



RIDGE

**FLOOD RISK ASSESSMENT AND
DRAINAGE STRATEGY
SPRUCE TOWN PLANNING -
FORMER DAIRY CREST DEPOT,
DUNSBURY WAY, HAVANT**
August 2021



**BELOW FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY – SPRUCE
TOWN PLANNING - FORMER DAIRY CREST DEPOT, DUNSBURY WAY,
HAVANT**

August 2021

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SECTION 1

INTRODUCTION

1. INTRODUCTION

1.1. Appointment and Brief

This Flood Risk Assessment (FRA) and Drainage Strategy (DS) report has been produced by Ridge and Partners LLP on the instructions Spruce Town Planning in support of alterations of the former Dairy Crest Depot in Havant. The site is to be redeveloped to provide a new dwelling scheme of circa 9 flats and 22 houses.

The purpose of the report is to assess the drainage network of the application site and any impact the new structures will have. The assessment is based on all sources, taken from recorded and modelled data where known, in order to position the development in the context of National Planning Policy Framework (March 2019) and its associated Planning Policy Guidance (PPG).

1.2. Aims and Objectives

The DS has been prepared with reference to the following requirements:

- The DS must:
 - Ensure that flood risk to the Application Site and surrounding area is not increased over the lifetime of the Proposed Development;
 - Conform with all relevant National and Local flood risk policies;
 - Adopt current design standards; and
 - Consider long-term maintenance with respect to practicality, ownership and funding.
- The DS should:
 - Mimic the existing drainage characteristics of the Application Site as far as is practical;
 - Look for opportunities to provide a reduction in flood risk to the Application Site and the surrounding area;
 - Adhere to current best practice guidance;
 - Contribute to the enhanced amenity and aesthetic value of the Application Site; and
 - Propose opportunities for biological enhancement and provide habitats for wildlife in urban areas.

1.3. Limitations

The purpose of this report as outlined in Section 1.3, together with those related matters specifically referred to therein and it is not intended to be used for any other purposes. The report is for the sole benefit and may only be relied upon by the addressee, to whom we will owe a duty of care. The report and any part of it is confidential to the addressee and should not be disclosed to any third party for any purpose, without the prior written consent of Ridge and Partners LLP as to the form and context of such disclosure. The granting of such consent shall not entitle the third party to place reliance on the report, nor shall it confer any third-party rights pursuant to the Contracts (Rights of Third Parties) Act. The report may not be assigned to any third party.

1.4. Reference Information

The following information has been obtained and interrogated as part of this study:

- Havant Borough Council (2011) Local Plan for flood and erosion risk.
- Southern Water (2021) Sewer records.

In addition, the following documents have been consulted:

- Communities and Local Government Document. (2019). The National Planning Policy Framework;
- Environment Agency. (2016). Flood Risk Assessments: Climate Change Allowances;
- Environment Agency. (2013). Rainfall Runoff Management for Developments;
- Environment Agency. (2019). Flood Risk Assessments: Climate Change Allowances;
- CIRIA. (2015). C753 – The SuDS Manual;
- Secretary of State. (2015). Building Regulations Approved Document H;
- Butler & Davies. (2012). 2nd Ed. Urban Drainage;
- British Geological Survey Online Mapping Tool;
- DEFRA / EA Interactive online mapping (magic.defra.gov.uk);
- Department for Environment, Food and Rural Affairs. (2015). Non-Statutory Technical Standards for Sustainable Drainage Systems;
- Department for Environment, Food and Rural Affairs & Environment Agency. (2017). Flood Risk Assessment for Planning Applications;

SECTION 2

PROJECT BACKGROUND

2. PROJECT BACKGROUND

2.1. Site Location and Existing Land Use

The application site is located at British National Grid co-ordinates 471320, 108224. The site is a former dairy crest depot. There is a former Co-Operative funeral care located in the South West of the site which has been relocated within the Local area. The site is bounded by a car and van rental to the east as well as trees to the south.



Figure 1: Site location

2.2. Existing Drainage Infrastructure

The Sewerage Undertaker is understood to be Southern water and review of their asset records (see appendices) suggests the following significant public infrastructure on or within close vicinity of the Application Site:

- To the north boundary
 - There is a 225mm diameter foul water sewer travelling from Fulford Road toward Dunsbury Way south.
 - There is also a 375mm diameter surface water sewer traveling from Fulford road toward Dunsbury Way where the diameter of the surface water increases to 450mm.
- To the Western boundary
 - There is a 225mm diameter foul water sewer travelling from north south in Dunsbury Way.
 - There is also a 450mm diameter surface water sewer traveling north to south Dunsbury Way.

- To the southern boundary
 - There is a 300mm diameter foul water sewer flowing east to west joining the foul sewer mentioned in Dunsbury way

The existing site is not known to have any surface water flow restriction or benefit from SuDS features but it is understood to have pre existing connections into the public sewer.

2.3. Topography

The site predominantly slopes from North East to South West an elevation of circa 18.0m Above Ordinance Datum (AOD) at down to circa 15.0m at North west of the site.

2.4. Geology and Hydrogeology

British Geological Survey (BGS) online mapping indicates that there are superficial deposits in the majority of the site which are Clay, silt, sand and gravel. However, small parts of the site (north and east) have no superficial deposits recorded. The Application Site is situated on a sedimentary bedrock of Sand.

The Environment Agency's online mapping suggests the underlying superficial soils in south east of the site to be classified Secondary A and the site is known to be located in a medium groundwater vulnerability zone. However, the underlying superficial in part of the north and west side of the site is classified as Unproductive and is located within a low (west) and unproductive (north) groundwater vulnerability zone.

2.5. Hydrology

The nearest main river is the River Lavant at Crosslands Drive to the south east of the site. There is a river along the south of the site which is a tributary of Hermitage Stream

2.6. Proposed Development

The proposed development is for a housing development which consist of circa 31 new dwellings made up of a block of flats and 22 terraced and semi-detached houses with associated parking and green space.



Figure 2: Site Plan

3. QUANTIFYING FLOOD RISK

Detailed flood data has been requested from the Environment Agency, but we are yet to receive a response. As such the following review is of the maps available on the gov.uk¹ site.

3.1. Flood Zone



Figure 3: Flood Zone map for Planning from EA

Figure 3 above confirms that the developed part of the site sits in a Flood Zone 1 area and it is circa 0.50 Ha. The site does not currently benefit from flood defences. Although, the site is close to an area within flood zone 3, it will not have an effect on the site.

¹ Flood risk maps accessed via [Flood map for planning - GOV.UK \(flood-map-for-planning.service.gov.uk\)](https://flood-map-for-planning.service.gov.uk/)

3.2. Surface Water Flooding



Figure 4: Extract of EA Flood map showing Extent of Surface Water flooding

As shown in figure 4, the majority of the site currently sits within areas that suffer from a very low extent of flooding from Surface Water. However, the south east area suffers from a low extent of flooding. The site is bound to the northwest by areas of surface water flooding which follows the natural topography of the surroundings. The high extent of surface water flooding is outside of the site to the south and this is due to the topography of the local watercourse. It is therefore considered that the site is at a **low risk** of flooding from surface water.

3.3. River and Sea Flooding



Figure 5 Extract of EA Flood map showing Extent of river or sea flooding.



Figure 5 shows that there is no flooding from rivers or the sea. The site is currently situated within areas that suffer from a very low extent of flooding from rivers or the sea. It is therefore considered that the site is at a **very low risk** of flooding from rivers or sea.

There is a river along the south of the site which is a tributary of Hermitage Stream. The river enters a culvert under Dunsbury way via an EA maintained screen in which if blocked it would cause the river to back up and flood. However, it is understood the screen is maintained in a very good condition and there is no report of flooding due to the screen.

3.4. Flooding from Reservoirs



Figure 6 Extract of EA Flood map showing extent of flood water due to Reservoir flood risk

As shown in figure 6, the developed site does not sit within areas that are at risk of flooding from reservoirs. It is therefore considered that the application site is currently at a **very low risk** of flooding from reservoirs.

Table 1: Level of risks of each source

SOURCE	LEVEL OF RISK
Surface water	Low
River and sea	Very Low
Reservoirs	Very Low

SECTION 3

ANALYSIS OF NATIONAL AND LOCAL POLICY

4. ANALYSIS OF NATIONAL AND LOCAL POLICY

4.1. National Policy

National Planning Policy Framework (NPPF)

Communities and Local Government Document. (2019). *The National Planning Policy Framework* requires the Planning Application to demonstrate that the Proposed Development will be safe for the duration of its' design life, taking into account the vulnerability of its' users and without increasing flood risk elsewhere, and where possible, reducing flood risk overall.

Non-Statutory Technical Standards for Sustainable Drainage Systems

Department for Environment, Food and Rural Affairs. (2015). *Non-Statutory Technical Standards for Sustainable Drainage Systems* state that the peak rate of discharge from a redevelopment during the 1:1 year and 1:100 year rainfall events should be as close as reasonably practical to the corresponding greenfield runoff rate, but should never exceed that of the pre-development state.

The standards also recommend that, where reasonably practicable, the runoff volume generated from the 1:100 year, 6 hour rainfall event should be constrained to the corresponding greenfield runoff volume.

Building Regulations Approved Document H

Secretary of State. (2015). *Building Regulations Approved Document H* establishes a hierarchy for surface water disposal and encourages a SuDS approach. The hierarchy stipulates that surface water runoff which is not collected for re-use must be discharged in the following order of priority:

1. Discharge to ground via infiltration; or, where not reasonably practicable,
2. Discharge to a surface water body (i.e. river, watercourse or the like); or, where not reasonably practicable,
3. Discharge to a surface water sewer, highway drain or other surface water drainage system; or, where not reasonably practicable,
4. Discharge to a combined sewer.

4.2. Local Policy

Havant Borough Council Local Plan-2011

Havant Borough Council Local Plan flood and erosion risk states the following:

Policy CS15 Flood and Coastal Erosion Risk

Development in areas at risk of flooding now and in the future as identified on the latest Environment Agency flood risk maps and Strategic Flood Risk Assessment climate change maps will only be permitted where:

1. It meets the sequential and exception test (where required) in relation to PPS25.
2. The site is located in a low hazard area as defined in the Strategic Flood Risk Assessment.
3. A site-specific flood risk assessment demonstrates that the development will be safe, including the access, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.
4. The scheme incorporates flood protection, flood resilience and resistance measures appropriate to the character and biodiversity of the area and the specific requirements of the site.
5. Appropriate flood warning and evacuation plans are in place.
6. New site drainage systems are designed taking account of events which exceed the normal design standard.

All development will be required to ensure that there is no net increase in surface water run off. Priority should be given to incorporating Sustainable Drainage Systems (SuDS) to manage surface water drainage, unless it is proven that SuDS are not appropriate. Where SuDS are provided arrangements must be put in place for their whole life management and maintenance.

The council will work with partners to implement the Coastal Policy Zones in the North Solent Shoreline Management Plan to ensure that development avoids areas at risk from coastal erosion and coastal flooding and that areas required to offset coastal squeeze and prevent habitat fragmentation, to allow species to adapt to climate change, are identified and protected from development

All FRAs should include topographic survey with levels reduced to ordnance datum Finished Floor levels must be set at an agreed level above ordnance datum which should include 600 millimetres freeboard.

Where appropriate, sustainable drainage systems (SuDS) should be incorporated into the design of the development.

4.3. Opportunities

The redevelopment of the former Dairy Crest Depot site currently has both foul and surface water discharge to a sewer. Therefore, there is an opportunity to reduce the current rate of discharge to the sewer.

The incorporation of sustainable drainage systems within the Proposed Development should seek to offer a reduction in peak runoff rates in accordance with the National, and local policies described above.

Subsequently, a reduction in peak flow rates would result in a lower surface water flood risk downstream of the Proposed Development, with larger reductions providing a greater betterment.

Surface water currently generated by the Site is believed to discharge un-treated directly to the public surface water network. Subsequently the management of surface water in accordance with the requirements of local policy and CIRIA. (2015). *C753 – The SuDS Manual* would result in an increase in the quality of the surface water generated by the Application Site as a result of the Proposed Development.

SECTION 4

FOUL WATER MANAGEMENT

5. FOUL WATER MANAGEMENT

5.1. Existing Discharge Rates and Points of Connection

There is an existing 225mm diameter foul water drain in Dunsbury way which originally accommodated the flows from the site. There is also a 300mm diameter lateral that extends from manhole 3201 towards the site and terminates at the boundary. As the existing building has been demolished, there is no flow currently leaving the site.

5.2. Proposed Discharge Rates and Points of Connection

The proposed development will provide a total of 31 (units) residential homes (9 flats and 22 houses). All foul water drainage will be designed and constructed in accordance with the Building Regulations Part H and it is intended to connect to new foul water drains constructed as part of the construction phase. Primary foul runs have been preliminarily sized as 150 mm diameter.

5.3. Analysis & Summary

The analysis demonstrates that the Proposed Development will generate a nett increase in foul water volume and peak flow to the public foul water sewer network, as summarised below:

DESCRIPTION	RESULT	UNIT
Existing Flow	0.25	l/s
Proposed Flow	1.44	l/s
Increase / Decrease	+ 1.19	l/s

The increase is directly attributable to the uplift in new residential units as part of the proposed development.

SECTION 5

SURFACE WATER MANAGEMENT

6. SURFACE WATER MANAGEMENT

6.1. Existing Site Location Data

The site location and hydrological data used within this assessment is summarised as follows:

- Grid Reference: SU 71319 08226, 471319, Eastern, 108226 Northern
- Average Annual Rainfall (SAAR): 800 mm/year
- Soil Index: 0.45
- UK Hydrological Region: Region 7

6.2. Existing Total Site Area

Total existing site area is calculated as follows:

ITEM	AREA (SQ. M)	AREA (HECTARES)
Within red line boundary	5000	0.50

Therefore, existing permeable percentages are calculated as follows:

	PERMEABLE	IMPERMEABLE
Area (Ha)	0.055	0.445
Percentage (%)	11	89

6.3. Calculation of Greenfield Runoff Rates

Greenfield runoff rates have been estimated for the site using the methodology outlined in the Institute of Hydrology Report 124 method as set out within the Interim Code of Practice for SuDS (ICP) and Environment Agency guidance for catchment areas of 50 hectares or less.

This method of assessment is widely recognised as current best practice for estimation of catchment release rates for small catchments.

Detailed calculations can be found within the appendices of this document with results summarised below:

RETURN PERIOD (1 IN X YEARS)	GREENFIELD RUN OFF RATE (L/S)	BROWNFIELD RUN OFF RATE (L/S)
1	2.2	6.6
QBar (2.3)	2.6	7.8
30	5.8	13.5
100	8.2	15.8

6.4. Proposed Site Total Area

Total proposed site area is calculated as follows:

ITEM	AREA (SQ. M)	AREA (HECTARES)
Within red line boundary	5000	0.5

6.5. Proposed Site Impermeable Area & Percentages

Total impermeable areas for the proposed site have been calculated as follows:

ITEM	AREA (SQ. M)	AREA (HECTARES)
Roads	633.93	0.063
Parking	550	0.055
Buildings	1220.43	0.122
Totals:	2404.36	0.240

Therefore, proposed permeable and impermeable percentages are calculated as follows:

	IMPERMEABLE	PERMEABLE
Area (Ha)	0.24	0.26
Percentage (%)	48	52
Change from Existing (%)	-37	+37

6.6. Allowance for Climate Change

Table 2 (Peak Rainfall Intensity Allowance in Small and Urban Catchments) of Environment Agency (2019). Flood Risk Assessments: Climate Change Allowances confirms the climate change allowance of **40%** should be adopted for the Application Site, assuming a lifespan of 100 years for residential development as recommended within the NPPF.

6.7. SuDS Management Train & Proposed SuDS Features

In accordance with the discharge hierarchy identified in Section 3, surface water generated by the Proposed Development should be discharged to ground via infiltration, where practicable to do so.

The underlying soils present at the Application Site are known to be unsuitable for soakaways and therefore discharge of surface water via infiltration-based SuDS features (i.e. soakaways, infiltration basins or permeable paving) is considered inappropriate.

With this in consideration, it is proposed that the Application Site will dispose of surface water to the public surface water sewer, subject to seeking appropriate permissions from the local sewerage undertaker. Surface water will be discharged at the QBAR green field run off rate via the incorporation of appropriate complex flow restriction devices to the system.

Resulting from this, surface water attenuation will be required to temporarily store surface water on-site. It is likely that these will take the form of permeable paving with increased sub base storage.

The Proposed Development also has potential for the incorporation of above-ground SuDS features offering complementary benefits, such as, tree pits and Water Butts, and the like and these will be explored further as part of the ongoing detailed design development.

6.8. Proposed Flow Restriction per Catchment and Attenuation Estimates

For storms up to and including the 1 in 100 year event, the catchment is restricted to the QBAR greenfield run off rate for the catchment.

Outline storage estimates along with the proposed catchment Flow restrictions are given below using the Quick Storage Estimate tool in Microdrainage, with detailed calculations within the appendices of this report: CIRIA 753.

CATCHMENT AREA	IMPERMEABLE AREA (HA)	FLOW RESTRICTION (L/S) UP TO 1: 100 YR + 40% EVENTS	DISCHARGE METHOD	1: 100 YR + 40% STORAGE REQUIREMENT	STORAGE METHOD
Building, Parking & Roads	0.24	2.6	Via permeable paving to surface water sewer	130 – 189 m ³	Permeable paving 400 mm depth of stones Min. 0.3 voids Providing 142m ³
Total	0.24	1.2			142m ³

6.9. Water Quality

The Proposed Development intends to construct new surface water sewers and associated drainage networks.

Car parking areas are understood to be to serve residents only and of an insufficient area to constitute a requirement for hydrocarbon interceptors. Notwithstanding this, the permeable paving will offer a level of treatment for hydrocarbons (in accordance with CIRIA 753).

This new construction to modern standards is likely to reduce the risk of overall pollutant loading and therefore the vulnerability of water quality within the wider surface water catchment is low and indeed reduced by the Proposed Development.

6.10. Summary

Surface Water management is summarised as follows:

- Surface water will be managed within the Application Site and as close to source as possible.
- Volume and rate of existing run-off will be reduced to the greenfield rate.
- This will demonstrate a reduction of circa **84%** during the 1 in 100 year storm event.
- The scheme proposes a significant decrease in impermeable area through the introduction of gardens and green spaces.

With the above in consideration, the Proposed Development would therefore contribute to a reduction in flood risk associated with the exceedance of the public sewerage network within the vicinity of the Application Site, by providing a significant reduction in peak discharge rates and avoiding an increase in total runoff volume.

SECTION 6

OUTLINE OWNERSHIP AND MAINTENANCE SCHEDULE

7. OUTLINE OWNERSHIP AND MAINTENANCE SCHEDULE

To ensure the long-term performance of the proposed DS, the on-site drainage system will be owned and maintained by the a maintenance company (MC) in accordance with the indicative schedule below:

ELEMENT / DRAINAGE COMPONENT	OWNERSHIP	MAINTENANCE REQUIREMENTS
Flow Restriction Device & Chamber	MC	To be monitored for silt build-up and cleaned as required using suction methods. Check function of flow restriction componentry to suit manufacturer's guidance. Inspection annually and before / after extreme storm events.
Catchpit Manholes	MC	To be monitored for silt build-up and cleaned as required using suction methods. Inspection annually and before / after extreme storm events.
Permeable paving	MC	Non-aggressive brushing of the whole surface (avoiding disruption of the jointing material, with suction rates adjusted, based on a trial), either manually or mechanically carried out annually. Top up of the gritstone may be required after cleaning. Weed control – excessive weed growth can be managed by localised spot-treatment with weed killers, in accordance with suppliers' recommendations. Inspection annually.
Rain Water Pipes	Homeowners	Clearance of leaves / debris from guttering and hopper inlets. Rodding points provided to clear blockages via conventional rodding methods. Inspection annually and before / after extreme storm events.
Soil Vent Piles/ "Stub Stacks"	Homeowners	Rodding points to be provided to clear blockages via conventional rodding methods. Inspection annually.
Below Ground Pipework Generally	MC	To be inspected for reduction in cross-sectional area (i.e. due to blockage, silt or debris build-up, root ingress etc) general condition of materials, pipe displacement and the like. Inspection annually and where appropriate before / after extreme storm events.

Manholes Inspection Chambers Generally	/ MC	To be inspected for debris and integrity of chambers and covers generally. Inspection annually and where appropriate before / after extreme storm events.
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SECTION 7

CONCLUSIONS

8. CONCLUSIONS

- The scheme proposes the construction of 31 residential homes units and associated car parking and access roads.
- Due to the suitable nature of the underlying soils at the site, the incorporation of soakaways and other infiltration devices is considered to be impracticable.
- No watercourses or appropriate surface water bodies are present within the application site, and it is therefore proposed to discharge to the existing public sewer system for the disposal of surface water.
- Surface water will be managed within the application site and as close to source as possible.
- The scheme proposes an increase in permeable area.
- The proposed development will present an overall increase in foul water volume and peak flow to the public sewer, which is directly comparable to the increase in units on the site.
- It should be noted that this strategy presents one possible solution to demonstrate that the Proposed Development can be sustainably drained and should not be interpreted as the definitive solution.

APPENDIX A

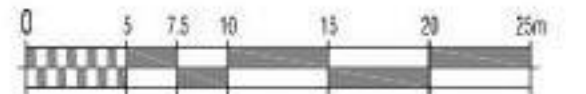
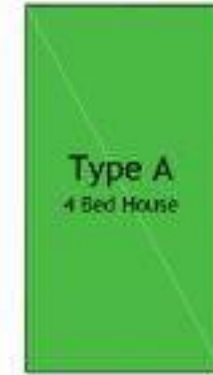
SOUTHERN WATER ASSEST RECORDS

APPENDIX B

PROPOSED SITE PLAN



- Notes:
1. The contents of this document are for information only.
 2. Do not scale. Figures are approximate.
 3. Contractors must verify all dimensions and report any discrepancies to the architect before construction.



Rev	Date	Description	By	Rev
1	18/10/2018	FEASIBILITY		

FEASIBILITY

Pathway

Dunsbury Way,
Havant.

Sketch Site Plan

Scale: 1:1000	Units: 31	
Rev: 1.000	Order: 1.000	
Project ID: FE.ASP.17.670.003		Drawn: 1.000

ARCHITECTURE - PLANNING - PROJECT MANAGEMENT - COM

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APPENDIX C

FOUL WATER CALCULATIONS

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PROJECT

Spruce Town Planning - Former Dairy Crest Depot,
Dunsbury Way

CALCULATION

Foul Water Flow Estimate

CALCULATION SHEET

JOB No.

5016160

PAGE

1 of 1

DATE

19/08/2021

BY

A.A

CHECKED

TC

Foul water discharge rates are to be calculated in accordance with Sewers for Adoption and Urban Drainage (*Butler & Davies, 2nd Ed, 2004*):

OFFICES 750 l / 12

Area	G	Infiltration	Peak Flow	Volume
m ²	l/100m ² .day	Factor	Factor	l/day/100m ² l/day
220	750	1.1	6	4950 10890

Anticipated Usage Hours: 12 hrs = 43200 s Estimated Flow (Q_f): 0.25 l/s

RIDGE

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PROJECT

Spruce Town Planning - Former Dairy Crest Depot,
Dunsbury Way

CALCULATION

Foul Water Flow Estimate

CALCULATION SHEET

JOB No.

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DATE

19/08/2021

BY

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CHECKED

TC

Foul water discharge rates are to be calculated in accordance with Sewers for Adoption and Urban Drainage (*Butler & Davies, 2nd Ed, 2004*):

RESIDENTIAL (Note that minimum design flow of 4000 l/s/unit applies, after recommendations given in SFA)

Description	Units	Persons	G l/hd.day	Infiltration Factor	Peak Flow Factor	Volume l/day/unit	l/day
1 bed 2 person			15	1.10	6	4000	0
2 bed 3 person	15		15	1.10	6	4000	60000
2 bed 4 person			15	1.10	6	4000	0
3 bed 5 person	12		15	1.10	6	4000	48000
3 bed 6 person	4		15	1.10	6	4000	16000
	31					TOTAL:	124000

Anticipated Usage Hours: 24 hrs = 86400 s
20% usage reduction

Estimated Flow (Q_f): 1.44 l/s
Estimated Flow (Q_f): 1.15 l/s

APPENDIX D

SURFACE WATER CALCULATIONS

Ridge and Partners LLP		Page 1																								
The Cowyards Blenheim Park, Oxford Road Woodstock OX20 1QR																										
Date 02/09/2021 12:20 File	Designed by tomclark Checked by																									
Innovyze	Source Control 2020.1																									
<u>ICP SUDS Mean Annual Flood</u> Input <table> <tr> <td>Return Period (years)</td> <td>100</td> <td>Soil</td> <td>0.450</td> </tr> <tr> <td>Area (ha)</td> <td>0.500</td> <td>Urban</td> <td>0.000</td> </tr> <tr> <td>SAAR (mm)</td> <td>800</td> <td>Region Number</td> <td>Region 7</td> </tr> </table> Results 1/s <table> <tr> <td>QBAR Rural</td> <td>2.6</td> </tr> <tr> <td>QBAR Urban</td> <td>2.6</td> </tr> <tr> <td>Q100 years</td> <td>8.2</td> </tr> <tr> <td>Q1 year</td> <td>2.2</td> </tr> <tr> <td>Q30 years</td> <td>5.8</td> </tr> <tr> <td>Q100 years</td> <td>8.2</td> </tr> </table>			Return Period (years)	100	Soil	0.450	Area (ha)	0.500	Urban	0.000	SAAR (mm)	800	Region Number	Region 7	QBAR Rural	2.6	QBAR Urban	2.6	Q100 years	8.2	Q1 year	2.2	Q30 years	5.8	Q100 years	8.2
Return Period (years)	100	Soil	0.450																							
Area (ha)	0.500	Urban	0.000																							
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<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 100 Soil 0.450 Area (ha) 0.593 Urban 0.750 SAAR (mm) 800 Region Number Region 7 Results l/s QBAR Rural 3.0 QBAR Urban 7.8 Q100 years 15.8 Q1 year 6.6 Q30 years 13.5 Q100 years 15.8		
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Summary of Results for 100 year Return Period (+40%)							
Half Drain Time : 458 minutes.							
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
15 min Summer	15.140	0.140	0.0	2.6	2.6	49.6	Flood Risk
30 min Summer	15.193	0.193	0.0	2.6	2.6	68.2	Flood Risk
60 min Summer	15.248	0.248	0.0	2.6	2.6	87.7	Flood Risk
120 min Summer	15.300	0.300	0.0	2.6	2.6	106.3	Flood Risk
180 min Summer	15.325	0.325	0.0	2.6	2.6	114.9	Flood Risk
240 min Summer	15.336	0.336	0.0	2.6	2.6	118.9	Flood Risk
360 min Summer	15.345	0.345	0.0	2.6	2.6	122.3	Flood Risk
480 min Summer	15.347	0.347	0.0	2.6	2.6	122.7	Flood Risk
600 min Summer	15.346	0.346	0.0	2.6	2.6	122.4	Flood Risk
720 min Summer	15.343	0.343	0.0	2.6	2.6	121.5	Flood Risk
960 min Summer	15.335	0.335	0.0	2.6	2.6	118.7	Flood Risk
1440 min Summer	15.312	0.312	0.0	2.6	2.6	110.6	Flood Risk
2160 min Summer	15.269	0.269	0.0	2.6	2.6	95.2	Flood Risk
2880 min Summer	15.228	0.228	0.0	2.6	2.6	80.7	Flood Risk
4320 min Summer	15.163	0.163	0.0	2.6	2.6	57.5	Flood Risk
5760 min Summer	15.120	0.120	0.0	2.6	2.6	42.5	Flood Risk
7200 min Summer	15.098	0.098	0.0	2.5	2.5	34.8	O K
8640 min Summer	15.087	0.087	0.0	2.3	2.3	30.8	O K
10080 min Summer	15.079	0.079	0.0	2.0	2.0	28.1	O K
15 min Winter	15.159	0.159	0.0	2.6	2.6	56.5	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	128.182	0.0	48.7	26
30 min Summer	86.387	0.0	68.4	40
60 min Summer	55.544	0.0	92.3	68
120 min Summer	34.441	0.0	116.0	128
180 min Summer	25.630	0.0	130.2	186
240 min Summer	20.620	0.0	140.0	244
360 min Summer	15.205	0.0	155.3	360
480 min Summer	12.227	0.0	166.8	414
600 min Summer	10.316	0.0	176.0	476
720 min Summer	8.973	0.0	183.7	538
960 min Summer	7.194	0.0	196.2	674
1440 min Summer	5.259	0.0	214.3	952
2160 min Summer	3.835	0.0	236.2	1348
2880 min Summer	3.061	0.0	250.3	1732
4320 min Summer	2.224	0.0	269.5	2428
5760 min Summer	1.771	0.0	285.3	3112
7200 min Summer	1.485	0.0	296.3	3752
8640 min Summer	1.286	0.0	305.1	4488
10080 min Summer	1.139	0.0	312.0	5152
15 min Winter	128.182	0.0	55.5	26

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Summary of Results for 100 year Return Period (+40%)

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	15.219	0.219	0.0	2.6	2.6	77.5	Flood Risk
60 min Winter	15.281	0.281	0.0	2.6	2.6	99.6	Flood Risk
120 min Winter	15.341	0.341	0.0	2.6	2.6	120.7	Flood Risk
180 min Winter	15.369	0.369	0.0	2.6	2.6	130.5	Flood Risk
240 min Winter	15.382	0.382	0.0	2.6	2.6	135.4	Flood Risk
360 min Winter	15.395	0.395	0.0	2.6	2.6	140.0	Flood Risk
480 min Winter	15.397	0.397	0.0	2.6	2.6	140.4	Flood Risk
600 min Winter	15.393	0.393	0.0	2.6	2.6	139.0	Flood Risk
720 min Winter	15.389	0.389	0.0	2.6	2.6	137.7	Flood Risk
960 min Winter	15.377	0.377	0.0	2.6	2.6	133.4	Flood Risk
1440 min Winter	15.342	0.342	0.0	2.6	2.6	121.2	Flood Risk
2160 min Winter	15.277	0.277	0.0	2.6	2.6	98.1	Flood Risk
2880 min Winter	15.213	0.213	0.0	2.6	2.6	75.4	Flood Risk
4320 min Winter	15.123	0.123	0.0	2.6	2.6	43.7	Flood Risk
5760 min Winter	15.091	0.091	0.0	2.3	2.3	32.2	O K
7200 min Winter	15.078	0.078	0.0	2.0	2.0	27.6	O K
8640 min Winter	15.070	0.070	0.0	1.8	1.8	24.6	O K
10080 min Winter	15.064	0.064	0.0	1.5	1.5	22.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	86.387	0.0	77.6	40
60 min Winter	55.544	0.0	104.2	68
120 min Winter	34.441	0.0	130.8	126
180 min Winter	25.630	0.0	146.7	182
240 min Winter	20.620	0.0	157.7	238
360 min Winter	15.205	0.0	174.9	350
480 min Winter	12.227	0.0	187.8	456
600 min Winter	10.316	0.0	198.1	500
720 min Winter	8.973	0.0	206.8	568
960 min Winter	7.194	0.0	220.8	724
1440 min Winter	5.259	0.0	241.2	1030
2160 min Winter	3.835	0.0	266.0	1460
2880 min Winter	3.061	0.0	282.0	1824
4320 min Winter	2.224	0.0	304.2	2468
5760 min Winter	1.771	0.0	322.1	3064
7200 min Winter	1.485	0.0	334.9	3752
8640 min Winter	1.286	0.0	345.4	4432
10080 min Winter	1.139	0.0	353.7	5240

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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)	19.600	Shortest Storm (mins)	15
Ratio R	0.344	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.240

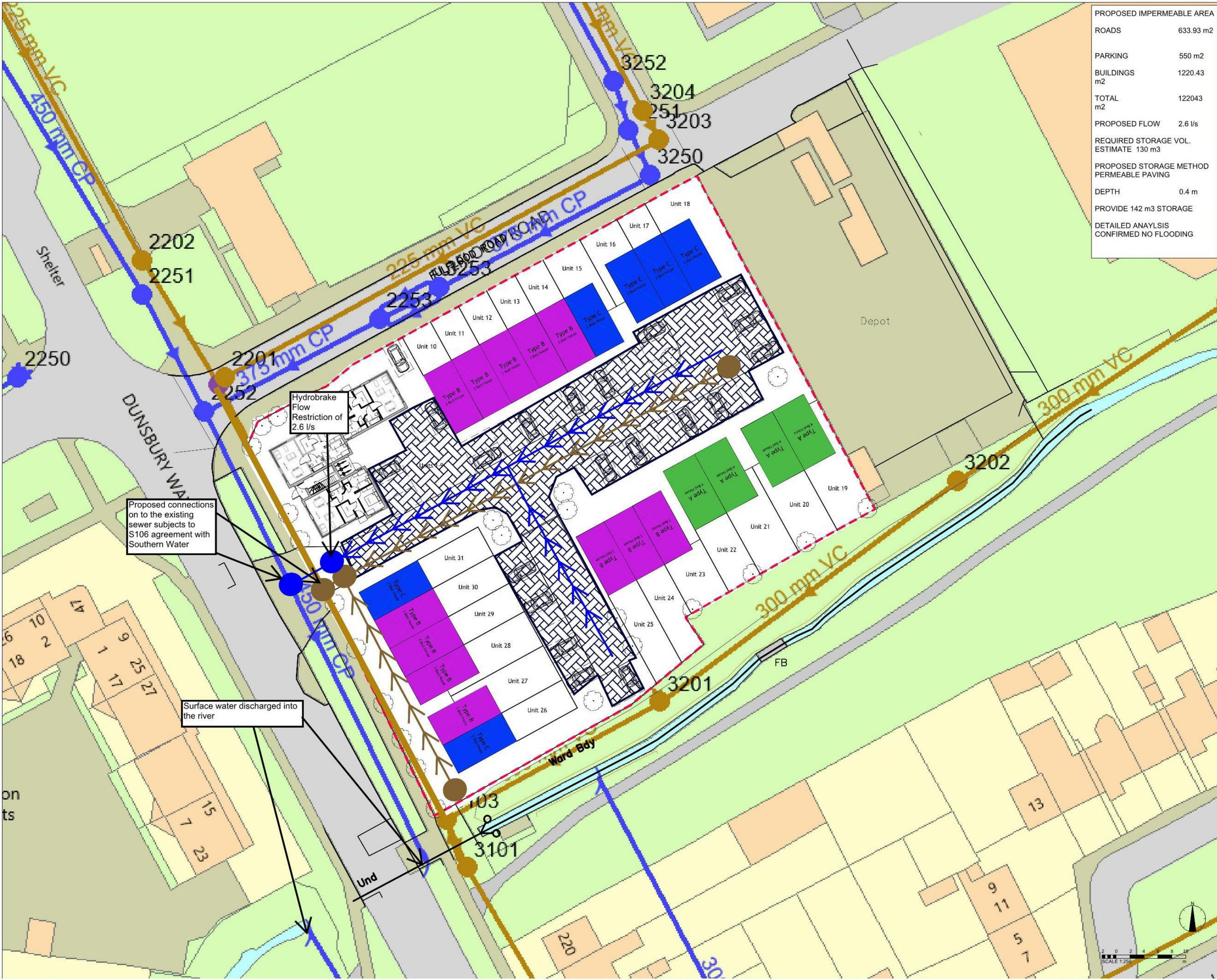
Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
From:	To:	From:	To:	From:	To:
0	4	4	8	8	12
	0.080		0.080		0.080

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<u>Model Details</u>							
Storage is Online Cover Level (m) 15.400							
<u>Porous Car Park Structure</u>							
Infiltration Coefficient Base (m/hr)	0.00000	Width (m) 10.0					
Membrane Percolation (mm/hr)	1000	Length (m) 118.0					
Max Percolation (l/s)	327.8	Slope (1:X) 0.0					
Safety Factor	2.0	Depression Storage (mm) 5					
Porosity	0.30	Evaporation (mm/day) 3					
Invert Level (m)	15.000	Membrane Depth (m) 0					
<u>Hydro-Brake® Optimum Outflow Control</u>							
Unit Reference	MD-SHE-0085-2600-0400-2600						
Design Head (m)	0.400						
Design Flow (l/s)	2.6						
Flush-Flo™	Calculated						
Objective	Minimise upstream storage						
Application	Surface						
Sump Available	Yes						
Diameter (mm)	85						
Invert Level (m)	15.000						
Minimum Outlet Pipe Diameter (mm)	100						
Suggested Manhole Diameter (mm)	1200						
Control Points	Head (m)	Flow (l/s)					
Design Point (Calculated)	0.400	2.6					
Flush-Flo™	0.134	2.6					
Kick-Flo®	0.294	2.3					
Mean Flow over Head Range	-	2.1					
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated							
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6	1.200	4.3	3.000	6.6	7.000	10.0
0.200	2.5	1.400	4.6	3.500	7.1	7.500	10.4
0.300	2.3	1.600	4.9	4.000	7.6	8.000	10.7
0.400	2.6	1.800	5.2	4.500	8.0	8.500	11.0
0.500	2.9	2.000	5.5	5.000	8.4	9.000	11.3
0.600	3.1	2.200	5.7	5.500	8.9	9.500	11.7
0.800	3.6	2.400	6.0	6.000	9.3		
1.000	4.0	2.600	6.2	6.500	9.6		
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APPENDIX E

BELLOW GROUND DRAINAGE STRATEGY



PROPOSED IMPERMEABLE AREA	
ROADS	633.93 m2
PARKING	550 m2
BUILDINGS	1220.43 m2
TOTAL	122043 m2
PROPOSED FLOW	2.6 l/s
REQUIRED STORAGE VOL. ESTIMATE	130 m3
PROPOSED STORAGE METHOD PERMEABLE PAVING	
DEPTH	0.4 m
PROVIDE 142 m3 STORAGE	
DETAILED ANALYSIS CONFIRMED NO FLOODING	

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ARCHITECT REFERENCE: ASPIRE ARCHITECTS LTD
DWG No.: FE-ASP-17-670-003 Rev. 1 (DATED JUNE 2020)

SOUTHERN WATER RECORDS REFERENCE:
632560-1 (DATED 24/08/2021)

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- SITE BOUNDARY
 - PRIVATE FOUL DRAIN
 - S.W. FLOW ROUTE
 - FOUL MANHOLE
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 - PERMEABLE PAVING

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CLIENT: SPRUCE TOWN PLANNING		
IN ASSOCIATION WITH:		
PROJECT: FORMER DAIRY CREST DEPOT		
TITLE: DRAINAGE STRATEGY		
TECH: JM	CSE:	ICSE:
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