Gate Burton Energy Park Environmental Statement

Volume 3, Appendix 9-C: Outline Drainage Strategy
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Gate Burton Energy Park Limited

Prepared for:

Gate Burton Energy Park Limited

Prepared by:

AECOM Limited

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1. Introduction

1.1 Background

1.1.1 This Outline Drainage Strategy has been prepared in support of the Environmental Statement for Gate Burton Energy Park (hereafter referred to as 'the Scheme').

1.1.2 The Order limits comprises the Solar and Energy Storage Park and the Grid Connection Corridor. Refer to **ES Volume 2: Figure 9-1 [EN010131/APP/3.2]** which shows the Order limits in relation to water environment attributes.

1.1.3 Full details of the various Scheme components are provided in **ES Volume 1, Chapter 2: The Scheme [EN010131/APP/3.1]**.

1.1.4 In summary, the Scheme core components comprise:

- PV tables (mounting structures) and panels;
- Inverters;
- Transformers;
- An on-site Substation;
- Onsite cabling;
- A Battery and Energy Storage System (BESS);
- An underground 7.5km 400kV electrical connection to the National Grid Substation at Cottam Power Station;
- Fencing and security measures;
- Access tracks; and
- Landscaping and biodiversity enhancement.

1.1.5 During the construction phase, one main construction compound and three secondary compounds will be established as well as mobile welfare units and smaller compound areas together with temporary roadways to facilitate access to all land within the Solar and Energy Storage Park.

1.1.6 This Outline Drainage Strategy sets out the outline drainage strategy for the Scheme, with regards to handling surface water generated within the Solar and Energy Storage Park.

1.1.7 No long term drainage strategy is proposed for the Grid Connection Corridor, as they were deemed to not contribute any runoff to the drainage system; the cables will be buried, and the routes will be restored to greenfield conditions. The **Framework Construction Environment Management Plan (CEMP) [EN010131/APP/7.3]** has been developed which details the measures to manage surface water runoff during the construction phase and will be secured by a requirement of the draft DCO. Refer to Section 3.2 for discussion on construction phase SuDS approach and pollution prevention measures.

1.2 Design Assumptions

1.2.1 The following design assumptions have been used to produce this assessment:

- The drainage system has been designed to accommodate the 1 in 100-year storm, plus a 40% allowance for an increase in peak rainfall intensity due to climate change, including a 300mm freeboard allowance.
- An infiltration rate of 1 x 10-5 m/s has been assumed. This is based on a conservative infiltration rate estimation for soil suitable for infiltration, referenced from CIRIA SuDS Manual (C753). The Soilscape map viewer (Ref. 4), for the site, describes the soils beneath the Solar and Energy Storage Park as '*Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils*'. Further details on the soil type can be found in **ES Volume 1, Chapter 9: Water Environment [EN010131/APP/3.1].**
- A Volumetric Runoff Coefficient (Cv) of 1 has been used in this design for impermeable area. The percentage impermeable area (PIMP) value was assumed to be 10% equivalent for the solar fields and 100% for the proposed substation and paved areas.
- All swale features will avoid all archaeological sites and will maintain a minimum 10m buffer to watercourses and sensitive sites.
- No permanent water features are proposed. Surface water runoff will largely collect at existing low spots and infiltrate to ground, as existing.
- Flood Studies Report (FSR) rainfall data has been used for this assessment.
- Access tracks across the Order limits will be of an unbound, granular, permeable material such as Type 2 subbase, with surface water runoff draining at source, with no increase in impermeable area.

2. Supporting Information

2.1 Flood Risk

2.1.1 The potential flood risk to and from the Scheme is summarised in Table 1 below. For further detail on the Scheme's assessment of flood risk, refer to **ES Volume 3, Appendix 9-D: Flood Risk Assessment [EN010131/APP/3.3].**

Table 1 – Flood Risk Summary for Storage and Energy Storage Park Only

Flood Risk Source	Pre-Development Risk	Post Development Risk	Comments
Fluvial	Low (majority), high (North east side and east boundary, associated with Padmoor drain)	Low (Residual)	The majority of the Solar and Energy Storage Park is located within Flood Zone 1, however the north-east corner of the Solar and Energy Storage Park does cross an area of Flood Risk Zone 2 and 3 associated with Padmoor drain (Ordinary watercourse) along Kexby Lane. Flood zones are illustrated on **ES Volume 2: Figure 9-2 [EN010131/APP/3.2]**. Infrastructure has been sequentially located to areas of lowest risk with no permanent above ground development in Flood Zone 2 or 3. Residual risk of PV panels within Flood Zone 3 has been taken into account with panels raised to a minimum of 0.8m above ground level.
Tidal	Negligible	Negligible	The Solar and Energy Storage Park is not considered at risk of tidal flooding from the River Trent based on a review of the Environment Agency Flood Map.
Pluvial (Surface Water)	Very Low (majority) Low – high (localised shallow patches)	Low	The risk of surface water flooding is generally very low (annual chance of flooding of less than 0.1% AEP) for most of the site, with areas of low (chance of flooding of between 0.1% and 1% AEP), medium (chance of flooding of between 1% and 3.3% AEP) and high risk (chance of flooding of greater than 3.3% AEP) generally associated flow pathways following topographic low points including drains and agricultural ditches (see **ES Volume 2: Figure 9-3 [EN010131/APP/3.2]**), Padmoor Drain, the western side of the railway line embankment and the southern fields draining from the Solar and Energy Storage Park show the greatest extent of potential surface water flooding.

			The water depth associated with both the high and medium risk scenarios (see **ES Volume 2: Figure 9-3a and Figure 9-b [EN010131/APP/3.2])** is generally less than 900mm and very localised. For the low risk (chance of flooding of between 0.1% and 1%) scenario depths only exceed 900mm in only a very limited area see **ES Volume 2: Figure 9-3c [EN010131/APP/3.2])**
Groundwater	Low	Low	The British Geological Survey (BGS) 'Susceptibility to Groundwater flooding' mapping (see **ES Volume 2: Figure 9-5 [EN010131/APP/3.2]** indicates that the majority of the site is classified as having a 'limited potential for groundwater flooding to occur'. However, isolated sections of the site, particularly near Kexby Lane and Clay Farm are categorised as either having the 'potential for groundwater flooding of property situated below ground level' or the 'potential for groundwater flooding to occur at surface'.
Sewers	Very Low	Very Low	The Solar and Energy Storage Park is considered to be at a very low risk of sewer flooding based on location and extent of assets shown in the Anglian Water Drainage & Water Plans.
Artificial Sources	Very Low	Very Low	The Environment Agency Flood Risk from Reservoirs indicates that the Solar and Energy Storage Park is not at risk of flooding in the unlikely event of a failure of a major reservoir. The closest extent associated with reservoir failure is located approximately 250m from the western edge of the Solar and Energy Storage Park at its closest point but is generally greater than 500m. The flood extent associated with the reservoir failure is constrained within the River Trent floodplain with predominant flooding occurring to the west of the River Trent, therefore not affecting the Solar and Energy Storage Park. There are no canals within or near the Solar and Energy Storage Park that are considered a risk. Based on the information available, the Solar and Energy Storage Park is considered to be at very low risk of flooding from artificial sources.

2.2 Existing Drainage

2.2.1 The area within the Scheme boundary is largely greenfield. It consists of a combination of individual trees, hedgerow, tree belts (linear), small woodland block, agricultural fields (arable), farm buildings, a train line, watercourses, dry ditches and farm access tracks. There is currently no known formal piped drainage system within the Scheme boundary, though it is unknown if the railway has any rail track drainage. It is assumed that for low intensity rainfall events, rainfall would infiltrate to ground where it lands. For rainfall events where rainfall intensity exceeds the local rate of infiltration, it is assumed that any runoff generated within the Order limits would naturally flow overland to low spots within the Order limits where it would collect and infiltrate as the event subsides. Where parts of the Order limits interact with watercourses, excess runoff will naturally drain from the catchment into the watercourse.

2.3 Geology and Hydrogeology

2.3.1 The bedrock and superficial geology for the area has been identified from mapping produced by the British Geological Survey online (Ref. 1). These maps indicate Superficial Deposits are absent for portions of the Scheme. However, there are areas of sand and gravel from Glaciofluvial Deposits throughout portions of the Order limits.

2.3.2 The majority of the Bedrock geology seen within the Scheme is Scunthorpe Mudstone Formation and Penarth Group. Both bedrock geologies are sedimentary bedrock formations, consisting of mudstone.

2.3.3 Further information was sought through purchase of the British Geological Survey (BGS) 'Susceptibility to Groundwater flooding' mapping (see **ES Volume 2: Figure 9-5 [EN010131/APP/3.2]).** This dataset consists of strategic mapping that displays areas susceptible to groundwater flooding on a 50m grid. A suite of rules grounded upon geological, hydrogeological, and topographic information, are utilised to classify the grid cells into one of four classes:

- A: Limited potential for groundwater flooding to occur;
- B: Potential for groundwater flooding of property situated below ground level;
- C: Potential for groundwater flooding to occur at surface; and
- Elsewhere (onshore): Not considered to be prone to groundwater flooding.

2.3.4 Comparison with the site boundary of the Solar and Energy Storage Park shows that the majority of the site is classified as Class A, with isolated areas of Class C.

2.3.5 The Soilscape map viewer (Ref. 4), for the site, describes the soils beneath the Solar and Energy Storage Park area of the Scheme as '*Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils*'. Further details on the soil type can be found in **ES Volume 1, Chapter 9: Water Environment [EN010131/APP/3.1].**

3. Proposed Drainage Arrangements

3.1 Design Guidance and Policy

3.1.1 National and Local Planning policy for the DCO submission, relating to flood risk and drainage is discussed in detail within the Flood Risk Assessment; **ES Volume 3: Appendix 9-D [EN010131/APP/3.3]**), which has been consulted in developing this Outline Drainage Strategy.

3.1.2 Salient National and Local Planning policy relating to drainage and climate change is set out below for reference, for the Outline Drainage Strategy:

- National Policy Statement for Energy (NPS EN-1) and Draft NPS EN-1 and Draft NPS EN-3; and
- NPPF (2021) and associated PPG (2022).

3.1.3 DEFRA: Sustainable Drainage Systems - Non-statutory technical standards for sustainable drainage systems:

- Central Lincolnshire Local Plan (2017);
- Lincolnshire County Council SuDS Guidance (2018);
- CIRIA SuDS Manual (C753);
- Bassetlaw District Council Core Strategy (2011); and
- Draft Bassetlaw Local Plan 2020 – 2037 (2021).

3.2 Construction Phase SuDS

3.2.1 Subject to the confirmation of the construction and installation method of the cables along the cable routes, the following guidance shall be applied to the management of surface water runoff during construction:

- DEFRA: Sustainable Drainage Systems - Non-statutory technical standards for sustainable drainage systems;
- The Construction Industry Research and Information Association (CIRIA), Environmental Good Practice on Site (C741);
- CIRIA, The SuDS Manual (C753); and
- CIRIA, Control of Water Pollution from Linear Construction Sites (C649).

3.2.2 Surface water runoff and pollution incidents that could result from construction activities will be mitigated through the implementation of construction phase SuDS and the application of industry good practice as per CIRIA Guidance (C741). To prevent sediment increase in associated runoff during the construction of the Scheme, construction SuDS measures will effectively prevent sediment entering surrounding watercourses by:

- Minimising the level of contaminants being generated such as silt;
- Minimising volume of water entering an excavation such as from rainfall or runoff;

- Preventing contaminated water moving to a river or stream, through silt bunds / silt lagoons for example; and
- Disposing of water that enters the excavation via silt control interventions to treat runoff prior to discharge back into a waterbody.

3.2.3 The implementation of such construction phase mitigation will be captured in Water Management Plan (WMP). The WMP will be a technical appendix to the detailed CEMP. The requirement for a WMP will be secured via the **Framework CEMP [EN010131/APP/7.3]**.

3.3 Surface Water Drainage Strategy

3.3.1 As previously mentioned, the Site is largely a greenfield site. It is considered that rainfall will mostly permeate into the ground where it falls and that any runoff generated within arable fields collects in local low spots where it infiltrates to ground or enter a watercourse as appropriate where the Scheme drainage interacts with one. The proposed surface water drainage strategy, for the Scheme, aims to mimic the natural drainage conditions of the Scheme as much as possible.

3.3.2 The proposed solar PV panels will be held above ground individually on narrow diameter piled legs (<100mm diameter). This prevents sealing the ground with an impermeable surface beneath solar panels allowing rainfall/runoff to infiltrate to ground throughout the Scheme. As a result, it is considered that the Scheme's impermeable area will remain consistent to its pre-development state. All PV panels have been sequentially located within Flood Zone 1 – no panels have been placed within Flood Zone 2 or Flood Zone 3.

3.3.3 To prevent ponding occurring around the solar panels or overland flow routes directing runoff outside of the boundary of the Scheme, a series of swales and infiltration basins will be constructed within the areas proposed for solar PV panels in identified low spots throughout the Scheme to collect and store runoff, allowing it to infiltrate to ground. The locations of the proposed swales and detention basins can be seen in outline drainage drawings 60664324-ACM-ZZ-XX-DR-CE-000001 - 15, in Annex D. Detailed drainage designs and SuDS feature locations will be determined post consent at detailed design stage.

3.3.4 To mitigate potential channelisation of the ground between the solar PV arrays, from surface water runoff, and to promote interception and infiltration potential throughout the Solar PV Array Works Area, the grounds surrounding and between the PV Arrays are proposed to be planted with native species rich grassland and wildflower mix which will act as dripline planting.

3.4 Contributing Areas

3.4.1 The total area contributing to the proposed drainage system is presented in Table 2 below. In calculating this area, the following conservative assumptions were made:

- Heritage, Archaeological Mitigation, Ecology Enhancement and Proposed Woodland areas were deemed to contribute 0% of their total area to runoff, as the areas were deemed too small to contribute to the overall excess runoff and currently drain at source to ground.
- Compound areas would contribute 100% runoff with BESS and Substation areas were deemed to contribute 100% of their total area to runoff.
- As the solar panel fields are greenfield areas, the contributing area for calculations was prorated to represent an effective impermeable area in order to calculate runoff volumes using the MicroDrainage software, as it only allows impermeable areas to include in the calculation. It is generally accepted that 10% of the greenfield area would be a fair representation of the equivalent impermeable area to input into MicroDrainage or other modelling software, to enable a model to analyse greenfield runoff (modelling software does not inherently facilitate greenfield areas as a positive drainage catchment; drainage software defaults to impermeable contributing areas only (i.e. 100% impermeable). As previously mentioned, the solar PV panels will be held above ground on four-legged stands. This will allow most rainfall to infiltrate ground within the solar PV fields, at source, to ground between the maintenance strips between the panels.
- The Grid Connection Corridor is not deemed to contribute any runoff to the drainage system, regarding the long term operation phase of the Scheme. As such, it is deemed that no long term drainage strategy will be required for the Grid Connection Corridor. The proposed cable will be buried, and the greenfield conditions will be restored. The Grid Connection Corridor constitutes 171.66 ha.

Table 2 Contributing Areas

	Area (ha)	Pre-Development PIMP* (%)	Post-Development PIMP* (%)	Post Development Greenfield Contributing Area (ha) as Effective Impermeable area	Post-Development Impermeable Areas (ha) (BESS / Compound Areas)	Effective combined Post-Development Contributing Area (ha) to proposed drainage system **
Solar and Energy Storage Park	623	0%	10%	62.3	3.1	65.4
TOTAL	**623**				**TOTAL**	**65.4**

*- Percentage Impermeable (PIMP)

**- Includes Solar and Energy Storage Parks

3.5 Greenfield Runoff Rates

3.5.1 The equivalent greenfield runoff rates for the Scheme have been calculated for the Scheme using HR Wallingford's UKSuDS Greenfield Runoff Rate Estimation tool (Ref. 2) based on the proposed contributing impermeable area. These rates are shown in Table 3, with full results in Annex B.

Table 3 Greenfield Discharge Rates

Return Period (years)	Discharge Rate (l/s) (652 ha)
1	1606
Qbar	1935
30	3870
100	4973

3.6 Proposed Discharge Rates

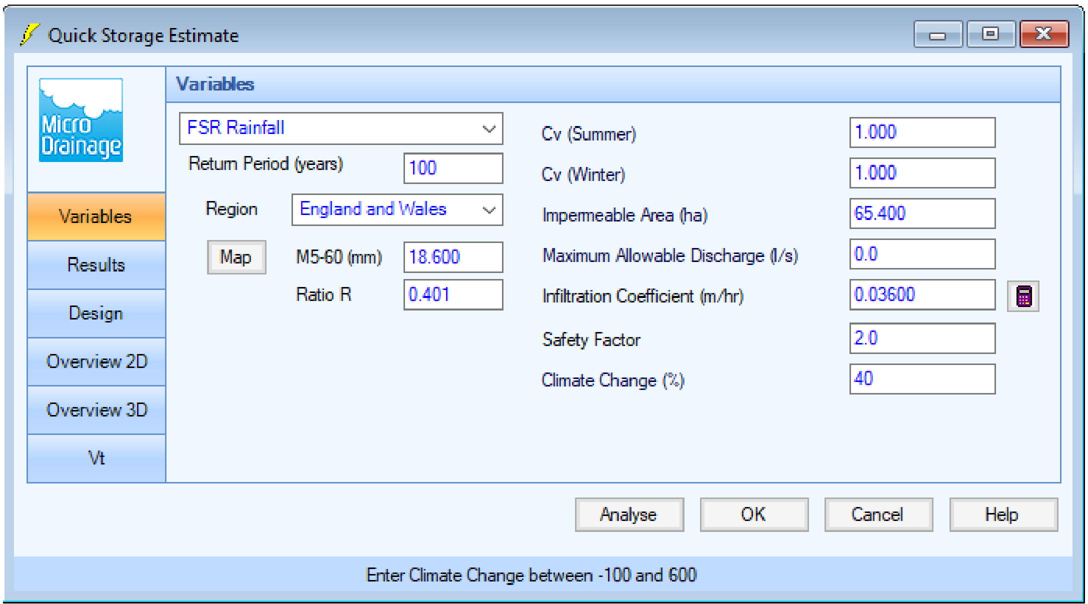
3.6.1 As mentioned earlier, it is not intended to discharge surface water runoff outside of the Scheme's boundary. Instead, any surface water runoff generated within the Scheme will be disposed of via infiltration to mimic existing conditions. In the absence of ground investigation data, the Scheme's infiltration potential has been assessed based on the desktop study.

3.6.2 As mentioned earlier, the Scheme lies in areas of sand and gravel; ground material typically associated with good infiltration rates. As a conservative approach, the Scheme's infiltration rate has been modelled with an infiltration rate of 1 x 10-5m/s in line with CIRIA SuDS Manual (C753) (Ref. 3) Table 25.1. The percentage of impermeable area for compound areas, BESS and substations, found within the Scheme, have not yet been confirmed; detailed layouts will be re-assessed post planning to ensure the SuDS strategy and required attenuation is provided. Taking a conservative approach, at present it is assumed 100% impermeable area for Scheme compounds and substations, and 100% impermeable for BESS areas, to account for fire water capture and runoff. Increases to existing contributing area are to be balanced by infiltration techniques, with exceedance flows captured by surrounding swales and to be attenuated within the freeboard provided.

3.7 Proposed Attenuation

3.7.1 Attenuation will be required, within the Scheme, to temporarily store any excess peak surface water runoff generated within the Scheme boundary before it is infiltrated to ground. Attenuation will be provided in the form of swales and infiltration basins. These features will be strategically located based on existing overland flow routes to capture runoff. The swales/infiltration basins will be 600 mm deep with no steeper than 1 in 3 side slopes. Check dams will be placed strategically within swales to optimise their storage potential on steeper slopes. Where the attenuation lies within the solar field, the legs of the solar panel will be extended so that the solar panel lies above any potential flooding. The outline strategy presents locations for attenuation, which will be refined during detailed design, post-DCO consent.

3.7.2 The attenuation features have been sized to accommodate the 1 in 100 year flood event plus a 40% allowance for climate change. The required storage volume was determined for the entire Scheme using the MicroDrainage 'Quick Storage Estimate' tool. The volume of storage required for specific solar fields, compound area or substation areas was determined proportionately based on the contributing area. The 'Quick Storage Estimate' tool provides an upper and lower estimate for the storage volume required, as shown in Image 1.



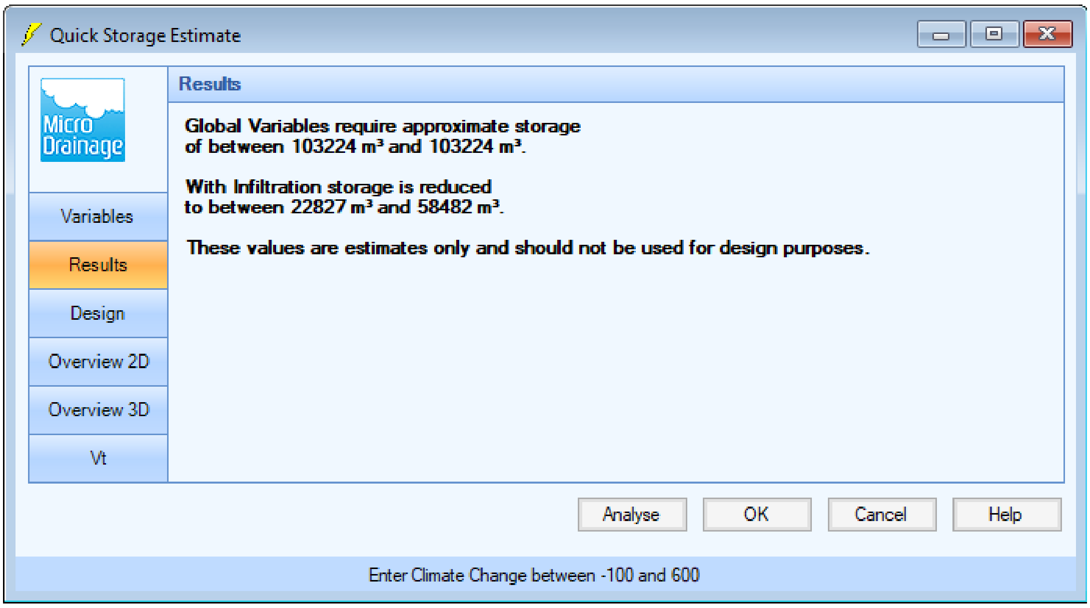


Image 1 MicroDrainage Quick Storage Estimator Analysis for BESS/Compound Areas

3.7.3 The Scheme will provide minimal alterations to the existing topography and ground conditions on-site. It was therefore assumed a portion of runoff generated would infiltrate to ground before it reached a proposed storage feature or would become trapped in a local low spot. As such, it was decided that the upper estimate for the storage volume required would result in redundant storage. The required storage volume was therefore based on the average of the upper and lower estimate. The total storage to be provide onsite is presented in Table 4 below. For a detail breakdown of the storage to provide for each catchment, refer to Annex D.

3.7.4 Details of the proposed attenuation volumes are shown below in Table 4.

Table 4 Proposed Storage Features

Total storage required (m^3) *	Total storage provided (m^3)
22,827 to 58482 (average: 40,655)	54,825

3.8 Water Quality

3.8.1 CIRIA C753 The SuDS Manual (Ref. 3) states that *“SuDS provide an opportunity to capture and treat runoff by intercepting, filtering, and degrading pollutants, and by reducing the volume of potentially contaminated water…while at the same time conveying, storing and infiltrating surface water to protect flood risk, river morphology and water resources, and delivering amenity and biodiversity value for the development”*. To assess the risk to receiving watercourses an assessment has been undertaken of the proposed surface water drainage system in accordance with the SuDS manual. This is a simplistic method that can be used to assess the level of treatment a drainage system could potentially provide to captured surface water runoff.

3.8.2 This method is known as the Simple Index Approach; it states the following:

Total SuDS Mitigation Index ≥ Pollution hazard index

3.8.3 The SuDS manual only provides a limited number of land uses. The land uses in Table 5 below were chosen as the most suitable components of the Scheme. The pollution hazard indices for solar PV panels were based on residential roofs as the outside casing of the panel is constructed from glass and is unlikely to create a significant pollution risk (no oil / fluid is present in the panels etc).

3.8.4 Surface water runoff from the solar PV panel fields, compound areas, BESS and substation areas will drain runoff overland to either swales or infiltration basins. From here, runoff will infiltrate to ground. Table 5 below lists the pollutant hazard indices and mitigation indices used as part of the Simple Index Approach (SIA) and demonstrates the proposed SuDS are sufficient to treat the Scheme runoff.

3.8.5 The impermeable areas chosen within the simple index method below consist of the solar PV panels and the low traffic roads and non-residential car parking with infrequent movements. The areas containing BESS and transformers are contained within the ‘low traffic roads’ as they are self-contained containers or bunded areas. Under normal operation, runoff from these areas is considered to be low risk as it will be treated as roof / road runoff.

3.8.6 Transformers will be installed with suitable bunds to contain any oil spillage in case of an oil-leakage event. Bunds will be designed to contain at least 110% of the volume of the oil to ensure there is some tolerance to prevent breaching of the bund. Under normal conditions any rainwater collected within the bund will be removed by use of special pump, which automatically switches off if it detects the smallest presence of oil in the water. Pumps will be linked to control and monitoring equipment to raise alarms if oil is detected.

3.8.7 Firefighting water, and its potential containments, is not included here as any fire water applied to BESS areas would be contained within a lined separate lagoon structure and removed from the Scheme via controlled methods (e.g. tanker) if the water is polluted, *i.e.* it will not drain into the surface water drainage network without prior testing to confirm it is free of contaminants (please see section below on Fire Water Runoff).

Table 5 Assessment against CIRIA C753 The SuDS Manual Sample Index Approach

Land use	**Pollution Hazard Indices**			
	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Solar PV panels*	Very Low	0.2	0.2	0.05
Low Traffic roads and non-residential car parking with infrequent change (i.e. <300 traffic movements/day)**	Low	0.5	0.4	0.4
Total Pollution index		0.7	0.6	0.45
*The pollution hazard indices for solar panels has been based on residential roofs.				
**Compound areas and substation areas				
Type of SuDS Component		Mitigation indices		
		TSS	Metals	Hydrocarbons
Swales		0.5	0.6	0.6
Infiltration Basin		0.5	0.5	0.6
Total Mitigation Index		1.0	1.1	1.2

3.8.8 From the above assessment the results are calculated, a pass is where the total mitigation index is greater than the pollution hazard index. According to the SIA, with the provision of swales and infiltration basins, there is adequate treatment being provided for the key pollutants considered by the SIA of the SuDS manual (i.e. TSS, metals and hydrocarbons).

3.9 Exceedance Flows

3.9.1 The proposed surface water drainage network has been designed to accommodate runoff from all storms up to and including the 1 in 100 year +40% return period. For an extreme storm event, any exceedance flows that cannot be retained by the proposed attenuation flow overland, following the existing topography, where ultimately, they will be contained within the SuDS features.

3.10 Amenity and Ecological Value of SuDS Features

3.10.1 Due to the nature of the Scheme, personnel involved in the Scheme will have minimal interaction with the proposed drainage features. Consequently, the potential amenity benefit provided by the drainage is not considered relevant to the design. The design of the drainage, however, will be discreet so that is does not hinder the aesthetic value of the Scheme.

3.10.2 Incorporating swales and infiltration basins within the Scheme should maintain some ecological value within the fields that may be lost from the introduction of solar panels. **ES Volume 1, Chapter 8: Ecology and Nature Conservation [EN010131/APP/3.1]** (Section 8:10) provides details of habitat creation and enhancement, these are all intended to contribute to the Scheme achieving Biodiversity Net Gain (BNG) in line with the Environment Act 2021.

3.11 Impact of Sites of Special Scientific Interest (SSSI) Sites

3.11.1 There are no SSSIs, SACs, SPAs, Local Wildlife Sites, scheduled monuments or listed buildings identified within the Order limits. For further details refer to **ES Volume 1, Chapter 7: Cultural Heritage** and **Chapter 8: Ecology and Nature Conservation_[EN010131/APP/3.1]**. Runoff from firewater from the battery storage area will be captured so it cannot discharge off site or to ground and will be tested/removed by tanker off site if contamination is found to be present.

3.12 Fire Water Runoff

3.12.1 The BESS areas require fire water tanks to supress a fire, should one break out in the BESS containers.

3.12.2 Fire water runoff may contain particles from a fire. In the unlikely event of fire water being discharged, the runoff must be contained and tested/treated before being allowed to discharge to the proposed SuDS (watercourse / infiltration).

3.12.3 It is proposed to contain the fire water runoff within a bunded lagoon structure where it can be held and tested before either being released into the SuDS system or taken off site by a tanker for treatment elsewhere. The lagoon will then be cleaned of all contaminants.

3.12.4 The lagoon will be controlled by a penstock valve that can be automatically closed during a fire, i.e. under normal circumstances rainfall will be allowed to drain through the lagoon into the SuDS system.

3.12.5 The volume of this lagoon is yet to be provided, though is to be provided by the fire water strategy consultants. For further details refer to **Outline Battery Safety Management Plan [EN010131/APP/7.6]**. The lagoon shown in the drainage strategy drawings is indicative, with the volume yet to be provided.

3.13 Adoption and Maintenance

3.13.1 The proposed drainage strategy will be maintained by the Applicant or a private company employed by the Applicant. All proposed drainage features should be maintained according to standard practice. Refer to Annex C for maintenance schedules of proposed SuDS features.

4. Conclusion

4.1.1 The design of the Scheme has ensured that impermeable surfaces and hardstanding has been kept to a minimum, for BESS and compound areas.

4.1.2 The surface water runoff associated with the Solar and Energy Storage Park will be managed by suitable SuDS measures, including vegetation to limit channelisation and the implementation of swales and natural detention basins across the Site.

4.1.3 SuDS during construction will be mitigated through the guidance and approach outlined in this strategy and captured in a CEMP post DCO consent to ensure flood risk and pollution is not impacted during construction of PV arrays and the cable route.

4.1.4 For lower return periods, the implemented mitigation measures will act to reduce any effects of runoff from the Order limits draining to the wider catchment relative to the existing greenfield runoff regime, and therefore provide betterment.

4.1.5 Following implementation of the proposed mitigation measures, the limited introduction of hard-standing associated with the Scheme will not lead to an increase in surface water runoff from the Site above greenfield levels in up to and including the 1:100-year (+40 % CC) return period, with consideration for exceedance flows within the design.

5. References

Ref. 1 British Geological Society (2022). Website - Geology of Britain viewer.

Ref. 2 HR Wallingford (2022). UKSuDS Greenfield Runoff Rate Estimation tool

Ref. 3 CIRIA (2016) Report C753 The SuDS Manual 2nd Edition.

Ref. 4 Cranfield Soil and Agrifood Institute, Soilscapes website.

Annex A Proposed Attenuation Volume

Catchment No.	Area (ha.)	PIMP	Impermeable Area (ha.)	Storage Required (m^3)	Total Volume Available (m^3)	Ref S.C$_n$.1	Ref S.C$_n$.2	Ref S.C$_n$.3	Ref S.C$_n$.4	Ref S.C$_n$.5	Ref S.C$_n$.6	Ref S.C$_n$.7	Ref S.C$_n$.8	Ref S.C$_n$.9	Ref S.C$_n$.10	Ref P.C$_n$.1	Ref P.C$_n$.2
1	6.4	10%	0.6	377	425	425	0	0	0	0	0	0	0	0	0	0	0
2	52.2	10%	5.2	3263	3579	306	357	1061	142	384	66	363	0	0	0	900	0
3	14.0	10%	1.4	879	1312	777	304	231	0	0	0	0	0	0	0	0	0
4	10.4	10%	1.0	628	754	205	143	134	122	0	0	0	0	0	0	150	0
5	24.8	10%	2.5	1569	1981	511	296	156	222	219	177	0	0	0	0	400	0
6	10.6	10%	1.1	691	934	55	322	157	0	0	0	0	0	0	0	400	0
7	54.9	10%	5.5	3451	3632	525	188	545	421	423	244	427	159	0	0	350	350
8	8.4	10%	0.8	502	554	137	117	0	0	0	0	0	0	0	0	300	0
9	14.9	10%	1.5	941	1008	67	616	325	0	0	0	0	0	0	0	0	0
10	3.3	10%	0.3	188	361	192	169	0	0	0	0	0	0	0	0	0	0
12	1.4	10%	0.1	63	229	59	170	0	0	0	0	0	0	0	0	0	0
13	5.1	10%	0.5	314	397	212	185	0	0	0	0	0	0	0	0	0	0
14	15.2	10% / 100%	1.4 / 3.5	3075	3668	505	163	0	0	0	0	0	0	0	0	3000	0
15	40.6	10%	4.1	2572	3273	488	600	185	0	0	0	0	0	0	0	2000	0
16	29.4	10%	2.9	1820	2159	51	266	602	256	220	164	0	0	0	0	600	0
17	49.6	10%	5.0	3137	3364	329	165	157	150	206	136	662	308	121	130	700	300
18	27.8	10%	2.8	1757	1882	212	252	663	155	0	0	0	0	0	0	300	300

Catchment No.	Area (ha.)	PIMP	Impermeable Area (ha.)	Storage Required (m^3)	Total Volume Available (m^3)	Ref $S.C_n.1$	Ref $S.C_n.2$	Ref $S.C_n.3$	Ref $S.C_n.4$	Ref $S.C_n.5$	Ref $S.C_n.6$	Ref $S.C_n.7$	Ref $S.C_n.8$	Ref $S.C_n.9$	Ref $S.C_n.10$	Ref $P.C_n.1$	Ref $P.C_n.2$
19	12.5	10%	1.3	816	878	554	128	196	0	0	0	0	0	0	0	0	0
20	8.4	10%	0.8	502	552	337	215	0	0	0	0	0	0	0	0	0	0
21	17.9	10%	1.8	1130	1403	357	300	151	347	248	0	0	0	0	0	0	0
22	24.7	10%	2.5	1569	1740	634	519	287	0	0	0	0	0	0	0	300	0
23	10.8	10%	1.1	691	785	263	55	209	108	0	0	0	0	0	0	150	0
24	23.9	10%	2.4	1506	2223	186	194	144	80	219	0	0	0	0	0	1000	400
25	16.2	10%	1.6	1004	1184	460	475	249	0	0	0	0	0	0	0	0	0
26	7.5	10%	0.8	502	800	289	71	82	62	296	0	0	0	0	0	0	0
27	20.7	10%	2.1	1318	1360	255	193	117	202	184	409	0	0	0	0	0	0
28	6.3	10%	0.6	377	471	163	308	0	0	0	0	0	0	0	0	0	0
32	13.0	10%	1.3	816	968	268	0	0	0	0	0	0	0	0	0	700	0
33	3.0	10%	0.3	188	188	188	0	0	0	0	0	0	0	0	0	0	0
34	11.8	10%	1.2	753	1135	151	236	109	226	255	158	0	0	0	0	0	0
35	9.6	10%	1.0	628	813	81	178	342	212	0	0	0	0	0	0	0	0
36	4.9	10%	0.5	314	464	202	127	135	0	0	0	0	0	0	0	0	0
37	5.1	10%	0.5	314	364	160	113	91	0	0	0	0	0	0	0	0	0
38	8.7	10%	0.9	565	621	109	219	90	203	0	0	0	0	0	0	0	0
39	8.1	10%	0.8	502	560	131	117	312	0	0	0	0	0	0	0	0	0
40	3.2	10%	0.3	188	430	97	209	124	0	0	0	0	0	0	0	0	0

Catchment No.	Area (ha.)	PIMP	Impermeable Area (ha.)	Storage Required (m^3)	Total Volume Available (m^3)	Ref $S.C_n.1$	Ref $S.C_n.2$	Ref $S.C_n.3$	Ref $S.C_n.4$	Ref $S.C_n.5$	Ref $S.C_n.6$	Ref $S.C_n.7$	Ref $S.C_n.8$	Ref $S.C_n.9$	Ref $S.C_n.10$	Ref $P.C_n.1$	Ref $P.C_n.2$
41	7.0	10%	0.7	439	719	272	118	181	77	71	0	0	0	0	0	0	0
42	7.0	10%	0.7	439	708	163	437	108	0	0	0	0	0	0	0	0	0
43	14.4	10%	1.4	879	909	281	264	154	210	0	0	0	0	0	0	0	0
44	8.0	10%	0.8	502	626	97	198	214	117	0	0	0	0	0	0	0	0
45	4.5	10%	0.5	314	352	80	122	0	0	0	0	0	0	0	0	150	0
46	3.8	10%	0.4	251	352	167	185	0	0	0	0	0	0	0	0	0	0
47	5.5	10%	0.6	377	471	61	128	143	139	0	0	0	0	0	0	0	0
48	31.5	10%	3.2	2008	2173	449	506	48	440	65	229	180	106	0	0	150	0
			TOTALS	40,655	52,761												

Annex B Greenfield Runoff Rates

Print Close Report

Greenfield runoff rate estimation for sites

[redacted] | Greenfield runoff tool

Calculated by:	Alistair Goodfellow
Site name:	Gate Burton
Site location:	Gate Burton Energy Park

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	53.34646° N
Longitude:	0.7306° W
Reference:	2805134710
Date:	Nov 11 2022 14:31

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 652

Methodology

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

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

Hydrological characteristics	Default	Edited
SAAR (mm):	588	588
Hydrological region:	4	4
Growth curve factor 1 year:	0.83	0.83
Growth curve factor 30 years:	2	2
Growth curve factor 100 years:	2.57	2.57
Growth curve factor 200 years:	3.04	3.04

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	1935.21	1935.21
1 in 1 year (l/s):	1606.22	1606.22
1 in 30 years (l/s):	3870.42	3870.42
1 in 100 year (l/s):	4973.49	4973.49
1 in 200 years (l/s):	5883.04	5883.04

Gate Burton ENERGY PARK

Annex C Maintenance Schedules

Infiltration Basins

Infiltration basins are vegetated open surface basins designs to store water and allow it to infiltrate into the ground. Vegetation provides amenity benefit and filtration of pollutants and is therefore as important to its function as the basin itself. A schedule setting out the maintenance operations, actions and frequency is included below. Please also refer to the manufacturer's operation and maintenance manual for any inlet structures or valves if available.

CIRIA C753 TABLE 13.2 Operation and maintenance requirements for infiltration basins

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter, debris and trash	Monthly
	Cut grass – for landscaped areas and access routes	Monthly (during growing season) or as required
	Cut grass – meadow grass in and around basin	Half yearly: spring (before nesting season) and autumn
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
Occasional maintenance	Reseed areas of poor vegetation growth	Annually, or as required
	Prune and trim trees and remove cuttings	As required
	Remove sediment from pre-treatment system when 50% full	As required
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realign the rip-rap	As required
	Repair or rehabilitate inlets, outlets and overflows	As required
	Rehabilitate infiltration surface using scarifying and spiking techniques if performance deteriorates	As required
	Relevel uneven surfaces and reinstate design levels	As required
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly

Maintenance schedule	Required action	Typical frequency
	Inspect inlets and pre-treatment systems for silt accumulation; establish appropriate silt removal frequencies	Half yearly
	Inspect infiltration surfaces for compaction and ponding	Monthly

Swales

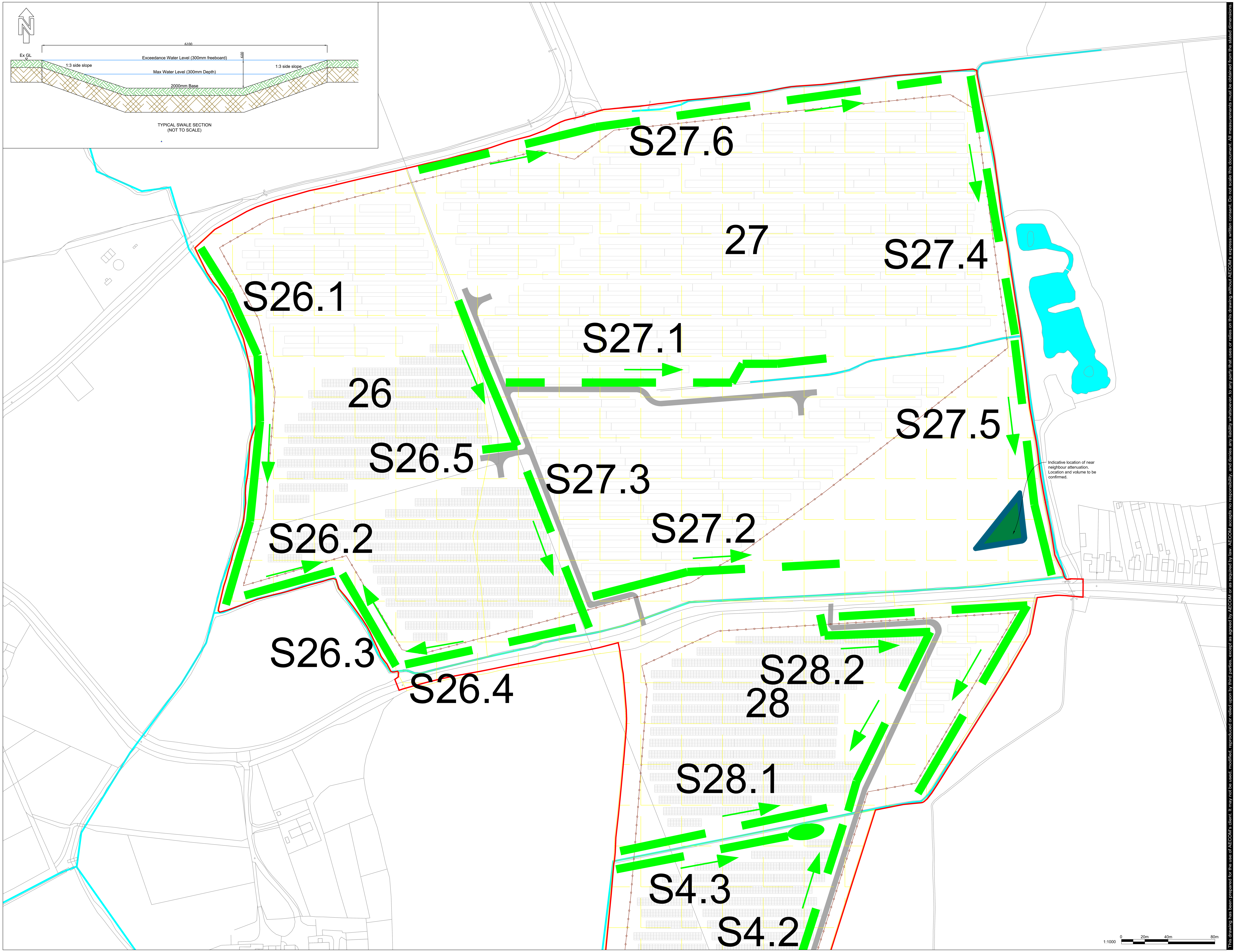
Swales are man-made linear depressions designed to convey water along a specified route. Upkeep of swales and their inlets and outlets is key to their function. A schedule setting out the maintenance operations, actions and frequency is included below. Please also refer to the manufacturers operation and maintenance manual for any inlet structures if available.

CIRIA C753 TABLE 17.1 Operation and maintenance requirements for swales

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required

Maintenance schedule	Required action	Typical frequency
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Annex D Drainage General Arrangements



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Gate Burton ENERGY PARK

CONSULTANT

AECOM
63-77 Victoria Street
St Albans
Herts, AL1 3ER
United Kingdom

T +44 (0)1727 535000
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KEY

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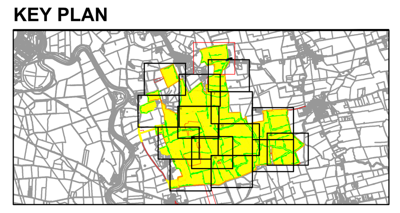
- SOLAR FIELD AREA
- EXISTING WATERCOURSE
- SWALE (0.6m DEEP)
- INFILTRATION BASIN (0.6m DEEP)
- FIRE WATER STORAGE LAGOON WITH PENSTOCK
- FIREWATER DRAINAGE ROUTE
- SOLAR PANEL
- ACCESS ROADS
- ACCESS ROADS (OPERATION)

ISSUE/REVISION

Rev	Date	Detail	Made	Chk'd	App'd
P02	13.12.22	Site Layout Updated	AG	CB	NM
P01	13.10.22	First Issue	AG	CB	NM

KEY PLAN



PROJECT NUMBER

60664324

SHEET TITLE

Gate Burton Energy Park
Drainage Strategy
Sheet 1 of 15

SHEET NUMBER

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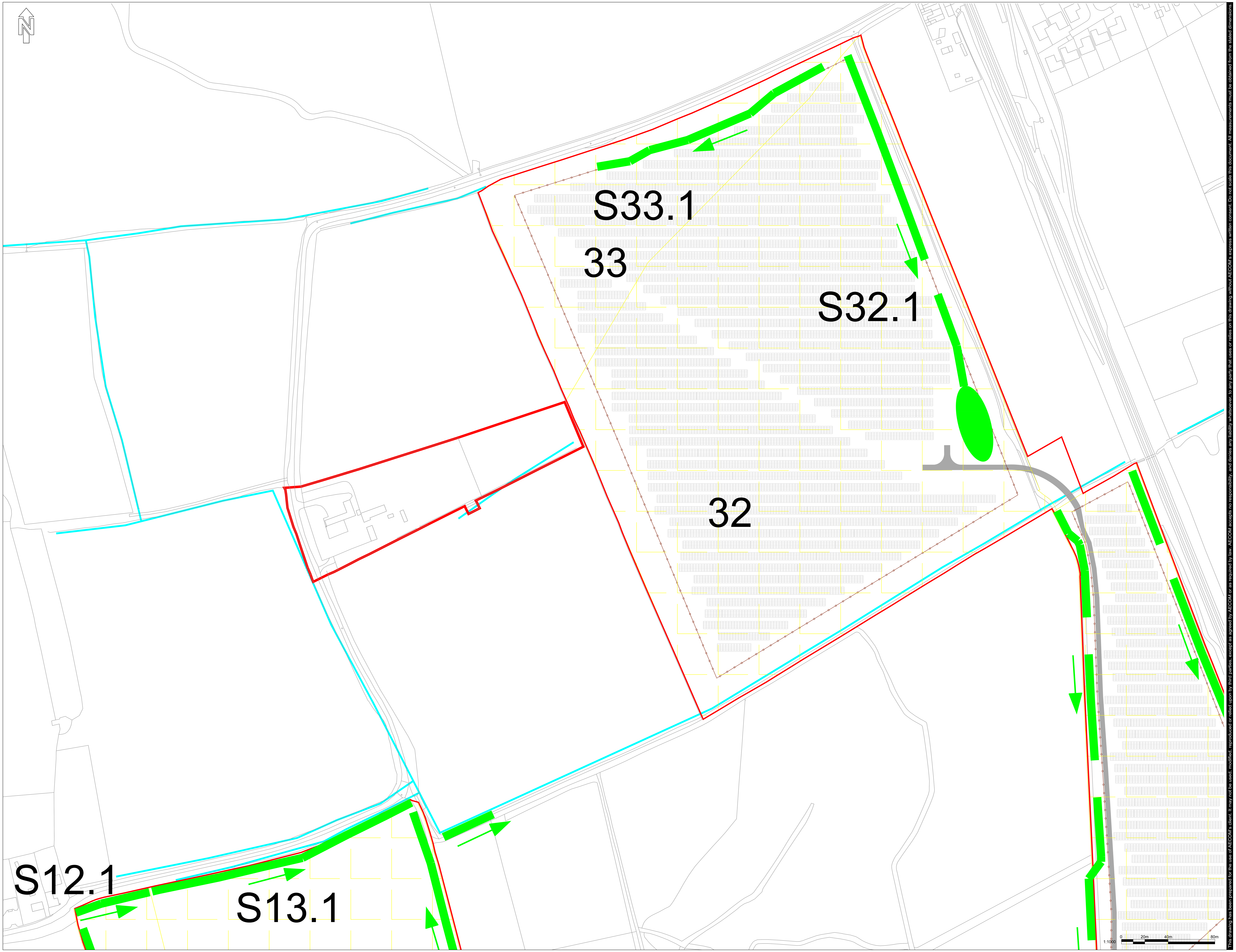

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FIREWATER DRAINAGE ROUTE
SOLAR PANEL
ACCESS ROADS
ACCESS ROADS (OPERATION)

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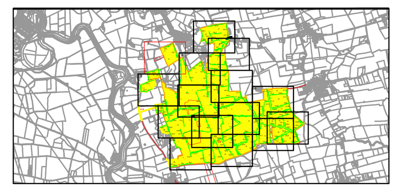

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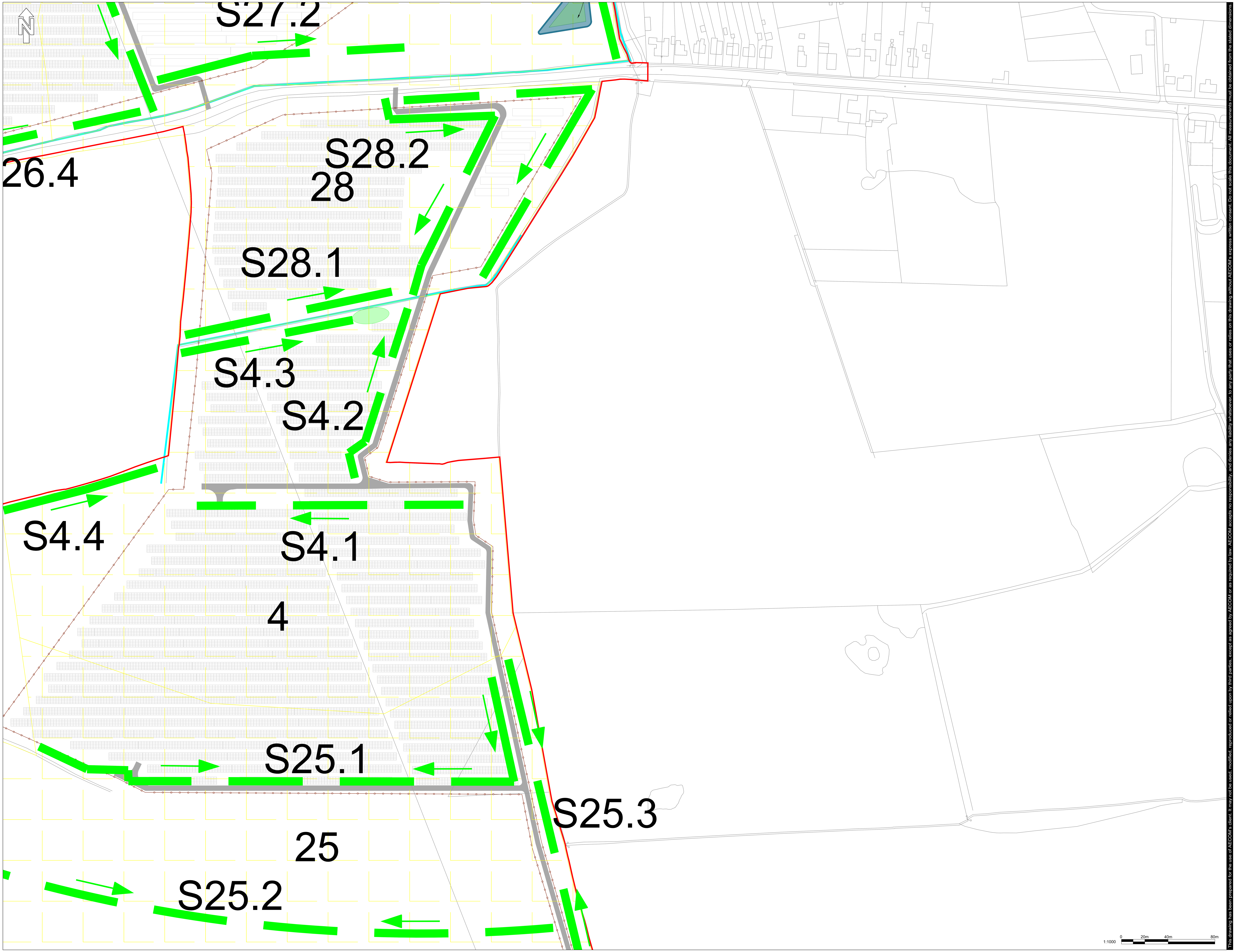

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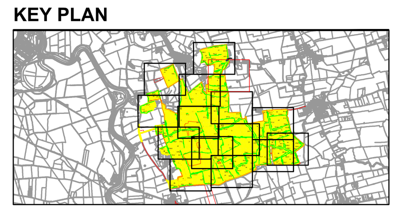

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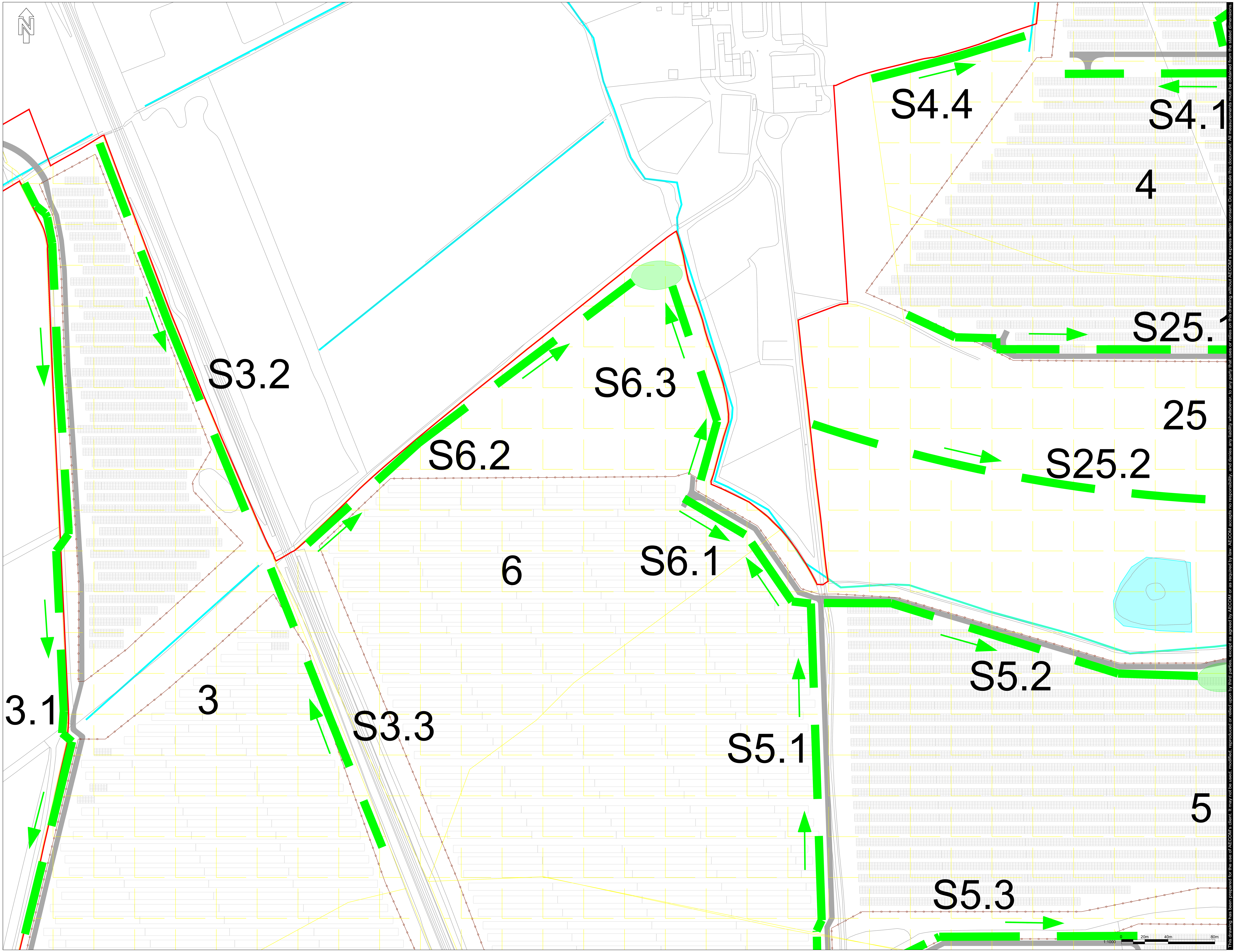

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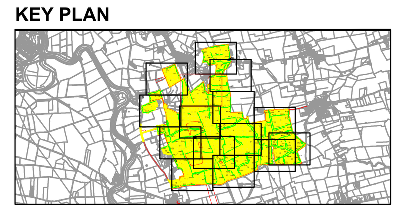

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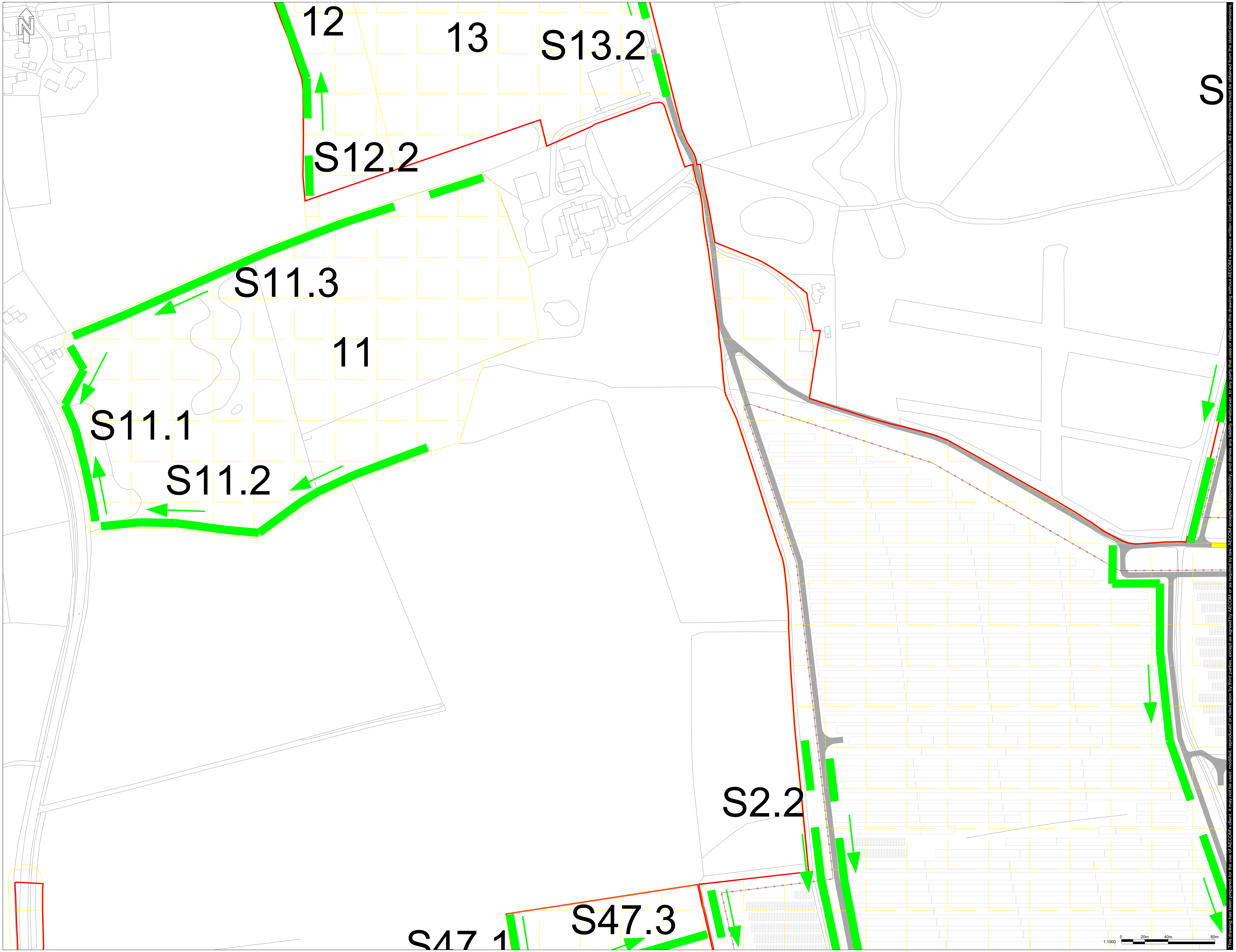

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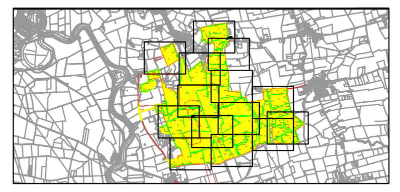

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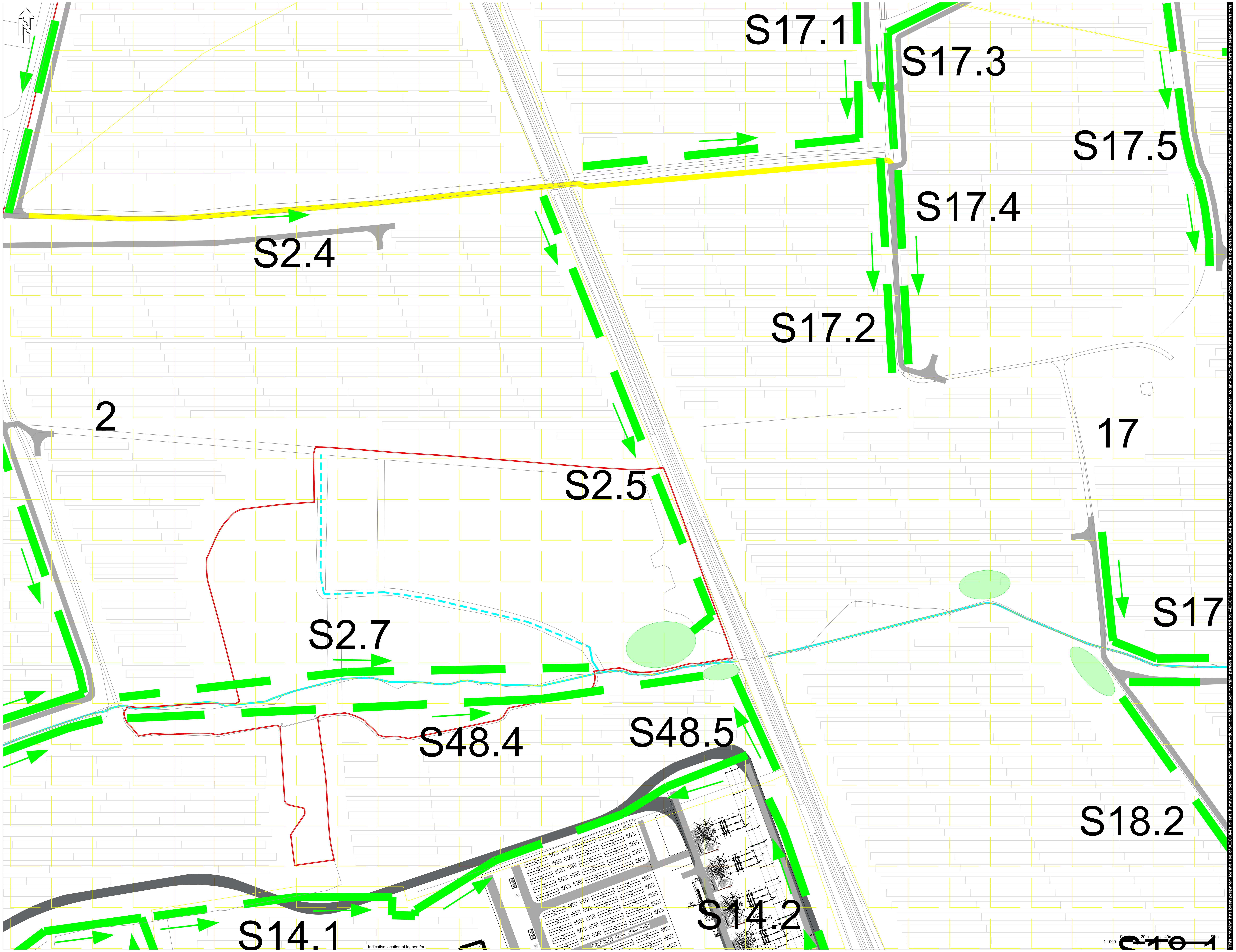

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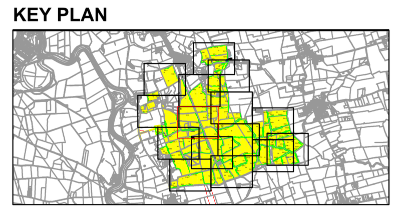

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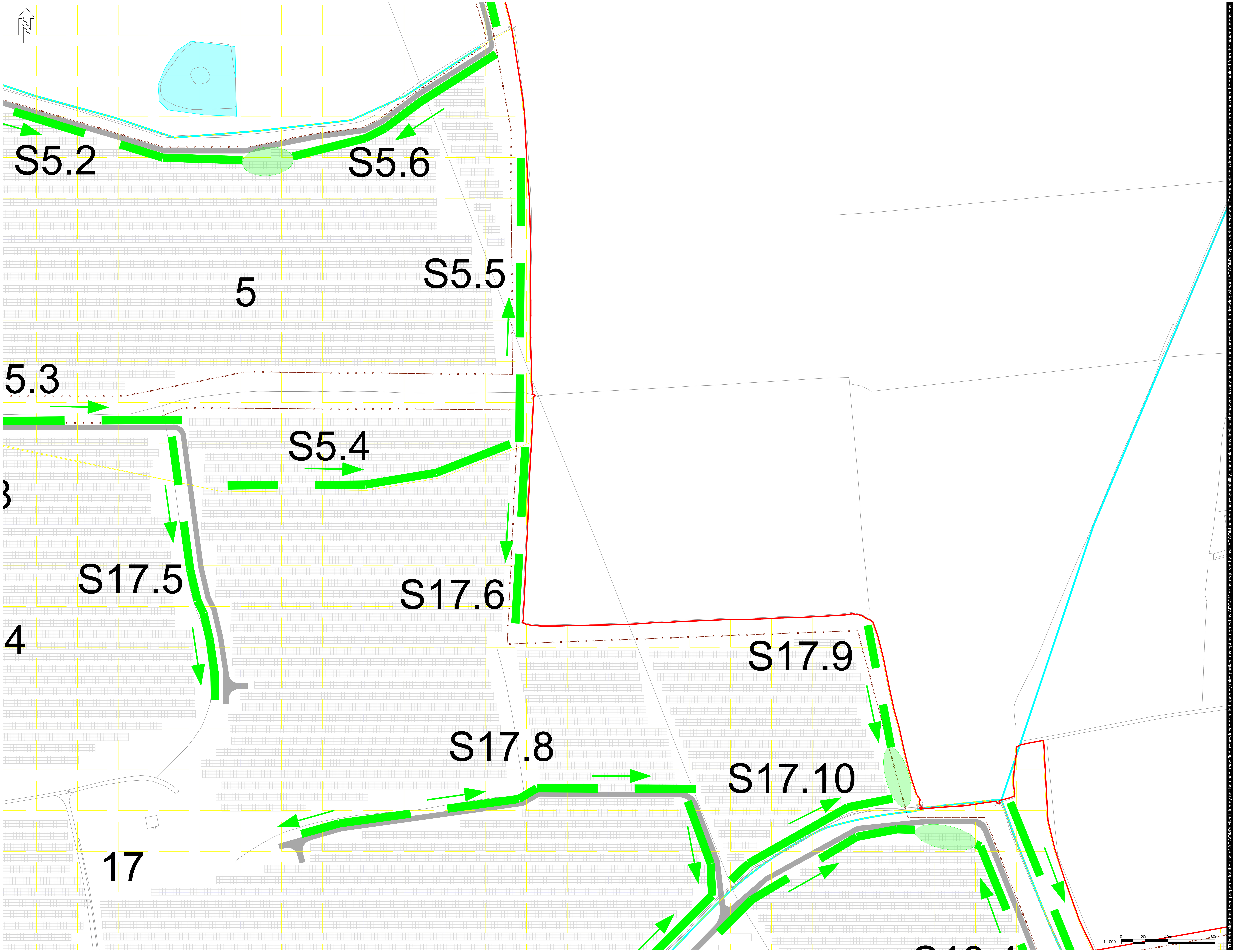
SHEET NUMBER

60664324-ACM-ZZ-XX-DR-CE 0006



AECOM

PROJECT

Gate Burton Energy Park

CLIENT

Gate Burton
ENERGY PARK

CONSULTANT

AECOM
63-77 Victoria Street
St Albans
Herts, AL1 3ER
United Kingdom

T +44 (0)1727 535000
www.aecom.com

NOTES

1. Do not scale from the drawing.
2. All levels shown are in meters Above Ordnance Datum (AOD) unless stated otherwise.
3. The information on this plan is given without obligation or warranty. No liability of any kind whatsoever is accepted by AECOM for any errors or omissions. Drainage Strategy design indicative and subject to change.
4. The following have been used in the production of this drawing:
   Proposed Site Plan
   - L-1011-UK01
5. All proposed levels are indicative and are to be confirmed.
6. Swale locations are indicative and are to be confirmed. Swales are to maintain a 10m buffer from the nearest watercourse.
7. Levels taken from LiDAR data for 3D levels.

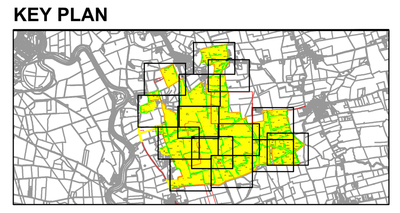
KEY

- SOLAR ENERGY STORAGE PARK
- SOLAR FIELD AREA
- EXISTING WATERCOURSE
- SWALE (0.6m DEEP)
- INFILTRATION BASIN (0.6m DEEP)
- FIRE WATER STORAGE LAGOON WITH PENSTOCK
- FIREWATER DRAINAGE ROUTE
- SOLAR PANEL
- ACCESS ROADS
- ACCESS ROADS (OPERATION)

ISSUE/REVISION

Rev	Date	Detail	Made	Chk'd	App'd
P02	13.12.22	Site Layout Updated	AG	CB	NM
P01	13.10.22	First Issue	AG	CB	NM

KEY PLAN



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SHEET TITLE

Gate Burton Energy Park
Drainage Strategy
Sheet 7 of 15

SHEET NUMBER

60664324-ACM-ZZ-XX-DR-CE 0007

ISO A0 841mm x 1189mm Approved: ____ Checked: ____ Designer: ____ Project Management Initials:
Filename: \\EU.AECOMNET.COM\EMIA\UK\UKSTA1\JOBS\60664324 - GATE BURTON SF DCO\900_CAD_GIS\910_CAD\20_SHEETS\60664324-ACM-ZZ-XX-DR-CE-000001 DRAINAGE STRATEGY.DWG Last saved by: ALISTAIR.GOODFELLOW Last Plotted: 2022-12-14