Management of water in a local area and can include below ground storage / attenuation, detention basins, large infiltration devices.
- iv. **Regional Control** – Management of water from a site or various sites and can include wetlands and balancing ponds.

4.5.3 SuDS Site Constraints

SuDS techniques are suitable for all sites; therefore, an assessment of the existing site is required so that SuDS limitations can be determined.

- *Land Use Characteristics:* The size and type of development enables the potential range of prevention, source control and site control SuDS devices to be considered.

- *Site Characteristics:* An intrusive site investigation has been carried out at the site. Initial findings are that infiltration techniques would be suitable. Formal soakaway tests to be completed as part of the main Phase 2 SI.
- *Catchment Characteristics:* The site is currently classed as Brownfield having always been developed.
- *Environmental and Amenity Performance:* The inclusion of SuDS within the overall development is a key driver in providing both amenity and habitat creation. All types of SUDs will be considered and blended into the landscaping zone, if possible. Safety to all future users is paramount and so best practice guidance will be incorporated so that these devices blend into the surrounding without the need for significant safety precautions. Maintenance plans will be prepared for all SuDS devices that are included.

4.5.4 SuDS Methods

Figures 7 and 8 on the following pages provide an assessment of various above and below ground SuDS methods that can provide water quality treatment and management of flows to reduce runoff rates and volumes and whether they can be suitably incorporated at this development site. The purpose of this assessment is to set out options to be considered at the planning stage with consideration to time constraints, viability and lifetime maintenance of the restaurant development.

Method	Comment	Suitability for Development
Green Roofs	Can be used on suitable low-rise buildings to provide retention, attenuation and treatment of rainwater, and promotes evaporation and local biodiversity.	<u>Not suitable:</u> Existing roof would not enable a green roof to be retrofitted. New roof partly glazed.
Water Butts	Plastic tanks placed at the base of rainwater down pipes to collect rainwater runoff from the roof areas.	<u>Not Suitable:</u> Limited end use for a restaurant.
Rainwater Harvesting	Rainwater harvesting reduces the total runoff volume from the developed site and reduces treated water consumption.	<u>Partly Suitable:</u> The client is reviewing proposals for utilising grey water harvesting.
Infiltration Options	Reduces total run off volume from the development.	<u>Not Suitable:</u> Intrusive investigation would indicate that the underlying clay sub-strata would not be suitable for infiltration.
Permeable Surfacing (Infiltration)	- Reduces total run off volume from the development. - Can be used to enhance water quality.	<u>Partly Suitable:</u> - Existing tarmac car park to retained. - Existing grassed overspill car park to be re-surfaced in gravel.
Permeable Surfacing (Standard)	- Can be used to enhance quality of runoff water. - Sub-base provides 'source' storage and reduces the volume of storage downstream. - The storage can be created with selection of the stone fill or use of plastic box stems. - Impermeable membrane at base of construction to prevent impact on pavement stability.	<u>Partly Suitable:</u> - Existing tarmac car park to retained. - Existing grassed overspill car park to be re-surfaced in gravel.

Swales, basins and ponds	• Provide areas for above ground surface runoff storage. • Swales also allow filtering of particulate matter, improving water quality	<u>Not suitable:</u> • No available area for attenuation pond to be allocated.
Bio-Retention	• Collect and retain run-off to help improve water quality, prior to discharge in piped system on infiltration.	<u>Not suitable:</u> • Space constraints on site do not permit large above ground areas for flood storage. • No scope to reduce development area due to site viability.

Figure 7 Surface SuDS Methods

Method	Comment	Suitability for Development
Geocellular Storage	• Suitable for sites with insufficient space for basins etc. • Suitable for sites where topography prevents the use of open basins etc. • Can be very effective infiltration devices subject to ground conditions.	<u>Suitable:</u> • To be incorporated as part of the attenuation options beneath the new terracing to act as the means of retaining the peak storm events.
Large Diameter Pipes, Culverts or Tanks	• Suitable for sites with insufficient space for basins etc. • Provide a volume of below ground storage with a high void ratio and good man entry provision to allow for future maintenance and cleaning. • Generally, be suitable for adoption by the statutory water company (e.g. Severn Trent Water).	<u>Not suitable:</u> • More suited to adoptable drainage networks

Figure 8 Sub-Surface SuDS Methods

4.5.5 SuDS Hierarchal Approach

Based on the SuDS assessment in Figure 7 and 8, plus an assessment of the local site conditions, the SuDS hierarchal approach for discharge of surface water at the development site is considered in greater detail below:

Method	Suitability	Suitability for Development
Infiltration to Ground	No	The Phase 2 site investigation would indicate that the underlying ground would not be suitable for infiltration-based options.
Connection to Watercourse	No	No watercourse in close proximity
Connection to Surface Water Sewer	No	No surface water sewer in close proximity
Connection to a Combined Sewer	Yes	Reuse existing connection to the combined water sewer at restricted rates.

Figure 9 SuDS Hierarchal Approach

4.5.6 SuDS Design Philosophy

The SuDS philosophy for the development site is the promotion of Source Control and Site Control Techniques:

The following design philosophy is proposed:

- Surface water treatment using the 'Management Train' approach to remove and isolate contamination at all SuDS facilities prior to conveyance to the local watercourse.
- Source Control by the use of permeable surfacing to the overspill car park.
- Site Control features in the form of a below ground geocellular attenuation tank to accommodate the surface water runoff generated by the reduction in peak discharge rates from the restaurant building.
- Aim to limit where possible the impermeable fraction of development.

4.6 Outline Surface Water Drainage Strategy

- 4.6.1 The general principal of the surface water drainage strategy is to collect the runoff from the new extension to the restaurant building and direct the flows to a below ground surface water drainage network. The network will then pick up the new runoff from the external terracing and outflow via a flow restricting device rated at 5l/s to the existing combined water drainage. A new geocellular tank will retain the surcharge water during times of peak rainfall events. The existing car park area will remain unchanged. The new overspill car park will be constructed in permeable surfacing. In line with RMBC policy the flow restricting device will be restricted to 5l/s, considered the minimum orifice size to reduce the risk of blockage.
- 4.6.2 The proposed private drainage layout for the new development will be designed in accordance with BS EN 752: 2008 and Building Regulations part H guidance. Due to the ground falls at the site there is limited opportunity to retain any exceedance flooding and thus the attenuation will be designed to provide no flooding up to the 100-year plus climate change storm return period criterion.
- 4.4 A reduced flow rate of 5l/s for the new drainage has been applied to determine the outline attenuation volumes as defined in Figure 10 below based on this flow rates and an impermeable area of 0.054ha.

New Impermeable Area	New Peak Flow Rate	Attenuation Volume for 30-year Event	Attenuation Volume for 100 year + 20% CC Event
0.054 ha	5.0 l/s	4.1m ³	9.2m ³

Figure 10 Outline Attenuation Volumes

- 4.6.4 It is noted that these rates and volumes are preliminary for this outline assessment and are likely to alter at detailed design stage when more site-specific information is made available.
- 4.6.5 Drawing 2772-101 in Appendix C indicates the outline drainage strategy based on the Architects masterplan intent, with the outline hydraulic attenuation calculations in Appendix D.
- 4.6.6 Any future drainage calculations carried out as part of a site wide drainage strategy or for the development layouts themselves must include the appropriate increase in rainfall to satisfy the future Climate change allowances.

4.7 Pollution Control

- 4.7.1 Silt is to be prevented from entering the drainage system by the use of trapped gullies, channels with silt traps, catchpits and the use of Sustainable Drainage techniques.

4.8 Maintenance

4.8.1 The long-term maintenance of the new drainage and SuDS infrastructure will be with the owner / occupier of the restaurant in line with best practice guidance. Annual inspections will need to be carried out and clearing of gullies, channel drains, catchpits constructed.

Typically the maintenance regime will be in line with Figure 11 below.

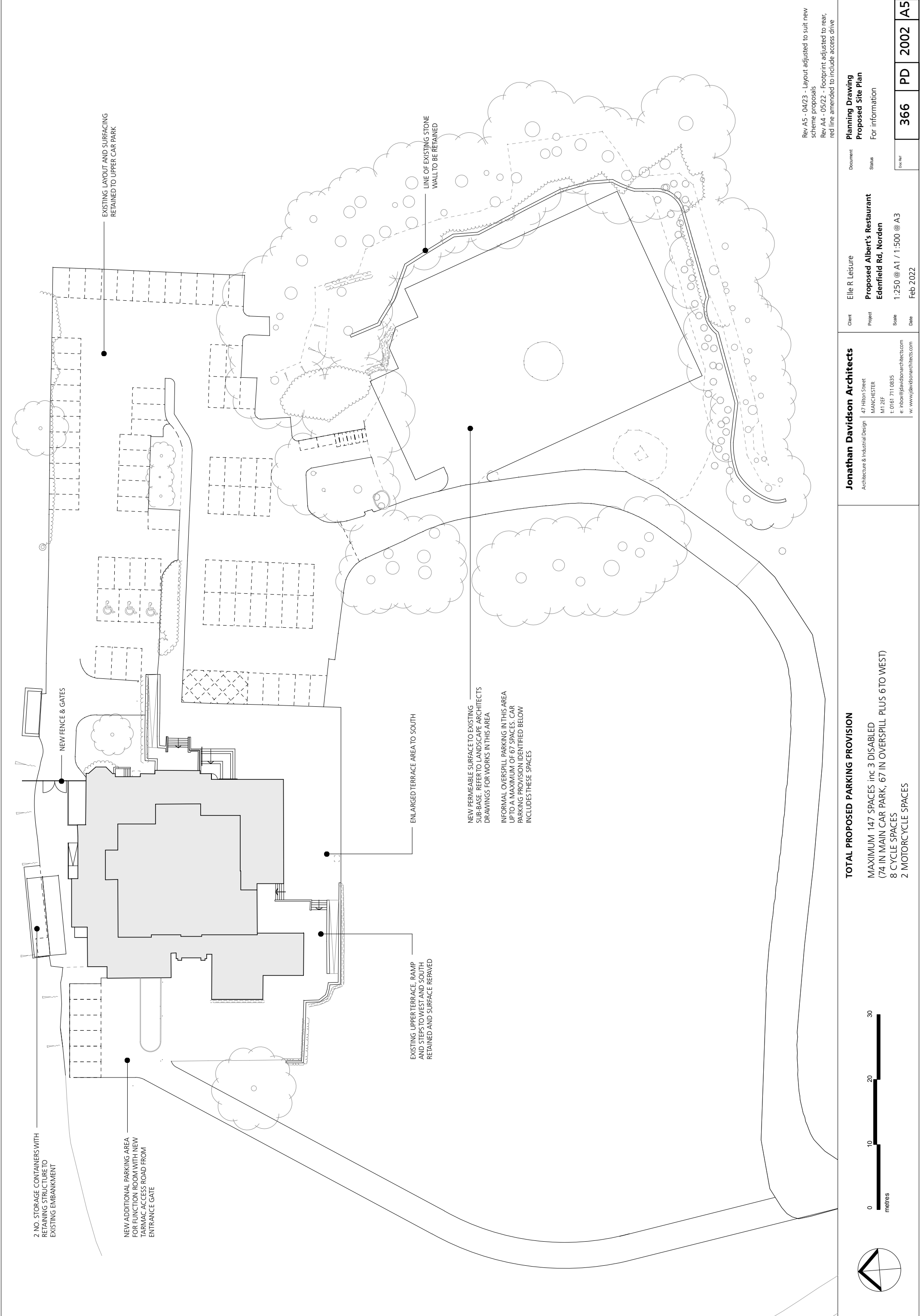
Future Maintenance of the Drainage System			
Responsibility	Feature	Maintenance	Frequency
Owner	Rainwater gutters, downpipes and above ground drainage.	Regular maintenance and inspections.	Ad-hoc sweeping and emptying of silt and debris required. Annual visual inspections to check for damage/leaks.
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

Figure 11 Outline Management and Maintenance Strategy

4.9 Foul Water Strategy

4.9.1 The outline foul water drainage strategy is to construct a new foul water drainage network around the restaurant building and outfall to the existing combined water drainage serving the current site and outfalling to the combined water sewer.

Appendix A – Architects Drawings



Appendix B – Topographical Survey

Project Title Albert's Restaurant, Norden, OL12 7TT - Drainage Strategy Report
Project No 2772
Date 28th April 2023



Appendix C – Brennan Consult Drawings

Appendix D – Hydraulic Calculations

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Summary of Results for 30 year Return Period Half Drain Time : 9 minutes. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Control (l/s)</th><th>Max Outflow (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>231.373</td><td>0.173</td><td>0.0</td><td>4.3</td><td>4.3</td><td>2.5</td><td>O K</td></tr><tr><td>30 min Summer</td><td>231.438</td><td>0.238</td><td>0.0</td><td>4.6</td><td>4.6</td><td>3.4</td><td>O K</td></tr><tr><td>60 min Summer</td><td>231.460</td><td>0.260</td><td>0.0</td><td>4.7</td><td>4.7</td><td>3.7</td><td>O K</td></tr><tr><td>120 min Summer</td><td>231.430</td><td>0.230</td><td>0.0</td><td>4.6</td><td>4.6</td><td>3.3</td><td>O K</td></tr><tr><td>180 min Summer</td><td>231.386</td><td>0.186</td><td>0.0</td><td>4.3</td><td>4.3</td><td>2.6</td><td>O K</td></tr><tr><td>240 min Summer</td><td>231.351</td><td>0.151</td><td>0.0</td><td>4.1</td><td>4.1</td><td>2.1</td><td>O K</td></tr><tr><td>360 min Summer</td><td>231.314</td><td>0.114</td><td>0.0</td><td>3.6</td><td>3.6</td><td>1.6</td><td>O K</td></tr><tr><td>480 min Summer</td><td>231.297</td><td>0.097</td><td>0.0</td><td>3.1</td><td>3.1</td><td>1.4</td><td>O K</td></tr><tr><td>600 min Summer</td><td>231.287</td><td>0.087</td><td>0.0</td><td>2.8</td><td>2.8</td><td>1.2</td><td>O K</td></tr><tr><td>720 min Summer</td><td>231.279</td><td>0.079</td><td>0.0</td><td>2.5</td><td>2.5</td><td>1.1</td><td>O K</td></tr><tr><td>960 min Summer</td><td>231.270</td><td>0.070</td><td>0.0</td><td>2.1</td><td>2.1</td><td>1.0</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>231.259</td><td>0.059</td><td>0.0</td><td>1.6</td><td>1.6</td><td>0.8</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>231.250</td><td>0.050</td><td>0.0</td><td>1.2</td><td>1.2</td><td>0.7</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>231.245</td><td>0.045</td><td>0.0</td><td>1.0</td><td>1.0</td><td>0.6</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>231.238</td><td>0.038</td><td>0.0</td><td>0.7</td><td>0.7</td><td>0.5</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>231.234</td><td>0.034</td><td>0.0</td><td>0.6</td><td>0.6</td><td>0.5</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>231.232</td><td>0.032</td><td>0.0</td><td>0.5</td><td>0.5</td><td>0.5</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>231.230</td><td>0.030</td><td>0.0</td><td>0.5</td><td>0.5</td><td>0.4</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>231.228</td><td>0.028</td><td>0.0</td><td>0.4</td><td>0.4</td><td>0.4</td><td>O K</td></tr><tr><td>15 min Winter</td><td>231.404</td><td>0.204</td><td>0.0</td><td>4.5</td><td>4.5</td><td>2.9</td><td>O K</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>61.929</td><td>0.0</td><td>6.3</td><td>22</td></tr><tr><td>30 min Summer</td><td>43.389</td><td>0.0</td><td>8.8</td><td>31</td></tr><tr><td>60 min Summer</td><td>29.238</td><td>0.0</td><td>11.8</td><td>46</td></tr><tr><td>120 min Summer</td><td>19.092</td><td>0.0</td><td>15.5</td><td>78</td></tr><tr><td>180 min Summer</td><td>14.653</td><td>0.0</td><td>17.8</td><td>108</td></tr><tr><td>240 min Summer</td><td>12.099</td><td>0.0</td><td>19.6</td><td>136</td></tr><tr><td>360 min Summer</td><td>9.227</td><td>0.0</td><td>22.4</td><td>194</td></tr><tr><td>480 min Summer</td><td>7.599</td><td>0.0</td><td>24.6</td><td>254</td></tr><tr><td>600 min Summer</td><td>6.531</td><td>0.0</td><td>26.4</td><td>312</td></tr><tr><td>720 min Summer</td><td>5.768</td><td>0.0</td><td>28.0</td><td>374</td></tr><tr><td>960 min Summer</td><td>4.736</td><td>0.0</td><td>30.7</td><td>492</td></tr><tr><td>1440 min Summer</td><td>3.580</td><td>0.0</td><td>34.8</td><td>736</td></tr><tr><td>2160 min Summer</td><td>2.699</td><td>0.0</td><td>39.3</td><td>1092</td></tr><tr><td>2880 min Summer</td><td>2.209</td><td>0.0</td><td>42.9</td><td>1456</td></tr><tr><td>4320 min Summer</td><td>1.667</td><td>0.0</td><td>48.6</td><td>2204</td></tr><tr><td>5760 min Summer</td><td>1.366</td><td>0.0</td><td>53.1</td><td>2936</td></tr><tr><td>7200 min Summer</td><td>1.171</td><td>0.0</td><td>56.9</td><td>3640</td></tr><tr><td>8640 min Summer</td><td>1.033</td><td>0.0</td><td>60.3</td><td>4352</td></tr><tr><td>10080 min Summer</td><td>0.931</td><td>0.0</td><td>63.3</td><td>4992</td></tr><tr><td>15 min Winter</td><td>61.929</td><td>0.0</td><td>7.0</td><td>22</td></tr></table>				Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status	15 min Summer	231.373	0.173	0.0	4.3	4.3	2.5	O K	30 min Summer	231.438	0.238	0.0	4.6	4.6	3.4	O K	60 min Summer	231.460	0.260	0.0	4.7	4.7	3.7	O K	120 min Summer	231.430	0.230	0.0	4.6	4.6	3.3	O K	180 min Summer	231.386	0.186	0.0	4.3	4.3	2.6	O K	240 min Summer	231.351	0.151	0.0	4.1	4.1	2.1	O K	360 min Summer	231.314	0.114	0.0	3.6	3.6	1.6	O K	480 min Summer	231.297	0.097	0.0	3.1	3.1	1.4	O K	600 min Summer	231.287	0.087	0.0	2.8	2.8	1.2	O K	720 min Summer	231.279	0.079	0.0	2.5	2.5	1.1	O K	960 min Summer	231.270	0.070	0.0	2.1	2.1	1.0	O K	1440 min Summer	231.259	0.059	0.0	1.6	1.6	0.8	O K	2160 min Summer	231.250	0.050	0.0	1.2	1.2	0.7	O K	2880 min Summer	231.245	0.045	0.0	1.0	1.0	0.6	O K	4320 min Summer	231.238	0.038	0.0	0.7	0.7	0.5	O K	5760 min Summer	231.234	0.034	0.0	0.6	0.6	0.5	O K	7200 min Summer	231.232	0.032	0.0	0.5	0.5	0.5	O K	8640 min Summer	231.230	0.030	0.0	0.5	0.5	0.4	O K	10080 min Summer	231.228	0.028	0.0	0.4	0.4	0.4	O K	15 min Winter	231.404	0.204	0.0	4.5	4.5	2.9	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	61.929	0.0	6.3	22	30 min Summer	43.389	0.0	8.8	31	60 min Summer	29.238	0.0	11.8	46	120 min Summer	19.092	0.0	15.5	78	180 min Summer	14.653	0.0	17.8	108	240 min Summer	12.099	0.0	19.6	136	360 min Summer	9.227	0.0	22.4	194	480 min Summer	7.599	0.0	24.6	254	600 min Summer	6.531	0.0	26.4	312	720 min Summer	5.768	0.0	28.0	374	960 min Summer	4.736	0.0	30.7	492	1440 min Summer	3.580	0.0	34.8	736	2160 min Summer	2.699	0.0	39.3	1092	2880 min Summer	2.209	0.0	42.9	1456	4320 min Summer	1.667	0.0	48.6	2204	5760 min Summer	1.366	0.0	53.1	2936	7200 min Summer	1.171	0.0	56.9	3640	8640 min Summer	1.033	0.0	60.3	4352	10080 min Summer	0.931	0.0	63.3	4992	15 min Winter	61.929	0.0	7.0	22
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																																																																													
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600 min Summer	231.287	0.087	0.0	2.8	2.8	1.2	O K																																																																																																																																																																																																																																																																													
720 min Summer	231.279	0.079	0.0	2.5	2.5	1.1	O K																																																																																																																																																																																																																																																																													
960 min Summer	231.270	0.070	0.0	2.1	2.1	1.0	O K																																																																																																																																																																																																																																																																													
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Oak House, 2 Gatley Road Cheadle Stockport, SK8 1PY	Albert's Norden 30yr Attenuation V2 28.04.223	
Date 28/04/2023 File Alberts Norden - 30yr B...	Designed by paulg Checked by	
Innovyze	Source Control 2017.1.2	

Summary of Results for 30 year Return Period							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	231.479	0.279	0.0	4.7	4.7	4.0	O K
60 min Winter	231.485	0.285	0.0	4.7	4.7	4.1	O K
120 min Winter	231.410	0.210	0.0	4.5	4.5	3.0	O K
180 min Winter	231.347	0.147	0.0	4.1	4.1	2.1	O K
240 min Winter	231.315	0.115	0.0	3.7	3.7	1.6	O K
360 min Winter	231.290	0.090	0.0	2.9	2.9	1.3	O K
480 min Winter	231.278	0.078	0.0	2.4	2.4	1.1	O K
600 min Winter	231.270	0.070	0.0	2.1	2.1	1.0	O K
720 min Winter	231.265	0.065	0.0	1.8	1.8	0.9	O K
960 min Winter	231.258	0.058	0.0	1.5	1.5	0.8	O K
1440 min Winter	231.249	0.049	0.0	1.1	1.1	0.7	O K
2160 min Winter	231.242	0.042	0.0	0.9	0.9	0.6	O K
2880 min Winter	231.237	0.037	0.0	0.7	0.7	0.5	O K
4320 min Winter	231.232	0.032	0.0	0.5	0.5	0.5	O K
5760 min Winter	231.229	0.029	0.0	0.4	0.4	0.4	O K
7200 min Winter	231.227	0.027	0.0	0.4	0.4	0.4	O K
8640 min Winter	231.225	0.025	0.0	0.3	0.3	0.4	O K
10080 min Winter	231.224	0.024	0.0	0.3	0.3	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	43.389	0.0	9.8	32
60 min Winter	29.238	0.0	13.3	48
120 min Winter	19.092	0.0	17.3	80
180 min Winter	14.653	0.0	19.9	108
240 min Winter	12.099	0.0	21.9	136
360 min Winter	9.227	0.0	25.1	194
480 min Winter	7.599	0.0	27.6	252
600 min Winter	6.531	0.0	29.6	312
720 min Winter	5.768	0.0	31.4	374
960 min Winter	4.736	0.0	34.4	494
1440 min Winter	3.580	0.0	39.0	740
2160 min Winter	2.699	0.0	44.1	1084
2880 min Winter	2.209	0.0	48.1	1472
4320 min Winter	1.667	0.0	54.4	2180
5760 min Winter	1.366	0.0	59.5	2904
7200 min Winter	1.171	0.0	63.7	3592
8640 min Winter	1.033	0.0	67.5	4384
10080 min Winter	0.931	0.0	70.9	5088

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Date 28/04/2023 File Alberts Norden - 30yr B...	Designed by paulg Checked by	
Innovyze	Source Control 2017.1.2	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.256	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.054

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To: (ha)		From: To: (ha)		From: To: (ha)	
0 4 0.010		8 12 0.010		16 20 0.004	
4 8 0.020		12 16 0.010			

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Oak House, 2 Gatley Road Cheadle Stockport, SK8 1PY	Albert's Norden 30yr Attenuation V2 28.04.223	
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Innovyze	Source Control 2017.1.2	

Model Details

Storage is Online Cover Level (m) 233.000

Cellular Storage Structure

Invert Level (m) 231.200 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	15.0	15.0	5.200	0.0	27.4
0.400	15.0	21.2	5.600	0.0	27.4
0.800	15.0	27.4	6.000	0.0	27.4
0.801	0.0	27.4	6.400	0.0	27.4
1.201	0.0	27.4	6.800	0.0	27.4
2.000	0.0	27.4	7.200	0.0	27.4
2.400	0.0	27.4	7.600	0.0	27.4
2.800	0.0	27.4	8.000	0.0	27.4
3.200	0.0	27.4	8.400	0.0	27.4
3.600	0.0	27.4	8.800	0.0	27.4
4.000	0.0	27.4	9.200	0.0	27.4
4.400	0.0	27.4	9.600	0.0	27.4
4.800	0.0	27.4	10.000	0.0	27.4

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0098-5000-1500-5000
Design Head (m) 1.500
Design Flow (l/s) 5.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 98
Invert Level (m) 231.200
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	5.0
Flush-Flo™	0.431	4.9
Kick-Flo®	0.878	3.9
Mean Flow over Head Range	-	4.3

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

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Oak House, 2 Gatley Road Cheadle Stockport, SK8 1PY	Albert's Norden 30yr Attenuation V2 28.04.223	
Date 28/04/2023 File Alberts Norden - 30yr B...	Designed by paulg Checked by	
Innovyze	Source Control 2017.1.2	

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.2	1.200	4.5	3.000	6.9	7.000	10.3
0.200	4.4	1.400	4.8	3.500	7.4	7.500	10.7
0.300	4.8	1.600	5.1	4.000	7.9	8.000	11.0
0.400	4.9	1.800	5.4	4.500	8.4	8.500	11.3
0.500	4.9	2.000	5.7	5.000	8.8	9.000	11.6
0.600	4.8	2.200	6.0	5.500	9.2	9.500	11.9
0.800	4.3	2.400	6.2	6.000	9.6		
1.000	4.1	2.600	6.5	6.500	10.0		

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Oak House, 2 Gatley Road Cheadle Stockport, SK8 1PY	Albert's Norden 100yr + 20% CC Attenuation V2 28.04.223	
Date 28/04/2023 File Alberts Norden - 100yr ...	Designed by paulg Checked by	
Innovyze	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+20%)								
Half Drain Time : 19 minutes.								
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (1/s)	Max Control (1/s)	Max Σ Outflow (1/s)	Max Volume (m³)	Status	
15 min Summer	231.536	0.336	0.0	4.8	4.8	4.8	O	K
30 min Summer	231.688	0.488	0.0	4.9	4.9	7.0	O	K
60 min Summer	231.760	0.560	0.0	4.9	4.9	8.0	O	K
120 min Summer	231.729	0.529	0.0	4.9	4.9	7.5	O	K
180 min Summer	231.647	0.447	0.0	4.9	4.9	6.4	O	K
240 min Summer	231.567	0.367	0.0	4.9	4.9	5.2	O	K
360 min Summer	231.450	0.250	0.0	4.6	4.6	3.6	O	K
480 min Summer	231.379	0.179	0.0	4.3	4.3	2.6	O	K
600 min Summer	231.337	0.137	0.0	4.0	4.0	2.0	O	K
720 min Summer	231.316	0.116	0.0	3.7	3.7	1.7	O	K
960 min Summer	231.296	0.096	0.0	3.1	3.1	1.4	O	K
1440 min Summer	231.276	0.076	0.0	2.3	2.3	1.1	O	K
2160 min Summer	231.263	0.063	0.0	1.8	1.8	0.9	O	K
2880 min Summer	231.255	0.055	0.0	1.4	1.4	0.8	O	K
4320 min Summer	231.247	0.047	0.0	1.1	1.1	0.7	O	K
5760 min Summer	231.242	0.042	0.0	0.9	0.9	0.6	O	K
7200 min Summer	231.238	0.038	0.0	0.7	0.7	0.5	O	K
8640 min Summer	231.236	0.036	0.0	0.7	0.7	0.5	O	K
10080 min Summer	231.234	0.034	0.0	0.6	0.6	0.5	O	K
15 min Winter	231.597	0.397	0.0	4.9	4.9	5.7	O	K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	95.745	0.0	9.7	24
30 min Summer	67.879	0.0	13.7	34
60 min Summer	46.096	0.0	18.7	50
120 min Summer	30.088	0.0	24.4	82
180 min Summer	22.937	0.0	27.9	114
240 min Summer	18.822	0.0	30.5	144
360 min Summer	14.230	0.0	34.6	202
480 min Summer	11.641	0.0	37.7	260
600 min Summer	9.949	0.0	40.3	318
720 min Summer	8.743	0.0	42.5	374
960 min Summer	7.120	0.0	46.1	494
1440 min Summer	5.314	0.0	51.6	736
2160 min Summer	3.952	0.0	57.6	1092
2880 min Summer	3.202	0.0	62.2	1468
4320 min Summer	2.384	0.0	69.5	2156
5760 min Summer	1.936	0.0	75.3	2936
7200 min Summer	1.649	0.0	80.1	3616
8640 min Summer	1.449	0.0	84.5	4312
10080 min Summer	1.299	0.0	88.4	5032
15 min Winter	95.745	0.0	10.9	24

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Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	231.774	0.574	0.0	4.9	4.9	8.2	O K
60 min Winter	231.843	0.643	0.0	4.9	4.9	9.2	O K
120 min Winter	231.750	0.550	0.0	4.9	4.9	7.8	O K
180 min Winter	231.605	0.405	0.0	4.9	4.9	5.8	O K
240 min Winter	231.490	0.290	0.0	4.7	4.7	4.1	O K
360 min Winter	231.362	0.162	0.0	4.2	4.2	2.3	O K
480 min Winter	231.315	0.115	0.0	3.6	3.6	1.6	O K
600 min Winter	231.298	0.098	0.0	3.1	3.1	1.4	O K
720 min Winter	231.287	0.087	0.0	2.8	2.8	1.2	O K
960 min Winter	231.275	0.075	0.0	2.3	2.3	1.1	O K
1440 min Winter	231.262	0.062	0.0	1.7	1.7	0.9	O K
2160 min Winter	231.252	0.052	0.0	1.3	1.3	0.7	O K
2880 min Winter	231.246	0.046	0.0	1.0	1.0	0.7	O K
4320 min Winter	231.239	0.039	0.0	0.8	0.8	0.6	O K
5760 min Winter	231.235	0.035	0.0	0.6	0.6	0.5	O K
7200 min Winter	231.232	0.032	0.0	0.5	0.5	0.5	O K
8640 min Winter	231.230	0.030	0.0	0.5	0.5	0.4	O K
10080 min Winter	231.228	0.028	0.0	0.4	0.4	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	67.879	0.0	15.4	34
60 min Winter	46.096	0.0	20.9	54
120 min Winter	30.088	0.0	27.3	88
180 min Winter	22.937	0.0	31.2	118
240 min Winter	18.822	0.0	34.1	148
360 min Winter	14.230	0.0	38.7	204
480 min Winter	11.641	0.0	42.2	256
600 min Winter	9.949	0.0	45.1	316
720 min Winter	8.743	0.0	47.6	372
960 min Winter	7.120	0.0	51.7	488
1440 min Winter	5.314	0.0	57.8	736
2160 min Winter	3.952	0.0	64.5	1120
2880 min Winter	3.202	0.0	69.7	1468
4320 min Winter	2.384	0.0	77.9	2204
5760 min Winter	1.936	0.0	84.3	2840
7200 min Winter	1.649	0.0	89.8	3672
8640 min Winter	1.449	0.0	94.6	4368
10080 min Winter	1.299	0.0	99.0	5144

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.256	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.054

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To: (ha)		From: To: (ha)		From: To: (ha)	
0 4 0.010		8 12 0.010		16 20 0.004	
4 8 0.020		12 16 0.010			

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Model Details

Storage is Online Cover Level (m) 233.000

Cellular Storage Structure

Invert Level (m) 231.200 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	15.0	15.0	5.200	0.0	27.4
0.400	15.0	21.2	5.600	0.0	27.4
0.800	15.0	27.4	6.000	0.0	27.4
0.801	0.0	27.4	6.400	0.0	27.4
1.201	0.0	27.4	6.800	0.0	27.4
2.000	0.0	27.4	7.200	0.0	27.4
2.400	0.0	27.4	7.600	0.0	27.4
2.800	0.0	27.4	8.000	0.0	27.4
3.200	0.0	27.4	8.400	0.0	27.4
3.600	0.0	27.4	8.800	0.0	27.4
4.000	0.0	27.4	9.200	0.0	27.4
4.400	0.0	27.4	9.600	0.0	27.4
4.800	0.0	27.4	10.000	0.0	27.4

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0098-5000-1500-5000
Design Head (m) 1.500
Design Flow (l/s) 5.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 98
Invert Level (m) 231.200
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	5.0
Flush-Flo™	0.431	4.9
Kick-Flo®	0.878	3.9
Mean Flow over Head Range	-	4.3

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

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<u>Hydro-Brake® Optimum Outflow Control</u>							
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.2	1.200	4.5	3.000	6.9	7.000	10.3
0.200	4.4	1.400	4.8	3.500	7.4	7.500	10.7
0.300	4.8	1.600	5.1	4.000	7.9	8.000	11.0
0.400	4.9	1.800	5.4	4.500	8.4	8.500	11.3
0.500	4.9	2.000	5.7	5.000	8.8	9.000	11.6
0.600	4.8	2.200	6.0	5.500	9.2	9.500	11.9
0.800	4.3	2.400	6.2	6.000	9.6		
1.000	4.1	2.600	6.5	6.500	10.0		

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