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Lower Farm Barns
Sustainable Drainage Strategy
September 2022

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This document has been produced by Land Studio on behalf of Plant & Robinson Construction Limited. The contents of the document are intended for discharge of planning conditions related to the redevelopment proposals at Lower Farm, Lower Farm Road, Bowling Bank, Wrexham. Land Studio has prepared this report in accordance with the instructions of the above-named client for their sole and specific use. Any third parties who may use the information contained herein do so at their own risk.

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The Site

1.0

1.0 The Site

1.1 Introduction

Land Studio have been appointed by Phil Robinson at Plant & Robinson Construction Ltd to produce a Sustainable Drainage Strategy in support of the discharge of planning condition 11 of application P/2019/0647.

11. No part of the development shall commence until a scheme for the comprehensive and integrated drainage of the site indicating provision for foul water, surface water and land drainage has been submitted to and approved in writing by the Local Planning Authority. Prior to submission of those details, an assessment shall be carried out into the potential for disposing of surface water by means of Sustainable Urban Drainage Systems (SuDS) in accordance with the principles of sustainable drainage systems set out in Technical Advice Note 15: Development and Flood Risk, and the results of the assessment shall be submitted in writing to the Local Planning Authority.

(i) Provide information about the design storm period and intensity, the method employed to delay and control the surface water discharged from the site and the measures taken to prevent pollution of receiving ground water and/ or surface water.

(ii) Specify the responsibilities of each party for the implementation of the SuDS scheme, together with a timetable for implementation; and,

(iii) Provide a timescale for implementation, management and maintenance plan for the liftetime of the development which shall include the arrangements for adoption by any public authority or statutory undertaker and any other arrangements to secure the operation of the scheme throughout its lifetime.

This document has been carried out in accordance with Planning Policy Wales (PPW), Technical Advice Note 15 (TAN15), Natural Resource Wales (NRW) guidance and the statutory water authority requirements.

In preparation of the report and performance of any other services, Land Studio has relied upon publicly available information, information provided by the client and information provided by third parties. Accordingly, the conclusions reached in this report are valid only to the extent that the information provided was accurate and complete. Land Studio cannot accept liability for the accuracy or otherwise of any information derived from third party sources.

The existing site is located at

Lower Farm, Lower Farm Road, Bowling Bank, Wrexham, LL13 9RY,

National Grid Reference SJ 40889 50542

The site location is indicated in Figure 1 with the redline boundary for the proposed works indicated in Figure 2

Whilst the planning application included Barn 6 details of this have been discharged separately under application P/2021/0604 and are therefore not covered in this report.

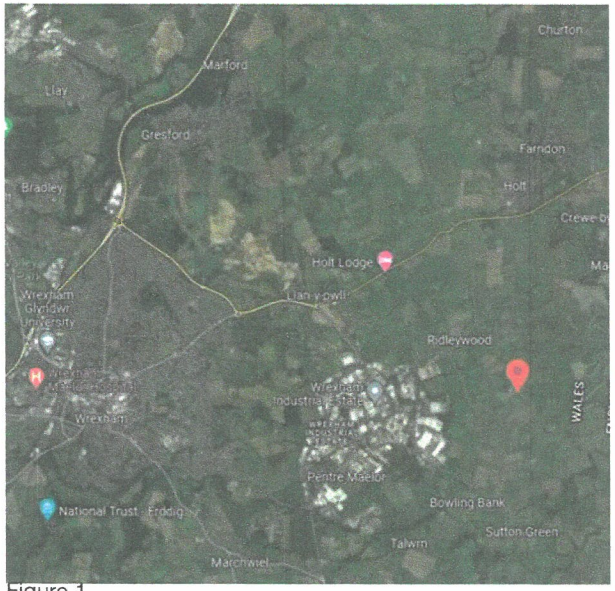


Figure 1



Figure 2

1.0 The Site

1.2 Proposed Development

The proposed development comprises of the redevelopment of the existing barns 1-5, construction of new access roads, car parking and landscaping within the redline boundary.

The proposed red line boundary of the site is 0.85ha as indicated in Figure 2 with a developed area of 0.62ha with the proposed landscape plan indicated in Figure 3.



Figure 3

Planning Policy and Guidance

2.0

2.0 Planning Policy and Guidance

2.0 Planning Policy and Guidance

The following legislation and planning guidance has been reviewed and considered in preparation of the proposed drainage strategy.

2.1 Planning Policy Wales (PPW)

Section 6.6 of the PPF 11th Edition dated January 2021 states that the planning system protects water features and fosters sustainable water management as key attributes of attractive and resilient places to live and is closely aligned with securing the multiple benefits of green infrastructure. The outcome of which should make a contribution towards achieving the requirements imposed by EU Water Framework Directive along with Welsh Government Policy for the integrated planning and management of water both in the urban and rural areas.

New developments of more than one dwelling or where the area covered by construction work equals or exceeds 100m² also requires approval from the SuDS Approval Body (SAB) before construction can commence.

The provision of SuDS must be considered as an itegral pat of the design of new developments and proposals shoudl incorporate design of surface water maangement based on the principles which work with nature to facilitate the natural functioning of the water cycle.

Any developments discharging domestic sewage should connect to the foul sewer where it is reasonable to do so. Developments proposing the use of non-mains drainage schemes will only be considered acceptable where connection to the main sewer is not feasible. Non mains drainage schemes should be subject to as assessment of their effects on the environment, amenity and public health in the locality.

All developments should reduce, and must not increase, flood risk arising from river and/or coastal flooding on and off the development itself.

All developments should not cause additional run-off and therefore requires control as close to source as possible by the use of SuDS.

2.2. Technical Advice Note 15: Development and Flood Risk

TAN15 provides technical guidance which supplements the policy set out in PPW in relation to development and flooding.

The development advice maps are based on Environment Agency's extreme flood outlines and British Geological Survey drift data. These indicate the level of risk assoicated fluvial, coastal and surface water on the location of the site and how to assess the consequences of flooding on the site.

To reduce surface water run-off from the site sustainable drainage solutions both hard and soft can be employed to manage and treat surface water run-off prior to discharge. TAN15 gives further details on the type of SuDS possible and these are discussed in more detail in Section 4.5.

2.3 Statutory Authority Guidance

The approach outlined in the Welsh Government Sustainable Drainage Systems Standards for Wales (SuDS Standards) and the CIRIA SuDS manual seek to manage the quality and quantity of rainwater runoff close to where it falls and to bring not just drainage design solutions but also amenity benefits to site users and encourage biodiversity.

The SuDS Standards require compliance with the following objectives and are covered further in Section 4.0 of this report.

- S1. Surface water runoff destination
- S2. Surface water runoff hydraulic control
- S3. Water Quality
- S4. Amenity
- S5. Biodiversity

2.4 Climate Change

The DEFRA peak rainfall climate change allowances for the Dee catchment are shown in Table 1

3.3% annual exceedance rainfall event		
Timescale	Central	Upper
2050s	20%	35%
2070s	30%	40%

1% annual exceedance rainfall event		
Timescale	Central	Upper
2050s	25%	40%
2070s	30%	45%

Table 1 – Peak Rainfall Climate Change Allowances

The central allowance for climate change is to be included within the provided storm-water attenuation. The upper allowance for climate change can be attenuated above ground (exceedance flooding) so long as this stormwater volume does not leave the site and therefore does not increase flood risk downstream.

The design therefore will allow for 40% climate change.

Review of Baseline Data

3.0

3.0 Review of Baseline Data

3.1 Sources of Information

The following third-party information has been used in production of this report.

- Site Layout as Proposed Drg No 01E
- Ref P/2019/0647 Planning decision notice dated 27/01/2020
- Battlefield Land Surveys Topographical information 13175/1 Rev -
- Welsh Water Sewer Maps dated 21st July 2022

3.2 Site Topography

A topographical survey has been undertaken of the redline boundary for the development. The site is relatively flat with falls away from existing barns, The lowest part of the site is to the front of the properties within a natural basin around the access road. A copy of the full topographical surveys undertaken within the redline boundary can be found in Appendix A.

3.3 Geological Setting

A review of the NSRI soilscape maps and bgs mapping indicate that the site is located in an area of slowly permeable seasonally wet slightly acid but rich based loamy and clayey soils. The area is mainly grasslands and arable land.

Infiltration testing has been undertaken on the site to confirm this.

3.4 Groundwater

Excavations which have been dug show no signs of groundwater ingress.

3.5 Flood Risk

The development maps provided by Natural Resources Wales indicate that the site is in a Flood Zone A and there no risk from flooding for rivers, seas or reservoirs. Indicated in green, orange and blue in Figure 4.

The maps indicate there is a high risk of surface water and small watercourse flooding within the site indicated in pink in Figure 4 below.



Figure 4 Flood Map

It is proposed that Flood Risk will not increase as a result of the development. It is proposed to restrict the run-off rates to mimic the greenfield scenario for the 1 in 1 year event (discussed in more details in Section 3.7). This means that flood risk betterment to runoff rates is provided for any storm that exceeds this design event (1 in 1 year) up to and including the extreme 1 in 100 year storm + 40% climate change.

Surface water management trains will also be introduced which will improve or manage the existing surface water flooding within the site.

Surface Water Drainage Strategy

4.0

4.0 Surface Water Drainage Strategy

4.1 Basis of Design

Design Codes

The following British Standards and design guides shall be used for storm water design purposes. Please note that this list is not exhaustive but covers the overall general drainage requirements.

- BS EN 752 Drain and Sewer Systems Outside Buildings
- BS EN 16933-2 Drain and Sewer Systems Outside Buildings Part 2: Design
- CIRIA C635 The SuDS Manual
- DEFRA/EA Preliminary Rainfall Run Off Management for Developments (2013)
- CIRIA Interim Code of Practice for Sustainable Drainage (2004)
- CIRIA C635 Designing for Exceedance in Urban Drainage Good Practice (2006);
- HR Wallingford Wallingford Procedure for Design and Analysis of Urban Storm Drainage
- PPG3 Environment Agency Pollution Prevention Guidelines 3 (Withdrawn but remains best practice

Design Criteria

The proposed surface water drainage shall be designed so that there is no surcharging of pipework during storms up to a 1:2-year annual probability and no flooding on the surface, apart from wihtin green SuDS features during storms up to a 1:30-year annual probability.

The design will also be checked to ensure no flooding of third-party land or buildings during storms up to a 1:100-year annual probability + 40% increased allowance for climate change.

4.2 S1: Surface Water Runoff Destination

The SuDS Standard has five priority levels for surface water runoff. These are:

- Priority 1: Surface water runoff collected for use
- Priority 2: Surface water runoff is infiltrated to ground
- Priority 3: Surface water runoff is discharged to a surface water body
- Priority 4: Surface water runoff is discharged to a surface water sewer, highway drain or another drainage system
- Priority 5: Surface water runoff is discharged to a combined sewer

The discharge hierarchy has been reviewed here in more detail.

Priority 1: Water Reuse

Solutions that reuse rainwater prior to discharge include rainwater harvesting for on-site non-potable use, flushing toilets for example or for landscape maintenance in the form of water butts or larger scale attenuation with a pumped outlet. Passive irrigation is also an effective way of utilising rainwater, particularly in low-intensity events, and reduces maintenance requirements for planted areas. Whilst water butts will be utilised within the scheme for landscape irrigation, due to the exsting roof pitches and internal structural arrangement it is not deemed suitable for full rainwater harvesting. Section G1.6 of the Statutory Standards for SuDS states that "in most cases, rainwater harvesting along will not be adequate to deal with the site drainage and provision will be required for an overflow to a Priority Level 2 or lower priority runoff destination", as such full rainwater harvesting systems are not considered suitable fully on this site.

Priority 2: Infiltration to Ground

Ground information obtained through review of the soilscape website and infiltration testing in the location of proposed SuDS features indicate that infiltration methods are not possible as the main source of discharge on this site.

Priority 3: To Surface Water Body/Watercourse

There is an existing ditch (ordinary watercourse) which exists to the front of the property into which the exsting roof drainage currently discharges into. This then flows east towards the River Dee.

Priority 4 and 5: To sewer

There are no public sewer assets within the vicinity of the site. Due to the proximity of the ordinary watercourse, a connection to the public sewer for surface water drainage will not be required.

It is therefore proposed that surface water from the site will discharge via infiltration where possible but will have a positive connection into the existing ordinary watercourse.

4.3 S2: Surface Water Runoff Hydraulic Control

The runoff rates proposed will aim to not exceed the 1 in 1-year greenfield rate (i.e. 4.1 l/s/ha) for all storm events up to and including the extreme 1 in 100 year event plus a 40% accommodation for climate change.

The restriction of run-off rates will generate storm-water attenuation volumes that will be retained on-site prior to outfall.

The betterment of runoff rates will compensate for the inevitable increase in runoff volumes due to the increase in impermeable area. By restricting volumes until the storm has passed and allowing them to be released slowly, the capacity of the downstream catchment will be able to accommodate surface water run-off.

Volumes can be reduced by way of partial infiltration. Whilst infiltration is not shown to be a viable outfall solution due to the underlying soils, however, partial/slow infiltration should be enabled within the design where possible, by removing the use of impermeable membranes from from standard installation guidance, allow the system to recharge the surrounding soils.

Surface level sustainable drainage systems allow for further evaporation. This can be achieved by ensuring that the 1 in 100 year plus 40% climate change is attenuated at surface level through localised ponding within the drainage features.

Whilst permeable surfacing is proposed to the majority of the hard landscaped areas infiltration is slow and this is evident by the surface water flooding noted on the mapping data. Storage within the subbase will slow down the water entering the downstream watercourse.

The proposed impermeable area of the development is 0.33 ha (3359m2) which includes the permeable surfaced areas as infiltration is not deemed possible for these areas in the design so allowance for positive drainage and falls at surface level are to be included.

4.4 Proposed Volume of Attenuation

The restriction of run-off rates will require the storage of surface water within the site prior to discharge. A restricted discharge of 1.35 l/s requires the storage volume indicated in Table 4.

Discharge Rate (l/s)	Return Period	Storage Volume Requ (m3/ha)
1.35	1 in 100 + 40% cc	256

Table 4: Storage Volumes

4.0 Surface Water Drainage Strategy

4.5 Sustainable Drainage Systems (SuDS)

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

Planning policy promotes sustainable management of surface water runoff from a new development or redevelopment, and the use of SuDS is recommended.

The 'Management Train Approach' should be central to the surface water drainage strategy of a proposed site. The main objective is the treatment and control of runoff as near to source as possible, thus protecting downstream habitats and further enhancing the amenity value of the site. Due to the restrictions imposed on the surface water discharge rate, a minimum of 256m^3 of attenuation will need to be incorporated within the design of the surface water drainage for the site.

A review of potential sustainable drainage systems has been undertaken to identify the likely form of attenuation which could be included, and which methods are viable for this site. Refer to table 5 for this review.

The proposed surface water scheme will therefore include the following SuDS feaures.

- Permeable paving and subbase attenuation (potential for in access of 295m^3 in subbase attenuation - depth of subbase will be dependant on proposed levels and falls in below ground pipework)

- Detension basin (115m^3 of storage possible)

- Raingardens (20m^3 of storage possible)

4.6 S3: Water Quality

The quality of runoff from the site to support and protect the natural environment effectively needs to be taken into account in the design of the drainage systems.

The SuDS philosophy for a development site is the promotion of Pollution Prevention and Site Control Techniques. The following design philosophy is therefore proposed:

- Surface water treatment using the 'Management Train' approach to remove and isolate contamination at all SuDS facilities prior to conveyance.

- Surface water discharge into the stream network at a reduced rate that mimics the annual greenfield scenario.

- Prevention measures in the form of reducing the overall potential impermeable area of the site.

- Site Control features (attenuation) to accommodate the additional surface water runoff generated by the development site.

- Provision of suitable pollution prevention measures.

Where practical treatment systems should be designed to be close to the source of runoff and reviewed in accordance with Water Quality design criteria set in Chapter 4 and Water Quality Management: Design Methods in Chapter 26 of The SuDS Manual CIRIA C753 2015.

It is proposed that the development site has at least two levels of treatment.

The use of permeable paving is an excellent treatment solution where pollutants and debris are prevented from entering the system via filtration through the block paving (or permeable bitmac if chosen). The majority of pollutants are absorbed at surface level through aerobic digestion and UV exposure. Debris and larger items are easily noticed at surface level and removed quickly, reducing overall maintenance requirements.

Persistent pollutants are treated as water filtrates through the sand bedding layer and granular subbase which provides a high surface area for aerobic digestion of most pollutants.

The use of green SuDS features such as raingardens, detension basin and bioretention features that provide effective treatment through the removal of sediments by filtration through the surface vegetation and groundcover, and the removal of fine particles and associated contaminants by infiltratin through the underlying filter medium layers.

The treatment of heavy metals and organic pollutants such as phosphates and nitrates is most readily provided through contact with a biologically active soil medium and root zone which allows for phytoremediation. Therefore, any surface water volumes attenuated should have access to the surrounding soils and plants therein.

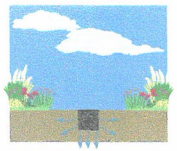
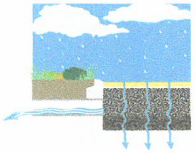
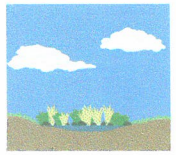
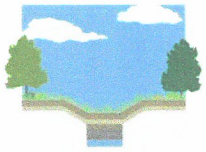
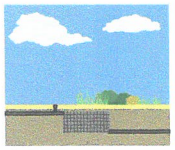
4.7: S4: Amenity

The provision of the detention basin to the front of the building allows for the space to be utilised as amenity space.

4.8: S5: Biodiversity

The provision of the raingarden areas, detention basin and wetland area allows for biodviersity to be incorporated into the landscape design.

Table 5: SuDS Solutions

	Solution	Advantages	Disadvantages	Suitability at Lower Farm Barns
Traditional Soakaways 	Excavations either filled or lined with brickwork, precast concrete or polyethylene rings/perforated structures to allow surface water runoff to be stored and discharged directly to ground.	- Minimal land take. - Reduces the volume of runoff. - Effective at pollutant removal if filled - Contributes to groundwater recharge. - Simple and cost-effective. - Easy performance observation. - Can be retrofitted. - Easy to maintain.	- Soakaways need to be located away from substructure to prevent adverse effect on foundations. - Not suitable in poor draining soils. - Requires testing on site prior to design - Not appropriate for draining polluted runoff. - Increase risk of groundwater pollution. - No amenity or biodiversity. - Limited to small catchments.	Ground conditions indicate that infiltration is unlikely and therefore it is assumed that soakaway design is not possible.
Permeable Paving and/ or subbase attenuation 	Porous paving allows runoff to infiltrate through the surface to the subbase layer. Water can then either be infiltrated into ground or conveyed into storage within the subase and/ or downstream drainage systems.	- Provides attenuation at source. - Provides low level water treatment. - If designed for infiltration contributes towards groundwater recharge. - Easy to install and retrofit. - Simple to maintain if lined and can be used where groundwater is sensitive. - Subbase attenuation can be utilized without poroussurfacing.	- Some surfacing not suitable in some heavily trafficked or turning areas. - If subbase attenuation used with block paving this requires regular maintenance to prevent clogging with dirt. - Requires increased build up in some situations although dependant on CBR values - Coordination with services essential to ensure routes provided through the subbase attenuation.	Permeable paving and subbase attenuation are suitable. Infiltration unlikley so subbase used for storage prior to discharge into open features.
Detention Basins 	Provides both storm water attenuation and treatment in large grassed depressions either formed into community facilities or subtly through depressions in the land.	- The retention time promotes good removal of pollutants through sedimentation. - Can be used where groundwater is vulnerable. - Good community acceptability. - High ecological, and amenity benefits. - Runoff from each rain event is detained and treated in the pool.	- No reduction in run-off volume. - High land take required. - Depths can be constrained by external levels.	A detention basin can be utilised for collection of surface water to the front elevation of the buildings.
Wetland 	Shallow, extended detention, pond wetland, pocket wetland, submerged gravel wetland. Wetlands provide stormwater attenuation and treatment and comprise of shallow ponds/marshy areas covered in aquatic vegetation.	- Good pollutant removal. - If lined can be used where groundwater is vulnerable. - Good community acceptability. - Good ecological and amenity benefits. - Wetlands can detain flows for an extended period to allow sediments to settle and to remove contaminants - Must be incorporated within the landscape plans to give maximum benefit.	- High land take if used for full attenuation system. - Requires baseflow to keep areas wet. - Little reduction in run-off volume. - Not suitable for steep sites.	A wetland is to be incorporated into the scheme prior to final discharge into the existing watercourse.
Swales 	Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where ground conditions allow.	- Can be incorporated into landscaping design. - Good removal of pollutants. - Reduces run-off rates and volumes. - Low cost drainage feature.	- Not suitable for steep sites. - Land take required to fit swales in.	Whilst swales could be incorporated to the rear of the property it is not deemed suitable for this development layout.
Modular geocellular systems 	Underground plastic geocellular systems which are either wrapped or allowed to infiltrate dependent on ground conditions.	- Modular and flexible. - Dual usage (infiltration if possible and/or storage). - High void ratios. - Can be installed beneath trafficked and soft landscaped areas. - Light and easily installed. - Can slow discharge of water downstream. - Flexible as they can be kept shallow over a larger plan area or small plan area but deeper	- Difficult to maintain if installed under the building footprint. - If infiltration is possible, then this needs to be more than 5m away from the building's substructure. - Size restricted to unit size. - No treatment of water to improve water quality. - No amenity impact - No biodiversity impact	Geocellular tanks could be incorporated here there is not enough storage available in green SuDS

Foul Drainage

5.0

5.0 Foul Water Drainage Strategy

5.1 Basis of Design

The following British Standards and design guides shall be used for storm water design purposes. Please note that this list is not exhaustive but covers the overall general drainage requirements.

- BS EN 752 Drain and Sewer Systems Outside Buildings
- BS EN 16933-2 Drain and Sewer Systems Outside Buildings Part 2: Design
- CIRIA C635 The SuDS Manual
- CIRIA Interim Code of Practice for Sustainable Drainage (2004)
- PPG3 Environment Agency Pollution Prevention Guidelines 3 (Withdrawn but remains best practice

5.2 Proposed Foul Design

The sewer records indicate that there are no accessible public sewers in the vicinity of the site therefore a private sewage treatment plant will be requied to serve the development. A Biodisc treatment plant is proposed and woudl provide sufficient treatment for domestic foul flows. Additional chemical dosing can be incoporated to reduce phosphates within the system to get a 95.4% reduction within the plant. The chemical dosing process is started when the sludge return pump is activated and operates for a predetermined time. The chemical is intermittently pumped into the dosing point. The chemical mixes with the dissolved phosphate and coagulates together to form settleable particles which settle in the FST.

The sewerage treatment plant will be located more than 7m from habitable buildings and 10m from the watercourse.

It is then proposed for the treated effluent to discharge via gravity into a new bioretention area with final discharge into the watercourse. Discharge to the watercourse may require formal discharge consent from NRW.

6.0 Management, Maintenance and Residual Risk

6.1 S6: Design of drainage for construction, operation and maintenance.

Standard S6 of the Statutory Standards for SuDs states

1) All elements of the surface water drainage system should be designed so that they can be constructed easily, safely and cost-effectively, in a timely manner, and with the aim of minimising the use of scarce resources and embedded carbon.

2) All elements of the surface water drainage system should be designed to ensure maintenance and operation can be undertaken (by the relevant responsible body) easily, safely, cost effectively, in a timely manner and with the aim of minimising the use of scarce resources and embedded carbon.

3) The surface water drainage system should be designed to ensure structural integrity of all elements under anticipated loading conditions over the design life of the development site, taking into account the requirement for reasonable levels of maintenance.

The design of the proposed surface water drainage system is to follow the good practice contained in SuDS Standards and the CIRIA SuDS manual, including the necessary provisions for future operation and maintenance. The SuDS features incoporated will be maintained by a private maintenance company along with the landscaping within the site.

6.2 Maintenance Schedule

The maintenance of the underground drainage elements will be undertaken in accordance with the recommendations provided within the SuDS manual and manufacturer requirements for bespoke systems such as the foul treatment plant.

Any parties involved with the disposal of any waste materials from the underground drainage system should hold appropriate management licenses to undertake any such activities. Disposal of any site materials is required to be made in accordance with current legislation and guidance.

The maintenance schedule has been prepared using guidance provided in 'CIRIA C625 – Model agreements for sustainable water management systems', CIRIA 626 – Rainwater and Greywater systems and manufacturer's recommendation for specialist drainage elements. The following tables, taken from the SuDS manual note the likely maintenance requirements for this project,

TABLE 20.15 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

TABLE 22.1 Operation and maintenance requirements for detention basins

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

TABLE 18.3 Operation and maintenance requirements for bioretention systems

Maintenance schedule	Required action	Typical frequency
Regular inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect inlets and outlets for blockage	Quarterly
Regular maintenance	Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants, to maintain planting density	As required
	Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to biannually
Occasional maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years

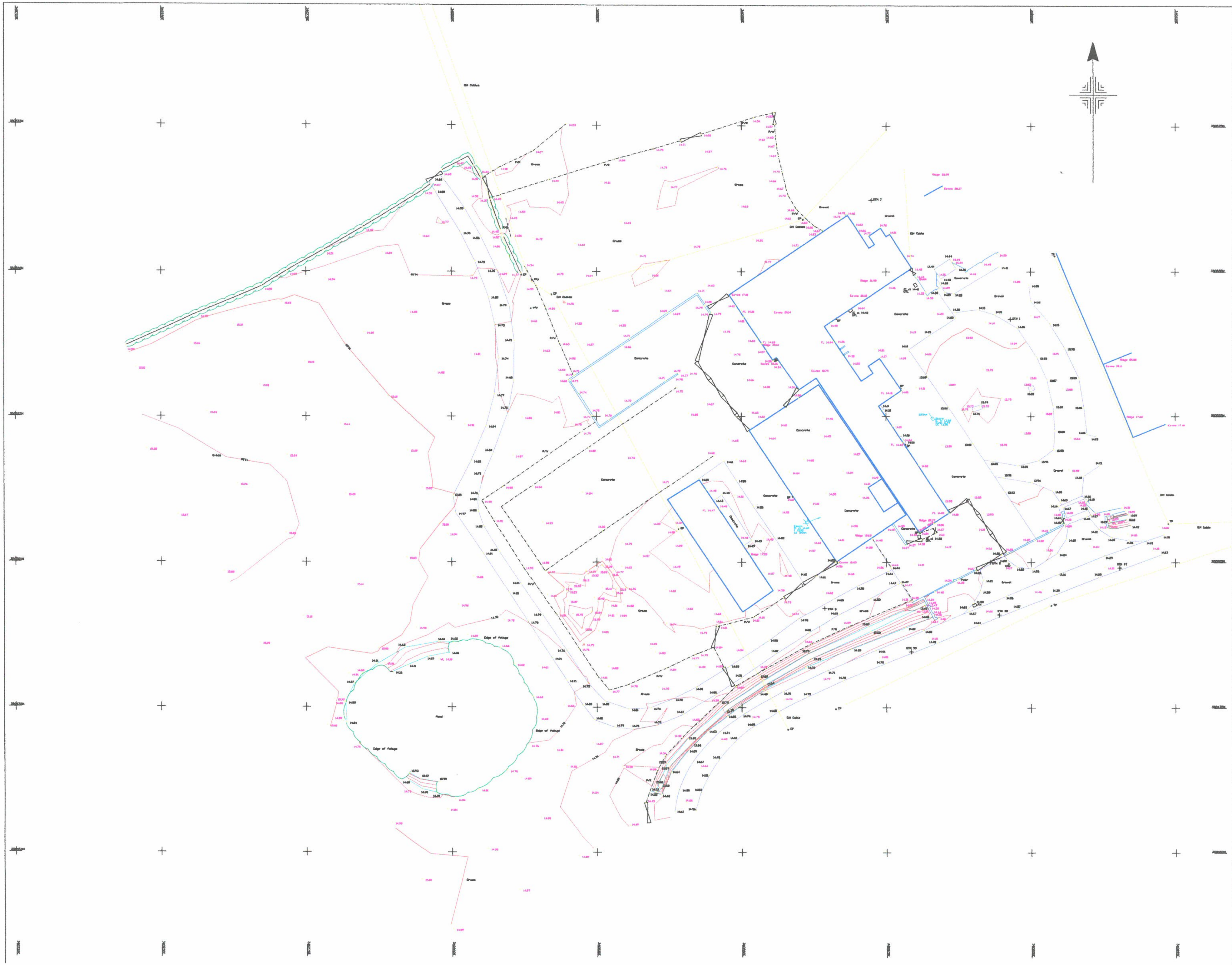
TABLE 23.1 Operation and maintenance requirements for ponds and wetlands

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public areas	Monthly (during growing season)
	Cut the meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options	Half yearly
	Check any mechanical devices, eg penstocks	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1 m above water level	Annually
	Tidy all dead growth (scrub clearance) before start of growing season (Note: tree maintenance is usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay.	Every 1–5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.	Every 5 years, or as required
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, eg every 25–50 years
Remedial actions	Repair erosion or other damage	As required
	Replant, where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair / rehabilitate inlets, outlets and overflows.	As required

Appendices

7.0

Appendix 1 - Topographical Survey



Legend

BL BOLLARD
BS BUS STOP
CATV CABLE TV COVER
CL COVER LEVEL
CPS CONCRETE PAVING SLAB
DP DRAIN PIPE
DK DROP KERB
EL ELECTRICITY COVER
EP ELECTRICITY POLE
ER EARTH ROD
FH FIRE HYDRANT
FL FLOOR LEVEL
FS FLAG STAFF
G GAS COVER
GLY GULLY
GSV GAS STOP VALVE
IC INSPECTION COVER
IL INVERT LEVEL
LB LITTER BIN
LP LAMP POST
MKR MARKER
NB NOTICE BOARD
P POST
PH POST HOLE
PLP PEDESTRIAN LAMP POST
RE RODDING EYE
RS ROAD SIGN
STN SURVEY STATION
STY STAY WIRE
T TELECOMMUNICATIONS COVER
TL TRAFFIC LIGHT
TP TELEGRAPH POLE
TWL TOP OF WALL LEVEL
UTL UNABLE TO LIFT
UTM UNABLE TO MEASURE
VP VENT PIPE
WL WATER LEVEL
WP WASTE PIPE
WSV WATER STOP VALVE

FENCE TYPES

B/W BARBED WIRE
C/B CLOSE BOARD
P/W POST AND WIRE
P/R POST AND RAIL
C/L CHAIN LINK
C/P CHESTNUT PALE
C/W CHICKEN WIRE
M/R METAL RAIL (SECURITY TYPE)
P/F PANEL FENCE
C/I CORRUGATED IRON
I/R IRON RAILING
RWL RETAINING WALL

Notes

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DENOTES OVERHEAD CABLES

DENOTES UNDERGROUND SERVICES

LEVELS AT ROAD KERBS ARE TAKEN AT CHANNEL LEVELS UNLESS OTHERWISE REQUESTED

STATION CO-ORDINATES

STN	1	E	340896.484	N	350541.858	H	14.101
STN	2	E	340892.899	N	350586.092	H	14.185
STN	7	E	340872.412	N	350562.159	H	14.612
STN	97	E	340915.361	N	350479.106	H	14.274
STN	98	E	340894.462	N	350491.075	H	14.654
STN	99	E	340879.292	N	350484.739	H	14.841

BATTLEFIELD LAND SURVEYS LTD
3 YEOMANRY ROAD
BATTLEFIELD ENTERPRISE PARK
SHREWSBURY
SHROPSHIRE SY1 3EH
TEL/FAX 01743 443388
EMAIL MAILBOX@BLSURVEYS.CO.UK

Client: PLANT + ROBINSON CONSTRUCTION LTD

Title: LOWER FARM, BOWLING BANK, WREXHAM

Scale	Date	Job No	Dwg. No	Rev.
A0@ 1 : 200	01/07/22	13175	1	-

Surveyed by	Checked	Scanned	Levels are related to . . .
JS/JG	JS	NO	OS DATUM (VRS)

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HR Wallingford
Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Lisa Sawyer
Site name:	Lower Farm Barns
Site location:	Wrexham

This is an estimation of the greenfield runoff rates that are used 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). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	53.04880° N
Longitude:	2.88314° W
Reference:	925350434
Date:	Sep 26 2022 14:43

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 1

Methodology

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

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics	Default	Edited
SAAR (mm):	677	677
Hydrological region:	9	9
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 30 years:	1.78	1.78
Growth curve factor 100 years:	2.18	2.18
Growth curve factor 200 years:	2.46	2.46

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	4.64	4.64
1 in 1 year (l/s):	4.09	4.09
1 in 30 years (l/s):	8.26	8.26
1 in 100 year (l/s):	10.12	10.12
1 in 200 years (l/s):	11.42	11.42

This report was produced using the greenfield runoff 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 www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. 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 this data in the design or operational characteristics of any drainage scheme.

Print | Close Report

HR Wallingford
Working with water

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Lisa Sawyer
Site name:	Lower Farm Barns
Site location:	Wrexham

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 Details

Latitude:	53.04897° N
Longitude:	2.88285° W
Reference:	1733862498
Date:	Sep 26 2022 14:13

Site characteristics

Total site area (ha):	0.33
Significant public open space (ha):	0
Area positively drained (ha):	0.33
Impermeable area (ha):	0.33
Percentage of drained area that is impermeable (%):	100
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):	0.33
Net impermable area for storage volume design (ha):	0.33
Pervious area contribution to runoff (%):	30

* 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	Flow control to max of 2 l/s/ha or Qbar
Interception rainfall depth (mm):	5
Minimum flow rate (l/s):	2

Methodology

esti	IH124
Q_{BAR} estimation method:	Specify Qbar manually
SPR estimation method:	Specify SPR manually

Soil characteristics	Default	Edited
SPR:	0.47	0.47

Hydrological characteristics	Default	Edited
Rainfall 100 yrs 6 hrs:	--	61
Rainfall 100 yrs 12 hrs:	--	73.73
FEH / FSR conversion factor:	1.01	1.01
SAAR (mm):	677	677
M5-60 Rainfall Depth (mm):	17	17
'r' Ratio M5-60/M5-2 day:	0.3	0.3
Hydological region:	9	9
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 10 year:	1.42	1.42
Growth curve factor 30 year:	1.78	1.78
Growth curve factor 100 years:	2.18	2.18
Q_{BAR} for total site area (l/s):	1.53	1.35
Q_{BAR} for net site area (l/s):	1.53	1.35

Site discharge rates	Default	Edited
1 in 1 year (l/s):	2	2
1 in 30 years (l/s):	2	2
1 in 100 year (l/s):	2	2

Estimated storage volumes	Default	Edited
Attenuation storage 1/100 years (m^3):	256	256
Long term storage 1/100 years (m^3):	0	0
Total storage 1/100 years (m^3):	256	256

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	40	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	0.900	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
East	0.110	5.00	13.750	150	340893.815	350530.497	0.400
West	0.220	5.00	14.300	150	340853.328	350508.984	0.490

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	17.000	Drain Down Time (mins)	240
Ratio-R	0.300	Additional Storage (m³/ha)	0.0
Summer CV	0.900	Check Discharge Rate(s)	x
Winter CV	0.900	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node East Online Orifice Control

Flap Valve	x	Invert Level (m)	13.350	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Diameter (m)	0.020		

Node West Online Orifice Control

Flap Valve	x	Design Depth (m)	0.480	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	0.9		
Invert Level (m)	13.810	Diameter (m)	0.025		

Node East Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	13.350
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	274.0	0.0	0.400	306.0	0.0

Flow+ v10.4 Copyright © 1988-2022 Causeway Technologies Ltd

Node West Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	13.810
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Time to half empty (mins)	

Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	1343.0	0.0	0.490	1343.0	0.0

Flow+ v10.4 Copyright © 1988-2022 Causeway Technologies Ltd

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	East	1380	13.684	0.334	3.5	96.1261	0.0000	OK
1440 minute winter	West	1380	14.296	0.486	7.1	196.0159	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
1440 minute winter	East	Orifice	0.5	32.4
1440 minute winter	West	Orifice	0.9	60.9

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Foul Discharge Design

Project Ref: 285 **Project:** Lower Farm Barns **Date:** 18/07/2022

Source of Waste				Flow Litre / Day		BOD Grams / Day		NH3	
Description	No of units	Max Occupancy	Total	Per Head	Total	Per Head	Total	Per Head	Total
No 1	1	7	7	150	1050	60	420	8	56
No 2	1	6	6	150	900	60	360	8	48
No 3	1	5	5	150	750	60	300	8	40
No 4	1	4	4	150	600	60	240	8	32
No 5	1	5	5	150	750	60	300	8	40
TOTAL LOAD		27	**27**		**4050**		**1620**		**216**
m3/day					**4.05**				
Average Daily Flow (l/s)					**0.05**				
Peak Flow					**0.28**				

>5m3 but <20m3 therefore standard environmental permit should be acceptable

Surface water is to be excluded from the foul drainage network
Grease Trap - Not provided in this situation

Appendix 3 - Landscape Proposals



PLANTING NOTES

1.1 Prior to Planting :
- All contaminated plants to be watered in the container prior to planting.
- All bare root plants to be lifted from the nursery, stored and transported in accordance with the HTA Planting Handling Code.
- No planting should occur when the ground is frozen or water logged.
- All planting areas to be bare ground free of grass, weeds and other vegetation.
- Planting areas to have a 450mm depth of topsoil (topsoil to BS 3882: 2007). Before applying topsoil, remove all debris and contaminants, lightly cultivate the surface depth of approx. 300mm to loosen soil and create a 'key' for the new topsoil, or to break up compacted topsoil.

1.2 Planting Guidance :
- New tree planting in grass areas to be in a 0.5m diameter, weed free circle
- All whip/shrub planting is to be planted in to a weed free bed a minimum 250mm wider than the planting area, plants to be set 100mm back from any fence or wall.
- Planting pits to be dug to a depth of 1000mm for trees and 300mm for shrub planting. The sides of the pit to be loosened so as to avoid no smoothing of sides.
- All bare root whips to have Tubex (or equivalent) Combitube Standard Tree Shelter 750mm high x 73mm Ø fitted to a 25x25x900mm timber stake, as per manufacturers recommendations.
- All bare root shrub whips to have Tubex (or equivalent) Shelter guard shrub shelter 60cm x 130-180mm Ø fitted to a 25x25x900mm timber stake, as per manufacturers recommendations.
- All standard trees to be staked and with spiral guard.

1.2.1 Planting Mixes :
- All hedge whip planting to be planted with species in groups of 3.
- The hedge planting is to be planted at 400mm centres in a double staggered row.

1.4 Immediately After Planting :
- All plants to be thoroughly watered in immediately after planting.

Watering Trees :
-Trees planted dormant, between November and March, should not be "watered in".
-Containers grown trees planted in spring/ early summer: Soak the pot prior to planting. Soak the root area after planting with about 10-15 gallons of water and then leave it alone.
-If the summer after planting is dry, watering may be necessary on large specimens. If so, then flood the root zone with about 20 gallons of water on 2 or 3 occasions between June and September. More than this on most soils will cause water-logging and root death.
-Small to medium sized trees planted dormant and kept weed free usually do not require watering.
- All planting beds to be thoroughly mulched with 75mm lightly consolidated depth of wood chip.
- The mulching material to be in accordance with PAS 100:2005 and applied to the 0.5m diameter, weed free circle around trees planted in grass.

5 YEAR ESTABLISHMENT MAINTENANCE OF NEW PLANTING :

2.1 General Notes:
During the 5 yr establishment period visit at eight weekly intervals from April - December to carry out the following to planting areas:
- Control weed growth. Maintaining a weed free area around each plant during the first few years will allow quick establishment of the plants and reduce the likelihood of defects.
- Prune dead and broken branches/shoots
- Check stakes and ties. Adjust or replace as necessary
- Litter picking of beds

2.2 Weed Control in Grass Areas :
This weed free areas to be maintained as weed free for the first 5 years following planting with mulch woodchip material, all areas topped up to maintain a 75mm depth for the maintenance period. Occasional spraying with a contact herbicide in accordance with the manufacturers instructions may be required.

2.3 Watering :
During the first year after planting it may be necessary to water all plants in prolonged periods of dry weather. This usually occurs during May - September. All planting areas should be watered to field saturation using clean fresh water on a weekly basis.

2.4 Replacements (Within 5 years)
FAILURES OF PLANTING DURING THE FIRST FIVE YEARS
General: Any plants that fail to thrive in the first year will be replaced. All Standard Trees and Specimen Shrubs that have failed to thrive during the first 5 years will be replaced.
Replacements: To match original specification.
Timing of making good: During the next suitable planting season.

2.5 Removal of Stakes and Ties :
All spiral guards, canes and tree stakes should be removed at the end of years 3-5 following planting.

2.6. Formative Pruning of Trees :
Prune to shape young trees, but don't cut back the leader.
Remove crossing branches and branches that grow back towards the centre of the tree.
As young trees grow, remove lower branches gradually to raise the crown, and remove branches that are too closely spaced on the trunk. Remove multiple leaders on evergreens and other trees where a single leader is desirable.

2.7 Hedge Maintenance :
New hedges are to be allowed to grow to an approximate height of 1600mm and to be trimmed every year to ensure dense vegetation. Hedge cutting to take place during November - February (outside bird nesting periods).

PLANTING SCHEDULE

Native Hedgerow Mix *To be planted in a double staggered row*

Species	Specification	% Mix	Metres	Density per linear metre	Total plants
Crataegus monogyna	*1+1 bare root 40-60cm whip*	50	177	6	1062
Prunus padus	*1+1 bare root 40-60cm whip*	10	35.4	6	212
Acer campestre	*1+1 bare root 40-60cm whip*	10	35.4	6	212
Rosa canina	*1+1 bare root 40-60cm whip*	10	35.4	6	212
Corylus avellana	*1+1 bare root 40-60cm whip*	10	35.4	6	212
Prunus spinosa	*1+1 bare root 40-60cm whip*	10	35.4	6	212
Total m:		**354**			**2124**

Tree Planting

Species	Specification	No
Malus domestica 'James Grieves' (Md)	*1+1, bare root, grafted onto dwarf root stock M26. 200-250cm*	3
Pyrus communis 'Conference' (Pc)	*1+1, bare root, grafted on to semi dwarf root stock. Quince A. 200-250cm*	3
Quercus robur (Qr)	*Height 200cm. Girth 10-12cm. RB*	2
Acer pseudoplatanus (Ap)	*Height 200cm. Girth 10-12cm. RB*	2
Acer campestre (Ac)	*Height 200cm. Girth 10-12cm. RB*	4
Populus tremula (Pt)	*Height 200cm. Girth 10-12cm. RB*	1
Alnus glutinosa (Ag)	*Height 200cm. Girth 10-12cm. RB*	5
Total:		**20**

Rain Garden Planting Mix: 01

Species	Specification	% Mix	Area/ m²	Density per square metre	Total plants
Carex elata 'Aurea'	*3L container grown*	50	25	6	150
Rudbeckia birta	*3L container grown*	10	5	6	30
Bergenia cordifolia	*3L container grown*	20	10	6	60
Allium 'Purple King'	*Bulb*	20	10	3	30
Total m²:			**50**		**270**

Rain Garden Planting Mix: 02

Species	Specification	% Mix	Area/ m²	Density per square metre	Total plants
Miscanthus sinensis	*5L container grown*	5	5.3	2	11
Rudbeckia birta	*3L container grown*	20	21.2	6	127
Hakonechloe macra 'Aureola'	*3L container grown*	20	21.2	6	127
Stipa gigantea	*5L container grown*	5	5.3	1	5
Juncus effusus	*5L container grown*	15	15.9	2	32
Cornus sanguinea	*5L container grown*	15	15.9	2	32
Crocosmia	*3L container grown*	15	15.9	5	80
Iris pseudacous	*3L container grown*	5	5.3	6	32
Total m²:			**106**		**445**

Ornamental Planting Mix: 01

Species	Specification	% Mix	Area/ m²	Density per square metre	Total plants
Lavandula hidcote	*3L container grown*	20	12.8	6	77
Rosmarinus officinalis	*3L container grown*	20	12.8	6	77
Thymus vulgaris	*3L container grown*	20	12.8	6	77
Carex elata 'Aurea'	*3L container grown*	20	12.8	6	77
Stipa tenuissima	*5L container grown*	20	12.8	6	77
Total m²:			**64**		**384**

Ornamental Planting Mix: 02

Species	Specification	% Mix	Area/ m²	Density per square metre	Total plants
Lavandula angustifolia 'lelagance pink'	*3L container grown*	30	55.5	6	333
Stipa gigantea	*5L container grown*	10	18.5	2	37
Miscanthus sinensis	*5L container grown*	10	18.5	2	37
Verbena bonariensis	*3L container grown*	20	37	3	111
Rudbeckia birta	*3L container grown*	30	55.5	6	333
Total m²:			**185**		**851**

Gravel Garden Accent Planting

Species	Specification	Total plants
Miscanthus sinensis	*12L container grown*	9
Stipa gigantea	*12L container grown*	12
Stipa tenuissima	*12L container grown*	20
Total		**41**

Wetland Meadow Mixture:
EM84 Emorsgate Wildflowers for Wetlands Mixture: 1.5g per m²
Total: 431g

Amenity Grass / Lawn
EGZ2 Emorsgate Strong Lawn Mixture: 25g per m²
Total: 97,505g

Notes

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This drawing is to be read in conjunction with all the relevant surveys alongside the Architectural and Engineers drawings.
Only figured dimensions are to be taken from this drawing. Dimensions should not be scaled from this drawing. Its setting of this drawing cannot be assumed.
All dimensions are to millimetres unless specified otherwise.
The contractor must visit the site and be responsible for taking and checking all dimensions, services and setting out before any work is put in hand.
All coordinates are set as dimensional guidance to enable easy cross referencing on site.
All setting out points are to be verified on site and any discrepancies should be clarified by the Landscape Architect.
This drawing is not a technical representation of surface patterns, contractors are to follow the line of direction specified on drawings. Where no line of direction is given contractor to contact Landscape Architect before laying.
All levels should be checked on site and conflicts reported to the design office.

- If in doubt ask

Rev	Date	Description
P01	23/09/22	For discharge of planning condition

Client:
Plant and Robinson Construction Ltd

Project:
Lower Farm Barns

Drawing Title:
Landscape General Arrangement Plan

Drawing No:
285-LST-XX-XX-DR-L-1000

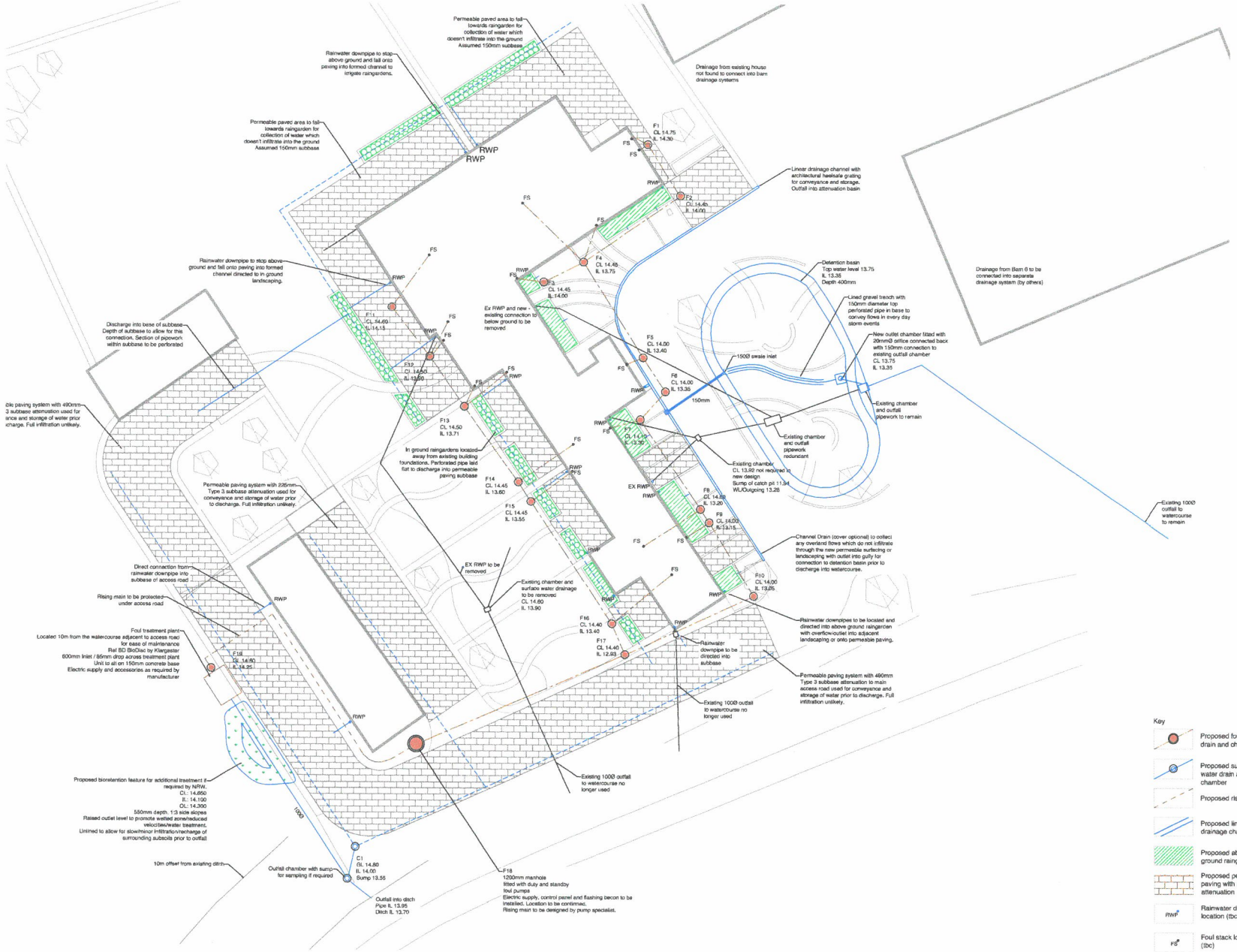
Drawn By: SRo	Date: 16.09.22
Checked By: LS	Date: 23.09.22
Drawing Scale: 1:200	Sheet Size: A1
Revision: P01	Status: S2

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Appendix 4 - Proposed Drainage General Arrangement



Notes

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- This drawing has been developed using information provided to Land Studio by a number of third parties. Land Studio can not accept responsibility for the accuracy of the information shown and derived from third-party information.
- This drawing is to be read in conjunction with the architects and landscape architects drawings.
- All levels should be checked on site and conflicts reported to the engineer.
- Do not scale from this drawing.
- All levels are in metres above ordnance datum UNO.
- Final foul stack and rainwater downpipe locations are assumed at this stage and therefore subject to change. The strategy for discharge though will remain the same.
- No existing below ground services are envisaged. Existing below ground drainage servicing the barns has been traced where possible and indicated on this drawing.
- On site surface water drainage has been designed up to and including the 1 in 100 year storm event plus 45% climate change. Exceedance flows are directed away from the buildings within the proposed levels design.
- Where below ground pipe junctions connect at an oblique angle, connections are to be installed as per the oblique junction arrangement detail to prevent future blockages.
- Pipes are not designed for construction traffic; contractor will take necessary precautions to protect pipes during construction.
- It is assumed that all above ground drainage connections at each house are roddable and vented from above ground.

Material Specification

- Concrete for general drainage works designated mix Gen 3 to BS 8500 - 1:2006, BS EN 206 - 1:2013.
- Polypropylene inspection chambers to be in accordance with BS7158 or BS EN 13598-1 or agreement certified. OSMA ref 6D928 or similar approved.
- All chamber covers to be minimum B125 double sealed and lockable. D400 to be used in trafficked areas.
- For pipes with more than 1200mm cover below external ground level to have Class S surround U.N.O. in accordance with Building Regulations Document H.
- For pipes with less than 1200mm cover to crown pipe bedding to be Class Z surround or protective cover slab U.N.O. in accordance with Building Regulations Document H.
- All surface water pipes to be HOPE structured wall to BS EN 1401-1, kitemarked, agrement certified or CE marked U.N.O.
- All domestic foul water pipes to be vitrified clay to BS EN 295-1:1991/BS 65 as appropriate, kitemarked, agrement certified or CE marked U.N.O.
- All perforated pipes to be 110mm PVC-U wrapped in geotextile to BS 4962.
- All foul branch connections to be DN110 at 1:40 minimum gradient U.N.O.
- All surface water branches to be DN150 at 1:80 minimum gradient U.N.O.
- Root protection barriers to be installed where drainage trenches are within 5m of existing or proposed trees.

Attenuation Volume Split

- Detention Basin 115m3
- Access Road Subbase (East) 100m3
- Access Road Subbase (West) 195m3

Total - 410m3 (required storage 256m3)

- Additional storage not included for in calculations at this stage within above ground rain gardens and permeable paving build up.

Rev	Date	Description
P01	26.09.22	Discharge of planning condition

Client: Plant & Robinson Construction

Project: Lower Farm Barns

Drawing Title: Drainage General Arrangement

Drawing No: XXX-LST-XX-XX-DR-D-0100

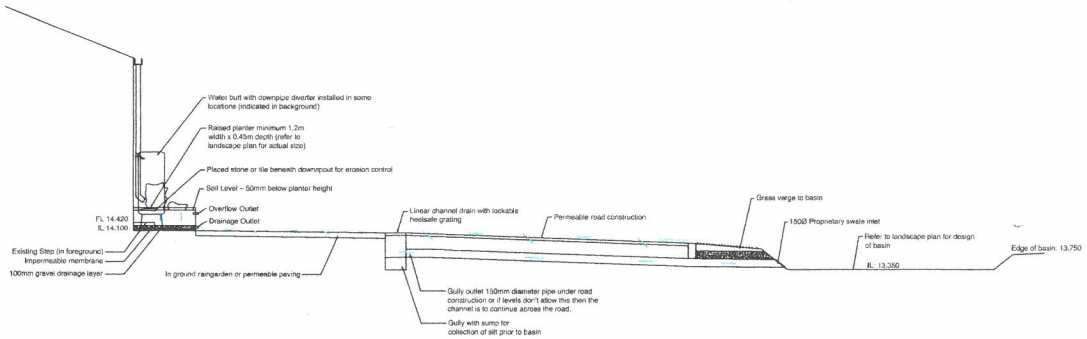
Drawn By:	AW	Date:	20.09.2022
Checked By:	LS	Date:	26.09.2022
Drawing Scale:	1:200	Sheet Size:	A1

Revision: P01 Status: S2

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Outfall from above ground rainwater planter to basin

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- Only figured dimensions are to be taken from this drawing. Dimensions should not be scaled from this drawing, as scaling of this drawing cannot be assured.

Rev	Date	Description
P01	26.09.22	For discharge of planning condition

Client:
Plant & Robinson Construction

Project:
Lower Farm Barns

Drawing Title:
Drainage Sections

Drawing No:
XXX-LST-XX-XX-DR-D-0400

Drawn By: AW	Date: 26.09.22
Checked By: LS	Date: 26.09.22
Drawing Scale: 1:50	Sheet Size: A1

Revision P01 Status S2

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