considine
civil + structural engineers

HAVEN HOLIDAY PARKS

ALLHALLOWS

ROCHESTER

KENT, ME3 9QD

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

FOR

HAVEN LEISURE LTD

3rd August 2023

Report No.: 5720 FRADS

P02

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Original Author: Jack Moss MEng (Hons) CEng MICE MCIWEM

Original Checker: Mike Frazer MEng (Hons) GMICE

Original Approver: Jack Moss MEng (Hons) CEng MICE MCIWEM

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Considine Limited
25 Hollingworth Court
Turkey Mill, Ashford Road
Maidstone
Kent ME14 5PP

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1. Introduction and Brief

This report has been prepared for Haven Leisure Ltd to assess flood risk and to provide guidance on the method of surface water disposal for the proposed residential development at Haven Holiday Parks, Allhallows, Rochester, ME3 9QD. The proposal is to construct a link building between the existing arcade building and existing show & bar building.

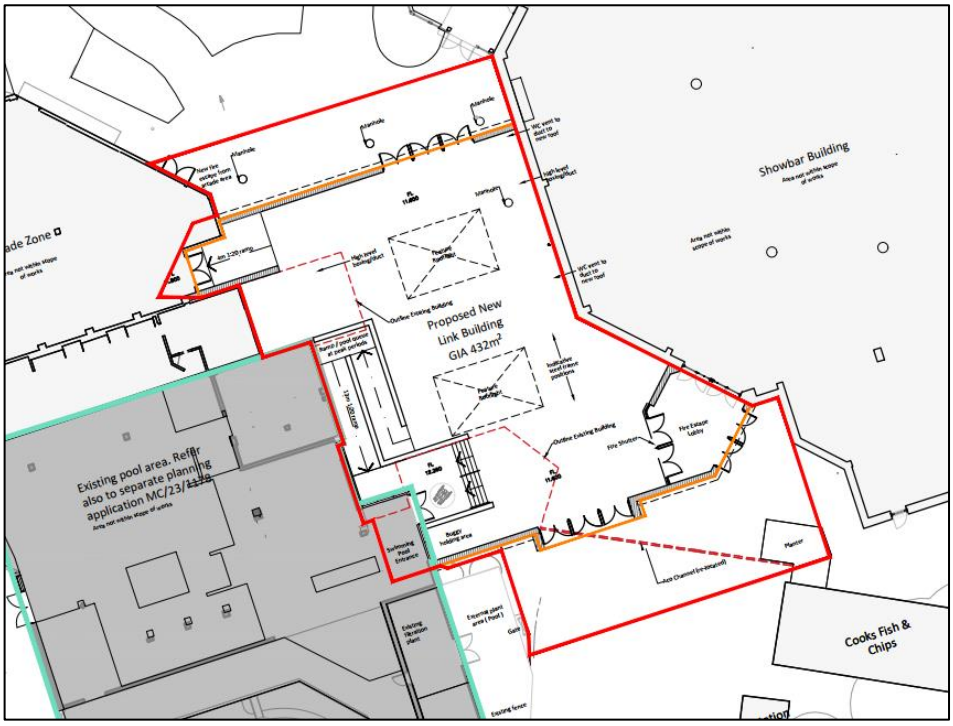


Figure 1.1 – Development Proposals – full drawings within Appendix 1

This document has been produced in accordance with current best practice and recommendations and guidance set out in the National Planning Policy Framework (NPPF).

Considine has no responsibility to any other parties to whom this report may be circulated, in part or in full, and any such parties rely on the contents of this report solely at their own risk.

2. Existing Site Conditions

2.1 Location

The development site is located at Haven Holiday Parks, Allhallows, Rochester, ME3 9QD. The British National Grid Reference is: E: 583818, N: 178686. The figures below show the site in the wider area, more locally and then an aerial image to show the site in its current context.

Figure 2.1 – Site location general area. Location shown by red circle. © Google Maps

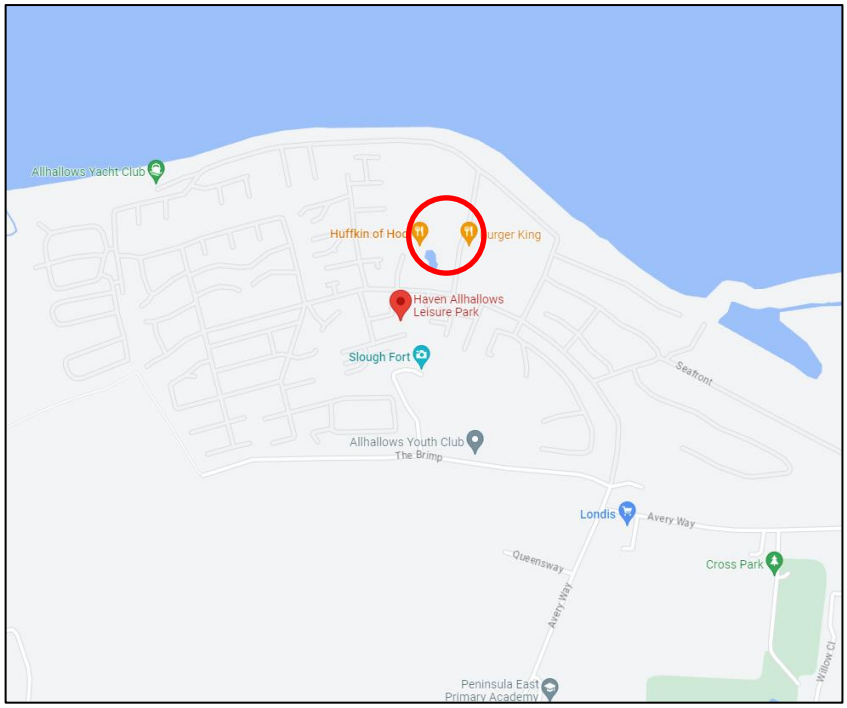


Figure 2.2 – Site location more locally. Location shown by red circle. © Google Maps

The following aerial image provides additional information about the context of the site and surrounding areas.

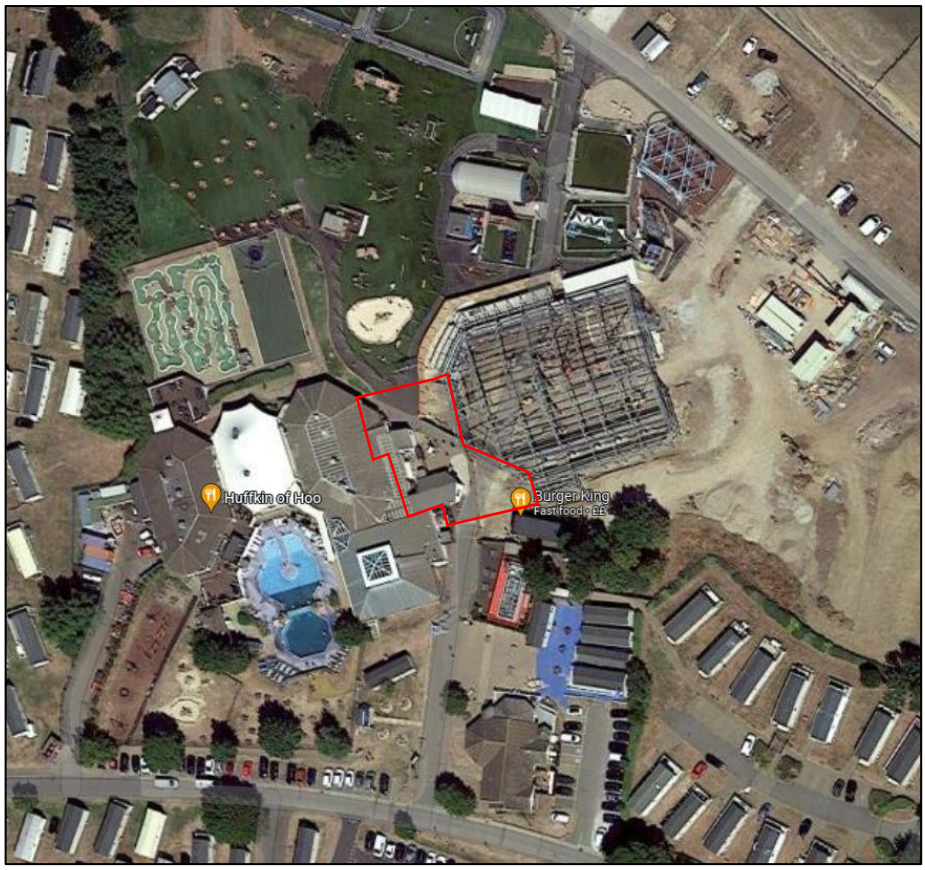


Figure 2.3 – Aerial image of site © Google Maps. Approximate site boundary shown in red.

The site is an existing leisure park comprising holiday accommodation and various amenity provisions, including swimming facilities, eateries, and entertainment spaces. The application site is immediately surrounded by a show and bar facility to the east, arcade and swimming facilities to the west, fast food provisions to the south and various entertainment spaces to the north. All of these are served by a network of roads and hardstandings. The wider site is bounded by the River Thames to the north, the village of Allhallows to the south, marshland to the east, and agricultural fields to the west.

The existing development impermeable areas are summarised as follows:

	Area (m^2)
Total Site Area:	694
Existing Roof Area:	114
Existing Impermeable Hardstandings:	514
Total Existing Impermeable Area:	628

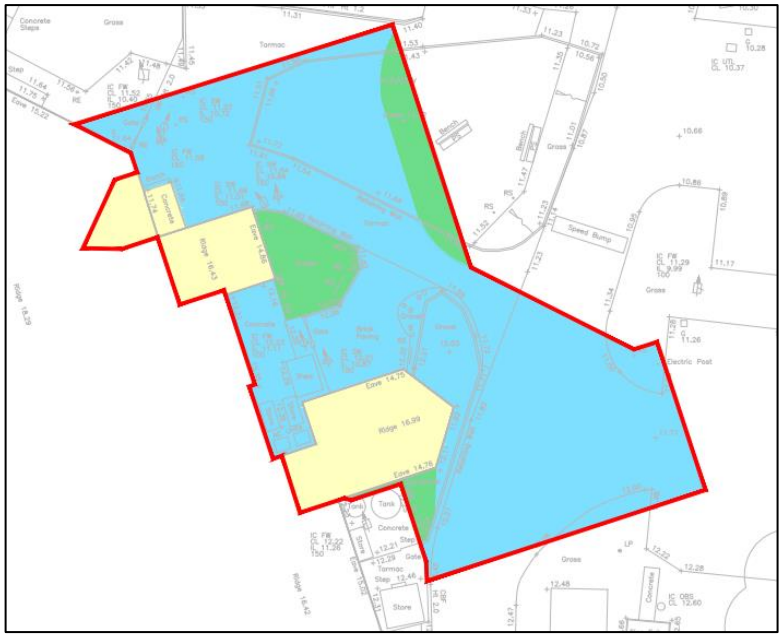


Figure 2.4 – Drained Areas Analysis Extract (Pre-Development)

2.2 Site Topography

A review of the topographical survey indicates that the site generally falls from the west to the east. Overall, there is a fall of approximately 0.8m.

2.3 Site Geology

A review of the BGS online bedrock mapping tool has identified that the development site is likely underlain by the London Clay formation (Clay & Silt). This is sedimentary bedrock.

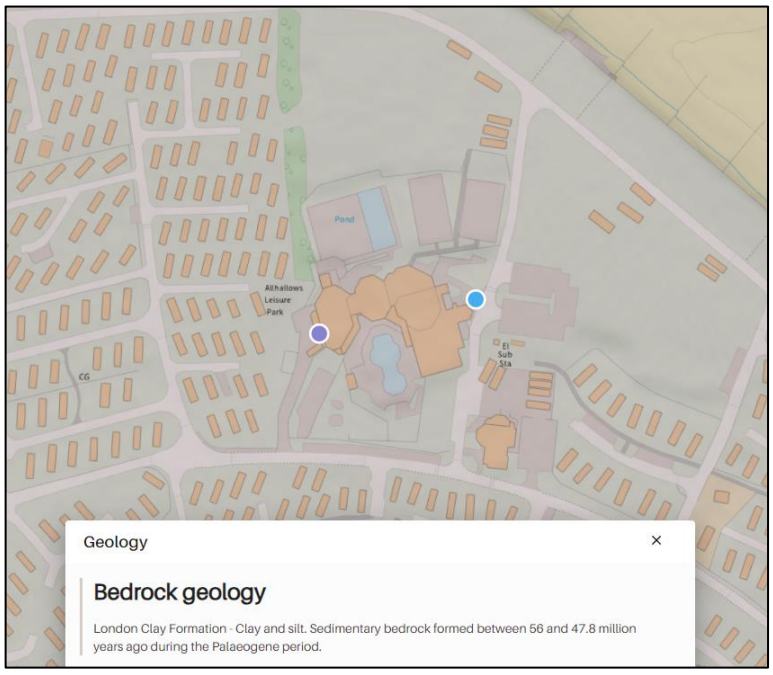


Figure 2.5 – BGS Extracts: Bedrock Geology © BGS

A review of the BGS online superficial deposits mapping tool has identified that the development site is not known to be underlain by superficial deposits.

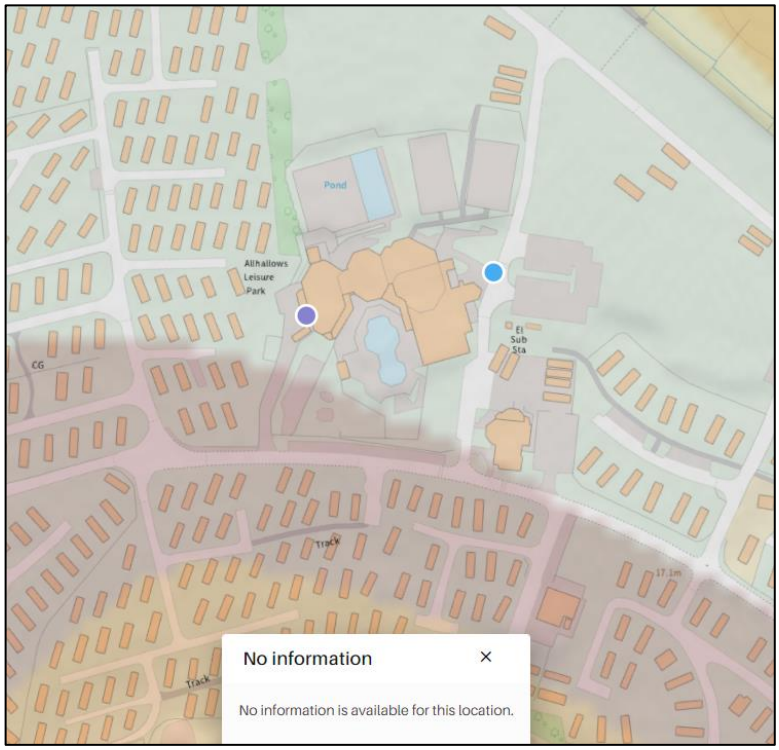


Figure 2.6 – BGS Extracts: Superficial Geology © BGS

A site investigation carried out by Ground Engineering Limited, in 2019, within the immediate area confirms that the site is underlain by the London Clay formation with areas of made ground.

2.4 Hydrogeology and Hydrology

The Environment Agency provide information about the groundwater and aquifers. Review of that information confirms that the site is not within a Ground Water Source Protection Zone. It is also not located over an Aquifer in terms of the Bedrock and it is also not located within a Groundwater Vulnerability Zone. The following EA Extracts identify the zoning for the site.

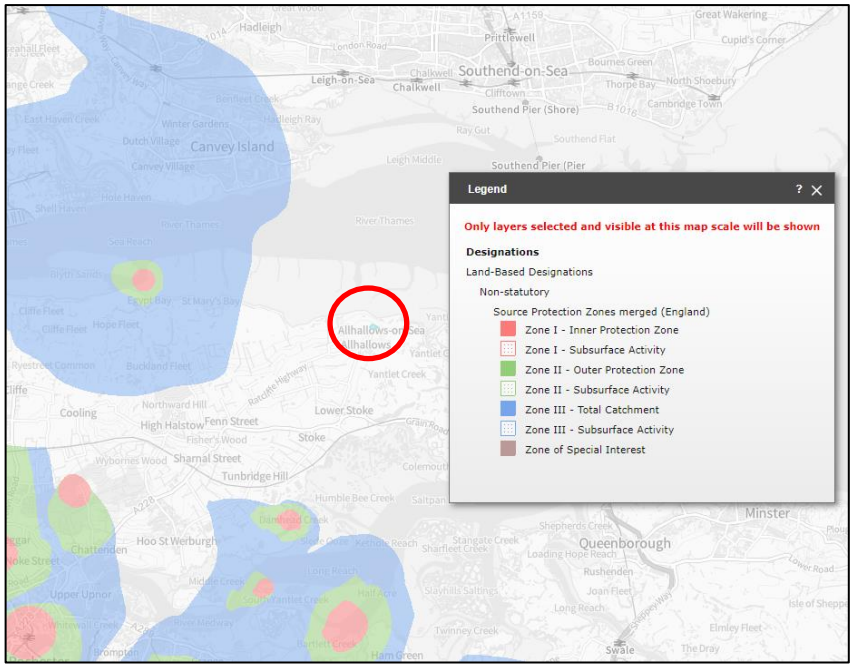


Figure 2.7 – Groundwater Source Protection Zone © Environment Agency

As defined within the figure above, the site is not within a groundwater source protection zone.

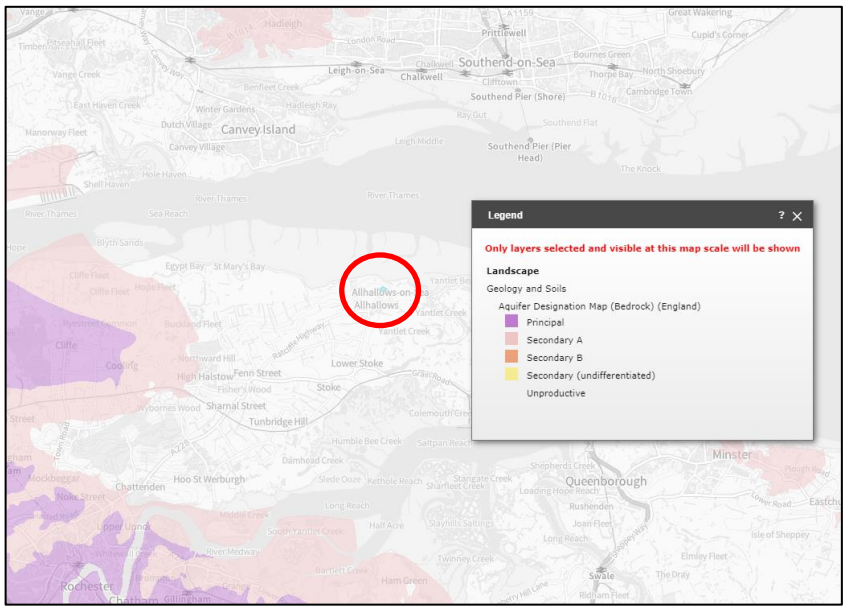


Figure 2.8 – Aquifer Designations Map (Bedrock) © Environment Agency

As noted within the figure above, the site is not above an aquifer (unproductive). This area has rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

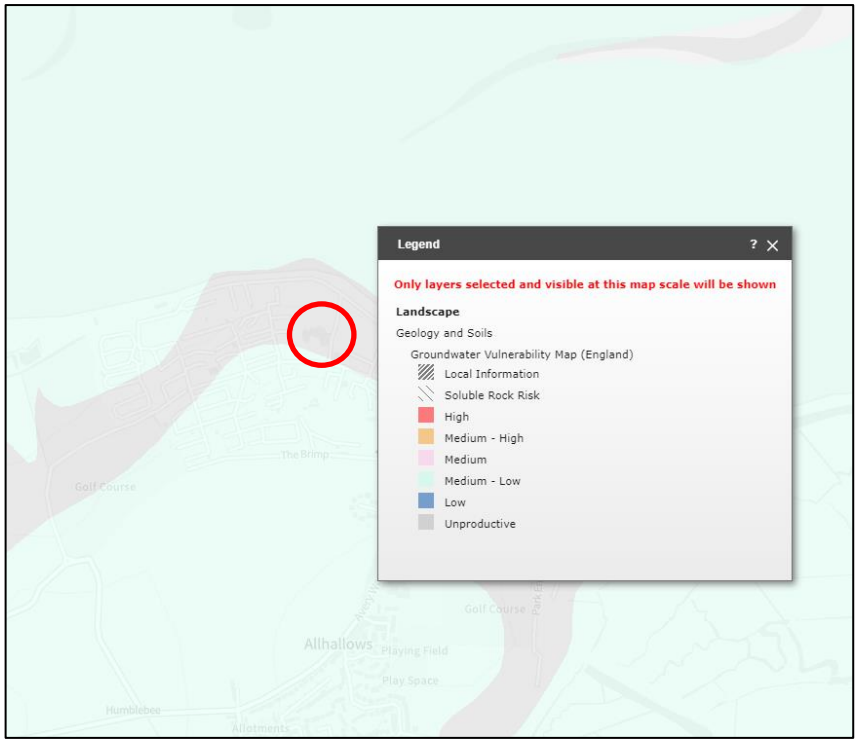


Figure 2.9 – Groundwater Vulnerability Zone Map © Environment Agency

As noted within the above figure, the site is within the unproductive groundwater vulnerability zone. The medium-low groundwater vulnerability zone is within the vicinity though, and this zone is defined as offering some groundwater protection.

It is important though to understand that pollution risks are an issue for the underlying geology. As such the risk of Pollution can be assessed using the Source, Pathway, Receptor model as follows.

Source – there are two sources of potential contamination on the site. Firstly, contamination as a result of current and previous site activities and secondly from the proposed site activities. The existing site area serves as amenity space for leisure park users, presenting a low risk. Although a link building is to be constructed, the site use will remain unchanged. Therefore, the risk shall remain low.

Pathway – the pathway is the vertical movement of water through the subsoils and the bedrock. This can be by direct surface down soakage or from drainage features such as soakaways or other infiltration systems. The infiltration potential at ground level is low at the site, and therefore the opportunities for ingress of contaminants is also low.

Receptor – the receptor is the actual uses of groundwater that receives flow from the vicinity of the discharge, such as groundwater, watercourses etc. Investigations carried out for a development within the immediate vicinity of this development concluded that groundwater was observed at 3.2m below ground level. Should infiltration techniques be proposed, a suitable unsaturated zone should be applied. At the time of writing, the risk is considered medium.

Water Quality and Surface Water runoff is addressed later in this report.

3. Proposed Development

The proposal is to construct a link building between the existing arcade building and existing show & bar building. The figure below shows the Architect's current proposals.

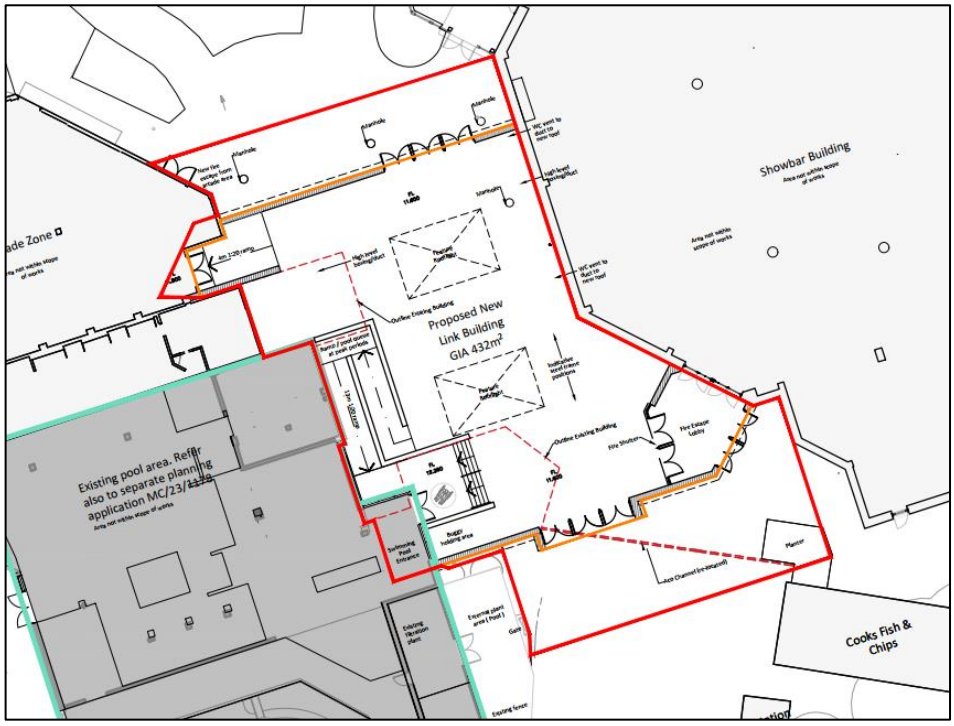


Figure 3.1 – Development Proposals – full drawings within Appendix 1

The proposed development impermeable areas are shown in the figure below and are summarised as follows:

	Area (m^2)
Total Site Area:	694
Proposed Roof Area:	487
Proposed Permeable Hardstandings:	0
Proposed Impermeable Hardstandings:	207
Total Proposed Impermeable Area:	694

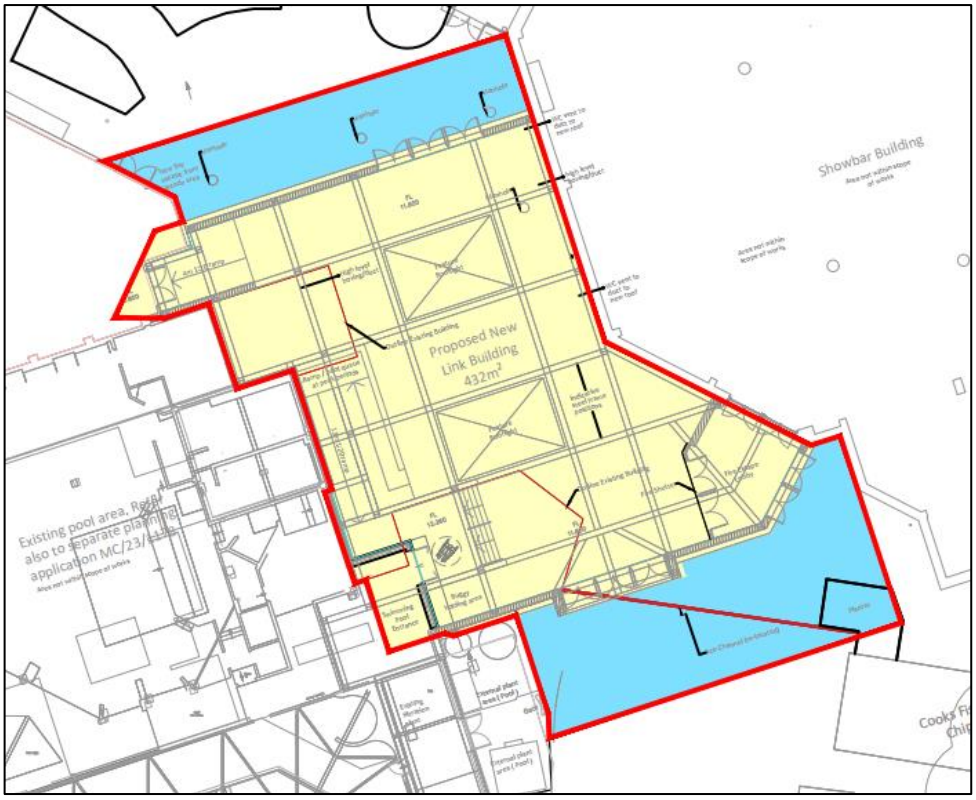


Figure 3.2 – Drained Areas Analysis Extract (Post-Development)

It is evident that the proposals increase the impermeable areas by 66m^2.

In accordance with national guidance, an allowance for urban creep is not required for commercial spaces. Therefore, an impermeable area of 694m^2 needs to be considered for positive surface water design.

4. Flood Risk

This Flood Risk Assessment (FRA) is based on the guidance provided within section 10 of the NPPF and accompanying Planning Practice Guidance (PPG).

4.1 Criteria

As according to the PPG, a site typically requires a specific detailed FRA where the total site area is greater than 1ha or the site is found to be at risk of flooding.

The site is less than 1ha and, therefore, the requirement for an FRA is subject to the site being within Flood Zone 2 or Flood Zone 3.

4.2 Flood Risk Zones

The PPG defines a number of flood zones based on the probability of flooding, and provides guidance on the most appropriate form of development within each zone. The flood risk is summarised below:

Table 4.1 – Flood Zone Definitions

Flood Zone	Definition
Zone 1 – Low Probability	Land having a less than 1 in 1000 annual probability of river or sea flooding.
Zone 2 – Medium Probability	Land having between 1 in 100 and 1 in 1000 annual probability of river flooding, or land having between 1 in 200 and 1 in 1000 annual probability of sea flooding.
Zone 3a – High Probability	Land having a 1 in 100 or greater annual probability of river flooding, or Land having a 1 in 200 or greater annual probability of sea flooding.
Zone 3b – The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessment (SFRA) areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

The vulnerability of flooding at the site has been explored further on the following pages.

4.3 Tidal and Fluvial Flooding

A review of the Environment Agency's online mapping tool has identified that the development site is within Flood Zone 1, an area with a low probability of flooding from Rivers and Sea.

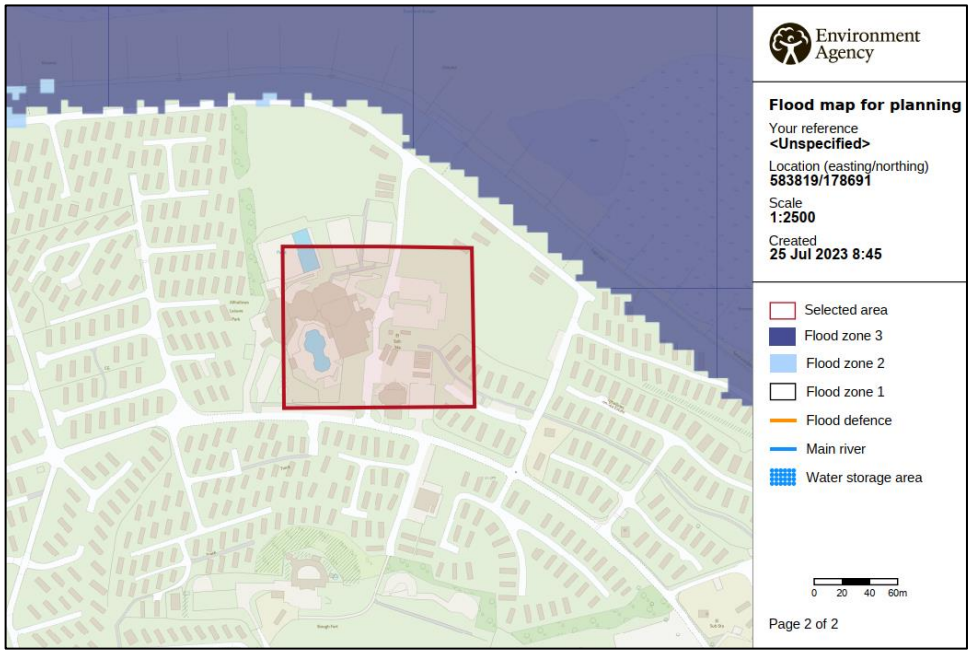


Figure 4.2 – Extract of Environment Agency's Flood Map for Planning

Flood Zone 1 comprises land assessed as having a <0.1% (1 in 1000) AEP of flooding from rivers or sea. Therefore, the risk of flooding from Fluvial or Tidal Sources is considered to be negligible.

In accordance with the NPPF and PPG an FRA is, therefore, not strictly required.

4.4 Flood Risk Summary

This site has been assessed in accordance with the guidance provided within the NPPF, accompanying Planning Practice Guidance (PPG). The site is less than 1ha and is not at risk of flooding; therefore, an FRA is not required.

5. Proposed Surface Water Strategy

5.1 Existing Surface Water Strategy

It is evident from Southern Water sewer asset records that there are no surface water sewers within the vicinity of the site. However, there is an abundance of private surface water networks that generally flow north, towards The Thames.

The existing roof area and hardstandings appear to discharge surface water into these networks, that are understood to discharge at an unrestricted rate to the nearby watercourse.

Given the soil at the site, it is unlikely that the areas of softscape drain fully to ground. It is anticipated that for severe storm events, these areas surcharge and also discharge into the positive drainage networks.

The recently constructed 'Show Bar' building and associated access road is understood to discharge to a swale located north-east of the building. Rainwater pipes attributed to the Show Bar building that shall be enclosed by this new link building shall therefore need to continue to drain as existing.

5.2 Existing Run Off Rates

The development area currently comprises the outer limits of an existing roof, hardstandings and small areas of softscape. In general, the development area is considered brownfield in nature.

The underlying geology from review of BGS data indicates that the site is likely impermeable in terms of infiltration. As the site is actually brownfield in nature, the existing runoff rates from the site development have been assessed.

The brownfield site has been assessed using the modified rational method to understand the pre-development and post-development discharge rates and volumes. The following tables highlight the findings of this assessment, and the calculations can be found within the appendices.

Table 5.1 - Summary of Brownfield Runoff Rates.

	Pre-Development Runoff Rates	Post-Development Runoff Rates	Post-Development Runoff Rates (+45% CC)
1 in 2 year (l/s)	6.002	6.633	9.618
1 in 30 years (l/s)	14.094	15.576	22.585
1 in 100 years (l/s)	18.181	20.048	29.069

The previous table defines the pre-development and post-development runoff rates, based on the average intensity for a 15min storm for the respective events and assuming no restriction within the proposed drainage network. It is evident that there shall be a small net increase from the proposed development.

Table 6.3 - Summary of Brownfield Runoff Volumes.

	Pre-Development Runoff Volumes	Post-Development Runoff Volumes	Post-Development Runoff Volumes (Whole Site +45% CC
1 in 100 years (m^3)	45.31	50.07	72.61

The previous table defines the pre-development and post-development runoff volume, based on the average intensity for a 360min storm for the respective event and assuming no restriction within the proposed drainage network. It is evident that there shall be a small increase in offsite discharge as a result of the development.

Based on the above, any offsite discharge from the proposed impermeable developed area should be restricted to 50% of the brownfield runoff rate in accordance with national policy. As the positively drained areas are increased, this should be 50% of the pre-development runoff rate. Therefore, any offsite discharge should be restricted to 3l/s. Therefore, it is proposed that the offsite discharge is restricted to 3l/s for the 1:100-year event plus an allowance for climate change.

Methods for managing surface water are discussed in the following sections.

5.3 Managing Surface Water

The management of surface water has been assessed in accordance with the guidance set out in CIRIA report C753 'The SuDS Manual 2015'.

To mimic the natural catchment processes as closely as possible, a "management train" is required. This concept is fundamental to successful management of surface water and employs drainage techniques in series to incrementally reduce pollution, flow rates and volumes.

The hierarchy of techniques and processes that should be considered in developing the management train are as follows:

- Prevention. The use of good site design and housekeeping measures to prevent run off transporting pollutants to the drainage system.

- Source Control. Control of run off at or very near to its source. This includes disposal methods that comprise green roofs, permeable pavements, rainwater harvesting or other permeable surfaces.

- Site Control. Management of surface water locally within a development site. This includes disposal techniques that comprise infiltration structures and detention basins.

- Regional Control. Management of run off from a site, or series of sites, typically in a balancing pond or wetland. However, for this development regional controls do not apply.

5.4 Managing Surface Water – Scheme Proposals

Wherever possible, surface water should be managed in small cost effective landscaped features located within small sub catchments rather than being conveyed to and managed in large systems at the bottom of the drained area. The techniques that are higher in the hierarchy are preferred to those further down so that prevention and control of water at source should always be considered before site or regional controls. However, where upstream opportunities are restricted, a number of lower hierarchy options should be used in series and water should only be conveyed elsewhere if it cannot be dealt with on site.

5.4.1 Prevention & Water Quality

There are a number of factors that contribute to pollution incidents and water quality issues such as sediments, oil, fertilisers, pesticides, animal waste and litter, but improvements can be made by managing surface water and stormwater particularly during extreme weather events.
Sustainable drainage systems mimic natural drainage and help to improve water quality by reducing sediment and contaminants from runoff leading to a number of benefits such as aesthetic, health, and opportunities for wildlife and biodiversity.

It is proposed that this minor network is connected to the recently constructed network as defined within planning reference MC/19/1820. This network comprises a swale structure that enhances water quality and reduces downstream pollution. The network shall also benefit from the use of catchpits which shall further assist with pollution prevention.

CIRIA C753 Pollution Indices calculations has been produced and can be found in Appendix 5. It is evident that using the aforementioned features shall not increase the risk of polluting downstream waters.

5.4.2 Source Control

As already noted, source control features include permeable pavements and other infiltration structures which are explored further as follows.

Permeable Pavements (Type A & B)

It is unlikely that infiltration is viable at the site, and therefore Type A & B permeable pavements have been discounted from this development.

Green Roofs

Given the nature of the roof structure and required plant, the benefits of green roofs are outweighed by the structural requirements on this development. Therefore, green roofs have been discounted from this development.

Rainwater Harvesting

Rainwater harvesting has not been considered for this development

5.4.3 Site Control

As previously mentioned, site control includes disposal techniques that comprise infiltration structures and detention basins. The opportunities of utilising these have been explored below.

Soakaways

The site is unlikely suitable for concentrated infiltration techniques such as soakaways due to the anticipated strata. Therefore, soakaways have been discounted at this stage.

Attenuation Tanks

As infiltration is unlikely viable, it is proposed that an attenuation tank is utilised to assist with a restricted offsite discharge of surface water.

Ponds

The site use does not naturally lend itself to the use of ponds. Therefore, ponds have been discounted from this development.

Detention Basins

The site use does not naturally lend itself to the use of detention basins. Therefore, detention basins have been discounted from this development.

Permeable Pavements (Type C)

There are limited adjustments to pavements. Therefore any replacement paved areas are to be impermeable to match surrounding pavements and reduce the risk of maintenance issues.

Swales

The application site use does not naturally lend itself to the use of swales. Therefore, swales have been discounted from this development. However, the surface water drainage shall connect to the wider network that benefits from a swale structure prior to discharging to The Thames.

5.4.4 Strategy Proposals & Preliminary Sizing Estimations

An element of site control must include provision for Climate Change.

National policy for climate change allowance changed in 2022, requiring developments to consider the 1:30 year event plus climate change allowance and the 1:100 year event plus climate change allowance, in addition to all events previously considered. The climate change allowance varies between areas and a site specific assessment of the required climate change allowance is required by referring to the Department for Environment, Food and Rural Affairs (DEFRA) online tool. Designs should consider the upper end climate change allowance for the relevant epoch.

A summary of the allowances for this particular site can be found within the following table.

Table 6.4 – Climate Change Allowances

Peak Rainfall Climate Change Allowances		
Epoch	2050s	2070s
1:30 year event (3.3% AEP)	35%	35%
1:100 year event (1% AEP)	45%	40%

Based on the previous table, the following events and respective climate change allowance should be considered for the development: 1:30 year event plus 35% climate change allowance, and the 1:100 year event plus 45% climate change allowance.

As previously calculated, the brownfield runoff from all of the post-development areas is anticipated to be 6l/s for the 1:2 year event. Based on the above, any offsite discharge from the proposed impermeable developed area should be restricted to 50% of the brownfield runoff rate in accordance with national policy. As the positively drained areas are increased, this should be 50% of the pre-development runoff rate. Therefore, any offsite discharge should be restricted to 3l/s. Therefore, it is proposed that the offsite discharge is restricted to 3l/s for the 1:100-year event plus an allowance for climate change. This shall be an improvement on the anticipated pre-development scenario as the site had a similar drained area with no restricted discharge.

It is proposed that the drainage from the new building connects to the existing surface water network. Due to site constraints and associated drainage levels, it is anticipated that a package pumping station shall be required which shall act as the flow control. A geocellular attenuation tank shall provide storage sufficient for the 1:100 year event plus 45% climate change allowance.

The individual elements have been explored further below:

Geocellular Attenuation Tank

As previously mentioned, the offsite discharge is to be restricted to 3l/s for the 1:100 year event, plus a 45% climate change allowance. As can be seen by the appended MicroDrainage calculations, a geocellular attenuation tank with effective dimensions of 8m x 3m x 1.2m deep can fully accommodate the 1:100 year event with a 45% climate change allowance. The attenuation tank requires a minimum of 95% voids.

5.5 Exceedance and Surface Water Conveyance

Exceedance routes shall be provided by appropriate external levels design during the detailed design stage. The exceedance routes shall need to accommodate system failure and events greater than the 1:100 year event inclusive of a 45% climate change allowance.

5.6 Surface Water Strategy Summary

It is evident from Southern Water sewer asset records that there are no surface water sewers within the vicinity of the site. However, there is an abundance of private surface water networks that generally flow north, towards The Thames.

The existing roof area and hardstandings appear to discharge surface water into these networks, that are understood to discharge at an unrestricted rate to the nearby watercourse.

Given the soil at the site, it is unlikely that the areas of softscape drain fully to ground. It is anticipated that for severe storm events, these areas surcharge and also discharge into the positive drainage networks.

The recently constructed 'Show Bar' building and associated access road is understood to discharge to a swale located north-east of the building. Rainwater pipes attributed to the 'Show Bar' building that shall be enclosed by this new link building shall therefore need to continue to drain as existing.

The proposal is to utilise a new geocellular attenuation tank and connect to the existing private network that benefits from a swale. Accordingly, all storm events up to and including the critical 100-year event with a 45% allowance for climate change will be assessed when considering the volume for the attenuation structure.

The attenuation structure will be sized to accommodate a 1 in 100 year storm event with a 45% allowance for future climate change. This is in accordance with the latest national policy.

It is anticipated that a condition will be imposed on a planning permission requiring further details of the surface water drainage system to be submitted for approval.

It is evident from the aforementioned that a suitable surface water network can be provided that accords with National and Local Planning Policy Guidance.

6. Conclusions

This document has been produced in accordance with current best practice and recommendations and guidance set out in the National Planning Policy Framework (NPPF).

The report concludes:

- The site is an existing leisure park comprising holiday accommodation and various amenity provisions, including swimming facilities, eateries, and entertainment spaces. The application site is immediately surrounded by a show and bar facility to the east, arcade and swimming facilities to the west, fast food provisions to the south and various entertainment spaces to the north. All of these are served by a network of roads and hardstandings. The wider site is bounded by the River Thames to the north, the village of Allhallows to the south, marshland to the east, and agricultural fields to the west.

- A review of the BGS online bedrock mapping tool has identified that the development site is likely underlain by the London Clay formation (Clay & Silt).

- A review of the BGS online superficial deposits mapping tool has identified that the development site is not known to be underlain by superficial deposits.

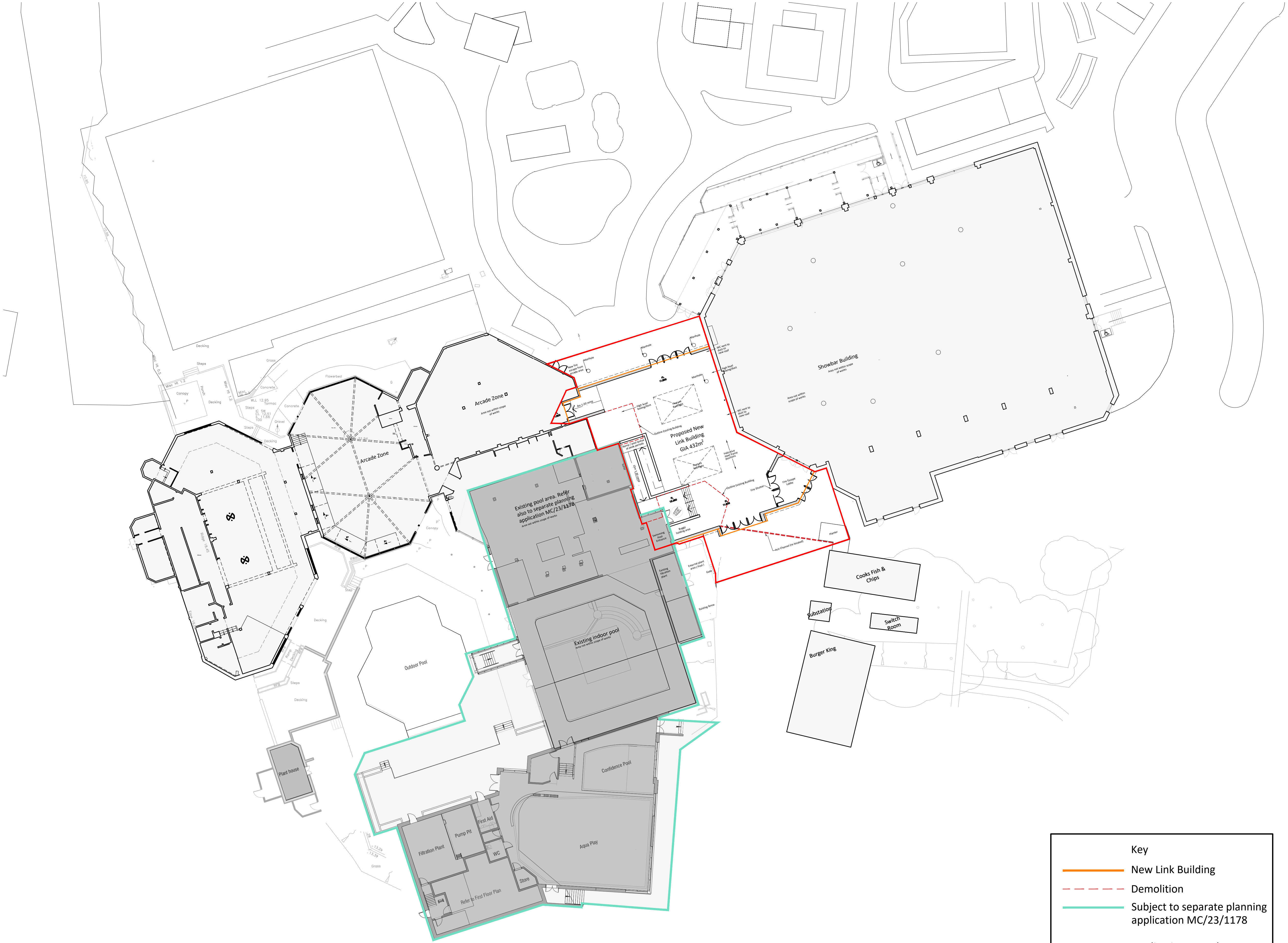
- A review of the Environment Agency's online mapping tool has identified that the development site is within Flood Zone 1, an area with a low probability of flooding from Rivers and Sea.

- The proposal is to construct a link building between the existing arcade building and existing show & bar building.

- It is proposed that the drainage from the new building connects to the existing surface water network. Due to site constraints and associated drainage levels, it is anticipated that a package pumping station shall be required which shall act as the flow control. A geocellular attenuation tank shall provide storage sufficient for the 1:100 year event plus 45% climate change allowance.

- It is evident that the site can be drained satisfactorily in accordance with Local and National Planning Policy Guidance. The details of the drainage systems should be the subject of suitably worded Planning Conditions which would require the schemes to be submitted to the local authority for approval prior to construction work commencing.

Appendix 1 – Proposed Site Plan



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/	11.07.2023	GENERAL UPDATE	NB
A	26.07.2023	GENERAL UPDATE INC. POSITION OF ROOFLIGHTS	NB
B	27.07.2023	UPDATED ANNOTATIONS	NB

PLANNING

Key
- New Link Building
- Demolition
- Subject to separate planning application MC/23/1178
- Application Boundary

0 10m 20m 30m 40m 50m

1:500

A 08 Proposed Site General Arrangement Plan
1:500@A3

JWA Architects Limited
1st Floor, Old Town Hall,
Church Street,
Market Harborough
Leicestershire, LE16 7AA

T +44 (0) 1858 525343
E office@jwa-architects.co.uk
W www.jwa-architects.co.uk

Client: Haven Leisure Ltd.

Project: Haven Holiday Parks
Allhallows
Rochester

Drawing: Proposed Site General Arrangement Plan

Purpose:	Planning	Date:	10/07/2023
Scale:	1:500 @ A3	Drawn:	NB
Dwg. No:	J9571-08	Revision:	B

Appendix 2 – Environment Agency Flood Map for Planning

Flood map for planning

Your reference	Location (easting/northing)	Created
<Unspecified>	**583819/178691**	**25 Jul 2023 8:45**

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

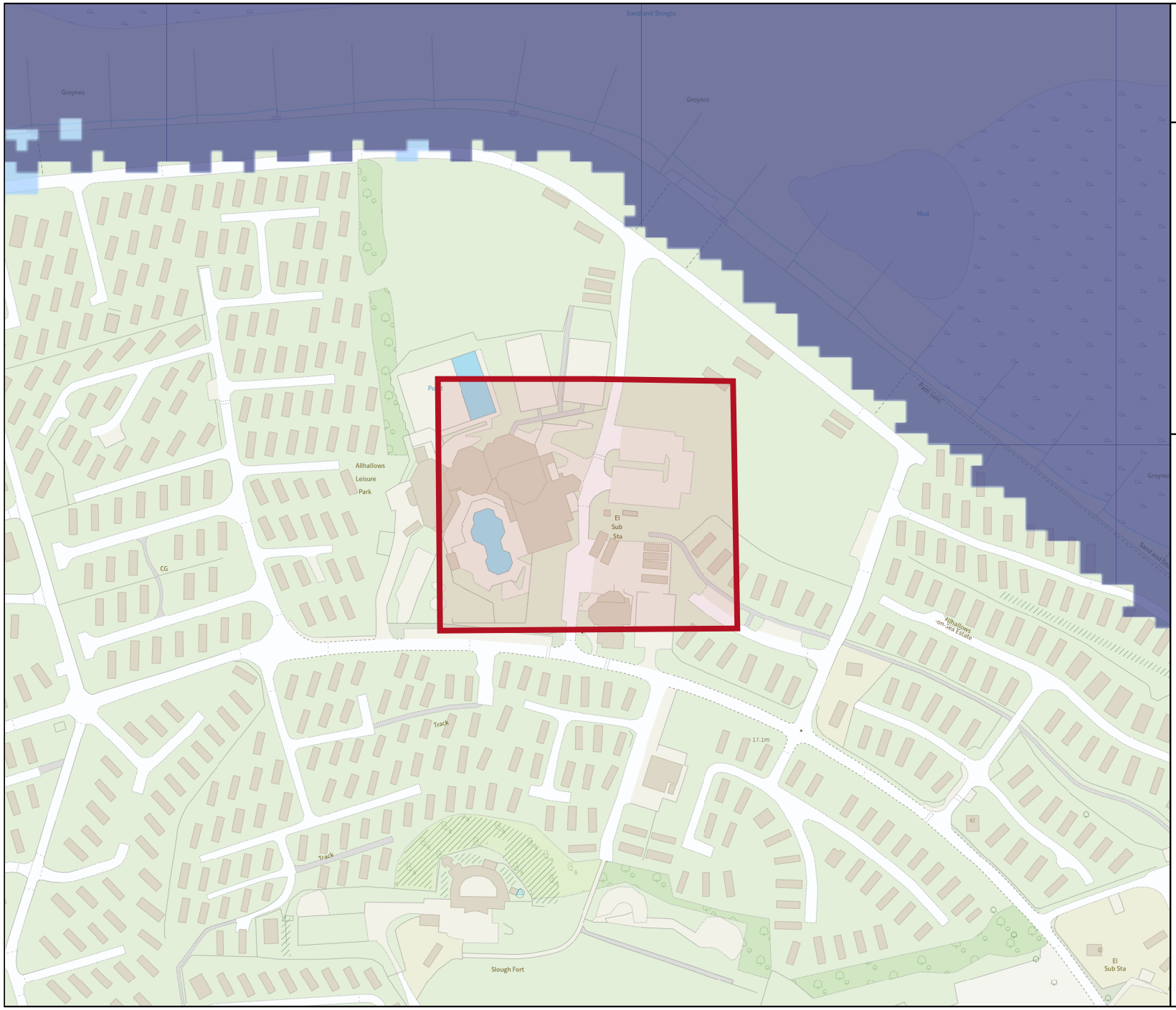
You will need to do a flood risk assessment if your site is **any of the following:**

- bigger that 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

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
<Unspecified>

Location (easting/northing)
583819/178691

Scale
1:2500

Created
25 Jul 2023 8:45

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m

Appendix 3 – Surface Water Drainage Strategy

CDM 2015 RESIDUAL RISKS

1. It is assumed that a competent Principal Contractor with the relevant skills, knowledge and experience of construction of this type of work and location will be appointed, and will be aware of the typical hazards.
2. Work required to and within the immediate vicinity of existing buildings. Contractor to be aware of associated structural risks and presence of services.

The above residual risks are for non-standard hazards. It is assumed that a competent contractor familiar with the construction of this type of work will be appointed who will be aware of the standard hazards.

KEY:

- Proposed Private Surface Water Pipe Ø as stated
- Proposed Private Surface Water Rising Main
- Proposed Private Surface Water PPIC
- CP — Proposed Catchpit
- Proposed Geo-Cellular Attenuation
- Proposed Surface Water Pump Station

DO NOT SCALE THIS DRAWING. ALL SETTING OUT TO ARCHITECT'S DETAILS AND DRAWINGS

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWING ISSUES AND THE SPECIFICATION.

Notes:

G1. All building materials, components and workmanship to comply with the appropriate public health acts, building regulations, british standards and codes of practice and the appropriate manufacturer's recommendations.

G2. For all specialist work see relevant drawings.

G3. Any discrepancies, errors or omissions to be reported to the project co-ordinator for further instructions before commencement of works.

G4. The Engineer is not responsible for dimensions, except where shown on his drawings. All setting out information, dimensions, etc, shall be calculated from the Architect's drawings.

Localised adjustments to be made to drainage features such as gullies and channel drains. Adjusted assets not to connect into attenuation tank network.

RWPs from existing building to be connected to existing surface water network.

Existing drainage in area to be diverted to reduce access covers within new link building.

RWPs from existing building to be connected to existing surface water network.

Rising main to connect to existing surface water network and downstream swale structure, as defined under planning reference MC/19/1820.

Surface Water Package Pumping Station. Discharge restricted to 3l/s.

Geocellular Attenuation Tank (ATT1)
8m x 3m x 1.2m effective depth.
95% voids required.

Localised adjustments to be made to drainage features such as gullies and channel drains. Adjusted assets not to connect into attenuation tank network.

Proposed New Link Building 432m²

Arcade Zone 246m² Area not within scope of works

Showbar Building Area not within scope of works

Existing pool area. Refer also to separate planning application MC/23/1178 Area not within scope of works

Existing indoor pool Area not within scope of works

Cooks Fish & Chips

Substation

Switch Room

Burger King

Area not within scope of works

Canopy

Tarmac

Gate

Existing fence

Existing filtration plant

External plant area (Pool)

Swimming Pool Entrance

Buggy holding area

Ramp / pool queue at peak periods

4m 1:20 ramp

13m 1:20 ramp

Feature Rooflight

Indicative steel frame positions

Fire Escape Lobby

Fire Shutter

Outline Existing Building

Eco Channel (re-located)

Platter

Manhole

New fire escape from arcade area

WC vent to duct to new roof

high level boxing/duct

FL 11.600

FL 12.260

FL 11.750

150mmØ

CP

1m 2m 3m 4m 5m 10m

SCALE 1-100

Rev	Amendment	Drn	Chk	Date
P02	Revised to suit updated Architect layout.	JEM	MJF	03.08.23
P01	Preliminary issue.	JEM	MJF	26.07.23

considine
civil + structural engineers
25 Hollingworth Court, Turkey Mill
Ashford Road, Maidstone. Kent ME14 5PP
t: 01622 919918 e: info@considine.co.uk
www.considine.co.uk

Client:
HAVEN LEISURE LTD

Project:
HAVEN HOLIDAY PARKS - ALLHALLOWS
ALLHALLOWS, ROCHESTER
ME3 9QD

Drawing Title:
DRAINAGE STRATEGY LAYOUT

considine ref	drawn by	date	drawing scales	original paper size
5720	JEM	JUL 23	1:200@A1	A1

drawing reference :

project	originator	volume	level	type	role	number
5720	CON	00	XX	DR	C	1810

status :	status description :
S0	SUITABLE FOR INFORMATION
revision :	revision status :
P02	PRELIMINARY

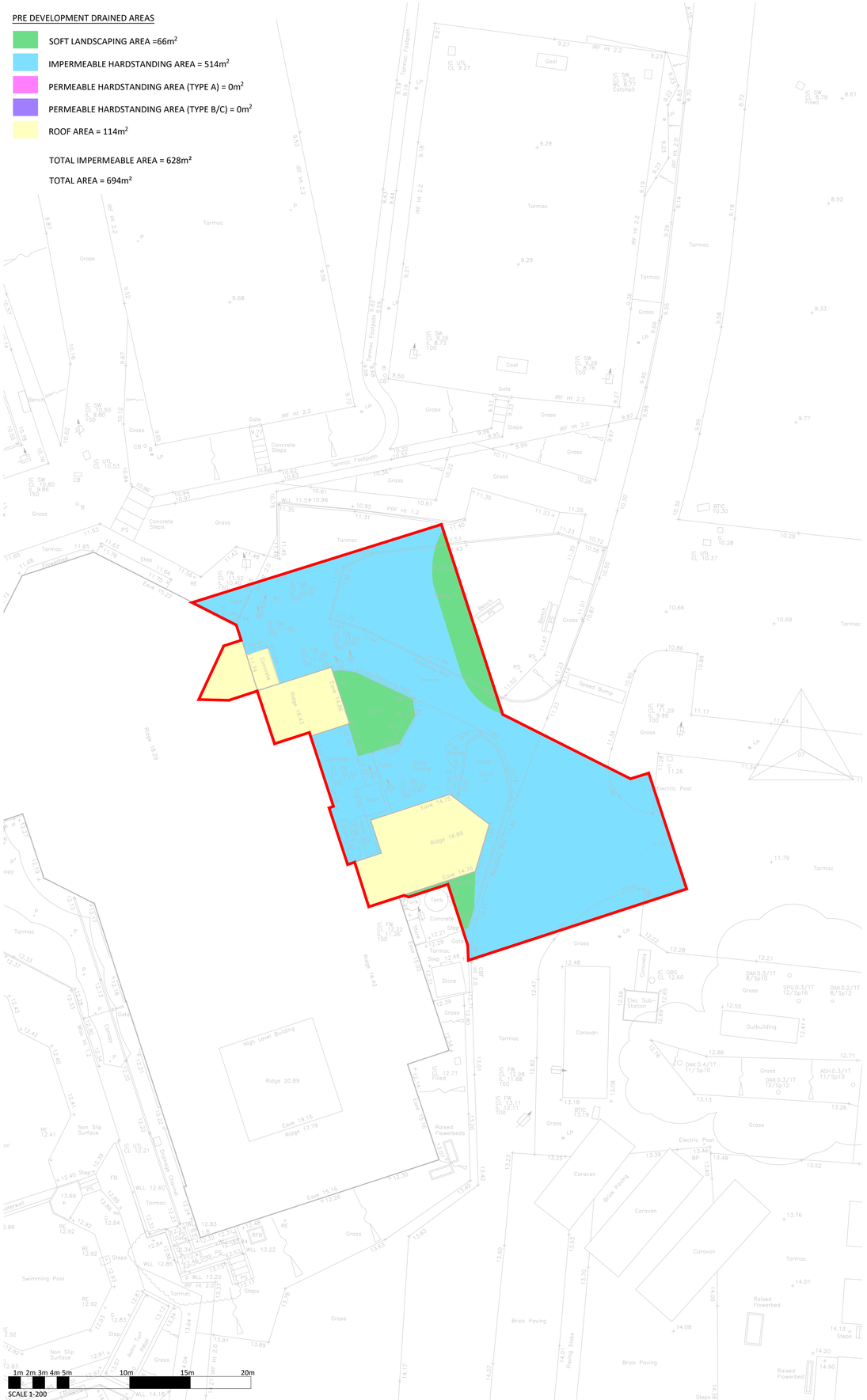
Appendix 4 – Drained Areas Analysis

PRE DEVELOPMENT DRAINED AREAS

- SOFT LANDSCAPING AREA =66m²
- IMPERMEABLE HARDSTANDING AREA = 514m²
- PERMEABLE HARDSTANDING AREA (TYPE A) = 0m²
- PERMEABLE HARDSTANDING AREA (TYPE B/C) = 0m²
- ROOF AREA = 114m²

TOTAL IMPERMEABLE AREA = 628m²

TOTAL AREA = 694m²

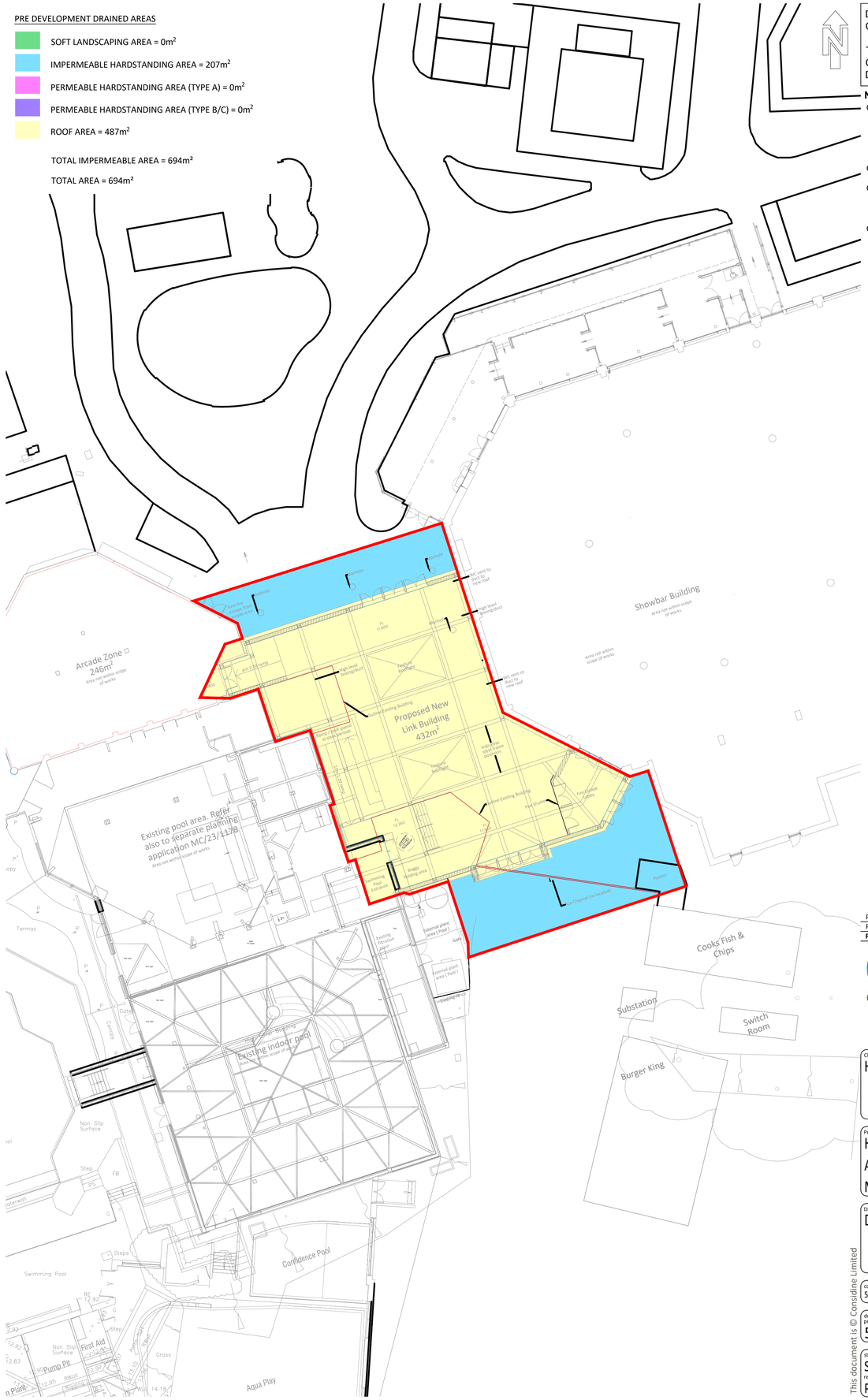


PRE DEVELOPMENT DRAINED AREAS

- SOFT LANDSCAPING AREA = 0m²
- IMPERMEABLE HARDSTANDING AREA = 207m²
- PERMEABLE HARDSTANDING AREA (TYPE A) = 0m²
- PERMEABLE HARDSTANDING AREA (TYPE B/C) = 0m²
- ROOF AREA = 487m²

TOTAL IMPERMEABLE AREA = 694m²

TOTAL AREA = 694m²



DO NOT SCALE THIS DRAWING. ALL SETTING OUT TO ARCHITECT'S DETAILS AND DRAWINGS

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWING ISSUES AND THE SPECIFICATION.

Notes:

G1. All building materials, components and workmanship to comply with the appropriate public health acts, building regulations, british standards and codes of practice and the appropriate manufacturer's recommendations.

G2. For all specialist work see relevant drawings.

G3. Any discrepancies, errors or omissions to be reported to the project co-ordinator for further instructions before commencement of works.

G4. The Engineer is not responsible for dimensions, except where shown on his drawings. All setting out information, dimensions, etc, shall be calculated from the Architect's drawings.

Rev	Amendment	Drn	Chk	Date
P02	Revised to suit updated Architect layout.	JEM	MJF	03.08.23
P01	Preliminary issue.	JEM	MJF	26.07.23

considine
civil + structural engineers
25 Hollingworth Court, Turkey Mill
Ashford Road, Maidstone. Kent ME14 5PP
t: 01622 919918 e: info@considine.co.uk
www.considine.co.uk

Client:
HAVEN LEISURE LTD

Project:
HAVEN HOLIDAY PARKS - ALLHALLOWS
ALLHALLOWS, ROCHESTER
ME3 9QD

Drawing Title:
DRAINED AREAS ANALYSIS SKETCH

considine ref	drawn by	date	drawing scales	original paper size
5720	JEM	JUL 23	1:200@A1	A1

drawing reference : project originator volume level type role number
5720 - CON - 00 - XX - DR - C - 1830

status :	status description :
S0	SUITABLE FOR INFORMATION
revision :	revision status :
P02	PRELIMINARY

Appendix 5 – CIRIA C573 Pollution Indices

CIRIA C753
POLLUTION INDICES

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Project No:	**5720**	Sheet No.	1
Made By:	**JEM**	Revision:	P01
Date:	**26/072023**	Project:	HAVEN HOLIDAY PARKS, ALLHALLOWS

Land Use	Pollution Hazard Level	Total Suspended Suspended Solids (TSS)	Metals	Hydrocarbons	Applicable
Residential Roofs	Very Low	0.20	0.20	0.05	
Other Roofs (typically commercial/industrial roofs)	Low	0.30	0.20	0.05	**X**
Individual property driveways, residential car parks, low traffic roads, (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.50	0.40	0.40	
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.70	0.60	0.70	
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored used or manufactured; industrial sites; trunk roads and motorways.	High	0.80	0.80	0.90	

Up to 0.8 where there is potential for metals to leach from the roof

These should only be used if considered appropriate as part of a detailed risk assessment. Refer to CIRIA C753

	Total Suspended Suspended Solids (TSS)	Metals	Hydrocarbons
Total Polution Hazard Indices	0.30	0.20	0.05

CIRIA C753
POLLUTION INDICES

considine
civil + structural engineers

Project No:	**5720**	Sheet No.	2
Made By:	**JEM**	Revision:	P01
Date:	**26/072023**	Project:	HAVEN HOLIDAY PARKS, ALLHALLOWS

Type of SuDS Component	Total Suspended Suspended Solids (TSS)	Metals	Hydrocarbons	Applicable
Filter Strip	0.40	0.40	0.50	
Filter Drain	0.40	0.40	0.40	
Swale	0.50	0.60	0.60	X
Bioretention System	0.80	0.80	0.80	
Permeable Pavement	0.70	0.60	0.70	
Detention Basin	0.50	0.50	0.60	
Pond	0.70	0.70	0.50	
Wetland	0.80	0.80	0.80	
Downstream Defender® Vortex	0.30	0.20	0.20	
Downstream Defender® Vortex Plus	0.50	0.40	0.50	
Downstream Defender® Advanced Vortex	0.50	0.40	0.50	
Klargester AquaTreat®	0.80	0.60	0.90	
Standard Catchpit	0.10	0.00	0.00	X

Select Primary Mitigation: Swale

	Total Suspended Suspended Solids (TSS)	Metals	Hydrocarbons
Total Mitigation Indices	0.55	0.60	0.60
Total Polution Hazard Indices	0.30	0.20	0.05
Indices Balance	-0.25	-0.4	-0.55
	ACCEPTABLE	**ACCEPTABLE**	**ACCEPTABLE**

Appendix 6 – Preliminary Surface Water Network Calculations

Summary of Results for 2 year Return Period

Half Drain Time : 8 minutes.

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
15 min Summer	98.097	0.097	0.0	3.5	3.5	2.5	O K
30 min Summer	98.095	0.095	0.0	3.5	3.5	2.4	O K
60 min Summer	98.074	0.074	0.0	3.5	3.5	1.9	O K
120 min Summer	98.060	0.060	0.0	3.5	3.5	1.5	O K
180 min Summer	98.033	0.033	0.0	3.5	3.5	0.8	O K
240 min Summer	98.010	0.010	0.0	3.5	3.5	0.2	O K
360 min Summer	98.002	0.002	0.0	3.5	3.5	0.1	O K
480 min Summer	98.001	0.001	0.0	2.6	2.6	0.1	O K
600 min Summer	98.001	0.001	0.0	3.5	3.5	0.1	O K
720 min Summer	98.001	0.001	0.0	2.6	2.6	0.1	O K
960 min Summer	98.000	0.000	0.0	1.4	1.4	0.1	O K
1440 min Summer	98.000	0.000	0.0	1.0	1.0	0.1	O K
2160 min Summer	98.000	0.000	0.0	0.7	0.7	0.0	O K
2880 min Summer	98.000	0.000	0.0	0.6	0.6	0.0	O K
4320 min Summer	98.000	0.000	0.0	0.4	0.4	0.0	O K
5760 min Summer	98.000	0.000	0.0	0.3	0.3	0.0	O K
7200 min Summer	98.000	0.000	0.0	0.3	0.3	0.0	O K
8640 min Summer	98.000	0.000	0.0	0.3	0.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	35.291	0.0	5.4	16
30 min Summer	22.454	0.0	7.0	25
60 min Summer	13.850	0.0	8.4	40
120 min Summer	9.669	0.0	11.8	72
180 min Summer	7.516	0.0	13.7	102
240 min Summer	6.181	0.0	15.1	130
360 min Summer	4.586	0.0	16.6	186
480 min Summer	3.659	0.0	17.4	262
600 min Summer	3.056	0.0	18.5	310
720 min Summer	2.631	0.0	18.9	414
960 min Summer	2.071	0.0	19.4	538
1440 min Summer	1.478	0.0	21.6	716
2160 min Summer	1.063	0.0	23.5	0
2880 min Summer	0.849	0.0	25.1	0
4320 min Summer	0.631	0.0	27.9	0
5760 min Summer	0.519	0.0	30.7	0
7200 min Summer	0.452	0.0	33.4	0
8640 min Summer	0.407	0.0	36.0	0

Summary of Results for 2 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	98.000	0.000	0.0	0.3	0.3	0.0	O K
15 min Winter	98.116	0.116	0.0	3.5	3.5	3.0	O K
30 min Winter	98.111	0.111	0.0	3.5	3.5	2.9	O K
60 min Winter	98.076	0.076	0.0	3.5	3.5	2.0	O K
120 min Winter	98.039	0.039	0.0	3.5	3.5	1.0	O K
180 min Winter	98.003	0.003	0.0	3.5	3.5	0.1	O K
240 min Winter	98.003	0.003	0.0	3.5	3.5	0.1	O K
360 min Winter	98.002	0.002	0.0	3.5	3.5	0.1	O K
480 min Winter	98.001	0.001	0.0	2.6	2.6	0.1	O K
600 min Winter	98.001	0.001	0.0	2.6	2.6	0.1	O K
720 min Winter	98.001	0.001	0.0	2.6	2.6	0.1	O K
960 min Winter	98.000	0.000	0.0	1.0	1.0	0.1	O K
1440 min Winter	98.000	0.000	0.0	0.7	0.7	0.0	O K
2160 min Winter	98.000	0.000	0.0	0.5	0.5	0.0	O K
2880 min Winter	98.000	0.000	0.0	0.4	0.4	0.0	O K
4320 min Winter	98.000	0.000	0.0	0.3	0.3	0.0	O K
5760 min Winter	98.000	0.000	0.0	0.3	0.3	0.0	O K
7200 min Winter	98.000	0.000	0.0	0.2	0.2	0.0	O K
8640 min Winter	98.000	0.000	0.0	0.2	0.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.375	0.0	38.7	0
15 min Winter	35.291	0.0	6.1	17
30 min Winter	22.454	0.0	7.7	26
60 min Winter	13.850	0.0	9.4	44
120 min Winter	9.669	0.0	13.2	76
180 min Winter	7.516	0.0	15.4	98
240 min Winter	6.181	0.0	16.8	124
360 min Winter	4.586	0.0	18.5	204
480 min Winter	3.659	0.0	19.5	308
600 min Winter	3.056	0.0	19.7	364
720 min Winter	2.631	0.0	20.7	348
960 min Winter	2.071	0.0	22.4	478
1440 min Winter	1.478	0.0	24.4	0
2160 min Winter	1.063	0.0	26.4	0
2880 min Winter	0.849	0.0	28.1	0
4320 min Winter	0.631	0.0	31.3	0
5760 min Winter	0.519	0.0	34.3	0
7200 min Winter	0.452	0.0	37.4	0
8640 min Winter	0.407	0.0	40.4	0

Summary of Results for 2 year Return Period

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
10080 min Winter	98.000	0.000	0.0	0.2	0.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.375	0.0	43.4	0

Rainfall Details

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 583814 178717 TQ 83814 78717
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.082

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.041	4	8	0.041

Model Details

Storage is Online Cover Level (m) 100.000

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	3.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	9.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.95	Cap Volume Depth (m)	1.200
Invert Level (m)	98.000	Cap Infiltration Depth (m)	1.200

Pump Outflow Control

Invert Level (m) 98.000

Depth (m)	Flow (l/s)
0.001	3.5000

Summary of Results for 30 year Return Period

Half Drain Time : 34 minutes.

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
15 min Summer	98.352	0.352	0.0	3.5	3.5	9.0	O K
30 min Summer	98.397	0.397	0.0	3.5	3.5	10.2	O K
60 min Summer	98.389	0.389	0.0	3.5	3.5	10.0	O K
120 min Summer	98.361	0.361	0.0	3.5	3.5	9.2	O K
180 min Summer	98.310	0.310	0.0	3.5	3.5	7.9	O K
240 min Summer	98.250	0.250	0.0	3.5	3.5	6.4	O K
360 min Summer	98.147	0.147	0.0	3.5	3.5	3.8	O K
480 min Summer	98.068	0.068	0.0	3.5	3.5	1.7	O K
600 min Summer	98.021	0.021	0.0	3.5	3.5	0.5	O K
720 min Summer	98.004	0.004	0.0	3.5	3.5	0.1	O K
960 min Summer	98.001	0.001	0.0	3.5	3.5	0.1	O K
1440 min Summer	98.001	0.001	0.0	3.5	3.5	0.1	O K
2160 min Summer	98.000	0.000	0.0	1.4	1.4	0.1	O K
2880 min Summer	98.000	0.000	0.0	1.1	1.1	0.1	O K
4320 min Summer	98.000	0.000	0.0	0.8	0.8	0.0	O K
5760 min Summer	98.000	0.000	0.0	0.6	0.6	0.0	O K
7200 min Summer	98.000	0.000	0.0	0.6	0.6	0.0	O K
8640 min Summer	98.000	0.000	0.0	0.5	0.5	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	82.868	0.0	12.8	18
30 min Summer	53.277	0.0	16.4	30
60 min Summer	32.875	0.0	20.4	48
120 min Summer	20.668	0.0	25.2	82
180 min Summer	15.451	0.0	28.2	116
240 min Summer	12.461	0.0	30.3	148
360 min Summer	9.085	0.0	33.3	208
480 min Summer	7.187	0.0	34.9	264
600 min Summer	5.970	0.0	36.1	316
720 min Summer	5.121	0.0	37.5	360
960 min Summer	4.012	0.0	38.7	532
1440 min Summer	2.840	0.0	40.4	736
2160 min Summer	2.024	0.0	42.9	1196
2880 min Summer	1.604	0.0	46.6	1528
4320 min Summer	1.178	0.0	52.2	0
5760 min Summer	0.961	0.0	56.7	0
7200 min Summer	0.829	0.0	61.2	0
8640 min Summer	0.741	0.0	65.6	0

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 Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	98.000	0.000	0.0	0.5	0.5	0.0	O K
15 min Winter	98.409	0.409	0.0	3.5	3.5	10.5	O K
30 min Winter	98.472	0.472	0.0	3.5	3.5	12.1	O K
60 min Winter	98.455	0.455	0.0	3.5	3.5	11.7	O K
120 min Winter	98.407	0.407	0.0	3.5	3.5	10.4	O K
180 min Winter	98.321	0.321	0.0	3.5	3.5	8.2	O K
240 min Winter	98.226	0.226	0.0	3.5	3.5	5.8	O K
360 min Winter	98.076	0.076	0.0	3.5	3.5	2.0	O K
480 min Winter	98.004	0.004	0.0	3.5	3.5	0.1	O K
600 min Winter	98.002	0.002	0.0	3.5	3.5	0.1	O K
720 min Winter	98.001	0.001	0.0	3.5	3.5	0.1	O K
960 min Winter	98.001	0.001	0.0	3.5	3.5	0.1	O K
1440 min Winter	98.001	0.001	0.0	2.6	2.6	0.1	O K
2160 min Winter	98.000	0.000	0.0	1.0	1.0	0.1	O K
2880 min Winter	98.000	0.000	0.0	0.8	0.8	0.0	O K
4320 min Winter	98.000	0.000	0.0	0.6	0.6	0.0	O K
5760 min Winter	98.000	0.000	0.0	0.5	0.5	0.0	O K
7200 min Winter	98.000	0.000	0.0	0.4	0.4	0.0	O K
8640 min Winter	98.000	0.000	0.0	0.4	0.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.677	0.0	70.0	0
15 min Winter	82.868	0.0	14.3	19
30 min Winter	53.277	0.0	18.3	31
60 min Winter	32.875	0.0	22.8	52
120 min Winter	20.668	0.0	28.4	88
180 min Winter	15.451	0.0	31.7	124
240 min Winter	12.461	0.0	33.9	156
360 min Winter	9.085	0.0	37.0	214
480 min Winter	7.187	0.0	39.4	254
600 min Winter	5.970	0.0	40.6	320
720 min Winter	5.121	0.0	41.6	298
960 min Winter	4.012	0.0	42.9	506
1440 min Winter	2.840	0.0	43.6	572
2160 min Winter	2.024	0.0	49.5	1160
2880 min Winter	1.604	0.0	53.0	0
4320 min Winter	1.178	0.0	58.4	0
5760 min Winter	0.961	0.0	63.5	0
7200 min Winter	0.829	0.0	68.5	0
8640 min Winter	0.741	0.0	73.5	0

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 Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	98.000	0.000	0.0	0.3	0.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.677	0.0	78.4	0

Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 583814 178717 TQ 83814 78717
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.082

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.041	4	8	0.041

Model Details

Storage is Online Cover Level (m) 100.000

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	3.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	9.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.95	Cap Volume Depth (m)	1.200
Invert Level (m)	98.000	Cap Infiltration Depth (m)	1.200

Pump Outflow Control

Invert Level (m) 98.000

Depth (m)	Flow (l/s)
0.001	3.5000

Summary of Results for 30 year Return Period (+35%)

Half Drain Time : 54 minutes.

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
15 min Summer	98.517	0.517	0.0	3.5	3.5	13.3	O K
30 min Summer	98.605	0.605	0.0	3.5	3.5	15.5	O K
60 min Summer	98.609	0.609	0.0	3.5	3.5	15.6	O K
120 min Summer	98.603	0.603	0.0	3.5	3.5	15.5	O K
180 min Summer	98.552	0.552	0.0	3.5	3.5	14.1	O K
240 min Summer	98.491	0.491	0.0	3.5	3.5	12.6	O K
360 min Summer	98.365	0.365	0.0	3.5	3.5	9.4	O K
480 min Summer	98.243	0.243	0.0	3.5	3.5	6.2	O K
600 min Summer	98.150	0.150	0.0	3.5	3.5	3.9	O K
720 min Summer	98.080	0.080	0.0	3.5	3.5	2.1	O K
960 min Summer	98.009	0.009	0.0	3.5	3.5	0.2	O K
1440 min Summer	98.001	0.001	0.0	3.5	3.5	0.1	O K
2160 min Summer	98.001	0.001	0.0	3.5	3.5	0.1	O K
2880 min Summer	98.000	0.000	0.0	1.5	1.5	0.1	O K
4320 min Summer	98.000	0.000	0.0	1.1	1.1	0.1	O K
5760 min Summer	98.000	0.000	0.0	0.9	0.9	0.0	O K
7200 min Summer	98.000	0.000	0.0	0.7	0.7	0.0	O K
8640 min Summer	98.000	0.000	0.0	0.7	0.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	111.872	0.0	17.3	19
30 min Summer	71.925	0.0	22.1	32
60 min Summer	44.381	0.0	27.5	52
120 min Summer	27.902	0.0	34.3	86
180 min Summer	20.859	0.0	38.1	120
240 min Summer	16.822	0.0	41.3	154
360 min Summer	12.265	0.0	45.0	218
480 min Summer	9.702	0.0	47.4	280
600 min Summer	8.060	0.0	48.8	336
720 min Summer	6.914	0.0	50.5	390
960 min Summer	5.417	0.0	52.6	492
1440 min Summer	3.834	0.0	55.9	668
2160 min Summer	2.733	0.0	58.5	1104
2880 min Summer	2.166	0.0	60.5	1576
4320 min Summer	1.591	0.0	69.3	2192
5760 min Summer	1.297	0.0	76.6	0
7200 min Summer	1.119	0.0	82.6	0
8640 min Summer	1.000	0.0	88.5	0

Summary of Results for 30 year Return Period (+35%)

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
10080 min Summer	98.000	0.000	0.0	0.6	0.6	0.0	O K
15 min Winter	98.595	0.595	0.0	3.5	3.5	15.3	O K
30 min Winter	98.709	0.709	0.0	3.5	3.5	18.2	O K
60 min Winter	98.727	0.727	0.0	3.5	3.5	18.6	O K
120 min Winter	98.701	0.701	0.0	3.5	3.5	18.0	O K
180 min Winter	98.621	0.621	0.0	3.5	3.5	15.9	O K
240 min Winter	98.524	0.524	0.0	3.5	3.5	13.4	O K
360 min Winter	98.326	0.326	0.0	3.5	3.5	8.4	O K
480 min Winter	98.155	0.155	0.0	3.5	3.5	4.0	O K
600 min Winter	98.037	0.037	0.0	3.5	3.5	1.0	O K
720 min Winter	98.004	0.004	0.0	3.5	3.5	0.1	O K
960 min Winter	98.001	0.001	0.0	3.5	3.5	0.1	O K
1440 min Winter	98.001	0.001	0.0	2.6	2.6	0.1	O K
2160 min Winter	98.000	0.000	0.0	1.3	1.3	0.1	O K
2880 min Winter	98.000	0.000	0.0	1.0	1.0	0.1	O K
4320 min Winter	98.000	0.000	0.0	0.8	0.8	0.0	O K
5760 min Winter	98.000	0.000	0.0	0.6	0.6	0.0	O K
7200 min Winter	98.000	0.000	0.0	0.5	0.5	0.0	O K
8640 min Winter	98.000	0.000	0.0	0.5	0.5	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.914	0.0	94.5	0
15 min Winter	111.872	0.0	19.2	20
30 min Winter	71.925	0.0	24.8	32
60 min Winter	44.381	0.0	30.5	58
120 min Winter	27.902	0.0	38.5	94
180 min Winter	20.859	0.0	43.1	132
240 min Winter	16.822	0.0	46.0	166
360 min Winter	12.265	0.0	49.8	232
480 min Winter	9.702	0.0	53.0	290
600 min Winter	8.060	0.0	54.9	336
720 min Winter	6.914	0.0	56.3	370
960 min Winter	5.417	0.0	58.7	588
1440 min Winter	3.834	0.0	61.4	716
2160 min Winter	2.733	0.0	63.2	1316
2880 min Winter	2.166	0.0	69.7	1516
4320 min Winter	1.591	0.0	78.9	0
5760 min Winter	1.297	0.0	85.8	0
7200 min Winter	1.119	0.0	92.5	0
8640 min Winter	1.000	0.0	99.2	0

Summary of Results for 30 year Return Period (+35%)

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
10080 min Winter	98.000	0.000	0.0	0.4	0.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.914	0.0	105.8	0

Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 583814 178717 TQ 83814 78717
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+35

Time Area Diagram

Total Area (ha) 0.082

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.041	4	8	0.041

Model Details

Storage is Online Cover Level (m) 100.000

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	3.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	9.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.95	Cap Volume Depth (m)	1.200
Invert Level (m)	98.000	Cap Infiltration Depth (m)	1.200

Pump Outflow Control

Invert Level (m) 98.000

Depth (m)	Flow (l/s)
0.001	3.5000

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 82 minutes.

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
15 min Summer	98.765	0.765	0.0	3.5	3.5	19.6	O K
30 min Summer	98.936	0.936	0.0	3.5	3.5	24.0	O K
60 min Summer	99.003	1.003	0.0	3.5	3.5	25.7	O K
120 min Summer	99.013	1.013	0.0	3.5	3.5	26.0	O K
180 min Summer	98.986	0.986	0.0	3.5	3.5	25.3	O K
240 min Summer	98.944	0.944	0.0	3.5	3.5	24.2	O K
360 min Summer	98.833	0.833	0.0	3.5	3.5	21.4	O K
480 min Summer	98.707	0.707	0.0	3.5	3.5	18.1	O K
600 min Summer	98.578	0.578	0.0	3.5	3.5	14.8	O K
720 min Summer	98.456	0.456	0.0	3.5	3.5	11.7	O K
960 min Summer	98.257	0.257	0.0	3.5	3.5	6.6	O K
1440 min Summer	98.032	0.032	0.0	3.5	3.5	0.8	O K
2160 min Summer	98.001	0.001	0.0	3.5	3.5	0.1	O K
2880 min Summer	98.001	0.001	0.0	2.6	2.6	0.1	O K
4320 min Summer	98.001	0.001	0.0	2.6	2.6	0.1	O K
5760 min Summer	98.000	0.000	0.0	1.2	1.2	0.2	O K
7200 min Summer	98.000	0.000	0.0	1.0	1.0	0.2	O K
8640 min Summer	98.000	0.000	0.0	0.9	0.9	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	154.658	0.0	23.8	20
30 min Summer	100.663	0.0	31.0	33
60 min Summer	62.393	0.0	38.4	60
120 min Summer	39.141	0.0	48.2	94
180 min Summer	29.532	0.0	54.6	128
240 min Summer	24.066	0.0	59.2	164
360 min Summer	17.884	0.0	65.5	232
480 min Summer	14.359	0.0	70.0	298
600 min Summer	12.046	0.0	73.6	360
720 min Summer	10.401	0.0	76.2	422
960 min Summer	8.197	0.0	79.7	536
1440 min Summer	5.806	0.0	84.8	750
2160 min Summer	4.089	0.0	88.8	1196
2880 min Summer	3.195	0.0	91.8	1508
4320 min Summer	2.276	0.0	97.3	1920
5760 min Summer	1.807	0.0	103.4	2944
7200 min Summer	1.530	0.0	111.6	3520
8640 min Summer	1.347	0.0	119.0	4376

Summary of Results for 100 year Return Period (+45%)

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
10080 min Summer	98.000	0.000	0.0	0.8	0.8	0.0	O K
15 min Winter	98.876	0.876	0.0	3.5	3.5	22.5	O K
30 min Winter	99.083	1.083	0.0	3.5	3.5	27.8	O K
60 min Winter	99.193	1.193	0.0	3.5	3.5	30.6	O K
120 min Winter	99.200	1.200	0.0	3.5	3.5	30.8	O K
180 min Winter	99.156	1.156	0.0	3.5	3.5	29.7	O K
240 min Winter	99.085	1.085	0.0	3.5	3.5	27.8	O K
360 min Winter	98.903	0.903	0.0	3.5	3.5	23.2	O K
480 min Winter	98.700	0.700	0.0	3.5	3.5	17.9	O K
600 min Winter	98.507	0.507	0.0	3.5	3.5	13.0	O K
720 min Winter	98.334	0.334	0.0	3.5	3.5	8.6	O K
960 min Winter	98.077	0.077	0.0	3.5	3.5	2.0	O K
1440 min Winter	98.002	0.002	0.0	3.5	3.5	0.1	O K
2160 min Winter	98.001	0.001	0.0	3.5	3.5	0.1	O K
2880 min Winter	98.001	0.001	0.0	2.6	2.6	0.1	O K
4320 min Winter	98.000	0.000	0.0	1.1	1.1	0.1	O K
5760 min Winter	98.000	0.000	0.0	0.9	0.9	0.0	O K
7200 min Winter	98.000	0.000	0.0	0.7	0.7	0.0	O K
8640 min Winter	98.000	0.000	0.0	0.7	0.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.217	0.0	125.7	0
15 min Winter	154.658	0.0	26.6	20
30 min Winter	100.663	0.0	34.6	34
60 min Winter	62.393	0.0	43.0	60
120 min Winter	39.141	0.0	54.0	102
180 min Winter	29.532	0.0	61.1	140
240 min Winter	24.066	0.0	66.4	178
360 min Winter	17.884	0.0	73.9	252
480 min Winter	14.359	0.0	78.4	320
600 min Winter	12.046	0.0	81.7	384
720 min Winter	10.401	0.0	85.0	440
960 min Winter	8.197	0.0	89.3	538
1440 min Winter	5.806	0.0	94.5	704
2160 min Winter	4.089	0.0	98.6	1188
2880 min Winter	3.195	0.0	101.8	1704
4320 min Winter	2.276	0.0	108.7	1952
5760 min Winter	1.807	0.0	119.5	0
7200 min Winter	1.530	0.0	126.5	0
8640 min Winter	1.347	0.0	133.6	0

Summary of Results for 100 year Return Period (+45%)

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
10080 min Winter	98.000	0.000	0.0	0.6	0.6	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	1.217	0.0	140.8	0

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 583814 178717 TQ 83814 78717
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.082

Time From: (mins)	To: (mins)	Area (ha)	Time From: (mins)	To: (mins)	Area (ha)
0	4	0.041	4	8	0.041

Model Details

Storage is Online Cover Level (m) 100.000

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	3.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	9.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.95	Cap Volume Depth (m)	1.200
Invert Level (m)	98.000	Cap Infiltration Depth (m)	1.200

Pump Outflow Control

Invert Level (m) 98.000

Depth (m)	Flow (l/s)
0.001	3.5000

Appendix 7 – Brownfield Runoff Rates

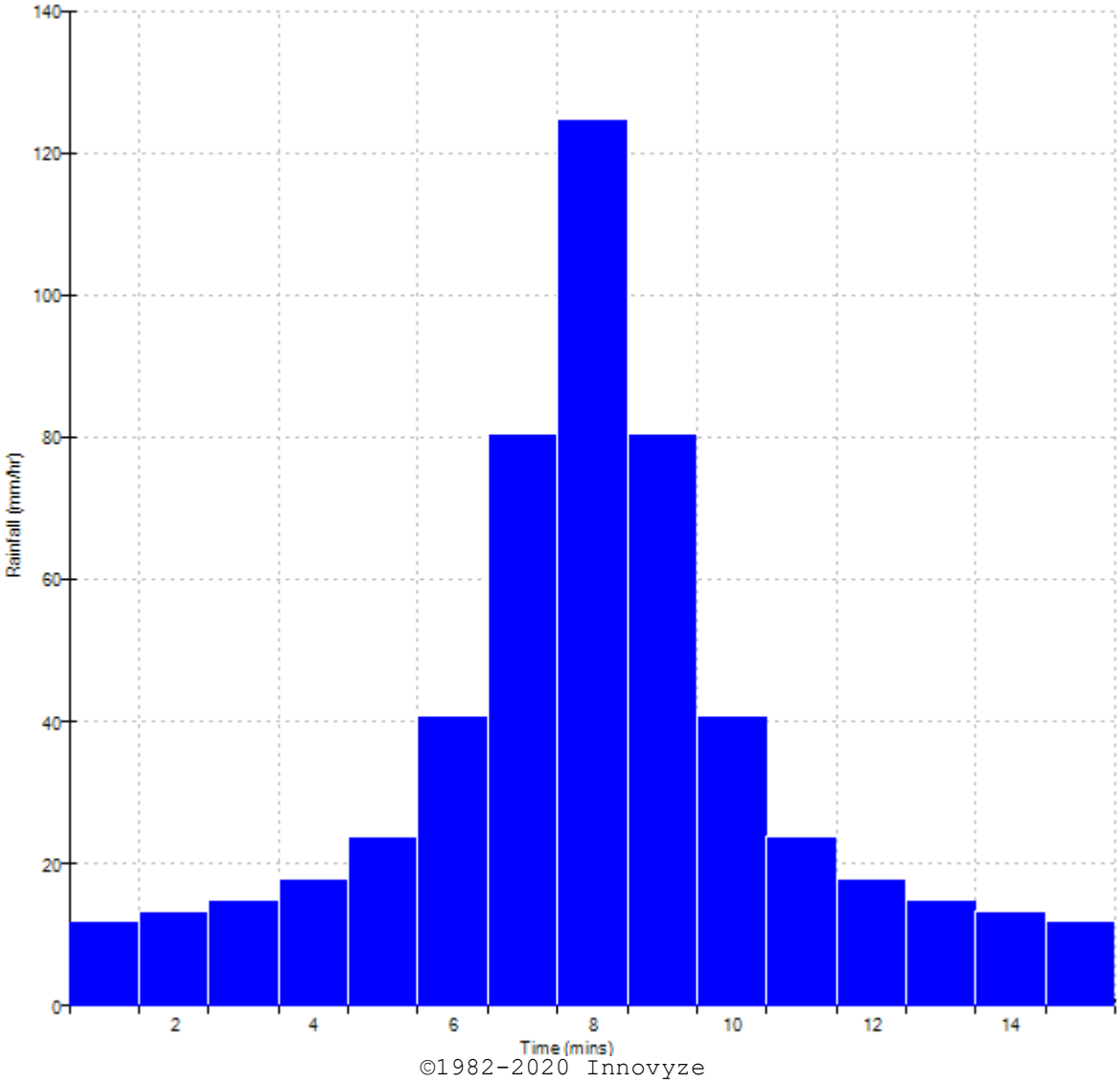
Considine Limited		Page 1
25 Hollingworth Court Kent ME14 5PP		
Date 25/07/2023 17:21 File	Designed by Jack Moss Checked by	
Innovyze	Source Control 2020.1	

Rainfall profile

Storm duration (mins) 15

FEH Data

FEH Rainfall Version	2013
Site Location	GB 583814 178717 TQ 83814 78717
Data Type	Point
Peak Intensity (mm/hr)	124.717
Ave. Intensity (mm/hr)	35.291
Return Period (years)	2.0

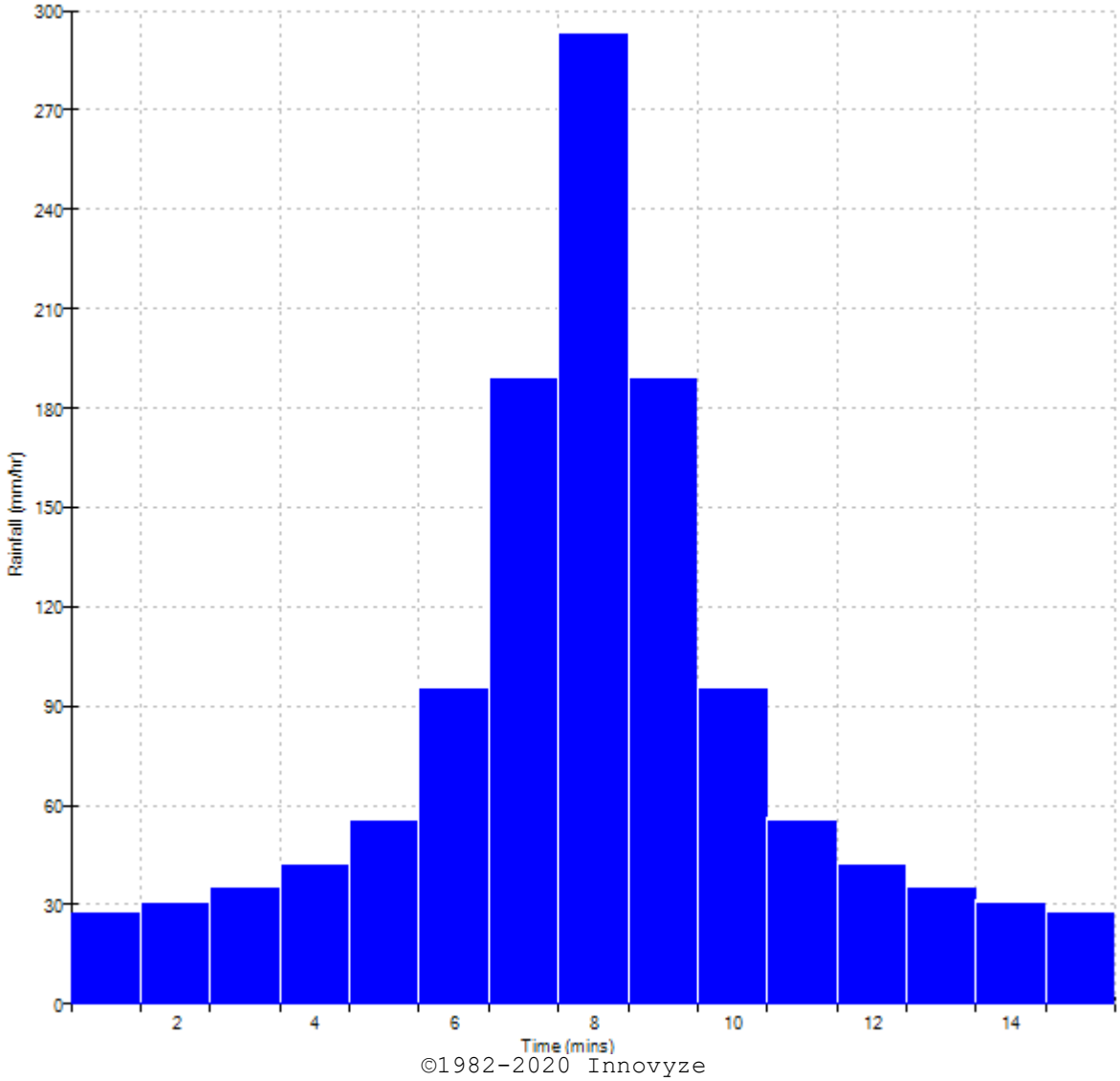


Rainfall profile

Storm duration (mins) 15

FEH Data

FEH Rainfall Version	2013
Site Location	GB 583814 178717 TQ 83814 78717
Data Type	Point
Peak Intensity (mm/hr)	292.856
Ave. Intensity (mm/hr)	82.868
Return Period (years)	30.0

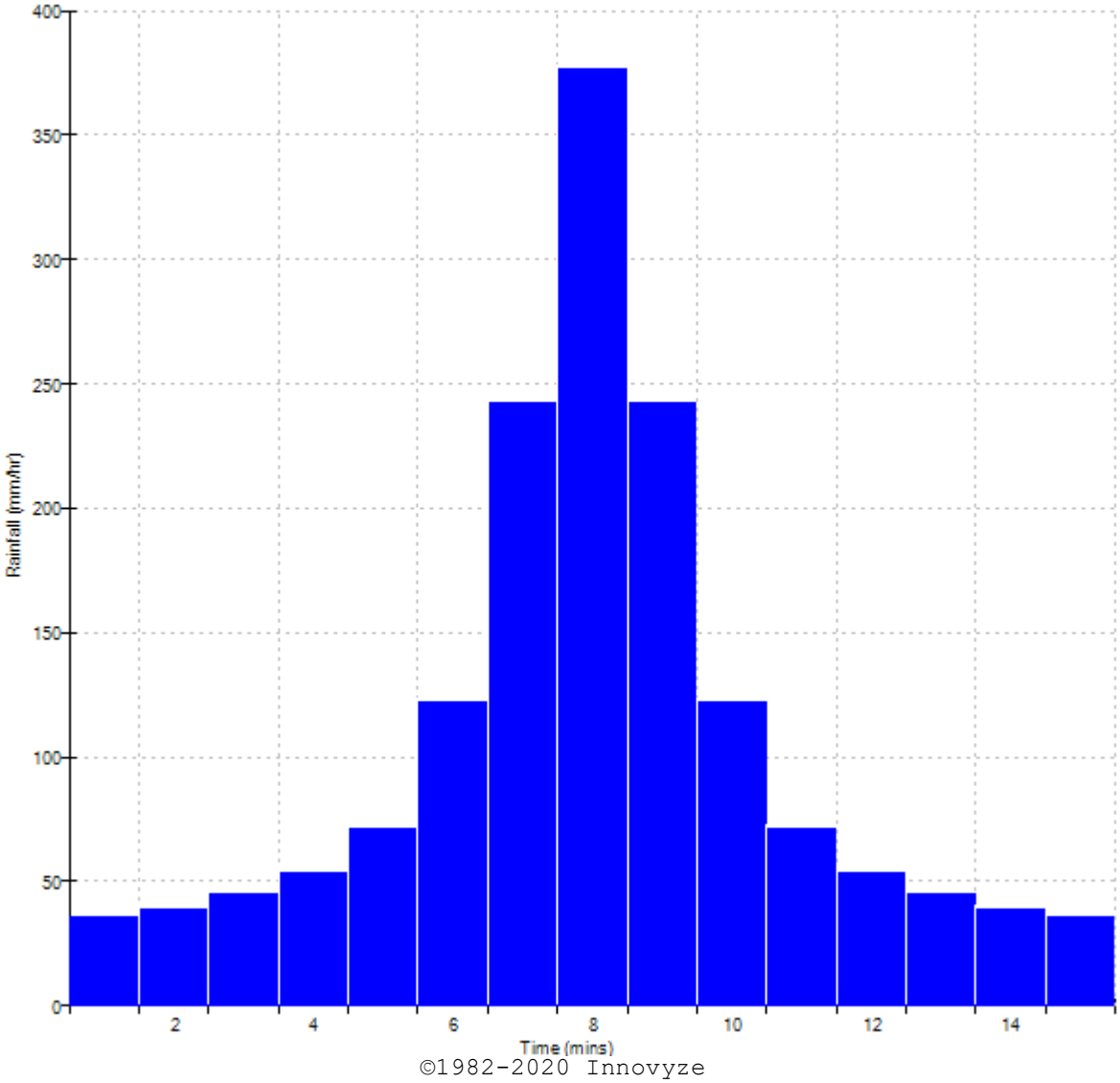


Rainfall profile

Storm duration (mins) 15

FEH Data

FEH Rainfall Version	2013
Site Location	GB 583814 178717 TQ 83814 78717
Data Type	Point
Peak Intensity (mm/hr)	376.939
Ave. Intensity (mm/hr)	106.661
Return Period (years)	100.0



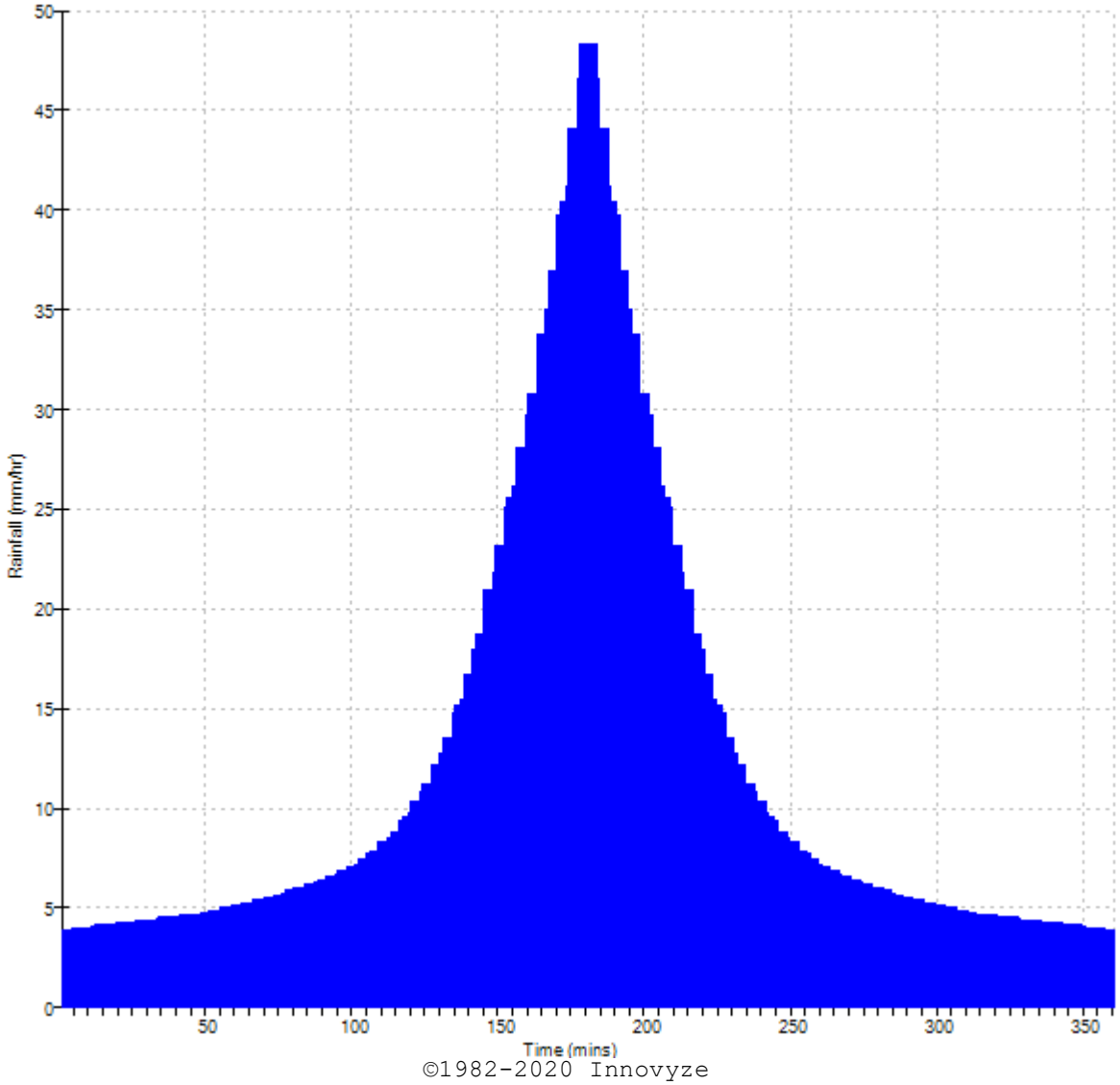
Considine Limited		Page 1
25 Hollingworth Court Kent ME14 5PP		
Date 25/07/2023 17:23 File	Designed by Jack Moss Checked by	
Innovyze	Source Control 2020.1	

Rainfall profile

Storm duration (mins) 360

FEH Data

FEH Rainfall Version	2013
Site Location	GB 583814 178717 TQ 83814 78717
Data Type	Point
Peak Intensity (mm/hr)	48.348
Ave. Intensity (mm/hr)	12.334
Return Period (years)	100.0



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Civil + Structural Engineers

Title	Haven Holiday Parks, Allhallows	Job No:	5720-P02
Decription :	Estimate of Existing and Proposed	By:	JEM
	Peak Run-Off Rate and Volume	Date:	03/08/2023
		Sheet No:	1

Climate Change Allowance 45%

Existing Site

Pre-Developed Site: Estimate Surface Water Run-Off Using the Modified Rational Method

Site Area = 694 m^2

Existing Impermeable Area = 628 m^2

Average Rate of Rainfall (Obtained from MicroDrainage using FEH data)

2 Year 15 Minute Event (M5-15D) =	35.291 mm/hr (i)	+ 45%	51.172	mm/hr (i)
30 Year 15 Minute Event (M5-15D) =	82.868 mm/hr (i)	+ 45%	120.16	mm/hr (i)
100 Year 15 Minute Event (M5-15D) =	106.661 mm/hr (i)	+ 45%	154.66	mm/hr (i)

FEH Rainfall data source:
Version 2013 FEH Data Set, Site: GB 583814 178717 (Point)

Peak Rate of Run-Off (Q_P)

$Q_P = C \cdot A_P \cdot i$ Where $C = C_V \cdot C_R$

C_V = 0.75 (Volumetric Co-efficient)
C_R = 1.3 (Routing Co-efficient)

Q_{P2} =	6.002 l/s	+ 45%	8.7035	l/s
Q_{P30} =	14.094 l/s	+ 45%	20.437	l/s
Q_{P100} =	18.141 l/s	+ 45%	26.305	l/s

Title	Haven Holiday Parks, Allhallows	Job No:	5720-P02
Decription :	Estimate of Existing and Proposed	By:	JEM
	Peak Run-Off Rate and Volume	Date:	03/08/2023
		Sheet No:	2

Proposed Development

Total Impermeable Area = 694 m^2

Adjust Average Rainfall for Climate Change in Accordance with National Planning Policy, for the upper end of the epoch that the development is designed for:

M2 - 15D + 45% = 51.172 mm/hr (i)

M30 - 15D + 45% = 120.159 mm/hr (i)

M100 - 15D + 45% = 154.658 mm/hr (i)

Proposed Peak Rate of Run-Off (Q_P)

Q_{P2} =	6.633 l/s	+ 45%	9.6182 l/s
Q_{P30} =	15.576 l/s	+ 45%	22.585 l/s
Q_{P100} =	20.048 l/s	+ 45%	29.069 l/s

Peak Volume Run-Off

This is calculated using the 100 Year return period, 360 minute storm event

Average rainfall (M100-360D) =	12.334 mm/hr	+ 45%	17.884 mm/hr
Average depth of rainfall =	74.004 mm (i_d)		107.31 mm (i_d)

Existing Volume Run-Off

$V = C . A_p . i$	V = 45.31 m^3	+ 45%	65.70 m^3

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Consulting Civil + Structural Engineers

Title	Haven Holiday Parks, Allhallows	Job No:	5720-P02
Decription :	Estimate of Existing and Proposed	By:	JEM
	Peak Run-Off Rate and Volume	Date:	03/08/2023
		Sheet No:	3

Proposed Volume Run-Off

Allowance for Climate Change = 45%

Average Rainfall (M100-360D) + 45% = 17.884 mm/hr

Average Depth of Rainfall = 107.306 mm(i_d)

Proposed Volume Run-Off

V = C . AP . i = 50.07 m^3 + 45% 72.61 m^3

Additonal Volume

V_{add} = V(Proposed) - V(Existing)

V_{add} = 4.76 m^3