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MARTINS FARM,
53 BOXWORTH ROAD
ELSWORTH, CAMBS

Solopark Ltd.
Job No. 111666

Flood Risk Assessment & Drainage Strategy

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1.0 INTRODUCTION

1.1 Ingleton Wood has been commissioned by Solopark Ltd to produce a Flood Risk Assessment and Drainage Strategy, in support of a new proposed residential development, on land at Martins Farm, 53 Boxworth road, Elsworth, Cambs, to be referred to hereafter as 'the Site'. Proposed Site Plans are provided in **Appendix A**.

1.2 This report has been prepared to identify the flood risk posed by the proposed 0.347Ha development located north of Boxworth Road on the existing site of Martin's Farm No. 53. This report is set out to establish the best practice mitigation measures in line with all applicable legislative obligations associated to the proposed works.

1.3 Following the implementation of the Flood & Water Management Act 2010, Sustainable Urban Drainage Systems (SuDS) are the requisite consideration for the treatment and disposal of surface water runoff for all new development works. As part of the planning consultation the Lead Local Flood Authority (LLFA) are required to provide approval for the proposed scheme to their satisfaction in line with the requirements listed below:

- National Planning Policy Framework (NPPF).
- National Planning Practice Guidance
- SuDS Manual 2015 (C753)

1.4 We will clarify this by considering the proposed development in context with the Level 1 Strategic Flood Risk Assessment (SFRA) provided by the Local Planning Authority (LPA), and resources made available from the Environment Agency (EA), chiefly their online maps detailing flood zoning and groundwater conditions.

1.5 It should be observed the report is prepared in support of the planning application to evaluate appropriate drainage provisions and any mitigation measures following the identification of residual flood risks.

1.6 The following data was reviewed as part of this assessment

- Environment Agency (EA) Flood data
- British Geological Survey's (BGS) 'Geology of Britain' on-line maps
- Existing Topographical Survey
- https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances
- South Cambridgeshire and Cambridge city Level 1 Strategic Flood risk Assessment
- Cambridgeshire's Local Flood Risk Management strategy 2015-2020
- Magic Map Aquifer Designation Map Superficial drift
- We have also utilised our knowledge of the local area and experience in dealing with similar related matters.

2.0 SITE APPRAISAL

Location

2.1 The Site lies to the east of Elsworth village and is vacant brownfield land previously occupied with residential and agricultural buildings, as shown in Fig 2.1 and 2.2 below. The George and Dragon public house lies to the west, with residential dwellings to the south and east. To the north there is agricultural farmland with existing barns.

2.2 The scheme proposals are for the provision of a new courtyard farm style residential development. This proposal will consist of a new access into the proposed developments, 10 new dwellings, a private access and associated parking and infrastructure.

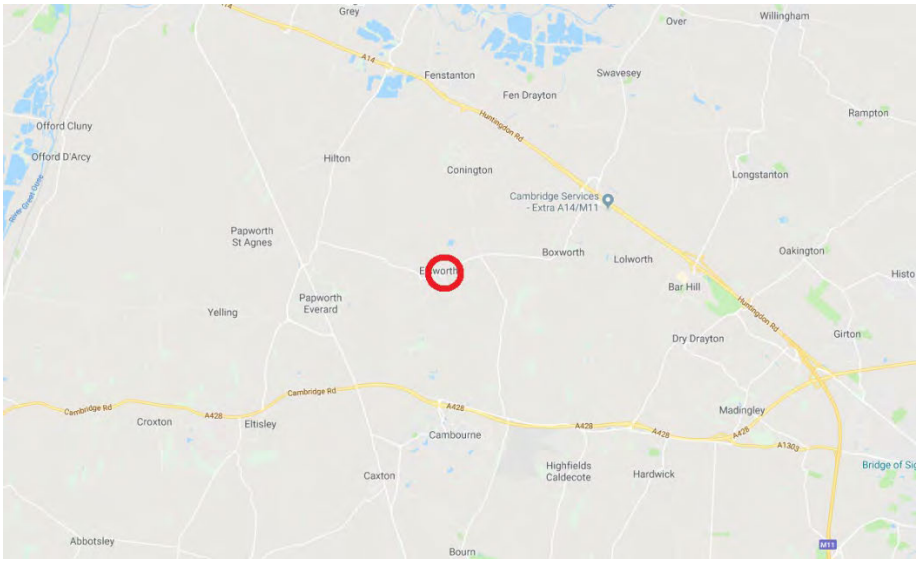


Figure 2.1: Site Location Plan

Figure 2.2: Site Location Plan: Aerial View

Topography

2.3 The most recent Topographical Survey Plan is provided in **Appendix B.** Ground levels fall from the front of the site at approx 26.50mAOD towards the back of the site approx. 24.80mAOD.

2.4 The area of the proposed development is vacant land previously occupied with residential and agricultural buildings and is therefore a brownfield site.

2.5 The total development works impermeable area is 0.347 Ha. This represents a nominal increase in impermeable and contributing area from the existing site condition.

Geology

2.6 **Published Geology –** The British Geological Survey (BGS) 1:50,000 map indicates the Bedrock geology of the Site to be directly underlain by West Walton Formation and Ampthill Clay formation (undifferentiated) – Mudstone.

"West Walton formation and Ampthill Clay Formation (undifferentiated) – Mudstone. Sedimentary Bedrock formed approximately 157 to 164 years ago in the Jurrasic Period. Local environment previously dominated by shallow seas."

West Walton Formation comprises of *"Calcareous mudstone, silty mudstone and siltstone, with subordinate fine-grained sandstones and argillaceous limestone (cementstone) or siltstone nodules; typically rhythmic alternations of dark grey, silty mudstone (rich in fine-grained shell and plant material) with pale grey mudstone; ooidal, and in some cases coralline marls and limestones developed locally (including Elsworth Rock Member; Upware Limestone Member), (Gallois and Cox, 1977; Cox and Gallois, 1979).*

Ampthill Clay formation comprises of *"Base of mudstones (as described under Lithology), resting on darker more silty mudstone of the West Walton Formation or on limestone/sandstone of that formation's members (Upware Limestone, Elsworth Rock) or of the Corallian Group; generally a marked colour change and break of slope at outcrop; change commonly well-marked on borehole geophysical (particularly gamma-ray) logs. Base of unit AmC1 in Fenland (Cox and Gallois, 1979)."*

2.7 The British Geological Survey (BGS) 1:50,000 map indicates no records of the Superficial deposits in the area of the proposed site. The closest record of superficial deposits in the area of the proposed site are Oadby Member – *"Diamicton. Superficial Deposits formed up to 2 million years ago in the Quaternary period. Local environment previously dominated by ice age conditions (U)."*

2.8 Nearby BGS borehole records (Borehole records BN-3215) indicate a common slightly sandy slightly gravelly clay, these can be seen in **Appendix C**

Infiltration Potential

2.9 In accordance with SUDs hierarchy disposal of surface water via infiltration structures must first be considered.

2.10 Infiltration testing – Testing carried out by EPS limited as illustrated in **Appendix D** highlighted that infiltration into the existing ground is not viable mainly due to the nature of the existing ground and soil type as mentioned above 'West Walton formation and Ampthill Clay Formation'.

2.11 Groundwater levels – Ground water levels were not established throughout the site due to the nature of the existing soil type.

Hydrogeology

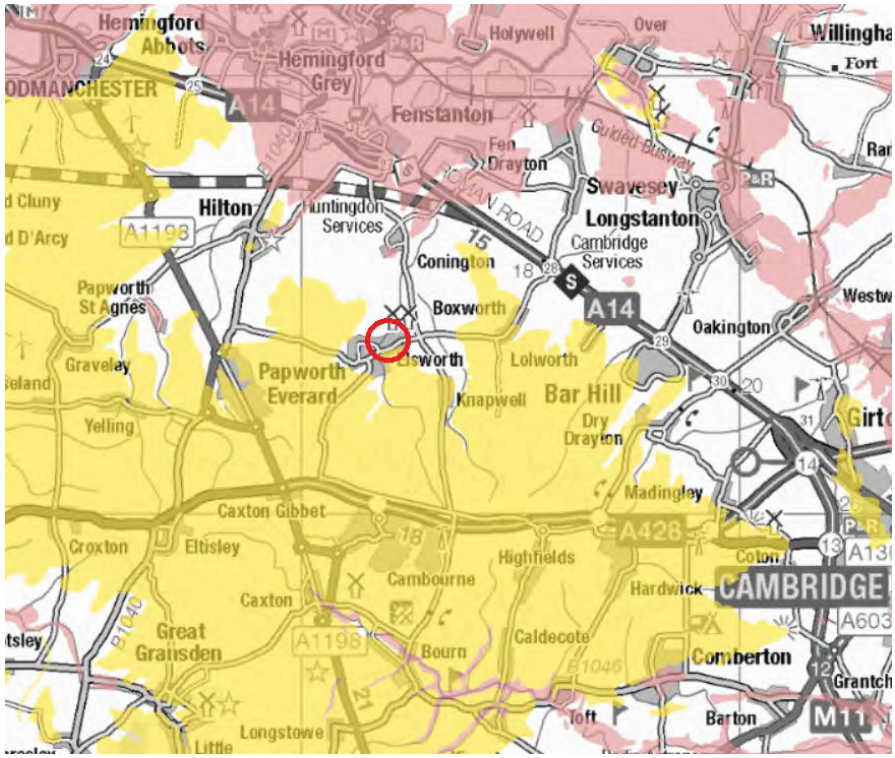


Figure 2.3: Magic Maps Application – Aquifer Designation Map (Superficial Drift)

Aquifer Characteristics

2.12 The Tidal Flat Deposits of Clay, Silt and Sand are classified by the EA as Unproductive Strata / Aquiclude. These are drift deposits with low to very low permeability have negligible significance for water supply or river base flow and do not allow ground water movement.

2.13 "Diamicton, grey, weathering brown, characterised by Cretaceous and Jurassic rock fragments; subordinate lenses of sand and gravel, clay and silt. Clay, brown to grey, and silty clay, with chalk and flint fragments - [Generic description: 'TMOS' Procedures]."

Source Protection Zone

2.14 The site is not within a Source Protection Zone.

Hydrology

The Site

2.15 The site lies to the east of Elsworth village on the site of 53 Martins Farm, Boxworth Road, CB23 4JQ, or Grid Reference; TL 3246 63824. The existing site currently comprises an existing dwelling, a number of existing barns and buildings together with private green space and gravelled parking areas. The George and Dragon public house together with residential dwellings are situated to the west of the proposed site, there is a further residential dwelling to the east. To the north there is agricultural farmland with existing barns. The total site area is circa 0.347 Ha in size.

2.16 The site is accessed via an existing driveway off Boxworth Road.

Surface Water Features

2.17 There is an existing drain on the eastern boundary of the site which then returns around the north of the site before heading off across third party land and ultimately discharging into the water course to the north. This existing ditch takes water from the culvert under Boxworth Road.

Natural (Greenfield) Run-Off Rate

2.18 The natural (greenfield) runoff for a 1.0ha area for the 1 year, QBAR, 30 year and 100 year storm events has been calculated in accordance with the ICP SuDS Mean Annual Flood methodology (refer to CIRIA C753 – SuDS Manual) as noted in table 2.1. Calculations are Shown in **Appendix E**

Natural Run-Off rates (l/s/ha)				
Return period (yrs)	1	(QBAR)	30	100
	0.9	1.1	2.4	3.4

Table 2.1: Natural Run-Off Ratecp

Sewerage

2.19 The AWS Asset Plan is Provided in **Appendix F** and indicates that there is no surface water sewer in the vicinity of the proposed site therefore a SuDS proposal is the only option for surface water discharge. There is a Foul water sewer located to the front of the proposed site in Boxworth Road, AW manhole 0701 will be the desired point of connection for the proposed scheme.

Climate Change

2.20 The importance of climate change in regard to flooding and development is highlighted in the NPPF and the impacts of climate change will be taken into account when designing the new site drainage infrastructure.

2.21 In accordance with the NPPF, the climate change allowance is dependent upon the development lifespan. This development falls within the upper end limit as described in Table 2 (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) requiring an allowance of 40% for the increase in rainfall rates.

Surface Water Disposal

2.22 Fundamentally flood risk must not be increased by the development to other land beyond the boundaries of the site, including downstream via the existing public sewer or alternative means of existing discharge. Reference will be made to the guidance set out in the Building Regulations Approved Document H: Drainage and waste disposal, including the order of preference for desired disposal of surface water runoff.

2.23 Consideration of surface water treatment is to be included to ensure compliance in accordance with the European Union's 'Water Framework Directive'.

2.24 Surface water drainage design is required to be evaluated over the lifetime of the development and the NPPF requires specific implications to accommodate for climate change in the future. Appropriate assessment will be made to detail the level of climate change allowance that will be catered for in the proposed works.

3.0 FLOOD RISK

3.1 Potential sources of flooding that may affect the Site have been reviewed and summarised in Table 3.1 below:

Source	Likelihood
Rivers and Sea: River flooding happens when a river cannot cope with the amount of water draining into it from the surrounding land. Sea flooding happens when there are high tides and stormy conditions.	Very Low (Source: EA Risk of Flooding from Rivers and Sea map, **Figure 3.2**)
Surface Water: This can result when high intensity rainfall falling onto impermeable surfaces (i.e. roofs and paved areas) or low permeability soils and geology (such as clayey soils) is unable to enter drainage systems or soak into the ground sufficiently rapidly. When this happens, the excess water can flow across the ground surface, including adjoining sites, and potentially cause flooding. *The majority of the Site is at very low risk from surface water flooding, however, there are some areas on the northern side of the existing buildings which are shown to be at low risk. Any development within these areas will be subject to relevelling to direct exceedance flows and **minimise risk.**	Very Low (Source: EA Risk of Flooding from Surface Water map, **Figure 3.3**)
Groundwater: This can occur in areas where the groundwater level is high, when rainfall raises the prevailing groundwater level to an extent such that structures within the ground become at risk of inundation. Typically this might include basements or drainage infrastructure. The Environment Agency and Councils do not currently monitor groundwater levels in the aquifers that outcrop in this area. Therefore, at this stage, the assessment of groundwater flood risk is limited.	-
Adopted Drains: Sewer failure can be the result of overloading, leading to surcharge and the escape of water from manholes, gullies, etc. or, more commonly, as a result of blockage.	Very Low
Private Drains: The failure of small diameter private sewers is likely to be more common through lack of maintenance, but the consequences are likely to be less severe.	Very Low

Source	Likelihood
Dam/Reservoir Breach: There are no Dam/Reservoir in the vicinity of the development site. This can be seen in **Figure 3.4**	N/A
Canals: There are no canals in the vicinity of the development site.	N/A
Sea Defences: The development Site is not subject to protection from such defences.	N/A
Historical Flooding: The EA Recorded show that flooding does not affect the proposed site.	N/A

Table 3.1: Sources of Flooding

Sequential Location

3.2 The Site is located in Flood Zone 1, as shown in Figure 3.3, and is consequently at low risk of flooding. The location meets the sequential requirements of the NPPF Guidance (Paragraph: 018 Reference ID: 7-018-20140306) requiring development to be located firstly in areas at lowest flood risk.

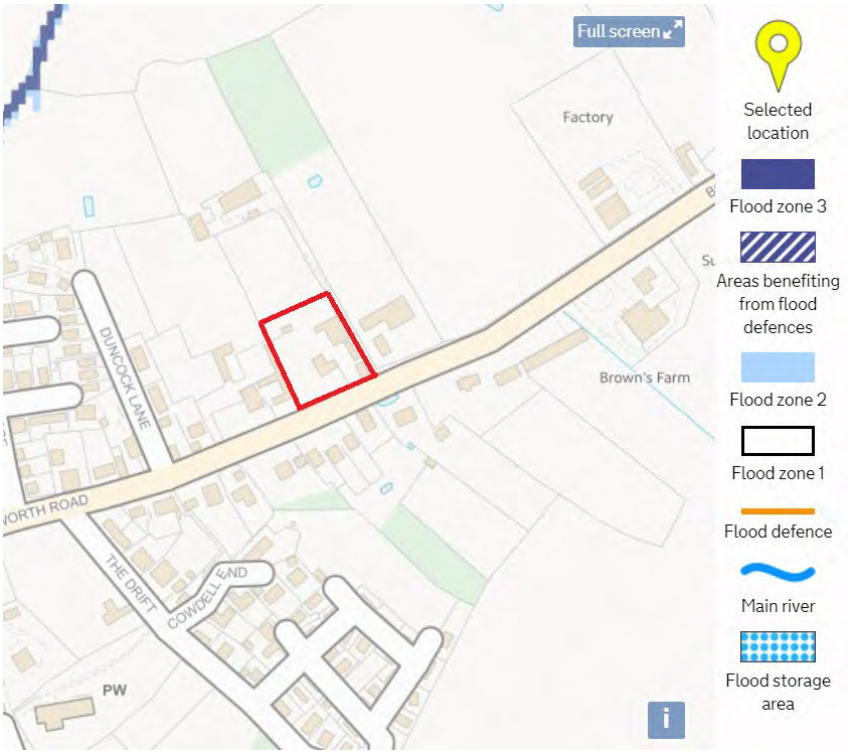


Figure 3.1 EA Flood Zone Map

Figure 3.2 EA Risk of Flooding from Rivers and Sea Map

Figure 3.3 EA Risk of Flooding from Surface Water Flooding

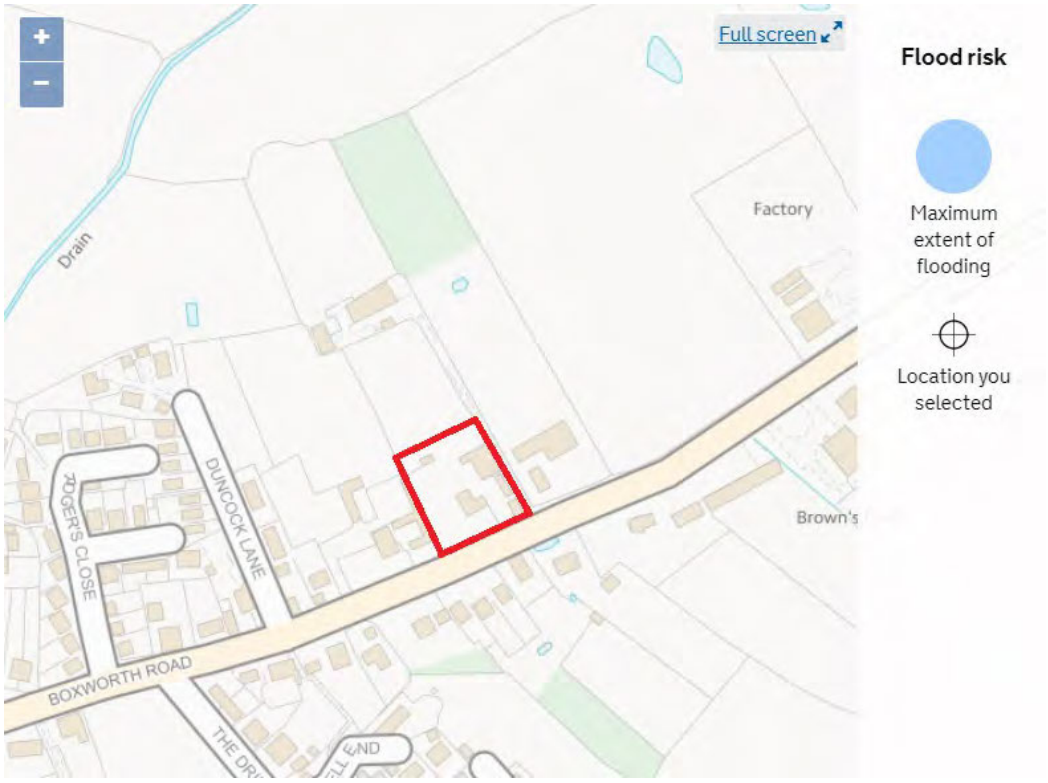


Figure 3.4 EA Risk of Flooding from Reservoirs

4.0 SURFACE WATER DRAINAGE STRATEGY

Existing Surface Water Drainage Strategy

4.1 The site has an existing dwelling together with a number of farm buildings, it is assumed that the surface water naturally falls towards the existing ditch to the east/north of the existing site. There are some existing drainage elements on the existing site, however an exact outfall has not been established.

4.2 The NPPF requires the surface water strategy to follow a sustainable (SuDS) approach. The emphasis of SuDS is to first consider source control (disposal of runoff within the plot boundary), followed by site control (site wide disposal) and then regional control (appropriate for larger developments with strategic drainage infrastructure). Where possible the drainage strategy should target a zero runoff from the immediate development area.

4.3 A hierarchical approach to the management and disposal of surface water has been considered for this development in accordance with Table 4.1. Each method is assessed to reach a conclusion appropriate to the development.

	Hierarchical SuDS Assessment		
	Comment	Issues To Consider	Appropriate To Development
Green roofs	• Can be used on suitable low rise buildings	• Safe maintenance access • In keeping with character/appearance of adjacent buildings	• Not appropriate due to development type
Rainwater Harvesting	• Rainwater harvesting reduces the total runoff volume from the developed Site, particularly first 5mm of rainfall, and reduces treated water consumption	• Economics for full rainwater harvesting systems	• Full rainwater harvesting likely to be uneconomical for this Site • Water butts for roof runoff unlikely to be fully utilised by development type
Site infiltration	• Reduces total runoff volume from the developed site	• Infiltration testing indicates poor infiltration rate precluding use of infiltration drainage • Required 1m unsaturated zone between base of soakaway and groundwater table unlikely to be achievable	• Not appropriate due to poor infiltration rate.

Infiltration Structures	• Infiltration structures can be located within landscaped areas to attenuate storm flows up to the 100 year plus climate change event	• Infiltration testing indicates poor infiltration rate precluding use of infiltration drainage • Required 1m unsaturated zone between base of soakaway and groundwater table unlikely to be achievable • Health and safety issues for potential open water bodies	• Poor infiltration as can be seen in infiltration testing carried out in **Appendix D**.
Detention Structures	• Detention structures can be located within landscaped areas to attenuate storm flows up to the 100 year plus climate change event	• Health and safety issues for potential open water bodies • High spatial demand	• Not appropriate due to limitations of existing topography.
Sub-surface storage (tanks and pipes)	• Suitable for use where there is insufficient space for open structures • Suitable for use where other factors prevent the use of open structures	• Below ground tanks or oversized pipes can be considered as part of a controlled discharge system	• Not appropriate due to restricted levels across site to discharge outfall in existing Water course to east of existing site.
Swales	• Swales provide above ground flood conveyance routes • Water quality enhancement is provided by filtration through vegetation and stone media • Swales are reliant on ground porosity for infiltration	• Infiltration testing indicates poor infiltration rate precluding use of infiltration drainage • Required 1m unsaturated zone between base of soakaway and groundwater table unlikely to be achievable • High spatial demand	• Appropriate, SUDS could potentially be accommodated in addition to tanked permeable paving should it have been required.
Permeable paving and sub-base drainage	• Can be used to provide pavement runoff water quality enhancement (treatment train) and sub-base attenuation • Permeable paving proprietary sub-base storage reduces requirements and volumes of storage structures •	• Poor infiltration as can be seen in infiltration testing carried out in **Appendix D**. • Required 1m unsaturated zone between base of soakaway and groundwater table unlikely to be achievable • Specialist maintenance equipment	• Permeable sub-base is not appropriate due to poor infiltration rate. • **Tanked Permeable paving is to be used to attenuate storm flows up to the 100 year plus climate change event prior to discharging into existing water-course**

Table 4.1: SuDS Assessment

4.4 In terms of a means of disposal of surface water NPP Guidance (Paragraph: 080 Reference ID: 7-080-20150323) requires a Surface Water Hierarchy to be considered. This requires consideration to be given in order of priority to:

a) disposal to the ground
b) disposal to a watercourse
c) disposal to a public surface water sewer
d) disposal to a combined sewer

4.5 Based on the assessment provided in Table 4.1, and that the ground conditions are not suitable as can be seen from the infiltration testing in **Appendix D**, the most appropriate form of surface water drainage for the site is discharging into the existing ditch to the east/north at the calculated greenfield rate with on line storage in the form of tanked permeable paving as illustrated in the Drainage Strategy in **Appendix G**.

4.6 Due to the topography of the existing site we have established a feasible gravity solution allowing both the proposed dwellings and the proposed access road and parking to both drain into the same gravity network. In all storm events the surface water will be discharged and stored within the proposed sub-base of the road and car park.

4.7 The combined discharge rate will be controlled to the natural greenfield (QBAR) runoff rate using a Hydro-brake or similar flow control device. The QBAR runoff rate to be applied to the design impermeable area – see Table 4.2, below:

Development discharge rate		
Impermeable area ha	QBAR	Proposed Discharge Rate
0.347	1.1 l/s	1.1 l/s

Table 4.2: Development runoff rate

4.8 The Drainage Strategy Plan is provided in **Appendix G**. Micro-drainage calculations are provided in **Appendix H**

Maintenance & Management

4.9 All surface water infrastructure will be located mainly within the main access and parking area within the site and will be under private ownership. A separate Drainage Management Plan will be prepared for the Site to ensure that the main surface water drainage features remain well maintained and operational, given the very low discharge rates, so as not to increase any flood risk.

Surface Water Attenuation & Discharge

4.10 Attenuation of all roof drainage is proposed within a below ground tanked permeable paving to cater for surface water in extreme flood events and restricted to greenfield rates before entering the piped network towards the existing ditch. Refer to **Appendix G** for the Proposed Drainage Strategy.

Surface Water Treatment

4.11 The greatest level of hazard for effective treatment of surface water runoff is noted to be nominal given the source of runoff from the development area is roof drainage. Water sensitivity of site is considered to be low due to the absence of a groundwater source protection zone. Effective treatment of runoff is therefore provided prior to discharge. The permeable sub-base will provide the first form or treatment. Permeable paving deals with surface water close to where rainfall hits the ground which is known as 'source control', this is fundamental to SuDS philosophy. Importantly, concrete block paving is also very effective at removing a wide range of pollutants from runoff, thus improving water quality. The second form of treatment will be that of a catchpit manholes, this will provide appropriate and localised protection by the suspension of silts to enable removal from the drainage system.

Surface Water Runoff Quality

4.12 In accordance with NPPF (Section 110) the development should not have a detrimental impact on the environment, including the water environment. NPP Guidance (Paragraph 016 Reference ID: 34-016-20140306) provides advice on the benefits of ensuring runoff quality is to an appropriate standard to enhance the water environment.

4.13 The SuDs Manual 2015 provides guidance on the treatment of surface water runoff for the form of land use and sensitivity of receiving water body. Table 4.3 (SM – 2015) rates the pollution hazard from 'residential roofing' runoff as VERY LOW. The pollution hazard from 'residential parking' runoff as LOW.

4.14 Runoff from LOW hazard areas, non-protected surface waters i.e. those outside of a source protection zone 1), requires a simple index approach. The method of water quality treatment may require a single mitigation system, or combination of mitigation components depending on the pollution hazard rating. A single SuDS component with a high capacity for removal of pollutants can be suitable.

4.15 The simple index approach requires that the mitigation indices for the mitigation proposed exceeds the pollution hazard indices for the pollution hazard level. Table 5.3 provides information on hazard indices and mitigation indices:

	Land Use	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Pollution Indices	Residential Roofing	0.2	0.2	0.05
Pollution Indices	Residential Parking	0.5	0.4	0.4
Mitigation Indices	Residential Parking	0.7	0.6	0.7

Table 4.3: Runoff mitigation assessment

4.16 Table 4.3 above demonstrates that the proposed surface water drainage strategy is suitable for ensuring adequate water quality treatment for all runoff. The treatment is provided through a close to source catchpit treatment prior to entering the impermeable sub-base for the roof run-off with treatment for the parking and residential access via the sub-base of the proposed before discharging via a piped network at a controlled rate into the existing ditch.

Exceedance Flows

4.17 Exceedance flows are those in excess of the design storm event (i.e. > 1 in 100+CC). Exceedance flows will be naturally routed towards the ditches located along the boundary of the Site.

4.18 Exceedance flow flood routes are shown on the Drainage Strategy Layout at **Appendix G**

Flood Risk Management Measures

4.19 All external hard standing areas will be designed to fall away from the proposed buildings.

4.20 In accordance with the NPPF, access and egress to the Site during all storm events should be considered with preference being over dry land. As the Site is wholly in Flood Zone 1 the access routes to and from the properties are naturally above the 1 in 100 year plus climate change event.

4.21 All on-site drainage infrastructure will be constructed in accordance with Building Regulation Standards.

Residual Risk

5.24 Whilst the drainage infrastructure will be considered to building regulation standards there remains a small residual risk of flooding due to blockage or failure of non-site private drains.

5.25 There are further residual risks related to the maintenance of off-site drainage assets by third parties, such as highway drainage, foul sewers and drainage ditches.

5.0 FOUL WATER MANAGEMENT

Existing Arrangement

5.1 The area of development consists of an existing dwelling together with a number of farm buildings and soft landscaping and is therefore considered brownfield development, with an existing foul water discharge from the site currently.

5.2 The incumbent sewerage provider is Anglian Water. The sewer asset plan shows a 150mm diameter gravity foul sewer located to the south of the proposed development located in Boxworth Road. The existing property at 53 Boxworth Road to the south of the proposed site currently discharges into the Anglian Water sewer. Records have been obtained and are illustrated in **Appendix F**. The proposed Micro-drainage Calculations for the Adoptable foul network have been provided in **Appendix J**

5.3 We recommend that a Pre-Planning Assessment Report is requested from AWS to assess the impact of additional flows to the existing sewerage network and local water recycling centre from the development.

Proposed Arrangement

5.4 Proposals are to connect into the nearby Anglian Water system via a gravity system. It is anticipated that peak foul flow rates from the proposed new development are considered to be nominal.

5.5 The final connection to the public sewer will be subject to a Section 106 agreement under the Water Industry Act 1991 for the flow discharge to the public sewer. A Section 104 agreement can potentially be sort to have the main spine through the development adopted by Anglian Water providing the required easement as shown in the Drainage Strategy in **Appendix G.**

6.0 ADOPTION AND MAINTENANCE

Adoption

6.1 The proposed surface water regime is subject to planning approval from the LPA with statutory consultee from the Water Authority and Environment Agency. Outfall is proposed via new connection into the existing ditch to the east of the proposed development at a controlled rate.

6.2 The surface water drainage is therefore to remain in private ownership including maintenance responsibility and is not subject to adoption or connection to the public sewer. The proposed outfall is to be constructed within the existing ditch adjacent to the proposed site and will potentially require Ordinary Watercourse Consent and approval for construction of a new Headwall structure.

6.3 New foul water drainage is proposed to drain by a gravity system into the existing Anglian water sewer discharging into a new manhole on the existing system. The foul water connection will therefore be subject to approval by Anglian Water via a Section 106 agreement under the Water Industry Act 1991 together with a S104 for the adoption of the sewer within the site and the new manhole to be constructed. Peak flows would be of a nominal value and should be accommodated within the existing public sewer.

Maintenance

6.4 To satisfy the requirements likely associated to the planning approval, it is anticipated a maintenance regime will be provided within the health & safety file following completion of the construction phase of works.

6.5 This will be subject to final installation of the drainage provisions and be in accordance with any associated manufacturer's recommendations of the selected drainage products installed by the contractor.

6.6 Compliance with Building Regulations standards for the installation of all drainage should provide a self-cleansing regime for all gravity drainage systems. This will result in minimal maintenance requirements and should keep the drains in good working order.

6.7 All drainage will be required to be routinely inspected in order to identify/prevent the formation of blockages within the system.

6.8 Rodding access is provided to all drainage points to satisfy the requirements of the Building Regulations and catchpit manholes will enable silt removal from the system where necessary.

6.9 Flow control devices are the point most likely to be subject to blockages occurring and should routinely be inspected to mitigate this. The installation of debris guards would minimise the risk of blockages occurring.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Flood Risk

7.1 The site is located in Flood Zone 1 and at low risk of flooding. All sources of flood risk have been identified and consideration made for the appropriateness of the proposed development.

7.2 Mitigation measures for the containment of the worst-case design storm return period has been allowed for, including allowance for climate change.

7.3 Exceedance flows are considered to flow into the existing ditch the east and north of the existing site. The design for the proposed site accommodates the extreme 1 in100 year rainfall event with a 40% allowance for climate change. It is assumed that if in the event of any exceedance above ground, surface water run-off will discharge into the existing watercourse surrounding the site to the north and the east as existing.

7.5 There are no obvious adverse environmental considerations arising from the proposed works. Sources of potential hazard are of nominal risk to receiving watercourse and have been adequately mitigated by the provision of surface water treatment prior to discharge.

7.6 The site is an existing brownfield with no considered contributing areas. All existing runoff to the development area is considered disposed of onsite currently.

7.7 All surface water runoff is proposed to be attenuated below ground within the drainage system for both the higher and lower severity storm duration events.

7.8 The use of catchpit type manholes will promote the suspension of all potential contaminants from the proposed car park extension and pavilion run-off.

7.9 Outfall will be to the existing Ditch to the east of the site at a restricted greenfield rate of runoff in accordance with the requirements of the NPPF and Building regulations.

7.10 The Foul water is proposed to discharge into the nearby Anglian Water system via a gravity system. It is anticipated that peak foul flow rates from the proposed new development are nominal. This will be subject to approval by the Water Authority for receiving flows.

7.11 All areas of proposed impermeable area are to discharge from site but with the implementation of sustainable drainage principles, at the equivalent greenfield rate of runoff.

7.12 Flood risk is therefore determined to be adequately mitigated with no associated flood risk to the development or adjacent land off site.

APPENDIX A: Proposed Site Layout Plans

Swimming Pool Building.

Garage with loft room.

Ground Level 17.85.

Approx. line of domestic curtiledge to neighbouring property.

Existing 'off site' tree.

Existing 'off site' tree.

Existing 'off site' trees.

Existing 'off site' Hedgerow, approx 4-5m high.

Existing 'off site' Hedgerow, approx 4-5m high.

Existing 'off site' Hedgerow, approx 4-5m high.

Existing workshop / Storage Barn to be retained / converted to form Carport / Family Room.

PLOT 1.

PLOT 2.

PLOT 3.

PLOT 4.

PLOT 5.

PLOT 6.

PLOT 7.

PLOT 8.

PLOT 9.

PLOT 10.

Outline of existing dwelling to be demolished.

Outline of existing dwelling to be demolished.

Agricultural Access for existing field.

Duck pond.

Visibility Splay 2.4m x 43.0m

Visibility Splay 2.4m x 43.0m

Existing 'off site' Ash tree.

51

BLOCK PLAN.

1/200 @ A1.

Finishes Legend.

Resin bonded gravel.
Car parking spaces to be as marked with brick pavors.

Tarmac 'crossover' with white chippings rolled into wearing course.

Footpaths finishes with pavings.

Flat top speed table finishes in permeable brick pavors.

REVISION

PROJECT
Proposed development at
Martins Farm, 53 Boxworth Road,
Elsworth,
Cambridge, Cambs.

DESCRIPTION
Block Plan As Proposed.

CLIENT
Solopark Ltd.

DATE
June 2019

SCALE
1/200 @ A1

The Clarke Smith Partnership
Architectural & Planning Consultants
[redacted]

Drawing
P 4078 - 01.

Existing 'off site' trees.

PLOT 6.
Garden Area 92.5 sq M.

PLOT 7.
Garden Area 64.5 sq M.

PLOT 8.
Garden Area 74 sq M.

PLOT 9.
Garden Area 61 sq M.

PLOT 10.
Garden Area 82 sq M.

PLOT 1.
Garden Area 173 sq M.

PLOT 2.
Garden Area 47 sq M.

PLOT 3.
Garden Area 136 sq M.

PLOT 4.
Garden Area 82 sq M.

PLOT 5.
Garden Area 310 sq M.

Agricultural Access to existing field.

Garden Building.

Car port windows (3No.) to be glazed with obscure glass.

legend.

Plot 1.....4 Bed House.....170 sq M.
inc. 35q M cupboards.
Excl. Ex. Carport.

Plots 2 & 3.....2 Bed Houses.....72 sq M. EACH UNIT.
inc. 2.55q M cupboards to each unit.

Plot 4.....2 Bed House.....82 sq M.
inc. 2.55q M cupboards.

Plot 5.....4 Bed House.....149 sq M.
inc 3 sq M cupboards.

Plots 6 & 7.....3 Bed Houses.....Plot 6. 89sq M.
Plot 7. 85sq M.
inc 3sq M cupboards to each unit.

Plots 8, 9 & 10....3 Bed Houses....Plot 8. 134sq M.
Plot 9. 110sq M.
Plot 10. 134sq M.
inc 3sq M cupboards to each unit.

Total G.I.A.....1097 sq M.

New Garages.....123 sq M.

Grand Total.....1220 sq M.

Areas to be demolished;

Bungalow.....152 sq M.
Annexe.....51-5 sq M.
Offices.....33.5 sq M.

Total.....237 sq M.

TOTAL AREA OF DEVELOPMENT 983 sq M.

GROUND FLOOR PLAN.

REVISION

PROJECT
Proposed development at
Martins Farm, 53 Boxworth Road,
Elsworth,
Cambridge, Cambs.

DESCRIPTION
Ground Floor Plan As Proposed.

CLIENT
Solopark Ltd.

DATE
June 2019

SCALE
1/125 @ A1

The Clarke Smith Partnership
Architectural & Planning Consultants
[redacted]

Drawing
P 4078 - 02.

PLOT 6.

PLOT 7.

PLOT 8.

PLOT 9.

PLOT 10.

PLOT 1.

PLOT 2.

PLOT 3.

PLOT 4.

PLOT 5.

Agricultural Access to existing field.

Bedroom 2.
Bedroom 3.
7.6sq M.
Bedroom 2.
10sq M.
Bedroom 1.
12sq M.
Bathroom.
Bedroom 1.
16sq M.

Bedroom 2.
17.8sq M.
Bedroom 3.
11sq M.
Bedroom 1.
12sq M.
Bedroom 2.
12sq M.
Bedroom 3.
Bedroom 2.
En Suite.
Bathroom.
Bathroom.
Bedroom 1.
23.5sq M.
Bedroom 3.
10sq M.
Bathroom.
Bedroom 1.

Bedroom 4.
8.8sq M.
Bedroom 3.
14.7sq M.
Bathroom.
Bedroom 1.
17.4sq M.
En Suite.
Bedroom 2.
13sq M.
Dressing.

Bedroom 1.
15.8sq M.
Bathroom.
Bedroom 3.
11.5sq M.
En Suite.
Bedroom 2.
11.5sq M.
Bedroom 4.
10.2sq M.

Bedroom 2.
13.7sq M.
Bathroom.
Bedroom 1.
15.5sq M.

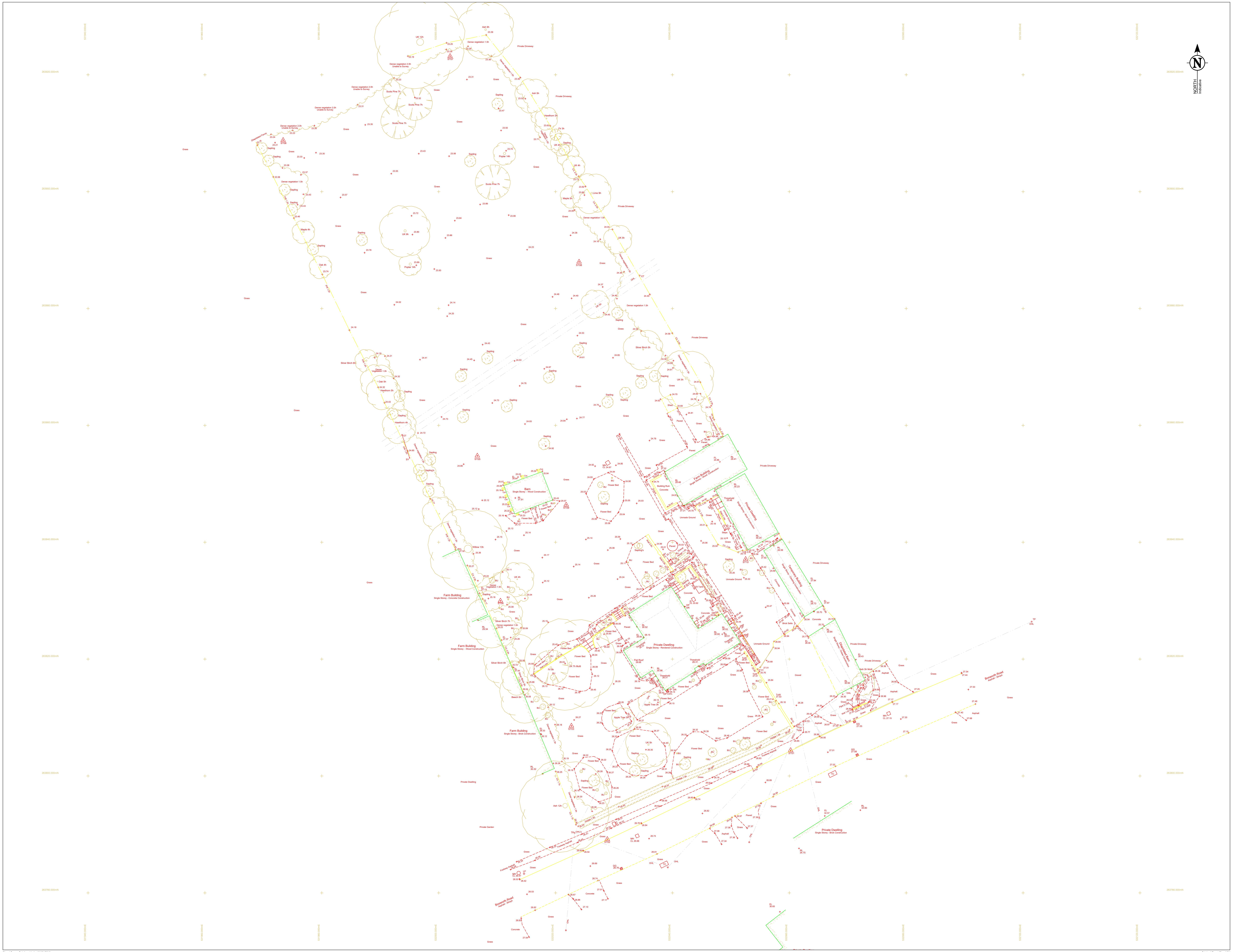
Bedroom 1.
11.8sq M.
Bedroom 2.
10.3sq M.
Bathroom.
Bathroom.
Bedroom 1.
Bedroom 2.

26.81

FIRST FLOOR PLAN.

REVISION	
PROJECT	Proposed development at Martins Farm, 53 Boxworth Road, Elsworth, Cambridge, Cambs.
DESCRIPTION	First Floor Plan As Proposed.
CLIENT	Solopark Ltd.
DATE	June 2019
SCALE	1/125 @ A1
The Clarke Smith Partnership Architectural & Planning Consultants [redacted]	
Drawing	P 4074 - 03.

APPENDIX B: Topographical Survey



Original Sheet Size A0H

TOPOGRAPHICAL & MEASURED BUILDING SURVEYS

ABBREVIATIONS & SYMBOLS

AH	Arch Head Height	FH	Fire Hydrant	RSJ	Rolled Steel Joist
AR	Assumed Route	FBD	Floor Board Direction	SI	Sign Post
AV	Air Valve	FH	Fire Hydrant	SP	Arch Spring Point Height
BB	Belisha Beacon	FL	Floor Level	SV	Stop Valve
BH	Bore Hole	FP	Flag Pole	SW	Surface Water
BL	Bed Level	FW	Foul Water	SY	Stay
BO	Bollard	GG	Gully Grate	Tac	Tactile Paving
BrP	Brace Post	GV	Gas Valve	TC	Telecom Cover
BS	Bus Stop	HH	Head Height	TH	Trial Pit
BU	Bush	IC	Inspection Cover	THL	Threshold Level
B/W	Barbed Wire Fence	IL	Invert Level	TL	Traffic Light
BX	Box (Utilities)	I/R	Iron Railings	ToW	Top of Wall
C/B	Close Board Fence	KO	Kerb Outlet	TP	Telegraph Pole
CH	Cill Height	LP	Lamp Post	TV	Cable TV Cover
CL	Cover Level	MH	Manhole	UB	Universal Beam
C/L	Chain Link Fence	MP	Marker Post	UC	Unknown Cover
C-Lev	Ceiling Level	NB	Name Board	UK	Unknown Tree
Col	Column	OHL	Overhead Line (approx)	USB	Under Side Beam
C/P	Chestnut Paling Fence	Pan	Panel Fence	UTL	Unable To Lift
CR	Cable Riser	PB	Post Box	VP	Vent Pipe
DC	Drainage Channel	PM	Parking Meter	WB	Waste Bin
DH	Door Head Height	PO	Post	WH	Weep Hole
DP	Down Pipe	P/R	Post & Rail Fence	WL	Water Level
DR	Drain	P/W	Post & Wire Fence	WM	Water Meter
EL	Eaves Level	P/Wall	Partition Wall	WO	Wash Out
EP	Electric Pole	RE	Rodding Eye	(X.XX)	Floor to Ceiling Height
ER	Earth Rod	RL	Ridge Level		
ET	EP+Transformer	RP	Reflector Post	(X.XX)F/C	Floor to False Ceiling Ht
FB	Flower Bed	RS	Road Sign		
FBD	Floor Board Direction	RSD	Roller Shutter Door	△	Survey Control Station

DRAWING NOTE

Topographical Surveys

Trees are drawn to scale showing the average canopy spread. Descriptions and heights should be used as a guide only.

All building names, descriptions, number of storeys, construction type including roof line details are indicative only and taken externally from ground level.

All below ground details including drainage, voids and services have been identified from above ground and therefore all details relating to these features including; sizes, depth, description etc will be approximate only. All critical dimensions and connections should be checked and verified prior to starting work.

Detail, services and features may not have been surveyed if obstructed or not reasonably visible at the time of the survey.

Measured Building Surveys

Measurements to internal walls are taken to the wall finishes at approx 1m above the floor level and the wall assumed to be vertical.

Cill heights are measured as floor to the cill and head heights are measured from cill to the top of window.

General

The contractor must check and verify all site and building dimensions, levels, utilities and drainage details and connections prior to commencing work. Any errors or discrepancies must be notified to Survey Solutions immediately.

The accuracy of the digital data is the same as the plotting scale implies. All dimensions are in metres unless otherwise stated.

The survey control listed is only to be used for topographical surveys at the stated scale. All control must be checked and verified prior to use.

Do not scale from this drawing.

CONTROL CO-ORDINATES

STATIONS	EASTINGS	NORTHINGS	LEVEL	DESCRIPTION
ST01	532060.228	263804.396	27.002	PK Nail
ST02	532028.856	263789.183	26.713	PK Nail
ST03	532022.708	263808.571	26.355	Peg & Nail
ST04	532010.566	263829.977	25.299	Peg & Nail
ST05	532006.610	263854.795	25.017	Peg & Nail
ST06	531973.385	263908.812	23.488	Peg & Nail
ST07	532001.952	263923.184	23.457	Peg & Nail
ST08	532024.022	263887.984	24.522	Peg & Nail
ST09	532021.815	263846.403	25.260	Peg & Nail
ST10	532052.529	263837.110	25.391	Peg & Nail

SURVEY GRID AND LEVEL DATUM

The coordinate system established for this survey is related to Ordnance Survey (OS) national grid at a single point using Smartnet, then orientated to grid north with a scale factor of 1.000.

The level datum established for this survey is related to Ordnance Survey (OS) using GPS Smartnet.

To avoid discrepancies any coordinated data used in conjunction with this survey must be derived directly from this control data.

REV	DESCRIPTION	DRAWN	APPR	DATE

SURVEY SOLUTIONS

Ipswich Coventry Yeovil Norwich Perth Nottingham Brentwood

Tel No: 0845 0405 969 Fax No: 0845 0405 970
www.survey-solutions.co.uk enquiries@survey-solutions.co.uk

LAND SURVEYING BUILDING SURVEYING UNDERGROUND SURVEYING

PROJECT TITLE 53 BOXWORTH ROAD, ELSWORTH, CAMBS, CB23 4JQ.				
DRAWING DETAIL TOPOGRAPHICAL SURVEY Sheet 1 of 1				
CLIENT SOLOPARK LTD				SCALE 1:200
SURVEYOR PJC	SURVEY DATE 25/10/16	CHECKED BY MG	APPROVED BY JIA	DWG STATUS FINAL
DRAWING NUMBER 18587ea-01			REVISION	ISSUE DATE 27/10/16

APPENDIX C: Existing nearby Borehole Records

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Site	Borehole Number
A14 Ellington to Fen Ditton	3215

Machine:	Casing Diameter	Ground Level (mOD)	Client	Job Number
Flush :		9.07	Highways Agency	5136919a
Core Dia: mm				
Method :	Location	Dates	Project Contractor	Sheet
	531947.9 E 263350.02 N	20/08/2008	Costain Skanska	1/1

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.30					B2		(0.30)	TOPSOIL Stiff brown mottled orange-brown slightly sandy slightly gravelly CLAY, with frequent rootlets. Sand is fine to coarse. Gravel is angular to subrounded fine and medium occasionally coarse of flint, rare chalk, sandstone.		
0.20					D1	8.77	0.30			
0.30-0.60					B4		(0.30)			
0.50	20		0	0	D3	8.47	0.60			
0.60-1.20					B6			Firm to stiff friable orange-brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to rounded fine and medium of flint and chalk. (HEAD DEPOSITS)		
1.00					D5		(0.60)			
1.20						7.87	1.20	Firm grey mottled orange-brown silty CLAY, with occasional rootlet remains. Occasional subangular to subrounded weathered light grey phopshatic nodules (<20mm). (OXFORD CLAY)		
							(0.30)			
						7.57	1.50			
	93		0	0				Firm fissured thinly laminated dark grey slightly sandy CLAY with occasional fragments (<6mm) of shell (probably bivalve). Fissures are subhorizontal (inclined <20 degrees) rough planar infilled (<20mm) with soft clay. (OXFORD CLAY)		
							(1.40)			
								Assumed zone of core loss. Soft CLAY (Driller's description) (OXFORD CLAY)		
2.70						6.17	2.90	Very stiff to stiff thinly laminated dark grey slightly sandy CLAY with occasional fragments (<6mm) of shell (probably bivalve). (OXFORD CLAY)		
	100		0	0						
3.60-4.08					C7		(1.30)			
4.20						4.87	4.20	Soft to firm thinly laminated dark grey slightly sandy CLAY with occasional fragments (<6mm) of shell (probably bivalves). (Possibly drilling disturbed) (OXFORD CLAY)		
							(0.40)			
						4.47	4.60	Very stiff fissured thinly laminated dark grey slightly sandy CLAY, with occasional (<6mm) of bivalve shell. Fissures are subhorizontal (inclined <20 degrees) rough planar occasionally infilled (<10mm) with clay. (OXFORD CLAY)		
	0		0	0						
							(1.10)			
5.70						3.37	5.70	No Recovery. Soft CLAY (Driller's description) (OXFORD CLAY)		
	100		0	0						
							(1.50)			
7.20						1.87	7.20	Very stiff fissured thinly laminated dark grey slightly sandy CLAY, with occasional (<6mm) of bivalve shell. Fissures are subhorizontal (inclined <20 degrees) rough planar occasionally infilled (<10mm) with clay. (OXFORD CLAY)		
	92		0	0						
							(1.50)			
8.70						0.37	8.70			
						0.27	8.80	Assumed zone of core loss. Soft CLAY (Driller's description) (OXFORD CLAY)		
							(0.27)			
						0.00	9.07	Very soft thinly laminated dark grey slightly sandy CLAY with occasional fragments (<6mm) of shell. (Possibly drilling disturbed) (OXFORD CLAY)		
9.40-9.82					C8 20/08/2008:		(0.93)			
					20/08/2008:			Very stiff and stiff thinly laminated dark grey slightly sandy CLAY with occasional fragments (<6mm) of bivalve shell. (OXFORD CLAY)		
						-0.93	10.00			

Remarks
Hand dug inspection pit to 1.20m depth. No services encountered. Open hole drilling from surface. Rotary coring from 1.20m to 10.0m. Borehole terminated at 10.0m on Engineer's instruction. Backfilled with bentonite on completion.

Scale (approx)	Logged By
1:50	

Figure No.

APPENDIX D: Infiltration Testing Report

[redacted]

[redacted]

By email: rodney@solopark.co.uk

8th August 2019

Subject: **Infiltration Testing – Martins Farm, Boxworth Road, Elsworth, Cambridgeshire, CB23 4JQ**
EPS Ref: **UK19.4578**

Rodney,

As you will be aware, EPS have recently undertaken infiltration testing at Martins Farm, Boxworth Road, Elsworth, CB23 4JQ as requested by Matthew Coelho of Ingleton Wood. The findings of this testing are summarised below. A site location plan is enclosed to the rear of this letter report (Appendix A).

The objective of these works was to provide information relating to the prevailing ground conditions and to undertake soakaway testing (in general accordance with *BRE 365 Soakaway Design*), to assess the infiltration characteristics of the subsurface soils across the site.

The scope of the works included the formation of two trial pits (TP01 - TP02) to a maximum depth of approximately 1.2m below ground level (bgl), using a compact/mini excavator at locations specified by the Engineer.

Undertaking an assessment or analysis for the presence of contamination did not form part of the brief for the completed investigations. However, ground conditions were recorded during excavation, with awareness for visual and olfactory evidence of contamination, trial pit logs can be found attached to this summary report.

Limitations and Constraints

The purpose of this report is to present the findings of a ground investigation conducted at the location(s) specified. When examining the data collected from the investigations made during the assessment, Environmental Protection Strategies Ltd (EPS) makes the following statements:

No investigation method is capable of completely identifying all ground conditions that might be present in the soil or groundwater under a site. Where outlined in our report, we have examined the ground beneath a site by constructing a number of boreholes and / or trial pits to recover soil and / or groundwater samples. The locations of these excavations and sampling points are considered to be representative of the condition of the whole site subsurface however, ground

conditions are naturally variable and it may be possible that the ground conditions encountered may differ to those encountered during the investigation.

EPS Ltd cannot confirm that Japanese Knotweed rhizomes do not exist at the site, this is due to the difficulty of identifying the plant, especially in the early stages of growth. It is recommended that if Japanese Knotweed, (or any other similarly invasive plants,) is suspected to be present, a specialist contractor should be commissioned to make a detailed assessment.

If third parties have been contracted / consulted during compilation of this report, the validity of any data they may have supplied, and which are included in the report, have been assessed as far as possible by EPS however, EPS cannot guarantee the validity of these data.

The report has been prepared for the client listed on the report title page and has been subject to standard internal EPS review procedures. EPS accepts no liability or responsibility for use of, or reliance upon, this report and / or the information contained within it by third parties.

No part of this report, or references to it, may be included in published documents of any kind without approval from EPS.

Findings of the Investigation

Site Location and Description

The site is located on Boxworth Road, towards the eastern fringes of Elsworth, around national grid reference 532015, 263863. The property lies at an approximate topographic elevation of between 28-30m above ordnance datum (AOD) with a step down in elevation from south to north, roughly in the middle of the site.

On the eastern boundary of the property there were a collection of barn buildings and a gravel driveway, extending to the northern boundary of the property. Access from Boxworth Road could be gained directly using this driveway. The centre of the site is occupied by a bungalow, which was split into two residential dwellings, with associated garden areas in the surrounding area, reaching the south, west and north site boundary. Surrounding the site in the south and west are residential properties, with housing density increasing westwards. To the north and east of the site are small fields, an agricultural yard, and arable land beyond that.

Utility plans were obtained as part of the investigation and several images of site activities including completed trial pits are attached to this summary report in Appendix B.

Ground Conditions

Geological maps of the area indicate the ground conditions comprise West Walton Formation and Ampthill Clay Formation with no overlying superficial drift.

Two trial pits were excavated as part of the infiltration testing conducted by EPS, and the ground conditions encountered from ground level, were found to differ slightly to those inferred from the geological mapping and have been interpreted to comprise the following: -

- Topsoil
- Made Ground
- Glacial Deposits

A summary of the strata encountered during the investigation is provided below:

Geological Strata	Maximum Depth to Base of Strata (m bgl)	Strata Thickness (m)
Topsoil	0.2	0.1 - 0.2
Made Ground	0.6	0.2 – 0.4
Ampthill Clay Formation	1.2	0.6 - 0.85

Topsoil

On the ground surface was manicured lawn overlying a soft, dark brown topsoil material described as a silty sandy clay with frequent fine roots. The topsoil materials were uniform between both trial pits.

Made Ground

At both trial pits, a strata of dark brown to grey, sandy and gravelly clay was identified beneath the topsoil. Gravels were found to be various shape, size and constituent, with both pits containing anthropogenic materials such as concrete, brick and other aggregate. In TP01, there were frequent occurrences of sub-angular to rounded cobbles and boulders, and, at 0.6m an assumed redundant metal land drain was uncovered at the side of the pit, with localised iron staining around the pipe. In TP02, there was a greater quantity of brick and concrete fragments. The materials continued to a maximum depth of 0.6m in TP1 and 0.3m in TP2.

Glacial Deposits

Soils interpreted as being Glacial Deposits were identified from below the Made Ground and this strata was found to be uniform in nature across the two trial pits. It was described as a soft to firm, brown to grey, slightly gravelly clay with gravel being fine to medium chalk.

A trial pit location plan and formal trial pit logs are also attached to the rear of this letter report in Appendix C and Appendix D, respectively.

Groundwater

Groundwater was not encountered during the forming of any of the trial holes, however there was some slow seepage of water in TP01, likely leaked from the exposed land drain.

Drainage

As mentioned, soakaway testing was undertaken in two trial pits (TP01 & TP02) to establish infiltration rates for the soils encountered, as summarised in the below table:

Trial Pit Location	Trial Pit Depth (m bgl)	Test 1 Calculated Infiltration Rate (m/s)	Test 2 Calculated Infiltration Rate (m/s)	Comments
TP01	1.20	$>1.0x10^{-8}$	n/a	Tests failed to reach completion over a minimum testing period of 36 hours, and therefore an accurate infiltration rate could not be calculated for these locations
TP02	1.15	$>1.0x10^{-8}$	**	

**In TP02, the water column was topped up to a depth of 0.26mbgl. Whilst in the made ground strata of the pit the infiltration rate was observed to be $f=1.75x10^{-6}m/s$. However, once the water level had dropped to the clay strata, the infiltration stopped.

Due to the low permeability nature of the natural soils encountered, the water level within TP01 and TP02 failed to drain to even 25% of its effective depth over a testing period in excess of 36 hours and therefore an accurate infiltration rate could not be calculated for these locations. Further to this, the calculated rates for TP01 and TP02 are identified to be representative of 'low permeability' to 'practically impermeable' conditions, thus suggesting that this method of water disposal is unlikely to be successful for this site and alternative means of surface water for disposal should be explored.

Enclosed

- Site Location Plan
- Selected Site Photos
- Trial Pit Location Plan
- Trial Pit Logs

We hope the above is clear. However, if you have any queries, or require any further information relating to this report, please do not hesitate to contact us.

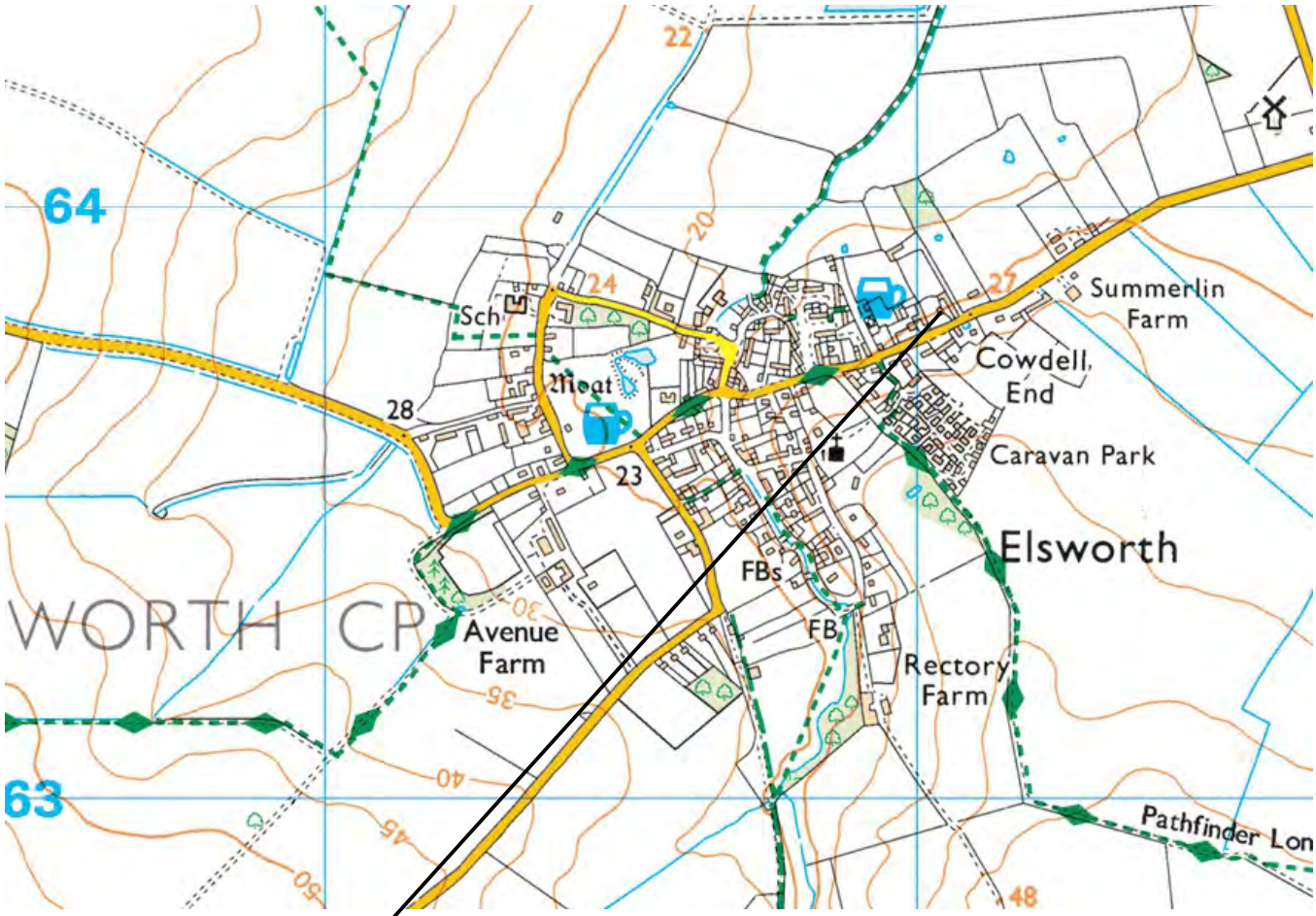
Best Regards,

Author:	Reviewed:	Authorised:
[redacted]	[redacted]	[redacted]
Darcy Crowther	Sam Setchell	Steve Bullock
Consultant	Senior Consultant	Director

APPENDICES

APPENDIX A

Site Location Plan



Approximate Site Location

Title: Site Location Plan

Project: Martins Farm, Boxworth Road, Elsworth, Cambs, CB23 4JQ

Appendix A

Scale: NTS

Drawn By: DC

Approved By: MB

Job Number: UK19.4570

Dwg No:Elsworth/0719/AppA

Date: July 2019

APPENDIX B

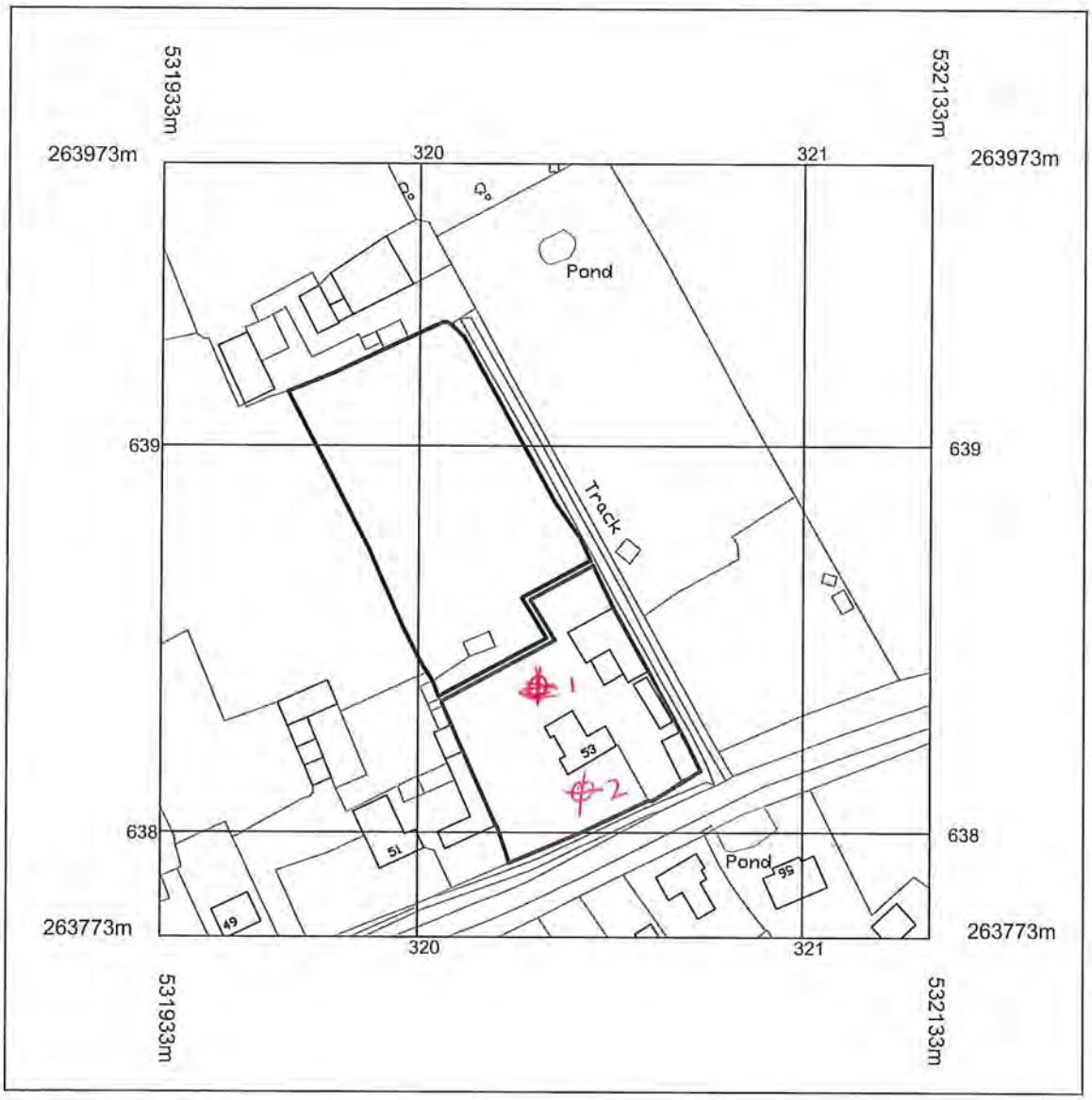
Selected Site Photographs

Photo 1: Image showing TP01.	Photo 2: Image showing TP02 with arisings in the background.
	
Photo 3: Photograph from TP01, outlining the composition of the made ground.	Photo 4: Photograph from TP02, outlining the composition of the Ampthill Clay Formation Strata.
	

APPENDIX C

Trial Pit Location Plan

Latitude VectorMap



TP LOCATIONS

20 0 20 40 60 80 100

Metres

N

PROJECT	Proposed development at Mardins Farm, 53 Boxworth Road, Elsworth, Cambridge. Cambs.
DESCRIPTION	Location Plan
CLIENT	Sotopark Ltd.
DATE	July 2017
SCALE	1/1250 @ A3

The Clarke Smith Partnership
Architectural & Planning Consultants
1, Chuck A Bush Farm Barn, Royston Road, Whittlesford, Cambridgeshire CB22 4NW.
Tel 01223 830989

DRAWING P.4074 - D11.

APPENDIX D

Trial Pit Logs

Trial Pit Log

Trialpit No **TP01**

Sheet 1 of 1

Project Name: Martins Farm, Elsworth	Project No. UK19.4578	Co-ords: 532015.00 - 263863.00 Level: 28.00	Date 29/07/2019
Location: Martins Farm, Boxworth Road, Elsworth, CB23 4JQ		Dimensions (m): 1.65 × 0.6 Depth 1.20	Scale 1:10
Client: Ingleton Wood			Logged DC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
							Soft, dark brown silty sandy CLAY. (TOPSOIL)
				0.20	27.80		Brown to grey sandy very gravelly CLAY with cobbles and occasional boulders. Gravel is angular to rounded fine to coarse flint chalk brick concrete. Cobbles and boulders are sub-angular to rounded. Metal pipe present at 0.6m with rusting and iron staining on the surrounding soil. (MADE GROUND)
				0.60	27.40		Soft to firm grey and brown slightly gravelly CLAY. Gravel is fine chalk.
				1.20	26.80		End of pit at 1.20 m

Remarks:

Stability:

Trial Pit Log

Trialpit No **TP02**

Sheet 1 of 1

Project Name: Martins Farm, Elsworth	Project No. UK19.4578	Co-ords: 532015.00 - 263863.00 Level: 30.00	Date 29/07/2019
Location: Martins Farm, Boxworth Road, Elsworth, CB23 4JQ		Dimensions (m): 1.2 × 0.6 Depth 1.15	Scale 1:10
Client: Ingleton Wood			Logged DC

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10	29.90		Soft dark brown sandy CLAY with turf on the surface. (TOPSOIL)
				0.30	29.70		Dark brown very sandy very gravelly CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to coarse with anthropogenic material. (MADE GROUND)
				1.15	28.85		Soft to firm grey brown slightly gravelly CLAY. Gravel is fine to medium chalk. End of pit at 1.15 m

Remarks:

Stability:

ISO 9001
Certificate No. GB2003472

Accredited Contractor
CHAS.co.uk

APPENDIX E: Greenfield Runoff Rates

[redacted]

Date 17/12/2019 13:59 | Designed by [redacted]
File 111666 GREENFIELD RATES.SRCX | Checked by
Innovyze | Source Control 2019.1

ICP SUDS Mean Annual Flood

Input

Return Period (years) 1 SAAR (mm) 550 Urban 0.000
Area (ha) 0.347 Soil 0.450 Region Number Region 6

Results l/s

QBAR Rural 1.1
QBAR Urban 1.1

Q1 year 1.0

Q1 year 1.0
Q30 years 2.6
Q100 years 3.7

APPENDIX F: Anglian Water Sewer Assets

(c) Crown copyright and database rights 2019 Ordnance Survey 100022432 | Date: 05/09/19 | Scale: 1:1250 | Map Centre: 532036,263827 | Data updated: 31/07/19 | Our Ref: 331887 - 1 | Wastewater Plan A3

- Foul Sewer
- Surface Sewer
- Combined Sewer
- Final Effluent
- Rising Main*
- Private Sewer*
- Decommissioned Sewer*
- Outfall*
- Inlet*
- Manhole*
- Sewage Treatment Works
- Public Pumping Station
- Decommissioned Pumping Station

*(Colour denotes effluent type)

[redacted]

Boxworth Rd,Elsworth

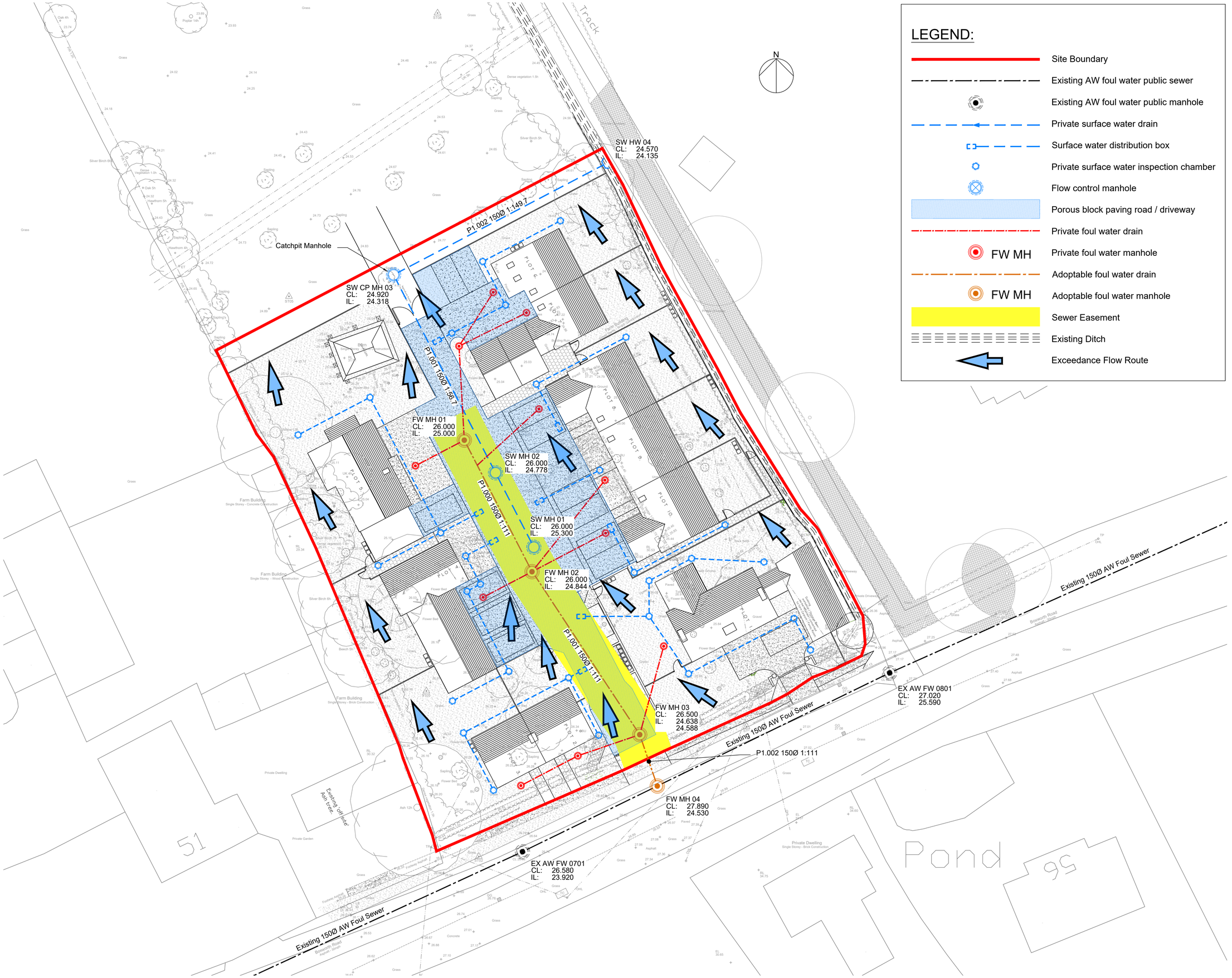
love every drop anglianwater

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
0701	F	26.58	23.92	2.66
0702	F	31.19	30.13	1.06
0801	F	27.02	25.59	1.43
1801	F	28.58	27.12	1.46
7702	F	24.8	22.47	2.33
7808	F	-	-	-
8701	F	25.47	22.93	2.54
8702	F	25.81	23.07	2.74
8703	F	-	-	-
8704	F	-	-	-
8705	F	-	-	-
8706	F	-	-	-
8707	F	-	-	-
8708	F	-	-	-
8800	F	-	-	-
8801	F	-	-	-
8802	F	-	-	-
9701	F	25.83	23.32	-
9702	F	26.11	23.53	2.58
9703	F	27.54	26.7	0.84

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

APPENDIX G: Proposed Drainage Strategy



LEGEND:

- Site Boundary
- Existing AW foul water public sewer
- Existing AW foul water public manhole
- Private surface water drain
- Surface water distribution box
- Private surface water inspection chamber
- Flow control manhole
- Porous block paving road / driveway
- Private foul water drain
- FW MH — Private foul water manhole
- Adoptable foul water drain
- FW MH — Adoptable foul water manhole
- Sewer Easement
- Existing Ditch
- Exceedance Flow Route

NOTES:

1. This drawing is to be read in conjunction with all other Architect's, Engineer's and Specialist's drawings, specifications and documentation as part of the design package of information.
2. All private drainage works are to be constructed in accordance with the Building Regulations Approved Document H : 2015.

DRAINAGE NOTES - GENERAL

1. Connections to the existing public sewers shall be subject to the approval of the Sewerage Undertaker and shall be carried out by a contractor approved by them. The contractor shall comply with the requirements of the Sewerage Undertaker with regards to submitting method statements, risk assessments etc for obtaining a 'permit to work' on the existing sewer.
2. Where possible orientation of manhole access covers to be orthogonal with adjacent kerb line.
3. Manhole covers to be set flush with binder course on new road construction and raised to final levels when surface course is laid at later date.
4. All cement and concrete products used in foul and surface water sewers to be sulphate resisting.
5. All pipes entering or leaving manholes shall be laid with their soffits level, unless shown or agreed otherwise.
6. Gully connections to be 150mm Dia at a gradient no flatter than 1 in 150 unless stated otherwise.
7. All private connections to adopted foul and surface water sewers to be made with either VC or concrete pipes.

PRIVATE DRAINAGE NOTES

1. All private foul and storm water sewers shall be 100/110mm dia clayware or PVC unless stated otherwise. Storm sewers shall be laid at a gradient no flatter than 1 in 100, and foul sewers to a gradient no flatter than 1 in 80 unless stated otherwise on the drawings. Private foul drains without a WC connected shall be laid to a gradient no flatter than 1 in 40.
2. All private connections to adopted foul and surface water sewers to be made with either VC or concrete pipes.
3. The private foul and storm water drainage shall be subject to inspections by the local building control officer. The contractor shall liaise with the building inspector with regard to making inspections at the appropriate stages of the work.

Protection To Private Sewers:-

4. Type S bedding to be used in non-trafficked areas.
5. Type S bedding to be used in trafficked areas where the cover to the crown of the sewer is greater than or equal to 900mm.
6. Concrete Pipe Surround (Type Z) to be used in trafficked areas where the cover to the crown of the sewer is less than 900mm.

ADOPTABLE DRAINAGE NOTES

1. All adoptable drainage to be installed/constructed to 'Sewers for Adoption 6th Edition' standards and in accordance with the Sewerage Undertaker's additions and deletions document.
2. Where drainage is to be adopted, manhole covers are to be permanently and visibly badged with the Sewerage Undertaker's logo and the lettering 'SW' for surface water and 'FW' for foul water.

PROTECTION TO ADOPTABLE SEWERS:-

3. Type S bedding to be used in non-trafficked areas, where the cover to crown is greater than or equal to 900mm.
4. Type S bedding to be used in trafficked areas where the cover to the crown of the sewer is greater than or equal to 1200mm.
5. Concrete Slab Protection (Type Z1) to be provided in trafficked areas where the cover to the crown of the sewer is less than 1200mm and in non-trafficked areas where the cover to crown is less than 900mm.

P2	Revised to reflect fixed Architects Layout	12/12/19	-	MC
P1	First issue.	09/09/19	-	MC
Rev	Description	Date	Chk	Apr

Project No:	Scale @ A1:	Drawn By:
111666	1:200	MC

Ingleton Wood
Property and Construction Consultants
Issuing offices: Cambridge
T: 01223 965200
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Vision, form and function

Project:
53 Boxworth Road,
Elsworth
Cambridgeshire
Essex

Client:
Solopark

Title:
Proposed Drainage Strategy

Drawing Number:
111666- IW -XX-XX-DR-C-SK1

Status:	Purpose of Issue:	Revision:
S2	For Planning	P2

APPENDIX H: Surface Water Network Micro-Drainage Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.450	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.103	4-8	0.066

Total Area Contributing (ha) = 0.169

Total Pipe Volume (m³) = 1.108

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	9.210	0.522	17.6	0.169	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	26.076	0.460	56.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	27.389	0.183	149.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

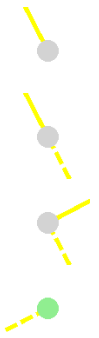
Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.06	25.300	0.169	0.0	0.0	0.0	2.41	42.6	22.9
1.001	50.00	5.39	24.778	0.169	0.0	0.0	0.0	1.34	23.7	22.9
1.002	50.00	5.95	24.318	0.169	0.0	0.0	0.0	0.82	14.5«	22.9

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	26.000	0.700	Open Manhole	1200	1.000	25.300	150				
2	26.000	1.222	Open Manhole	1200	1.001	24.778	150	1.000	24.778	150	
3	24.920	0.602	Open Manhole	1200	1.002	24.318	150	1.001	24.318	150	
Ex Ditch	24.570	0.435	Open Manhole	0		OUTFALL		1.002	24.135	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	532035.029	263825.945	532035.029	263825.945	Required	
2	532030.812	263834.133	532030.812	263834.133	Required	
3	532018.872	263857.320	532018.872	263857.320	Required	
Ex Ditch	532043.138	263870.022			No Entry	



PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	1	26.000	25.300	0.550	Open Manhole	1200
1.001	o	150	2	26.000	24.778	1.072	Open Manhole	1200
1.002	o	150	3	24.920	24.318	0.452	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	9.210	17.6	2	26.000	24.778	1.072	Open Manhole	1200
1.001	26.076	56.7	3	24.920	24.318	0.452	Open Manhole	1200
1.002	27.389	149.7	Ex Ditch	24.570	24.135	0.285	Open Manhole	0

Setting Out Information - True Coordinates (Storm)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Layout (North)
1.000	1	1200		532035.029	263825.945	532035.029	263825.945	
1.001	2	1200		532030.812	263834.133	532030.812	263834.133	
1.002	3	1200		532018.872	263857.320	532018.872	263857.320	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
1.002	Ex Ditch	0		532043.138	263870.022	

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	1	150	0.550	1.072	Unclassified	1200	0	0.550	Unclassified
1.001	2	150	0.452	1.072	Unclassified	1200	0	1.072	Unclassified
1.002	3	150	0.285	0.452	Unclassified	1200	0	0.452	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002	Ex Ditch	24.570	24.135	24.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	40.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.450		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 2, DS/PN: 1.001, Volume (m³): 1.5

Unit Reference	MD-SHE-0052-1100-0800-1100
Design Head (m)	0.800
Design Flow (l/s)	1.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	52
Invert Level (m)	24.778
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	1.1	Kick-Flo®	0.462	0.9
Flush-Flo™	0.229	1.0	Mean Flow over Head Range	-	0.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	0.800	1.1	2.000	1.7	4.000	2.3	7.000	3.0
0.200	1.0	1.000	1.2	2.200	1.7	4.500	2.4	7.500	3.1
0.300	1.0	1.200	1.3	2.400	1.8	5.000	2.5	8.000	3.2
0.400	1.0	1.400	1.4	2.600	1.9	5.500	2.6	8.500	3.2
0.500	0.9	1.600	1.5	3.000	2.0	6.000	2.8	9.000	3.3
0.600	1.0	1.800	1.6	3.500	2.1	6.500	2.9	9.500	3.4

Storage Structures for Storm

Porous Car Park Manhole: 1, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	25.0
Membrane Percolation (mm/hr)	1000	Length (m)	27.5
Max Percolation (l/s)	191.0	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	25.250	Membrane Depth (mm)	0

Manhole Headloss for Storm

PN	US/MH Name	US/MH Headloss
1.000	1	0.500
1.001	2	0.500
1.002	3	0.500

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.000
Region	England and Wales	Ratio R	0.450
Cv (Summer)	0.750		
Cv (Winter)	0.840		

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	1	360 Winter	1	+0%					25.390	-0.060	0.000
1.001	2	720 Winter	1	+0%	1/15 Summer				25.406	0.478	0.000
1.002	3	2160 Winter	1	+0%					24.345	-0.123	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.06		2.4	OK	
1.001	2	0.05		1.0	SURCHARGED	
1.002	3	0.08		1.0	OK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.450	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.103	4-8	0.066

Total Area Contributing (ha) = 0.169

Total Pipe Volume (m³) = 1.108

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	9.210	0.522	17.6	0.169	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	26.076	0.460	56.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	27.389	0.183	149.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

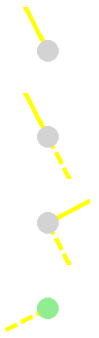
Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.06	25.300	0.169	0.0	0.0	0.0	2.41	42.6	22.9
1.001	50.00	5.39	24.778	0.169	0.0	0.0	0.0	1.34	23.7	22.9
1.002	50.00	5.95	24.318	0.169	0.0	0.0	0.0	0.82	14.5«	22.9

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	26.000	0.700	Open Manhole	1200	1.000	25.300	150				
2	26.000	1.222	Open Manhole	1200	1.001	24.778	150	1.000	24.778	150	
3	24.920	0.602	Open Manhole	1200	1.002	24.318	150	1.001	24.318	150	
Ex Ditch	24.570	0.435	Open Manhole	0		OUTFALL		1.002	24.135	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	532035.029	263825.945	532035.029	263825.945	Required	
2	532030.812	263834.133	532030.812	263834.133	Required	
3	532018.872	263857.320	532018.872	263857.320	Required	
Ex Ditch	532043.138	263870.022			No Entry	



PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	1	26.000	25.300	0.550	Open Manhole	1200
1.001	o	150	2	26.000	24.778	1.072	Open Manhole	1200
1.002	o	150	3	24.920	24.318	0.452	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	9.210	17.6	2	26.000	24.778	1.072	Open Manhole	1200
1.001	26.076	56.7	3	24.920	24.318	0.452	Open Manhole	1200
1.002	27.389	149.7	Ex Ditch	24.570	24.135	0.285	Open Manhole	0

Setting Out Information - True Coordinates (Storm)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Layout (North)
1.000	1	1200		532035.029	263825.945	532035.029	263825.945	
1.001	2	1200		532030.812	263834.133	532030.812	263834.133	
1.002	3	1200		532018.872	263857.320	532018.872	263857.320	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
1.002	Ex Ditch	0		532043.138	263870.022	

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	1	150	0.550	1.072	Unclassified	1200	0	0.550	Unclassified
1.001	2	150	0.452	1.072	Unclassified	1200	0	1.072	Unclassified
1.002	3	150	0.285	0.452	Unclassified	1200	0	0.452	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002	Ex Ditch	24.570	24.135	24.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	40.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.450		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 2, DS/PN: 1.001, Volume (m³): 1.5

Unit Reference	MD-SHE-0052-1100-0800-1100
Design Head (m)	0.800
Design Flow (l/s)	1.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	52
Invert Level (m)	24.778
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	1.1	Kick-Flo®	0.462	0.9
Flush-Flo™	0.229	1.0	Mean Flow over Head Range	-	0.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	0.800	1.1	2.000	1.7	4.000	2.3	7.000	3.0
0.200	1.0	1.000	1.2	2.200	1.7	4.500	2.4	7.500	3.1
0.300	1.0	1.200	1.3	2.400	1.8	5.000	2.5	8.000	3.2
0.400	1.0	1.400	1.4	2.600	1.9	5.500	2.6	8.500	3.2
0.500	0.9	1.600	1.5	3.000	2.0	6.000	2.8	9.000	3.3
0.600	1.0	1.800	1.6	3.500	2.1	6.500	2.9	9.500	3.4

Storage Structures for Storm

Porous Car Park Manhole: 1, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	25.0
Membrane Percolation (mm/hr)	1000	Length (m)	27.5
Max Percolation (l/s)	191.0	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	25.250	Membrane Depth (mm)	0

Manhole Headloss for Storm

PN	US/MH Name	US/MH Headloss
1.000	1	0.500
1.001	2	0.500
1.002	3	0.500

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.000	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.450	Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	1	480 Winter	30	+0%	30/30 Summer				25.604	0.154	0.000
1.001	2	600 Winter	30	+0%	30/15 Summer				25.616	0.688	0.000
1.002	3	480 Winter	30	+0%					24.346	-0.122	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.06		2.2	SURCHARGED	
1.001	2	0.05		1.1	SURCHARGED	
1.002	3	0.08		1.1	OK	

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	40
Ratio R	0.450	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.103	4-8	0.066

Total Area Contributing (ha) = 0.169

Total Pipe Volume (m³) = 1.108

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	9.210	0.522	17.6	0.169	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	26.076	0.460	56.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	27.389	0.183	149.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.06	25.300	0.169	0.0	0.0	9.2	2.41	42.6	32.0
1.001	50.00	5.39	24.778	0.169	0.0	0.0	9.2	1.34	23.7«	32.0
1.002	50.00	5.95	24.318	0.169	0.0	0.0	9.2	0.82	14.5«	32.0

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	26.000	0.700	Open Manhole	1200	1.000	25.300	150				
2	26.000	1.222	Open Manhole	1200	1.001	24.778	150	1.000	24.778	150	
3	24.920	0.602	Open Manhole	1200	1.002	24.318	150	1.001	24.318	150	
Ex Ditch	24.570	0.435	Open Manhole	0		OUTFALL		1.002	24.135	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	532035.029	263825.945	532035.029	263825.945	Required	
2	532030.812	263834.133	532030.812	263834.133	Required	
3	532018.872	263857.320	532018.872	263857.320	Required	
Ex Ditch	532043.138	263870.022			No Entry	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	1	26.000	25.300	0.550	Open Manhole	1200
1.001	o	150	2	26.000	24.778	1.072	Open Manhole	1200
1.002	o	150	3	24.920	24.318	0.452	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	9.210	17.6	2	26.000	24.778	1.072	Open Manhole	1200
1.001	26.076	56.7	3	24.920	24.318	0.452	Open Manhole	1200
1.002	27.389	149.7	Ex Ditch	24.570	24.135	0.285	Open Manhole	0

Setting Out Information - True Coordinates (Storm)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Layout (North)
1.000	1	1200		532035.029	263825.945	532035.029	263825.945	
1.001	2	1200		532030.812	263834.133	532030.812	263834.133	
1.002	3	1200		532018.872	263857.320	532018.872	263857.320	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
1.002	Ex Ditch	0		532043.138	263870.022	

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	1	150	0.550	1.072	Unclassified	1200	0	0.550	Unclassified
1.001	2	150	0.452	1.072	Unclassified	1200	0	1.072	Unclassified
1.002	3	150	0.285	0.452	Unclassified	1200	0	0.452	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002	Ex Ditch	24.570	24.135	24.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	40.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.450		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 2, DS/PN: 1.001, Volume (m³): 1.5

Unit Reference	MD-SHE-0052-1100-0800-1100
Design Head (m)	0.800
Design Flow (l/s)	1.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	52
Invert Level (m)	24.778
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	1.1	Kick-Flo®	0.462	0.9
Flush-Flo™	0.229	1.0	Mean Flow over Head Range	-	0.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	0.800	1.1	2.000	1.7	4.000	2.3	7.000	3.0
0.200	1.0	1.000	1.2	2.200	1.7	4.500	2.4	7.500	3.1
0.300	1.0	1.200	1.3	2.400	1.8	5.000	2.5	8.000	3.2
0.400	1.0	1.400	1.4	2.600	1.9	5.500	2.6	8.500	3.2
0.500	0.9	1.600	1.5	3.000	2.0	6.000	2.8	9.000	3.3
0.600	1.0	1.800	1.6	3.500	2.1	6.500	2.9	9.500	3.4

Storage Structures for Storm

Porous Car Park Manhole: 1, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	25.0
Membrane Percolation (mm/hr)	1000	Length (m)	27.5
Max Percolation (l/s)	191.0	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	25.250	Membrane Depth (mm)	0

Manhole Headloss for Storm

PN	US/MH Name	US/MH Headloss
1.000	1	0.500
1.001	2	0.500
1.002	3	0.500

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.000	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.450	Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	1	600 Winter	100	+40%	100/15 Summer				25.948	0.498
1.001	2	720 Winter	100	+40%	100/15 Summer	100/600 Winter			25.963	1.035
1.002	3	600 Winter	100	+40%					24.349	-0.119

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.08		2.9	FLOOD RISK	
1.001	2	0.000	0.06		1.3	FLOOD RISK	
1.002	3	0.000	0.09		1.3	OK	

APPENDIX J: Foul Water Network Micro-drainage Calculations

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FOUL SEWERAGE DESIGN

Design Criteria for Foul - Main

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Flow Per Person (l/per/day)	222.00	Maximum Backdrop Height (m)	1.500
Persons per House	3.00	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

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Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	17.331	0.156	111.0	0.000	4	0.0	1.500	o	100	Pipe/Conduit	
1.001	22.885	0.206	111.0	0.000	3	0.0	1.500	o	100	Pipe/Conduit	
1.002	6.362	0.057	111.0	0.000	3	0.0	1.500	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	25.000	0.000	0.0	4	0.0	14	0.29	0.63	5.0	0.2
1.001	24.844	0.000	0.0	7	0.0	18	0.35	0.63	5.0	0.3
1.002	24.588	0.000	0.0	10	0.0	19	0.37	0.83	14.7	0.5

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Manhole Schedules for Foul - Main

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
2	26.000	1.000	Open Manhole	1200	1.000	25.000	100				
2	26.000	1.156	Open Manhole	1200	1.001	24.844	100	1.000	24.844	100	
3	26.500	1.912	Open Manhole	1200	1.002	24.588	150	1.001	24.638	100	
	27.890	3.360	Open Manhole	150		OUTFALL		1.002	24.530	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
2	532027.159	263837.952	532027.159	263837.952	Required	
2	532035.093	263822.544	532035.093	263822.544	Required	
3	532047.715	263803.455	532047.715	263803.455	Required	
	532049.772	263797.435			No Entry	

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PIPELINE SCHEDULES for Foul - Main

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	100	2	26.000	25.000	0.900	Open Manhole	1200
1.001	o	100	2	26.000	24.844	1.056	Open Manhole	1200
1.002	o	150	3	26.500	24.588	1.762	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	17.331	111.0	2	26.000	24.844	1.056	Open Manhole	1200
1.001	22.885	111.0	3	26.500	24.638	1.762	Open Manhole	1200
1.002	6.362	111.0		27.890	24.530	3.210	Open Manhole	150

Setting Out Information - True Coordinates (Foul - Main)

PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Layout (North)
1.000	2	1200		532027.159	263837.952	532027.159	263837.952	
1.001	2	1200		532035.093	263822.544	532035.093	263822.544	
1.002	3	1200		532047.715	263803.455	532047.715	263803.455	

PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)
1.002		150		532049.772	263797.435	

Network Classifications for Foul - Main

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	2	100	0.900	1.056	Unclassified	1200	0	0.900	Unclassified
1.001	2	100	1.056	1.762	Unclassified	1200	0	1.056	Unclassified
1.002	3	150	1.762	3.210	Unclassified	1200	0	1.762	Unclassified

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002		27.890	24.530	24.530	150	0

Simulation Criteria for Foul - Main

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	0	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	0.000	Storm Duration (mins)	30
Ratio R	0.000		