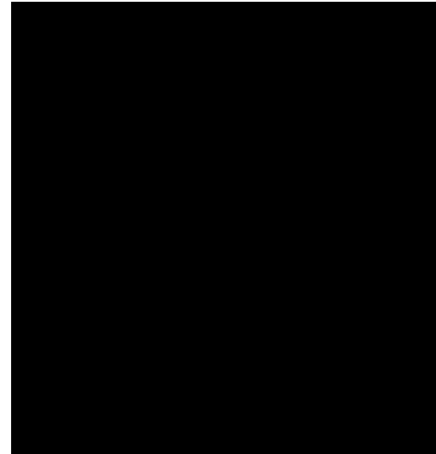




Flood Risk Assessment
incorporating the
Foul and Surface Water Drainage Strategy

Proposed Commercial Polytunnel at

Wicks Farm, Ford Lane

On behalf of

Agricultural Investments Limited

January 2019

Document History and Status

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1 Non-Technical Summary

- 1.1 This Flood Risk Assessment has been undertaken in accordance with the National Planning Policy Framework on behalf of Agricultural Investments Limited in support of a Planning Application for the construction of commercial Polytunnels with associated irrigation reservoir and ancillary buildings for packing produce, together with access roads and car parking on land at Wicks Farm, Ford Lane, Arundel, West Sussex.
- 1.2 This Assessment is to be read in conjunction with all planning, architectural and other reports that accompany the Planning Application for the proposed development.
- 1.3 The type of development proposed is classified as less vulnerable and suitable in all flood zones other than functional floodplain.
- 1.4 The proposed site is located in Flood Zones 1, 2 and 3a (High). The majority of the construction is within Flood Zone 1 (Low) with some limited changes in levels within Flood Zone 3, suitable flood storage compensation is to be provided as mitigation.
- 1.5 From analysis of the flood risk data and mapping available the risk to the development from all forms of flooding is low.
- 1.6 The proposed development will incorporate a Sustainable Drainage System (SuDS). Roof drainage from the polytunnel will be collected within an irrigation reservoir for re-use as a year-round water demand on the crops. The overflow, should the reservoir be full at the time of design storm, will discharge at a restricted rate comparable to pre-development greenfield run-off to a shallow basin. Where natural infiltration into the subsoils does not occur the overflow will drain overland to the adjacent woodland and watercourse to the west of the site at lower flows than the current situation.
- 1.7 Surface water runoff from the external paved area of the site, including the roofs of the ancillary building will be collected in roadside swales and attenuated within two on site storage ponds before discharging back to the swale providing the required water quality benefits to mitigate against potential pollutants.
- 1.8 The drainage strategy is not reliant on infiltration (although it will not be prevented) and therefore infiltration testing and ground water monitoring is not proposed prior to the determination of the Planning Application.
- 1.9 The specific details of the storage for run-off from drained areas other than the polytunnels will be confirmed at detailed design stage, however a feasible

solution has been presented. Alternatives could be proposed to accommodate using a variety of other methods such as permeable paving, voided subbase or cellular tanks upstream of conveyance to the environment.

- 1.10 Foul drainage will be discharged to the existing onsite private foul sewer which connects to the foul sewer beneath Ford Road and thereby an indirect connection to the public network. Personnel usage on the site is likely to remain similar to the current arrangement and therefore any additional loadings on the foul sewer are likely to be negligible.
- 1.11 The overall foul flows are comparatively low for the size of development. The Sewerage Undertaker (not the Applicant) is responsible for providing capacity in the public foul sewer network as re-established in the OFWAT ruling and subsequent clarification of change of approach from Southern Water on infrastructure charging and network capacity in April 2018.
- 1.12 This assessment concludes that the proposed development is suitable at this location and the level of flood risk is acceptable for the type of development proposed.

2 Planning Policy Context

2.1 National Planning Policy Framework

2.1.1 The National Planning Policy Framework was updated in July 2018.

2.1.2 With regard to planning and flood risk the policy framework states that :when determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment.

Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

- a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
- b) the development is appropriately flood resistant and resilient;
- c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
- d) any residual risk can be safely managed; and
- e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.~

2.1.3 With regard to minor developments the NPPF states that :applications for some minor development and changes of use (reference footnote 51) should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 50.~

2.1.4 Footnote 50 reads :a site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.)~

2.1.5 Footnote 51 reads :this includes householder development, small non-residential extensions (with a footprint of less than 250m²) and changes of

use; except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the sequential and exception tests should be applied as appropriate.~

2.1.6 With regard to major developments the NPPF states that :major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

- a) take account of advice from the lead local flood authority;
- b) have appropriate proposed minimum operational standards;
- c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
- d) where possible, provide multifunctional benefits~

2.1.7 Major development is defined as follows:

:For housing, development where 10 or more homes will be provided, or the site has an area of 0.5 hectares or more. For non-residential development it means additional floorspace of 1,000m² or more, or a site of 1 hectare or more, or as otherwise provided in the Town and Country Planning (Development Management Procedure) (England) Order 2015.~

2.2 Lead Local Flood Authority

2.2.1 West Sussex County Council became a Lead Local Flood Authority under the Flood and Water Management Act 2010 and was given a series of new responsibilities to coordinate the management of local flood risk.

2.2.2 As part of their role West Sussex County Council have produced the following documents

- ¿ Strategic Flood Risk Assessment dated J anuary 2010
- ¿ Preliminary Flood Risk Assessment dated May 2011
- ¿ Local Flood Risk Management Strategy dated May 2014

2.2.3 All documents have been reviewed in the preparation of this report.

2.3 Arun District Council

2.3.1 Arun District Council adopted the Strategic Flood Risk Assessment (Strategic Flood Risk Assessment) in August 2016.

2.3.2 Arun District Council adopted the 2011-2031 Local Plan on 18 J uly 2018. This replaces the saved policies within the 2003 Local Plan.

2.3.3 All documents have been reviewed in the preparation of this report.

2.4 Arun Local Plan 2011-2031

2.4.1 The following policies of the adopted Local Plan of relevance to this Flood Risk Assessment are as follows:

2.4.2 Policy W DM1 Water supply and quality states that :to ensure good water quality in the District, all major developments must:

- a. Illustrate, where necessary, how they have contributed to the protection and enhancement of waterbodies identified by the South East River Basin Management Plan objectives; and
- b. Demonstrate, where it will materially increase foul and/or surface water discharges, adequate drainage capacity exists or can be provided as part of the development. Where adequate capacity does not exist, there will be a requirement that facilities are adequately upgraded prior to the completion and occupation of development. In sewered areas, there will be a general presumption against the use of non-mains foul water drainage.

Developments with respect to all of the above shall also be consistent with all other Local Plan policies.~

2.4.3 POLICY W DM2 Flood Risk states :Development in areas at risk from flooding, identified on the latest Environment Agency flood risk maps and the Council's Strategic Flood Risk Assessment (SFRA), will only be permitted where all of the following criteria have been satisfied:

- a. The sequential test in accordance with the National Planning Policy Guidance has been met.
- b. A site-specific Flood Risk Assessment demonstrates that the development will be safe, including access and egress, without increasing flood risk elsewhere and reduce flood risk overall.
- c. The sustainability benefits to the wider community are clearly identified.
- d. The scheme identifies adaptation and mitigation measures.
- e. Appropriate flood warning and evacuation plans are in place; and
- f. New site drainage systems are designed to take account of events which exceed the normal design standard i.e. consideration of flood flow routing and utilising temporary storage areas.

The reports prepared as part of the criteria above must take into account contingency allowances, taking climate change into account as set out in Flood Risk Assessments: climate change allowances section of the NPPG.

In locations where strategic flood defence or resilient and resistant construction measures are necessary within the site itself, proposals will

be required to demonstrate how measures have been incorporated as an intrinsic part of the scheme in a manner which is compatible with the latest Strategic Flood Risk Assessment.

All development proposals must take account of relevant Surface Water Management Plans, Catchment Flood Management Plans and related Flood Defence Plans and strategies such as the Lower Tidal River Arun Strategy. The council may require financial contributions from development on sites where measures to address flood risk or to improve the environmental quality of watercourses have been identified by these Plans and Strategies.

2.4.4 POLICY W DM3 Sustainable Urban Drainage Systems states :To increase the levels of water capture and storage and improve water quality, all development must identify opportunities to incorporate a range of Sustainable Urban Drainage Systems (SUDS), appropriate to the size of development, at an early stage of the design process.

Proposals for both major and minor development proposals must incorporate SUDS within the private areas of the development in order to provide source control features to the overall SUDS design. These features include:

- ¿ Green roofs
- ¿ Permeable driveways and parking
- ¿ Soakaways
- ¿ Water harvesting and storage features including water butts.

Proposals for major development must also integrate SUDS within public open spaces and roads, reflecting discussion with the appropriate bodies. SUDS must therefore be integrated into the overall design of a development and must:

- a. Contribute positively to the appearance of the area, integrating access to allow maintenance of existing watercourses and the system.
- b. Effectively manage water (including its quality)
- c. Accommodate and enhance biodiversity by making connections to existing Green Infrastructure assets and
- d. Provide amenity for local residents (ensuring a safe environment)
- e. Retain the existing drainage network of the site and the wider area,
- f. Be maintained in perpetuity, supported through a Maintenance and Management Plan/Regime, including its financing, agreed with the Local Planning Authority.

In order to ensure that SUDS discharge water from the development at the same or lesser rate, as prior to construction, developers must:

- f. Follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations and the SUDS manual produced by CIRIA.
- g. Undertake up to six months groundwater monitoring within the winter period.
- h. Undertake winter percolation testing in accordance with BRE365.
- i. The proposed drainage system must be designed to ensure that there is no flooding on a 1 in 30-year storm event.
- j. The design must also take account of the 1 in 100-year storm event plus 30% allowance for climate change, on stored volumes, to ensure that there is no flooding of properties or the public highway or inundation of the foul sewerage system. Any excess flows must be contained within the site boundary, and within designated storage areas.

3 Existing Site

3.1 Site Location

3.1.1 The development site is located on the land north of Wicks Farm, Ford Lane, Arundel. The site is centred on Ordnance Survey reference SU 990 042. The nearest postcode is BN18 0DF.

3.1.2 The site is approximately 1.5 kilometres from the River Arun to the east and approximately 4 kilometres from the south coast. There is a tributary of the River Arun 200 meters to the north of the site known as the Little Tortington Stream which is classified as a Main River.



Image 1: Site Location

3.1.3 A copy of the site location plan is in Appendix 1 of this report.

3.2 Site Description

3.2.1 The site is approximately 9.74 ha in area and is currently an undeveloped arable field in agricultural use.

3.2.2 The site is bounded to the north by the West Coastway railway line, to the east by undeveloped farm land and west by undeveloped farm land and a wooded area containing a watercourse and pond.

3.2.3 The farm land to the south has Planning Consent for feedstock clamps, polytunnel and anaerobic digesters at Wicks Farm under WSCC Planning

Consent WSCC/019/17/F, which is yet to be constructed and is shown on the proposed Architect's Planning Layouts.

3.2.4 The site is at topographical levels of between 2m AOD and 6m AOD. Ground levels are at their highest point on the southern boundary of the site. The land falls towards the railway lines to the north, which are on a low raised embankment. There is a slight cross fall to the west and the low point of the site is in the northwest corner adjacent to the existing woodland.

3.2.5 A copy of the existing site layout plan is in Appendix 2 of this report.

3.3 Existing Drainage and Local Hydrology

3.3.1 The existing site currently discharges in part by infiltration to ground and part overland to adjacent farmland / woodland before entering the existing land drainage system.

3.3.2 There are no watercourses within or at the site boundary, overland run-off from the field drains to an area of woodland containing a pond to the northwest of the site and from there within a piped watercourse crossing below the railway lines.

3.3.3 The local land drainage system drains to the Little Tortington Stream to the north of the site flowing eastwards along the northern side of the railway line from Water Lane in Barnham to the west, discharging to the tidal reach of the River Arun to the east of the site at the Ship & Anchor Marina at the former eastern extent of the historic Portsmouth to Arundel Canal.

3.3.4 The existing greenfield runoff rate for the site has been established using XP Solutions Micro Drainage software based upon the Flood Studies Report Method which is appropriate for small catchments.

3.3.5 Q_{bar} for the existing pre-developed site has been established as 33.1 l/s and the 1:100-year peak runoff at 105.7 l/s. The equivalent greenfield runoff rates are 3.4 l/s/ha and 10.8 l/s/ha respectively.

ICF SUDS

ICF SUDS Input (F SR Method)

Return Period (Years): 100

Area (ha): 5.740

SAAR (mm): 700

Soil: Map 0.400

Growth Curve: (None)

Partly Urbanised Catchment (GBAR)

Urban: 0.000

Region: Region 7

Calculate

Results

GBAR rural (l/s): 33.1

GBAR urban (l/s): 33.1

Return Period Flood

Region	GBAR (l/s)	Q (100 yrs) (l/s)	Q (1 yrs) (l/s)	Q (50 yrs) (l/s)	Q (100 yrs) (l/s)
Region 1	33.1	82.2	28.2	62.8	82.2
Region 2	33.1	87.2	28.8	62.9	87.2
Region 3	33.1	88.9	28.5	58.2	88.9
Region 4	33.1	85.2	27.5	64.9	85.2
Region 5	33.1	118.0	28.8	78.6	118.0
Region 6/Region 7	33.1	105.7	28.2	75.1	105.7
Region 8	33.1	88.2	28.8	63.2	88.2
Region 9	33.1	72.2	28.2	58.4	72.2
Region 10	33.1	88.9	28.8	58.2	88.9
Ireland National	33.1	81.0	28.2	52.7	81.0
Ireland East	33.1	83.0	28.2	54.8	83.0
Ireland South	33.1	81.0	28.2	52.7	81.0
Ireland West	33.1	58.8	28.2	51.2	58.8
Ireland Greater Dublin	33.1	86.5	28.2	70.4	86.5

IH 124
 ICF SUDS
 AGAS 345
 FEH
 Ref HQ
 Greenfield Volume
 Greenfield Volume (Ref HQ)

Image 2: Greenfield Runoff Calculation

3.3.6 The Southern Water asset plans confirm that there are no existing public foul sewers in the immediate vicinity of the site. The nearest public sewer shown on asset plans is beneath Ford Road to the east.

3.3.7 There is a private foul sewer adjacent to the site within the Applicant's land ownership which currently serves the farmhouse and cottages to the south. This also serves the business park to the east and wider area of Wick Farm to the north of Ford Lane and discharges to the public foul sewer beneath Ford Road. The private sewer serves a single land ownership and therefore was not vested as part of The Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011.

3.3.8 A copy of the sewer records is in Appendix 3 of this report.

3.4 Geology and Groundwater

3.4.1 British Geological Survey borehole information indicates a variety of silty clays (Brick Earth) approximately 1m depth below ground level underlain by chalk layers in the wider locality.

3.4.2 No groundwater was recorded to at least 7m below ground.

3.4.3 The 'Magic Map' available from DEFRA confirms that the site is located above a major aquifer classified as having an intermediate vulnerability.

3.4.4 A copy of the geological borehole data is in Appendix 4 at the rear of this report.

4 Flood Zone and Flood History

4.1 Flood Zone for Planning

- 4.1.1 The Environment Agency's Product 4 mapping confirms that much of the site is located in Flood Zone 1, with an area at the north of the site located within Flood Zones 2 and 3a.
- 4.1.2 Flood risk to the site is from the main river to the north of the railway lines. The risk is present for both tidal and fluvial scenarios and occurs with and without flood defences with little change to the plan extent within the site boundary.
- 4.1.3 Maps included in the Arun District Council's Strategic Flood Risk Assessment confirm the site is located partially in Flood Zone 3a. The current EA flood risk modelling is the current best information on flood risk.

4.2 Flood History

4.2.1 Environment Agency

- 4.2.1.1 The Environment Agency has confirmed they have no record of historic flooding affecting the site.

4.2.2 West Sussex County Council

- 4.2.2.1 Neither the Preliminary Flood Risk Assessment dated May 2011, the Strategic Flood Risk Assessment dated January 2010 nor the Local Flood Risk Management Strategy dated May 2014 identify any specific flood incidents in the immediate vicinity of the site.

4.2.3 Arun District Council

- 4.2.3.1 The Strategic Flood Risk Assessment dated August 2016 does not identify any specific flood related incidents within the vicinity of the site.

5 Flooding Potential

5.1.1 The Environment Agency's flood maps identify the site as being within Flood Zone 1, 2 and 3 affected by the 0.5% (1:200 year) tidal event and the 1% (1:100 year) fluvial event.

5.1.2 The Environment Agency have provided two node points of modelled data, both on the northern edge of the site within the floodplain. The only modelled data available is for the 1%+CC Undefended Fluvial and the 2110 Future Year 0.5% (Undefended and Defended) Tidal.

5.2 Tidal Flooding

5.2.1 The site is located approximately 4km from the coast and is 1.5km from the tidal reach of the River Arun. Flood defences on the River Arun reduce the flood risk to the site. The current policy is to 'Hold the Line' and maintain as necessary. There is no reason to anticipate this will change within the lifetime of the development.

5.2.2 The Environment Agency modelled tidal flood levels do not confirm the current 0.5% defended tidal flood level but the maps provided show a small area in the northwest corner of the site as susceptible to the 0.1% annual exceedance (Flood Zone 2). The site is not affected by the 0.5% annual exceedance (Flood Zone 3).

5.2.3 The present day undefended tidal levels are not available in the modelling, but the flood maps provided indicate an area in the north west of the site as susceptible to the 5%, 0.5%, 0.1% and 2110 0.5% annual exceedance. All development is outside of this area and it should be noted that these are theoretical outlines for two reasons; the flood defences on the River Arun are earth embankments that defend large areas and will not be removed. Any breach scenario would cause a lesser effect on the site than the undefended scenario, which assumes no defences whatsoever. Undefended tidal scenarios are therefore assessed as being low risk to the development.

5.2.4 The site is at risk of tidal Flooding for the predicted future 2110, 0.5% tidal event. Therefore, at some point in its lifetime the proposed site is predicted to become part of Flood Zone 3 and suitable mitigation should be provided.

5.2.5 The modelling data shows the defended future year tidal flood level to be 3.69m AOD. When shown on topographic survey levels this outline encroaches on less of the site than indicated on the less accurate flood maps. All proposed development is above this level and will therefore not be affected.

5.3 Fluvial Flooding

5.3.1 The Environment Agency have provided modelled fluvial flood levels indicating the 1% annual exceedance (1:100-year) plus climate change undefended flood levels as 3.04m AOD. When shown on topographic survey levels this flood level outline encroaches on far less of the site than indicated on the less accurate flood maps. The majority of the site is outside this area, where this area may be encroached by the development compensatory flood storage is to be provided as shown in Appendix 10.

5.3.2 The flood maps also indicate area in the northwest of the site as susceptible to the 5% and 1% annual exceedance undefended scenarios. This demonstrates that the northwest corner of the proposed irrigation reservoir could be affected by the 1:100-year CC fluvial event, therefore flood storage compensation has been provided within the site to provide mitigation against any flood risk from the development.

5.3.3 There are no modelled flood levels for defended fluvial scenarios, but the flood maps show similar extents to the undefended scenarios indicating that the embankments on the River Arun have little effect on the fluvial flood risk to the site.

5.4 Groundwater Flooding

5.4.1 No ground water modelling is available for the site.

5.4.2 No instance of groundwater flooding or spring line is known at or near the site.

5.4.3 Borehole logs hosted on the British Geological Survey website confirm groundwater has not been recorded to at least 7m below ground level.

5.5 Pluvial Flooding and Potential for Surface Water Flooding

5.5.1 Any overland flow from the site will discharge to the western site boundary through the wooded area to the existing pond and watercourse to the west.

5.5.2 The surface water flood risk maps, available as part of the long-term flood risk map for England (Gov.uk), show an area in the northwest corner of the site similar in extent to the risk from other sources as being susceptible to surface water flood risk. The area includes high, medium and low risk which correspond to the 3.3% (1:30 year) 1% (1:100 year) and 0.1% (1:1,000 year) events.

5.5.3 All development is outside of the area of surface water flood risk and the new drainage system provided for the development, which will necessarily incorporate surface water attenuation, will reduce surface water flood risk

for all storms beyond the QBar event. This could be expected to remove, or at least greatly reduce, the existing surface water flood risk to (and from) the site for large return period storm events.

5.5.4 The surface water flood risk maps within the Arun SFRA show the same outline and are based on the same modelling.

5.6 Overland Flow Flood Routing

5.6.1 The natural route for flood waters to dissipate, should any ever occur on the site, is towards the north and west of the site and the existing watercourse within the wooded area to the north west.

5.6.2 A plan showing the existing flow paths within the site is in Appendix 6 of this report.

5.7 Flooding from Infrastructure

5.7.1 There are no foul or surface public sewers near the site and no known problems with the private foul sewer.

5.7.2 There is no risk from highway drains or external reservoirs.

5.7.3 The onsite irrigation reservoir will have a low above ground volume and will be designed to minimise the risk of flooding.

6 Development Proposals

6.1 Description

- 6.1.1 The development proposal is for the construction of 5.12 hectares of commercial horticultural polytunnel and associated irrigation reservoir, access road and parking on land north of Ford Lane, Ford, south of Arundel.
- 6.1.2 The polytunnels are arranged in two rectangular areas separated by a six-metre margin. The irrigation reservoir is positioned to the north adjacent to the railway lines. The two ancillary buildings, lorry yard and parking area are arranged to the south adjacent to the consented Anaerobic Digester site.
- 6.1.3 The proposed site layout includes a total impermeable area of 64,174m². This is comprised of 51,200m² Polytunnel, 3,240m² ancillary building roof, 7,130m² lorry yard, 544 m² car park and 2,060m² access road.
- 6.1.4 A plan showing the proposed Architect's Site Layout is in Appendix 7 of this report.

6.2 Drainage Strategy

- 6.2.1 The area currently drains to ground and overland to the existing land drainage system discharging to the Main River to the north of the railway lines.
- 6.2.2 Local geology indicates low permeability subsoils, whilst the bedrock geology is identified as Lewes Nodular Chalk on BGS mapping, the superficial deposits are river terrace deposits, therefore it is considered unlikely to be feasible to discharge a large drained area to ground. Some infiltration may be achievable based upon a shallow base draining basin or draining blanket. As the ability for ground infiltration is unknown the designs will not be reliant on this occurring.
- 6.2.3 The proposed polytunnels represent a year-round irrigation demand for produce growing, therefore rainfall is a resource to be collected and retained rather than a waste to be removed. The irrigation reservoir will store rainfall collected from the polytunnel roofs for re-use in a manner typical of small raised embankment reservoirs for farming utilising sealed rainwater downpipes from gutters to outflow allowing discharge to a level above ground. As such, much of the impermeable area of the site does not require a drainage outlet as would be required within a more traditional system,

- 6.2.4 The surface water drainage system will be designed to comply with the National Planning Policy Framework and its supporting guidance documents including the Non-Statutory Technical Standards for SuDS.
- 6.2.5 Storage will be provided to accommodate a 1:100-year storm event with an additional 20% allowed for within the design for the predicted effects of increased rainfall intensity due to future climate change and onsite capacity for the 100-year storm event + 40% climate change allowance (designing for exceedance).
- 6.2.6 For the purpose of the Planning Application a drainage strategy has been prepared, as described below, and shown on the Preliminary Surface Water Drainage Plan attached in Appendix 8 of this report.
- 6.2.7 The roof drainage from the polytunnels (most of the drained area of the site) will be collected for re-use within the irrigation reservoir which is designed to also store the 100-year design storm (plus allowance for future climatic change to rainfall intensities) above a restricted outlet designed to mimic the existing greenfield runoff rate.
- 6.2.8 The outflow from the reservoir will flow through a shallow basin created in the surrounding landscaping which will usually be dry soft landscaping but profiled to store the total restricted outflow volume during the design storm. This will percolate to ground with any excess discharging overland, or into the ground as per the existing situation, after the majority of the design storm water is contained within the reservoir.
- 6.2.9 The Q_{bar} greenfield runoff rate for the site is 3.4 l/s/ha. This equates to an equivalent Q_{bar} greenfield runoff rate for the proposed developed area of 33 l/s.
- 6.2.10 If all attenuation were stored within the reservoir with a single outflow sized to produce a maximum discharge of 33 litres per second the peak stored volume would be 5,164m³. However, runoff from the lorry yard, car park and access road would not meet the water quality for irrigation, therefore only the polytunnel roof will be drained to the reservoir, hard-paved areas and ancillary building roofs will be drained to a separate system.
- 6.2.11 Approximately 14,000m³ of storage is to be provided within the irrigation reservoir for use within the operation of the site. A total volume of 4,520m³ is required within the irrigation reservoir to store the surface water runoff generated by the polytunnel roof for a 100 year plus climate change rainfall event based upon a restricted outlet of 20 litres per second (Greenfield runoff rate). The remainder of the positively drained

area will require a further 788m³ storage within two shallow ponds in the southern section of the site. The runoff from this is to be discharged into a roadside swale before conveying through two storage ponds, surface water will be attenuated within the pond, the outflow from the pond will be controlled to 13l/s via the adjacent farm land before discharging to the main storage reservoir to the north of the site.

6.2.12 Storage basins are proposed with 1:3 sloped sides and maximum depth of 1m. The basins will require a surface area of approximately 1,230m² and will be located within the gap between the new access road and the polytunnels in the southern part of the site.

6.2.13 The surface water drainage detailed design could incorporate the combined use of other sustainable drainage techniques such permeable surfacing, filter strips and French drains.

6.2.14 Preliminary surface water drainage calculations and an indicative surface water drainage strategy plan is located in Appendix 8 at the rear of this report.

6.3 Flood Mitigation

6.3.1 The development is outside the areas of predicted flood risk from external sources and the sustainable drainage system will reduce the risk of flooding from the surrounding area from the site and within the site from rainfall events.

6.3.2 No further flood mitigation is required or proposed.

6.4 Foul Water

6.4.1 Overall usage of the site is likely to be similar to existing and therefore foul demand is likely to mimic the existing scenario. Should any additional toilets etc. be provided, given the automated operational nature of the site, the impact on the existing foul drainage sewer is likely to be negligible.

6.4.2 Foul drainage will be discharged into the existing onsite foul drainage sewer via gravity as per the existing system.

6.4.3 The Sewerage Undertaker is responsible for providing capacity within the public network funded by connection charges. No offsite works are required or proposed by the Applicant.

6.5 Water Quality

- 6.5.1 The proposed development is for farm industrial use. In accordance with CIRIA SuDS Manual 2015 (Report C753) the pollution hazard level for such types of development are considered medium.
- 6.5.2 Where surface water runoff is to be discharged into watercourses the SuDS components are only required to control potential contaminants for the frequent low-intensity rainfall events. As such, it is likely that natural high flow volumes within the receiving water body during a high-intensity rainfall event will dilute any contaminants received.
- 6.5.3 The surface water scheme will include mitigation to ensure that surface water is suitably treated with any pollution risk mitigated prior to discharge.
- 6.5.4 Table 26.2 in Chapter 26 of CIRIA report C753 :The SuDS Manual~ provides Pollution Hazard Indices for varying land types. Those of relevance to the development proposals are as follows:

	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Roofs	Low	0.30	0.20	0.05
Access Road, Yard and Delivery Areas	Medium	0.70	0.60	0.70

Table 1: Pollution Hazard Indices

- 6.5.5 Where multiple drainage components are used in series the individual mitigation index of secondary and tertiary components is lowered by 50% due to reduced performance associated with primary treatment.
- 6.5.6 In accordance with Tables 26.3 and 26.4 of CIRIA C753 the mitigation indices for the different drainage components are shown in the following table:

SuDS Type	Total Suspended Solids (TSS)	Metals	Hydro-carbons
Filter Strip	0.4	0.4	0.5
Permeable Paving	0.7	0.6	0.7
Swale	0.5	0.6	0.6
Detention Basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Soakaway with 300mm minimum depth underlying soil drainage media	0.4	0.4	0.4

Table 2: Mitigation Indices

- 6.5.7 The proposed use of swales and attenuation basins will meet the target treatment level required for runoff with medium risk of pollution hazard thus demonstrating that the surface water drainage system for the site can be designed to adequately mitigate against the risk of pollution.
- 6.5.8 The site will be maintained by the operator. An outline drainage maintenance schedule is in Appendix 9 of this report.

7 Safe Development

7.1 Flood Zone Compatibility

7.1.1 The site is located in Flood Zones 1, 2 and 3.

7.1.2 With reference to the Technical Guidance to the National Planning Policy Framework:

¿ Table 2: Flood Risk Vulnerability Classification.

The type of development proposed is classified as Less Vulnerable.

¿ Table 3: Flood Risk Vulnerability and Flood Zone Compatibility.

Less Vulnerable development is appropriate in Flood Zones 1 and 2 and 3.

7.2 Risk to Others

7.2.1 The proposed surface water drainage system will be designed to current standards incorporating SuDS elements providing treatment, attenuation and storage which will minimise runoff leaving the site during times of heavy rain.

7.2.2 Allowance has been made for 40% increase in rainfall intensities which accords with the latest figures published by the Environment Agency and in accordance with the requirements under the National Planning Policy Framework.

7.2.3 The proposed drainage system will incorporate adequate treatment prior to final discharge destination, thus mitigating the risk of pollution from the site.

7.2.4 The risk of flooding to others due to the proposed development is reduced by virtue of the storage of large return period storms that would otherwise discharge to rivers and watercourses via the land drainage system at greenfield run off rates, which are higher than the restriction selected for the reservoir based upon the Q_{bar} storm.

7.2.5 The risk of an increase in offsite flood risk as a result of surface water flooding is reduced by the proposed development and the resultant risk is negligible.

7.2.6 The northwest corner of the raised irrigation reservoir is located within Flood Zone 3, level for level and volume for volume flood compensation is proposed on the site to ensure there is no loss in floodplain capacity, whilst final details of this will be further demonstrated at the detailed design stage cut-fill calculations show this is achievable within the site

constraints. The supporting drawing is provided in Appendix 10 of this report.

7.2.7 Sewerage undertakers have an obligation to upgrade the existing networks if a connection to an equivalent sized public sewer is available.

7.2.8 The residual risk of sewer flooding from this development for the foreseeable future is therefore negligible.

7.2.9 The development is therefore considered to represent a nett benefit to the local area in flood risk terms.

7.3 Site Location

7.3.1 The topographical survey confirms that the site levels place the proposed new building within Flood Zone 1 - Low Risk.

7.3.2 With reference to Table 2 (Flood Risk Vulnerability Classification) and Table 3 (Flood Risk Vulnerability and Flood Zone Compatibility) of the Technical Guidance to the National Planning Policy Framework the proposed development is classified as less vulnerable and is considered suitable in Flood Zones 1, 2 and 3a.

7.4 Review of Suitability for Development

7.4.1 Paragraph 67 of the National Planning Policy Framework (NPPF) details the Flood Risk Vulnerability Classification and suitability of development for each flood zone. A copy of the table is reproduced below:

	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	V	V	V	V	V
Zone 2	V	Exception Test Required	V	V	V
Zone 3a	Exception Test Required	Ű	Exception Test Required	V	V
Zone 3b	Exception Test Required	Ű	Ű	Ű	V

Table 3: Flood Risk Vulnerability Classification

8 Conclusions

- 8.1 The type of development proposed is classified as less vulnerable and suitable in Flood Zones 1, 2 and 3a. The site is located in Flood Zone 1, 2 and 3. The development proposals are predominantly located in FZ1 (Low risk) with only a small section of the proposed storage reservoir located within FZ3, for which compensatory flood storage is to be provided. The development is deemed to comply with the Sequential Flood Risk Planning Policy defined within the NPPF.
- 8.2 The potential impact of any flood risk to polytunnels is low and the floor level of the ancillary buildings are at a minimum of 5m AOD providing a level far in excess of a safe freeboard above the modelled 100 year defended fluvial flood level and 1:200-year tidal flood level including allowances for climate change.
- 8.3 From detailed analysis of flood modelling the risk of flooding to the development from all forms of flood risk is low and the development would have no effect on flood water during design events.
- 8.4 Preliminary calculations indicate that surface water runoff generated by the proposed development can be attenuated on site for all rainfall events up to the 1:100-year event including appropriate allowances for climate change. The development therefore provides a nett benefit to the local area by reducing offsite surface water flows for large return period storms.
- 8.5 Water quality improvement will be provided to mitigate against any risk to the receiving waterbody and wider environment.
- 8.6 Foul drainage will discharge into the existing onsite foul drainage system, there will be negligible increase on the system due to largely automated working practices as an indirect connection to the public foul sewer, this will be further assessed at detailed design where required.
- 8.7 In terms of flood risk planning the proposed development is safe, will not increase flood risk elsewhere and will provide improvement to immediately adjacent sites by managing surface water from all rainfall events up to the 100 year plus climate change event.
- 8.8 The development proposals are suitable at this location.

9 List of Appendices, Images and Tables

Appendix 1	Site Location Plan
Appendix 2	Existing Site Layout Plan
Appendix 3	Sewer Records
Appendix 4	BGS Geological Borehole Data
Appendix 5	Environment Agency Product 4 Information and Flood Maps
Appendix 6	Existing Flow Path Plan
Appendix 7	Proposed Site Layout Plan
Appendix 8	Preliminary Surface Water Drainage Calculations and Drainage Plan
Appendix 9	Outline Drainage Maintenance Schedule
Appendix 10	Compensatory Flood Storage - Outline Cut / Fill Areas
Image 1	Site Location
Image 2	Greenfield Runoff Calculation
Image 3	Local Topography
Table 1	Pollution Hazard Indices
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