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Drainage Strategy Document Jepco Norfolk House Farm Gedney Marsh Spalding PE 12 9PB, UK

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CONTENTS

1.0	INTRODUCTION	4
2.0	SITE LOCATION	4
3.0	PROPOSED DEVELOPMENT	6
4.0	DRAINAGE STRATEGY	6
	4.1 Surface Water Drainage	8
4.1.1	Stormwater Mitigation Measures	8
4.1.2	Treatment Train	Error! Bookmark not defined.
4.1.3	Pollution Control	Error! Bookmark not defined.
4.1.4	Attenuation System	Error! Bookmark not defined.
4.1.5	Flood Risk	11
4.2	Wash Waters	11
4.3	Pond Water	12
4.4	Foul Water Discharge	13
4.5	Water Supply	14
APPENDIX 1	SUDS SITE ASSESSMENT	15
APPENDIX 2	HR WALLINGFORD SURFACE WATER STORAGE	26
APPENDIX 3	PETROL INTERCEPTORS	28
APPENDIX 4	FOUL WATER TREATMENT SYSTEM	30



1.0 INTRODUCTION

This document outlines the proposed design for the collection, treatment, conveyance and discharge of the foul and surface water discharge from the proposed development at the Jepco Norfolk House Farm Gedney Marsh Lincolnshire.

Jepco is an established grower leading the development of sustainable hydroponic vegetable farming. Jepco intend to grow nutritious, pesticide-free and herbicide-free leafy green produce, year round operation within a climate controlled glass house and packing infrastructure. The proposed technology will use less land, water and nutrients compared to conventional outdoor farming through a combination of cutting edge technology, design and optimal agriculture methods and hence minimises discharges to the local environment.

2.0 SITE LOCATION

JEPCO occupies over 300 hectares of essentially flat and fertile land approximately 2.5km from the Lincolnshire coast and the Wash, an expansive protected area designated as a Special Area of Conservation, Special Protection Area and Site of Special Scientific Interest bordering the site to the North and East.

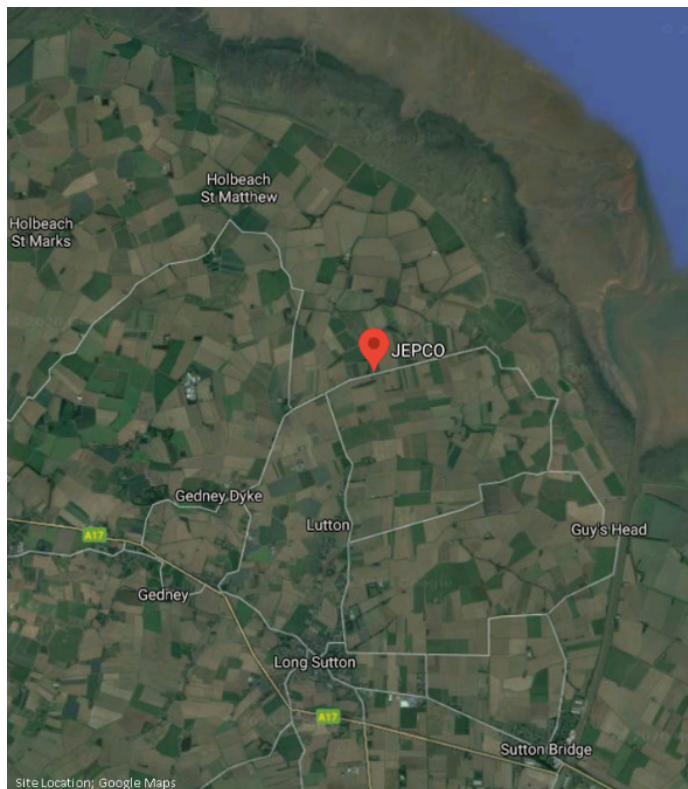


Figure 1 Site Location.

3.2 Site Location

The subject site of this particular planning permission is located on reclaimed fenland to the east and adjoining the existing Norfolk Farm site and covers approximately 15 ha



Figure 2 Existing Site.

The site is currently in agricultural use and houses on its Western side one of a number of lagoons which are utilised as rainwater attenuation for storage in the growing processes. The site is bounded on the North, East and West by additional Jepco holdings and on its South by the Main Road.

3.0 PROPOSED DEVELOPMENT

Jepco intend to convert approx. 10ha of farm land to enable undercover growing within glasshouses and to support same with an integrated preparation, processing, storage and dispatch facility and the associated required infrastructure. The overall scope can therefore be sub divided into the following components:

- Main Glasshouse Area containing Hydroponic Growing System.
- Glasshouse Annex containing Seeding and Germination processes
- Main Pack Building.
- Administration and Welfare Building
- Main Plant Room
- External Roads & Hardstandings
- Landscaping



Figure 3 Agri-tech Development Viewed From South.



4.0 DRAINAGE STRATEGY

The strategy for the drainage of the site along with all other site operations has been developed in consultation with Jepco management to ensure that the design and operations are strictly in accordance with the managed environment.

The Site operations will result in a number of individual drainage streams which must be addressed namely.

- Surface Water
- Washdown
- Pond Water
- Foul Water

The Surface water shall be further subdivided into Roof water run off which shall be collected for use in the site operations and hardstanding run off which shall be diverted through a suitable hydrocarbon filter before being discharged through the general Surface water system as is standard practice.

The nature of the growing and cultivation process being undertaken in a controlled environment negates the requirement for chemical washdowns of equipment etc and hence all wash waters from the packing building and are considered clean and are intended to be discharged through screens to the surface water system.

In addition, the Growing pond water contents which contain low level nutrients are emptied to a schedule about once every five years with an approximate volume of 288,000 litres. Again, the nature of this water discharge is suitable for discharge to once it achieved the Emission Limit Values (ELV) as and shall be conveyed to attenuation through the Petrol Interceptor.

The foul water discharge generated from the personnel operating the site shall be taken from point of origin and conveyed to a bespoke treatment system from where shall be dispersed through a percolation area, monitoring and management of same shall being undertaken by Jepco.

4.1 SURFACE WATER DRAINAGE

The CIRIA SuDS design document provides guidance on the control and management of stormwater from new development sites in their publications.

The storm management system design has been prepared on the basis of minimising the effect of the development by comparison with the expected storm run off for an undeveloped site. The attached HR Wallingford preliminary SUDS estimation tool gives (SAAR) average annual rainfall of 801mm.

The attenuation requirements of this development shall however include for the entire area of new roofs and hardstandings associated with the new development which as outlined in figure 2 amounts to a total of circa 3 ha broken down as follows:

New Roof Areas = 14ha

New Hardstanding = 1.8ha

Total = 3 ha

4.1.1 Stormwater Mitigation Measures

To comply with the principles of SuDS, stormwater mitigation measures are outlined below to ensure the proposed development has a minimal impact on the public drainage system.

As noted, the storm water systems will be constructed to allow for a 1:100-year storm event with a Climate change factor of 1.4. Firstly, the Gutters from the Greenhouse which are running from the South to the North shall be collected and conveyed to the previously approved Reservoir H06-0590-21.

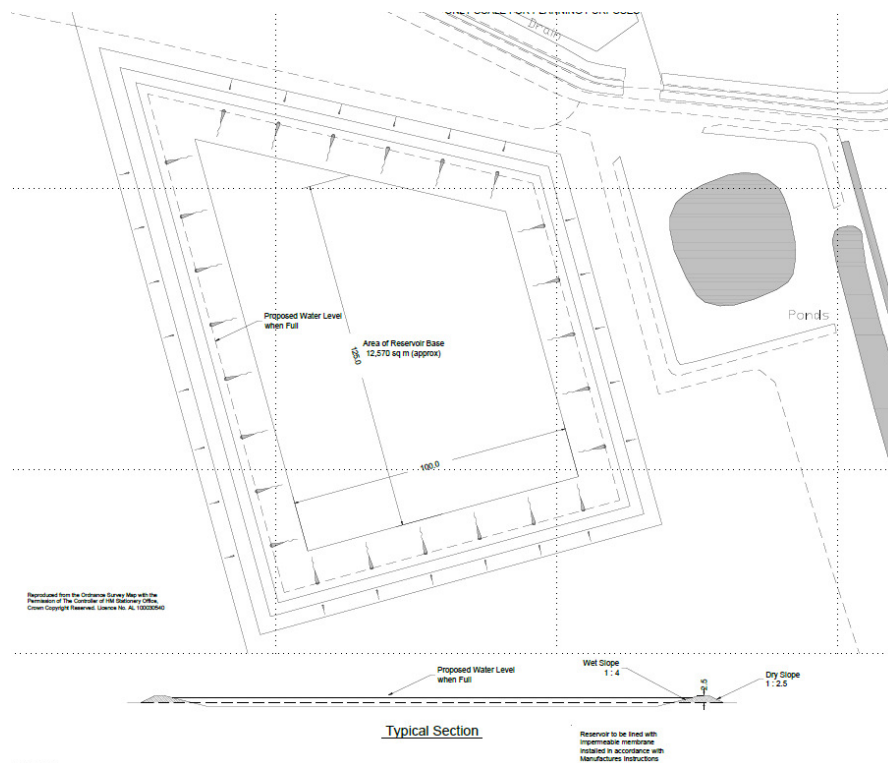
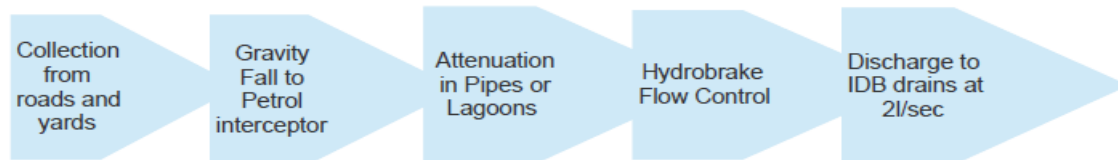


Figure 4 Approved Reservoir

The system supplying this reservoir shall be bedded within a 5m wide x 1.5m deep infiltration trench which if the system becomes inundated will facilitate an overflow to allow excess water discharge to the existing surface water dykes via the natural filtration through the underlying soils. Secondly all new hardstanding and roads shall be drained via underground pipework systems to three individual points where a full retention Petrol interceptor and piped attenuation system shall be located, in total the areas associated are approximately 1.8 ha.



This attenuation system shall combine all run off and be controlled by a hydro brake limiting discharge to 2l/sec to the existing IDB drainage ditch, the location of which is indicated on the drainage layout.

The junction between the ditch and the new pipework shall be formed with a concrete headwall and stilling chamber complete with grilles across the entry to the pipe to prevent water surge into the ditch causing erosion of the banks and bed, this access point shall be maintained by the site team.

Treatment Train

Sustainable Urban Drainage systems recommend that a series of measures be considered during the design stage, the SUDS website has developed an outline of this treatment train which forms the basis of the approach to the design of the site-specific systems.

Pollution Control

There is no hydrocarbon interception system currently installed on site, it is therefore intended to incorporate a new full retention Petrol interceptor catering for the new hardstanding areas upstream of the Attenuation Area on each of the drainage routes. The petrol interceptor shall be a Molloy type Aswaclear® NS100 as outlined in figure 4 below

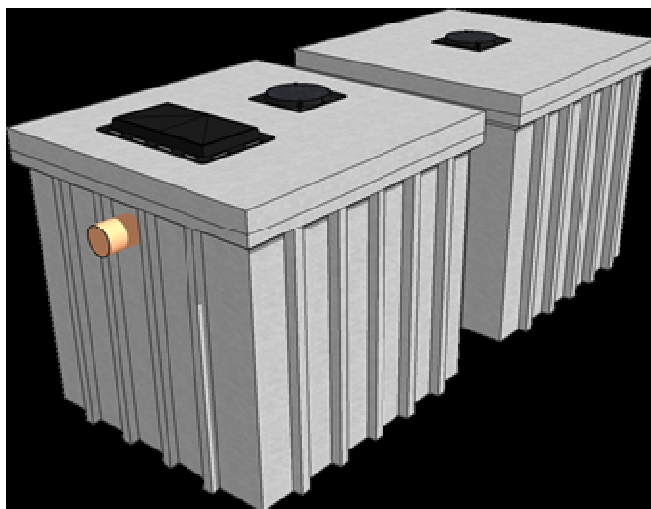


Figure 5 Petrol Interceptor

Attenuation System

The treatment train outlines several mitigation options, considering the built environment of the site it is reasonable to propose the design and installation of a sub-surface storage system within oversized pipes and a surface pond suitable to:

- Attenuate road runoff.
- Attenuate Car Park/Impermeable area runoff

The areas drained are as outlined above and are for the purposes of design separated into three sections:

- Main Loading area and Car Park
- Service Yards
- Perimeter Roadway

The attenuation system associated with the car park and loading bay area shall consist of a above ground pond storage which will be designed in accordance with the ecological requirements of the site.

The other two areas being relatively minor will be attenuated in oversized pipes.

A hydro brake limiting the discharge to 2l /sec shall be installed at end of line as outlined in figure 7 below and on drainage layout and details drawings.



Figure 6 MD 5 Hydro brake

which shall be located at the South East corner of the site, where a full retention Petrol interceptor and piped attenuation system shall be located. As they are considered free of hydrocarbons rainwater overflow from the glasshouse roof shall be diverted via dedicated drainage to avoid the PI and join the system upstream of the Attenuation system.

This attenuation system shall combine all run off and be controlled by a hydrobrake limiting discharge to 5l/sec to the existing ditch, the location of which has been confirmed with Bord Na Mona. The junction between the ditch and the new pipework shall be formed with a concrete headwall and stilling chamber complete with grilles across the entry to the pipe to prevent water surge into the ditch causing erosion of the banks and bed, this access point shall be maintained by the site team.

4.1.2 Flood Risk

The development is located within a Flood Risk 3a category but is categorised as a Less Vulnerable development. The risk posed emanates from Sea flooding due to the proximity to the Wash. An accompanying Flood Risk Assessment doc no 20008- 30-Rp-002 outlines the risks and the mitigations associated with same

4.2 Wash Waters

As previously outlined, the development does not contain any pollution sources other than domestic foul water which is piped directly to a packaged treatment system as outlined in section 4.4. There is some wash down water from floors and equipment as a resulting of cleaning and packing operations however the primary sanitiser to be used will be a peroxide product that breaks down to oxygen and water thus essentially rendering the discharges as clean water with the concentration of inorganics in the water discharge streams being comparable to that of the local well water. Potential Debris from the process such as leaves etc will be captured by removable baskets as per figure 8 which shall be installed within the internal stainless steel drainage channels.



Figure 7 Stainless Steel Drain and Basket

In addition, at the exit point of these drains from the packing plant at the Southern Elevation, an additional solids trap and screed shall be installed to further prevent the entry of salad leaf debris etc into the wash water system.

These wash waters represent 98% of the discharge waters from the process and shall amount to an average of 50,000 litres per week which equates to discharges of 0.32l/sec across typical 5-day operation.

The conductivity of the water from packing operations is 350 uS/cm and the remaining 2 percent of water being discharged will be from germination and propagation activities possessing a conductivity of circa 1200 uS/cm, average across the total flow would therefore be of the order of ~365 uS/cm with low (<5 ppm) N content.

The solids screened from the wash waters will be elevated and dropped into trailers which will be then spread across the adjoining Jepco farmland and the waters conveyed to a Reed Bed constructed on the Eastern boundary of the site.

The reed bed will harness the natural ecological processes for the breakdown of the organic matter in the washwater. It shall be constructed in accordance with Figure 9 and contain gravels and sands which are usually planted with either the common river reed (*Phragmites australis*) or Reed Mace (*Typha latifolia*).

The wash waters will be introduced at the Southern end and collected and percolated into the soil at the Northern elevation.

As the effluent passes through the gravels and sands it comes into contact with the thin film of bacteria which grows on the surfaces of the media particles. They are the primary agents that break down the organic matter in the effluent. These bacteria also grow around the root systems of the reeds where the oxygen rich atmosphere they produce assists this process.. The bed remains full of water at all times. In the Sub-Surface Flow type the level of the water is carefully controlled so that it is always 25-50 mm below the surface of the gravel media.

DR. NOWING

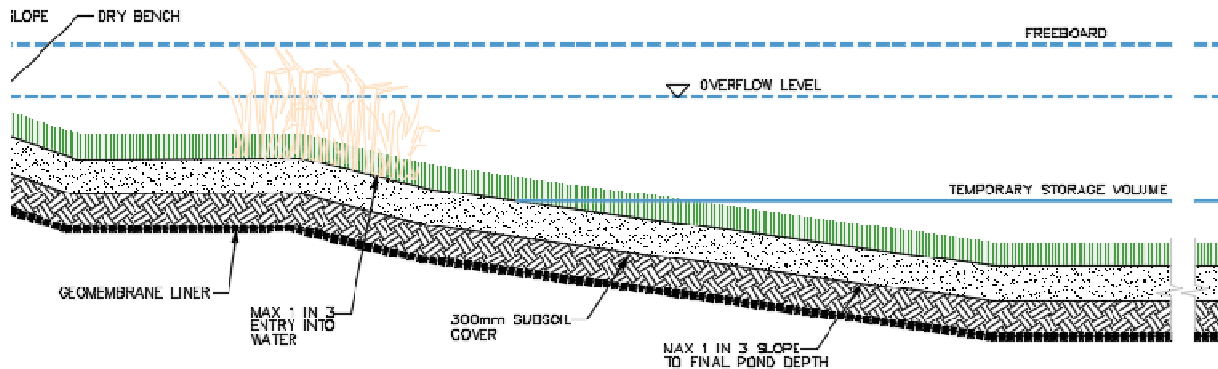


Figure 8 Reed Bed

4.3 Pond Water

The main production ponds within the glasshouse shall be filled from the site water supply over a protracted period up to full production and will during their lifecycle need to be emptied to facilitate maintenance etc. This is a scheduled operation and will occur approximately once every 5 years. The total volume of water to be discharged amounts to 228,000 litres which will not inundate the Reed bed system which has a capacity of 2,668,000litres.

On discharge, the pond waters shall follow a similar route to wash waters in that the residual organic matter such as salad leaves etc would be removed through screening prior to discharge to the main surface water system. The nature of these discharges will again be controlled by the Emission Limiting Values (ELV) dictated by IDB of which a key measure is Chemical Oxygen demand (COD) at 100mg/l.

The COD (mg/L) for typical deep water hydroponic system being developed by Jepco is generally 15- 20 mg/L and the very nature of the operation serves to reduce the Chemical Oxygen demand (COD) in that the hydroponic system is a biological reactor in itself.

4.4 Foul Water Discharge

As previously outlined the sole source of foul water from the site shall be of a domestic type and generated by the Staff employed therein. This shall be catered for by the collection and conveyance of said foul waters from the Welfare areas in the facility to a Viltra Oxtec plus 3-Stage Biological Process Sewage Treatment Systems which will consist of:

Primary Settlement

The primary settlement tank (PST) is a two-stage tank designed to maximize the removal of gross and suspended solids. The PST also has a sludge storage facility incorporated depending on desludge periods

Biozone

The biological treatment phase incorporates two proven principles of biological process in the form of a fixed film reactor and a suspended floc dispersed growth system for high transfer rates and operational control, achieving a stable treatment process unaffected by shock loads.

The heart of the process is a submerged, high-rate, plastic media on which a fixed film of biomass is grown. The film consumes incoming settled effluent, and oxygen is provided by a small blower. The media is aerated through HDPE membrane diffusers that provide fine bubble aeration.

The fine bubble aeration is carefully controlled providing optimum oxygen transfer rates and scouring to slough off excess biomass, keeping the thickness of the fixed biological film at optimum levels.

The fact that the media remains submerged means that there will be biomass which is “unfixed” to the media but achieves treatment through suspended aeration.

Final Settlement

The final settlement tank is designed to provide maximum settlement of any suspended solids prior to discharge. The system incorporates continuous sludge return airlift to return sludge from the final settlement tank back to the primary settlement tank.

This system also provides for continuous recycling of treated effluent back to the PST to not only provide dilution of incoming settled effluent, but also to ensure continuous flow during periods of low or no flow, thereby keeping the biomass in prime condition.

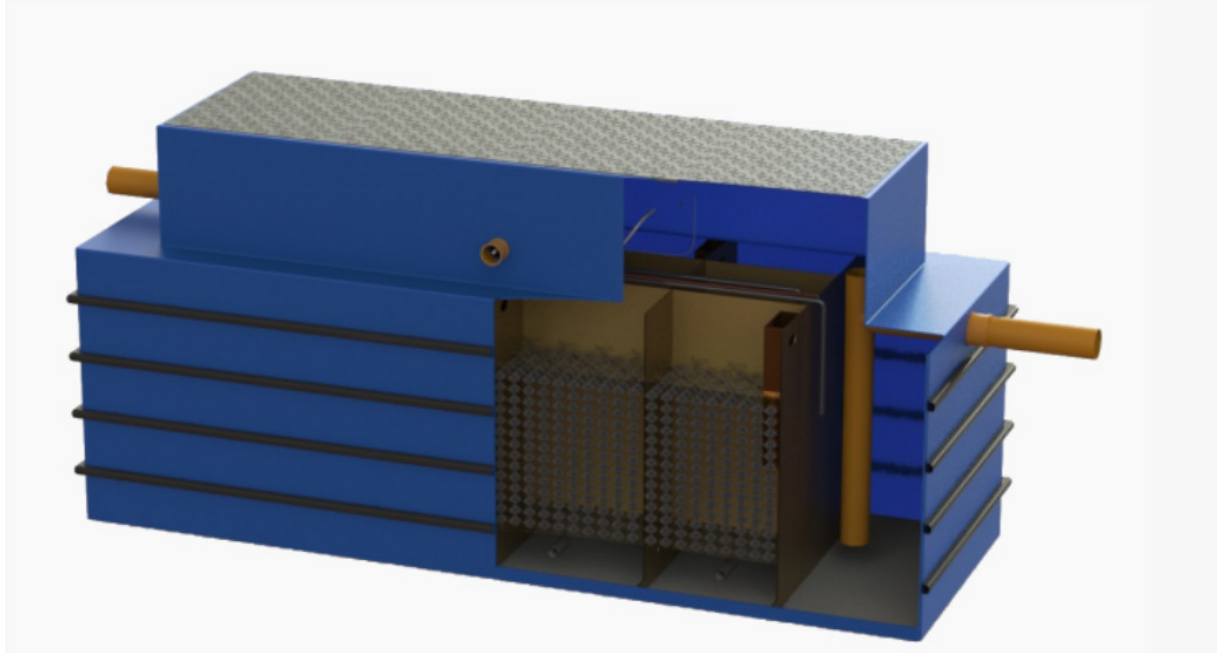


Figure 9 Foul Water Treatment System



After treatment the polished effluent shall be discharged to a percolation area located on the Western edge of the site in accordance with the drainage drawing and design contained in. Jepco will monitor the discharges from this system and ensure its continued serviceability.

4.5 Water Supply

As previously outlined, it is the intention of Jepco to maximise the utilisation of collected grey water in the operation of the site and hence the green house roof shall be collected to the local reservoir as previously noted.

As required this reservoir will feed a submersible pump system which shall provide the required water volumes for the operations of the site being stored in individual high level service tanks. In addition, a top up volume to the system shall be provided at this location from the site watermain to ensure sufficient volumes are available in times of low rainfall.

This site watermain shall be supplied from the existing Connection on the South East corner of the site and shall also serve in turn and the general service to the Welfare facilities located centrally on the Western Elevation of the Packing Building as well as multiple hydrants for fire fighting located around the site perimeter.



APPENDIX 1

SUDS SITE ASSESSMENT



Site Drainage Evaluation

Site name: Jepco

Site location: Gedney Marsh Lincs

Report Reference: 1618412665430

Date: 18082021

1. INTRODUCTION

This is a bespoke report providing initial guidance on potential implementation of SuDS for the development site in line with current best practice.

The use of this tool should be supplemented by more detailed guidance on SuDS best practice provided in a number of sources, principally the CIRIA SUDS Manual (2007), other CIRIA documents; the Use of SUDS in High Density Developments, HR Wallingford, (2005) and other HR Wallingford documents.

The objective is to provide some early guidance on the numbers and types of components that might be suitable for consideration within the site design. This may facilitate pre-application discussions with planners and other relevant authorities.

This guidance has been provided prior to the completion of the SUDS standards and the supporting guidance. However, the principles of this tool are unlikely to be very different to the aims of the SUDS standards. HR Wallingford is not liable for the use of any output from the use of this tool and the performance of the drainage system. It is recommended that detailed design using appropriately experienced engineers' professionals and tools is undertaken before finalising any drainage scheme arrangement for a site.

THE CONTENT OF THE REPORT

This report is split into 8 sections as follows:

- Generic SuDS Best Practice Principles
- Runoff Destination
- Hydraulic Design Criteria
- Water Quality Design Criteria
- Site-Specific Drainage Design Considerations
- SuDS Construction
- SuDS Components Performance
- Guidance on The Use of Individual Components



2. GENERIC SuDS BEST PRACTICE PRINCIPLES

To comply with current best practice, the drainage system should:

- (i) manage runoff at or close to its source.
- (ii) manage runoff at the surface.
- (iii) be integrated with public open space areas and contribute towards meeting the objectives of the urban plan.
- (iv) be cost-effective to operate and maintain.

The drainage system should endeavour to ensure that, for any particular site:

- (i) natural hydrological processes are protected through maintaining Interception of an initial depth of rainfall and prioritising infiltration, where appropriate.
- (ii) flood risk is managed through the control of runoff peak flow rates and volumes discharged from the site.
- (iii) stormwater runoff is treated to prevent detrimental impacts to the receiving water body as a result of urban contaminants.

In addition, it is desirable to maximise the amenity and ecological benefits associated with the drainage system where there are appropriate opportunities. SuDS are green infrastructure components and can provide health benefits and reduce the vulnerability of developments to the impacts of climate change.

3. RUNOFF DESTINATION

Introduction

Infiltration should be prioritised as the method of controlling surface water runoff from the development site, unless it can be demonstrated that the use of infiltration would have a detrimental environmental impact.

Groundwater (via Infiltration)

Infiltration may not be appropriate for managing runoff from this site. Robust studies are required to confirm the significance of the following constraints to infiltration:

- (1) The maximum groundwater level beneath the site is within 2 m of the ground surface. This means that there is unlikely to be in excess of the required 1m depth of unsaturated zone between the infiltration surface and the water table.

The groundwater beneath the site is designated as Hydrologically linked to sensitive receptor, and this designation will define the treatment requirement for any infiltrated water (See Water Quality Design Criteria).

Surface water body

All runoff that cannot be discharged to groundwater will be managed on site and discharged to a surface water body.

The receiving surface water body for runoff from the site is: the. The riparian owner is:



4. HYDRAULIC DESIGN CRITERIA

Introduction

Best practice criteria for hydraulic control require Interception, runoff and volume control.

Interception

To fulfil the requirements for Interception, there should normally be no runoff from the site for an initial depth of rainfall - usually 5mm. This is achieved through the use of infiltration, evapotranspiration, or rainwater harvesting.

Flow and Volume Control

The site has been previously developed. It is likely that there will be a requirement for the runoff to be constrained to levels as close to the equivalent greenfield rates and volumes as possible. Discharges that exceed equivalent pre-development rates and volumes will not, generally, be acceptable.

Rainwater harvesting, or the use of Long-Term Storage provide the means to achieve runoff volume control. Where volume control is not practicable, flows discharged from the site will need to be constrained to 2 l/s/ha.

5. WATER QUALITY DESIGN CRITERIA

Introduction

Current best practice takes a risk-based approach to managing discharges of surface runoff to the receiving environment. The following text provides guidance on the extent of water quality management likely to be appropriate for the site.

Hazard Classification

Runoff from clean roof surfaces (i.e., not metal roofs, roofs close to polluted atmospheric discharges, or roofs close to populations of flocking birds) is classified as Low in terms of hazard status.

Runoff from roads, parking and other areas of residential, commercial and industrial sites (that are not contaminated with waste, high levels of hydrocarbons, or other chemicals) is classified as Medium in terms of hazard status.

Treatment requirements for disposal to surface water systems

The catchment area of stream to the point of the discharge from the site is <50km², therefore it is classified as a sensitive receptor.

The level of urbanisation of the catchment at the point of the discharge from the site is >20%, therefore it may be classified as a sensitive receptor.

The receiving catchment is designated as an environmentally sensitive receptor.

Roof runoff will not require 1 treatment stage prior to discharge.

Runoff from other parts of this site such as roads, parking and other areas will require at least 3 treatment stages prior to discharge.



6. SITE-SPECIFIC DRAINAGE DESIGN CONSIDERATIONS

The design of SuDS with access to temporary or permanent water should consider public health and safety as well as issues associated with construction and operational management of the structures. Health and safety issues and risk mitigation features are presented in the CIRIA SuDS Manual.

Individual SuDS components should not be treated in isolation but should be seen together as providing a suite of drainage features which are appropriate in different combinations for varying scales. It is always desirable to have a mix of SuDS components across the site as different components have different capacities for treatment of individual pollutants.

7. SuDS CONSTRUCTION

SuDS are a combination of civil engineering structures and landscaping practice. Due to the limited experience of building SuDS in the water industry, there are a number of key issues which need to be particularly considered as their construction requires a change in approach to some standard construction practices.

- SuDS components should be constructed in line with either the manufacturer's guidelines or best practice methods.
- The construction of SuDS usually only requires the use of fairly standard civil engineering construction and landscaping operations, such as excavation, filling, grading, top soiling, seeding, planting etc. These operations are specified in various standard construction documents, such as the Civil Engineering Specification for the Water Industry (CESWI).
- Construction of soakaways is regulated by the Buildings Regulations part H (Drainage and waste disposal) which sets out the requirements for drainage of rainwater from the roofs of buildings.
- During construction, any surfaces which are intended to enable infiltration must be protected from compaction. This includes protecting from heavy traffic or storage of materials.
- Water contaminated with silt must not be allowed to enter a watercourse or drain as it can cause pollution. All parts of the drainage system must be protected from construction runoff to prevent silt clogging the system and causing pollution downstream. Measures to prevent this include soil stabilisation, early construction of sediment management basins, channelling run-off away from watercourses and surface water drains, and erosion prevention measures.
- After the end of the construction period and prior to handover to the site owner/operator:
 - Subsoil that has been compacted during construction activities should be broken up prior to the re-application of topsoil to garden areas and other areas of public open space to reinstate the natural infiltration performance of the ground.
 - Any areas of the SuDs that have been compacted during construction but are intended to permit infiltration must be completely refurbished.
 - Checks must be made for blockages or partial blockages of orifices or pipe systems.
 - Any silt deposited during the construction must be completely removed.
 - Soils must be stabilised and protected from erosion whilst planting becomes established.

Detailed guidance on construction related issues for SuDS is available in the SuDS Manual and the associated Construction Site handbook (CIRIA, 2007).



8. SuDS COMPONENTS PERFORMANCE

	Interception	Peak flow control: Low	Peak flow control: High	Volume reduction	Volume control	Gross sediments	Fine sediments	Hydrocarbons/PAHs	Metals	Nutrients
Rainwater Harvesting	Y	Y	S	Y	N	N	N	N	N	N
Pervious Pavement	Y	Y	Y	Y	Y	Y	Y	Y	Y	Var
Filter Strips	Y	N	N	N	N	Y	N	Y	Y	Var
Swales	Y	Y	S	Y(*)	N	Y	Y(+)	Y	Y	Y(-)
Trenches	Y	Y	S	Y(*)	N	N	N	Y	Y	Y(-)
Detention Basins	Y	Y	Y	N	Y	Y	Y(+)	Y	Y	Var
Ponds	N	Y	Y	N	Y	N(~)	Y	Limited	Y	Var
Wetlands	N	Y	S	N	Y	N(~)	Y	Limited	Y	Y
Green Roofs	Y	Y	N	N	N	N	N	Y	N	N
Bioretention Systems	Y	Y	S	Y(*)	N	N(~)	Y	Y	Y	Y
Proprietary Treatment Systems	N	N	N	N	N	Y	Y	Y(!)	Y(!)	Y(!)
Subsurface Storage	N	Y	Y	N	Y	N(~)	N	N	N	N
Subsurface Conveyance Pipes	N	N	N	N	Y	N(~)	N	N	N	N

Notes:

S: Not normally with standard designs, but possible where space is available, and designs mitigate impact of high flow rates.

Y (*): Where infiltration is facilitated by the design.

N (~): Gross sediment retention is possible, but not recommended due to negative maintenance and performance implications.

Y (+): Where designs minimise the risk of fine sediment mobilisation during larger events.

Y (!): Where designs specifically promote the trapping and breakdown of oils and PAH based constituents.

Y ("): Where subsurface soil structure facilitates the trapping and breakdown of oils and PAH based constituents.

Var: The nutrient removal performance is variable and can be negative in some situations.

Y (-): Good nutrient removal performance where subsurface biofiltration systems with a permanently saturated zone included within the design.

9. GUIDANCE ON THE USE OF INDIVIDUAL COMPONENTS

Rainwater Harvesting

• Roofs

Rainwater harvesting systems can be used to effectively drain roofs and provide both water supply and stormwater management benefits.



Pervious Pavement

- Roofs

Roof water can be drained into pervious pavement areas using diffusers to dissipate the point inflows. Detailed design of the pavement will need to take account of the additional impermeable roof area.

- Roads

Some types of pervious pavement can be used for relatively highly trafficked roads and pavement manufacturers should be consulted on the appropriate specification.

- Car parks/other impermeable surfaces

Pervious pavements provide effective drainage, storage and treatment of car park surfacing,

- Groundwater < 2m below surface

The design of the drainage system will need to fully mitigate the risks posed by a) the groundwater surface potentially rising above the base of the drainage system; and b) the reduction in unsaturated zone depth which may compromise any treatment function provided by the subsurface soils.

Filter Strips

- Roads

Filter strips can provide treatment for road runoff, upstream of swales or trench components. They can reduce the need for kerbing and runoff collection systems.

- Car parks/other impermeable surfaces

Filter strips can provide treatment for runoff from impermeable surfaces, upstream of swales or trench components. They can reduce the need for kerbing and runoff collection systems.

- Site size > 50ha

The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria.

- Groundwater < 2m below surface

The design of the drainage system will need to fully mitigate the risks posed by a) the groundwater surface potentially rising above the base of the drainage system; and b) the reduction in unsaturated zone depth which may compromise any treatment function provided by the subsurface soils.

Swales

- Roofs

Swales can be used to convey roof water to other parts of the site.

- Roads

Swales provide treatment and conveyance of road runoff. There are a range of swale types - standard grass channels, under drained swales, and wetland swales - depending on drainage requirements.

- Car parks/other impermeable surfaces



Swales provide treatment and conveyance of runoff from impermeable areas. There are a range of swale types - standard grass channels, under drained swales, and wetland swales - depending on drainage requirements.

- Site size > 50ha

The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria.

- Groundwater < 2m below surface

The design of the drainage system will need to fully mitigate the risks posed by a) the groundwater surface potentially rising above the base of the drainage system; and b) the reduction in unsaturated zone depth which may compromise any treatment function provided by the subsurface soils.

Trenches

- Roofs

Trenches can be used to convey roof water to other parts of the site.

- Roads

Trenches can provide treatment and conveyance of road runoff. They require effective pre-treatment to minimise the risk of blockage.

- Car parks/other impermeable surfaces

Trenches can provide treatment and conveyance of runoff for impermeable areas.

- Site size > 50ha

The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria.

- Groundwater < 2m below surface

The design of the drainage system will need to fully mitigate the risks posed by a) the groundwater surface potentially rising above the base of the drainage system; and b) the reduction in unsaturated zone depth which may compromise any treatment function provided by the subsurface soils.

Detention Basins

- Roofs

Detention basins can be used to attenuate and treat runoff.

- Roads

Detention basins can be used to attenuate and treat runoff.

- Car parks/other impermeable surfaces

Detention basins can be used to attenuate and treat runoff.

- Site size > 50ha

The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria. A risk assessment should be to determine the maximum appropriate depth of stored water in the basin.



Ponds

- Roofs

Ponds can be used to attenuate and treat roof runoff.

- Roads

Ponds can be used to attenuate and treat runoff. However, they are best implemented at the lower end of the treatment train as a 'polishing' component. They should not be used as sediment management devices, as sediment and wet vegetation is relatively costly to extract and dispose of. If poor quality water remains in ponds for extended periods, nutrient concentrations can rise - particularly in the summer months, and the pond can become unattractive with poor amenity and biodiversity potential.

- Car parks/other impermeable surfaces

Ponds can be used to attenuate and treat runoff. However, they are best implemented at the lower end of the treatment train as a 'polishing' component. They should not be used as sediment management devices, as sediment and wet vegetation is relatively costly to extract and dispose of. If poor quality water remains in ponds for extended periods, nutrient concentrations can rise - particularly in the summer months, and the pond can become unattractive with poor amenity and biodiversity potential.

- Site size>50ha

The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria.

- Other

Ponds built in permeable soils will require lining to maintain the water level of the permanent pool. The lining may be finished 100 or 200 mm lower than the outlet invert to encourage some infiltration to take place to contribute to interception.

Wetlands

- Roofs

Wetlands can be used to attenuate and treat roof runoff.

- Roads

Wetlands can be used to attenuate and treat runoff. However, they are best implemented at the lower end of the treatment train as a 'polishing' component. They should not be used as sediment management devices, as sediment and wet vegetation is relatively costly to extract and dispose of. If poor quality water remains in wetlands for extended periods, nutrient concentrations can rise - particularly in the summer months, and the wetland can become unattractive with poor amenity and biodiversity potential.

- Car parks/other impermeable surfaces

Wetlands can be used to attenuate and treat runoff. However, they are best implemented at the lower end of the treatment train as a 'polishing' component. They should not be used as sediment management devices, as sediment and wet vegetation is relatively costly to extract and dispose of. If poor quality water remains in wetlands for extended periods, nutrient concentrations can rise - particularly in the summer months, and the wetland can become unattractive with poor amenity and biodiversity potential.

- Site size>50ha

The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria.



- Groundwater < 2m below surface

Wetlands can perform satisfactorily where the groundwater level supports baseflows in the system. However, if there is a risk of higher levels then the loss in wetland capacity should be evaluated in the design. Consideration should also be given to any potential lowering of levels which may cause exfiltration from the system, and the system to dry out.

Green Roofs

- Roofs

Green roofs can be designed to provide interception, management and treatment of rainfall up to specified rainfall depths.

Bioretention Systems

- Roofs

Bioretention systems can be used to attenuate and treat roof runoff.

- Roads

Linear bioretention systems (i.e., biofiltration swales) can be used to attenuate and treat road runoff.

- Car parks/other impermeable surfaces

Bioretention systems can be used for car park drainage.

- Site size > 50ha

Bioretention systems will tend to be suitable for managing small areas only. The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria.

- Groundwater < 2m below surface

Infiltration systems should not be designed where maximum predicted groundwater levels are less than 1m below base of the proposed infiltration unit.

Proprietary Treatment Systems

- Roads

Proprietary treatment systems can be used where surface vegetated systems are impracticable. However, regular monitoring needs to be ensured so that they are maintained so that they continue to function effectively.

- Car parks/other impermeable surfaces

Proprietary treatment systems could be used where surface vegetated systems are impracticable. However, regular monitoring needs to be ensured so that they are maintained so that they continue to function effectively.

- Site size > 50ha

Proprietary treatment systems will tend to be suitable for managing small areas only. The size of area that can be drained will be limited by meeting the hydraulic and water quality criteria.



Subsurface Storage

- Roofs

Subsurface storage can be used to attenuate roof runoff.

- Roads

Subsurface storage can be used to attenuate road runoff.

- Car parks/other impermeable surfaces

Subsurface storage can be used to attenuate car park runoff.



APPENDIX 2

HR WALLINGFORD SURFACE WATER STORAGE REQUIREMENTS



Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by: michael keogh
Site name: Jepco
Site location: Gedney Marsh

Site Details

Latitude: 52.83969° N
Longitude: 0.14218° E
Reference: 1319177242
Date: Sep 03 2021 12:41

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site characteristics

Total site area (ha): 18
Significant public open space (ha): 0
Area positively drained (ha): 18
Impermeable area (ha): 15
Percentage of drained area that is impermeable (%): 83
Impervious area drained via infiltration (ha): 0
Return period for infiltration system design (year): 10
Impervious area drained to rainwater harvesting (ha): 0
Return period for rainwater harvesting system (year): 10
Compliance factor for rainwater harvesting system (%): 66
Net site area for storage volume design (ha): 18
Net impermeable area for storage volume design (ha): 15
Pervious area contribution to runoff (%): 0

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of Q_{BAR} and other flow rates will have been reduced accordingly.

Design criteria

Climate change allowance factor: 1.4
Urban creep allowance factor: 1.1
Volume control approach: Use long term storage
Interception rainfall depth (mm): 5
Minimum flow rate (l/s): 2

Methodology

esti
 Q_{BAR} estimation method: IH124
SPR estimation method: Calculate from SPR and SAAR
Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
SPR:	0.3	0.3

Hydrological characteristics

	Default	Edited
Rainfall 100 yrs 6 hrs:	--	63
Rainfall 100 yrs 12 hrs:	--	102.41
FEH / FSR conversion factor:	1.33	1.33
SAAR (mm):	566	566
M5-60 Rainfall Depth (mm):	20	20
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 10 year:	1.65	1.65
Growth curve factor 30 year:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Q_{BAR} for total site area (l/s):	25.58	25.58
Q_{BAR} for net site area (l/s):	25.58	25.58

Site discharge rates

	Default	Edited
1 in 1 year (l/s):	36	36
1 in 30 years (l/s):	62.7	62.7
1 in 100 year (l/s):	91.1	91.1

Estimated storage volumes

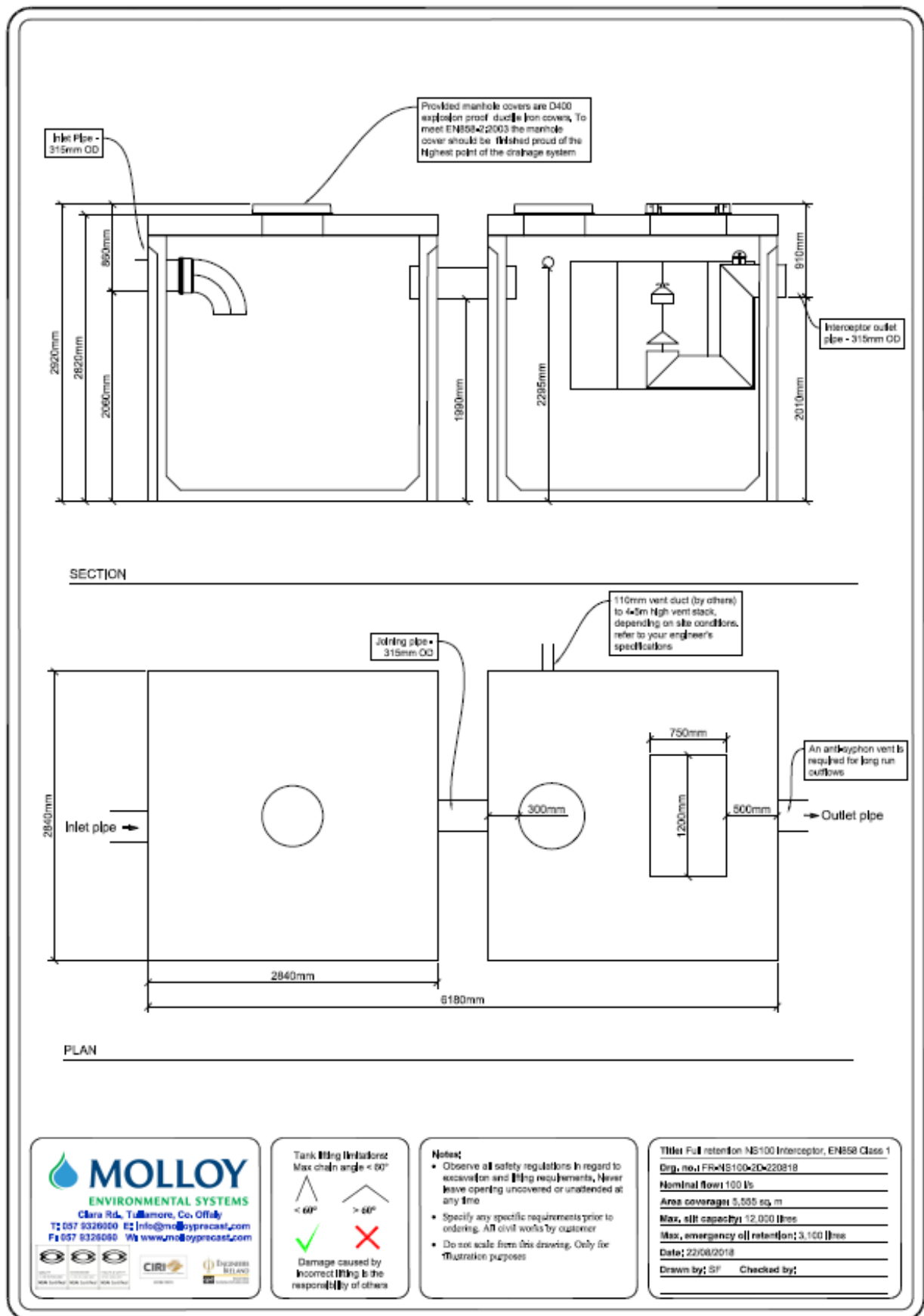
	Default	Edited
Attenuation storage 1/100 years (m³):	15236	15236
Long term storage 1/100 years (m³):	2701	2701
Total storage 1/100 years (m³):	17937	17937

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



APPENDIX 3

PETROL INTERCEPTORS

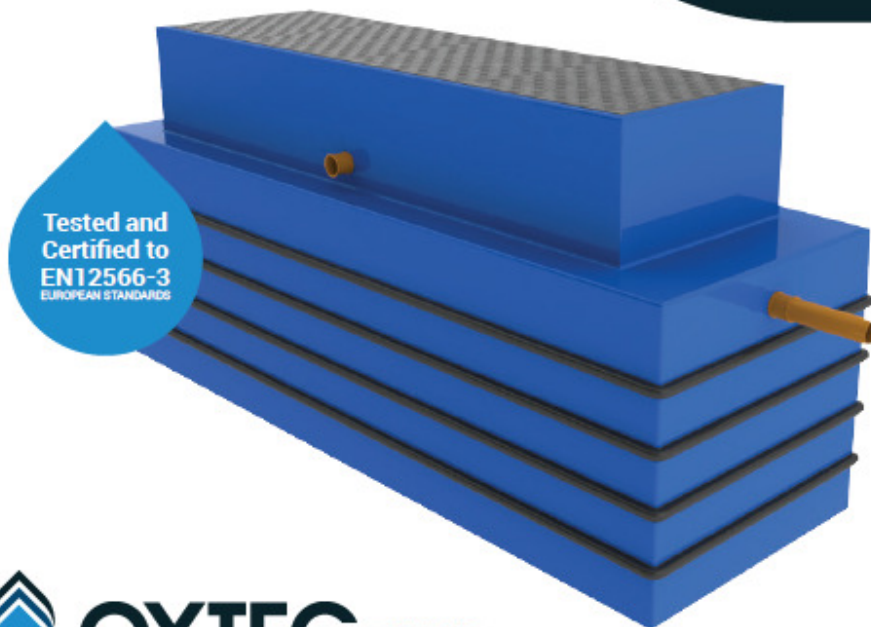




APPENDIX 4 FOUL WATER TREATMENT SYSTEM



**Efficient, reliable and
cost-effective wastewater
treatment plant for larger
applications.**



Manufactured from strong, robust, impact resistant tank grade polypropylene – unlike alternatives which are prone to cracking if not handled carefully

Single tank up to 300 person equivalent (Larger systems available in modular basis)

Low maintenance and running costs

Complete system can be manufactured to suit individual sites

Tested and Certified to EN12566-3 European Standards

Bespoke construction for deep and shallow inverts

Customisable for non-standard applications, i.e. schools, restaurants, etc.

Reliable & compact





Viltra's OXTEC PLUS is a 3-stage sewage treatment system in a single tank structure that uses a biological process to effectively treat sewage. It provides a very efficient, reliable and cost-effective solution to sewage disposal for any commercial, industrial or municipal application where there is no access to a main sewer.

Key Features

- Single tank installation to minimise costs
- Robust polypropylene construction for easy and cost-effective installation
- Non mechanical recirculation
- Flat, flush ground-level access covers
- Failure alarm systems as standard and not at additional cost
- No mechanical or electrical parts within unit



The certified performance of the OXTEC PLUS system is that it produces an average final effluent of;

- 11mg/l Biochemical Oxygen Demand (BOD)
- 16mg/l Suspended Solids (SS)
- 7mg/l Ammoniacal Nitrogen (NH₄)

- Consultancy & Design
- Site Survey and Design Proposals
- Environment Agency Site Suitability Advice and Management
- Installation & Commissioning
- Ongoing Servicing & Maintenance
- Spare Parts

It is important to note that the new standard relates to all units in the range from 6 person, (residential equivalent) and includes for process and structural testing, including installation in groundwater conditions.

Model Ref	Population Equivalent	BOD/ DAY	FLOW/ DAY M ³	LENGTH (mm)	WIDTH (mm)	DEPTH (mm)	INLET SIZE (mm)	WEIGHT (kg)	BLOWER RATING
OXTEC12	12	0.72	1.80	1900 Diameter		2118	110	300	80w
OXTEC18	18	1.08	2.70	2500 Diameter		2174	110	600	120w
OXTEC25	25	1.50	3.75	4710	1600	2174	160	1200	120w
OXTEC30	30	1.80	4.50	4010	2124	2174	160	1400	0.37kw
OXTEC40	40	2.40	6.00	5060	2124	2174	160	1700	0.37kw
OXTEC50	50	3.00	7.50	5610	2124	2174	160	1900	0.37kw
OXTEC60	60	3.60	9.00	6010	2124	2174	160	2100	0.75kw
OXTEC70	70	4.20	10.50	6810	2124	2174	160	2200	0.75kw
OXTEC80	80	4.80	12.00	6760	2524	2174	160	2400	0.75kw
OXTEC90	90	5.40	13.50	7360	2524	2174	160	2650	0.75kw
OXTEC100	100	6.00	15.00	7760	2524	2174	160	2900	0.75kw
OXTEC125	125	7.50	18.75	9100	2524	2174	160	3100	0.75kw
OXTEC150	150	9.00	22.50	10600	2524	2174	160	3300	1.10kw
OXTEC200	200	12.00	30.00	12000	2524	2174	160	3500	1.10kw
OXTEC250	250	15.00	37.50	12000	2524	2674	160	3700	1.10kw
OXTEC300	300	18.00	45.00	12000	2524	2712	160	4000	2.00kw

* Standard Invert Depths; Oxtec 12 - 18 - 550mm / Oxtec 18+ - 600mm
* Larger models available



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