FLOOD RISK AND DRAINAGE ASSESSMENT FOR A PROPOSED POULTRY UNIT DEVELOPMENT AT DITCHFORD BANK FARM, HANBURY, BROMSGROVE

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APPENDICES

1.0 INTRODUCTION

1.1 Background

1.1.1 Alan Wood & Partners were commissioned by G O Few and Son to prepare a Flood Risk and Drainage Assessment for a proposed free-range egg production unit on land at Ditchford Bank Farm, Hanbury, Bromsgrove, Worcestershire in support of an application for planning consent

1.1.2 A Flood Risk and Drainage Assessment (FRDA) for the proposed development is required to assess the development's risk from flooding and the suitability of the site in terms of drainage.

1.2 Layout of Report

1.2.1 Section 1 provides an introduction to the FRDA, explains the layout of this FRDA and provides an introduction to flood risk and the latest guidance on development and flood risk in England.

1.2.2 Section 2 provides an introduction to the site. The site description is based upon a desktop study and information provided by the developer. In order to obtain further information on flood risk, consultation was undertaken with the Environment Agency.

1.2.3 Section 3 of this report details the development proposals and considers the development proposals in relation to the current planning policy on development and flood risk in England (and what type of development is considered appropriate in different flood risk zones). National Planning Policy Framework (NPPF): and its associated Technical Guidance (Communities and Local Government, March 2012) is the current planning policy on flood risk in England, and an introduction to NPPF is provided below.

1.2.4 Section 4 considers the drainage arrangements for the proposed development.

1.2.5 Section 5 considers the operation and maintenance requirements for the proposed development.

1.2.6 Section 6 of this report considers the flood risk to site, and the potential for the development proposals to impact on flood risk. The assessment of flood risk is based on the latest planning policy and utilises all the information gathered in the preparation of the report.

1.2.7 Section 7 of this report provides details of any recommendations for further work to mitigate against possible flooding.

1.2.8 Section 8 of this report provides a summary of the report.

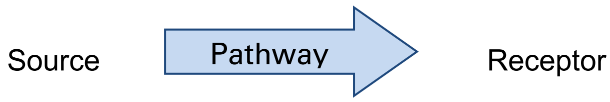
1.3 Flood Risk

1.3.1 Flood risk takes account of both the probability and the consequences of flooding.

1.3.2 Flood risk = probability of flooding x consequences of flooding

1.3.3 Probability is usually interpreted in terms of the return period, e.g. 1 in 100 and 1 in 200 year event, etc. In terms of probability, there is a 1 in 100 (1%) chance of one or more 1 in 100 year floods occurring in a given year. The consequences of flooding depends on how vulnerable a receptor is to flooding.

The components of flood risk can be considered using a source-pathway-receptor model.



1.3.4 Sources constitute flood hazards, which are anything with the potential to cause harm through flooding (e.g. rainfall extreme sea levels, river flows and canals). Pathways represent the mechanism by which the flood hazard would cause harm to a receptor (e.g. overtopping and failure of embankments and flood defences, inadequate drainage and inundation of floodplains). Receptors comprise the people, property, infrastructure and ecosystems that could potentially be affected should a flood occur.

1.4 National Planning Policy Framework

1.4.1 General

1.4.1.1 NPPF and its associated Technical Guidance replaces Planning Policy Statement 25 and provides guidance on how to evaluate sites with respect to flood risk.

1.4.1.2 A summary of the requirements of NPPF is provided below.

1.4.2 Sources of Flooding

1.4.2.1 NPPF requires an assessment to flood risk to consider all forms of flooding and lists six forms of flooding that should be considered as part of a flood risk assessment. These forms of flooding are listed in Table 1, along with an explanation of each form of flooding.

Table1: Forms of flooding

Flooding from Rivers (Fluvial Flooding)
Watercourses flood when the amount of water in them exceeds the flow capacity of the river channel. Flooding can either develop gradually or rapidly, depending on the characteristics of the catchment. Land use, topography and the development can have a strong influence on flooding from rivers.
Flooding from the Sea (Tidal Flooding)
Flooding to low-lying land from the sea and tidal estuaries is caused by storm surges and high tides. Where tidal defences exist, they can be overtopped or breached during a severe storm, which may be more likely with climate change.
Flooding from Land (Pluvial Flooding)
Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding. In developed areas this flood water can be polluted with domestic sewage where foul sewers surcharge and overflow. Local topography and built form can have a strong influence on the direction and depth of flow. The design of development down to a micro-level can influence or exacerbate this. Overland flow paths should be taken into account in spatial planning for urban developments. Flooding can be exacerbated if development increases the percentage of impervious area.

Flooding from Groundwater
Groundwater flooding occurs when groundwater levels rise above ground levels (i.e. groundwater issues). Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers). Chalk is the most extensive source of groundwater flooding.
Flooding from Sewers
In urban areas, rainwater is frequently drained into sewers. Flooding can occur when sewers are overwhelmed by heavy rainfall, and become blocked. Sewer flooding continues until the water drains away.
Flooding from Other Artificial Sources (i.e. reservoirs, canals, lakes and ponds)
Non-natural or artificial sources of flooding can include reservoirs, canals and lakes. Reservoir or canal flooding may occur as a result of the facility being overwhelmed and /or as a result of dam or bank failure.

1.4.3 Flood Zones

1.4.3.1 For river and sea flooding, NPPF uses four Flood Zones to characterise flood risk. These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences, and are detailed in Table 2.

Table 2: Flood zones

Flood Zone	Definition
1	Low probability (less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1%).
2	Medium probability (between 1 in 100 and 1 in 1,000 annual probability of river flooding (1%-0.1%) or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5%-0.1%) in any year).
3a	High probability (1 in 100 or greater annual probability of river flooding (>1%) in any year or 1 in 200 or greater annual probability of sea flooding (>0.5%) in any given year).
3b	This zone comprises land where water has to flow or be stored in times flood. Land which would flood with an annual probability of 1 in 20 (5%), or is designed to flood in an extreme flood (0.1%) should provide a starting point for discussions to identify functional floodplain.

1.4.4 Vulnerability

1.4.4.1 NPPF classifies the vulnerability of developments to flooding into five categories. These categories are detailed in Table 3.

Table 3: Flood risk vulnerability classification

Flood Risk Vulnerability Classification	Examples of Development Types
Essential Infrastructure	- Essential utility infrastructure including electricity generating power stations and grid and primary substations - Wind turbines
Highly Vulnerable	- Police stations, ambulance stations, fire stations, command centres and telecommunications installations required to be operational during flooding. - Emergency dispersal points. - Basement dwellings. - Caravans, mobile homes and park homes intended for permanent residential use.
More Vulnerable	- Hospitals. - Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. - Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. - Non-residential uses for health services, nurseries and educational establishments. - Sites used for holiday or short-let caravans and camping.
Less Vulnerable	- Building used for shops, financial, professional and other services, restaurants and cafes, hot foot takeaways, offices, general industry, storage and distribution, non-residential institutions not included in "more vulnerable" and assembly and leisure. - Land and buildings used for agriculture and forestry.
Water Compatible	- Docks, marinas and wharves. - Water based recreation (excluding sleeping accommodation). - Lifeguard and coastguard stations. - Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.

1.4.4.2 Based on the vulnerability of a development, NPPF states within what Flood Zones(s) the development is appropriate. The flood risk vulnerability and Flood Zone 'compatibility' of developments is summarised in Table 4.

Table 4: Flood risk vulnerability and flood zone compatibility

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test	✓	✓
	3a	Exception Test	✓	x	Exception Test	✓
	3b	Exception Test	✓	x	x	x

1.4.5 The Sequential Test, Exception Test and Sequential Approach

1.4.5.1 The Sequential Test is a risk-based test that should be applied at all stages of development and aims to steer new development to areas with the lowest probability of flooding (Zone 1). This is applied by the Local Planning Authority by means of a Strategic Flood Assessment (SFRA).

1.4.5.2 The SFRA and NPPF may require the Exception Test to be applied to certain forms of new development. The test considers the vulnerability of the new development to flood risk and, to be passed, must demonstrate that:

- There are sustainability benefits that outweigh the flood risk and;
- The new development is safe and does not increase flood risk elsewhere.

1.4.5.3 The Sequential Approach is also a risk based approach to development. In a development site located in several Flood Zones or with other flood risk, the sequential approach directs the most vulnerable types of development towards areas of least risk within the site.

1.4.6 Climate Change

1.4.6.1 This is a planning requirement to account for climate change in the proposed design. The recommended allowances should be based on the most relevant guidance from the Environment Agency and the Lead Local Flood Authority.

1.4.7 Sustainable Drainage

1.4.7.1 The key planning objectives in NPPF are to appraise, manage and where possible, reduce flood risk. Sustainable Drainage Systems (SuDS) provide an effective way of achieving some of these objectives, and NPPF and Part H of the Building Regulations (DTLR 2002) direct developers towards the use of SuDS wherever possible.

1.4.7.2 The surface water drainage has been designed in accordance with current CIRIA C753 SuDS Manual guidelines.

2.0 EXISTING SITE DESCRIPTION

2.1 Location

2.1.1 The area of the proposed development is located within an area of extensive agriculture to the east of Hanbury, Bromsgrove, Worcestershire.

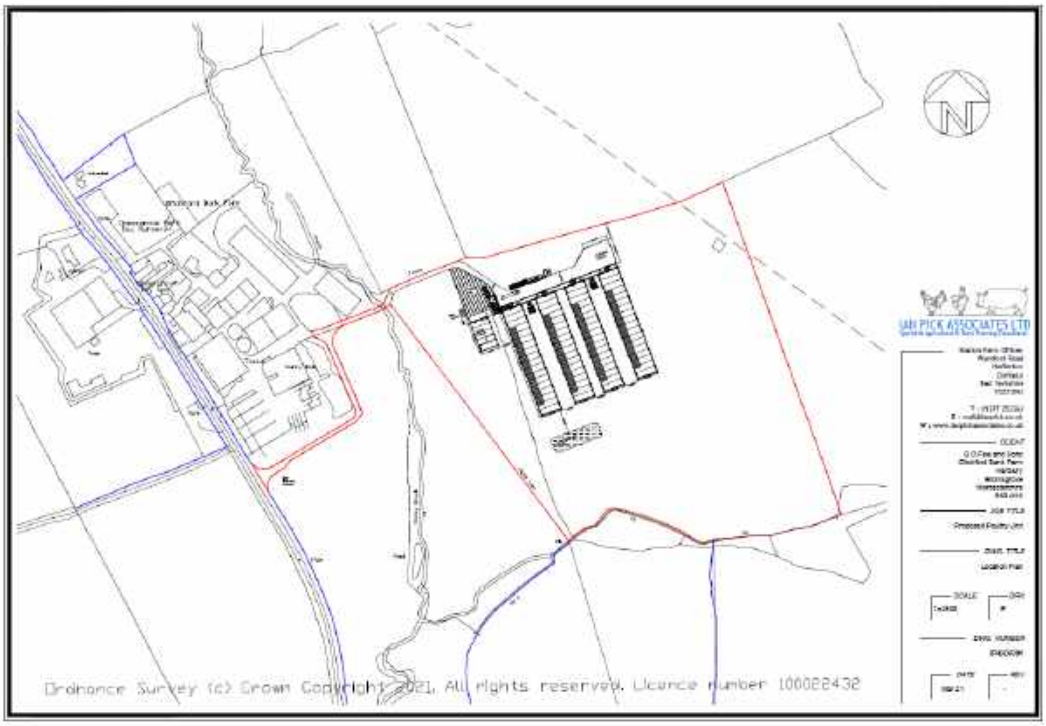
2.1.2 The site is located to the east of Ditchford Bank Road, to the east of the Ditchford Bank Farm buildings.

2.1.3 The development lies approximately 2.4km to the east of Hanbury, approximately 4.7km to the south west of Redditch and approximately 5.5km to the south of Bromsgrove.

2.1.4 An aerial photograph and location plan are included in Figures 1 and 2 below, which identify the location of the site.

Figure 1: Aerial Photograph

Figure 2: Site Location Plan



2.1.5 The Ordnance Survey grid reference for the centre of the site development is approximately 398900, 263760.

2.2 Surrounding Features

2.2.1 The area of the development lies within an extensive area of agricultural land.

2.2.2 The development is consequently surrounded by agricultural land, as indicated on the aerial photograph included in Figure 1 above.

2.2.3 Seeley Brook is located to the west of the development site.

2.2.4 There are existing farm buildings situated to the west of the development.

2.2.5 There is a small open watercourse located to the south of the development site.

2.3 Topography

2.3.1 A topographic survey of the development site has not been undertaken at this stage of the project.

2.3.2 However, Lidar data covering most of the area of the development site has been obtained.

2.3.3 Over the full area of the development the ground levels are shown to vary from approximately 64.94m up to approximately 69.19m OD(N), with the land generally falling from east to west.

2.3.4 Over the area of the poultry unit buildings, the existing ground levels are shown to vary from approximately 64.94m to 69.19m OD(N), with an average ground level of approximately 68.93m OD(N).

2.4 Ground Conditions

2.4.1 No ground investigation works have been undertaken in respect of the proposed development.

2.4.2 A desktop study of the British Geological Survey map reveals that the local geology consists of bedrock comprising Lias Group – Mudstone, Siltstone, Limestome and Sandstone with no superficial deposits.

2.4.3 The ground conditions in the area are therefore unsuitable for soakaways/infiltration to be used as the method for the disposal of surface water run-off from the development.

2.4.4 A study of the groundwater maps in the region shows that the proposed development overlays a secondary (undifferentiated) unproductive aquifer. The groundwater vulnerability in the area of the development is classified as ‘High’.

3.0 PROPOSED DEVELOPMENT

3.1 The Development

3.1.1 The proposed development comprises the construction of a new poultry unit to include the following:-

- 4 new poultry buildings, each with a plan area of approximately 2241m².
- Link corridor and annexes to provide transfer rooms, store room, office and amenity accommodation etc with a total plan area of approximately 612m².
- Biomass boiler house with a plan area of approximately 540m².
- Amenity building with a plan area of approximately 72m².
- Water tank
- Gas tanks
- Feed bins
- External concrete paving with a total plan area of approximately 1990m²
- Unsurfaced stone access track
- Unsurfaced hardstanding area

3.1.2 Copies of the indicative layout drawings showing the details of the of the proposed development are included in Appendix A.

3.2 Flood Risk

3.2.1 In terms of flood risk vulnerability, the proposals are considered to be ‘Less Vulnerable’ development (Table 3).

3.2.2 In terms of flood zone compatibility, the construction of ‘Less Vulnerable’ development is considered appropriate in Flood Zone 1 (Table 4).

4.0 DRAINAGE ASSESSMENT

4.1 General

4.1.1 The surface water drainage has been designed in accordance with current CIRIA C753 SuDS Manual guidelines.

4.2 Surface Water Drainage

4.2.1 Existing Site

4.2.1.1 From the aerial photograph included in Figure 3 below, it can be seen that the development area comprises agricultural land.

Figure 3: Aerial Photograph

4.2.1.2 The current surface water run-off from the area of the new poultry unit would be approximately 1.71 litres per second based upon an agricultural discharge rate of 1.4 litres per second per hectare.

4.2.2 Run-off Destination

4.2.2.1 Requirement H3 of the Building Regulations establishes a preferred hierarchy for disposal of surface water disposal. Consideration should firstly be given to soakaway, infiltration, watercourse and sewer in that priority order.

4.2.2.2 The underlying strata in the vicinity of the development is considered to be unsuitable for the disposal of surface water run-off from the development into soakaways or infiltration trenches (see Section 2.4).

4.2.2.3 The second preferred option would be to discharge the surface water run-off from the development to a watercourse.

4.2.2.4 There is an existing open watercourse located to the south, in proximity to the proposed development.

4.2.2.5 It is therefore proposed that the surface water run-off from the new development is discharged into this watercourse.

4.2.3 Flood Risk

4.2.3.1 For new developments, the current design criteria required for the surface water drainage will need to be based upon the critical 1 in 100 year storm event, with an additional allowance to account for climate change resulting from global warming. There should be no above ground flooding for the 1 in 30 year return period and no property flooding or off site flooding from the critical 1 in 100 year storm event, with the additional allowance to account for climate change.

4.2.4 Climate Change

4.2.4.1 An additional allowance of 40% has been included in the surface water drainage design to account for the anticipated increase in peak rainfall due to climate change resulting from global warming in compliance with Environment Agency climate change guidelines.

4.2.5 Peak Flow Control

4.2.5.1 Based upon the site layout drawing, the developable site area becoming impermeable in the form of roofs and areas of paving which will need to be positively drained has been calculated at approximately 12,170m².

4.2.5.2 The uncontrolled surface water run-off from the new development could be approximately 169 litres per second, based on BS EN 752 calculations, using a rainfall intensity of 50mm/hour. However, to meet the flood risk planning requirements, it is unacceptable to discharge flows freely from the proposed development site at an unrestricted rate. Therefore, flows from the proposed development are normally limited to the greenfield runoff rate, established as 1.4 litres per second per ha, based on the impermeable contributing area of the site. For this development this would only equate to approximately 1.71 litres per second, which cannot be achieved in practical terms.

4.2.5.3 It is considered that the lowest discharge rate which can be achieved without causing blockages and future maintenance issues is 3 litres per second and this rate has been used for design purposes.

4.2.5.4 Preliminary design work has shown that a gravity outfall to the watercourse can be achieved.

4.2.5.5 On this basis the restriction would be achieved by means of an appropriate flow control valve within the final chamber prior to the outfall.

4.2.5.6 The required design criteria for the surface water drainage will need to be based upon the critical 1 in 100 year storm with the required additional allowance to account for climate change resulting from global warming.

4.2.5.7 Hydraulic model studies of the surface water drainage networks to the proposed development have been undertaken in order to assess the pipework sizes and gradients, together with the required volume of storage.

4.2.5.8 Copies of the hydraulic model studies are included in Appendix B.

4.2.5.9 Pipe sizes are shown to vary from 150mm to 375mm diameter.

4.2.5.10 A summary of the storage volumes required is set out below.

Table 5: Summary of Storage Volumes Required

Storm Event	30 Year Storm	100 Year Storm + 30%
Storage Volume Required	434m^3	867m^3
Additional Storage Volume Required	Nil	433m^3

4.2.5.11 The required storage will be provided by creating a new attenuation lagoon which will be located in proximity to the watercourses.

4.2.5.12 A layout drawing of the proposed drainage network is included in Appendix C.

4.2.6 Volume Control

4.2.6.1 The run-off volume post development will be more than pre-development by the creation of impermeable areas and the formal drainage systems which must be installed. However, due to the limitations on infiltrations methods of disposal and the fact that the surface water drainage system will be designed and constructed to meet Building Regulations requirements standards, the opportunity to reduce the surface water discharge volume is limited.

4.2.6.2 SuDS guidelines advise that the run-off volume from the developed site for the 1 in 100 year 6-hour rainfall event should not exceed the greenfield run-off volume for the same event.

4.2.6.3 However, as detailed above, the minimum discharge rate it is considered can be provided would be approximately 3 litres per second.

4.2.6.4 Whilst the greenfield rate will be marginally exceeded at peak flow times, it is considered that this additional peak flow will not be sufficient to create any exceedance issues due to the agricultural nature of the area.

4.2.6.5 We consider that the impact on the receiving watercourse has been minimised as far as is reasonably practicable.

4.2.7 Pollution Control

4.2.7.1 It is a requirement to ensure that the quality of any receiving body is not adversely affected by the development.

4.2.7.2 Investigations have revealed that the development site overlays a Secondary (undifferentiated) aquifer and lies within an area where the Groundwater Vulnerability is classified as 'High'.

4.2.7.3 In order to minimise the risk of pollution to the final watercourse, clean roof water drainage should discharge directly into the sealed drainage network (i.e. not via gullies) prior to the outfall.

4.2.7.4 Surface water run-off from the paved areas should discharge to the sewer via trapped gullies or drainage channels.

4.2.7.5 Discharge to a watercourse enables dilution to take place at the discharge point and thus reduces the likelihood of pollution occurring.

4.2.7.6 In order to further minimise the risk of pollutants entering the watercourse, it is recommended that the final inspection chambers prior to each discharge to the watercourse should contain a silt trap.

4.2.7.7 On this basis, it is considered that the risk of pollutants being discharged to the watercourse is extremely remote.

4.2.8 Designing for Exceedance

4.2.8.1 Overland flood risk from exceedance flows and from off-site sources will be mitigated to a large extent by the creation of the new surface water drainage system as detailed within this report.

4.2.8.2 Where possible proposed ground levels will be best to channel flows away from the proposed building. Furthermore, the ground floor construction level for the building will be raised by a minimum of 150mm above the finished ground level in order to provide additional clearance above any likely flooding.

4.2.8.3 The existing overland flow routes should generally be maintained within the final layout of the development site without increasing the flood risk to off-site parties.

4.2.8.4 Any existing flood risk may reduce by the creation of a formal surface water drainage system but cannot be entirely removed.

4.2.8.5 Indicative drawings showing the anticipated overland surface water flood routing are included in Appendix D.

4.2.9 Highways Drainage

4.2.9.1 There is no formal highway drainage involved with the development.

4.2.10 Urban Creep

4.2.10.1 The project is agricultural and under the control of a single developer and consequently there is no requirement to allow an additional 10% to the calculated impermeable area within the design for urban creep.

4.2.11 Water Quality

4.1.11.1 The water quality from the development via the surface water drainage system has been assessed in accordance with the simple index approach set out in Chapter 26 of the CIRIA SuDS Manual C753.

4.1.11.2 The output shows that the water quality from the roof area and external paving is of an acceptable standard without any further treatment.

4.1.11.3 A copy of the matrix output from the assessment of the roof and paving is included in Appendix E.

4.3 Foul Water Drainage

4.3.1 The new development incorporates amenity facilities including toilets, wash hand basins and a shower.

4.3.2 There are no public sewers in the vicinity of the development and consequently an appropriate foul waste water treatment plant will need to be provided, with the treated waste water discharging into the ground or to the watercourse. Formal consent for the discharge will need to be obtained.

4.3.3 Assuming a maximum of 6 permanent full time site staff and guidance from British Water Flows and Loads 4, the maximum water consumption is unlikely to exceed 600 litres per day. Including design factors, the peak flow from the development would be negligible.

4.3.4 The details of the treatment package plant and the outfall will be finalised at detailed design stage.

4.3.5 An indicative foul water drainage layout is shown on the drawing included in Appendix C.

5.0 OPERATION AND MAINTENANCE

5.1 The drainage pipework is designed with self-cleansing gradients and consequently the network should require little or no maintenance.

5.2 All road gullies or drainage channel systems serving areas of hardstanding will need to be regularly inspected to ensure the system remains operable. See Table 6 below.

5.3 The inspection chambers should be regularly inspected to ensure the system is free-flowing. See Table 6 below.

Table 6: Operation and Maintenance Requirements for Silt Traps/Trapped Gullies (Based on CIRIA C753 Table 14.2)

Maintenance schedule	Required action	Typical frequency
Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	6 monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following significant spill
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	6 monthly
	Inspect filter media and establish appropriate replacement frequencies	6 monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every 6 months
*During the first year of operation, inspections should be carried out at least monthly (and after significant storm events) to ensure that the system is functioning as designed and that no damage is evident.		

5.4 On the basis that a Hydro-Brake® Vortex Flow Control Device station needs to be provided, then this should be maintained as set out in Table 7 below.

Table 7: Operation and Maintenance Requirements for Hydro-Brake® Vortex Flow Control Device (Based on Manufacturer's recommendations)

Maintenance schedule	Required action	Typical frequency
Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	6 monthly
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following significant spill
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Monthly during the first three months, then every 6 months
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every 6 months

5.5 Operation and maintenance requirements for the attenuation lagoon are set out in Table 8 below.

Table 8: Operation and Maintenance Requirements for Attenuation Lagoon

Maintenance schedule	Required action	Typical frequency*
Routine maintenance	Remove litter and debris	6 monthly
	Vegetation management	As required
Occasional maintenance	Clean inlet/outlet pipe	As required
Remedial actions	Repair/re-construct damaged component/structure	As required
	Remove silt and debris	As required
Monitoring	Inspect for evidence of damage or erosion	6 monthly
	Inspect sediment accumulation	Yearly
*During the first year of operation, inspections should be carried out at least monthly (and after significant storm events) to ensure that the system is functioning as designed and that no damage is evident.		

5.6 Operation and Maintenance of Waste Water Treatment Plants shall be carried out in accordance with the manufacturer's specification, and in accordance with any relevant local authority requirements. In the absence of any recommendations from the manufacturer the following guidelines may apply, detailed further in British Water Code of Practice for Maintenance and Servicing of Small Wastewater Treatment Systems (Package Plants).

5.7 The package sewage treatment plant should be regularly inspected and maintained to ensure it remains operational. See Table 10 below.

Table 10: Operation and Maintenance Requirements for Package Sewage Treatment Plant

Maintenance schedule	Required action	Typical frequency*
Monitoring	Check air blower is operational	Weekly
	Check beacon is not flashing, if flashing call service engineer	Weekly
Routine maintenance	Air blower - inspect intake filter, clean or replace	6 monthly
	Kiosk - visual inspection for damage repair or replace	6 monthly
	Aeration chamber - visual inspection for damage, repair or replace	6 monthly
	Outlet pipe - check for blockages, clean as necessary	6 monthly
	Alarm - test alarm is functioning, repair or replace	6 monthly
Occasional maintenance	Air blower - install service kit and filter kit (new diaphragms)	18 monthly
	De-sludging - inspect level of solid settlement. De-sludge when volume exceeds 70%	6 monthly

5.8 Operation and maintenance requirements of the drainage components, as listed above, should be undertaken in accordance with Chapter 32 of the CIRIA SuDS Manual, along with the relevant tables and any relevant manufacturer's recommendations. See also BS 8582:2013 Code of Practice for Surface Water Management for Development Sites Section 11 and Susdrain Fact Sheet on SuDS Maintenance and Adoption Options (England) dated September 2015.

5.9 The personnel undertaking the maintenance should have appropriate experience of SuDS and drainage maintenance and should be capable of keeping sufficiently detailed records of any inspections. If personnel do not have appropriate experience, then specific inspection visits may be necessary. During the first year of operations of SuDS, inspections should usually be carried out at monthly intervals (and after significant storm events).

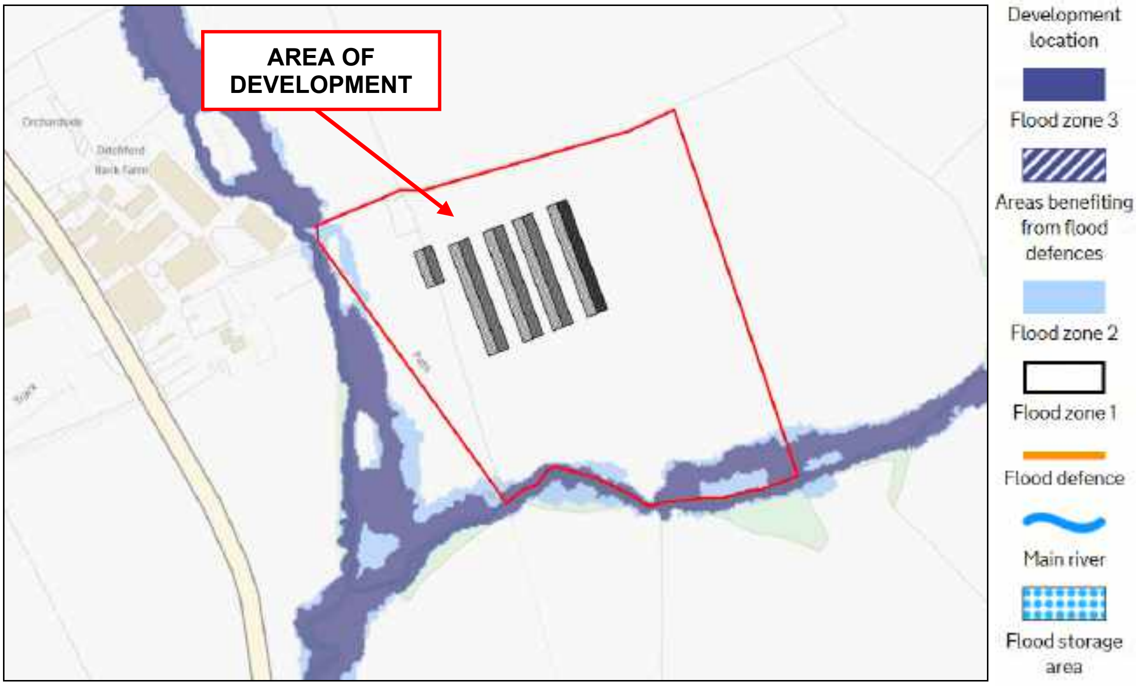
5.10 The responsibility for the operation and maintenance of the drainage and SuDS will lie with G O Few and Son, or any subsequent landowner of the site.

6.0 FLOOD RISK ASSESSMENT

6.1 Flood Zone

6.1.1 A copy of the Environment Agency Flood Map for Planning is included in Figure 4 below, which identifies the development site to be located within an area designated as Flood Zone 1, (low probability of flooding), with a less than 1 in 1000 annual probability of flooding in any year.

Figure 4: Environment Agency flood map for planning dated April 2021



6.2 Fluvial Flooding

6.2.1 Seeley Brook lies approximately 200m to the west of the development.

6.2.2 There is a small open watercourse located approximately 200m south of the development.

6.2.3 The site is considered to be sufficiently elevated and at a sufficient distance from these potential flood sources not to be at risk of flooding.

6.2.4 The risk of flooding to the development from this potential flood source is considered to be low and acceptable.

6.3 Flooding from Open Drainage Ditches

6.3.1 There is an open drainage ditch in the vicinity of the development site.

6.3.2 The risk of flooding to the development from this potential flood source is considered to be low and acceptable.

6.4 Surface Water Flooding

6.4.1 A copy of the Environment Agency map showing the extent of flooding from surface water is included in Figure 5 below.

Figure 5: Environment Agency map dated April 2021 showing the extent of flooding from surface water

6.4.2 The map shows that the new buildings lie in an area which is considered to be at 'very low risk' from overland surface water flooding.

6.4.3 The risk of flooding to the development from this potential flood source is considered to be low and acceptable.

6.5 Groundwater Flooding

6.5.1 Groundwater flooding can occur when the sub-surface water levels are high and emerges above ground level.

6.5.2 It is not anticipated that the proposed development will involve deep excavation works and consequently the risk to the development from this potential flood source is considered to be low and acceptable.

6.5.3 The risk of flooding to the development from this potential flood source is considered to be low and acceptable.

6.6 Flood Risk from Existing Water Mains

6.6.1 There are no existing water mains in the vicinity of the development.

6.6.2 The risk of flooding to the development from this potential flood source is considered to be low and acceptable.

6.7 Flood Risk from Existing Drainage Services

6.7.1 There are no existing drainage services in the vicinity of the development.

6.7.2 The risk of flooding to the development from this potential flood source is considered to be low and acceptable.

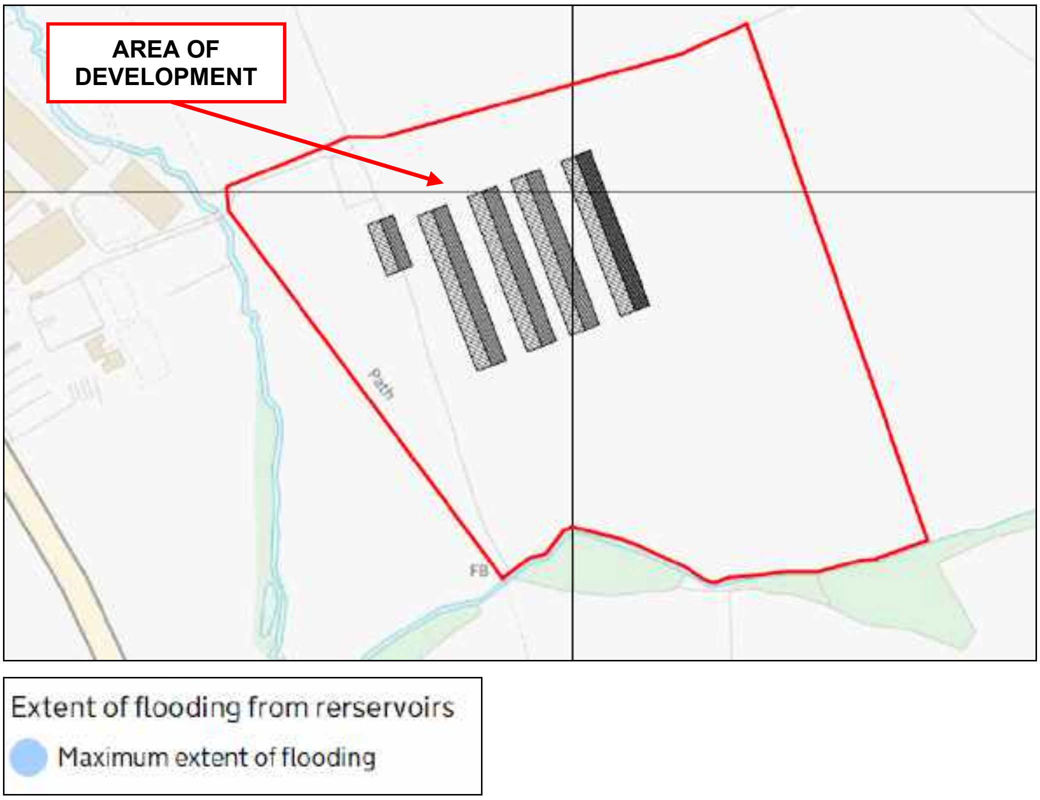
6.8 Flood Risk from Reservoirs, Canals and Other Artificial Sources

6.8.1 A study of the local area shows that there are a number of small ponds located approximately 900m to the north west of the development.

6.8.2 Due to the scale of these water features and their distance from the site, it is not considered that they pose any risk of flooding to the development.

6.8.3 A copy of the map produced by the Environment Agency showing the extent of flooding from reservoirs is included in Figure 6 below.

Figure 6: Environment Agency map dated April 2021 showing the extent of flooding from reservoirs



6.8.4 The map shows that the new buildings are not considered to be at risk from reservoir flooding.

6.8.5 The risk of flooding to the development from this potential flood source is considered to be low and acceptable.

7.0 FLOOD MITIGATION MEASURES

7.1 The building development is shown to lie within an area classified as 'low probability' of flooding on the maps produced by the Environment Agency.

7.2 The building development is not shown to be at risk from surface water flooding, or from reservoir flooding on the maps produced by the Environment Agency.

7.3 It is considered that the floor level of the new poultry unit buildings can be constructed at traditional levels of construction, normally approximately 150mm above adjacent external ground level. For this development, this would result in a floor construction level of approximately 67.5m OD(N).

7.4 At this level of construction, the development is considered to be adequately elevated above any potential flood source.

7.5 On this basis no specific flood mitigation measures are considered necessary in respect of the proposed development.

8.0 SUMMARY

8.1 This report has been prepared to assess the flood risk and drainage implications for the construction of a new poultry unit on land at Ditchford Bank Farm, Hanbury, Bromsgrove, Worcestershire.

8.2 The area of the new buildings fall in Flood Zone 1 (low probability of flooding) on the Environment Agency maps and the proposals are considered to be 'Less Vulnerable' in terms of flood vulnerability (Table 3) which is considered to be appropriate development in terms of flood zone compatibility (Table 4).

8.3 The area of the new buildings are not shown to be at risk from overland surface water flooding or from reservoir flooding on the maps produced from the Environment Agency.

8.4 The surface water drainage for the development should be installed in accordance with Section 4 of this report to ensure the development does not increase the risk of flooding to other parties.

8.5 This report has considered potential sources of flooding to the site, including fluvial, groundwater, surface water, existing sewers, water mains and other artificial sources.

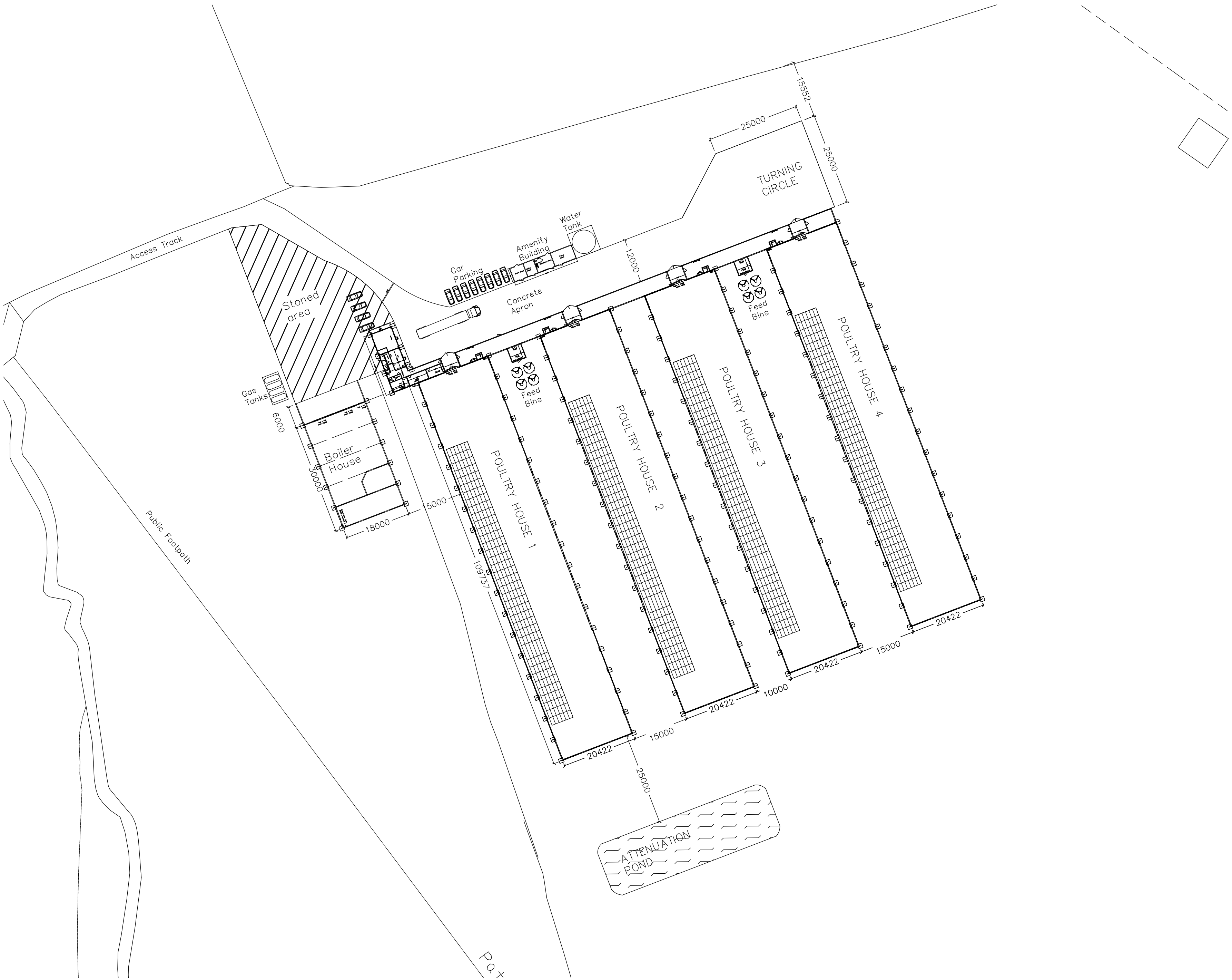
8.6 Overall, this report demonstrates that the flood risk to the site is reasonable and acceptable.

8.7 The report also demonstrates that the site can be suitably drained, with the development being designed to the required standards.

8.8 Suitably worded conditions can be applied to the grant of planning permission to control the delivery of the development in the usual manner.

APPENDIX A

Indicative Layout Drawings



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CLIENT

G O Few and Son
Ditchford Bank Farm
Hanbury
Bromsgrove
Worcestershire
B60 4HS

JOB TITLE

Proposed Poultry Unit

DWG. TITLE

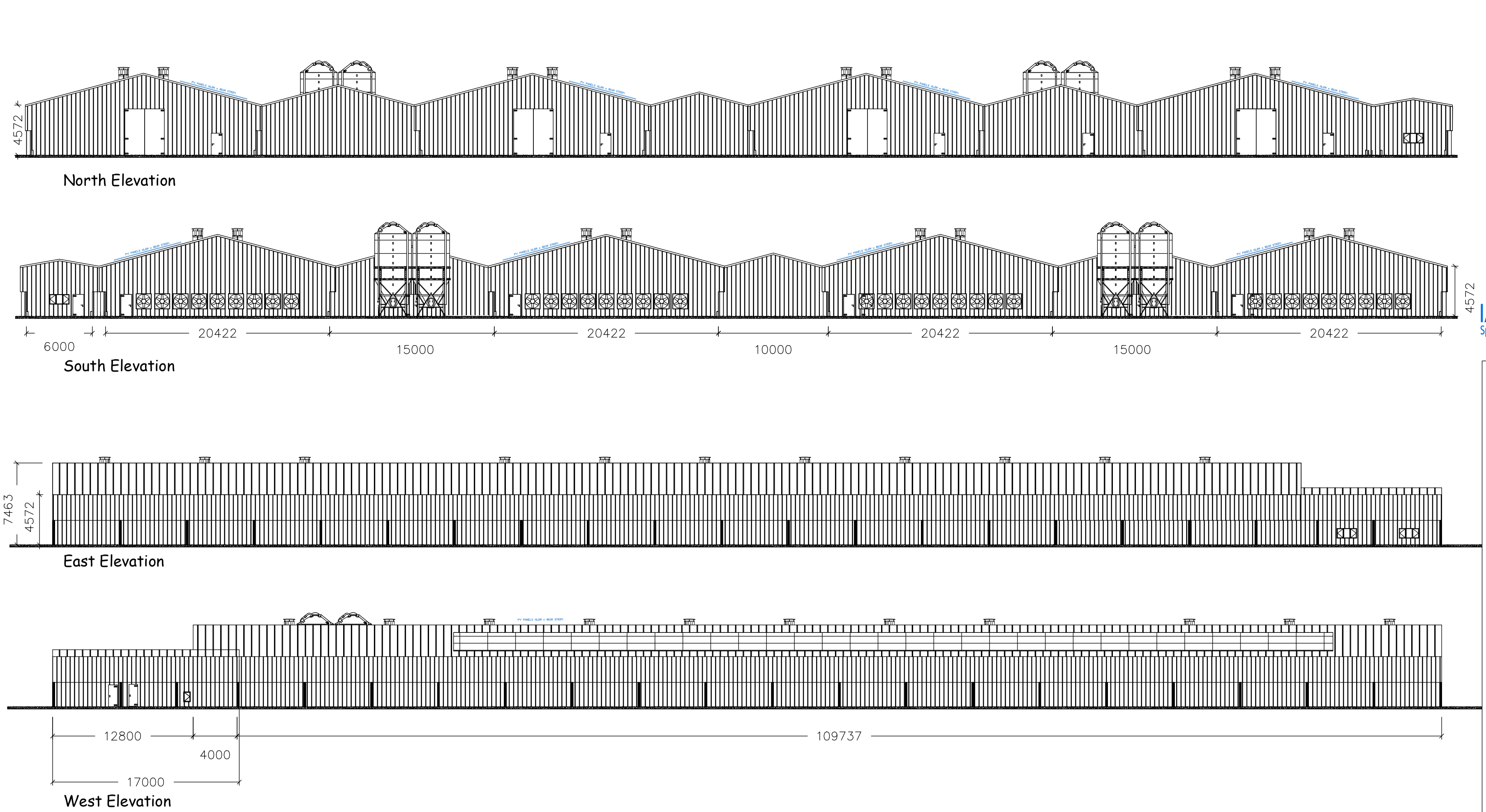
Site Plan A1

SCALE	*DRN*
1=500	IP

DWG. NUMBER

IP/GOF/02

DATE	*REV*
Mar 21	-



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JOB TITLE

Proposed Poultry Unit

DWG. TITLE

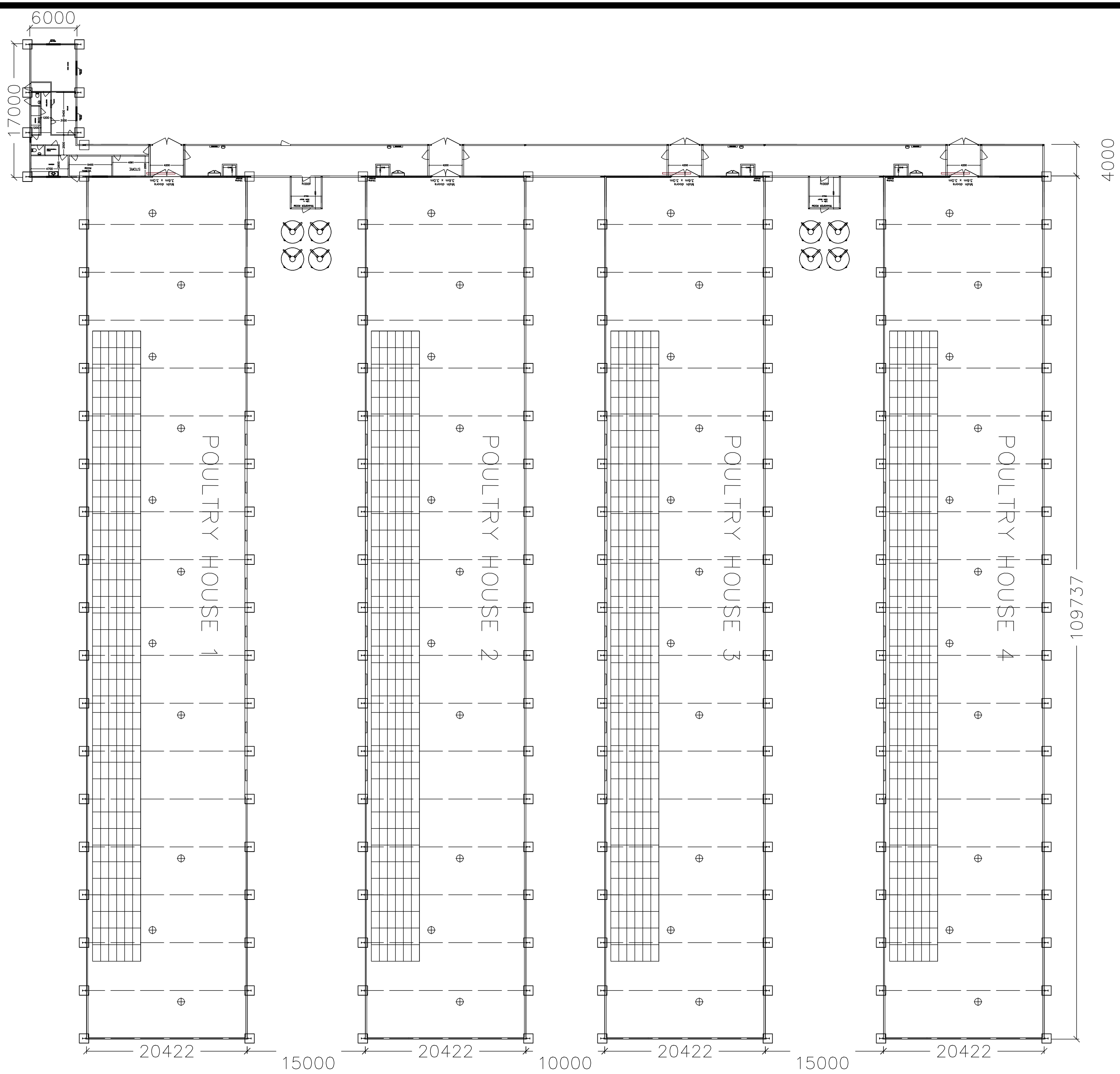
Elevations Poutry Houses A1

SCALE	DRN
1=200	IP

DWG. NUMBER

IP/GOF/03

DATE	REV
Mar 21	-



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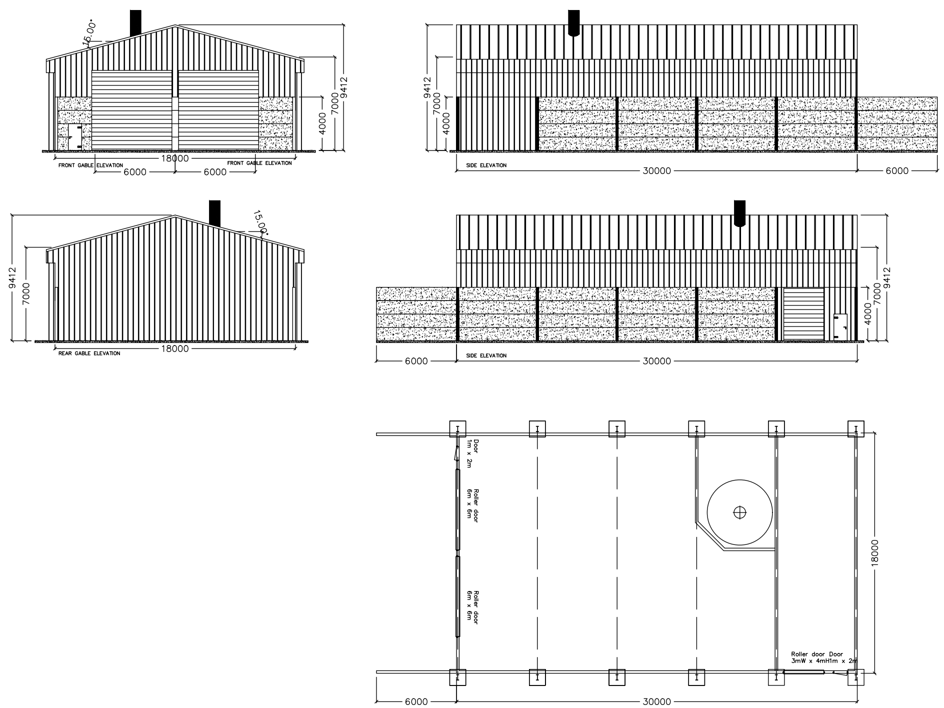
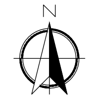
CLIENT	G O Few and Son Ditchford Bank Farm Hanbury Bromsgrove Worcestershire B60 4HS
JOB TITLE	Proposed Poultry Unit
DWG. TITLE	Floor Plans Poutry Houses A1
SCALE	1=250
DRN	IP
DWG. NUMBER	IP/GOF/04
DATE	Mar 21
REV	-





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Worcestershire
B60 4HS

JOB TITLE

Proposed Poultry Unit

DWG. TITLE

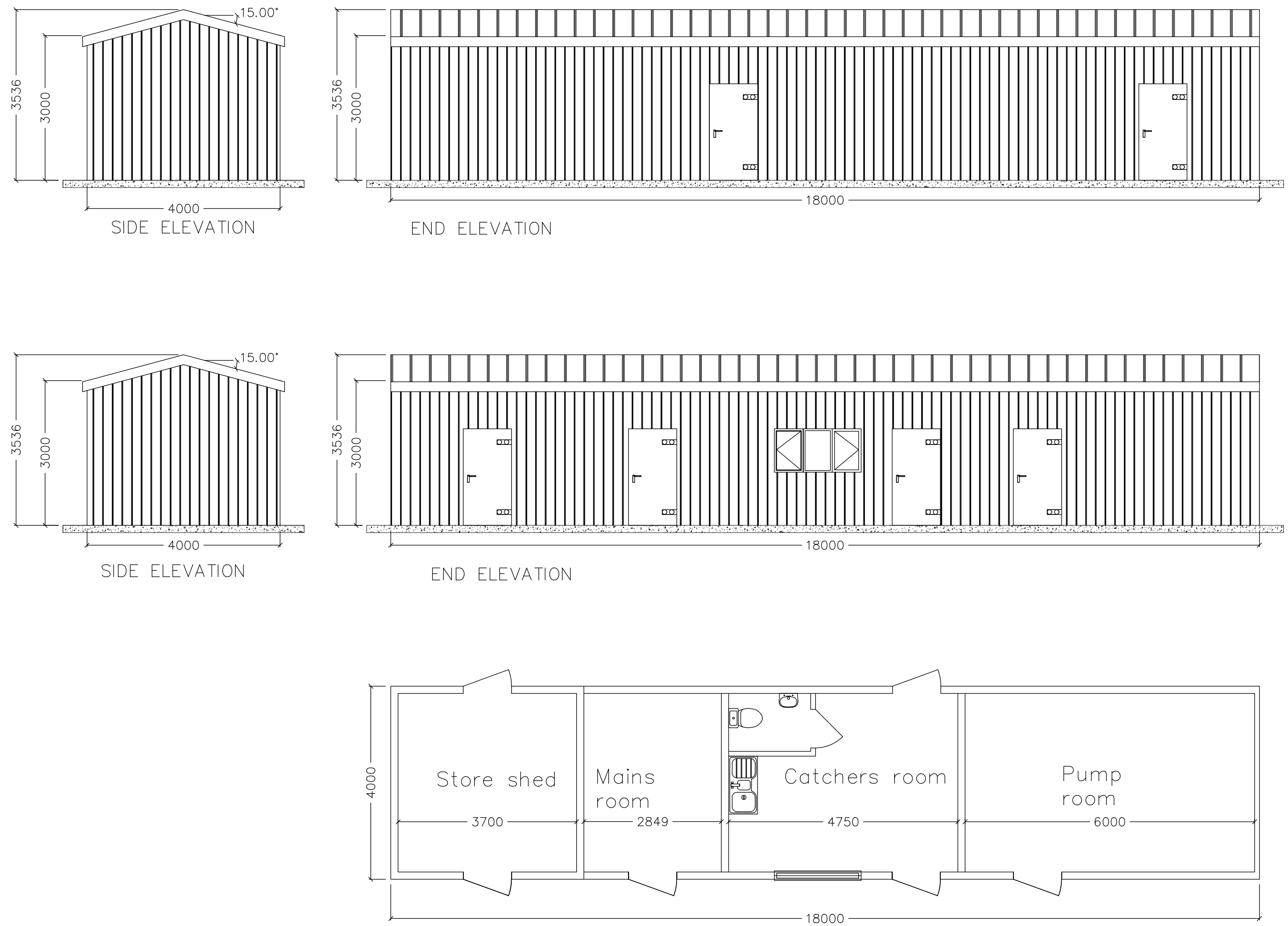
Biomass Boiler House Elevations
A1

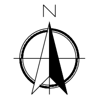
SCALE	DRN
1=200	IP

DWG. NUMBER

IP/GOF/05

DATE	REV
Mar 21	-





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Worcestershire
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JOB TITLE

Proposed Poultry Unit

DWG. TITLE

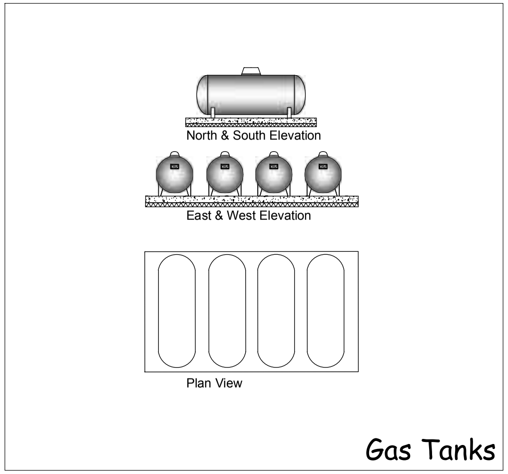
Amenity Building Elevations A1

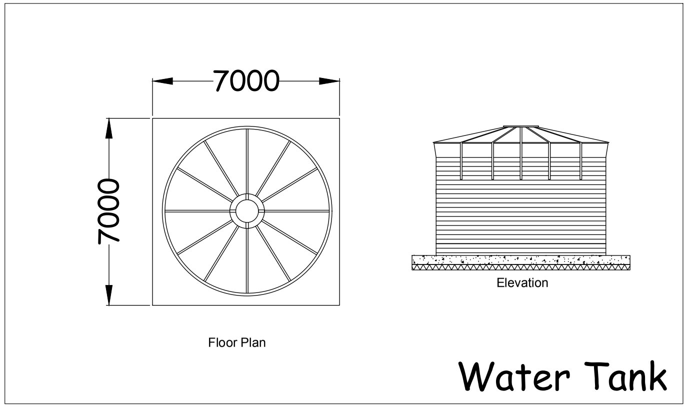
SCALE	*DRN*
1=50	IP

DWG. NUMBER

IP/GOF/06

DATE	*REV*
Mar 21	-





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JOB TITLE

Proposed Poultry Unit

DWG. TITLE

Water and Gas Tanks A1

SCALE	DRN
1=100	IP

DWG. NUMBER

IP/GOF/07

DATE	REV
Mar 21	-

APPENDIX B

Hydraulic Model Study

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	19.100	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.400	4-8	0.818	8-12	0.000

Total Area Contributing (ha) = 1.218

Total Pipe Volume (m³) = 82.082

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	55.685	0.655	85.0	0.048	1.00	0.0	0.600	o	300	Pipe/Conduit	🔒
S1.001	55.685	0.597	93.3	0.048	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	1.54	66.600	0.048	0.0	0.0	0.0	1.71	120.6	6.5
S1.001	50.00	2.11	65.945	0.096	0.0	0.0	0.0	1.63	115.1	13.0

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.002	26.538	0.227	116.9	0.039	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	54.316	0.690	78.7	0.050	1.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	54.316	0.689	78.8	0.050	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	8.547	0.089	96.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	54.279	0.735	73.8	0.050	1.00	0.0	0.600	o	300	Pipe/Conduit	
S3.001	54.279	0.734	73.9	0.050	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	25.745	0.425	60.6	0.039	0.00	0.0	0.600	o	300	Pipe/Conduit	
S4.000	55.512	0.901	61.6	0.049	1.00	0.0	0.600	o	225	Pipe/Conduit	
S4.001	55.512	0.900	61.7	0.049	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	5.300	0.053	100.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S5.000	55.431	0.928	59.7	0.049	1.00	0.0	0.600	o	225	Pipe/Conduit	
S5.001	55.431	1.000	55.4	0.049	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.002	50.00	2.42	65.348	0.135	0.0	0.0	0.0	1.45	102.7	18.3
S2.000	50.00	1.51	66.500	0.050	0.0	0.0	0.0	1.77	125.4	6.8
S2.001	50.00	2.02	65.810	0.100	0.0	0.0	0.0	1.77	125.3	13.5
S1.003	50.00	2.51	65.121	0.235	0.0	0.0	0.0	1.60	113.4	31.8
S3.000	50.00	1.49	66.500	0.050	0.0	0.0	0.0	1.83	129.5	6.8
S3.001	50.00	1.99	65.765	0.100	0.0	0.0	0.0	1.83	129.4	13.5
S1.004	50.00	2.72	65.031	0.374	0.0	0.0	0.0	2.02	143.0	50.6
S4.000	50.00	1.55	66.500	0.049	0.0	0.0	0.0	1.67	66.4	6.6
S4.001	50.00	2.11	65.599	0.098	0.0	0.0	0.0	1.67	66.3	13.3
S1.005	50.00	2.77	64.531	0.472	0.0	0.0	0.0	1.81	200.1	63.9
S5.000	50.00	1.54	66.500	0.049	0.0	0.0	0.0	1.70	67.4	6.6
S5.001	50.00	2.07	65.572	0.098	0.0	0.0	0.0	1.76	70.0	13.3

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.006	25.851	0.260	99.5	0.039	0.00	0.0	0.600	o	375	Pipe/Conduit	
S6.000	53.857	1.020	52.8	0.050	1.00	0.0	0.600	o	225	Pipe/Conduit	
S6.001	53.857	1.168	46.1	0.050	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.007	9.754	0.101	97.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S7.000	53.730	1.108	48.5	0.050	1.00	0.0	0.600	o	225	Pipe/Conduit	
S7.001	53.730	1.181	45.5	0.050	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.008	24.819	0.836	29.7	0.039	0.00	0.0	0.600	o	375	Pipe/Conduit	
S8.000	39.466	0.395	100.0	0.118	1.00	0.0	0.600	o	300	Pipe/Conduit	
S8.001	26.712	0.418	64.0	0.034	0.00	0.0	0.600	o	300	Pipe/Conduit	
S9.000	18.560	0.186	100.0	0.004	1.00	0.0	0.600	o	225	Pipe/Conduit	
S9.001	9.465	0.952	9.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.006	50.00	3.01	64.421	0.609	0.0	0.0	0.0	1.82	200.6	82.5
S6.000	50.00	1.50	66.500	0.050	0.0	0.0	0.0	1.80	71.7	6.8
S6.001	50.00	1.96	65.480	0.100	0.0	0.0	0.0	1.93	76.8	13.5
S1.007	50.00	3.09	64.161	0.709	0.0	0.0	0.0	1.84	203.2	96.0
S7.000	50.00	1.48	66.500	0.050	0.0	0.0	0.0	1.88	74.9	6.8
S7.001	50.00	1.94	65.392	0.100	0.0	0.0	0.0	1.94	77.3	13.5
S1.008	50.00	3.22	64.061	0.848	0.0	0.0	0.0	3.34	368.4	114.8
S8.000	50.00	1.42	66.100	0.118	0.0	0.0	0.0	1.57	111.1	16.0
S8.001	50.00	1.64	65.705	0.152	0.0	0.0	0.0	1.97	139.2	20.6
S9.000	50.00	1.24	66.500	0.004	0.0	0.0	0.0	1.31	52.0	0.5
S9.001	50.00	1.27	66.314	0.004	0.0	0.0	0.0	4.17	165.9	0.5

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S8.002	30.904	0.309	100.0	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S10.000	7.205	0.972	7.4	0.004	1.00	0.0	0.600	o	150	Pipe/Conduit	🔒
S8.003	5.837	0.058	100.0	0.003	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S8.004	13.104	0.131	100.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S8.005	23.269	0.233	99.9	0.005	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S11.000	58.322	0.583	100.0	0.033	1.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S11.001	23.458	0.235	100.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔓
S11.002	28.527	1.052	27.1	0.032	0.00	0.0	0.600	o	225	Pipe/Conduit	🔓
S8.006	9.287	0.093	100.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S8.007	53.990	0.540	100.0	0.048	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S8.008	53.990	0.623	86.7	0.048	0.00	0.0	0.600	o	300	Pipe/Conduit	🔓
S1.009	18.420	0.093	198.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	🔓
S12.000	13.611	0.368	37.0	0.000	1.00	0.0	0.600	o	375	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S8.002	50.00	1.97	65.288	0.197	0.0	0.0	0.0	1.57	111.1	26.7
S10.000	50.00	1.03	66.100	0.004	0.0	0.0	0.0	3.72	65.8	0.5
S8.003	50.00	2.03	64.978	0.204	0.0	0.0	0.0	1.57	111.1	27.6
S8.004	50.00	2.17	64.920	0.204	0.0	0.0	0.0	1.57	111.1	27.6
S8.005	50.00	2.42	64.789	0.209	0.0	0.0	0.0	1.57	111.2	28.3
S11.000	50.00	1.74	66.500	0.033	0.0	0.0	0.0	1.31	52.0	4.5
S11.001	50.00	2.04	65.917	0.033	0.0	0.0	0.0	1.31	52.0	4.5
S11.002	50.00	2.23	65.682	0.065	0.0	0.0	0.0	2.52	100.3	8.8
S8.006	50.00	2.52	64.556	0.274	0.0	0.0	0.0	1.57	111.1	37.1
S8.007	50.00	3.09	64.463	0.322	0.0	0.0	0.0	1.57	111.1	43.6
S8.008	50.00	3.62	63.923	0.370	0.0	0.0	0.0	1.69	119.4	50.1
S1.009	50.00	3.84	63.150	1.218	0.0	0.0	0.0	1.44	229.2	164.9
S12.000	50.00	1.08	63.500	0.000	0.0	0.0	0.0	2.99	329.9	0.0

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.010	97.619	0.976	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.010	50.00	5.46	63.057	1.218	0.0	0.0	0.0	1.00	17.8«	164.9

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.048	0.048	0.048
1.001	-	-	100	0.048	0.048	0.048
1.002	-	-	100	0.039	0.039	0.039
2.000	-	-	100	0.050	0.050	0.050
2.001	-	-	100	0.050	0.050	0.050
1.003	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.050	0.050	0.050
3.001	-	-	100	0.050	0.050	0.050
1.004	-	-	100	0.039	0.039	0.039
4.000	-	-	100	0.049	0.049	0.049
4.001	-	-	100	0.049	0.049	0.049
1.005	-	-	100	0.000	0.000	0.000
5.000	-	-	100	0.049	0.049	0.049
5.001	-	-	100	0.049	0.049	0.049
1.006	-	-	100	0.039	0.039	0.039
6.000	-	-	100	0.050	0.050	0.050
6.001	-	-	100	0.050	0.050	0.050
1.007	-	-	100	0.000	0.000	0.000
7.000	-	-	100	0.050	0.050	0.050
7.001	-	-	100	0.050	0.050	0.050
1.008	-	-	100	0.039	0.039	0.039
8.000	-	-	100	0.118	0.118	0.118
8.001	-	-	100	0.034	0.034	0.034
9.000	-	-	100	0.004	0.004	0.004
9.001	-	-	100	0.000	0.000	0.000
8.002	-	-	100	0.041	0.041	0.041
10.000	-	-	100	0.004	0.004	0.004
8.003	-	-	100	0.003	0.003	0.003
8.004	-	-	100	0.000	0.000	0.000
8.005	-	-	100	0.005	0.005	0.005
11.000	-	-	100	0.033	0.033	0.033
11.001	-	-	100	0.000	0.000	0.000
11.002	-	-	100	0.032	0.032	0.032
8.006	-	-	100	0.000	0.000	0.000
8.007	-	-	100	0.048	0.048	0.048
8.008	-	-	100	0.048	0.048	0.048
1.009	-	-	100	0.000	0.000	0.000
12.000	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
				Total 1.218	Total 1.218	Total 1.218

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.010	S	63.200	62.081	0.000	0	0

Simulation Criteria for Storm

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.100	Storm Duration (mins)	30
Ratio R	0.400		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S39, DS/PN: S1.010, Volume (m^3): 8.3

Unit Reference	MD-SHE-0066-3000-2550-3000
Design Head (m)	2.550
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	66
Invert Level (m)	63.057
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	2.550	3.0	Kick-Flo®	0.594	1.5
Flush-Flo™	0.288	1.9	Mean Flow over Head Range	-	2.2

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	1.6	1.200	2.1	3.000	3.2	7.000	4.8
0.200	1.9	1.400	2.3	3.500	3.5	7.500	5.0
0.300	1.9	1.600	2.4	4.000	3.7	8.000	5.1
0.400	1.9	1.800	2.6	4.500	3.9	8.500	5.3
0.500	1.8	2.000	2.7	5.000	4.1	9.000	5.4
0.600	1.5	2.200	2.8	5.500	4.3	9.500	5.5
0.800	1.8	2.400	2.9	6.000	4.5		
1.000	2.0	2.600	3.0	6.500	4.6		

Storage Structures for Storm

Tank or Pond Manhole: S38, DS/PN: S12.000

Invert Level (m) 63.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	188.0	2.500	729.3

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.100	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Summer	1	+0%	100/15 Summer				66.661
S1.001	S2	15 Summer	1	+0%	100/15 Summer				66.015
S1.002	S3	15 Summer	1	+0%	30/15 Summer				65.435
S2.000	S4	15 Summer	1	+0%	100/15 Summer				66.561
S2.001	S5	15 Summer	1	+0%	100/15 Summer				65.879
S1.003	S6	15 Summer	1	+0%	30/15 Summer				65.253
S3.000	S7	15 Summer	1	+0%	100/15 Winter				66.560
S3.001	S8	15 Summer	1	+0%	100/15 Summer				65.833
S1.004	S9	15 Summer	1	+0%	30/15 Summer				65.156
S4.000	S10	15 Summer	1	+0%	100/15 Summer				66.561
S4.001	S11	15 Summer	1	+0%	100/15 Summer				65.670
S1.005	S12	15 Summer	1	+0%	30/15 Summer				64.731

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.239	0.000	0.07			8.4	OK	
S1.001	S2	-0.230	0.000	0.12			12.8	OK	
S1.002	S3	-0.213	0.000	0.18			16.8	OK	
S2.000	S4	-0.239	0.000	0.07			8.8	OK	
S2.001	S5	-0.231	0.000	0.11			13.5	OK	
S1.003	S6	-0.168	0.000	0.40			30.0	OK	
S3.000	S7	-0.240	0.000	0.07			8.8	OK	
S3.001	S8	-0.232	0.000	0.11			13.7	OK	
S1.004	S9	-0.175	0.000	0.37			46.9	OK	
S4.000	S10	-0.164	0.000	0.13			8.6	OK	
S4.001	S11	-0.154	0.000	0.21			13.5	OK	
S1.005	S12	-0.175	0.000	0.55			59.5	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S5.000	S13	15 Summer	1	+0%	100/15 Winter				66.561
S5.001	S14	15 Summer	1	+0%	100/15 Summer				65.641
S1.006	S15	15 Summer	1	+0%	30/15 Summer				64.594
S6.000	S16	15 Summer	1	+0%					66.559
S6.001	S17	15 Summer	1	+0%	100/15 Summer				65.547
S1.007	S18	15 Summer	1	+0%	30/15 Summer				64.396
S7.000	S19	15 Summer	1	+0%					66.558
S7.001	S20	15 Summer	1	+0%	100/15 Summer				65.459
S1.008	S21	15 Summer	1	+0%	30/15 Summer				64.215
S8.000	S22	15 Summer	1	+0%	100/15 Summer				66.201
S8.001	S23	15 Summer	1	+0%	100/15 Summer				65.801
S9.000	S24	15 Summer	1	+0%	100/15 Summer				66.520
S9.001	S25	15 Summer	1	+0%	100/15 Summer				66.321
S8.002	S26	15 Summer	1	+0%	30/15 Summer				65.400
S10.000	S27	15 Summer	1	+0%	100/15 Summer				66.111
S8.003	S28	15 Summer	1	+0%	30/15 Summer				65.131
S8.004	S29	15 Summer	1	+0%	30/15 Summer				65.044
S8.005	S30	15 Summer	1	+0%	30/15 Summer				64.905
S11.000	S31	15 Summer	1	+0%					66.556
S11.001	S32	15 Summer	1	+0%	100/15 Summer				65.970
S11.002	S33	15 Summer	1	+0%	100/15 Summer				65.729
S8.006	S34	15 Summer	1	+0%	30/15 Summer				64.709
S8.007	S35	15 Summer	1	+0%	30/15 Summer				64.601
S8.008	S36	15 Summer	1	+0%	1/15 Summer				64.254
S1.009	S37	600 Winter	1	+0%	1/15 Summer				64.179
S12.000	S38	600 Winter	1	+0%	1/30 Winter				64.178
S1.010	S39	600 Winter	1	+0%	1/15 Summer				64.179

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S5.000	S13	-0.164	0.000	0.13			8.6	OK	
S5.001	S14	-0.156	0.000	0.20			13.7	OK	
S1.006	S15	-0.202	0.000	0.44			76.0	OK	
S6.000	S16	-0.166	0.000	0.13			8.8	OK	
S6.001	S17	-0.158	0.000	0.19			14.1	OK	
S1.007	S18	-0.140	0.000	0.70			86.6	OK	
S7.000	S19	-0.167	0.000	0.12			8.8	OK	
S7.001	S20	-0.158	0.000	0.19			14.4	OK	
S1.008	S21	-0.221	0.000	0.32			102.1	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S8.000	S22	-0.199	0.000	0.20			21.1	OK	
S8.001	S23	-0.204	0.000	0.20			25.2	OK	
S9.000	S24	-0.205	0.000	0.02			0.7	OK	
S9.001	S25	-0.219	0.000	0.01			0.8	OK	
S8.002	S26	-0.188	0.000	0.30			30.2	OK	
S10.000	S27	-0.139	0.000	0.01			0.8	OK	
S8.003	S28	-0.147	0.000	0.48			29.4	OK	
S8.004	S29	-0.176	0.000	0.34			30.6	OK	
S8.005	S30	-0.183	0.000	0.32			31.6	OK	
S11.000	S31	-0.169	0.000	0.11			5.7	OK	
S11.001	S32	-0.172	0.000	0.12			5.8	OK	
S11.002	S33	-0.179	0.000	0.09			8.8	OK	
S8.006	S34	-0.147	0.000	0.52			39.4	OK	
S8.007	S35	-0.162	0.000	0.41			43.4	OK	
S8.008	S36	0.031	0.000	0.41			45.9	SURCHARGED	
S1.009	S37	0.579	0.000	0.10			17.0	SURCHARGED	
S12.000	S38	0.303	0.000	0.01			2.5	SURCHARGED	
S1.010	S39	0.972	0.000	0.12			2.1	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.100	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Summer	30	+0%	100/15 Summer				66.696
S1.001	S2	15 Summer	30	+0%	100/15 Summer				66.065
S1.002	S3	15 Winter	30	+0%	30/15 Summer				65.778
S2.000	S4	15 Summer	30	+0%	100/15 Summer				66.596
S2.001	S5	15 Summer	30	+0%	100/15 Summer				65.928
S1.003	S6	15 Winter	30	+0%	30/15 Summer				65.709
S3.000	S7	15 Summer	30	+0%	100/15 Winter				66.594
S3.001	S8	15 Summer	30	+0%	100/15 Summer				65.881
S1.004	S9	15 Winter	30	+0%	30/15 Summer				65.618
S4.000	S10	15 Summer	30	+0%	100/15 Summer				66.600
S4.001	S11	15 Summer	30	+0%	100/15 Summer				65.724
S1.005	S12	15 Winter	30	+0%	30/15 Summer				65.451

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.204	0.000	0.18			20.5	OK	
S1.001	S2	-0.180	0.000	0.32			35.2	OK	
S1.002	S3	0.130	0.000	0.48			44.0	SURCHARGED	
S2.000	S4	-0.204	0.000	0.18			21.3	OK	
S2.001	S5	-0.182	0.000	0.31			37.3	OK	
S1.003	S6	0.288	0.000	0.89			66.8	SURCHARGED	
S3.000	S7	-0.206	0.000	0.17			21.3	OK	
S3.001	S8	-0.184	0.000	0.31			37.7	OK	
S1.004	S9	0.287	0.000	0.79			101.7	SURCHARGED	
S4.000	S10	-0.125	0.000	0.33			20.9	OK	
S4.001	S11	-0.100	0.000	0.56			36.0	OK	
S1.005	S12	0.544	0.000	0.98			105.4	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S5.000	S13	15 Summer	30	+0%	100/15 Winter				66.599
S5.001	S14	15 Summer	30	+0%	100/15 Summer				65.692
S1.006	S15	15 Winter	30	+0%	30/15 Summer				65.354
S6.000	S16	15 Summer	30	+0%					66.597
S6.001	S17	15 Summer	30	+0%	100/15 Summer				65.597
S1.007	S18	15 Winter	30	+0%	30/15 Summer				65.183
S7.000	S19	15 Summer	30	+0%					66.595
S7.001	S20	15 Summer	30	+0%	100/15 Summer				65.509
S1.008	S21	15 Winter	30	+0%	30/15 Summer				65.000
S8.000	S22	15 Summer	30	+0%	100/15 Summer				66.269
S8.001	S23	15 Summer	30	+0%	100/15 Summer				65.868
S9.000	S24	15 Summer	30	+0%	100/15 Summer				66.531
S9.001	S25	15 Summer	30	+0%	100/15 Summer				66.331
S8.002	S26	15 Winter	30	+0%	30/15 Summer				65.726
S10.000	S27	15 Summer	30	+0%	100/15 Summer				66.119
S8.003	S28	15 Winter	30	+0%	30/15 Summer				65.634
S8.004	S29	15 Winter	30	+0%	30/15 Summer				65.552
S8.005	S30	15 Winter	30	+0%	30/15 Summer				65.435
S11.000	S31	15 Summer	30	+0%					66.592
S11.001	S32	15 Summer	30	+0%	100/15 Summer				66.003
S11.002	S33	15 Summer	30	+0%	100/15 Summer				65.760
S8.006	S34	15 Winter	30	+0%	30/15 Summer				65.317
S8.007	S35	15 Winter	30	+0%	30/15 Summer				65.218
S8.008	S36	15 Winter	30	+0%	1/15 Summer				64.989
S1.009	S37	960 Winter	30	+0%	1/15 Summer				64.901
S12.000	S38	960 Winter	30	+0%	1/30 Winter				64.900
S1.010	S39	960 Winter	30	+0%	1/15 Summer				64.900

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S5.000	S13	-0.126	0.000	0.32			20.9	OK	
S5.001	S14	-0.104	0.000	0.54			36.5	OK	
S1.006	S15	0.558	0.000	0.80			139.7	SURCHARGED	
S6.000	S16	-0.128	0.000	0.31			21.6	OK	
S6.001	S17	-0.108	0.000	0.51			37.9	OK	
S1.007	S18	0.647	0.000	1.35			167.5	SURCHARGED	
S7.000	S19	-0.130	0.000	0.30			21.7	OK	
S7.001	S20	-0.108	0.000	0.52			38.3	OK	
S1.008	S21	0.564	0.000	0.65			206.5	SURCHARGED	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S8.000	S22	-0.131	0.000	0.50			52.1	OK	
S8.001	S23	-0.138	0.000	0.52			65.4	OK	
S9.000	S24	-0.194	0.000	0.04			1.9	OK	
S9.001	S25	-0.208	0.000	0.01			1.9	OK	
S8.002	S26	0.138	0.000	0.72			72.4	SURCHARGED	
S10.000	S27	-0.131	0.000	0.03			2.0	OK	
S8.003	S28	0.356	0.000	1.06			65.2	SURCHARGED	
S8.004	S29	0.332	0.000	0.69			62.4	SURCHARGED	
S8.005	S30	0.346	0.000	0.61			60.4	SURCHARGED	
S11.000	S31	-0.133	0.000	0.28			14.0	OK	
S11.001	S32	-0.139	0.000	0.30			14.3	OK	
S11.002	S33	-0.147	0.000	0.27			24.9	OK	
S8.006	S34	0.462	0.000	0.86			65.6	SURCHARGED	
S8.007	S35	0.456	0.000	0.68			71.2	SURCHARGED	
S8.008	S36	0.766	0.000	0.72			81.3	SURCHARGED	
S1.009	S37	1.301	0.000	0.15			25.2	SURCHARGED	
S12.000	S38	1.025	0.000	0.01			2.4	SURCHARGED	
S1.010	S39	1.693	0.000	0.15			2.6	SURCHARGED	

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.400
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.100 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	100	+40%	100/15 Summer				67.360
S1.001	S2	15 Winter	100	+40%	100/15 Summer				67.348
S1.002	S3	15 Winter	100	+40%	30/15 Summer				67.304
S2.000	S4	15 Winter	100	+40%	100/15 Summer				67.239
S2.001	S5	15 Winter	100	+40%	100/15 Summer				67.226
S1.003	S6	15 Winter	100	+40%	30/15 Summer				67.177
S3.000	S7	15 Winter	100	+40%	100/15 Winter				67.134
S3.001	S8	15 Winter	100	+40%	100/15 Summer				67.122
S1.004	S9	15 Winter	100	+40%	30/15 Summer				67.073
S4.000	S10	15 Winter	100	+40%	100/15 Summer				66.998
S4.001	S11	15 Winter	100	+40%	100/15 Summer				66.967
S1.005	S12	15 Winter	100	+40%	30/15 Summer				66.765

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.460	0.000	0.29			33.5	FLOOD RISK	
S1.001	S2	1.103	0.000	0.46			49.8	FLOOD RISK	
S1.002	S3	1.656	0.000	0.53			49.0	FLOOD RISK	
S2.000	S4	0.439	0.000	0.29			34.9	FLOOD RISK	
S2.001	S5	1.116	0.000	0.44			52.7	FLOOD RISK	
S1.003	S6	1.756	0.000	0.90			67.1	FLOOD RISK	
S3.000	S7	0.334	0.000	0.29			34.9	FLOOD RISK	
S3.001	S8	1.057	0.000	0.44			53.4	FLOOD RISK	
S1.004	S9	1.742	0.000	0.84			107.5	SURCHARGED	
S4.000	S10	0.273	0.000	0.54			34.3	SURCHARGED	
S4.001	S11	1.143	0.000	0.72			45.9	SURCHARGED	
S1.005	S12	1.859	0.000	1.31			140.0	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S5.000	S13	15 Winter	100	+40%	100/15 Winter				66.896
S5.001	S14	15 Winter	100	+40%	100/15 Summer				66.863
S1.006	S15	15 Winter	100	+40%	30/15 Summer				66.639
S6.000	S16	15 Summer	100	+40%					66.639
S6.001	S17	15 Winter	100	+40%	100/15 Summer				66.591
S1.007	S18	15 Winter	100	+40%	30/15 Summer				66.339
S7.000	S19	15 Summer	100	+40%					66.635
S7.001	S20	15 Winter	100	+40%	100/15 Summer				66.316
S1.008	S21	15 Winter	100	+40%	30/15 Summer				66.022
S8.000	S22	15 Winter	100	+40%	100/15 Summer				67.118
S8.001	S23	15 Winter	100	+40%	100/15 Summer				67.042
S9.000	S24	15 Winter	100	+40%	100/15 Summer				66.951
S9.001	S25	15 Winter	100	+40%	100/15 Summer				66.948
S8.002	S26	15 Winter	100	+40%	30/15 Summer				66.946
S10.000	S27	15 Winter	100	+40%	100/15 Summer				66.813
S8.003	S28	15 Winter	100	+40%	30/15 Summer				66.814
S8.004	S29	15 Winter	100	+40%	30/15 Summer				66.738
S8.005	S30	15 Winter	100	+40%	30/15 Summer				66.628
S11.000	S31	15 Summer	100	+40%					66.631
S11.001	S32	15 Winter	100	+40%	100/15 Summer				66.566
S11.002	S33	15 Winter	100	+40%	100/15 Summer				66.552
S8.006	S34	15 Winter	100	+40%	30/15 Summer				66.515
S8.007	S35	15 Winter	100	+40%	30/15 Summer				66.417
S8.008	S36	15 Winter	100	+40%	1/15 Summer				65.999
S1.009	S37	1440 Winter	100	+40%	1/15 Summer				65.698
S12.000	S38	1440 Winter	100	+40%	1/30 Winter				65.696
S1.010	S39	1440 Winter	100	+40%	1/15 Summer				65.697

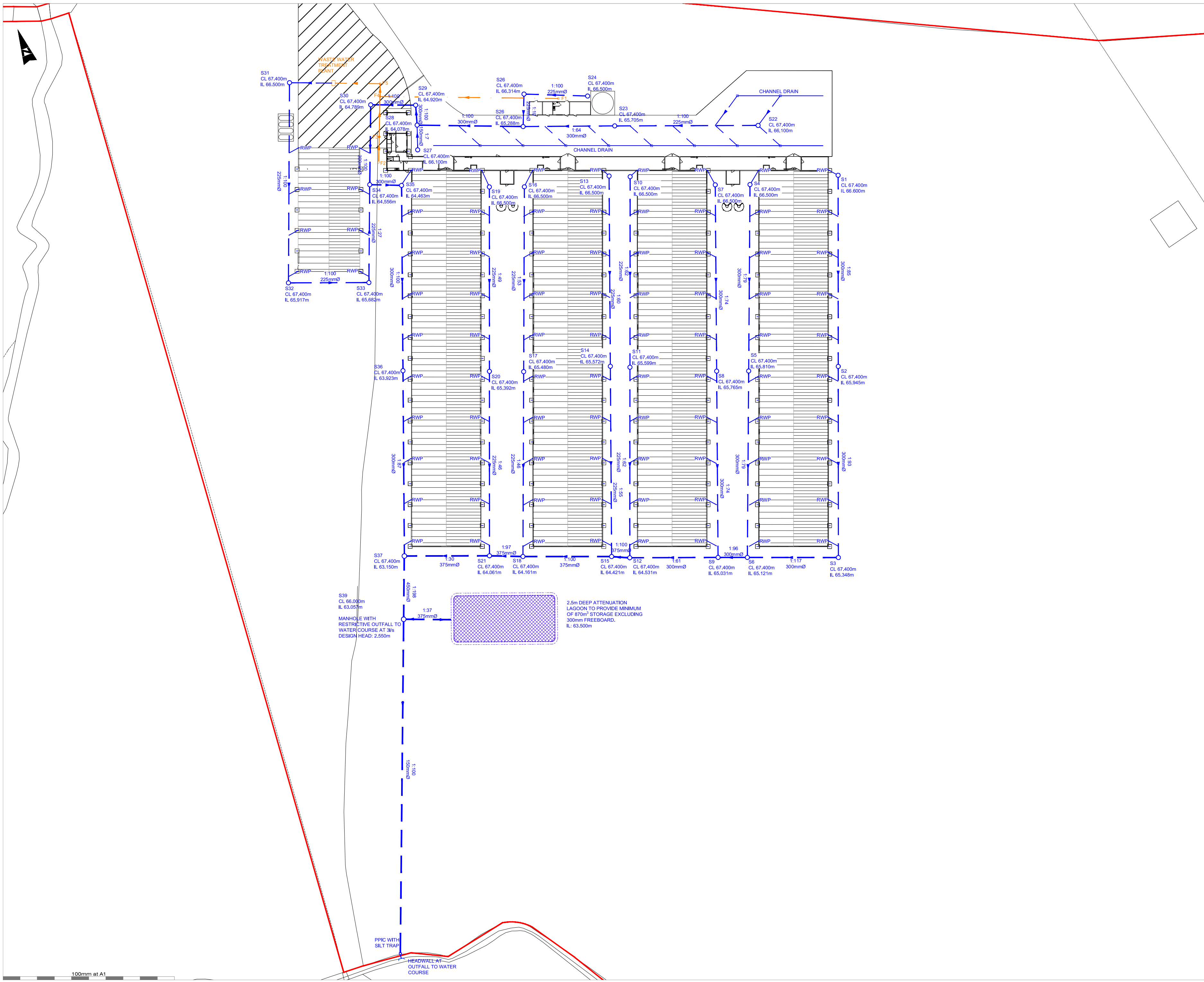
PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S5.000	S13	0.171	0.000	0.53			34.3	SURCHARGED	
S5.001	S14	1.066	0.000	0.69			46.5	SURCHARGED	
S1.006	S15	1.842	0.000	1.06			185.1	SURCHARGED	
S6.000	S16	-0.086	0.000	0.57			39.4	OK	
S6.001	S17	0.886	0.000	0.67			49.5	SURCHARGED	
S1.007	S18	1.803	0.000	1.78			220.3	SURCHARGED	
S7.000	S19	-0.090	0.000	0.55			39.4	OK	
S7.001	S20	0.699	0.000	0.69			51.4	SURCHARGED	
S1.008	S21	1.586	0.000	0.86			274.1	SURCHARGED	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S8.000	S22	0.718	0.000	0.81			83.2	FLOOD RISK	
S8.001	S23	1.036	0.000	0.73			91.9	SURCHARGED	
S9.000	S24	0.226	0.000	0.07			3.1	SURCHARGED	
S9.001	S25	0.408	0.000	0.08			11.5	SURCHARGED	
S8.002	S26	1.358	0.000	0.91			91.9	SURCHARGED	
S10.000	S27	0.563	0.000	0.05			3.0	SURCHARGED	
S8.003	S28	1.536	0.000	1.20			73.8	SURCHARGED	
S8.004	S29	1.518	0.000	0.71			64.8	SURCHARGED	
S8.005	S30	1.540	0.000	0.63			61.8	SURCHARGED	
S11.000	S31	-0.094	0.000	0.51			25.3	OK	
S11.001	S32	0.424	0.000	0.48			22.8	SURCHARGED	
S11.002	S33	0.645	0.000	0.38			35.3	SURCHARGED	
S8.006	S34	1.660	0.000	1.02			77.9	SURCHARGED	
S8.007	S35	1.654	0.000	0.87			91.3	SURCHARGED	
S8.008	S36	1.776	0.000	0.97			109.9	SURCHARGED	
S1.009	S37	2.098	0.000	0.18			31.5	SURCHARGED	
S12.000	S38	1.821	0.000	0.01			2.8	SURCHARGED	
S1.010	S39	2.490	0.000	0.17			3.0	SURCHARGED	

APPENDIX C

Drainage Layout Drawing



NOTES:

1. THESE NOTES ARE INTENDED TO AUGMENT DRAWINGS AND SPECIFICATIONS. WHERE CONFLICT OF REQUIREMENTS EXIST THE ORDER OF PRECEDENCE SHALL BE AS SHOWN IN THE SPECIFICATION. OTHERWISE THE STRICTEST PROVISION SHALL GOVERN.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEERS AND ARCHITECTS DRAWINGS.
3. DRAWINGS NOT TO BE SCALED. ALL DIMENSIONS TO BE CHECKED ON SITE BY THE CONTRACTOR. ANY DISCREPANCIES TO BE NOTIFIED TO THE ENGINEER AND FURTHER INSTRUCTIONS OBTAINED BEFORE WORK IS COMMENCED.
4. THE STRUCTURE IS DESIGNED TO BE SELF-SUPPORTING AND STABLE AFTER THE BUILDING IS FULLY COMPLETED. IT IS THE CONTRACTORS SOLE RESPONSIBILITY TO DETERMINE THE ERECTION PROCEDURE AND SEQUENCE AND ENSURE THAT THE BUILDING AND ITS COMPONENTS ARE SAFE DURING ERECTION. THIS INCLUDES THE ADDITION OF WHATEVER TEMPORARY BRACING, GUYS OR TIE-DOWNS WHICH MAY BE NECESSARY. SUCH MATERIAL REMAINING THE PROPERTY OF THE CONTRACTOR ON COMPLETION, AND FOR ENSURING THAT THE WORKS AND ANY ADJACENT PROPERTIES ARE SAFE IN THE TEMPORARY CONDITION.

KEY:

- PROPOSED SURFACE WATER PIPEWORK
- PROPOSED SURFACE WATER MANHOLE
- RWP PROPOSED RAIN WATER PIPE
- PROPOSED CHANNEL DRAIN
- PROPOSED SURFACE WATER ATTENUATION LAGOON
- WASTE WATER TREATMENT PLANT
- PROPOSED FOUL WATER PIPEWORK
- PROPOSED FOUL WATER MANHOLE

Rev	Description	Date	By	Chk	App
P2	POND MOVED NORTHWARDS	10/05/2021	EL	CD	--
P1	FIRST ISSUE	16/04/2021	DE	AD	--

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Project: PROPOSED POULTRY UNITS, DITCHFORD BANK FARM, WORCESTERSHIRE

Client: GO Few & Sons

Drawing: Proposed Drainage Layout

Role: Civil Engineer

Drawing Status: For Approval

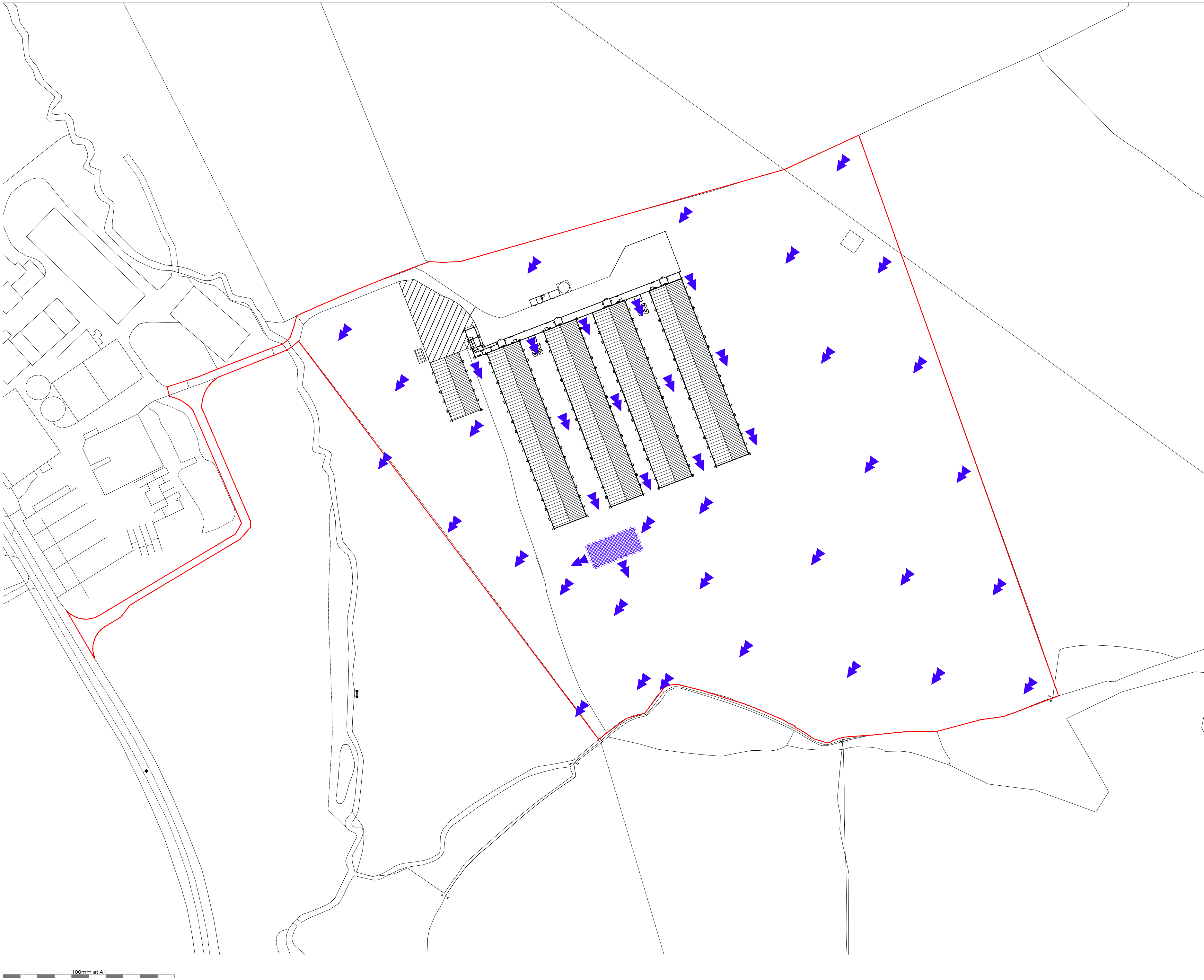
Job no. 45225 | Scale@ A1: 1:500 | Rev. P2

Project - Originator - Volume - Level - Type - Role - Number

GFO - AWP - ZZ - XX - DR - C - 3000

APPENDIX D

Surface Water Exceedance Flood Routing Drawings



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LEGEND:

PROPOSED SURFACE WATER EXCEEDANCE FLOOD ROUTING

Rev	Description	Date	By	Chk	App
P2	UPDATED POSITION OF ATTENUATION POND	07.06.21	DE	AD	CD
P1	FIRST ISSUE	DD.MM.YY	--	--	--

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York T. 01904 611594

Project: PROPOSED POULTRY UNITS, DITCHFORD BANK FARM, WORCESTERSHIRE

Client: GO Few & Sons

Drawing: Proposed Surface Water Exceedance Flood Routing

Role: Civil Engineer

Drawing Status: For Approval

Job. no. 45225 | Scale@ A1: 1:1000 | Rev. P2

Project - Originator - Volume - Level - Type - Role - Number

GFO - AWP - ZZ - XX - DR - C - 4000

NOTES:

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LEGEND:

EXISTING SURFACE WATER EXCEEDANCE FLOOD ROUTING

Rev	Description	Date	By	Chk	App
P1	FIRST ISSUE	14.04.21	DE	AD	--

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Sheffield	T. 01142 440077
York	T. 01904 611594

Project: PROPOSED POULTRY UNITS, DITCHFORD BANK FARM, WORCESTERSHIRE

Client: GO Few & Sons

Drawing: Existing Surface Water Exceedance Flood Routing

Role: Civil Engineer

Drawing Status: For Approval

Job. no. 45225 | Scale@ A1: 1:1000 | Rev. P1

Project - Originator - Volume - Level - Type - Role - Number

GFO - AWP - ZZ - XX - DR - C - 4001

APPENDIX E

CIRIA SuDS Manual Water Quality Matrix Output

SIMPLE INDEX APPROACH: TOOL

1. The steps set out in the tool should be applied for each inflow or 'runoff area' (ie each impermeable surface area separately discharging to a SuDS component).

2. The supporting 'Design Conditions' stated by the tool must be fully considered and implemented in all cases.

3. The process that is automated in this tool is described in the SuDS Manual, Chapter 26 (Section 26.7)

3. Relevant design examples are included in the SuDS Manual Appendix C.

4. Each of the steps below are part of the process set out in the flowchart on Sheet 3.

5. Sheet 4 summarises the selections made below and indicates the acceptability of the proposed SuDS components.

6. Interception should be delivered for all upstream impermeable areas as part of the strategy for water quantity and quality control for the site. This is required in order to deliver both of the water quality criteria set out in Chapter 4 of the SuDS Manual

DROP DOWN LIST	RELEVANT INPUTS NEED TO BE SELECTED FROM THESE LISTS, FOR EACH STEP
USER ENTRY	USER ENTRY CELLS ARE ONLY REQUIRED WHERE INDICATED BY THE TOOL

STEP 1: Determine the Pollution Hazard Index for the runoff area discharging to the proposed SuDS scheme

This step requires the user to select the appropriate land use type for the area from which the runoff is occurring

If the land use varies across the runoff area either

- use the land use type with the highest Pollution Ha ard Inde
- apply the approach for each of the land use types to determine whether the proposed SuDS design is sufficient for all If it is not consider collecting more ha ardous runoff separately and providing additional treatment

If the generic land use types suggested are not applicable select Other and enter a description of the land use of the runoff area and agreed user defined indices in the row below the drop down lists

	Runoff Area Land Use Description	Hazard Level	Pollution Hazard Indices: Total Suspended Solids	Metals	Hydrocarbons
Select land use type from the drop down list (or 'Other' if none applicable): →	Agricultural/industrial roofing Inert materials	Very low	0	0 2	0 05
If the generic land use types in the drop down list above are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in this row:					
	Landuse Pollution Hazard Index	**Very low**	**0.3**	**0.2**	**0.05**

DESIGN CONDITIONS

1

2

STEP 2A: Determine the Pollution Mitigation Index for the proposed SuDS components

This step requires the user to select the proposed SuDS components that will be used to treat runoff - before it is discharged to a receiving surface waterbody or downstream infiltration component
If the runoff is discharged directly to an infiltration component, without upstream treatment, select 'None' for each of the 3 SuDS components and move to Step 2B

This step should be applied to evaluate the water uality protection provided by proposed SuDS components for discharges to receiving surface waters or downstream infiltration components note in England and Wales this will include components that allow any amount of infiltration however small even where infiltration is not specifically accounted for in the design

If you have fewer than components select None for the components that are not re uired

If the proposed component is bespoke and or a proprietary treatment product and not generically described by the suggested components then Proprietary treatment system or User defined indices should be selected and a description of the component and agreed user defined indices should be entered in the rows below the drop down lists

	SuDS Component Description	Pollution Mitigation Indices: Total Suspended Solids	Metals	Hydrocarbons
Select SuDS Component 1 (i.e. the upstream SuDS component) from the drop down list: →	Detention basin	0 5	0 5	0 6
Select SuDS Component 2 (i.e. the second SuDS component in a series) from the drop down list: →	None	0	0	0
Select SuDS Component 3 (i.e. the third SuDS component in a series) from the drop down list: →	None	0	0	0
If the proposed SuDS components are bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary treatment system' or 'User defined indices' and enter component descriptions and agreed user defined indices in these rows:				
	Aggregated Surface Water Pollution Mitigation Index	**0.5**	**0.5**	**0.6**

DESIGN CONDITIONS

1	2
SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual See also checklists in Appendi B	Detention basins should be designed to ensure the effective retention and management of sediment such that the sediment will not be re-suspended and washed out in subse uent events

Note If the total aggregated mitigation inde is 1 which is not a realistic outcome then the outcome is fi ed at 0 5 In this scenario the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use note where risk assessment is re uired this outcome would need more detailed verification

Is the runoff now discharged to an infiltration component?

Yes ? Go to Step 2B
No ? Go to Step 2

STEP 2B: Determine the Pollution Mitigation Index for the proposed Groundwater Protection

This step requires the user to select the type of groundwater protection that is either part of the SuDS component or that lies between the component and the groundwater

This step should be applied where a SuDS component is specifically designed to infiltrate runoff note in England and Wales this will include components that allow any amount of infiltration however small even where infiltration is not specifically accounted for in the design

Groundwater protection describes the proposed depth of soil or other material through which runoff will flow between the runoff surface and the underlying groundwater

Where the discharge is to surface waters and risks to groundwater need not be considered select None

If the proposed groundwater protection is bespoke and or a proprietary product and not generically described by the suggested measures then a description of the protection and agreed user defined indices should be entered in the row below the drop down list

		Pollution Mitigation Indices: Total Suspended Solids	Metals	Hydrocarbons
Select type of groundwater protection from the drop down list: →	None			
If the proposed groundwater protection is bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary product' or 'User defined indices' and enter a description of the protection and agreed user defined indices in this row:				
	Groundwater Protection Pollution Mitigation Index	**0**	**0**	**0**

DESIGN CONDITIONS

1

2

4

STEP 2C: Determine the Combined Pollution Mitigation Indices for the Runoff Area

This is an automatic step which combines the proposed SuDS Pollution Mitigation Indices with any Groundwater Protection Pollution Mitigation Indices

	Combined Pollution Mitigation Indices: Total Suspended Solids	Metals	Hydrocarbons
Combined Pollution Mitigation Indices for the Runoff Area	**0.5**	**0.5**	**0.6**

Note If the total aggregated mitigation inde is 1 which is not a realistic outcome then the outcome is fi ed at 0 5 In this scenario the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use note where risk assessment is re uired this outcome would need more detailed verification

STEP 2D: Determine Sufficiency of Pollution Mitigation Indices for Selected SuDS Components

This is an automatic step which compares the Combined Pollution Mitigation Indices with the Land Use Hazard Indices, to determine whether the proposed components are sufficient to manage each pollutant category type

When the combined mitigation inde e ceeds the land use pollution ha ard inde then the proposed components are considered sufficient in providing pollution risk mitigation

In England and Wales where the discharge is to protected surface waters or groundwater an additional treatment component ie over and above that re uired for standard discharges or other e uivalent protection is re uired that provides environmental protection in the event of an une pected pollution event or poor system performance Protected surface waters are those designated for drinking water abstraction In England and Wales protected groundwater resources are defined as Source Protection one 1 In Northern Ireland a more precautionary approach may be re uired and this should be checked with the environmental regulator on a site by site basis

Sufficiency of Pollution Mitigation Indices: Total Suspended Solids	Metals	Hydrocarbons
Sufficient	Sufficient	Sufficient

Note: In order to meet both Water Quality criteria set out in the SuDS Manual (Chapter 4), Interception should be delivered for all impermeable areas wherever possible. Interception delivery and treatment may be met by the same components, but Interception requires separate evaluation.

DESIGN CONDITIONS

1

eference to local planning documents should also be made to identify any additional protection re uired for sites due to habitat conservation see *Chapter 7 The SuDS design process* The implications of developments on or within close pro imity to an area with an environmental designation such as a Site of Special Scientific Interest SSSI should be considered via consultation with relevant conservation bodies such as Natural England

SIMPLE INDEX APPROACH: TOOL

1. The steps set out in the tool should be applied for each inflow or 'runoff area' (ie each impermeable surface area separately discharging to a SuDS component).

2. The supporting 'Design Conditions' stated by the tool must be fully considered and implemented in all cases.

3. Relevant design examples are included in the SuDS Manual Appendix C.

4. Each of the steps below are part of the process set out in the flowchart on Sheet 3.

5. Sheet 4 summarises the selections made below and indicates the acceptability of the proposed SuDS components.

DROP DOWN LIST	RELEVANT INPUTS NEED TO BE SELECTED FROM THESE LISTS, FOR EACH STEP
USER ENTRY	USER ENTRY CELLS ARE ONLY REQUIRED WHERE INDICATED BY THE TOOL

STEP 1: Determine the Pollution Hazard Index for the runoff area discharging to the proposed SuDS scheme

This step requires the user to select the appropriate land use type for the area from which the runoff is occurring

If the land use varies across the 'runoff area', either:

- use the land use type with the highest Pollution Hazard Index

- apply the approach for each of the land use types to determine whether the proposed SuDS design is sufficient for all. If it is not, consider collecting more hazardous runoff separately and providing additional treatment.

If the generic land use types suggested are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in the row below the drop down lists.

	Runoff Area Land Use Description	*Pollution Hazard*	Total Suspended Solids (*Pollution Hazard Indices*)	Metals	Hydrocarbons	*DESIGN CONDITIONS* 1	2
Select land use type from the drop down list (or 'Other' if none applicable): →	Standard commercial yard or delivery area	Medium	0.7	0.6	0.7	This classification is not appropriate for haulage yards, lorry parks, waste management areas, or chemical storage/handling zones	
If the generic land use types in the drop down list above are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in this row:							
	Landuse Pollution Hazard Index	**Medium**	**0.7**	**0.6**	**0.7**		

STEP 2A: Determine the Pollution Mitigation Index for the proposed SuDS components

This step requires the user to select the proposed SuDS components that will be used to treat runoff - before it is discharged to a receiving surface waterbody or downstream infiltration component

If the runoff is discharged directly to an infiltration component, without upstream treatment, select 'None' for each of the 3 SuDS components and move to Step 2B

This step should be applied to evaluate the water quality protection provided by proposed SuDS components for discharges to receiving surface waters or downstream infiltration components (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

If you have fewer than 3 components, select 'None' for the components that are not required

If the proposed component is bespoke and/or a proprietary treatment product and not generically described by the suggested components, then 'Proprietary treatment system' or 'User defined indices' should be selected and a description of the component and agreed user defined indices should be entered in the rows below the drop down lists

	SuDS Component Description	Total Suspended Solids (*Pollution Mitigation Indices*)	Metals	Hydrocarbons	*DESIGN CONDITIONS* 1	2	3
Select SuDS Component 1 (i.e. the upstream SuDS component) from the drop down list: →	Detention basin	0.5	0.5	0.6	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B		
Select SuDS Component 2 (i.e. the second SuDS component in a series) from the drop down list: →	Filter drain (where the trench is not designed as an infiltration component)	0.4	0.4	0.4	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Filter drains should be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events	
Select SuDS Component 3 (i.e. the third SuDS component in a series) from the drop down list: →	None						
If the proposed SuDS components are bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary treatment system' or 'User defined indices' and enter component descriptions and agreed user defined indices in these rows:							
	Aggregated Surface Water Pollution Mitigation Index	**0.7**	**0.7**	**0.8**	Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).		

Is the runoff now discharged to an infiltration component?

Yes ? Go to Step 2B
No ? Go to Step 2C

STEP 2B: Determine the Pollution Mitigation Index for the proposed Groundwater Protection

This step requires the user to select the type of groundwater protection that is either part of the SuDS component or that lies between the component and the groundwater

This step should be applied where a SuDS component is specifically designed to infiltrate runoff (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

'Groundwater protection' describes the proposed depth of soil or other material through which runoff will flow between the runoff surface and the underlying groundwater.

Where the discharge is to surface waters and risks to groundwater need not be considered, select 'None'

If the proposed groundwater protection is bespoke and/or a proprietary product and not generically described by the suggested measures, then a description of the protection and agreed user defined indices should be entered in the row below the drop down list

		Total Suspended Solids (*Pollution Mitigation Indices*)	Metals	Hydrocarbons	*DESIGN CONDITIONS* 1	2	3	4
Select type of groundwater protection from the drop down list: →	None							
If the proposed groundwater protection is bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary product' or 'User defined indices' and enter a description of the protection and agreed user defined indices in this row:								
	Groundwater Protection Pollution Mitigation Index	**0**	**0**	**0**				

STEP 2C: Determine the Combined Pollution Mitigation Indices for the Runoff Area

This is an automatic step which combines the proposed SuDS Pollution Mitigation Indices with any Groundwater Protection Pollution Mitigation Indices

	Total Suspended Solids (*Combined Pollution Mitigation Indices*)	Metals	Hydrocarbons	
Combined Pollution Mitigation Indices for the Runoff Area	**0.7**	**0.7**	**0.8**	Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

STEP 2D: Determine Sufficiency of Pollution Mitigation Indices for Selected SuDS Components

This is an automatic step which compares the Combined Pollution Mitigation Indices with the Land Use Hazard Indices, to determine whether the proposed components are sufficient to manage each pollutant category type

When the combined mitigation index exceeds the land use pollution hazard index, then the proposed components are considered sufficient in providing pollution risk mitigation.

In England and Wales, where the discharge is to protected surface waters or groundwater, an additional treatment component (ie over and above that required for standard discharges), or other equivalent protection, is required that provides environmental protection in the event of an unexpected pollution event or poor system performance. Protected surface waters are those designated for drinking water abstraction. In England and Wales, protected groundwater resources are defined as Source Protection Zone 1. In Northern Ireland, a more precautionary approach may be required and this should be checked with the environmental regulator on a site by site basis.

Total Suspended Solids (*Sufficiency of Pollution Mitigation Indices*)	Metals	Hydrocarbons	*DESIGN CONDITIONS* 1
Sufficient	Sufficient	Sufficient	Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see *Chapter 7 The SuDS design process*). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England

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