

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

Studley Solar Farm

Land at Studley Farm
Atworth
Melksham
Wiltshire

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Prepared by: Rosie Wagstaff

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1 INTRODUCTION

Background

- 1.1 RMA Environmental Limited was commissioned by Melksham Calne Green Limited to prepare a Flood Risk Assessment (FRA) to discharge Condition 10 for a full planning application (Wiltshire Council planning application reference: PL/2021/08690) for a proposed solar farm and battery storage facility ("the proposed development") on land at Studley Farm in Atworth, near Melksham, Wiltshire ("the site").
- 1.2 For ease of reference, the wording of Condition 10 is as follows:
- "No development shall commence on site until a scheme for the discharge of surface water from the site/phase, including sustainable drainage systems and all third party approvals, has been submitted to and approved in writing by the Local Planning Authority in consultation with the Lead Local Flood Authority.*
- *Details should include swale design and operation for the lifetime of the development.*
 - *Details should also include:*
 - *Evidence that the drainage system can accommodate any predicted flood volumes in addition to additional runoff from the site during a 100 year + CC event.*
 - *Calculations with MADD factor of zero for any drainage related to the associated infrastructure buildings/access".*
- 1.3 The drainage strategy for the BESS area is being undertaken by others and will be provided at a later stage.
- 1.4 This FRA has been prepared in accordance with the National Planning Policy Framework (NPPF), associated Planning Practice Guidance (PPG) and Environment Agency (EA) standing advice on flood risk for new development.

Site Location and Land Use

- 1.5 The site comprises greenfield land which is currently in agricultural use; it extends to an area of approximately 33 hectares (ha) (35 ha including cable route) and is located at National Grid Reference ST 86890 65435 (refer to Figure 1.1).
- 1.6 The site is bordered by the following land-uses:
- agricultural land surrounds the site;
 - Studley Farm is located in the centre beyond the site boundaries;
 - Atworth and Bath Road (A365) is located to the north of the site;
 - Broughton Gifford is located to the south-east of the site;
 - Solar farm development is located to the south-east of the site;
 - Coombe Lane is located to the south of the site; and

- Bradford Road is located to the west of the site.
- 1.7 Access to the site is via Studley Farm Lane leading to Bath Road. Further details on site topography, geology and hydrology are set out in Section 2.

Proposed Development

- 1.8 The proposed development comprises the installation of a solar farm and battery storage facility with associated infrastructure. The operational lifetime of the proposed development is 40 years.
- 1.9 The metal framework that supports the solar panels would be fixed into the ground by posts, which would be pile-driven into the ground to a suitable depth based on site ground conditions.
- 1.10 The solar panels would utilise a fixed tilt system, facing south with a tilt of 15-30 degrees. At their lower edge panels would be approximately 0.8 m from the ground and up to approximately 2.49 m at their higher edge.
- 1.11 The site would be accessed via the existing access point via Studley Farm Lane to the north. This access route would be used during both the construction and operational phases.

Requirements for a Flood Risk Assessment

- 1.12 The requirements for FRA are provided in the NPPF and associated PPG. Footnote 63 in Paragraph 181 of the NPPF (December 2024) requires that a site-specific FRA should be submitted with planning applications for:
- all sites greater than 1 ha in Flood Zone 1;
 - for sites of any size within Flood Zones 2 or 3;
 - in an area within Flood Zone 1 which has critical drainage problems;
 - in an area within Flood Zone 1 which is identified in a strategic flood risk assessment as being at increased flood risk in the future; and/or
 - an area within Flood Zone 1 that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.
- 1.13 The EA's Flood Zones are defined as follows:
- Flood Zone 1 is defined as land with little or no flood risk (an annual exceedance probability [AEP] of flooding of less than 0.1%);
 - Flood Zone 2 is defined as having a medium flood risk (an AEP of between 0.1% and 0.5% for tidal areas or 0.1% and 1.0% for rivers); and
 - Flood Zone 3 is defined as high risk (with an AEP of greater than 0.5% for tidal areas or greater than 1.0% for rivers).

- 1.14 The EA's Surface Water Risk and Risk of Flooding from Rivers and Sea Extents are defined as follows:
- Very low surface water flood risk is defined the area has less than 1 in 1000 (0.1%) chance of flooding in any given year;
 - Low surface water flood risk is defined where the area has less than 1 in 100 (1%) but greater than or equal to 1 in 1000 (0.1%) chance of flooding in any given year;
 - Medium surface water flood risk is defined where this area has less than 1 in 30 (3.3%) but greater than or equal to 1 in 100 (1%) and 1 in 30 (3.3%) chance of flooding in any given year; and
 - High surface water flood risk is defined where this area has greater than or equal to 1 in 30 (3.3%) chance of flooding in any given year.
- 1.15 FRAs should describe and assess all flood risks (from rivers, the sea, surface water, sewers, reservoirs and groundwater) to and from the development and demonstrate how they will be managed, including an evaluation of climate change effects.

2 BASELINE ENVIRONMENTAL CONDITIONS

Topography

- 2.1 A site-specific topographical survey has been undertaken which indicates that the eastern part of the site generally slopes in a south-easterly direction (refer to Appendix A). The north-western part of the site slopes in a north-easterly direction towards the watercourse along the northern boundary and in an easterly direction towards the watercourse beyond the site boundaries near the centre of the site. The south-western part of the site slopes in northerly and southerly directions towards a number of low points.
- 2.2 The highest surveyed ground level is 63.41 metres Above Ordnance Datum (mAOD) along Studley Farm Lane in the northern part of the site, falling to the lowest level of 51.22 mAOD in the south-eastern corner of the site.
- 2.3 The topographical survey does not include the underground cable route. Light Detection and Ranging (LiDAR) data shows that the ground levels for this route ranges between 43.1 mAOD and 67.9 mAOD.

Hydrology

- 2.4 A 'main river'¹ and a number of 'ordinary watercourses'² are located within and surrounding the site (refer to Figure 2.1).
- 2.5 South Brook flows underneath Corsham Road along the underground cable route and flows in an easterly direction into the River Avon approximately 2.7 km to the south-east. This watercourse is classified by the EA as a 'main river' approximately 550 m to the north of the site (near Applecroft Farm) and is classified as an 'ordinary watercourse' upstream of this point. This watercourse has a catchment area of approximately 8.6 km² at the site location.
- 2.6 An unnamed 'ordinary watercourse' (hereafter referred to as South Brook Tributary) is located in the north-eastern part of the site along the underground cable route. At the site location, South Brook Tributary has a small catchment area of approximately 0.7 km² and flows in a southerly direction into South Brook approximately 760 m to the east of the site.
- 2.7 An unnamed 'ordinary watercourse' (hereafter referred to as Bradford Brook) flows along part of the northern boundary of the site before reissuing a short distance beyond the site boundaries, to the south. At the site location, Bradford Brook has a small catchment area of approximately 0.8 km² and flows in a south-easterly direction into River Avon approximately 2.6 km to the south-east.

¹ Main river is defined by the EA as any watercourse that contributes significantly to the hydrology of a catchment.

² Ordinary watercourse is defined by the EA as any watercourse including every river, stream, ditch, drain, cut, dyke, sluice, sewer (other than a public sewer) and passage through which water flows and which does not form part of a main river.

- 2.8 An unnamed 'ordinary watercourse' (hereafter referred to as Newhouse Brook) is located approximately 355 m to the south-west of the site. At the nearest location to the site, Newhouse Brook has a small catchment area of approximately 0.9 km² and flows in a south-easterly direction into other unnamed 'ordinary watercourses' approximately 1.2 km to the south-west of the site.
- 2.9 An unnamed 'ordinary watercourse' (hereafter referred to as Oak Brook) is located approximately 520 m to the east of the site. At the nearest location to the site, Oak Brook has a small catchment area of approximately 0.9 km² and flows in a south-easterly direction into Bradford Brook approximately 1.4 km to the east of the site.
- 2.10 A number of ponds are identified on Ordnance Survey (OS) mapping along the site boundaries however, these ponds are not identified on the topographical survey which may be due to dense vegetation.
- 2.11 There are no other significant watercourses or water bodies within the surrounding area.

Geology and Hydrogeology

- 2.12 When reviewing the British Geological Survey (BGS) online map viewer, the majority of the site is not underlain by any superficial geology however, the north-eastern part of the underground cable route is underlain by the superficial geology River Terrace Deposits comprising sand and gravel.
- 2.13 The majority of the site is underlain by the bedrock geology of the Kellaways Formation comprising sandstone, siltstone and mudstone. A few isolated areas along the western boundary and along Studley Farm Lane are underlain by the bedrock geology of the Cornbrash Formation comprising limestone. Areas along the underground cable route are underlain by the bedrock geology of the Oxford Clay Formation comprising mudstone.
- 2.14 The EA classify the Kellaways Formation and the Oxford Clay Formation as Unproductive Strata; these are defined as *"rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow"*.
- 2.15 The EA classify the River Terrace Deposits and the Cornbrash Formation as Secondary A Aquifers; these are defined as *"permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers."*
- 2.16 The site is not located within a groundwater Source Protection Zone (SPZ).

3 EXTERNAL FLOOD RISK

Flooding Mechanisms

- 3.1 Part of the cable route is located within Flood Zones 2 and 3 and at risk of other sources of flooding (i.e. surface water, groundwater and sewer flooding). The underground cabling will be constructed of flood resistant materials and would not be adversely affected by groundwater flooding. Given that the cable route is underground and follows the road network, there is no potential for an adverse impact within the site or an increase in flood risk for people and property in the vicinity of the site or the site itself. Therefore, the cable route is not discussed further.
- 3.2 The Environment Agency's (EA's) flood map for planning (refer to Figure 3.1) indicates that the majority of the site is located within Flood Zone 1 (low risk) except part of the cable route which is located within Flood Zones 2 and 3 (medium and high risk respectively).
- 3.3 The EA's risk of flooding from surface water mapping identifies that the majority of the site has a very low risk of flooding from surface water; however, a number of areas have up to a high surface water flood risk during the current and future scenarios (refer to Figures 3.2 and 3.3). This is discussed further below.
- 3.4 The Wiltshire Council Level 1 Strategic Flood Risk Assessment (SFRA; JBA Consulting, 2019) indicates that the majority of the site has '*no risk*' of groundwater flooding, except a number of isolated areas along the western boundary and Studley Farm Lane have '*groundwater levels between 0.025 m and 0.5 m below the ground surface*'. This risk is discussed further below.
- 3.5 A review of the SFRA and EA flood maps, has identified that there are no other significant sources of flooding at the site, i.e. from sewers or reservoirs.

Historic Flooding

- 3.6 The SFRA (JBA Consulting, 2019) has been reviewed to identify any records of flooding at or in close proximity to the application site. This identified that the SFRA did not contain any historic flood records for the site or surrounding area.
- 3.7 The EA's recorded flood extents indicate that there are no historic flood records for the site or surrounding area.
- 3.8 The EIA Screening Opinion indicates that '*there is evidence of risk of surface water flooding on the two southwest fields of the wider site*'. However, no further information has been provided and the surface water flood risk within the site is discussed further below.

Fluvial Flood Risk

- 3.9 The risk of flooding from river and seas (RoFRS) map published in January 2024 indicates that the majority of the site is located outside of the flood extents and a small section along the cable route has up to a medium risk (refer to Figure 3.4). Therefore, this mapping suggests that the majority of the site is located in Flood Zone 1 and a small section along the cable route is located in Flood Zones 2 and 3.
- 3.10 The EA's latest 2024 mapping for RoFRS with climate change shows the surface water flood extents with the climate change for the central allowance (for the years 2040 to 2069). The majority of the site is free from flooding however, a small section along the cable route has up to a high risk during the climate change scenario (refer to Figure 3.5).
- 3.11 The SFRA (JBA Consulting, 2019) indicates that the solar arrays and other associated infrastructure are located outside of the 1.0% AEP plus 35% climate change (CC) and the 1% AEP plus 70% CC flood extents.
- 3.12 The operational lifetime of the development is 40 years and, therefore, the climate allowances for the 2040 to 2069 timescale is appropriate. Based on this operational timescale, the latest guidance on climate change states that for 'essential infrastructure' development within the Avon Bristol and North Somerset Streams Management Catchment, climate change could increase river flows by 19% for the higher central allowance.
- 3.13 Additionally, the climate change extent within the SFRA (JBA, Consulting, 2019) is greater than the appropriate climate change allowance required for the development and, therefore, the solar arrays and the other associated infrastructure are considered to be located within Flood Zone 1 for the lifetime of the development.

Surface Water Flood Risk

- 3.14 The EA's Risk of Flooding from Surface Water mapping (refer to Figures 3.2 and 3.3) shows that the majority of the site has a very low surface water flood risk; however, a number of areas throughout the site have a low, medium or high risk of surface water flooding during the current and future scenarios.
- 3.15 The EA's mapping shows what *"happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead."* It is noted that this type of flooding is difficult to predict and was based on the best information available to the EA regarding ground levels and drainage.
- 3.16 Areas of low, medium and high risk areas are located within the vicinity of the Bradford Brook and are considered to be related to the fluvial flooding of this watercourse during the current scenario and with climate change. The EA's surface water flood mapping is considered appropriate to assess the fluvial flooding from the ordinary watercourses due to the small catchment sizes.
- 3.17 During the current scenario and with climate change, a surface water flow pathway with up to a high surface water flood risk is located in the south-western part of the site. This surface water pathway flows in a south-westerly direction into the Newhouse Brook.

- 3.18 There is a surface water flow pathway in the south-eastern part of the site with up to a high surface water flood risk which flow in a south-easterly direction into the Oak Brook during the current scenario and with climate change.
- 3.19 There are areas of isolated ponding of surface water with up to a high surface water flood risk throughout the site during the current scenario and with climate change.
- 3.20 The proposed development area has up to a medium risk of the flood depths up to 0.3 m during the climate change scenario (refer to Figure 3.6). It is noted that the areas with a higher risk of flooding to 0.3 m are located along the field boundaries or in the vicinity of Bradford Brook.

Groundwater Flooding

- 3.21 The Wiltshire Council Level 1 Strategic Flood Risk Assessment (SFRA; JBA Consulting, 2019) indicates that the majority of the site has '*no risk*' of groundwater flooding, except a number of isolated areas along the western boundary and Studley Farm Lane have '*groundwater levels between 0.025 m and 0.5 m below the ground surface*'. The isolated areas potentially at risk of groundwater flooding is related to the Secondary A Aquifer present in these areas.
- 3.22 The Soakaway Test Report undertaken by Ruddlesden Geotechnical (2021) indicates that groundwater was encountered at a depth of 3.35 metres below ground level (mbgl) in one of the trial pits (refer to Appendix B).
- 3.23 According to a borehole record adjacent to Studley Farm Lane within the Cornbrash Formation, groundwater was encountered to a maximum depth of 2.1 mbgl (BGS Reference: ST86NE119).
- 3.24 There are no records of groundwater flooding in the vicinity of the site and the development does not propose any ground lowering; therefore, the likelihood of groundwater flooding impacting the proposed development is considered to be low.

Mitigation Measures

Design Levels

- 3.25 A sequential approach has been taken in the layout whereby the most vulnerable parts of the development will be located in the areas at lowest risk of flooding. In particular, the battery storage facility, substation and inverter stations will be located outside of the surface water flood extents with climate change.
- 3.26 Solar arrays will be located within the surface water flood extent with climate change where the estimated depths are shallow. The EA's surface water with climate change flood depth map indicates a maximum flood depth of up to 300 mm in the area of the panels; however, the flood depths for the vast majority of the site are significantly less. The solar panels will be elevated on framework at least 0.8 m above ground level and, therefore, the panels are raised above the surface water flood depths with additional freeboard.

- 3.27 With the above mitigation measures, the proposed development would remain operational in all modelled flood events and would not increase flood risk within the site or elsewhere.

Floodplain Compensation

- 3.28 Solar arrays have only been located within areas at risk of flooding where the depth is below the level of the solar panels, i.e. where only the framework would be inundated and, therefore, flow would not be impeded and the displacement of floodplain storage would be negligible. As such, it is not considered necessary to provide floodplain compensation.
- 3.29 The battery storage area, substation and inverter stations are located outside of the low surface water flood event and, therefore, these structures would not displace any floodplain storage or impede any surface water flow paths.
- 3.30 As such, it is concluded that the proposed development will not result in a significant increase in flood risk elsewhere.

Safe Access/Egress

- 3.31 Access/egress to the site would be via Studley Farm Lane to the north. This access/egress route is located partially within the low surface water flood extent.
- 3.32 During the surface water flood event with climate change, isolated areas along the access/egress route have up to a high risk of flood depths up to 0.6 m (refer to Figure 3.6). In accordance with FD2320/TR2³, the hazard rating for this route would be classified as a 'danger for some' and a 'danger for most' depending on the velocity.
- 3.33 A 'danger for some' is defined as a danger for children, the elderly and disabled people. A 'danger for most' is defined as a danger for the general public.
- 3.34 It is anticipated that personnel will only be on-site during the construction and decommissioning phases of the proposed development and for occasional maintenance visits twice a month once construction has been completed. There will be no other personnel present at the site for the majority of the operational lifetime of the development.
- 3.35 The developer and maintenance contractor would sign up to the EA's flood warning service for the local area, where available. This would ensure that all personnel would have sufficient time to leave the site or reschedule their planned visits.
- 3.36 On this basis, it is concluded that future occupants of the development would be safe during the design flood event for the operational lifetime of the development.

Land Use Vulnerability

- 3.37 Annex 3 of the NPPF sets out a schedule of land uses based on their vulnerability or sensitivity to flooding. Solar farms are considered as being 'essential infrastructure' to flooding. Referring to Table 2 of the NPPF PPG, all land uses are considered appropriate within Flood Zone 1.

³Framework and Guidance for Assessing and Managing Flood Risk for New Development

- 3.38 Therefore, on the basis of land use vulnerability, the development should be deemed appropriate in planning policy terms in its proposed location.

Other Considerations

Maintenance Buffers

- 3.39 A minimum of 6 m buffer for the 'ordinary watercourses' will be provided from the top of bank to the proposed development in order to ensure access for maintenance.
- 3.40 Where planting is proposed in the maintenance buffers, this will be in the form of grassland that would not prohibit access to the watercourses.

4 DRAINAGE ASSESSMENT

Introduction

- 4.1 This drainage strategy has been prepared in accordance with Defra's *"Non-statutory technical standards for sustainable drainage systems"* (March 2015) to ensure that the proposed development does not increase flood risk to the site or elsewhere and where practicable reduces flood risk over the lifetime of the development.
- 4.2 Surface water arising from a developed site should, as far as is practicable, be managed to mimic the surface water flows arising from the site prior to the proposed development while reducing the flood risk to the site itself and elsewhere.
- 4.3 The surface water drainage strategy has been prepared in association with Pitman Associates and is provided in Appendix C.

Drainage Strategy

Solar Arrays

- 4.4 The surface water drainage strategy has been based on the research report "Hydrologic Response of Solar Farms" (Cook and McCuen, 2013) published in the Journal of Hydrologic Engineering. It should be noted that the report states *"this study, along with design recommendations, can be used as a guide for the future design of solar farms"*. The report provides robust evidence that SuDS are not required to manage solar farm surface water runoff.
- 4.5 Cook and McCuen (2013) demonstrates that the solar panels and their metal framework do not have a significant effect on runoff volumes, peaks or time to peak if grass cover is located underneath panels and between rows. The study concludes that this is true for the 2 year, 25 year and 100 year events for a range of storm durations.
- 4.6 The report also notes that although the panels could concentrate runoff onto the ground, this only has the potential to cause erosion if it falls directly onto bare ground or a gravel surface.
- 4.7 On this basis, it is concluded that solar farms only significantly change the hydrologic response if gravel is placed under panels or if patchy or bare ground is created between rows. Therefore, the proposed planting framework discussed below will maintain the current hydrological response of the site and will not increase flood risk elsewhere.
- 4.8 The research report also investigated the effects of ground slope on the solar farm. It considers the differences in the hydrological response between a slope of 1% (i.e. 1 in 100) and 5% (i.e. 1 in 20). The report concluded that the *'greater ground slope did not significantly influence the response of the solar farm'*.

- 4.9 The proposed development will result in a reduction in runoff rates and improved water quality of runoff due to the absence of typical farming activities such as ploughing and soil compaction by heavy machinery.
- 4.10 The current arable use, comprising ploughed fields, gives rise to poor vegetation cover and bare ground following harvesting, resulting in increased runoff and erosion. It is considered that with the proposed planting framework discussed below, there is likely to be a reduction in surface water runoff and erosion.
- 4.11 Operational vehicle trips will include approximately two maintenance visits per month, typically with a transit style van and, therefore, the risk from erosion by vehicle traffic is low.

Proposed Planting Framework Mitigation

- 4.12 The Landscape and Ecology Management Plan (LEMP) outlines the proposed planting framework and enhancement to the quality of grass cover. The LEMP states that the site will be permanently vegetated with modified grassland located beneath the solar arrays and between rows.
- 4.13 It is recommended that longer grass should be grown along field boundaries and watercourses where practicable, which will provide a further betterment to surface water runoff and erosion.
- 4.14 The proposed planting will reduce runoff, encourage interception, infiltration and evapotranspiration and provide water quality treatment before surface water enters the watercourses within and surrounding the site. The proposed planting will also provide sufficient mitigation against soil erosion.
- 4.15 Grass cover would be inspected and maintained at least twice a year or after periods of significant drought, which is considered an appropriate level of mitigation. It is recommended that during maintenance, any patchy grass or bare ground is re-seeded.
- 4.16 The increased interception, evapotranspiration and infiltration due to the proposed planting will provide a betterment on the existing runoff rates at the site and, therefore, will also provide a betterment in any future climate change scenarios.

Proposed Swales

- 4.17 Notwithstanding the above planting framework which is considered to provide sufficient mitigation, as a precautionary approach swales and attenuation basins have been included along the downslope boundaries throughout the site (refer to Appendix C).
- 4.18 The “Hydrologic Response of Solar Farms” report states that “*when comparing the pre-panelled to the panelled condition, the increase in runoff volume with the 6 hour storm was less than 1% regardless of the return period*” and that “*the trends in the hydrological response of the solar farms did not vary with storm duration*”.
- 4.19 As such, the swales and attenuation basins have been sized to accommodate a 1% increase in greenfield runoff volume for the 1 in 100 year event (refer to table of swale sizes in Appendix C).

- 4.20 Swales and attenuation basins will be located along the downslope boundaries and will intercept and store surface water runoff, promote evaporation and provide biodiversity benefits. For those sub-catchments where it is not possible to provide all storage in swales, additional storage will be provided in basins. It is recognised that infiltration rates might not be sufficient to discharge the entire volume retained within each swale and attenuation basin following major rainfall events. However, given the uncertainty as to whether or not there will be an increase in the rates and volume of runoff from the solar panels (and in recognition of the proposed planting framework), the below approach to replicate the existing sheet flow is considered appropriate, as dispersion by means of evapotranspiration is also feasible given the shallow depths of attenuation.
- 4.21 The swales and attenuation basins would have a maximum depth of 500 mm and side slopes of 1 in 3 (refer to DR-001, Appendix C). To prevent runoff passing along the swale and flowing from the low point at an uncontrolled rate, check dams along the swale (refer to DR-002, Appendix C). The re-profiled ground level on the lower side of swale will ensure any excess runoff is discharged as sheet flow. This will best replicate the existing sheet flow from the fields at greenfield rates.
- 4.22 Full details of the proposed swales are provided in Appendix C.

Inverter Stations

- 4.23 Inverter stations comprise a 30 m² plan area storage container sited on a granular sub-base with a plan area of 38.4 m² and a depth of 300 mm (refer to DR-004 in Appendix C). It is proposed to construct the sub-base above a permeable membrane and allow runoff to infiltrate into the ground as far as practicable. This will mimic the existing greenfield surface water runoff arising from the site and ensure that runoff rates are not increased post-development.
- 4.24 Any excess runoff will overflow the perimeter of the sub-base at rates approximating greenfield rates, which would be further intercepted by the swales. This approach is considered preferable to piped connections to watercourses given the small size and isolated distribution of the inverter stations.

Tracks and Roads

- 4.25 Internal tracks would be required to facilitate vehicle movement around the site for construction and maintenance purposes. The proposed development will utilise the existing access tracks where possible to minimise the extent of new tracks required.
- 4.26 All proposed access roads will be constructed of a permeable material; therefore, there would be no increase in runoff from these areas. The tracks will be formed of MOT type 3 (or equivalent material with at least 30% void ratio and low fines content) which will provide a permeable surface, whilst also offering a significant storage volume greater than that of the existing soil structure.
- 4.27 This will mimic the existing greenfield runoff from these areas of the site and, as such, it is not considered necessary to provide further drainage mitigation for these surfaces. Over time, it is likely that the tracks will become vegetated due to low usage.

Water Quality Treatment

- 4.28 Water quality treatment will be provided for surface water runoff from the solar arrays, inverter stations and access roads.
- 4.29 In this instance, mitigation with an index or combined indices of more than 0.2 for Total Suspended Solids (TSS), 0.2 for metals and 0.05 for hydrocarbons is acceptable for the solar arrays as the pollution hazard level would be very low. The proposed grassland beneath the panels will meet the water quality requirements required for the proposed development. It is considered that the proposed grassland will provide a similar level of treatment to a filter strip.
- 4.30 Mitigation with an index or combined indices of more than 0.3 for TSS, 0.2 for metals and 0.05 for hydrocarbons is acceptable for the other aspects of the development as the pollution hazard level would be low. The granular sub-base beneath the inverter stations and the permeable access tracks will meet the water quality requirements. It is considered that the granular material in the sub-base will provide a similar level of treatment to permeable paving.

Construction

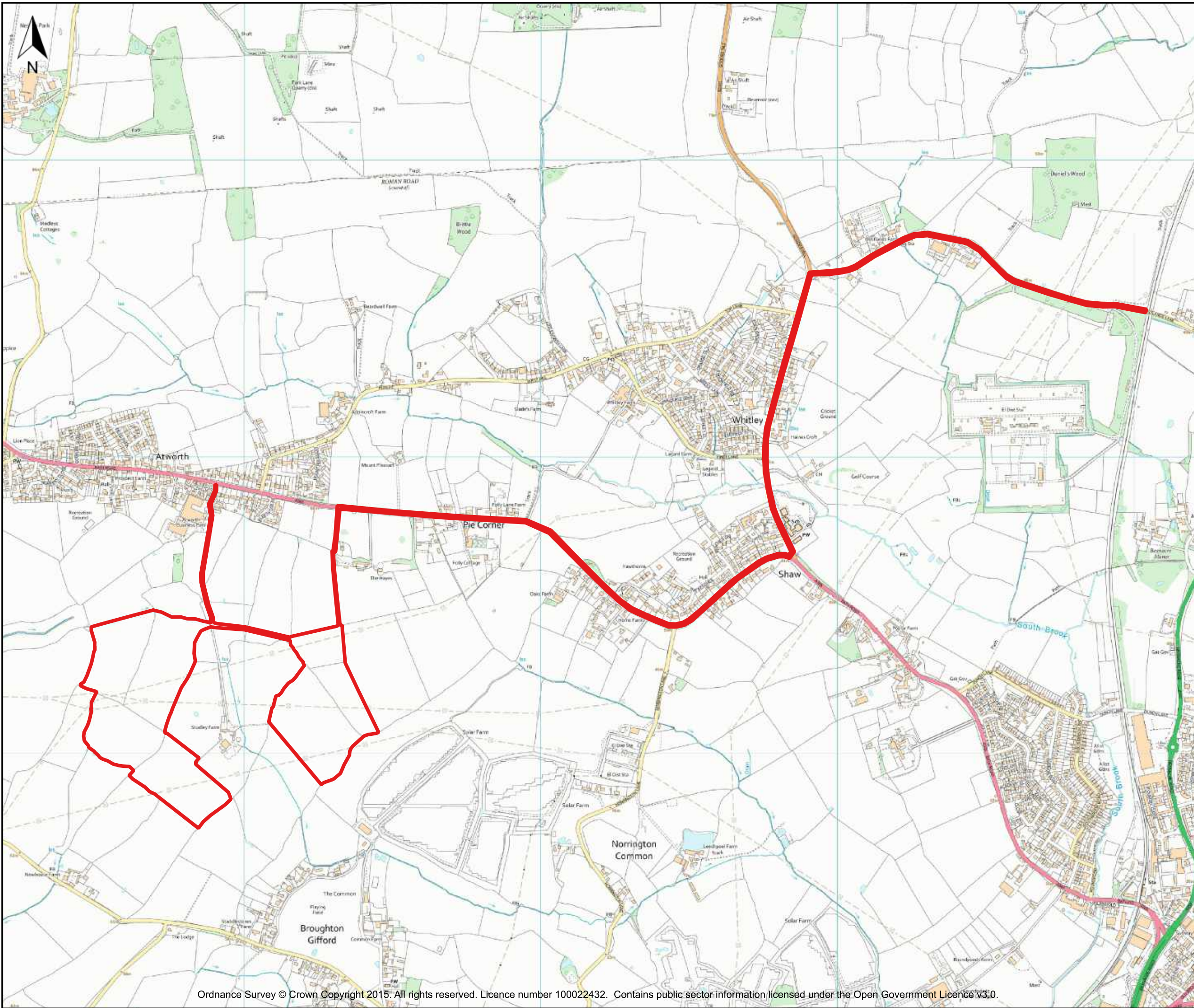
- 4.31 Good construction practices will be undertaken to ensure that no adverse impacts on surface water or groundwater quality occur during the construction phase.
- 4.32 The internal access roads will be completed during initial construction stage so temporary haul routes are unnecessary.
- 4.33 Construction vehicles will be properly maintained to reduce the risk of hydrocarbon contamination and will only be active when required. Construction materials will be stored, handled and managed with due regard to the sensitivity of the local aquatic environment and thus the risk of accidental spillage or release will be minimised.
- 4.34 The cable trenches will be backfilled with the excavated material to maintain the characteristics of the ground.
- 4.35 It is possible that construction could give rise to some ground compaction; however, it is considered that this would be no worse than other traditional farming practices which use heavier machinery.
- 4.36 During construction, it is recommended that vegetation disturbance should be minimised as much as possible and any bare ground resulting from construction should be re-seeded.

5 CONCLUSIONS

- 5.1 The requirements for Flood Risk Assessment are provided in the National Planning Policy Framework and its associated Planning Practice Guidance, together with the Environment Agency's Guidance Notes. This policy and associated guidance have been followed in the preparation of this FRA.
- 5.2 Part of the cable route is located within Flood Zones 2 and 3 and at risk of other sources of flooding. The underground cabling will be constructed of flood resistant materials and would not be adversely affected by groundwater flooding. Given that the cable route is underground and follows the road network, there is no potential for an adverse impact within the site or an increase in flood risk for people and property in the vicinity of the site or the site itself.
- 5.3 The EA's flood map for planning indicates that the site is located within Flood Zone 1 (low risk). The climate change extent within the SFRA is greater than the appropriate climate change allowances required for the development and, therefore, the proposed solar arrays are considered to be located within Flood Zone 1 for the lifetime of the development.
- 5.4 The EA's risk of flooding from surface water mapping identifies that the majority of the site has a very low risk of flooding from surface water and some areas have up to a high surface water flood risk during the current and future scenarios. The proposed development area has up to a medium risk of the flood depths up to 0.3 m during the climate change scenario. It is noted that the areas with a higher risk of flooding to 0.3 m are located along the field boundaries or in the vicinity of Bradford Brook.
- 5.5 The site is potentially at risk of flooding from groundwater; however, flood risk to the site from this source is considered to be low.
- 5.6 A sequential approach has been taken in the layout whereby the most vulnerable parts of the development will be located in the areas at lowest risk of flooding. In particular, the battery storage facility, substation and inverter stations will be located outside of the surface water flood extents with climate change.
- 5.7 Solar arrays will be located within the surface water flood extent with climate change where the estimates depths are shallow. The EA's surface water flood depth map indicates a maximum flood depth of approximately of up to 300 mm in the area of the panels; however, the flood depths for the vast majority of the site are significantly less. The solar panels will be elevated on framework at least 0.8 m above ground level and, therefore, the panels are raised above the surface water flood depths with additional freeboard.
- 5.8 Appropriate buffers will be provided from the top of the bank of the watercourses in order to ensure access for maintenance.

- 5.9 It is not considered necessary to provide SuDS for the proposed solar panel arrays. Cook and McCuen (2013) demonstrated that solar panels do not have a significant effect on runoff volumes, peaks or time to peak if grass cover is well maintained underneath panels and between rows. Therefore, it is proposed to implement a planting framework and maintain the grass cover to prevent areas of bare ground and erosion occurring.
- 5.10 Notwithstanding the proposed planting framework which is considered to provide sufficient mitigation, as a precautionary approach, swales and attenuation basins have been included along the downslope boundaries throughout the site.
- 5.11 Inverter stations containers will be sited on a granular sub-base with a plan area of 38.4 m² and a depth of 300 mm. The sub-base will allow runoff to percolate into the ground as far as practicable. Any excess runoff will overflow the perimeter of the sub-base at rates approximating greenfield rates, which would be further intercepted by the surplus volume provided in the swales.
- 5.12 All proposed roads and tracks will be constructed of a permeable material; therefore, there would be no increased runoff from these areas.
- 5.13 This FRA has therefore demonstrated that the proposed development will be safe and that it would not increase flood risk elsewhere. The proposed land use is classified as 'essential infrastructure' and is considered appropriate in relation to the flood risk vulnerability classifications set out in Table 3 of the NPPF. The development should therefore be considered acceptable in planning policy terms.

Figures



Key
Application Site

Figure 1.1: Site Location Plan

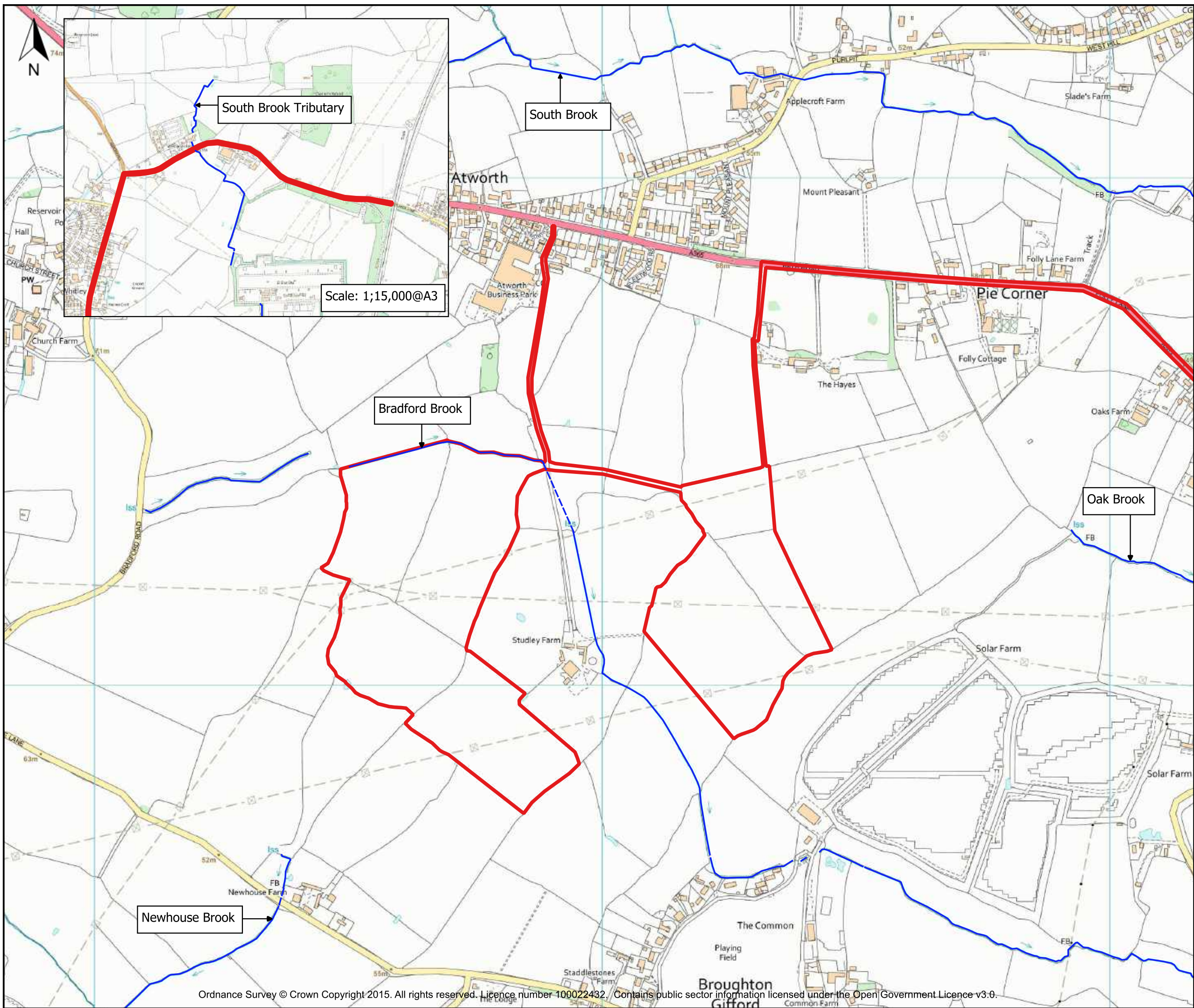
Client: **Melksham Calne Green Limited**

Project: **Studley Solar Farm**

Project No.: **C2788**



Drawn: RW	Checked: RM	Date: 11/03/2025	Scale: 1:12,000@A3
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Key

Application Site

Watercourse

Figure 2.1: **Watercourse Plan**

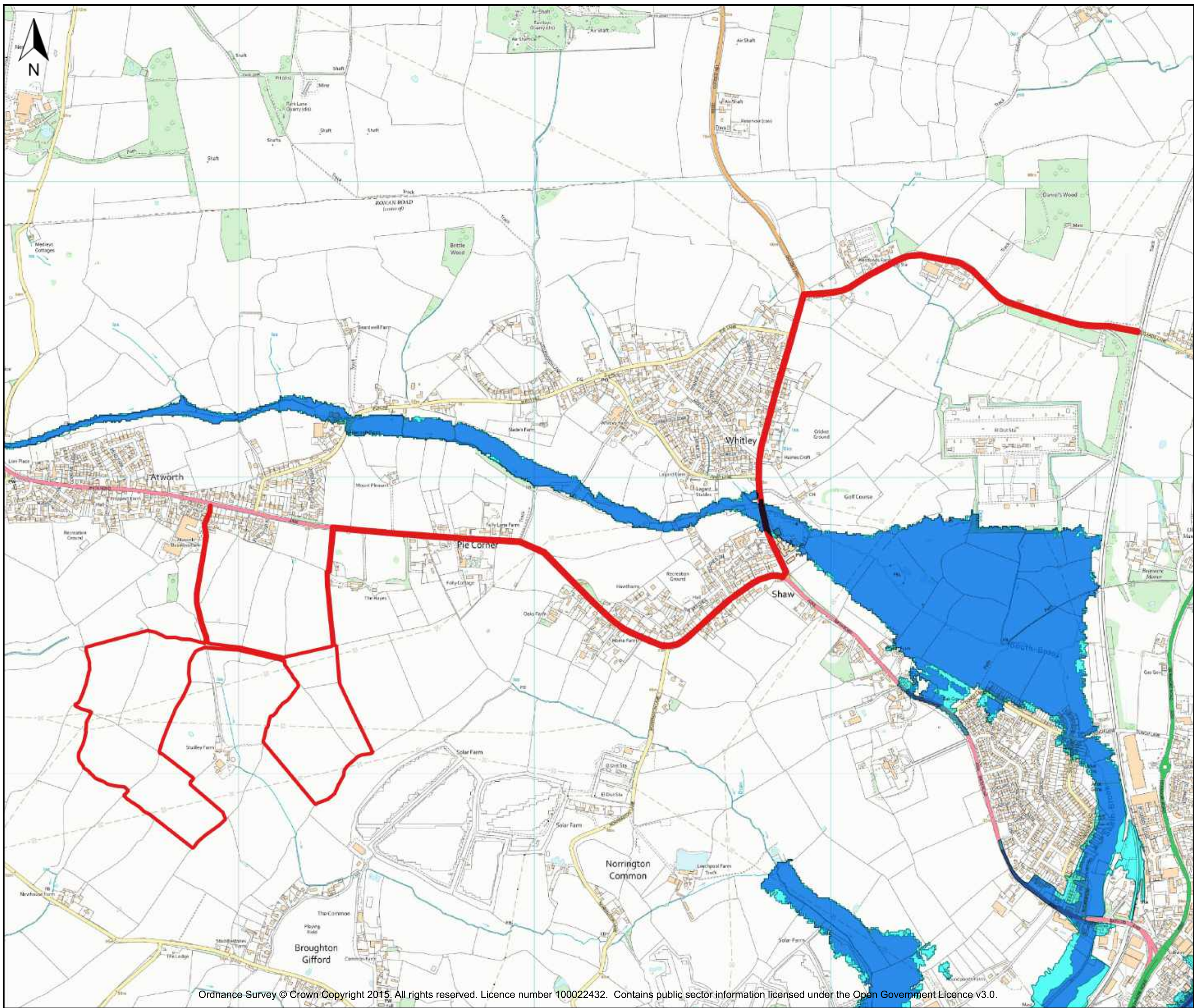
Client: **Melksham Calne Green Limited**

Project: **Studley Solar Farm**

Project No.: **C2788**

RMA
ENVIRONMENTAL

Drawn: RW	Checked: RM	Date: 11/03/2025	Scale: 1:7,000@A3
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Key

- Application Site
- Flood Zone 2
- Flood Zone 3

Figure 3.1: EA's Flood Map for Planning

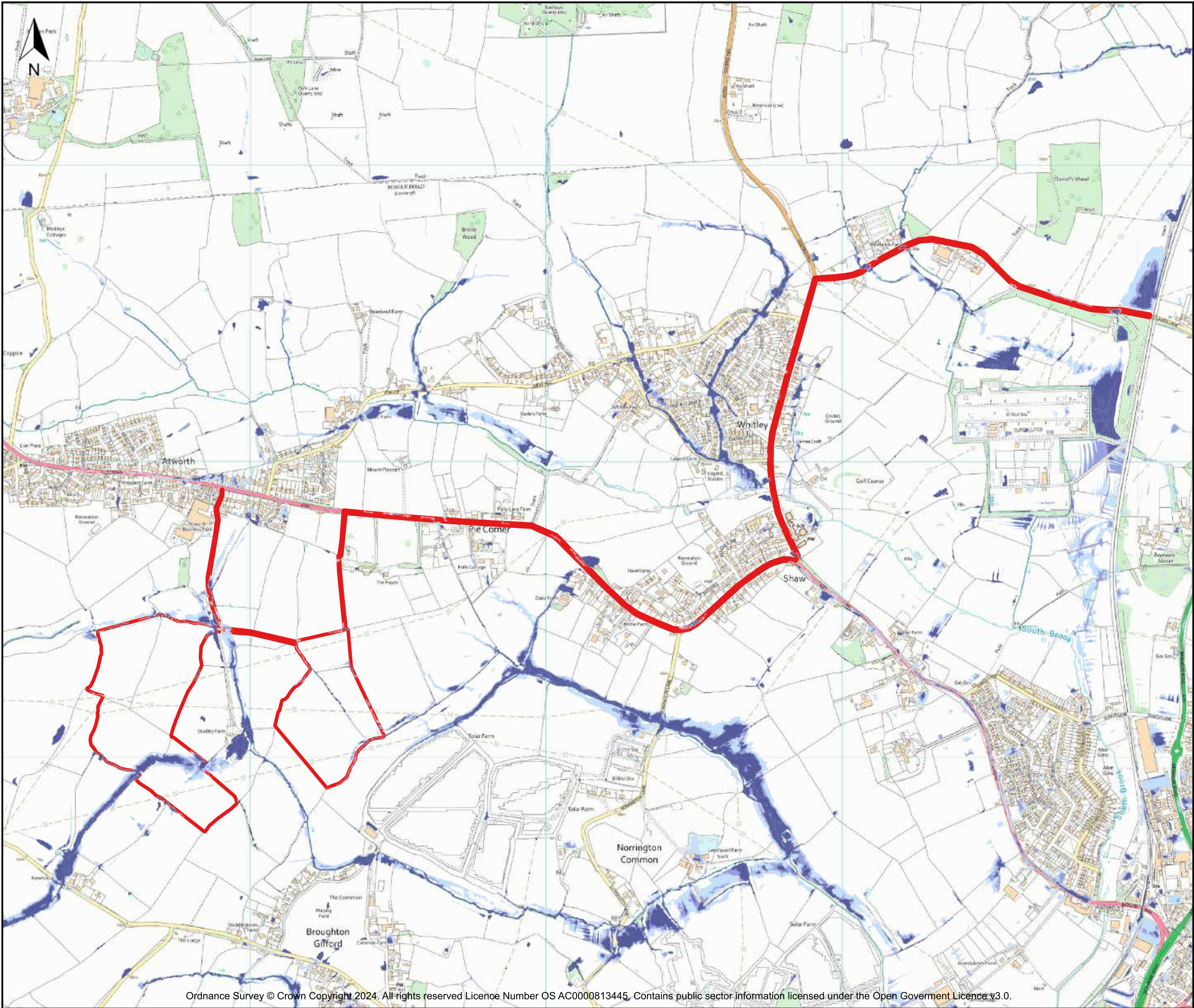
Client: **Melksham Calne Green Limited**

Project: **Studley Solar Farm**

Project No.: **C2788**



Drawn: RW	Checked: RM	Date: 11/03/2025	Scale: 1:12,000@A3
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Key

- Application Site
- Low Risk
- Medium Risk
- High Risk

Figure 3.2: EA's Surface Water Flood Map

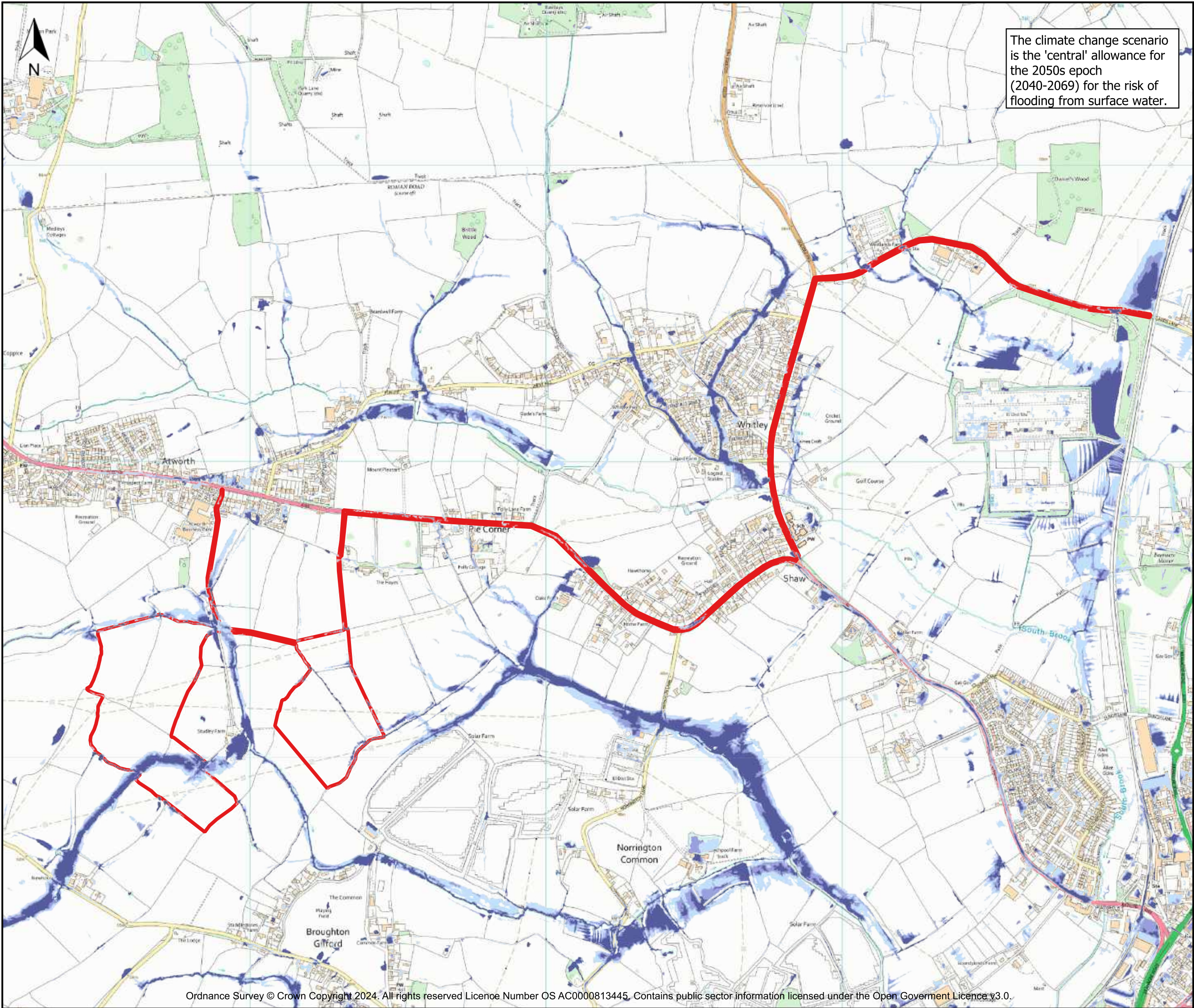
Client: **Melksham Calne Green Limited**

Project: **Studley Solar Farm**

Project No.: **C2788**



Drawn: RW	Checked: RM	Date: 11/03/25	Scale: 1:12,000@A3
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The climate change scenario is the 'central' allowance for the 2050s epoch (2040-2069) for the risk of flooding from surface water.

Key

- Application Site
- Low Risk
- Medium Risk
- High Risk

Figure 3.3: EA's Surface Water Flood with Climate Change Map

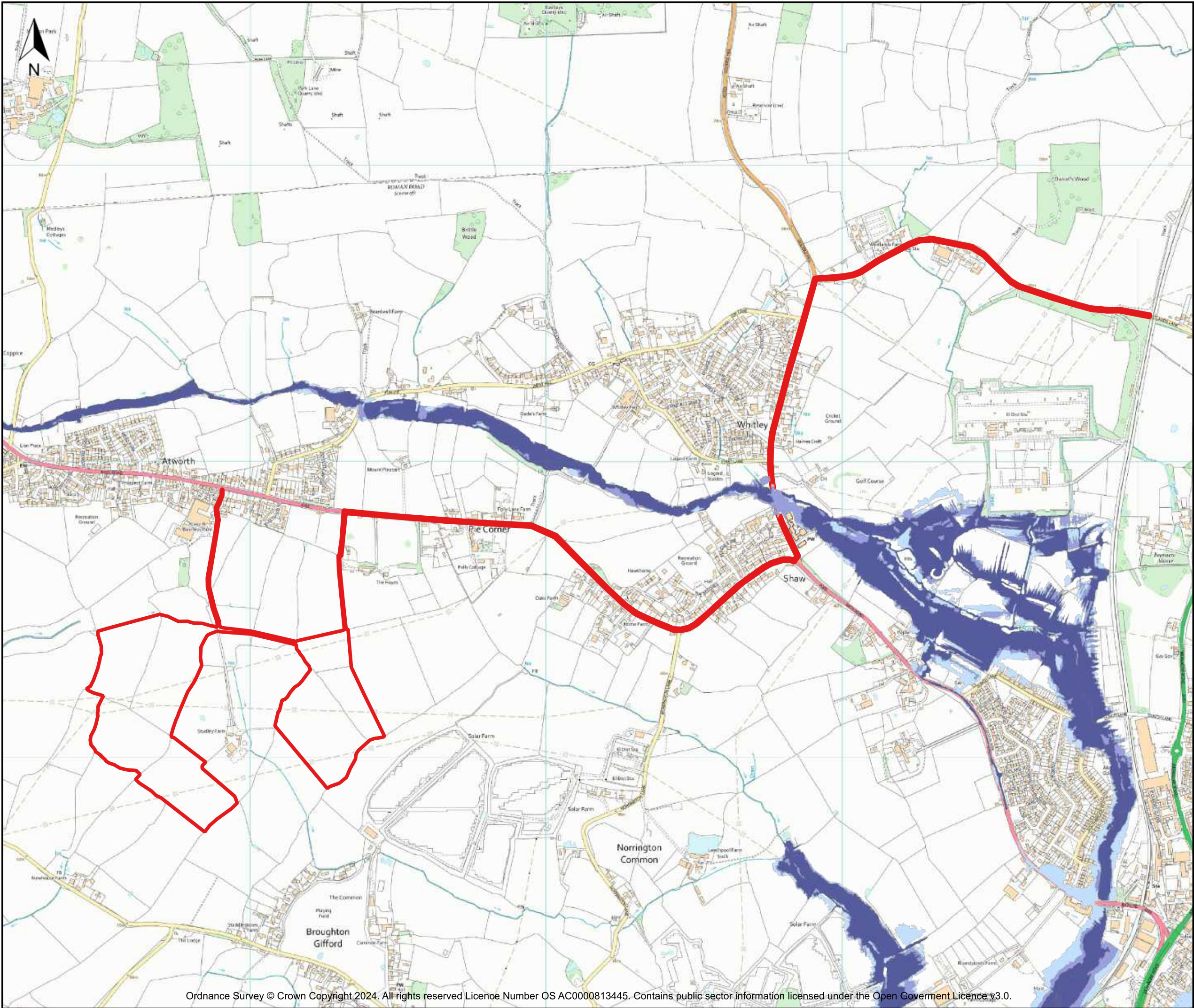
Client: Melksham Calne Green Limited

Project: Studley Solar Farm

Project No.: C2788



Drawn: RW	Checked: RM	Date: 11/03/25	Scale: 1:12,000@A3
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Key

Application Site

Very Low Risk

Low Risk

Medium Risk

High Risk

Figure 3.4: EA's Risk of Flooding from Rivers and Sea Map

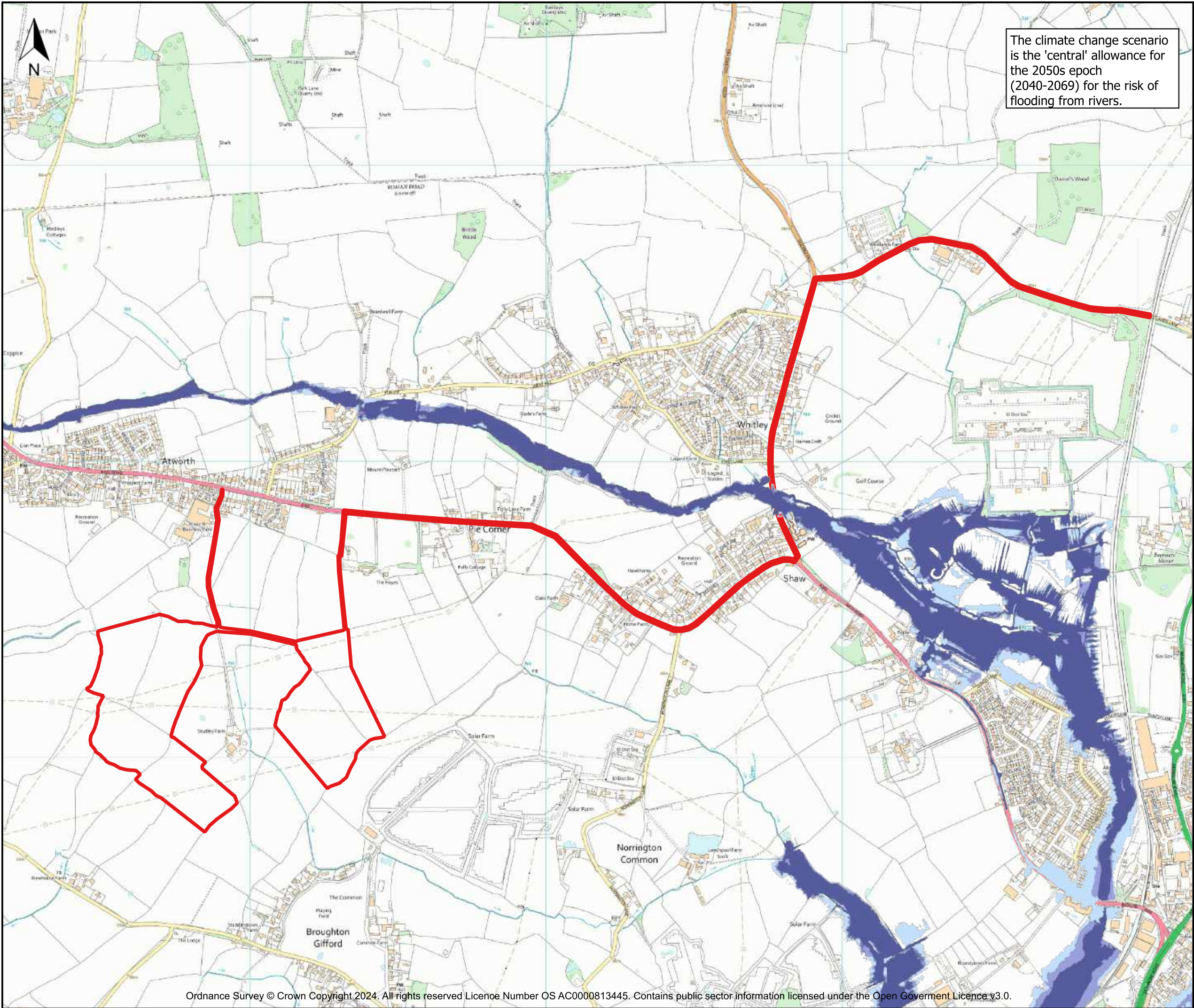
Client: Melksham Calne Green Limited

Project: Studley Solar Farm

Project No.: C2788



Drawn: RW	Checked: RM	Date: 11/03/25	Scale: 1:12,000@A3
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The climate change scenario is the 'central' allowance for the 2050s epoch (2040-2069) for the risk of flooding from rivers.

- Key**
- Application Site
 - Very Low Risk
 - Low Risk
 - Medium Risk
 - High Risk

Figure 3.5: EA's Risk of Flooding from Rivers and Sea with Climate Change Map

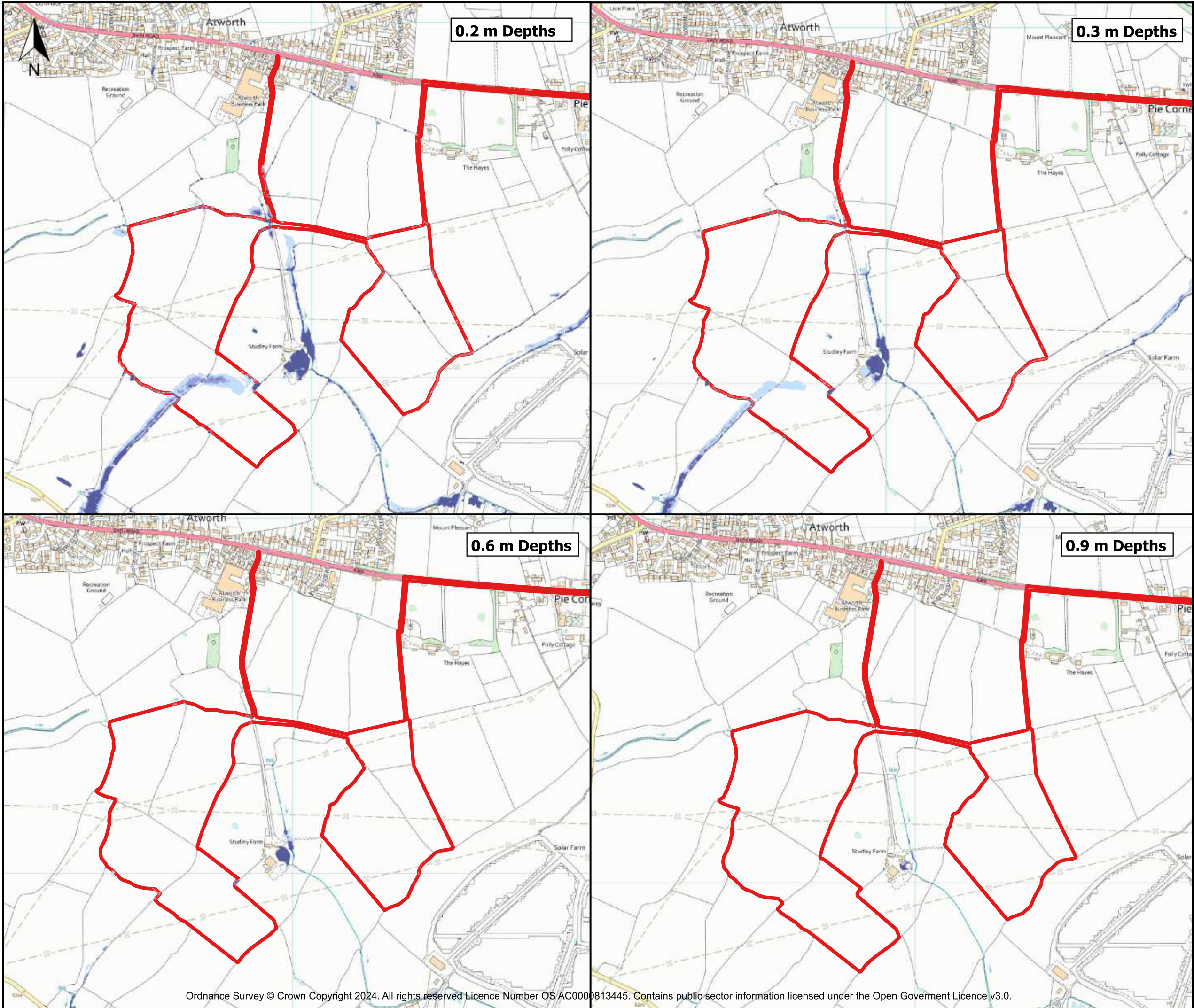
Client: **Melksham Calne Green Limited**

Project: **Studley Solar Farm**

Project No.: **C2788**



Drawn: RW	Checked: RM	Date: 11/03/25	Scale: 1:12,000@A3
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Key

- Application Site
- Low Risk
- Medium Risk
- High Risk

Figure 3.6: EA's Surface Water Flood with Climate Change Depth Map

Client: Melksham Calne Green Limited

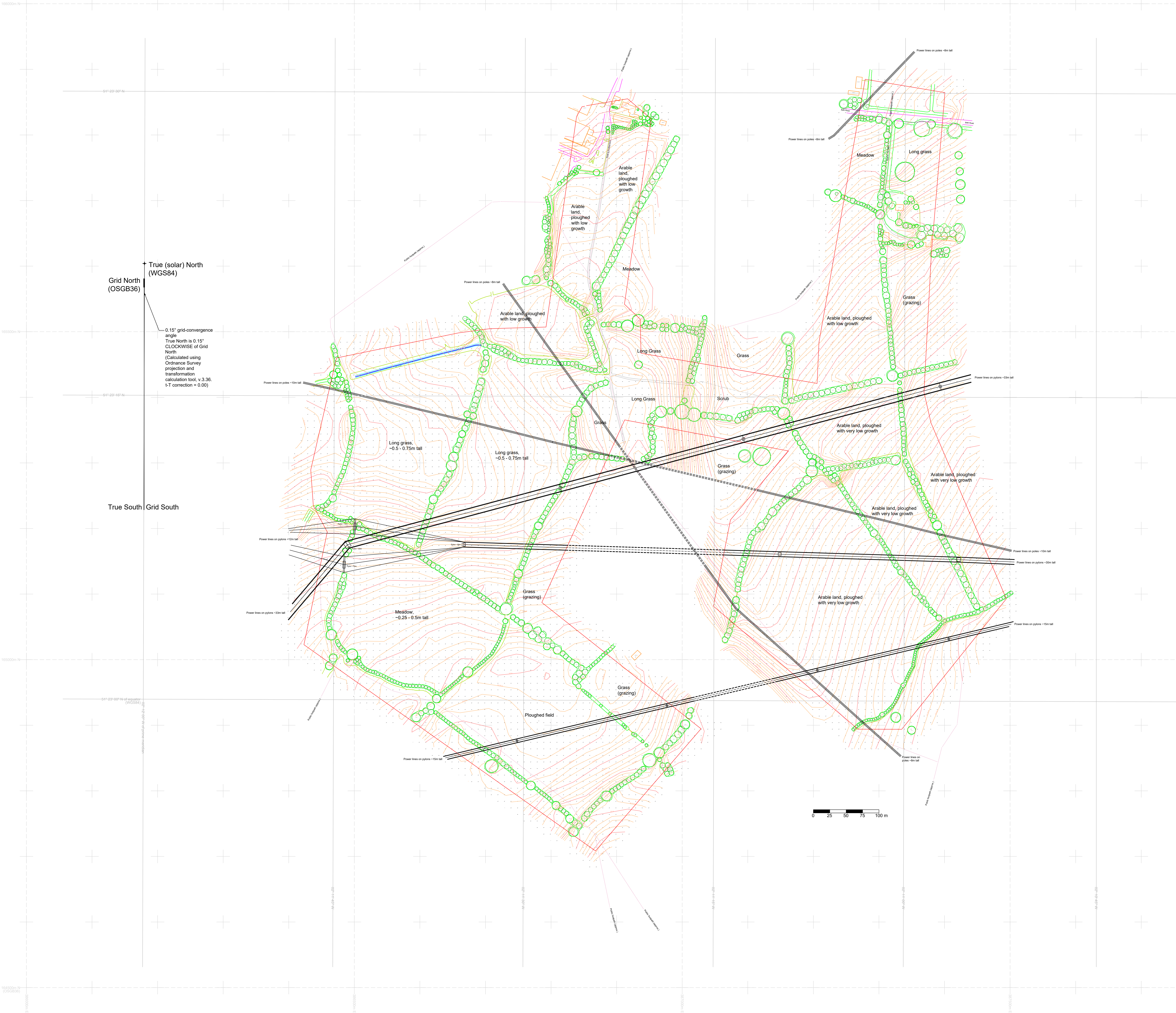
Project: Studley Solar Farm

Project No.: C2788

**RMA**
ENVIRONMENTAL

Drawn: RW	Checked: RM	Date: 11/03/25	Scale: 1:10,000@A3
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Appendix A: Topographical Survey



LEGEND

- Tree canopy/hedgerow/foilage. Heights where given are to nearest meter.¹
- Tree shapes for use in PVcase. **These do not represent exact tree locations**, but rather, entities which will be automatically recognised and converted to appropriate shading elements by PVcase. Areas of forest are therefore filled with trees of appropriate height. Height to nearest meter.¹
- Water (dashed for apparent drainage feature or approx. path)
- Sealed road
- Unsealed track
- Power-line (or other overhead line) with utility post
- Fence, gate
- Railway track
- Public footpath/bridleway
- Apparent field boundary (As seen from aerial survey. NOT official boundary.)
- UAV mapping boundary (approx.)
- Building or other permanent structure
- Stone wall

ELEVATIONS

- Elevation of point above vertical datum (see 'COORDINATE REFERENCE SYSTEM AND DATUM' at bottom).²
- Contours (0.25 m) of digital surface model (dashed when over areas of obvious crop or vegetation).^{3,4}

G.I.S. DATA

- 100m grid in OSGB36 map projection
- The specific lines of latitude and longitude which pass through the site are marked in degrees, minutes, seconds (WGS84).
- Grid North follows the direction of the North-South lines of the OSGB36 grid. True North follows lines of longitude, which converge on the axis of rotation of the Earth. True South points to the equator. The convergence angle (precision 2 d.p.) between Grid North and True North for this specific location is given. Magnetic North is not shown (but will be different again).

Third-party data

Site boundaries from client. Approx. public footpath routes from OS map.

NOTES

- Heights of hedgerows and dense trees are marked alongside the foliage. All tree/hedge heights given are approximate heights above nearby ground, based on the Digital Surface Model.
- It is important to note that this grid is from a Surface Model, not a Terrain Model, and therefore point-heights can only be interpreted as terrain when on areas of earth or hardstanding.
- Likewise, the Contours are surface contours, not terrain contours, so should be interpreted carefully. Where contours are obviously not on earth or hardstanding, they are dashed.
- Contours are generated from a subsampled (10m) terrain model to provide smooth but representative contour lines. Where contours cross trees, the path of the contour below the tree(s) is approximated.
- Lat./long. lines are precisely calculated, but should be considered approximate because they represent a spherical coordinate system on a map projection. Locations and dimensions are accurate in the underlying map projection. But conversion of coordinates from the map projection to lat./long. (if required) should be performed using the appropriate transformation, not by inference from this plot.
- Features hidden under dense vegetation (e.g. walls, fences) are only marked if visible from drone footage (or location otherwise provided or noted).

REVISIONS

1.0	12 June 2021	Published to client [TMH]

PROJECT

ENSO ENERGY - UAV SURFACE TOPOGRAPHY
Atworth Project in West Wiltshire, U.K.

TITLE

ATWORTH LINework ("CAD")

DETAILS

Enso Energy, Top Floor, The Priory, Dursley,
Gloucestershire, GL11 4HR (Simon Chamberlayne)



Above Surveying Ltd.
Block C2 Knowledge Gateway
Newfield Road,
Colchester, CO4 3ZL, U.K.
T: +44 1206 483043
E: support@abovesurveying.com

LOCATION

South-East of Atworth, West Wiltshire, SN12, U.K.

COORDINATE SYSTEM AND DATUM

OSGB36, British National Grid Map Projection (EPSG: 27700). Units: meters
Elevations relative to sea level as height in meters above Ordnance Datum Newlyn (ODN) (EPSG: 5101). Geoid model, OSGM15.

SCALE OF MAIN DRAWING:
1:2000 when printed 100% on A0
Do not scale from this plot. All dimensions to be checked on-site.

Appendix B: Soakaway Test Report (Ruddlesden Geotechnical, 2021)



Ruddlesden geotechnical

Soakaway Test Report



Land at Studley Farm, Atworth, Melksham,
Wiltshire

RMA Environmental

June 2021

MT/GD/SR/21264/STR

REPORT CONTROL SHEET

Site Address	Proposed Solar Farm at Studley Farm, Atworth, Melksham, Wiltshire
Client	RMA Environmental
Report Title	Soakaway Test Report
Issue Date	28 July 2021
Report No.	MT/GD/SR/21264/STR
Issue No.	2

Prepared by	Megan Trunks
Signature	
Position	Assistant Engineering Geologist
Qualifications	BSc. (Hons) FGS.

Checked by	Geoff Davis
Signature	
Position	Principal Engineering Geologist
Qualifications	BSc (Hons). MSc. CEng. MIMMM. MICE. CGeol. FGS

Approved by	Simon Ruddlesden
Signature	
Position	Director
Qualifications	BSc (Hons). MSc. DIC. CGeol. FGS. EurGeol.

Ruddlesden geotechnical
The Stables, 65 Langaton Lane,
Pinhoe, Exeter, EX1 3SP

01392 678082
mail@ruddlesden.co.uk
www.ruddlesden.co.uk



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1.3	Objectives	1
1.4	Scope of Investigation	1
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4	RESULTS OF THE INVESTIGATION	4
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4.2	Ground Conditions Encountered	4
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4.4	Soakaway Test Results	5
5	DISCUSSION OF RESULTS AND RECOMMENDATIONS	6
6	REFERENCES	7
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APPENDICES

APPENDIX A	TRIAL PIT LOGS (9 pages)
APPENDIX B	PHOTOGRAPHS (4 pages)
APPENDIX C	SOAKAWAY TEST RESULTS (18 pages)
APPENDIX D	SOAKAWAY TEST LOCATION PLAN (1 page)



1 INTRODUCTION

1.1 General

In June 2021, a soakaway test investigation was undertaken by Ruddlesden geotechnical on behalf of RMA Environmental at a proposed solar farm at Studley Farm, Atworth, Melksham, Wiltshire.

The investigation comprised the formation of six soakaway tests in accordance with BRE Digest 365.

1.2 Development Proposals

It is proposed to develop the site with the construction of a solar farm and associated infrastructure. The proposed layout is shown on the soakaway test location plan (Dwg. No. 21264/01, Appendix D).

1.3 Objectives

The investigation was undertaken to determine the permeability of the ground, to assess the suitability of the ground for soakaway drainage and, if suitable, to provide soil infiltration rates for design.

1.4 Scope of Investigation

The investigation covers aspects relating to soakaway drainage design. The scope of investigation comprised the following:

- undertake in-situ soakaway testing in accordance with BRE Digest 365;
- assess the suitability of the ground for soakaway drainage and/ or
- use the data obtained to provide soil infiltration rates.

1.5 Scope of Report

The report is presented as a description of the procedures employed and the data obtained. This is followed by a description of the ground conditions and soakaway test results. The final part of the report comprises a discussion of the results together with recommendations for soakaway drainage.



2 THE SITE

2.1 Site Location

The site is located at Studley Farm, Atworth, Melksham, Wiltshire. The British National Grid Reference of the centre of the site is 386928, 165162, and the postcode is SN12 8JN.

The site is located within a rural area, approximately 500m to the south of the village of Atworth. The surrounding topography is relatively flat, with very gentle hills; there is a small valley that runs through the site from the north to south.

Access to the site is gained via Studley Farm Lane, to the north.

2.2 Site Description

The site is irregular in shape, comprising two lobes on either side of Studley Farm Lane, covering approximately 33 hectares. The site slopes very gently down to the east, and gently down to the west, falling from a level of approximately 59mAOD in the east of the site and from a level of 57mAOD in the west of the site to a level of approximately 55mAOD in the centre of the site at the small valley (Plate 1).

The site comprises seven fields: four to the west of Studley Farm Lane (Plates 2-3); and three to the east of Studley Farm Lane (Plate 4). The western fields are currently used for livestock grazing. The eastern fields are currently used for arable farming.

The site is bordered on all sides by further fields. The boundaries of the site are mixed-species hedgerows with some deciduous trees. Around 100m to the northwest of Studley Farm, a pond is present with a water level at around 0.40m below ground level, which may reflect the groundwater conditions on site (Plate 5).

Photographs of the site are presented in Appendix B of this report.

2.3 Site Geology

The British Geological Survey (BGS) map of the area indicates the site to be underlain by the Jurassic Kellaways Formation, which is described as a grey mudstone which is commonly silty or sandy, with some calcareous siltstone and sandstone.

BGS mapping indicates the strata regionally to dip very gently down to the east.



3 FIELDWORK

3.1 General

All fieldwork was undertaken on 08 and 09 June 2021.

Six soakaway tests were undertaken in general accordance with BRE Digest 365: Soakaway Design. The approximate locations of the trial pits were determined by Pitman Associates Ltd, Consulting Engineers. The setting out of all the trial pits was the responsibility of Ruddlesden geotechnical.

A further three trial pits were excavated for use as groundwater observation pits.

Three of the trial pits, TPOBS 01, TP01 and TP04, had to be relocated to avoid local buried services.

Co-ordinates provided on the logs were obtained using a hand-held GPS device, typically accurate to 4m.

3.2 Soakaway Testing

The trial pits were excavated to a depth deemed sufficient to represent a section of the design soakaway. The vertical sides were trimmed square. A 1500-gallon water bowser was used to supply the large volumes of water required at a quick rate.

The pits were filled with water and allowed to drain. The fall in water level was recorded with time.

Trial pit logs and photographs, showing the ground conditions encountered, are presented in Appendix A and Appendix B, respectively. The soakaway testing results are presented in Appendix C, and a plan showing the soakaway test locations is presented in Appendix D.



4 RESULTS OF THE INVESTIGATION

4.1 General

The following sections provide a summary of the ground conditions encountered and the soakaway testing results. Further details are provided in the appendices of this report.

4.2 Ground Conditions Encountered

4.2.1 Topsoil

Topsoil was encountered to depths of between 0.20m and 0.25m below existing ground levels.

4.2.2 Natural Geology

Kellaways Formation

Beneath the topsoil, firm or stiff clay was encountered to the full depth of the trial pits, up to 3.80m below ground levels.

4.3 Groundwater

Groundwater was encountered at the following depths during the course of the investigation:

Table 4.1: Occurrence of Groundwater

Hole ID	Water Level (mBGL)	Rate of Inflow
TPOBS 03	3.35	Very slow (0.05m in 2.5 hours)



4.4 Soakaway Test Results

Full details of the soakaway testing results are provided in Appendix C of this report and are summarised in the table below:

Table 4.2: Summary of Soakaway Test Results

Test No.	Total Recorded Fall of Water Level (m)	Duration of Test (minutes)	Soil Infiltration Rate (m/s)
TP01	0.00	181	N/A*
TP02	0.02	297	N/A*
TP03	0.00	157	N/A*
TP04	0.00	154	N/A*
TP05	-0.02	320	N/A*
TP06	0.00	169	N/A*

* Test failed to reach 25% of the effective depth. No soil infiltration rate calculation possible.



5 DISCUSSION OF RESULTS AND RECOMMENDATIONS

Soakaways are proposed as a means of surface water drainage for the proposed solar farm at Studley Farm, Atworth. The proposed layout of the solar farm is shown on the soakaway test location plan (Appendix D of this report).

All of the tests failed to reach 75% of the effective depth, with only slight changes in the water levels recorded in some of the pits.

These results indicate that the ground has a relatively low permeability and is not suitable for the adoption of soakaway drainage.

Off-site discharge, possibly combined with on-site attenuation, is considered likely to be the most suitable drainage solution at this site.

It should be noted that, due to the low permeability of the ground, the observation pits are not likely to reflect the true groundwater conditions at the site. In clay terrains such as this, groundwater is typically found at shallow depth. The pond 100m to the northwest of Studley Farm, with a water level at around 0.40m below ground level, is likely to represent the true local groundwater level.



6 REFERENCES

- Building Research Establishment (2016): Digest 365: Soakaway Design.



7 LIMITATIONS, TERMS AND CONDITIONS

1. The comments given in this report assume that ground conditions do not vary beyond the range revealed by the investigation. There may, however, be conditions at or adjacent to the site that have not been disclosed by the investigation and which, therefore, have not been considered in this report. Accordingly, a careful watch should be maintained during any future groundworks and the recommendations of this report reviewed as necessary.
2. All comments and recommendations relating to groundwater are based on conditions encountered at the time of investigation. It should be noted that groundwater levels might fluctuate according to the season and from year to year. This may have implications on the recommendations made within this report. It should also be noted that observations of groundwater flowing into exploratory holes, whilst useful for giving recommendations on the practicalities of construction, may not accurately reflect the long-term groundwater pressures. The latter can only be fully understood through the installation of groundwater monitoring instruments.
3. All third-party data referred to in the report, e.g. geological information, has been obtained in good faith from bona-fide sources. Ruddlesden geotechnical Ltd cannot be held liable for any incorrect information supplied to us.
4. The location of exploratory holes was limited by the presence of underground services.
5. The presence of asbestos-containing materials (ACM) within buildings and invasive plants are outside the scope of this report and should be addressed by respective suitably qualified experts, if necessary.
6. The infiltration rates provided within this report are applicable to the locations and depths tested only.
7. The copyright of this report is owned by Ruddlesden geotechnical Ltd. With the exception of the named client, who may copy and distribute the report for purposes directly relating to its commission, this report may not be reproduced, published or adapted without written consent of Ruddlesden geotechnical Ltd.
8. Assignment of this report to any third party is prohibited without the written consent of Ruddlesden geotechnical Ltd.
9. New information and updated practices and legislation may necessitate an alteration to this report in whole or in part after its submission. Therefore, with any change in circumstances, including changes to site conditions, this report should be referred to Ruddlesden geotechnical Ltd for reassessment and, if necessary, reappraisal.
10. Whilst Ruddlesden geotechnical Ltd is confident in the findings of this report, the recommendations may not necessarily be accepted by other authorities without question. It is advisable that, where appropriate, the report be submitted to the relevant statutory authorities and approval obtained before detailed design, site works or other irrevocable action is undertaken.



APPENDICES



APPENDIX A

TRIAL PIT LOGS



Key to Trial Pit and Borehole Logs (Common Symbols)

Strata legend



Made Ground

Topsoil

Clay

Silt

Sand

Gravel

Peat

Composite soil types will be signified by combined symbols, e.g. silty sand



Chalk

Limestone

Coal

Mudstone

Siltstone

Sandstone

Fine grained igneous rock (e.g. basalt)

Medium grained igneous rock (e.g. granite)

Fine grained metamorphic rock (e.g. slate)

Groundwater



Groundwater strike



Standing groundwater level

Installations



Cement seal

Bentonite seal

Filter pack (slotted pipe)

Samples

D	Small disturbed sample
J	Small disturbed sample (amber glass jar)
B	Disturbed bulk sample
U100	Undisturbed sample (100mm diameter)
W	Water sample

Rotary drilling

TCR	Total core recovery (%)
SCR	Solid core recovery (%)
RQD	Rock quality designation (%)
FI	Fracture index (fractures/m)
NI	Non-intact

In-situ testing

SPT	Standard Penetration Test (split spoon sampler)
SPT(C)	Standard Penetration Test (solid cone)
V	Shear vane test
CBR	California Bearing Ratio

SPT results (examples)

30	N-Value (blows recorded for 300mm penetration, following 150mm seating drive)
50/125	50 blows for 125mm penetration

Field Identification and Description of Soils (Based on Table 7 of BS 5930: 2015 (+A1: 2020))

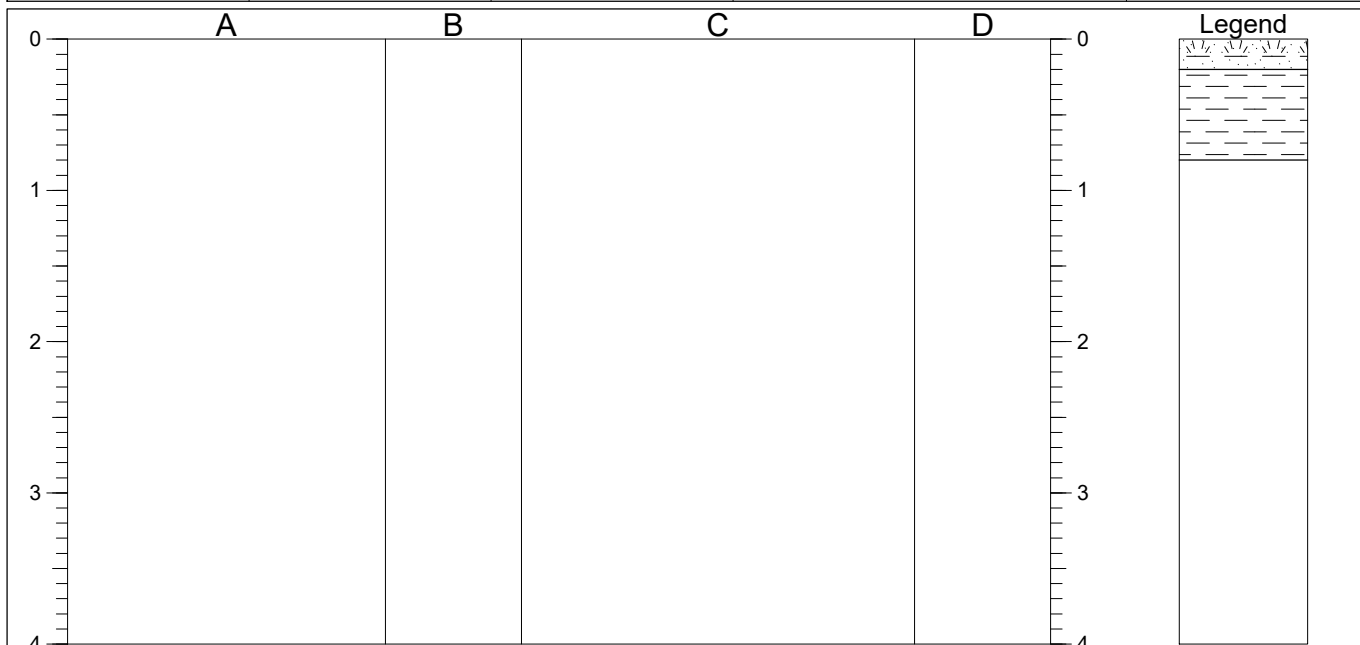
SOIL GROUP	Very coarse soils			Coarse soils						Fine soils					
PRINCIPAL SOIL TYPE	BOULDERS		COBBLES	GRAVEL			SAND			SILT			CLAY		
Particle size (mm)	Large boulder	Boulder	Cobble	Coarse	Medium	Fine	Coarse	Medium	Fine	Coarse	Medium	Fine			
	>630	630-200	200-63	63-20	20-6.3	6.3-2.0	2.0-0.63	0.63-0.2	0.2-0.063	0.063-0.02	0.02-0.0063	0.0063-0.002	<0.002		
Visual identification	Only seen complete in pits or exposures. Difficult to recover whole from boreholes.			Easily visible to naked eye; particle shape can be described; grading can be described.			Visible to naked eye; no cohesion when dry; grading can be described.			Only coarse silt visible with hand lens; exhibits little plasticity and marked dilatancy; slightly granular or silky to the touch; disintegrates in water; lumps dry quickly; possesses cohesion but can be powdered easily between fingers.			Dry lumps can be broken but not powdered between the fingers; dry lumps disintegrate under water but more slowly than silt; smooth to the touch; exhibits plasticity but no dilatancy; sticks to the fingers and dries slowly; shrinks appreciably on drying usually showing cracks.		
Density/ Consistency	No terms defined. Qualitative description of packing by inspection and ease of excavation.			Classification of relative density on the basis of N-value, or field assessment using hand tests may be made. SPT N-values = 0 – 4 = Very loose 4 – 10 = Loose 10 – 30 = Medium dense 30 – 50 = Dense >50 = Very dense					Term	Very soft	Soft	Firm	Stiff	Very stiff	
									Field test	Finger easily pushed in up to 25mm. Exudes between fingers.	Fingers pushed in up to 10mm. Moulded by light finger pressure.	Thumb makes impression easily. Cannot be moulded by fingers. Rolls to thread.	Can be indented slightly by thumb. Crumbles in rolling thread. Remoulds.	Can be indented by thumb nail. Cannot be moulded, crumbles.	
Discontinuities	Describe spacing of features such as fissures, shears, partings, isolated beds or laminae, desiccation cracks, rootlets, etc. Fissured: breaks into blocks along unpolished discontinuities. Sheared: breaks into blocks along polished discontinuities.					Scale of spacing of discontinuities	Term	very widely	widely	medium	closely	very closely	extremely closely		
							Mean spacing (mm)	>2000	2000-600	600-200	200-60	60-20	<20		
Bedding	Describe thickness of beds in accordance with geological definition. Alternating layers of materials are inter-bedded or inter-laminated and should be described by thickness term if in equal proportions, or by a thickness of and spacing between subordinate layers where unequal.					Scale of bedding thickness	Term	very thickly bedded	thickly bedded	medium bedded	thinly bedded	very thinly bedded	thickly laminated	thinly laminated	
							Mean thickness (mm)	>2000	2000-600	600-200	200-60	60-20	20-6	<6	
Colour	HUE can be preceded by LIGHTNESS and/ or CHROMA			Red/ Pink/ Orange/ Yellow/ Cream/ Brown/ Green/ Blue/ White/ Grey/ Black Light/ -/ Dark Reddish/ Pinkish/ Orangish/ Yellowish/ Brownish/ Greenish/ Bluish/ Greyish								Colours may be mottled More than 3 colours is multi-coloured			
Secondary constituents	For mixtures including very coarse soils see section 33.4.4.2 of BS 5930 (2015 (+A1: 2020)).			Terms in coarse soils	slightly (sandy) ^{B)}	(sandy) ^{B)}	very (sandy) ^{B)}	SAND AND GRAVEL		Terms in fine soil	slightly sandy ^{D)}	(sandy) ^{D)}	very (sandy) ^{F)}	Silty CLAY Clayey SILT	Terms used to reflect secondary fine constituents where this is important
				Proportion secondary ^{A)}	<5%	5-20% ^{C)}	>20% ^{C)}	About 50%	Proportion secondary ^{A)}	<35%	35-65% ^{E)}	>65% ^{E)}			
Mineralogy	Terms can include: glauconitic/ micaceous/ shelly/ organic/ calcareous. For example: slightly (glauconitic)/ (glauconitic)/ very (glauconitic). Carbonate Content: slightly calcareous – weak or sporadic effervescence from HCl/ calcareous – clear but not sustained effervescence from HCl/ highly calcareous – strong, sustained effervescence from HCl. Organic soils contain secondary finely divided or discrete particles of organic matter often with distinctive smell, might oxidise rapidly. For example: slightly organic-grey/ organic-dark grey/ very organic-black														
Particle shape	Very angular/ Angular/ Subangular/ Subrounded/ Rounded/ Well-rounded A dominant shape can be described, for example: Cubic/ Flat/ Elongate														
PRINCIPAL SOIL TYPE	LARGE BOULDERS	BOULDERS	COBBLES	GRAVEL			SAND			SILT			CLAY		
Tertiary constituents	Example terms include: shell fragments/ pockets of peat/ gypsum crystals/ pyrite nodules/ calcareous concretions/ flint gravel/ brick fragments/ rootlets/ plastic bags. Qualitative proportions can be given: with rare/ with occasional/ with numerous/ frequent/ abundant. Proportions are defined on a site or material specific basis, or subjectively.														
Geological unit	Name in accordance with published geological maps, memoirs or sheet explanations. For example: River Terrace Deposits/ Glacial Sand And Gravel/ Made Ground/ Crackington Formation/ Weathered Heavitree Breccia Formation/ Meadfoot Group/ Upper Devonian Slates/ Alluvium/ Topsoil/ Laminated Beds/ Bude Formation/ Sherwood Sandstone Group														
A) Percentage coarse or fine soil type assessed excluding cobbles and boulders B) Gravelly or sandy and/ or silty or clayey					C) Can be described as fine soil depending on mass behaviour D) Gravelly and/ or sandy					E) Can be described as coarse soil depending on mass behaviour F) Gravelly or sandy					



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Pinhoe, Exeter EX1 3SP
Telephone: 01392 678082

TRIAL PIT LOG

Project Land at Studley Farm, Atworth, Melksham, Wiltshire				TRIAL PIT No TP01
Job No 21264	Date 08-06-21	Ground Level (mAOD)	Co-Ordinates (BNG) E 386698 N 165381	
Contractor	Method/ Plant Terex 860 sx			Sheet 1 of 1



STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	Type	Remarks/Tests	
0.00-0.20		TOPSOIL: Dark brown silty clay with rootlets.				
0.20-0.80		Firm mottled light grey and orangish brown slightly gravelly CLAY. Gravel is fine siltstone. (Kellaways Formation)				

Shoring/Support: None. Stability: Stable. Groundwater: None encountered. 1.60 A D B 1.00 C	GENERAL REMARKS 1. Trial pit terminated at depth specified for soakaway test.
--	---

All dimensions in metres Scale 1:50	Client: RMA Environmental	Logged By MT
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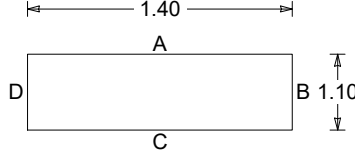
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TRIAL PIT LOG

Project Land at Studley Farm, Atworth, Melksham, Wiltshire				TRIAL PIT No TP02
Job No 21264	Date 08-06-21	Ground Level (mAOD)	Co-Ordinates (BNG) E 386687 N 165012	
Contractor	Method/ Plant Terex 860 sx			Sheet 1 of 1

STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	Type	Remarks/Test
0.00-0.20		TOPSOIL: Dark brown silty clay with rootlets.			
0.20-0.90		Firm mottled grey and orangish brown CLAY with pockets of gravelly clay. Gravel is fine to medium subangular siltstone. (Kellaways Formation)			

Shoring/Support: None. Stability: Stable. Groundwater: None encountered. 	GENERAL REMARKS 1. Trial pit terminated for soakaway test.
---	---

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All dimensions in metres
Scale 1:50

Client:

RMA Environmental

Logged By

MT



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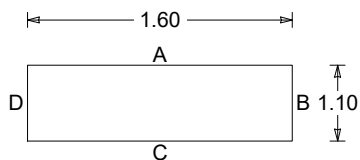
TRIAL PIT LOG

Project Land at Studley Farm, Atworth, Melksham, Wiltshire				TRIAL PIT No TP03
Job No 21264	Date 09-06-21	Ground Level (mAOD)	Co-Ordinates (BNG) E 387344 N 165116	
Contractor	Method/ Plant Terex 860 sx			Sheet 1 of 1

0	A	B	C	D	0	Legend
1					1	
2					2	
3					3	
4					4	

STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	Type	Remarks/Tests
0.00-0.10		TOPSOIL: Dark brown silty clay with rootlets.			
0.10-0.60		Firm light orangish brown slightly sandy CLAY. (Kellaways Formation)			
0.60-0.80		Firm mottled light grey and orangish brown CLAY. (Kellaways Formation)			

Shoring/Support: None. Stability: Stable. Groundwater: None encountered.	GENERAL REMARKS 1. Trial pit terminated for soakaway test.
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All dimensions in metres Scale 1:50	Client: RMA Environmental	Logged By MT
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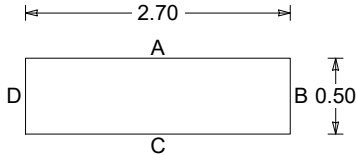
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The Stables, 65 Langaton Lane
Pinhoe, Exeter EX1 3SP
Telephone: 01392 678082

TRIAL PIT LOG

Project Land at Studley Farm, Atworth, Melksham, Wiltshire				TRIAL PIT No TP04
Job No 21264	Date 08-06-21	Ground Level (mAOD)	Co-Ordinates (BNG) E 386703 N 165389	
Contractor	Method/ Plant Terex 860 sx			Sheet 1 of 1

0	A	B	C	D	0	Legend
1					1	
2					2	
3					3	
4					4	

STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	Type	Remarks/Tests
0.00-0.25		TOPSOIL: Dark brown silty clay with rootlets.			
0.25-1.70		Firm mottled grey and orangish brown slightly gravelly CLAY. Gravel is fine of siltstone. (Kellaways Formation)			
1.70-2.30		Firm light grey mottled orange brown gravelly CLAY. Gravel is fine lithorelics and clear crystals (possible gypsum or selenite). (Kellaways Formation)			
2.30-2.40		Stiff mottled light grey and orangish brown dark grey indistinctly thinly and thickly laminated CLAY with abundant lithorelics. (Kellaways Formation)			

Shoring/Support: None. Stability: Stable. Groundwater: None encountered.		GENERAL REMARKS 1. Trial pit terminated for soakaway test.
		

All dimensions in metres Scale 1:50	Client: RMA Environmental	Logged By MT
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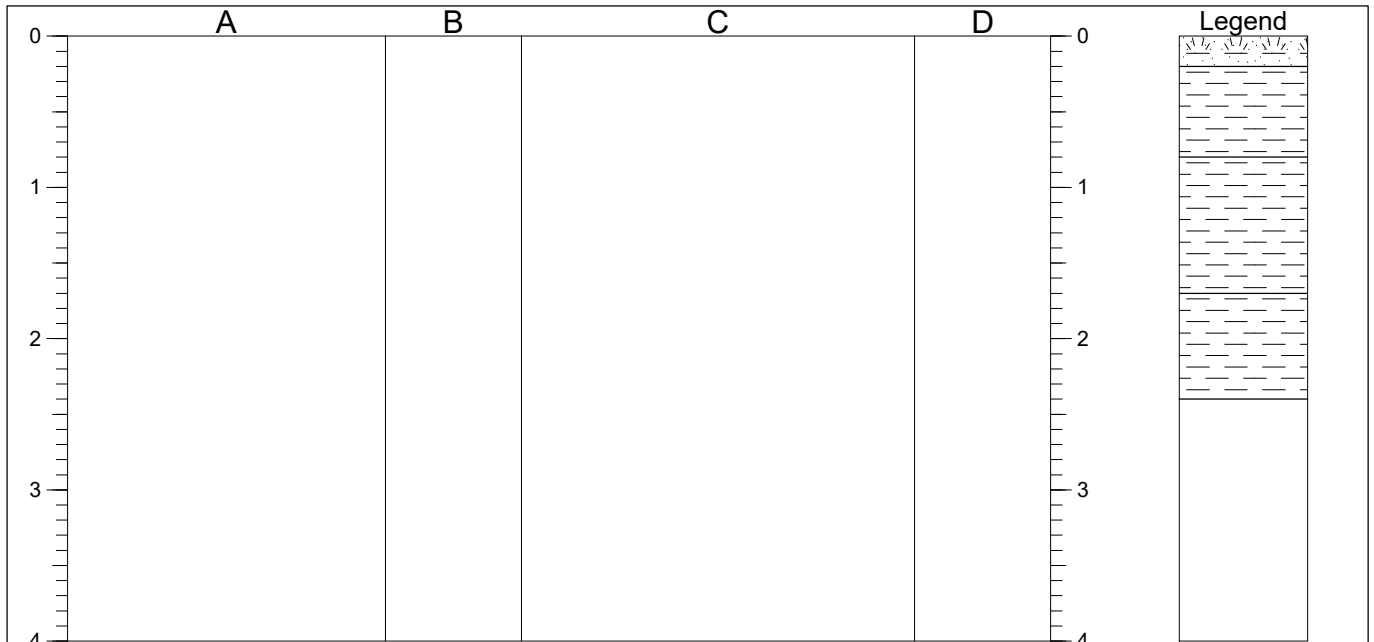
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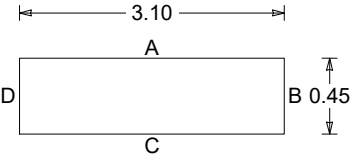
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The Stables, 65 Langaton Lane
Pinhoe, Exeter EX1 3SP
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TRIAL PIT LOG

Project Land at Studley Farm, Atworth, Melksham, Wiltshire				TRIAL PIT No TP05
Job No 21264	Date 08-06-21	Ground Level (mAOD)	Co-Ordinates (BNG) E 386673 N 165005	
Contractor	Method/ Plant Terex 860 sx			Sheet 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	Type	Remarks/Tests
0.00-0.20		TOPSOIL: Dark brown silty clay with rootlets.			
0.20-0.80		Firm mottled grey and orangish brown slightly gravelly CLAY. Gravel is fine to medium mudstone and siltstone. (Kellaways Formation)			
0.80-1.70		Firm light grey mottled orangish brown CLAY. (Kellaways Formation)			
1.70-2.40		Firm mottled grey and orangish brown indistinctly thinly laminated CLAY some fine gravel of clear crystals. (Kellaways Formation)			
		2.20 ... with partings of silt in laminations.			

Shoring/Support: None. Stability: Stable. Groundwater: None encountered. 	GENERAL REMARKS
	1. Trial pit terminated for soakaway test.

All dimensions in metres Scale 1:50	Client: RMA Environmental	Logged By MT
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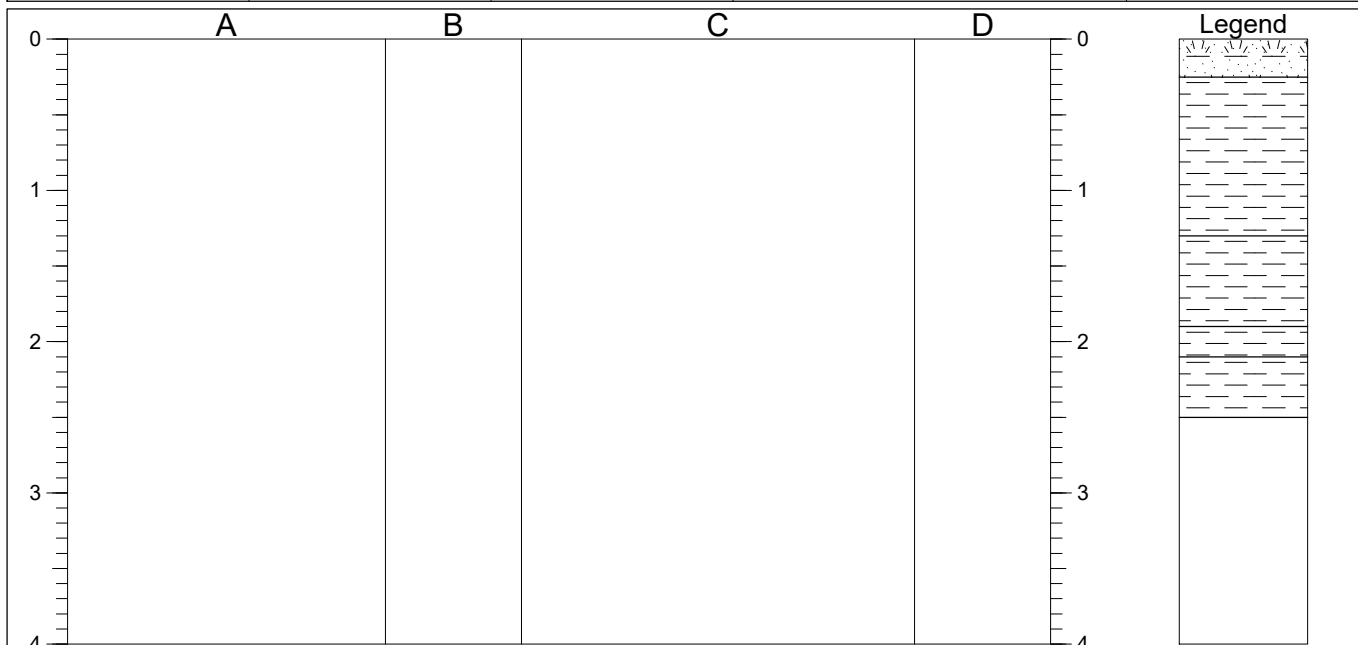
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Telephone: 01392 678082

TRIAL PIT LOG

Project Land at Studley Farm, Atworth, Melksham, Wiltshire				TRIAL PIT No TP06
Job No 21264	Date 09-06-21	Ground Level (mAOD)	Co-Ordinates (BNG) E 387370 N 165083	
Contractor	Method/ Plant Terex 860 sx			Sheet 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	Type	Remarks/Test
0.00-0.25		TOPSOIL: Dark brown silty clay with rootlets.			
0.25-1.30		Firm orangish brown slightly sandy CLAY. (Kellaways Formation)			
1.30-1.90		Firm mottled light grey and orangish brown sandy CLAY. (Kellaways Formation)			
1.90-2.10		Firm mottled light grey and orangish brown indistinctly laminated CLAY with partings of silt. (Kellaways Formation)			
2.10-2.50		Firm dark bluish grey slightly gravelly slightly silty with shell fragments. Gravel is fine to medium siltstone. (Kellaways Formation)			

Shoring/Support: None. Stability: Some collapse after 2 hours. Groundwater: None encountered.		GENERAL REMARKS 1. Trial pit terminated for soakaway test.
A rectangular diagram representing a trial pit. The top horizontal dimension is labeled '3.50' with arrows indicating the full width. Below this, the top-left corner is labeled 'A', the top-right corner is labeled 'B', the bottom-left corner is labeled 'D', and the bottom-right corner is labeled 'C'. The right vertical dimension is labeled '0.50' with arrows indicating the full height.		

All dimensions in metres Scale 1:50	Client: RMA Environmental	Logged By MT
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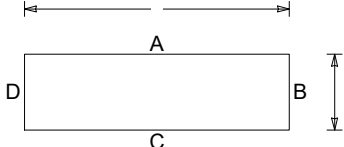
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Pinhoe, Exeter EX1 3SP
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TRIAL PIT LOG

Project Land at Studley Farm, Atworth, Melksham, Wiltshire				TRIAL PIT No TPOBS 01
Job No 21264	Date 08-06-21	Ground Level (mAOD)	Co-Ordinates (BNG) E 386712 N 165396	
Contractor	Method/ Plant Terex 860 sx			Sheet 1 of 1

A	B	C	D	Legend
0				0
1				1
2				2
3				3
4				4

STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	Type	Remarks/Tests
0.00-0.25		TOPSOIL: Dark brown silty clay with rootlets.			
0.25-1.20		Firm mottled light grey and orangish brown CLAY. (Kellaways Formation)			
1.20-3.05		1.10 ... more friable silty clay with pockets of crystalline gravelly clay. Firm mottled light grey and orangish brown indistinctly laminated CLAY with abundant lithorelics. (Kellaways Formation)			
		2.00 ... thin bed of laminated light grey fine sand.			
3.05-3.40		Stiff bluish grey CLAY with abundant lithorelics. (Kellaways Formation)			

Shoring/Support: None. Stability: Stable. Groundwater: None encountered.		GENERAL REMARKS 1. Trial pit terminated for groundwater observation.
		

All dimensions in metres Scale 1:50	Client: RMA Environmental	Logged By MT
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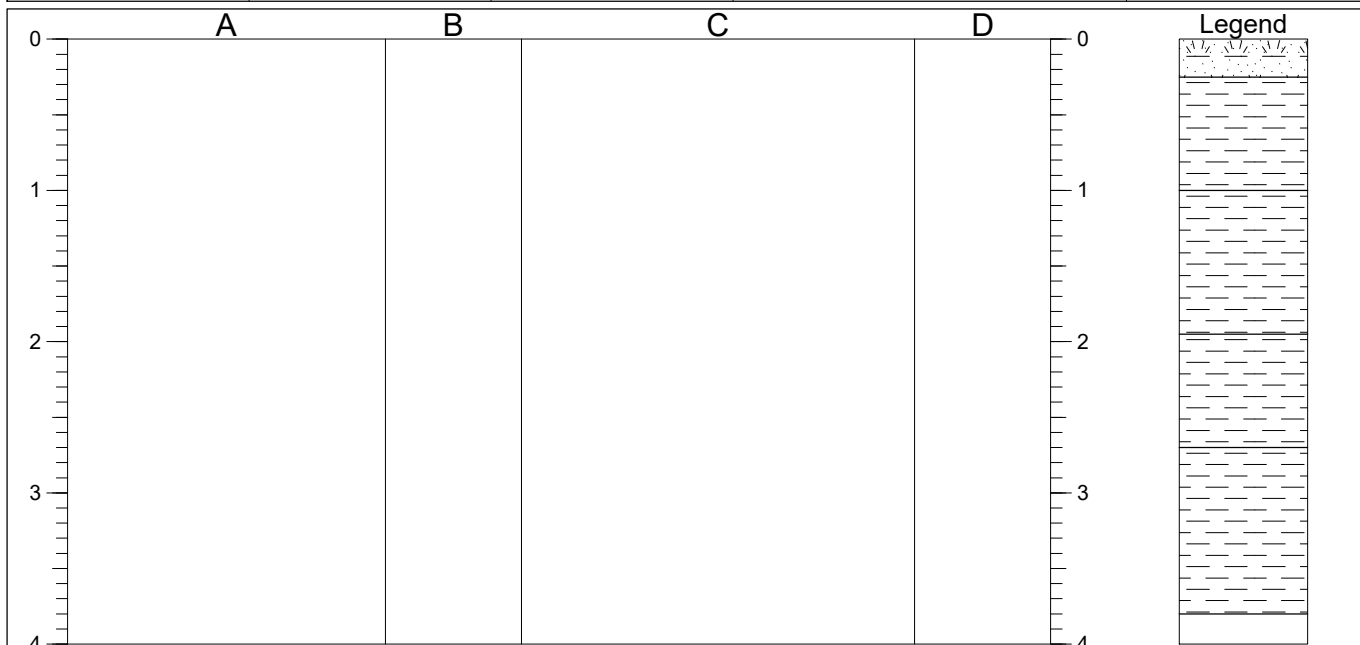
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The Stables, 65 Langaton Lane
Pinhoe, Exeter EX1 3SP
Telephone: 01392 678082

TRIAL PIT LOG

Project Land at Studley Farm, Atworth, Melksham, Wiltshire				TRIAL PIT No TPOBS 02
Job No 21264	Date 08-06-21	Ground Level (mAOD)	Co-Ordinates (BNG) E 386646 N 164986	
Contractor	Method/ Plant Terex 860 sx			Sheet 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	Type	Remarks/Test
0.00-0.25		TOPSOIL: Dark brown silty clay with rootlets.			
0.25-1.00		Firm mottled grey and orangish brown CLAY with pockets of gravelly clay. Gravel is fine and medium siltstone. (Kellaways Formation)			
1.00-1.95		Firm mottled light grey and orangish brown CLAY with pockets of orange brown silt up to 100mm across. (Kellaways Formation)			
1.95-2.70		Firm mottled bluish grey, brown and yellowish brown CLAY with abundant fine and medium gravel size lithorelics. (Kellaways Formation)			
2.70-3.80		Stiff blue grey indistinctly laminated CLAY. (Kellways Formation) ... becoming thickly laminated with depth.			

Shoring/Support: None. Stability: Stable. Groundwater: None encountered. A diagram of a rectangular trial pit. Above the rectangle is a horizontal dimension line with arrows at both ends, labeled 'A'. Below the rectangle is a horizontal dimension line with arrows at both ends, labeled 'C'. To the left of the rectangle is a vertical dimension line with arrows at both ends, labeled 'D'. To the right of the rectangle is a vertical dimension line with arrows at both ends, labeled 'B'.	GENERAL REMARKS 1. Trial pit terminated for groundwater observation.
---	---

All dimensions in metres Scale 1:50	Client: RMA Environmental	Logged By MT
--	------------------------------	-----------------

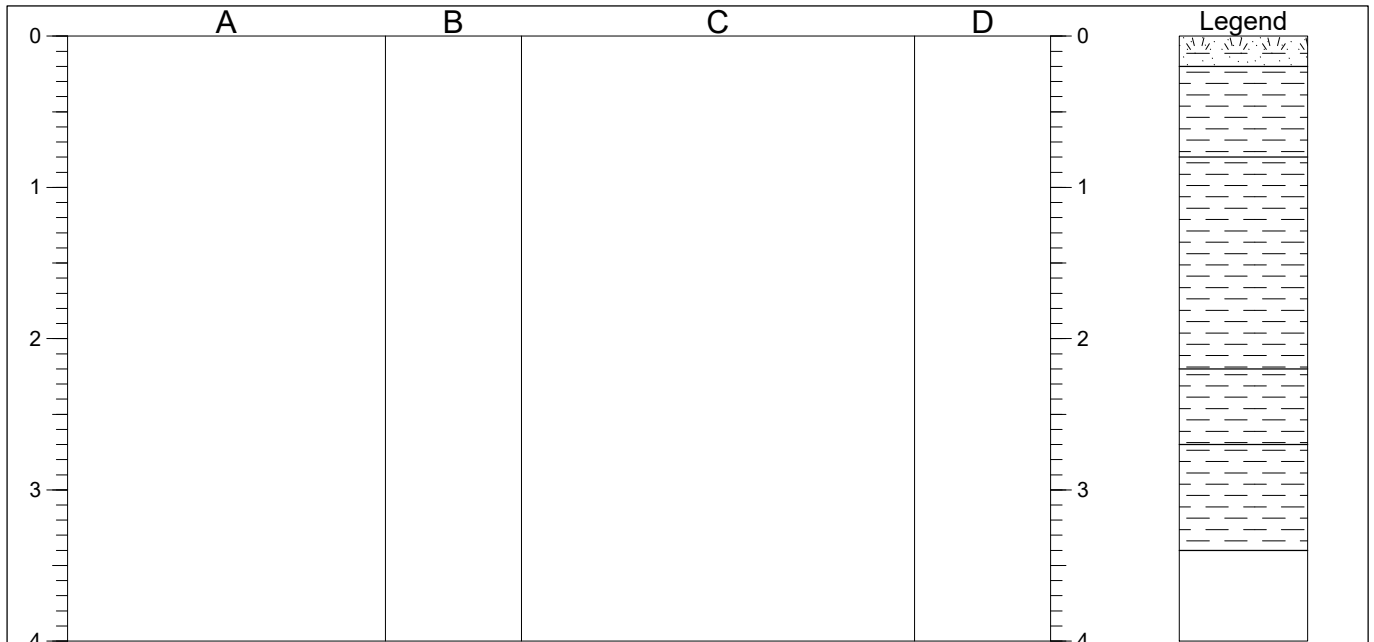
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The Stables, 65 Langaton Lane
Pinhoe, Exeter EX1 3SP
Telephone: 01392 678082

TRIAL PIT LOG

Project Land at Studley Farm, Atworth, Melksham, Wiltshire				TRIAL PIT No TPOBS 03
Job No 21264	Date 09-06-21	Ground Level (mAOD)	Co-Ordinates (BNG) E 387325 N 165137	
Contractor	Method/ Plant Terex 860 sx			Sheet 1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	Type	Remarks/Tests
0.00-0.20		TOPSOIL: Dark brown silty clay with rootlets.			
0.20-0.80		Firm light brown slightly sandy CLAY with plant rootlets in upper 0.20m. (Kellaways Formation)			
0.80-2.20		Stiff mottled light grey and orangish brown indistinctly laminated silty CLAY. (Kellaways Formation) 1.40 ... becoming more silty.			
2.20-2.70		Firm friable bluish grey slightly sandy CLAY with shell fragments. (Kellaways Formation)			
2.70-3.40		Stiff bluish grey CLAY. (Kellaways Formation) 3.10 ... becoming thickly bedded.			

Shoring/Support: None. Stability: Stable. Groundwater: Little groundwater present at base of pit (0.05m) after 2.5 hours, running from a silty layer at approximately 1.40mbgl. 	GENERAL REMARKS 1. Trial pit terminated for groundwater observation.
---	--

All dimensions in metres Scale 1:50	Client: RMA Environmental	Logged By MT
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AGS3 UK TP 21264 - PROPOSED SOLAR FARM AT STUDLEY FARM, ATWORTH, MELKSHAM, WILTSHIRE.GPJ AGS 3.1.GDT 28/7/21

APPENDIX B

PHOTOGRAPHS



**Plate 1**

The small valley that runs from north to south on site, viewed from the southwest.

**Plate 2**

The northwest of the site, viewed from the east. This field was the location for TPOBS 01, TP01 and TP04.

**Plate 3**

The southwest of the site, viewed from the northeast. This field was the location for TPOBS 02, TP02 and TP05.

**Plate 4**

The northeast of the site, viewed from the southwest. This field was the location for TPOBS 03, TP03 and TP06.

**Plate 5**

The pond present off-site, around 100m to the northwest of Studley Farm. The water level in the pond was approximately 0.40mBGL at the time of the investigation.

**Plate 6**

TPOBS 03, typical of the ground conditions encountered at the site.

**Plate 7**

Arisings from TPOBS 06, typical of the ground conditions encountered at the site.

APPENDIX C

SOAKAWAY TEST RESULTS



In Accordance with BRE 365 "Soakaway Design"

Job No.: 21264

Date: Jun-21

TP01

Length (m):	1.60
Width (m):	1.00
Depth (m):	0.80
Start Water Level (m):	0.40
Total Depth of Test	0.40

[illegible]

Soakaway Test Results

In Accordance with BRE 365 "Soakaway Design"

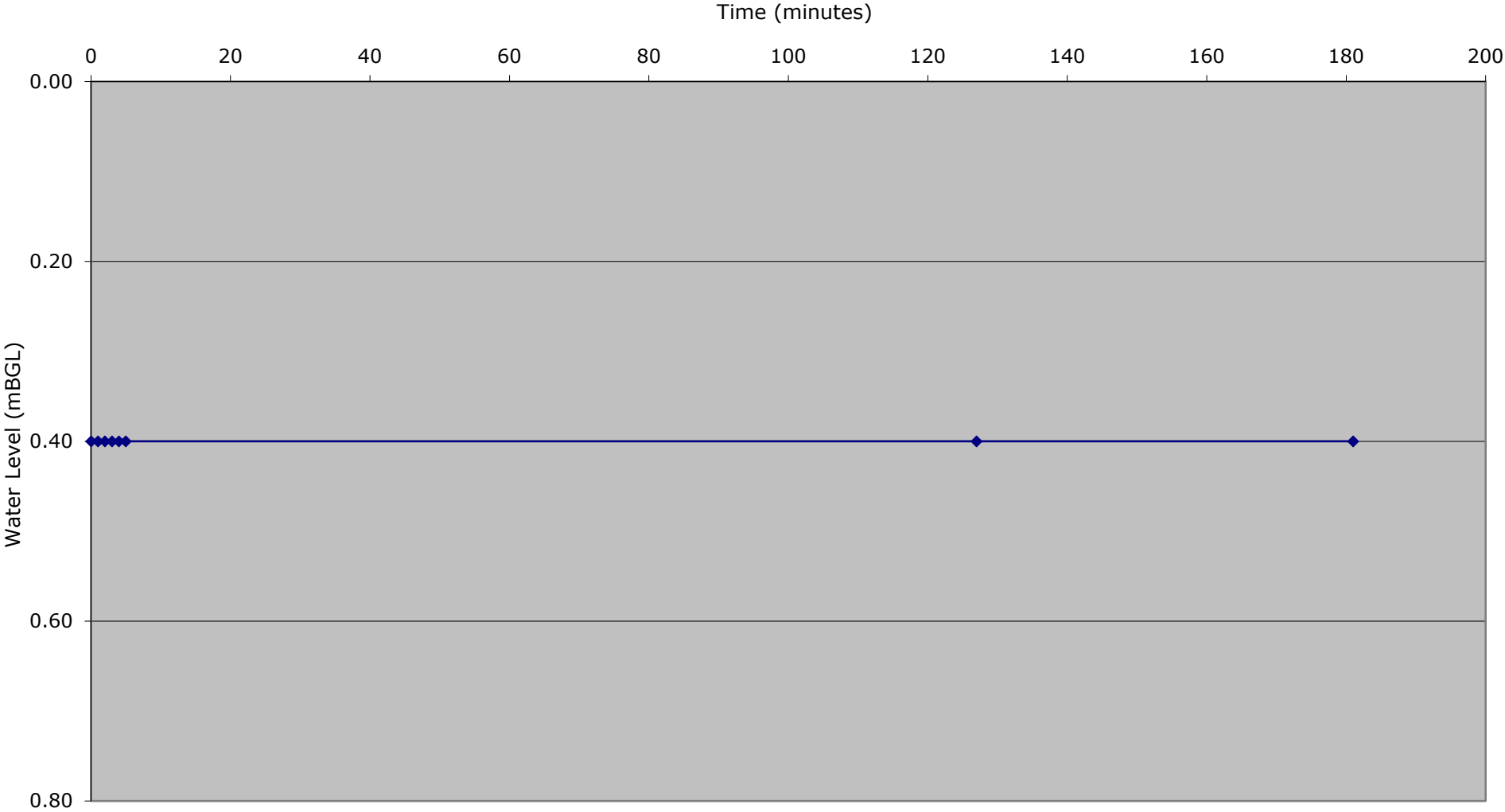
Calculations

$$\begin{aligned} \text{Soil Infiltration Rate (f)} &= (V_{p75-25}) / (a_{p50} \times t_{p75-25}) \\ \\ \text{Where} \\ V_{p75-25} &= \text{effective storage volume of water in the trial pit between 75\% and 25\% effective depth} \\ &= 1.60 \times 1.00 \times 0.20 \\ &= \underline{0.32 \text{ m}^3} \\ a_{p50} &= \text{internal surface area of the trial pit up to 50\% effective depth and including the base area} \\ &= 0.40 + 0.64 + 1.60 \\ &= \underline{2.64 \text{ m}^2} \\ t_{p75-25} &= \text{time for the water level to fall from 75\% to 25\% effective depth} \\ &\quad \begin{array}{l} 25\% \text{ effective depth} = 0.5 \\ 75\% \text{ effective depth} = 0.7 \end{array} \\ &= \text{ } - \text{ } \text{ mins} \\ &= 0 \text{ mins} \\ &= \underline{0 \text{ secs}} \\ \text{Soil Infiltration Rate (f)} &= (V_{p75-25}) / (a_{p50} \times t_{p75-25}) \\ &= 0.32 / 2.64 \times 0 \\ &= \underline{\#DIV/0! \text{ m/s}} \end{aligned}$$

OTHER NOTES:



Soakaway Test Results - TP01



In Accordance with BRE 365 "Soakaway Design"

Job No.: 21264

Date: Jun-21

TP02

Length (m):	1.40
Width (m):	1.10
Depth (m):	0.90
Start Water Level (m):	0.40
Total Depth of Test	0.50

[illegible]

Soakaway Test Results

In Accordance with BRE 365 "Soakaway Design"

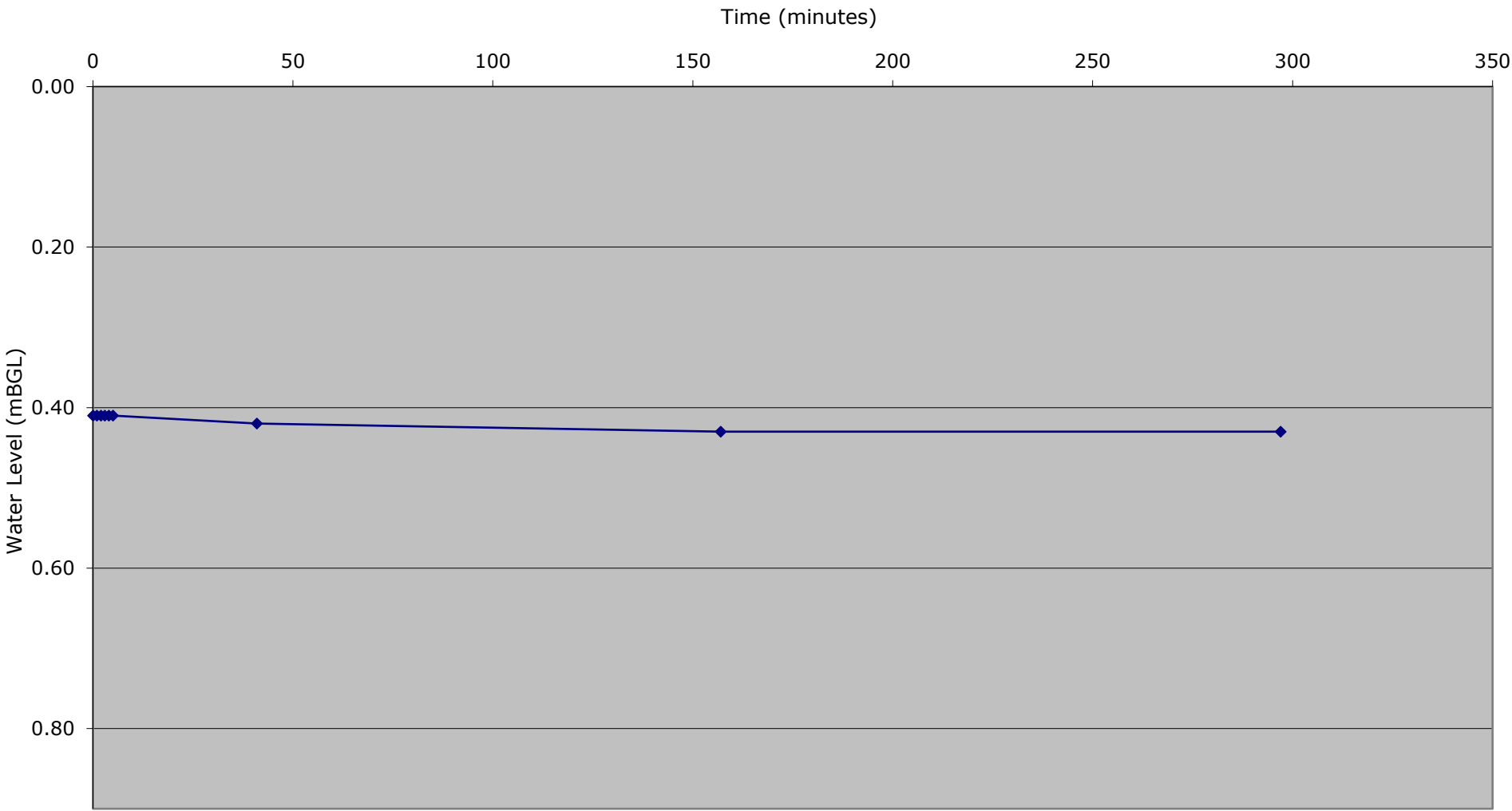
Calculations

$$\begin{aligned} \text{Soil Infiltration Rate (f)} &= (V_{p75-25}) / (a_{p50} \times t_{p75-25}) \\ \\ \text{Where} \\ V_{p75-25} &= \text{effective storage volume of water in the trial pit between 75\% and 25\% effective depth} \\ &= 1.40 \times 1.10 \times 0.25 \\ &= \underline{0.385 \text{ m}^3} \\ a_{p50} &= \text{internal surface area of the trial pit up to 50\% effective depth and including the base area} \\ &= 0.55 + 0.70 + 1.54 \\ &= \underline{2.79 \text{ m}^2} \\ t_{p75-25} &= \text{time for the water level to fall from 75\% to 25\% effective depth} \\ &\quad \begin{aligned} 25\% \text{ effective depth} &= 0.525 \\ 75\% \text{ effective depth} &= 0.775 \end{aligned} \\ &= \text{ } - \text{ } \text{ mins} \\ &= 0 \text{ mins} \\ &= \underline{0 \text{ secs}} \\ \text{Soil Infiltration Rate (f)} &= (V_{p75-25}) / (a_{p50} \times t_{p75-25}) \\ &= 0.385 / 2.79 \times 0 \\ &= \underline{\#DIV/0! \text{ m/s}} \end{aligned}$$

OTHER NOTES:



Soakaway Test Results - TP02



In Accordance with BRE 365 "Soakaway Design"

Job No.: 21264

Date: Jun-21

TP03

Length (m):	1.60
Width (m):	1.10
Depth (m):	0.80
Start Water Level (m):	0.40
Total Depth of Test	0.40

[illegible]

Soakaway Test Results

In Accordance with BRE 365 "Soakaway Design"

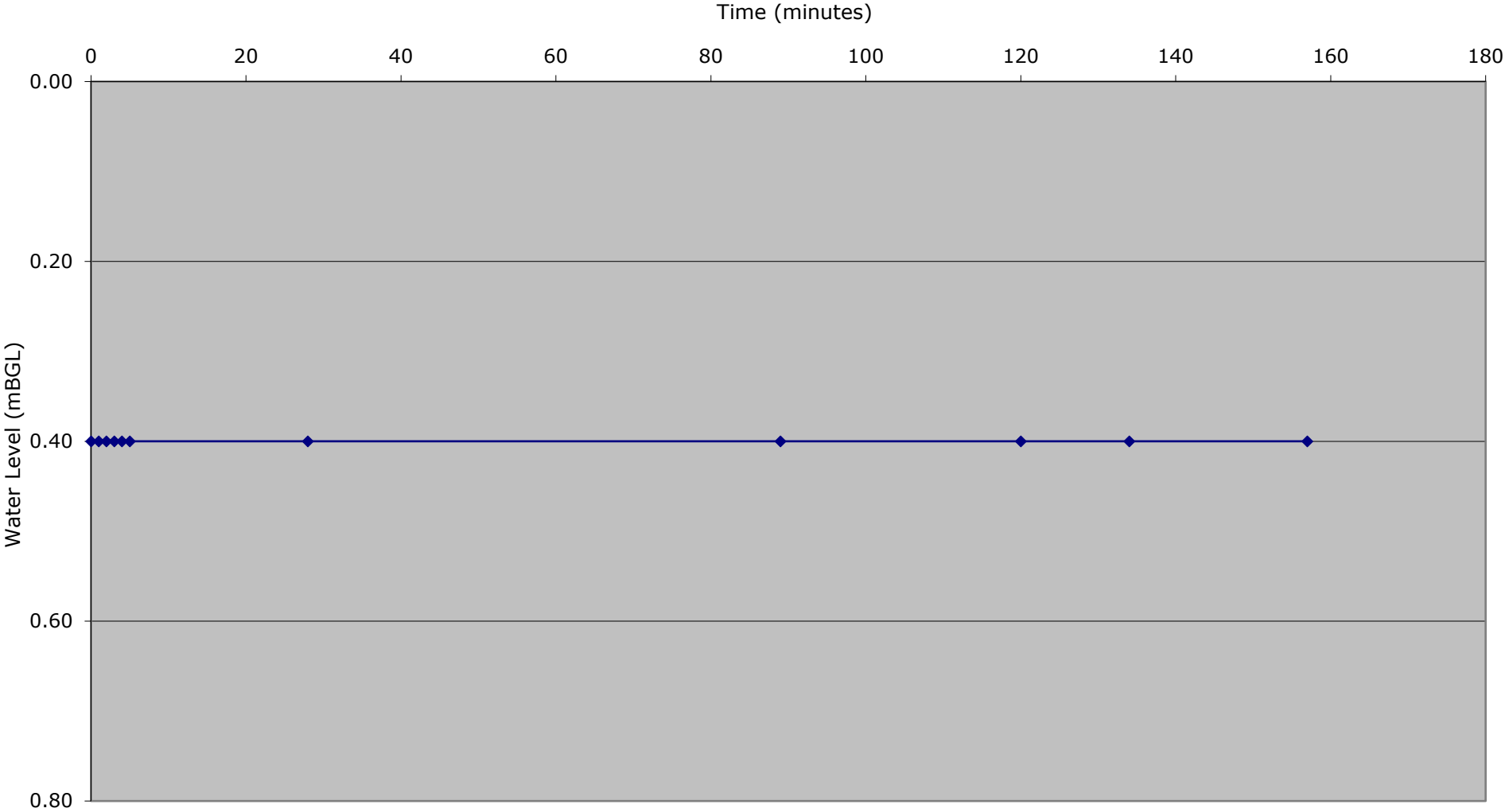
Calculations

$$\begin{aligned}
 \text{Soil Infiltration Rate (f)} &= (V_{p75-25}) / (a_{p50} \times t_{p75-25}) \\
 \\
 \text{Where} \\
 V_{p75-25} &= \text{effective storage volume of water in the trial pit between 75\% and 25\% effective depth} \\
 &= 1.60 \times 1.10 \times 0.20 \\
 &= \underline{0.352 \text{ m}^3} \\
 a_{p50} &= \text{internal surface area of the trial pit up to 50\% effective depth and including the base area} \\
 &= 0.44 + 0.64 + 1.76 \\
 &= \underline{2.84 \text{ m}^2} \\
 t_{p75-25} &= \text{time for the water level to fall from 75\% to 25\% effective depth} \\
 &\quad \begin{array}{l} 25\% \text{ effective depth} = 0.5 \\ 75\% \text{ effective depth} = 0.7 \end{array} \\
 &= \text{ } - \text{ } \text{ mins} \\
 &= 0 \text{ mins} \\
 &= \underline{0 \text{ secs}} \\
 \text{Soil Infiltration Rate (f)} &= (V_{p75-25}) / (a_{p50} \times t_{p75-25}) \\
 &= 0.352 / 2.84 \times 0 \\
 &= \underline{\#DIV/0! \text{ m/s}}
 \end{aligned}$$

OTHER NOTES:



Soakaway Test Results - TP03



In Accordance with BRE 365 "Soakaway Design"

Job No.: 21264

Date: Jun-21

TP04

Length (m):	2.70
Width (m):	0.50
Depth (m):	2.40
Start Water Level (m):	0.99
Total Depth of Test	1.41

[illegible]

Soakaway Test Results

In Accordance with BRE 365 "Soakaway Design"

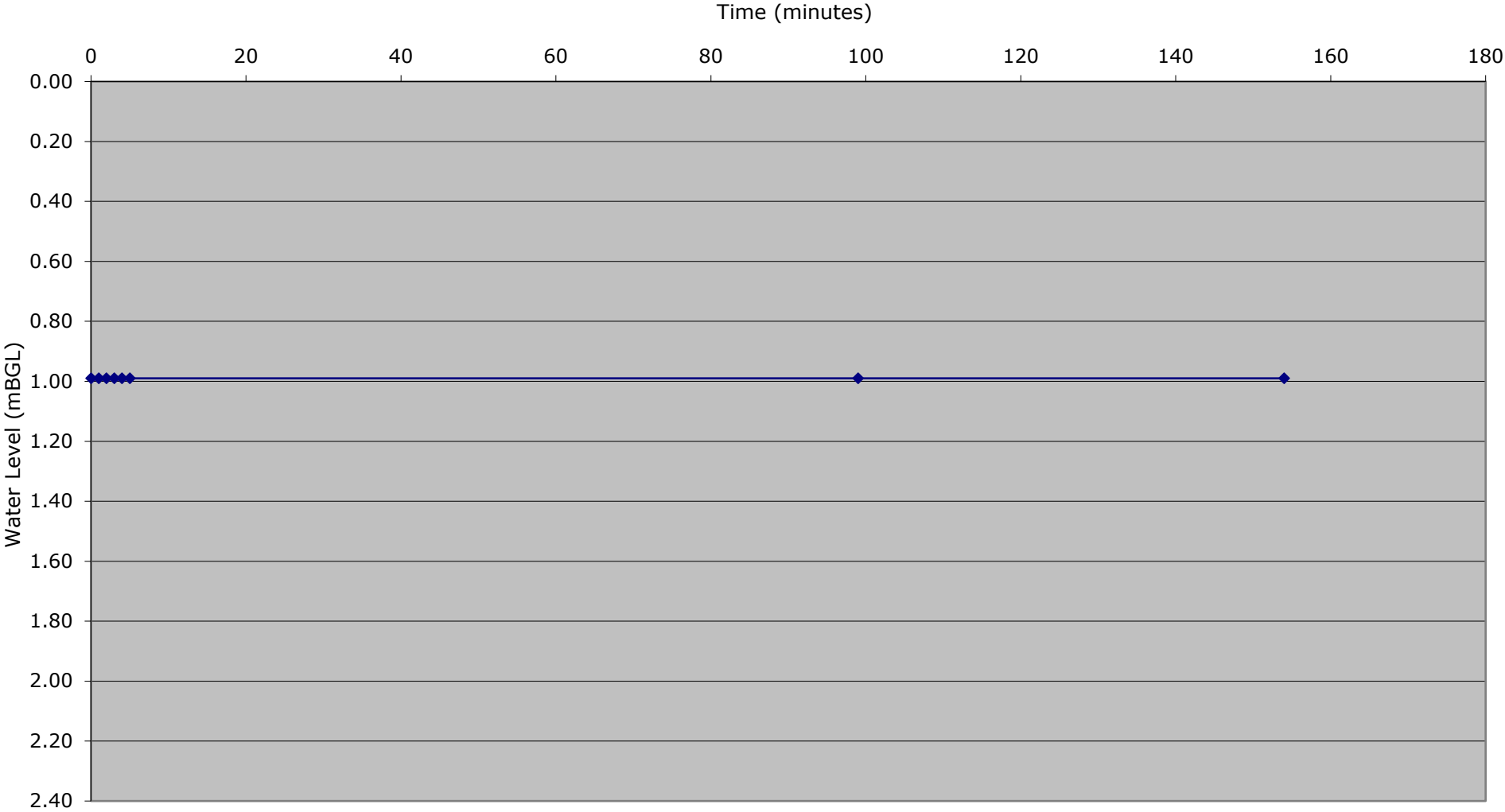
Calculations

$$\begin{aligned} \text{Soil Infiltration Rate (f)} &= (V_{p75-25}) / (a_{p50} \times t_{p75-25}) \\ \\ \text{Where} \\ V_{p75-25} &= \text{effective storage volume of water in the trial pit between 75\% and 25\% effective depth} \\ &= 2.70 \times 0.50 \times 0.71 \\ &= \underline{0.95175 \text{ m}^3} \\ a_{p50} &= \text{internal surface area of the trial pit up to 50\% effective depth and including the base area} \\ &= 0.71 + 3.81 + 1.35 \\ &= \underline{5.862 \text{ m}^2} \\ t_{p75-25} &= \text{time for the water level to fall from 75\% to 25\% effective depth} \\ &\quad \begin{array}{l} 25\% \text{ effective depth} = 1.3425 \\ 75\% \text{ effective depth} = 2.0475 \end{array} \\ &= \text{ } - \text{ } \text{ mins} \\ &= 0 \text{ mins} \\ &= \underline{0 \text{ secs}} \\ \text{Soil Infiltration Rate (f)} &= (V_{p75-25}) / (a_{p50} \times t_{p75-25}) \\ &= 0.95175 / 5.862 \times 0 \\ &= \underline{\#DIV/0! \text{ m/s}} \end{aligned}$$

OTHER NOTES:



Soakaway Test Results - TP04



In Accordance with BRE 365 "Soakaway Design"

Job No.: 21264

Date: Jun-21

TP05

Length (m):	3.10
Width (m):	0.45
Depth (m):	2.40
Start Water Level (m):	0.95
Total Depth of Test	1.45

[illegible]

Soakaway Test Results

In Accordance with BRE 365 "Soakaway Design"

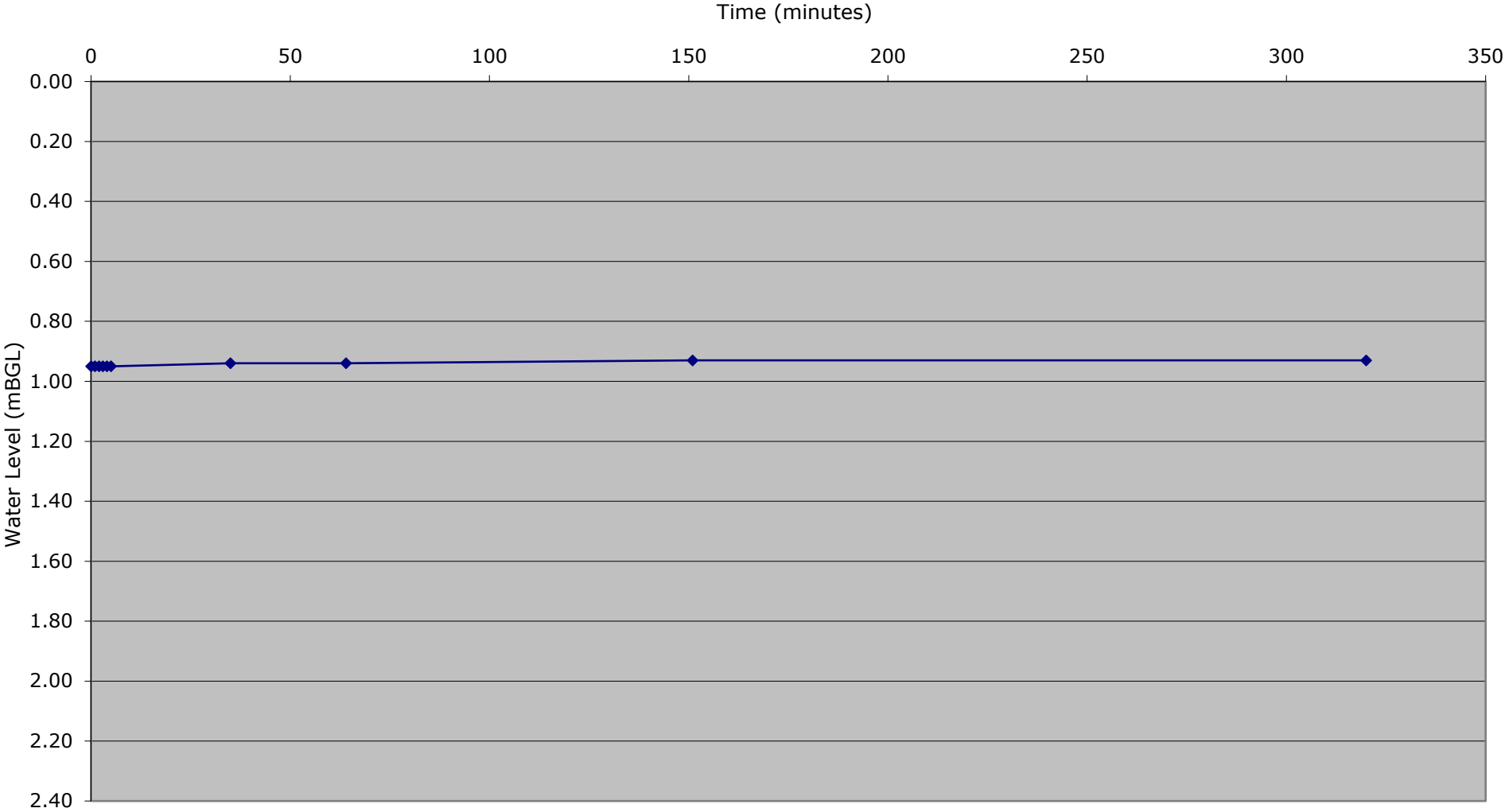
Calculations

$$\begin{aligned} \text{Soil Infiltration Rate (f)} &= (V_{p75-25}) / (a_{p50} \times t_{p75-25}) \\ \\ \text{Where} \\ V_{p75-25} &= \text{effective storage volume of water in the trial pit between 75\% and 25\% effective depth} \\ &= 3.10 \times 0.45 \times 0.73 \\ &= \underline{1.011375 \text{ m}^3} \\ a_{p50} &= \text{internal surface area of the trial pit up to 50\% effective depth and including the base area} \\ &= 0.65 + 4.50 + 1.40 \\ &= \underline{6.5425 \text{ m}^2} \\ t_{p75-25} &= \text{time for the water level to fall from 75\% to 25\% effective depth} \\ &\quad \begin{array}{l} 25\% \text{ effective depth} = 1.3125 \\ 75\% \text{ effective depth} = 2.0375 \end{array} \\ &= \text{ } - \text{ } \text{ mins} \\ &= 0 \text{ mins} \\ &= \underline{0 \text{ secs}} \\ \text{Soil Infiltration Rate (f)} &= (V_{p75-25}) / (a_{p50} \times t_{p75-25}) \\ &= 1.011375 / 6.543 \times 0 \\ &= \underline{\#DIV/0! \text{ m/s}} \end{aligned}$$

OTHER NOTES:



Soakaway Test Results - TP05



In Accordance with BRE 365 "Soakaway Design"

Job No.: 21264

Date: Jun-21

TP06

Length (m):	3.50
Width (m):	0.50
Depth (m):	2.50
Start Water Level (m):	1.00
Total Depth of Test	1.50

[illegible]

Soakaway Test Results

In Accordance with BRE 365 "Soakaway Design"

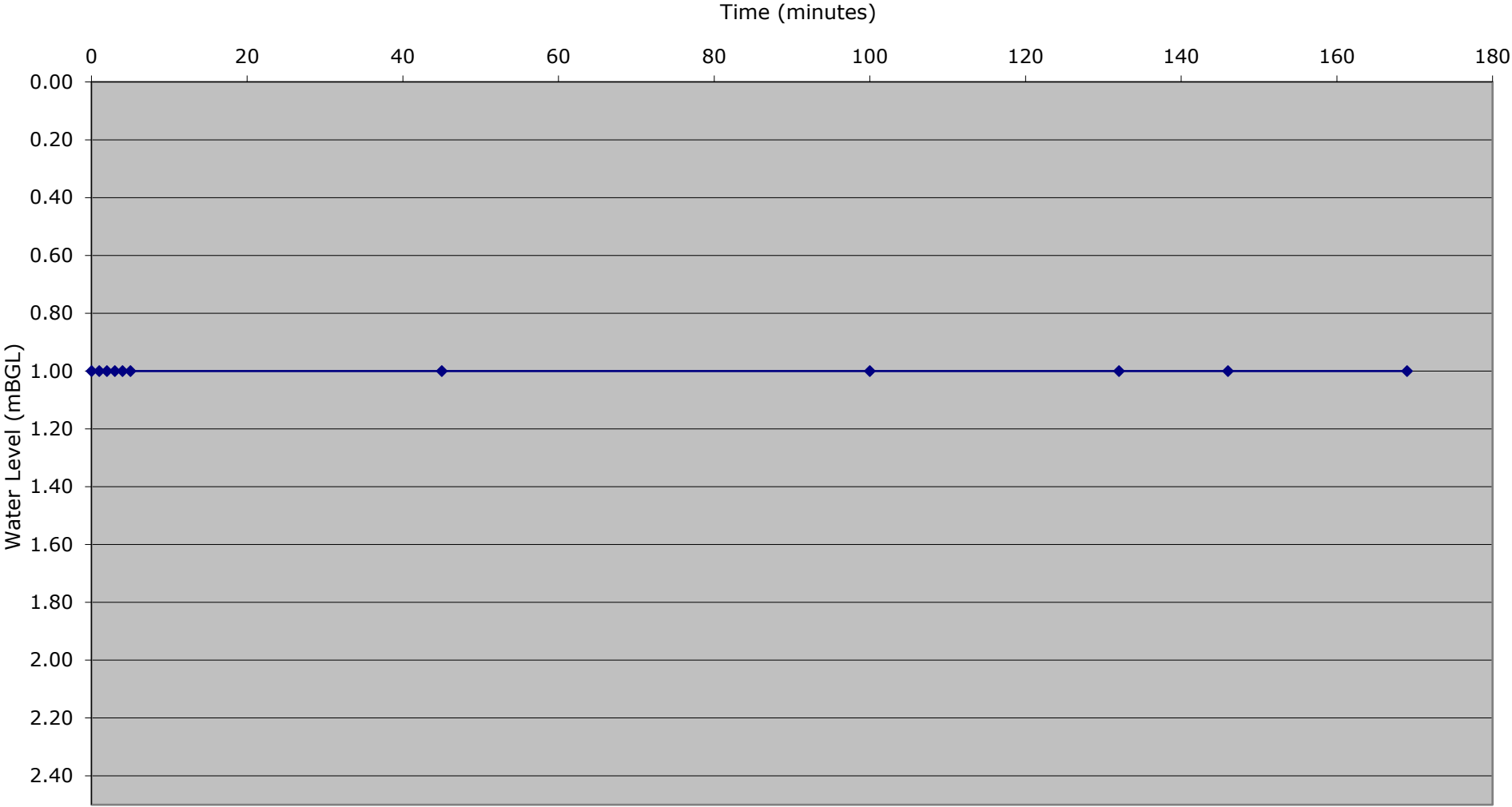
Calculations

$$\begin{aligned}
 \text{Soil Infiltration Rate (f)} &= (V_{p75-25}) / (a_{p50} \times t_{p75-25}) \\
 \\
 \text{Where} \\
 V_{p75-25} &= \text{effective storage volume of water in the trial pit between 75\% and 25\% effective depth} \\
 &= 3.50 \times 0.50 \times 0.75 \\
 &= \underline{1.3125 \text{ m}^3} \\
 a_{p50} &= \text{internal surface area of the trial pit up to 50\% effective depth and including the base area} \\
 &= 0.75 + 5.25 + 1.75 \\
 &= \underline{7.75 \text{ m}^2} \\
 t_{p75-25} &= \text{time for the water level to fall from 75\% to 25\% effective depth} \\
 &\quad \begin{array}{l} 25\% \text{ effective depth} = 1.375 \\ 75\% \text{ effective depth} = 2.125 \end{array} \\
 &= \text{ } - \text{ } \text{ mins} \\
 &= 0 \text{ mins} \\
 &= \underline{0 \text{ secs}} \\
 \text{Soil Infiltration Rate (f)} &= (V_{p75-25}) / (a_{p50} \times t_{p75-25}) \\
 &= 1.3125 / 7.75 \times 0 \\
 &= \underline{\#DIV/0! \text{ m/s}}
 \end{aligned}$$

OTHER NOTES:



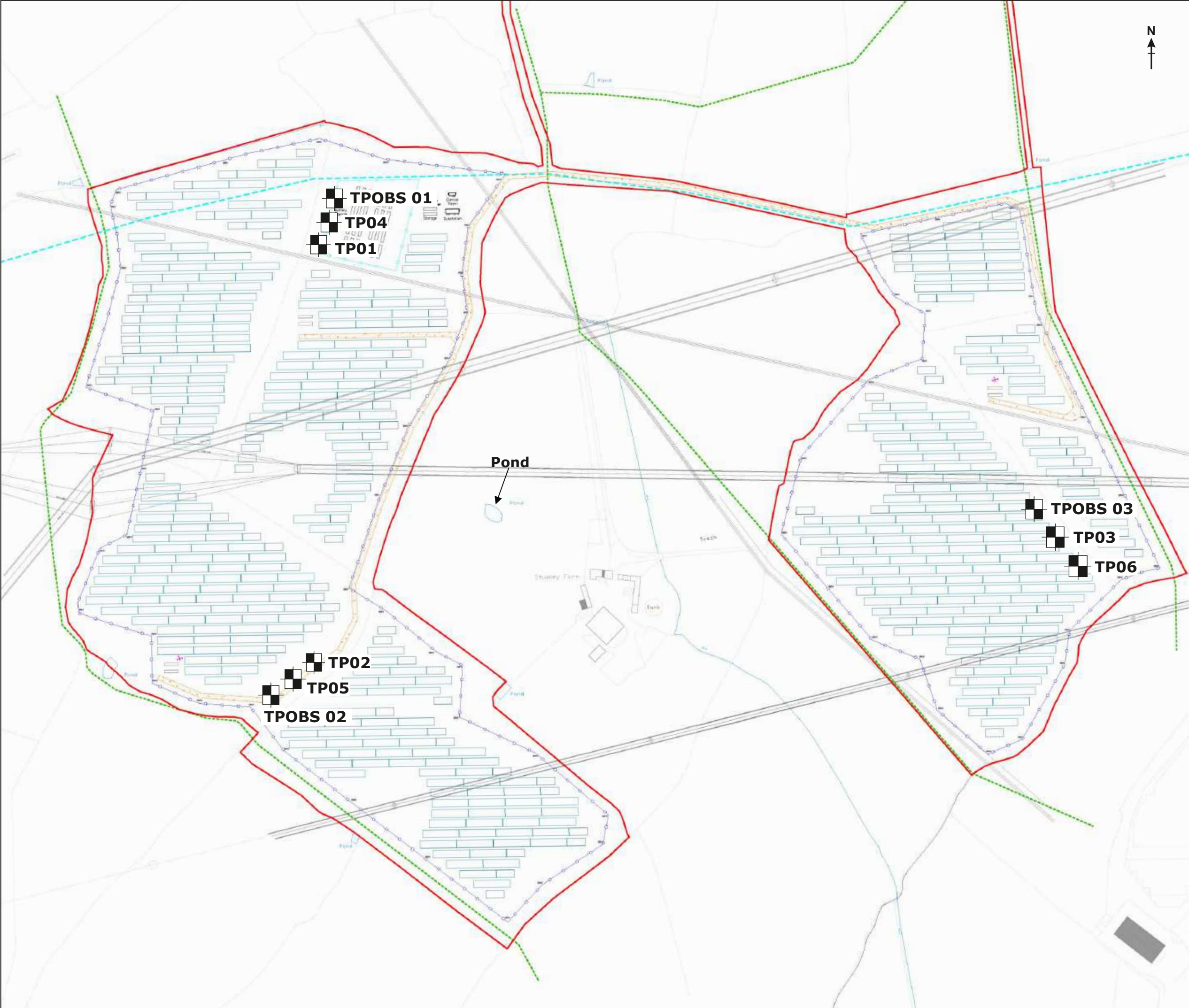
Soakaway Test Results - TP06



APPENDIX D

SOAKAWAY TEST LOCATION PLAN





LEGEND:

 Soakaway Test Location/
Trial Pit

NOTES:

Drawn on plan supplied by client

Job Title:	Proposed Solar Farm at Studley Farm, Atworth, Melksham, Wiltshire
Drawing Title:	Soakaway Test Location Plan
Client:	RMA Environmental
 Ruddlesden geotechnical Ltd The Stables 65 Langaton Lane Pinhoe Exeter EX1 3SP www.ruddlesden.co.uk	
Dwg. No:	21264/01
Date:	June 2021
Scale:	NTS

Appendix C: Surface Water Drainage Strategy (Pitman Associates, 2025)

PURPOSE

The purpose of this Design Statement is to describe how the surface water drainage strategy for the proposed solar farm on land at Studley Farm, Atworth will manage runoff in a manner that will mitigate the risk of flooding and pollution to the environment.

SCOPE

This design addresses runoff from the following areas within the redline planning boundary:

- Any additional runoff from the panels.
- The permanent access tracks within the site.
- The inverter stations.

DESIGN CONSTRAINTS

Percolation tests were carried out in June 2021. Results of the tests indicated there was negligible potential for the disposal of runoff by means of infiltration.

In view of the above it will be necessary to develop a strategy that mimics greenfield runoff rates as far as practicable.

DESIGN STANDARDS

The proposed surface water drainage system is to be designed to ensure that all runoff from the 100year rainfall event is managed as far as practicable in accordance with DEFRA's Technical Standards for Sustainable Drainage Systems.

DESIGN - STRATEGY

Additional Runoff From Panels

Research indicates that an increase in the rate and volume of runoff from extensive areas covered in solar panels is negligible.

However, to mitigate any potential risk it is proposed to provide swales and basins to intercept runoff from the covered areas. These swales will be located to intercept overland flows from as much of the area as practicable.

The proposed drainage strategy for runoff from the panels is shown on drawing DR-001 in Appendix B.

The maximum likely additional volume of runoff has been established using the MicroDrainage software - refer to the calculation included in Appendix A.

Inverter Stations

Inverter stations comprise a 30m² plan area storage container sited on a 38.4m² x 0.3m deep granular sub-base. It is proposed to construct the sub-base above a permeable membrane and allow runoff to percolate into the ground as far as practicable. Any excess runoff will overflow the perimeter of the sub-base at rates approximating greenfield rates and be intercepted by the proposed swales.

The proposed drainage strategy for runoff from the inverter stations is shown on drawing DR-001 in Appendix B.

Permanent Access Tracks Within the Site

Proposed permanent access tracks will be constructed of permeable materials, such that runoff from the tracks will mimic greenfield conditions. The tracks will be constructed in accordance with the best practice principles set out in CIRIA C768, Guidance on the Construction of SuDS.

APPENDIX A

CALCULATIONS

1. Additional volume of runoff generated by solar panels
2. Design of swales
3. Design of basins
4. Design of proposed inverter stations

1. Additional volume of runoff generated by solar panels

From DR-001 it can be seen that the panels have been located in 5 sub-catchments.

Simplified MicroDrainage models of each sub-catchment have been used to establish the greenfield runoff volume for the 100yr-6hr rainfall event with a simulation time of 2days. The additional volume of runoff from each of these sub-catchments was then estimated by increasing the site area by 1%. The model printouts for Sub-catchment 1 are included below. The results for all sub-catchments are summarised in the following table.

PRE-DEVELOPMENT RUNOFF			POST-DEVELOPMENT RUNOFF			INCREASE IN RUNOFF VOLUME (m ³) (45%)
VOLUME (m ³)			VOLUME (m ³) (45%)			
100yr-6hr			100yr-6hr			
Ref	Area (ha)	(m3)	Ref	Area (ha)	(m3)	
1	2.318	656	1	2.341	960	304
2	1.001	283	2	1.011	415	132
3	6.455	1831	3	6.520	2655	824
4	3.041	869	4	3.071	1260	391
5	5.523	1565	5	5.578	2295	730

2. Design of Swales

Swales have been designed to provide the volume of storage identified in calculation 1 above.

It is recognised that infiltration rates might not be sufficient to discharge the entire volume retained within each swale following major rainfall events. However, given the uncertainty as to whether or not there will be an increase in the rates and volume of runoff from the solar panels, the following approach is considered appropriate, as dispersion by means of evapotranspiration is also feasible given the shallow depths of attenuation.

It is proposed to limit the depth of all swales to a maximum of 500mm. To prevent runoff passing along the swale and flowing from the low point at an uncontrolled rate, check dams will be provided as shown in the following sketch. The re-profiled ground level on the lower side of the swale will ensure any excess runoff is discharged as sheet flow.

The following table shows the width and depth of swale proposed for each sub-catchment and confirms that the appropriate volume of storage will be provided.

Area (Ref)	Swale length (m)	Average Gradient	Swale depth (m)	Distance between check dams (m)	Effective Storage Length (m)	Effective Storage (%)	Effective length (m)	Swale width (m)	Average effective cross-sectional area (m ²)	Storage Volume Provided (m ³)	Storage Volume Required (m ³)	Surplus (m ³)
1	180	80	0.50	40.0	38.6	0.97	174	4.00	1.125	195	304	8
1a	80	99	0.50	49.5	48.1	0.97	78	5.00	1.500	117		
2	60	80	0.50	40.0	38.6	0.97	58	7.50	2.438	141	132	9
3	190	110	0.50	55.0	53.6	0.97	185	7.50	2.438	451		
3a basin	approx basin volume									377	824	4
4	65	1000	0.50	500.0	498.6	1.00	65	10.00	3.375	219		
4a basin	approx basin volume									575	391	403
5	120	120	0.50	60.0	58.6	0.98	117	3.00	0.750	88		
5a	120	50	0.50	25.0	23.6	0.94	113	8.00	2.625	297	730	536
5b basin	approx basin volume									465		
5c basin	approx basin volume									350		
5d	20	100	0.50	50.0	48.6	0.97	19	10.00	3.375	66		

Notes

1 & 2 From DR-001

3 = Average gradient x swale depth

4 = Distance between check dams -1.4m (see sketch above)

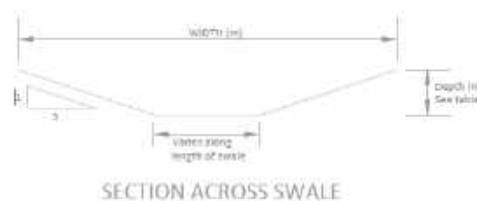
5 = 3 divided by 4

6 = 1 multiplied 5

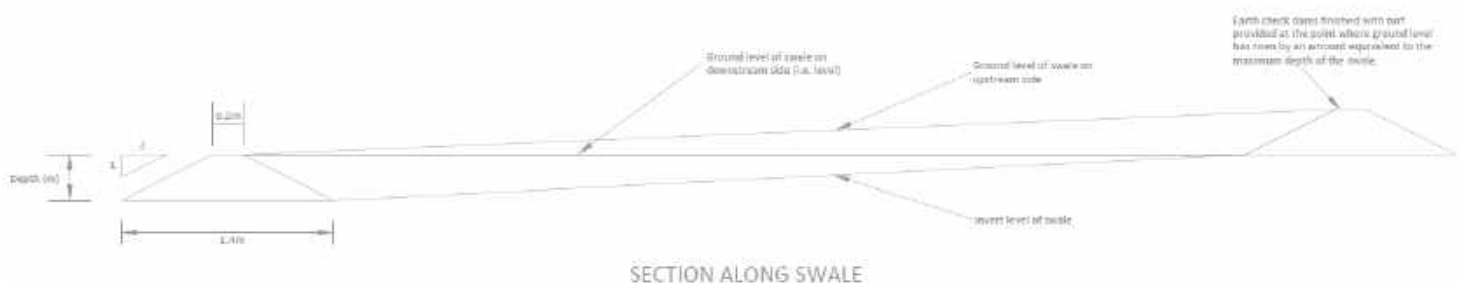
7 = area at midpoint between dams (i.e. point where depth = 50% max depth)

8 = 6 multiplied by 7

9 From calculation 1 above



Sub-catchment	Depth at d/s wall (mm)	Width across top (mm)
1	500	1000
2	500	6400
3	500	8800
4	500	1000
5	500	7200



3. Design of basins

For those sub-catchments where it is not possible to provide all storage in swales, additional storage will be provided in basins. The volume provided in each basin has been established assuming a frustrum. The equation to calculate the volume of a frustrum is:

$$\frac{h}{3}(A_1 + A_2 + \sqrt{A_1 A_2}) \quad \text{where:}$$

h = depth of basin (m)

A_1 = surface area of basin at top water level (m²)

A_2 = surface area of basin at invert level (m²)

4. Design of Proposed inverter stations

The dimensions for each of the drainage blankets are as follows.

12.8m x 3.0m x 0.3m x 0.3 porosity

This provides a volume of 3.456m³ of attenuation.

The table below shows this is sufficient capacity to store all runoff for durations up to the 10hr event for the 30yr+45% return period. The same table also shows sufficient capacity to store all runoff up to the 3hr duration for the 100yr+45% return period. Excess runoff from longer duration events will be conveyed as sheet flow approximating to greenfield runoff rates.

Storm event (Mins)	Rain (mm/hr) (100yr)	rainfall depth (mm) (100yr)	Total volume of runoff (m3) (100yr)	Rain (mm/hr) (30yr)	rainfall depth (mm) (30yr)	Total volume of runoff (m3) (30yr)
15	148.397	37.09925	1.4246112	114.371	28.59275	1.0979616
30	96.86	48.43	1.859717	74.15	37.075	1.42368
60	60.447	60.447	2.3211648	45.992	45.992	1.7660928
120	36.735	73.47	2.021240	28.194	56.388	2.1652992
180	27.617	82.851	3.1814784	21.18	63.54	2.439936
240	22.587	90.348	3.4693632	17.266	69.064	2.6520576
360	17	102	3.9168	12.885	77.31	2.968704
480	13.846	110.784	4.2541056	10.43	83.44	3.204096
600	11.764	117.64	4.517376	8.827	88.27	3.389568
720	10.266	123.192	4.7305728	7.687	92.244	3.5421696
960	8.224	131.584	5.0528256	6.153	98.448	3.7804032
1440	5.925	142.2	5.46048	4.454	106.896	4.1048064
2160	4.192	150.912	5.7950208	3.19	114.84	4.409856
2880	3.262	156.576	6.0125184	2.516	120.768	4.6374912
4320	2.276	163.872	6.2926848	1.808	130.176	4.9987584
5760	1.769	169.824	6.5212416	1.441	138.336	5.3121024
7200	1.467	176.04	6.759936	1.221	146.52	5.626368
8640	1.266	182.304	7.0004736	1.074	154.656	5.9387904
10080	1.124	188.832	7.2511488	0.969	162.792	6.2512128

APPENDIX B

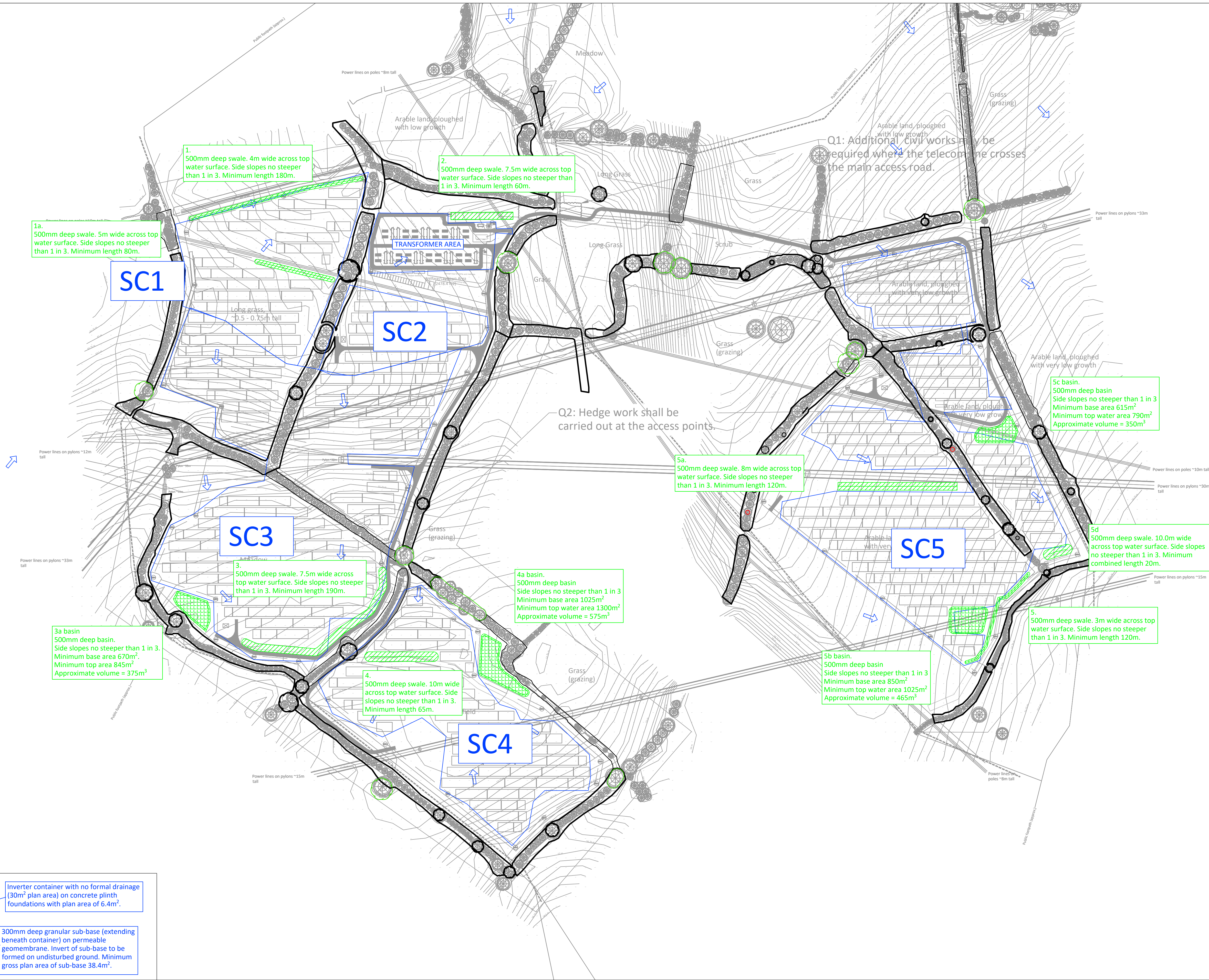
DRAWINGS

DR-001 Surface Water Drainage Strategy & Inverter Stations
DR-002 Swale Detail

(solar) North
Grid North
(OSGB36)

0.15° grid-convergence
angle
True North is 0.15°
CLOCKWISE of Grid
North
(Calculated using
Ordnance Survey
projection and
transformation
calculation tool, v.3.36.
t-T correction = 0.00)

True South | Grid South

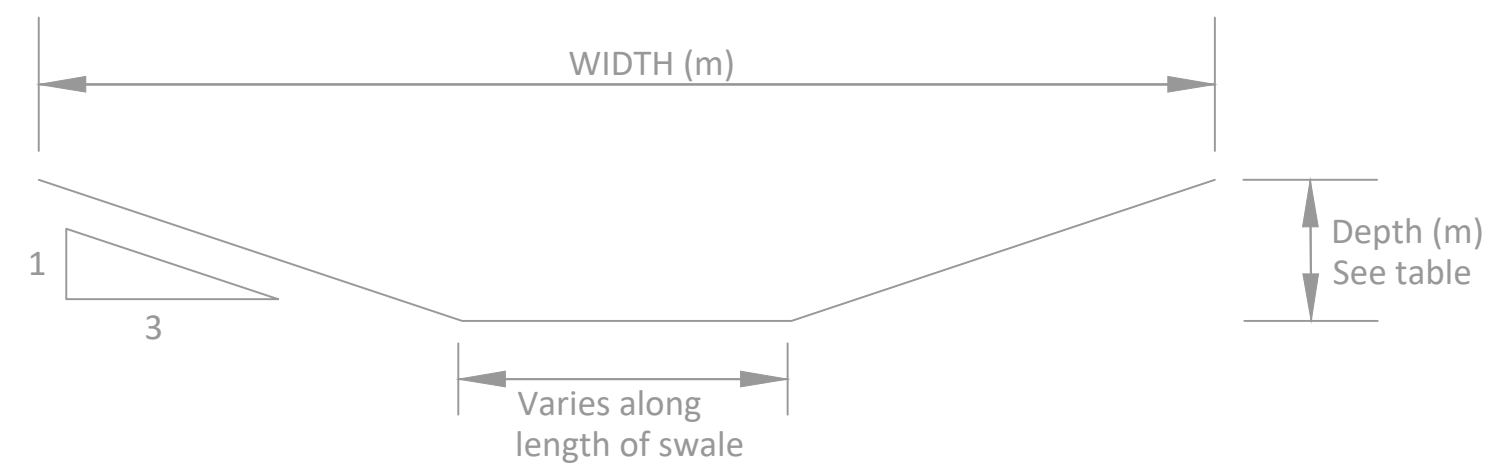
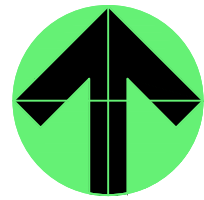


NOTES
1. See DR-002 for details of swales.

B	28.02.2025	FOR CONDITION
A	27.07.2021	INITIAL ISSUE
REV	DATE	DESCRIPTION
CLIENT:		

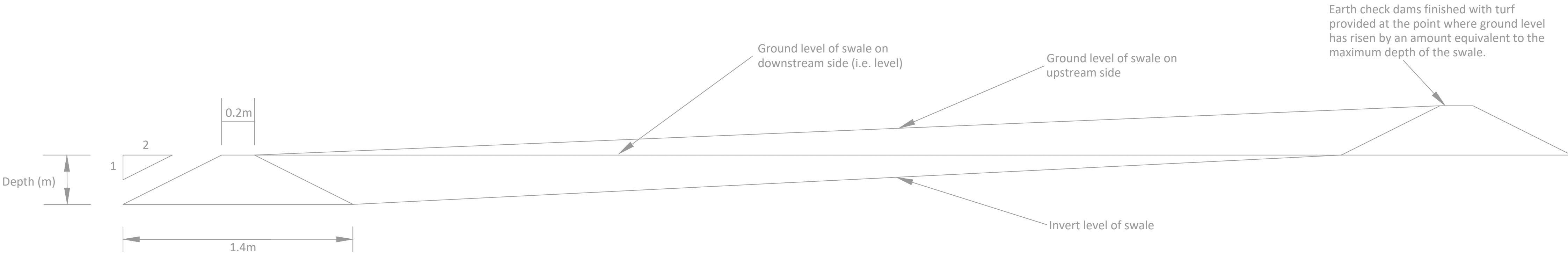
PROJECT: STUDLEY SOLAR FARM		
TITLE: SURFACE WATER DRAINAGE LAYOUT		
REV: B	PROJECT No: 0536	DRAWING No: DR-001
SCALE @ A1: 1:2000		





SECTION ACROSS SWALE

Sub-catchment	Depth at d/s end (mm)	Width across top (mm)
1	300	5000
2	300	6400
3	500	6800
4	350	5000
5	500	7200



SECTION ALONG SWALE

NOTES
1. See DR-001 for location of swales.

A 27.07.2021 INITIAL ISSUE		PROJECT: STUDLEY SOLAR FARM	
REV DATE DESCRIPTION		TITLE: SWALE DETAILS	
CLIENT:		REV: A	PROJECT No: 0536
		DRAWING No: DR-002	
		SCALE @ A1: NTS	



STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	50.000	1.000	50.0	0.000	5.00	0.0	0.600	o	600	Pipe/Conduit	
S1.001	50.000	0.855	58.5	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	75.00	5.24	59.000	0.000	0.0	0.0	0.0	3.45	975.3	0.0
S1.001	75.00	5.50	58.000	0.000	0.0	0.0	0.0	3.19	901.6	0.0

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	60.000	1.000	Open Manhole	1500	S1.000	59.000	600				
S2	59.000	1.000	Open Manhole	1500	S1.001	58.000	600	S1.000	58.000	600	
S	58.000	0.855	Open Manhole	0		OUTFALL		S1.001	57.145	600	

No coordinates have been specified, layout information cannot be produced.

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South Lodge Exminster Devon EX6 8AT		
Date 29/11/2024 13:40 File SC1.MDX	Designed by Karl Checked by	
XP Solutions	Network 2020.1	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd	Diam	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	Sect	(mm)	Name	(m)	(m)	(m)	Connection	(mm)
S1.000	o	600	S1	60.000	59.000	0.400	Open Manhole	1500
S1.001	o	600	S2	59.000	58.000	0.400	Open Manhole	1500

Downstream Manhole

PN	Length	Slope	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	(m)	(1:X)	Name	(m)	(m)	(m)	Connection	(mm)
S1.000	50.000	50.0	S2	59.000	58.000	0.400	Open Manhole	1500
S1.001	50.000	58.5	S	58.000	57.145	0.255	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall	Outfall	C. Level	I. Level	Min	D,L	W
Pipe Number	Name	(m)	(m)	I. Level (m)	(mm)	(mm)
S1.001	S	58.000	57.145	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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)	2880
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	6

Number of Input Hydrographs 1 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	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 387050 164850 ST 87050 64850
C (1km)	-0.024
D1 (1km)	0.374
D2 (1km)	0.426
D3 (1km)	0.217
E (1km)	0.279
F (1km)	2.476
Summer Storms	No
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	360

Designed by Karl
Checked by



Network 2020.1

```
Margin for Flood Risk Warning (mm) 300.0      DVD Status OFF
      Analysis Timestep   Fine Inertia Status OFF
      DTS Status          ON
```

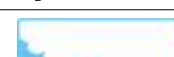
PN	US/MH Name	Water	Surcharged	Flooded			Half Drain	Pipe	Status
		Level	Depth	Volume	Flow /	Overflow	Time	Flow	
		(m)	(m)	(m³)	Cap.	(l/s)	(mins)	(l/s)	
S1.000	S1	59.075	-0.525	0.000	0.04			32.1	OK
S1.001	S2	58.077	-0.523	0.000	0.04			32.1	OK

Input Variables

FEH Rainfall Version	1999
Site Location GB 387050 164850 ST 87050 64850	
C	-0.02422
D1	0.37398
D2	0.42436
D3	0.22103
E	0.28136
F	2.46659
Area (Ha)	2.318
SAAR (mm)	774
CWI	114.548
Urban (1990)	0.0549
SPR	32.940
DPSBAR	17.300
DPLBAR	1.110
PROPWET	0.340
LAG (hrs)	0.000
Base Flow (l/s)	(Calculated)
Areal Reduction Factor	1.000
BFIHOST	0.498
FARL	1.000

TP(0) (mins)	174	TPt (mins)	183	TB (mins)	461	PR (%)	36.237
T (mins)	18	Q (l/s)	16.7	Base Flow (l/s)	0.5		

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
6	0.5	66	1.1	126	3.3	186	9.3	246	19.0	306	28.2	366	32.1	426	28.5
12	0.5	72	1.3	132	3.7	192	10.2	252	20.0	312	28.9	372	32.1	432	27.8
18	0.5	78	1.4	138	4.1	198	11.1	258	21.0	318	29.7	378	31.9	438	27.2
24	0.6	84	1.6	144	4.6	204	12.0	264	22.0	324	30.2	384	31.7	444	26.5
30	0.6	90	1.8	150	5.1	210	13.0	270	22.9	330	30.8	390	31.4	450	25.8
36	0.7	96	1.9	156	5.6	216	13.9	276	23.9	336	31.3	396	31.0	456	25.1
42	0.8	102	2.1	162	6.3	222	14.9	282	24.9	342	31.6	402	30.6	462	24.4
48	0.8	108	2.4	168	7.0	228	15.9	288	25.7	348	31.8	408	30.2	468	23.6
54	0.9	114	2.7	174	7.7	234	16.9	294	26.6	354	32.1	414	29.6	474	22.9
60	1.0	120	2.9	180	8.5	240	17.9	300	27.5	360	32.1	420	29.0	480	22.1

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XP Solutions		Network 2020.1

Input Hydrograph Manhole S1, DS/PN S1.000 (Storm)
360 minute 100 year Winter
Input Hydrograph Type: FEH Dynamic

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
486	21.3	786	0.5	1086	0.5	1386	0.5	1686	0.5	1986	0.5	2286	0.5	2586	0.5
492	20.5	792	0.5	1092	0.5	1392	0.5	1692	0.5	1992	0.5	2292	0.5	2592	0.5
498	19.7	798	0.5	1098	0.5	1398	0.5	1698	0.5	1998	0.5	2298	0.5	2598	0.5
504	18.9	804	0.5	1104	0.5	1404	0.5	1704	0.5	2004	0.5	2304	0.5	2604	0.5
510	18.1	810	0.5	1110	0.5	1410	0.5	1710	0.5	2010	0.5	2310	0.5	2610	0.5
516	17.3	816	0.5	1116	0.5	1416	0.5	1716	0.5	2016	0.5	2316	0.5	2616	0.5
522	16.5	822	0.5	1122	0.5	1422	0.5	1722	0.5	2022	0.5	2322	0.5	2622	0.5
528	15.7	828	0.5	1128	0.5	1428	0.5	1728	0.5	2028	0.5	2328	0.5	2628	0.5
534	14.8	834	0.5	1134	0.5	1434	0.5	1734	0.5	2034	0.5	2334	0.5	2634	0.5
540	14.0	840	0.5	1140	0.5	1440	0.5	1740	0.5	2040	0.5	2340	0.5	2640	0.5
546	13.2	846	0.5	1146	0.5	1446	0.5	1746	0.5	2046	0.5	2346	0.5	2646	0.5
552	12.4	852	0.5	1152	0.5	1452	0.5	1752	0.5	2052	0.5	2352	0.5	2652	0.5
558	11.7	858	0.5	1158	0.5	1458	0.5	1758	0.5	2058	0.5	2358	0.5	2658	0.5
564	10.9	864	0.5	1164	0.5	1464	0.5	1764	0.5	2064	0.5	2364	0.5	2664	0.5
570	10.2	870	0.5	1170	0.5	1470	0.5	1770	0.5	2070	0.5	2370	0.5	2670	0.5
576	9.5	876	0.5	1176	0.5	1476	0.5	1776	0.5	2076	0.5	2376	0.5	2676	0.5
582	8.8	882	0.5	1182	0.5	1482	0.5	1782	0.5	2082	0.5	2382	0.5	2682	0.5
588	8.1	888	0.5	1188	0.5	1488	0.5	1788	0.5	2088	0.5	2388	0.5	2688	0.5
594	7.5	894	0.5	1194	0.5	1494	0.5	1794	0.5	2094	0.5	2394	0.5	2694	0.5
600	6.9	900	0.5	1200	0.5	1500	0.5	1800	0.5	2100	0.5	2400	0.5	2700	0.5
606	6.2	906	0.5	1206	0.5	1506	0.5	1806	0.5	2106	0.5	2406	0.5	2706	0.5
612	5.7	912	0.5	1212	0.5	1512	0.5	1812	0.5	2112	0.5	2412	0.5	2712	0.5
618	5.2	918	0.5	1218	0.5	1518	0.5	1818	0.5	2118	0.5	2418	0.5	2718	0.5
624	4.7	924	0.5	1224	0.5	1524	0.5	1824	0.5	2124	0.5	2424	0.5	2724	0.5
630	4.3	930	0.5	1230	0.5	1530	0.5	1830	0.5	2130	0.5	2430	0.5	2730	0.5
636	3.9	936	0.5	1236	0.5	1536	0.5	1836	0.5	2136	0.5	2436	0.5	2736	0.5
642	3.5	942	0.5	1242	0.5	1542	0.5	1842	0.5	2142	0.5	2442	0.5	2742	0.5
648	3.2	948	0.5	1248	0.5	1548	0.5	1848	0.5	2148	0.5	2448	0.5	2748	0.5
654	2.9	954	0.5	1254	0.5	1554	0.5	1854	0.5	2154	0.5	2454	0.5	2754	0.5
660	2.6	960	0.5	1260	0.5	1560	0.5	1860	0.5	2160	0.5	2460	0.5	2760	0.5
666	2.3	966	0.5	1266	0.5	1566	0.5	1866	0.5	2166	0.5	2466	0.5	2766	0.5
672	2.1	972	0.5	1272	0.5	1572	0.5	1872	0.5	2172	0.5	2472	0.5	2772	0.5
678	1.9	978	0.5	1278	0.5	1578	0.5	1878	0.5	2178	0.5	2478	0.5	2778	0.5
684	1.7	984	0.5	1284	0.5	1584	0.5	1884	0.5	2184	0.5	2484	0.5	2784	0.5
690	1.6	990	0.5	1290	0.5	1590	0.5	1890	0.5	2190	0.5	2490	0.5	2790	0.5
696	1.4	996	0.5	1296	0.5	1596	0.5	1896	0.5	2196	0.5	2496	0.5	2796	0.5
702	1.3	1002	0.5	1302	0.5	1602	0.5	1902	0.5	2202	0.5	2502	0.5	2802	0.5
708	1.2	1008	0.5	1308	0.5	1608	0.5	1908	0.5	2208	0.5	2508	0.5	2808	0.5
714	1.1	1014	0.5	1314	0.5	1614	0.5	1914	0.5	2214	0.5	2514	0.5	2814	0.5
720	1.0	1020	0.5	1320	0.5	1620	0.5	1920	0.5	2220	0.5	2520	0.5	2820	0.5
726	0.9	1026	0.5	1326	0.5	1626	0.5	1926	0.5	2226	0.5	2526	0.5	2826	0.5
732	0.8	1032	0.5	1332	0.5	1632	0.5	1932	0.5	2232	0.5	2532	0.5	2832	0.5
738	0.8	1038	0.5	1338	0.5	1638	0.5	1938	0.5	2238	0.5	2538	0.5	2838	0.5
744	0.7	1044	0.5	1344	0.5	1644	0.5	1944	0.5	2244	0.5	2544	0.5	2844	0.5
750	0.7	1050	0.5	1350	0.5	1650	0.5	1950	0.5	2250	0.5	2550	0.5	2850	0.5
756	0.6	1056	0.5	1356	0.5	1656	0.5	1956	0.5	2256	0.5	2556	0.5	2856	0.5
762	0.6	1062	0.5	1362	0.5	1662	0.5	1962	0.5	2262	0.5	2562	0.5	2862	0.5
768	0.5	1068	0.5	1368	0.5	1668	0.5	1968	0.5	2268	0.5	2568	0.5	2868	0.5
774	0.5	1074	0.5	1374	0.5	1674	0.5	1974	0.5	2274	0.5	2574	0.5	2874	0.5
780	0.5	1080	0.5	1380	0.5	1680	0.5	1980	0.5	2280	0.5	2580	0.5	2880	0.5

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	50.000	1.000	50.0	0.000	5.00	0.0	0.600	o	600	Pipe/Conduit	
S1.001	50.000	0.855	58.5	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	75.00	5.24	59.000	0.000	0.0	0.0	0.0	3.45	975.3	0.0
S1.001	75.00	5.50	58.000	0.000	0.0	0.0	0.0	3.19	901.6	0.0

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	60.000	1.000	Open Manhole	1500	S1.000	59.000	600				
S2	59.000	1.000	Open Manhole	1500	S1.001	58.000	600	S1.000	58.000	600	
S	58.000	0.855	Open Manhole	0		OUTFALL		S1.001	57.145	600	

No coordinates have been specified, layout information cannot be produced.

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd	Diam	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	Sect	(mm)	Name	(m)	(m)	(m)	Connection	(mm)
S1.000	o	600	S1	60.000	59.000	0.400	Open Manhole	1500
S1.001	o	600	S2	59.000	58.000	0.400	Open Manhole	1500

Downstream Manhole

PN	Length	Slope	MH	C.Level	I.Level	D.Depth	MH	MH DIAM., L*W
	(m)	(1:X)	Name	(m)	(m)	(m)	Connection	(mm)
S1.000	50.000	50.0	S2	59.000	58.000	0.400	Open Manhole	1500
S1.001	50.000	58.5	S	58.000	57.145	0.255	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall	Outfall	C. Level	I. Level	Min	D,L	W
Pipe Number	Name	(m)	(m)	I. Level (m)	(mm)	(mm)

S1.001	S	58.000	57.145	0.000	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	45.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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)	2880
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	6

Number of Input Hydrographs 1 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	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 387050 164850 ST 87050 64850
C (1km)	-0.024
D1 (1km)	0.374
D2 (1km)	0.426
D3 (1km)	0.217
E (1km)	0.279
F (1km)	2.476
Summer Storms	No
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	360



Network 2020.1

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Margin for Flood Risk Warning (mm) 300.0      DVD Status OFF
      Analysis Timestep   Fine Inertia Status OFF
      DTS Status          ON
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PN	US/MH Name	Water	Surcharged	Flooded			Half Drain	Pipe	Status
		Level	Depth	Volume	Flow /	Overflow	Time	Flow	
		(m)	(m)	(m³)	Cap.	(l/s)	(mins)	(l/s)	
S1.000	S1	59.090	-0.510	0.000	0.06			47.1	OK
S1.001	S2	58.094	-0.506	0.000	0.06			47.1	OK

Input Variables

FEH Rainfall Version	1999
Site Location GB 387050 164850 ST 87050 64850	
C	-0.02422
D1	0.37398
D2	0.42436
D3	0.22103
E	0.28136
F	2.46659
Area (Ha)	2.341
SAAR (mm)	774
CWI	114.548
Urban (1990)	0.0549
SPR	32.940
DPSBAR	17.300
DPLBAR	1.110
PROPWET	0.340
LAG (hrs)	0.000
Base Flow (l/s)	(Calculated)
Areal Reduction Factor	1.000
BFIHOST	0.498
FARL	1.000

TP(0) (mins)	174	TPt (mins)	183	TB (mins)	461	PR (%)	36.237
T (mins)	18	Q (l/s)	16.9	Base Flow (l/s)	0.5		

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
6	0.5	66	1.2	126	3.3	186	9.4	246	19.1	306	28.5	366	32.5	426	28.8
12	0.5	72	1.3	132	3.7	192	10.3	252	20.2	312	29.2	372	32.5	432	28.1
18	0.5	78	1.4	138	4.1	198	11.2	258	21.2	318	30.0	378	32.2	438	27.4
24	0.6	84	1.6	144	4.6	204	12.1	264	22.2	324	30.5	384	32.0	444	26.8
30	0.6	90	1.8	150	5.2	210	13.1	270	23.2	330	31.1	390	31.7	450	26.1
36	0.7	96	2.0	156	5.7	216	14.1	276	24.1	336	31.6	396	31.3	456	25.3
42	0.8	102	2.2	162	6.4	222	15.1	282	25.1	342	31.9	402	30.9	462	24.6
48	0.8	108	2.4	168	7.1	228	16.1	288	26.0	348	32.2	408	30.5	468	23.8
54	0.9	114	2.7	174	7.7	234	17.1	294	26.9	354	32.4	414	29.9	474	23.1
60	1.1	120	3.0	180	8.6	240	18.1	300	27.8	360	32.4	420	29.3	480	22.3

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Input Hydrograph Manhole S1, DS/PN S1.000 (Storm)
360 minute 100 year Winter
Input Hydrograph Type: FEH Dynamic

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
486	21.5	786	0.5	1086	0.5	1386	0.5	1686	0.5	1986	0.5	2286	0.5	2586	0.5
492	20.7	792	0.5	1092	0.5	1392	0.5	1692	0.5	1992	0.5	2292	0.5	2592	0.5
498	19.9	798	0.5	1098	0.5	1398	0.5	1698	0.5	1998	0.5	2298	0.5	2598	0.5
504	19.1	804	0.5	1104	0.5	1404	0.5	1704	0.5	2004	0.5	2304	0.5	2604	0.5
510	18.3	810	0.5	1110	0.5	1410	0.5	1710	0.5	2010	0.5	2310	0.5	2610	0.5
516	17.5	816	0.5	1116	0.5	1416	0.5	1716	0.5	2016	0.5	2316	0.5	2616	0.5
522	16.6	822	0.5	1122	0.5	1422	0.5	1722	0.5	2022	0.5	2322	0.5	2622	0.5
528	15.8	828	0.5	1128	0.5	1428	0.5	1728	0.5	2028	0.5	2328	0.5	2628	0.5
534	15.0	834	0.5	1134	0.5	1434	0.5	1734	0.5	2034	0.5	2334	0.5	2634	0.5
540	14.2	840	0.5	1140	0.5	1440	0.5	1740	0.5	2040	0.5	2340	0.5	2640	0.5
546	13.4	846	0.5	1146	0.5	1446	0.5	1746	0.5	2046	0.5	2346	0.5	2646	0.5
552	12.6	852	0.5	1152	0.5	1452	0.5	1752	0.5	2052	0.5	2352	0.5	2652	0.5
558	11.8	858	0.5	1158	0.5	1458	0.5	1758	0.5	2058	0.5	2358	0.5	2658	0.5
564	11.0	864	0.5	1164	0.5	1464	0.5	1764	0.5	2064	0.5	2364	0.5	2664	0.5
570	10.3	870	0.5	1170	0.5	1470	0.5	1770	0.5	2070	0.5	2370	0.5	2670	0.5
576	9.6	876	0.5	1176	0.5	1476	0.5	1776	0.5	2076	0.5	2376	0.5	2676	0.5
582	8.9	882	0.5	1182	0.5	1482	0.5	1782	0.5	2082	0.5	2382	0.5	2682	0.5
588	8.2	888	0.5	1188	0.5	1488	0.5	1788	0.5	2088	0.5	2388	0.5	2688	0.5
594	7.6	894	0.5	1194	0.5	1494	0.5	1794	0.5	2094	0.5	2394	0.5	2694	0.5
600	6.9	900	0.5	1200	0.5	1500	0.5	1800	0.5	2100	0.5	2400	0.5	2700	0.5
606	6.3	906	0.5	1206	0.5	1506	0.5	1806	0.5	2106	0.5	2406	0.5	2706	0.5
612	5.8	912	0.5	1212	0.5	1512	0.5	1812	0.5	2112	0.5	2412	0.5	2712	0.5
618	5.3	918	0.5	1218	0.5	1518	0.5	1818	0.5	2118	0.5	2418	0.5	2718	0.5
624	4.7	924	0.5	1224	0.5	1524	0.5	1824	0.5	2124	0.5	2424	0.5	2724	0.5
630	4.3	930	0.5	1230	0.5	1530	0.5	1830	0.5	2130	0.5	2430	0.5	2730	0.5
636	3.9	936	0.5	1236	0.5	1536	0.5	1836	0.5	2136	0.5	2436	0.5	2736	0.5
642	3.5	942	0.5	1242	0.5	1542	0.5	1842	0.5	2142	0.5	2442	0.5	2742	0.5
648	3.2	948	0.5	1248	0.5	1548	0.5	1848	0.5	2148	0.5	2448	0.5	2748	0.5
654	2.9	954	0.5	1254	0.5	1554	0.5	1854	0.5	2154	0.5	2454	0.5	2754	0.5
660	2.6	960	0.5	1260	0.5	1560	0.5	1860	0.5	2160	0.5	2460	0.5	2760	0.5
666	2.4	966	0.5	1266	0.5	1566	0.5	1866	0.5	2166	0.5	2466	0.5	2766	0.5
672	2.1	972	0.5	1272	0.5	1572	0.5	1872	0.5	2172	0.5	2472	0.5	2772	0.5
678	1.9	978	0.5	1278	0.5	1578	0.5	1878	0.5	2178	0.5	2478	0.5	2778	0.5
684	1.8	984	0.5	1284	0.5	1584	0.5	1884	0.5	2184	0.5	2484	0.5	2784	0.5
690	1.6	990	0.5	1290	0.5	1590	0.5	1890	0.5	2190	0.5	2490	0.5	2790	0.5
696	1.4	996	0.5	1296	0.5	1596	0.5	1896	0.5	2196	0.5	2496	0.5	2796	0.5
702	1.3	1002	0.5	1302	0.5	1602	0.5	1902	0.5	2202	0.5	2502	0.5	2802	0.5
708	1.2	1008	0.5	1308	0.5	1608	0.5	1908	0.5	2208	0.5	2508	0.5	2808	0.5
714	1.1	1014	0.5	1314	0.5	1614	0.5	1914	0.5	2214	0.5	2514	0.5	2814	0.5
720	1.0	1020	0.5	1320	0.5	1620	0.5	1920	0.5	2220	0.5	2520	0.5	2820	0.5
726	0.9	1026	0.5	1326	0.5	1626	0.5	1926	0.5	2226	0.5	2526	0.5	2826	0.5
732	0.8	1032	0.5	1332	0.5	1632	0.5	1932	0.5	2232	0.5	2532	0.5	2832	0.5
738	0.8	1038	0.5	1338	0.5	1638	0.5	1938	0.5	2238	0.5	2538	0.5	2838	0.5
744	0.7	1044	0.5	1344	0.5	1644	0.5	1944	0.5	2244	0.5	2544	0.5	2844	0.5
750	0.7	1050	0.5	1350	0.5	1650	0.5	1950	0.5	2250	0.5	2550	0.5	2850	0.5
756	0.6	1056	0.5	1356	0.5	1656	0.5	1956	0.5	2256	0.5	2556	0.5	2856	0.5
762	0.6	1062	0.5	1362	0.5	1662	0.5	1962	0.5	2262	0.5	2562	0.5	2862	0.5
768	0.5	1068	0.5	1368	0.5	1668	0.5	1968	0.5	2268	0.5	2568	0.5	2868	0.5
774	0.5	1074	0.5	1374	0.5	1674	0.5	1974	0.5	2274	0.5	2574	0.5	2874	0.5
780	0.5	1080	0.5	1380	0.5	1680	0.5	1980	0.5	2280	0.5	2580	0.5	2880	0.5