Gate Burton
ENERGY PARK

Gate Burton Energy Park Environmental Statement

Volume 3, Appendix 8-E: Aquatic Baseline Report
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Gate Burton Energy Park Limited

Prepared for:

Gate Burton Energy Park Limited

Prepared by:

AECOM Limited

Contents

1. Executive Summary

AECOM was commissioned to undertake surveys to provide an investigation into the ecological quality of water body crossings with the potential to be impacted during the construction and operation of Gate Burton Energy Park.

This baseline report covers the water bodies considered likely to be affected by the Scheme: i.e., through culverting for access road crossings and open-cut crossing along the Grid Connection Corridor. A desk study has been carried out to identify records of protected and notable species within 2km of the Order limits, or within a greater distance for connected aquatic habitats. A prioritization exercise was carried out to identify those water bodies at the highest risk of potential impacts, including assigning a level of sensitivity to these aquatic receptors – this informed the scoping of aquatic features for further survey and assessment.

Aquatic macrophyte survey results indicate that Water Framework Directive (WFD) classification for Tributary 1 of Padmoor Drain was Poor, while Seymour Drain and Ditch 3 were Moderate. Seymour Drain had a high abundance of the Schedule 9 Invasive Non-Native Species (INNS), Nuttall's pondweed *Elodea nuttallii*, and a low abundance of flat-stalked pondweed *Potomogeton friesii,* which is listed as near threatened on the GB Red List and vulnerable on the England Red list. No other notable or protected macrophyte species were found.

Aquatic macroinvertebrate survey results indicated that Tributary 1 of Padmoor Drain had a Community Conservation Index indicating a Fairly High conservation value, while Seymour Drain, Ditch 3, Cow Pasture Lane, and Marton Drain were of Moderate conservation value. The Fairly High value at Padmoor Drain was largely driven by the presence of an individual of the of the nationally scarce water beetle *Scarodytes halensis* in the sample. Present at all three reaches were high abundances of the non-native but non-invasive New Zealand mud snail *Potamopyrgus antipodarum*, particularly Tributary 1 of Padmoor Drain and Ditch 3. Whilst *P. antipodarum* was identified, there are no statutory obligations resulting from legislation due to the presence of the species.

The assemblage of aquatic macroinvertebrates, and to some extent macrophytes, are indicative of the notable aquatic species assemblages listed in the citations of several Local Wildlife Sites (LWS) in and around the Scheme boundary. Macrophyte community was somewhat limited by regular management of ditches for drainage purposes in a predominantly arable landscape, including dredging and weed cutting.

It is recommended that further macroinvertebrate surveys are conducted in spring 2023, as notable or protected species may not be readily present when surveying in autumn alone. This baseline report will be updated when the results of pending surveys of outstanding water bodies are completed.

2. Introduction

2.1 Project Overview

2.1.1 The Gate Burton Energy Park aquatic ecological investigations were completed to evaluate the ecological quality of watercourses and ditches to inform the assessment of potential impacts, if any, of the construction of Gate Burton Energy Park.

2.1.2 Surveys undertaken include;

- Aquatic macroinvertebrates; and
- Aquatic macrophytes.

2.2 Background

2.2.1 AECOM has been commissioned by Gate Burton Energy Park Ltd (hereafter referred to as 'Gate Burton Energy Park') to coordinate an Environmental Impact Assessment (EIA) for the proposed Gate Burton Energy Park ('the Scheme'). The Scheme comprises the installation of solar photovoltaic (PV) generating panels and on-site energy storage facilities across a proposed site (hereafter referred to as the 'Solar and Energy Storage Park' in the village/hamlet of Gate Burton near Gainsborough, Lincolnshire and grid connection infrastructure (hereafter referred to as the 'Grid Connection Corridor'. The entire Scheme, including both the Solar and Energy Storage Park and Grid Connection Corridor is referred to as the 'Site'. Further information on the Scheme is provided in **ES Volume 1, Chapter 2: The Scheme [EN010131/APP/3.1].**

2.2.2 The Site is located approximately 4 kilometres (km) south of Gainsborough, approximate grid reference: SK 84377 83972 and approximate post code: DN21 5BE. The precise Grid Connection Corridor location is to be confirmed. The Scheme will allow for the generation, storage, and export of up to 540 megawatts (MW) electrical generation capacity. The Solar and Energy Storage Park, and the Grid Connection Corridor are presented in **ES Volume 2: Figure 1-1 and Figure 1-2 [EN010131/APP/3.2].**

2.2.3 Following a desk study, a scoping exercise was carried out to identify water bodies that are to be impacted by the Scheme e.g., through culverting for access road crossings and open-cut crossings along the Grid Connection Corridor (GCC). Only water bodies that have been assessed as being potentially impacted by the Scheme have been included in this assessment.

2.2.4 Water body crossings were given a "sensitivity classification" based on assessment of aquatic ecology receptors through desk study and aerial imagery, and according to the likely severity of impact from the Scheme. Only water bodies with higher sensitivity crossing points were surveyed.

2.3 Study Area

2.3.1 The impacted habitats within the Solar and Energy Storage Park are comprised of a tributary of Padmoor Drain (SK 84969 85595, hereafter

referred to as “tributary 1 of Padmoor Drain”), another tributary of Padmoor Drain (SK 84960 83947, hereafter referred to as “tributary 2 of Padmoor Drain”) and 0.27km of an unnamed ditch (SK 85152 85428, hereafter referred to as “Ditch 1”).

2.3.2 Within the Grid Connection Corridor, the impacted habitats are comprised of an unnamed ditch (SK 84923 81947, hereafter referred to as “Ditch 2”), Marton Drain (SK 83674 81172), Carr Drain (SK 82630 80923), Seymour Drain (SK 82077 80720), an unnamed ditch (SK 81421 80610, hereafter referred to as “Ditch 3”), Cow Pasture Lane Drain (SK 80697 80258), and an unnamed ditch (SK 80970 78826, hereafter referred to as “Ditch 4”).

2.3.3 At the time of writing, seven sites with moderate to high sensitivity classification have been surveyed. Of these, four have been scoped out; three of these were found to be dry at the time of survey, and a further wetted ditch that had been surveyed has since been scoped out due to no longer being subject to crossing or culverting through the Scheme.

2.3.4 This present draft report provides details of aquatic macrophyte and macroinvertebrate survey results for tributary 1 of Padmoor Drain, Seymour Drain and Ditch 3. Macroinvertebrate survey results are also presented for Marton Drain and Cow Pasture Lane. However, no macrophyte surveys on Marton Drain and Cow Pasture Lane were performed as instructions to survey were outside of the macrophyte survey season.

2.3.5 Tributary 1 of Padmoor Drain at SK 84969 85595 flows east from Knaith Park and is bordered by arable and Kexby lane for the majority of its length; 0.58km of the river lies within the main site boundary, plus an additional 0.65km of its riparian zone. The substrate consisted entirely of a silt bed, with both emergent and floating aquatic plants present downstream of the culvert at SK 84969 85593. Upstream of the culvert, the bed was not visible as the channel was choked with bankside terrestrial plants.

2.3.6 Seymour Drain (SK 82077 80720) is a Water Framework Directive (WFD) water body (WFD water body ID: GB104028058340) and tributary of the River Trent; 0.296km of Seymour Drain lies within the Grid Connection Corridor and is bordered by arable fields. At the time of surveying, the drain was largely devoid of riparian vegetation due to extensive vegetation cutting on both banks. The section within the Order limits is not a Priority River Habitat but is mentioned within catchment plans.

2.3.7 Ditch 3 at SK 81421 80610 flows through arable and pasture fields and is located south of Broad Land near Cottam; 0.16km of this river lies within the Grid Connection Corridor. At the time of survey there was little water, and the substrate consisted of an entirely silt bed, with small, isolated areas of aquatic plants present. The riparian zone was largely absent of vegetation due to cutting on both banks.

2.4 Purpose and Scope of Aquatic Surveys

2.4.1 A desk study was carried out to review the current WFD status of the water bodies within the proposed Solar and Energy Storage Park and Grid Connection Corridor which encompass both the Witham Upper and Trent and

Trib Operational Catchments. Data was sought from the Local Environmental Records Centres and online open-source data.

2.4.2 Aquatic macroinvertebrate samples were collected to identify the conservation value of aquatic macroinvertebrate communities, to record the presence of any notable and/or protected species and provide an indication of water and habitat quality.

2.4.3 Macrophyte (aquatic plant) surveys were undertaken to characterise water and habitat quality and to record the presence of any notable, protected, or invasive species (Invasive Non-Native Species – INNS).

2.4.4 Surveyed reaches are illustrated in Annex A: Figure A.1.

2.5 Legislation

2.5.1 This assessment has been undertaken within the context of some or all of the following relevant legislative instruments, planning policies and guidance documents:

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive');
- The Bern Convention (1979) also known as the Convention on the Conservation of European Wildlife and Natural habitats;
- Convention on Wetlands of International Importance ('Ramsar convention');
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017;
- Wildlife and Countryside Act 1981 (as amended) (the 'WCA')
- Section 41 of the NERC Act (2006) provides a list of habitats and plant species of principal importance for nature conservation in England;
- The Conservation of Habitats and Species Regulations 2010 (as amended);
- Environmental Protection Act 1990;
- The Eels (England and Wales) Regulations 2009;
- Nitrate Vulnerable Zones/Nitrates Directive (The Nitrates Directive 1991);
- Regulation 1143/2014 on invasive alien species; and
- UK Post-2010 Biodiversity Framework.

3. Methodology

3.1 Desk Study

3.1.1 A desk-based review of current Water Framework Directive (WFD) status was conducted for all WFD water bodies crossed by the proposed Gate Burton

Energy Park main site and Grid Connection Route, using the Environment Agency's (EA) Catchment Data Explorer website[1]. Environment Agency ecological survey data from the last 10 years, or from a longer period where these were considered useful to support the assessment, from sites downstream of the impacted areas, were reviewed using the Environment Agency Ecology and Fish Data Explorer[2]. Open-source historical records of protected and notable species were reviewed using NBN atlas[3]. MAGIC Map[4] was used to identify landscape designated sites and notable habitats within the potential zone of influence.

3.1.2 Records of relevant statutory designated sites, non-statutory designated sites, legally protected and/or notable species, as well as invasive species (INNS), within a 2km radius of the Solar and Energy Storage Site, were sourced from the Greater Lincolnshire Nature Partnership (GLNP)[5].

3.2 Aquatic Macroinvertebrate Surveys

3.2.1 Aquatic macroinvertebrate samples were undertaken on 25 October 2022 at Tributary 1 of Padmoor Drain, Seymour Drain, and Ditch 3 and on 29th September 2022 for Cow Pasture Lane and Marton Drain (Table 1). No surveys were undertaken during or immediately following periods of high flow in accordance with best practice guidance.

Table 1 Aquatic macroinvertebrate survey locations

Watercourse name	NGR	Reach description
Tributary 1 of Padmoor Drain	SK 84960 85595	Artificial drain with submerged, emergent, and floating leaved macrophytes
Seymour Drain	SK 82074 80721	Artificial drain with submerged, emergent, and floating leaved macrophytes
Ditch 3	SK 81467 80498	Artificial drain with recently cut riparian vegetation and low water levels
Cow Pasture Lane	SK 80697 80258	Narrow-cut artificial drain
Marton Drain	SK 83674 81172	Wide artificial drain close to outflow on River Trent

3.2.2 Macroinvertebrate survey followed aquatic macroinvertebrate sampling procedures standardised by the Environment Agency (Ref 5), which conform to BS EN ISO 10870:2012 Water Quality – Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters. These methods allow characterisation of aquatic macroinvertebrate communities and can be used to determine whether rare or notable species or communities are present. Samples were collected using a standard FBA

[1] https://environment.data.gov.uk/catchment-planning
[2] https://environment.data.gov.uk/ecology/explorer/
[3] [redacted]
[4] https://magic.defra.gov.uk/magicmap.aspx
[5] [redacted]

pattern pond net (mesh size: 1 mm). The habitats present were sampled through a combination of kick sampling and sweep sampling for three minutes followed by a one-minute hand search of larger substrates in accordance with standard methods. The samples collected were subsequently preserved in Industrial Methylated Spirit (IMS) for laboratory processing.

3.2.3 Each of the samples collected was sorted and analysed in a laboratory setting by suitably trained and experienced aquatic ecologists. Lists of the aquatic macroinvertebrate taxa present were produced in line with Environment Agency guidance (Ref 4). The aquatic macroinvertebrate samples were identified to 'mixed-taxon level' using a stereo-microscope. Most groups were identified to species level (where practicable), except for the following:

- Worms (Oligochaeta), which were identified to sub-class;
- Marsh beetles (Scirtidae), which were identified to family;
- True-fly larvae, which were identified to the maximum resolution possible; and
- Immature or damaged specimens, which were identified to the maximum resolution possible on a case-by-case basis.

3.2.4 The survey data was then used to calculate metrics that can be used to inform an assessment of relative nature conservation value, habitat condition and general degradation as detailed below.

Community Conservation Index (CCI)

3.2.5 A Community Conservation Index (CCI) (Ref 3) was calculated for each Reach as detailed in Annex B. The CCI classifies many groups of aquatic macroinvertebrates according to their scarcity and nature conservation value in England as understood at the time that the classification was developed. Species scores range from 1 to 10, with 1 being Very Common and 10 being Endangered. Since its initial publication, in some cases the references used in the CCI classification to define scarcity and value have been superseded by more recent assessments. Due to this, the author has provided AECOM with updated species scores to take account of this new information (Chadd, *pers. comm*., 2018). These updated scores have been used within this assessment.

Lotic-invertebrate Index for Flow Evaluation (LIFE)

3.2.6 Lotic-invertebrate Index for Flow Evaluation (LIFE) scores were calculated (Ref 6). This is an index that links benthic macroinvertebrate data to flow regimes prevailing in UK waters. Flow scores have been allocated to various macroinvertebrates based on species/family abundance and ecological association with different flows, as detailed in Annex C D. The overall LIFE score for a Reach is calculated as the sum of the individual scores divided by the number of scoring species/families. LIFE scores increase with current velocity, scores <6.00 generally indicating sluggish or still water conditions and score >7.5 indicate fast flows. LIFE allows the mean flow preference of invertebrates colonising a reach to be determined so that effect of habitat changes such as sediment accumulation can be monitored.

Proportion of Sediment-sensitive Invertebrates (PSI)

3.2.7 Calculations were undertaken to determine the proportion of sediment sensitive macroinvertebrates present using the Proportion of Sediment-sensitive Invertebrates (PSI) index (Ref 7). Using this approach, individual taxa of aquatic macroinvertebrate are assigned a Fine Sediment Sensitivity Rating (FSSR) ranging from A to D, as detailed in Annex D. The PSI score for each aquatic macroinvertebrate sample was derived from individual species scores and abundances. The derived PSI score corresponds to the percentage of fine sediment-sensitive taxa present in a sample and ranges from 0 to 100, where low scores correspond to watercourses with high fine sediment cover. The PSI score therefore provides an indication of the extent to which watercourses are influenced by fine sediments, and therefore by inference the potential sensitivity of the associated aquatic macroinvertebrate community to changes in silt load and deposition.

Whalley, Hawkes, Paisley & Trigg (WHPT)

3.2.8 The aquatic macroinvertebrate data were analysed to generate the Whalley, Hawkes, Paisley & Trigg (WHPT) score Average Score Per Taxon (ASPT), and Number of scoring taxa (NTAXA) values, which provides an indication of the ecological quality in the watercourse (Ref 19). This assigns numerical value to taxa according to their sensitivity to organic pollution. The average of the values for each taxon in a sample, known as ASPT is a stable and reliable index of organic pollution. Therefore, these assessments can indicate to what extent an aquatic macroinvertebrate community is exposed to organic pollution (further information is provided in Annex E). It is important to note that these indices can vary between geological regions and habitat types. Ditches for example are unable to support many of the high-scoring taxa associated with fast flowing habitats. Therefore, the resultant metrics should be reviewed with an awareness of their potential limitations, and the reach-specific context, as described in this report.

3.2.9 The WHPT method has been primarily designed to respond to organic pollution, however it is suitable for monitoring other types of impact and is used for assessing the WFD classification parameter “General degradation” (Ref 19).

River Invertebrate Classification Tool (RICT)

3.2.10 Resultant WHPT-ASPT and NTAXA values and environmental data collected may be processed through the River Invertebrate Classification Tool version 2 (RICT) web application, available on the Freshwater Biological Association website[6], once all field data has been collected. This part of the analysis has therefore not yet been presented.

3.2.11 RICT predicts the WHPT-ASPT and NTAXA scores for the surveyed locations based on the Reach location, altitude, alkalinity, slope, discharge category, distance from source, channel dimensions and substrate composition. The predicted scores are then compared to actual scores and the output is an Ecological Quality Ratio (EQR). The EQR can be translated into a Water

[6] [redacted]

Framework Directive (WFD) classification (High, Good, Moderate, Poor, or Bad). Alkalinity data should be obtained from monthly analysis of samples from each over a period of at least one year, whereas here, alkalinity was based on the average of two samples collected during the survey visits, which is typical for an assessment of this type.

3.3 Aquatic Macrophyte Surveys

3.3.1 Aquatic macrophyte (plant) surveys were undertaken in conjunction with the macroinvertebrate samples on 22 Sept 2022 at three survey locations (Table 2). The recommended time period for aquatic macrophyte surveys is between 1st June and 30th September and should not be undertaken during or immediately after periods of high flow.

Table 2 Aquatic macrophyte survey locations

Watercourse name	NGR Start (downstream)	NGR Centre	NGR End (upstream)
Tributary 1 of Padmoor Drain	SK 85033 85607	SK 85129 85617	SK 85176 85610
Seymour Drain	SK 82087 80667	SK 82072 80714	SK 82099 90763
Ditch 3	SK 81385 80722	SK 81410 80757	SK 81423 80807

Aquatic Macrophyte Survey Methodology

3.3.2 The aquatic macrophyte surveys followed guidance set out in the UKTAG River Assessment Method (Macrophytes and Phytobenthos) for use with LEAFPACS2 (Ref 17), which conforms to BS EN 14184:2014 Water quality - Guidance for the surveying of aquatic macrophytes in running waters. The survey was carried out by walking within the channel of each watercourse along a 100m transect, where safely accessible. Any inaccessible areas were bypassed as necessary before re-entering the channel at the next available access point. A list of all macrophytes encountered was collated and their relative abundance was recorded using Taxon Cover Values (TCV), detailed below (Table 3).

Table 3 Taxon Cover Values (TCV) and their associated percentage cover

TCV	Percentage cover for the macrophyte taxon
C1	<0.1%
C2	0.1 to 1%
C3	1 to 2.5%
C4	2.5 to 5%
C5	5 to 10%

TCV	Percentage cover for the macrophyte taxon
C6	10 to 25%
C7	25 to 50%
C8	50 to 75%
C9	>75%

3.3.3 Aquatic macrophyte data was processed through the River LEAFPACS2 calculator, available from the WFD UKTAG website[7]. Four metrics were calculated using macrophyte species and groups data:

- **River macrophyte nutrient index (RMNI)** – Macrophyte taxa are allocated a score based on their relative tolerance of nutrients. The overall observed RMNI score for a survey is the cover weighted average of the individual scores of the different taxa found.
- **Number of macrophyte taxa (NTAXA)** – The number of scoring taxa recorded in the field survey. Only true hydrophytes are included.
- **Number of functional groups (NFG)** – Hydrophytes are allocated to one of 24 "functional groups". These are groups of organisms which exploit a resource in a similar way.
- **Cover of filamentous green algae (ALG)** – The percentage cover of filamentous green algae over the whole of the surveyed section.

3.3.4 LEAFPACS2 predicts the RMNI, NTAXA and NFG scores for the surveyed Reach based on altitude, alkalinity, and slope. The predicted scores are then compared to reference scores and the output is an Ecological Quality Ratio (EQR). The EQR can be translated into a Water Framework Directive (WFD) classification (High, Good, Moderate, Poor, or Bad) as shown in Annex G. Alkalinity data should be obtained from monthly analysis of samples from each over a period of at least one year, whereas here, alkalinity was based on the average of two samples collected during the survey visits.

3.3.5 River LEAFPACS2 analysis was designed to reflect the impact of nutrient enrichment on macrophyte communities, with High status indicating there is no impact and Bad status indicating there is a severe impact. The method may also be sensitive to alterations in river flow and/or modifications to morphological conditions which may impact macrophyte communities (Ref 17).

3.3.6 Aquatic macrophyte species were cross referenced against the JNCC Taxon Designations list[8] and the Leicester, Leicestershire & Rutland Biodiversity Action Plan 2016-2026[9] to identify if any protected and/or notable species were recorded during the surveys.

[7] [redacted]
[8] Available at: https://hub.jncc.gov.uk/assets/478f7160-967b-4366-acdf-8941fd33850b
[9] Available at: [redacted]

4. Results

4.1 Desk Study

Water Framework Directive Status

4.1.1 The proposed Solar and Energy Storage Park and Grid Connection Corridor span across both the Witham Upper and Trent and Trib Operational Catchments, monitored by the Environment Agency for the purpose of the Water Framework Directive. The statuses of all affected WFD water bodies are summarised below.

Witham Upper Operational Catchment

4.1.2 Tributary of Till[10] (WFD water body ID: GB105030062480) is currently classified by the Environment Agency as having Poor ecological status. The quality elements preventing the water body from achieving Good status are invertebrates and macrophytes and phytobenthos combined. The reasons for not achieving Good status (RNAG) have been assessed as land drainage and poor soil management. The objectives for this water body are to improve the quality status of invertebrates and macrophytes and phytobenthos combined to Good by 2027.

4.1.3 Skellingthorpe Main Drain[11] (WFD water body ID: GB105030062390) is currently classified by the Environment Agency as having Moderate ecological status. The quality elements preventing the water body from achieving Good status are invertebrates and dissolved oxygen. The reasons for not achieving Good status (RNAG) have been assessed as physical modification and point source pollution. According to the Environment Agency, it is disproportionately expensive and technically infeasible to improve invertebrates and dissolved oxygen elements to Good status.

Trent and Trib Operational Catchment

4.1.4 Trent from Carlton-on-Trent to Laughton Drain[12] (WFD Water Body ID: GB104028058480) is currently classified by the Environment Agency as having Moderate ecological status. The quality elements preventing the water body from achieving Good status are invertebrates, phosphate, Perfluorooctane sulphonate (PFOS), Mercury and Its Compounds and Polybrominated diphenyl ethers (PBDE). The reasons for not achieving Good status have been assessed as diffuse source pollution from poor soil management and transport drainage, point source pollution from waste water and physical modification. The objectives for this water body are to improve the quality status of phosphate to Good by 2027, however, the Environment Agency describes this as technically infeasible.

4.1.5 Marton Drain Catchment (trib of Trent)[13] (WFD water body ID: GB104028057840) is currently classified by the Environment Agency as

[10] https://environment.data.gov.uk/catchment-planning/Water body/GB105030062480
[11] https://environment.data.gov.uk/catchment-planning/Water body/GB105030062390
[12] https://environment.data.gov.uk/catchment-planning/Water body/GB104028058480
[13] https://environment.data.gov.uk/catchment-planning/Water body/GB104028057840

having Moderate ecological status. The quality element preventing the water body from achieving Good status is phosphate. The reasons for not achieving Good status (RNAG) have been assessed as elevated phosphate due to diffuse source pollution from poor livestock management and point source pollution from sewage discharge. The objectives for this water body are to improve the quality status of phosphate to Good by 2027, however, the Environment Agency describes this as technically infeasible.

4.1.6 Seymour Drain Catchment (trib of Trent)[14] (WFD water body ID: GB104028058340) is currently classified by the Environment Agency as having Moderate ecological status. The quality elements preventing the water body from achieving Good status are invertebrates, macrophytes and phytobenthos combined, phosphate and dissolved oxygen. The reasons for not achieving Good status (RNAG) have been assessed as diffuse source pollution from poor soil management and transport drainage, point source pollution from sewage discharge, and physical modification. The objectives for this water body are to improve the quality status of invertebrates, dissolved oxygen and phosphate to Good by 2027, but the Environment Agency describes this as disproportionately expensive.

Notable Species

4.1.7 An ecological data search of protected, notable, and invasive species within 2km of the Order limits was carried out by Greater Lincolnshire Nature Partnership (GLNP). The full list of notable aquatic species is shown in Annex H.

4.1.8 Protected aquatic species identified in the GLNP data search are shown in Table 4, with the relevant designation under which they are notable or afforded protection.

4.1.9 Atlantic salmon (*Salmo salar*) are anecdotally known to use the River Trent as a migratory route. The closest record to the Order limits was a capture in a seine net at Stoke Bardolph (SK 64980 41715) approximately 60km upstream of the Site in November 2021.

4.1.10 European Eel are recorded in Padmoor drain and are likely to be present both in this watercourse and its tributaries and other connected water bodies. Eel also make use of ditches and standing water bodies.

Table 4 Protected aquatic species identified by GNLP and EA

Species	Designation
European eel *Anguilla anguilla*	NERC S41; UKBAP priority species; Eel Regs
Atlantic Salmon *Salmo salar*	Habs Dir. Annex II, V; NERC S41
Spined loach *Cobitis taenia*	Habs Dir. Annex II; UKBAP
Brown/sea trout *Salmo trutta*	UKBAP; NERC S41

[14] https://environment.data.gov.uk/catchment-planning/Water body/GB104028058340

Species	Designation
Tubular Water-dropwort *Oenanthe fistulosa*	NERC (S. 41); UKBAP priority species

4.1.11 Historical records of species sightings are available as open-source data on NBN Atlas. A search of the database was conducted within a 2km radius of the Solar and Energy Storage Park, and downstream of any potential Grid Connection Corridor crossings. Notable species identified are shown in Table 5.

Table 5 Notable NBN species records identified within the study area

Species	Status	Total number of records	Most recent record	Location
European eel *Anguilla anguilla*	NERC S41; UKBAP priority species; Eel Regs	3	1995	Kexby Grange
Canadian pondweed *Elodea canadensis*	WCA Sch 9 INNS	4	2016	Trib of Trent
Nuttall's waterweed *Elodea nuttallii* (INNS)	WCA Sch 9 INNS	4	2016	Trib of Trent; Seymour Drain
Water beetle *Hydrochus elongatus*	RDB Near Threatened	1	2002	Mother Drain
Water beetle *Hygrotus quinquelineatus*	RDB Nationally Scarce	4	2001	Mother Drain

Historic records of fish, macroinvertebrate and aquatic macrophyte species within the last ten years are available from the Environment Agency ecology and fish data explorer[15] through their routine monitoring programme. Details of relevant Environment Agency monitoring sites are summarised in Table 6.

[15] https://environment.data.gov.uk/ecology/explorer/

Table 6 Location of relevant Environment Agency fish, macroinvertebrate and macrophyte monitoring sites

Site name (ID)	WFD Water body	Site National Grid Reference	Distance from Site	Year last surveyed	Group monitored
Marton Drain (52709)	GB104028057840	SK8350081240	0.05km d/s of GCC crossing	2020	Macrophytes
Marton Drain (54038)	GB104028057840	SK8412980987	0.02km d/s of GCC crossing	2013	Invertebrates
Seymour Drain (165003)	GB104028058340	SK8216480935	0.2km d/s of GCC crossing	2015	Macrophytes
Seymour Drain (158852)	GB104028058340	SK8258081417	0.9km d/s of GCC crossing	2012	Invertebrates
Padmoor Drain (160480/161709)	GB105033062480	SK8723683541	Within main site boundary	2016	Invertebrates, Macrophytes

GCC – Grid Connection Corridor

4.1.12 Environment Agency fish monitoring sites are present downstream of the Solar and Energy Storage Park and Grid Connection Corridor.

4.1.13 Three macroinvertebrate surveys were undertaken at the Marton Drain (52709) EA monitoring site between March and October 2013. A total of 47 macroinvertebrate taxa were recorded, including two non-native (but not statutorily invasive) species: the New Zealand mud snail *Potamopyrgus antipodarum* and amphipod 'shrimp' *Crangonyx pseudogracilis/floridanus*. No protected macroinvertebrate taxa were recorded.

4.1.14 One macroinvertebrate survey was undertaken at the Seymour Drain (158852) EA monitoring site in March 2012. A total of 28 macroinvertebrate taxa were recorded, including the non-native *C. pseudogracilis/floridanus*. No protected macroinvertebrate taxa were recorded.

4.1.15 Four macroinvertebrate surveys were undertaken at the Padmoor Drain (160480) EA monitoring site in March and September 2013 and 2016. A total of 61 macroinvertebrate taxa were recorded, including two non-native species: *P. antipodarum* and *C. pseudogracilis/floridanus*. No protected macroinvertebrate taxa were recorded.

4.1.16 One macrophyte survey was undertaken at the Marton Drain (52709) EA monitoring site in August 2020. A total of 15 macrophyte taxa were recorded, including the INNS Nuttall's waterweed *Elodea nuttallii*. No protected macrophyte species were recorded.

4.1.17 Two macrophyte surveys were undertaken at the Seymour Drain (165003) EA monitoring site in June 2013 and August 2015. A total of 20 macrophyte taxa were recorded, including the INNS *E. nuttallii*. No protected macrophyte species were recorded.

Notable Habitats

4.1.18 Designated sites and habitats within the Order limits and a 2km radius were also provided by Greater Lincolnshire Nature Partnership. There are no Statutory Designated sites within the study area.

4.1.19 There is a total of nine Non-Statutory Designated sites of aquatic importance within the study area. These include three Local Wildlife Sites (LWS) within a 2km radius of the Solar and Energy Storage Park, and a further six LWS which are crossed by the proposed Grid Connection Corridor. Details of these sites are shown in Table 7 below.

Table 7 Non-Statutory Designated Sites of aquatic importance within the study area

Site name	Designation	Grid Reference	Distance from site	Nature conservation interest
Mother Drain, Upper Ings	LWS	SK 82148 83371	Crossed by GCC	**A drain of interest for water beetles**
Thornhill Lane Drain	LWS	SK 81402 82850	Crossed by GCC	**A drain of interest for water beetles**
Littleborough Lagoons	LWS	SK 82719 83297	Crossed by GCC	A shallow lagoon with flood bank and drain of botanical and ornithological importance
Coates Wetland	LWS	SK 83136 81442	Crossed by GCC	**A group of pools** with rough grazing land and a section of the River Trent, providing an area of zoological and botanical interest
Cow Pasture Lane Drains	LWS	SK 80682 80384	Crossed by GCC	**Drains with notable aquatic and bank-side vegetation**
Cottam Wetlands	LWS	SK 83031 79169	Crossed by GCC	An excellent wetland mosaic comprising lagoons, marshy grasslands, swamp, and **a representative length of the River Trent**
Priory Farm	LWS	SK 84076 86949	1.1km from main site boundary	Manor House Moat is a wetland habitat supporting notable species such as water-violet. A high-quality shallow ditch north of the woodland contains notable species such as tufted sedge and water-violet. Water voles are reported to be present.
Out Ings	LWS	SK 82566 84730	0.5km from main site boundary	A diverse mosaic of grassland, **open water**, and carr communities adjacent to the River Trent
Thurlby Wood	LWS	SK 84676 86417	0.4km from main site boundary	Semi-natural ancient woodland of significant botanical interest. **Wettest parts of the site, including a pond, support a range of macrophytes**

4.2 Aquatic Macroinvertebrate Survey Results

Autumn Survey Results

4.2.1 The full aquatic macroinvertebrate taxa list can be found in Table F1 in Annex F.

4.2.2 A single individual of the nationally scarce water beetle *Scarodytes halensis* (Ref 7) was found in Tributary 1 of Padmoor Drain.

4.2.3 The non-native (but non-invasive) New Zealand mud snail *Potamopyrgus antipodarum* was found at all sites, notably in Tributary 1 of Padmoor Drain and Ditch 3, with 241 and 247 individuals respectively. Whilst *P. antipodarum* was identified, there are no statutory obligations due to the presence of the species.

4.2.4 Tributary 1 of Padmoor Drain was dominated by *P. antipodarum* which comprised 73.9% of the identified specimens. The amphipod 'shrimp'

Gammarus pulex was the next most abundant at 4.6%, with the rest of the macroinvertebrate community consisting largely of small numbers of a range of pollution-tolerant taxa including oligochaete worms, leeches, true flies, beetles, and true bugs. There was a notably high diversity of beetles, with small abundances of 12 different species present, including one individual of the nationally scarce water beetle *Scarodytes halensis*.

4.2.5 Seymour drain was dominated by molluscs, which accounted for 63.2% of all taxa, with *Valvata piscinalis*, *Ampullaceana balthica* and *Bithynia leachii* the most dominant. The next most dominant taxa were the water slater *Asellus aquaticus* at 10.6%, freshwater shrimp *Gammarus pulex* at 7.2% and the beetle *Haliplus lineatocollis* at 5.7%.

4.2.6 Ditch 3 was also dominated by molluscs, accounting for 50.9% of the taxa surveyed. The most abundant of these was the New Zealand mud snail *P. antipodarum* which comprised 23.3% of all taxa, with the whirlpool ramshorn *Anisus vortex* and margined ramshorn *Planorbis planorbis* next most abundant at 13% and 7.8% respectively.

4.2.7 Cow Pasture Lane was dominated by molluscs, which accounted for 71.8% of all macroinvertebrates. The most abundant of these was the New Zealand mud snail *P. antipodarum* which comprised 31%, followed by *A. balthica* at 19.5% and *Pisidium sp*. at 16.7%. Trueflies were the next largest group, comprising 14% of all invertebrates and included Tanypodinae, Limoniidae and Culicidae. Other taxa included Hydracarina mites, juvenile dragonfly larvae and small numbers of the aquatic beetles *Haliplus lineaticollis* and *Graptodytes pictus*.

4.2.8 Marton Drain had was dominated by Baetid mayflies, which accounted for 42.3% of all inverts, split evenly between *Cloeon dipterum* and *Baetis sp*. Crustaceans made up the next most abundant group, mostly *Crangonyx floridanus/pseudogracilis*, (22.6%) and *Asellus aquaticus* (5.3%) with much smaller numbers of *Gammarus sp*. Molluscs made up 12.5% of the macroinvertebrates covering 13 species, with just one *P. antipodarum.* Aquatic beetles were fairly diverse at eight species and accounted for 10.6% of all macroinvertebrates.

4.2.9 The macroinvertebrate communities at all sites are indicative of slow-flowing or standing waters with silted substrates. While few individually notable species were identified, the overall assemblage of macroinvertebrates, in particular water beetles, was notable and indicative of suitable habitat conditions as per the citations of several LWS (Table 7).

4.3 Aquatic Macroinvertebrate Indices and WFD Classification

4.3.1 Based on the criteria outlined in Section 3, Community Conservation Index (CCI), Whalley, Hawkes, Paisley & Trigg (WHPT) score Average Score Per Taxon (ASPT), and Number of scoring taxa (NTAXA) values for each survey reach are detailed in Table 8.

Table 8 Aquatic macroinvertebrate indices and WFD classification

Index	Trib. 1 of Padmoor Drain	Seymour Drain	Ditch 3	Cow Pasture Lane	Marton Drain
NTAXA (WHPT)	17	21	19	12	23
ASPT (WHPT)	4.076	3.214	3.647	3.642	3.804
CCI score	13.125	8.571	7.000	6.000	9.483
CCI score - interpretation	Fairly High conservation value	Moderate conservation value	Moderate conservation value	Moderate conservation value	Moderate conservation value
LIFE score (MTL)	6.471	5.909	5.643	5.800	6.069
LIFE score (MTL) - interpretation	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows	Low sensitivity to reduced flows
PSI score (MTL)	20.690	10.000	4.651	0.000	8.621
PSI score (MTL)	Sedimented	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented	Heavily Sedimented

4.3.2 The Community Conservation Index (CCI) score for Tributary 1 of Padmoor Drain was 13.125 which is representative of Fairly high conservation value. All other sites were indicative of invertebrate communities of Moderate conservation value.

4.3.3 The presence of the of the nationally scarce water beetle *Scarodytes halensis* was the primary driver for the Fairly high conservation value of Tributary 1 of Padmoor Drain. The non-native but non-invasive New Zealand mud snail was identified at all survey reaches, but there are no statutory constraints to the spread of this species.

4.3.4 Autumn LIFE scores indicated a macroinvertebrate community of low sensitivity to reduced flows at all reaches, which is to be expected with the nature of the ditches, which were standing water or of very low velocity.

4.3.5 PSI scores reflected a macroinvertebrate community adjusted towards sedimented or heavily sedimented conditions. Only Tributary 1 of Padmoor Drain was adjusted towards sedimented conditions, with all other sites heavily sedimented. Again, this may be expected in slow-flowing or standing water ditches typical of land drainage in a largely arable landscape.

4.3.6 The PSI score of 0.000 for Cow Pasture Lane is due to the lack of PSI scoring species at this site.

4.4 Aquatic Macrophyte Survey Results

4.4.1 A full list of macrophytes identified during the surveys can be found in Annex G.

4.4.2 Seymour Drain contained a low abundance (TCV 1) of *Potamogeton friesii* which is listed as near threatened on the GB Red List and vulnerable on the England Red list (Ref 15).

4.4.3 One Schedule 9 listed INNS, Nuttall's waterweed *Elodea nuttallii*, was found in high abundance (TCV of 9) in Seymour Drain.

4.4.4 Tributary 1 of Padmoor Drain had 40% macrophyte coverage of 11 species, largely wetland and emergent species. It was unshaded and characterised by large quantities of algae, covering approximately 70% of the reach and just one submerged taxon, a starwort *Callitriche* sp.

4.4.5 Seymour Drain had 85% macrophyte coverage and the most diverse macrophyte assemblage of the four reaches with 13 species recorded. This unshaded reach had recently been dredged, with the spoil placed on the banktop. It had large quantities of fat duckweed *Lemna gibba* and Nuttall's waterweed *Elodea nuttallii.* However, it also had three species of *Potamogeton* and a species of *Callitriche*.

4.4.6 Ditch 3 had no shading and seven macrophyte species, all of which were in low abundances. The most abundant with a TCV score of 3 each, were fool's watercress *Helosciadium nodiflorum,* and watercress *Rorippa nasturtium-aquaticum agg*.

4.5 Aquatic Macrophyte Indices and WFD Classification

4.5.1 River Macrophyte Nutrient Index (RMNI), number of macrophyte taxa (NTAXA), Number of Functional Groups (NFG) and cover of filamentous green algae (ALG), observed and predicted scores for each survey reach are detailed in Table 9. The table also includes the overall Ecological Quality Ratio (EQR) and equivalent WFD macrophyte status for each survey reach.

Table 9 Macrophyte metric observed and predicted scores, ecological quality ratio and Water Framework Directive (WFD) classification

Metric		Trib. 1 of Padmoor Drain	Seymour Drain	Ditch 3
River macrophyte nutrient index (RMNI)	Observed	8.10	8.60	8.37
	Predicted	7.47	8.05	7.78
Number of macrophyte taxa (NTAXA)	Observed	4	9	3
	Predicted	9.55	9.69	9.69
Number of functional groups (NFG)	Observed	4	8	3
	Predicted	6.04	6.12	6.12
Cover of filamentous green algae (ALG)	-	6.25	37.5	0.00
Overall Ecological Quality Ratio (EQR)	-	0.335	0.412	0.493

Metric		Trib. 1 of Padmoor Drain	Seymour Drain	Ditch 3
WFD macrophyte classification	-	**Poor**	**Moderate**	**Moderate**

4.5.2 The Ecological Quality Ratio (EQR) of 0.335 at Tributary 1 of Padmoor Drain equates to Poor WFD status, indicating the reach is substantially impacted by eutrophication and/or modification to morphological conditions. Seymour Drain and Ditch 3 scored 0.412 and 0.493 respectively, equating to a Moderate WFD status.

4.5.3 Alkalinity data used with the LEAFPACS calculator should be obtained from monthly analysis of samples from each over a period of at least one year, whereas here the average of samples collected during the two survey visits was used. Consequently, these results should be treated with caution.

5. Discussion

Desk study

5.1.1 The desk study identified records of the UKBAP priority species European eel *Anguilla anguilla* within Tributary 1 of Padmoor Drain in 2012. European eels are present in the River Trent and are likely to occur in interconnected watercourses and ditches throughout the Order limits. Potential impacts to eel have been addressed in **ES Volume 1, Chapter 8: Ecology and Nature Conservation [EN010131/APP/3.1]**.

5.1.2 The Environment Agency Explorer produced records in the River Trent within 60km of the Scheme of the following notable and/or protected fish species: Atlantic salmon *Salmo salar*, brown trout *Salmo trutta*, lamprey ammocetes Petromyzontidae, spined loach *Cobitis taenia* and bullhead *Cottus gobio*. Though these records did not fall within the drains and ditches assessed in the present report, migratory species such as salmon, sea trout, European eel, and lamprey will be present within the River Trent at the crossing point, and there is potential for these and other fish species to utilise water bodies connected to the River Trent. The potential impacts to these species have been addressed in more detail within **ES Volume 1, Chapter 8: Ecology and Nature Conservation [EN010131/APP/3.1]**.

5.1.3 The desk study identified records held by the Greater Lincolnshire Nature Partnership of the protected tubular water-dropwort *Oenanthe fistulosa* (Natural Environment Research Council (NERC) S41, Red Data List (RDL)) within 2km of the site, and the county-rare *Groenlandia densa* recorded within Thornhill Lane Drain, Littleborough LWS, and it is considered they may be found in surrounding drains.

Macroinvertebrate Surveys

5.1.4 The macroinvertebrate surveys indicated that Tributary 1 of Padmoor Drain was of fairly high conservation value, while Seymour Drain and Ditch 3 were of moderate conservation value. Tributary 1 of Padmoor Drain had a notable assemblage of aquatic beetles including the nationally scarce *Scarodytes halensis* (Ref 7), comparable with the citations of several LWS, which indicate ‘drains of interest for water beetles’.

5.1.5 Macroinvertebrate survey results presented here pertain to a single autumn survey season. It should be noted that it is recommended that surveys are carried out in both spring and autumn for full WFD assessment and in order to identify notable species, which may be present in spring but absent in autumn.

Macrophyte Surveys

5.1.6 Tributary 1 of Padmoor Drain achieved a Moderate WFD status equivalent, while Seymour Drain and Ditch 3 scored Poor status. It should be noted that prior to the surveys, the banks of Tributary 1 of Padmoor Drain and Seymour Drain had undergone extensive vegetation clearance. It is possible that prior to the vegetation removal, the channel of Tributary 1 of Padmoor Drain and

Seymour Drain were too shaded to support extensive macrophyte growth. In addition, the vegetation clearance is likely to have removed existing emergent or wetland species from these drains. As Ditch 3 contained only three WFD scoring species, all of which are emergent or wetland species capable of enduring dry periods, it is considered that this ditch is subject to frequent drying.

5.1.7 The survey results of Seymour Drain identified abundant growth of the INNS species Nuttall's waterweed, which is listed in Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) and the Invasive Alien Species (Enforcement and Permitting) Order 2019. The legislation referenced makes it an offence to plant, or otherwise cause to grow (including allowing to spread), listed plant species in the wild. If transported off site, there is a duty of care with regards to the disposal of any part of the plant that may facilitate establishment in the wild and cause environmental harm (as per the Environmental Protection Act 1990). The legislation also makes in an offense to release, or allow to escape, listed species (or species not ordinarily resident in and is not a regular visitor to Great Britain in a wild state) into the wild.

5.1.8 Seymour Drain contained a low abundance (TCV 1) of *Potomogeton friesii* which is listed as near threatened on the GB Red List and vulnerable on the England Red list (Ref 15).

5.1.9 It is likely that the majority of ditches (and some watercourses) in this largely arable landscape are subject to regular dredging and/or weed cutting, and this may limit the number and diversity of macrophyte species present. This also provides an opportunity for enhancement of these ditches through reduced management, should this be required to support Biodiversity Net Gain (BNG) objectives.

6. Recommendations

Design Mitigation

6.1.1 It is recommended that clear span bridges are constructed over watercourses where possible. This will allow the transport of sediment and other materials downstream and will retain the riparian area to allow passage of mammals such as otter, and also minimise shading on aquatic macrophytes.

6.1.2 Where the temporary or permanent culverting of watercourses or ditches is required, including the extension of existing culverts, this should ensure continued connectivity along water bodies including for fish passage. Culverts should be designed according to best practice guidance, refer also to **ES Volume 1, Chapter 9: Water Environment [EN010131/APP/3.1]**. Culvert design should allow for larger dimensions of culvert upgrades/extensions, with mammal ledge and allowance for fish passage through the culvert by the creation of a natural bed and no drop inlet/outlet at either end of the culvert, and raising the soffits of these structures to increase light into the watercourses.

6.1.3 It is recommended that Sustainable Drainage System (SuDS) features such as swales or retention ponds are considered and excessive surface water from the main site does not drain directly into any of the water bodies that are spanned to minimise further sedimentation and potential water quality impacts.

6.1.4 The Scheme should avoid any deterioration of WFD status of water bodies or pose any constraints to their potential to reach Good status in the future – refer also to the WFD Compliance Assessment in **Volume 3, Appendix 9-A [EN010131/APP/3.1]**. for the Scheme.

6.1.5 A suite of recommendations for appropriate design mitigation will be provided in the **ES Volume 1, Chapter 8: Ecology and Nature Conservation [EN010131/APP/3.1]**.

Construction Phase Mitigation

6.1.6 If direct impacts to watercourses or water bodies are proposed, for example through drain-down, culverting, open-trenching, or realignment / diversion, additional mitigation may be required, and may include the following:

- Avoidance of key fish migration timings, e.g., April to October for European eel, June to November for Atlantic salmon and brown/sea trout, October to April for Lamprey (for example, during HDD beneath the River Trent);
- Fish rescue and/or translocation during drain-down of watercourses or water bodies, and during the installation of culverts or over-pumping for open trenching through watercourses/ditches;
- Consideration must be given to invasive non-native species (INNS) known to be present in water bodies, most notably Nuttall's waterweed, with appropriate biosecurity measures implemented.

6.1.7 The following pollution prevention measures are recommended during the construction phase:

- Prevent erosion and runoff by minimising vegetation and soil disturbance. Ensure the implementation of exclusion buffer zones (10 m or as recommended in **ES Volume 1, Chapter 9: Water Environment [EN010131/APP/3.1]**) for the full length of watercourses within the construction buffer zone. Include further preventative measures, such as runoff/settlement ponds and/or silt fencing if necessary;
- Where construction vehicles are required to pass over the water bodies, vehicles/plant must be cleaned away from the water in dedicated vehicle washing areas to prevent potential pollutants entering the surface water system, before crossing over the water body;
- Control the spread of dust and sediment through fine water spraying of vehicle routes;
- Regularly service, monitor and inspect on-site plant for leaks to prevent construction spillages and to ensure pollutants do not enter the waterways. Refuel plant and machinery in dedicated refuelling areas, with drip-trays used routinely and spill kits available;
- Cover and protect all surface water drainage systems from pollution and sediment input; and

6.1.8 A suite of recommendations for appropriate construction-phase mitigation will be provided in **ES Volume 1, Chapter 8: Ecology and Nature Conservation [EN010131/APP/3.1]**.

Invasive Non-Native Species (INNS)

6.1.9 Section 14 of the Wildlife and Countryside Act 1981 (as amended) makes it an offence to 'plant, or otherwise cause to grow', any plant species listed on Schedule 9 of the Act. Likewise, it is an offence to introduce into the wild any animal listed in Schedule 9 of the Act.

6.1.10 A pre-commencement INNS survey should be conducted prior to construction to inform an eradication and management plan. Of concern is the confirmed presence of Nuttall's waterweed in Seymour Drain, Marton Drain, and a tributary of the River Trent in the desk study, and other INNS found in the desk study including Canadian pondweed, and Himalayan balsam. Mismanagement of spoil heaps or vegetation could result in the spread of these species which would constitute an offence. Other non-native (but non-invasive) aquatic macroinvertebrates were identified, and therefore best-practice biosecurity measures should be implemented during construction.

6.1.11 Biosecurity protocols will be required during any in-channel works to prevent the spread of INNS and water-borne diseases such as crayfish plague – such measures will be detailed in the Biosecurity Management Plan, as secured by the **Framework Construction Environmental Management Plan (CEMP) [EN010131/APP/7.3].**

6.1.12 A suite of appropriate recommendations for biosecurity and controlling the spread of INNS will be provided in the **ES Volume 1, Chapter 8: Ecology and Nature Conservation [EN010131/APP/3.1].**

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Ref 18. WFD-UKTAG (Water Framework Directive – United Kingdom Advisory Group) (2020). *UKTAG River Assessment Method Macrophytes and Phytobenthos: Phytobenthos - Diatoms for Assessing River and Lake Ecological Quality (River DARLEQ3)*

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Annex A. Survey Locations

Figure 8E-1 Survey locations

Revision: 0 Drawn: BF Checked: DH Approved: RW Date: 2023-01-19

Filename: X:\Projects\Gate Burton Energy Park\02_Maps\Environmental Statement\Chapter 08 - Ecology\ECO_ES_App8E-1_Aquatic Survey.mxd

Tributary 1 of Padmoor Drain
Tributary 1 of Padmoor Drain
Ditch 1
Ditch
Tributary 2 of Padmoor Drain
Tributary 2 of Padmoor Drain
Ditch 2
Marton Drain
Ditch
Ditch
Carr Drain
Seymour Drain
Ditch
Ditch
Ditch 3
Seymour Drain
Seymour Drain
Ditch 3
Cow Pasture Lane Drain
Ditch
Ditch
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Ditch 4

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AECOM

PROJECT

Gate Burton Energy Park

CLIENT

Gate Burton ENERGY PARK

CONSULTANT

AECOM Limited
Sunley House
4 Bedford Park
Surrey, CR0 2AP, UK
www.aecom.com

LEGEND

- Order Limits
- Aquatic Walkover Survey Locations
- Aquatic Macroinvertebrate Survey Locations
- Aquatic Walkover and Macroinvertebrate Survey Locations
- Aquatic Macrophyte Survey Locations

NOTES

ISSUE PURPOSE

Environmental Statement

PROJECT NUMBER

60664324

FIGURE TITLE

Aquatic Ecology Survey Locations

FIGURE NUMBER

Figure 8E.1

Annex B. Community Conservation Index (CCI)

The Community Conservation Index (Ref 3) allows a classification of the nature conservation value associated with a macroinvertebrate community. The CCI score for one sample is derived from individual Conservation Scores (CS), assigned to some species of aquatic macroinvertebrates and relating closely to the available published Red Data Books (Ref 1, Ref 2; Ref 13). Conservation Scores assigned to individual species vary from 1 to 10, as detailed on the Table C1 below. The derived CCI scores generally vary from 0 to > 20, as detailed in the Table C2 below. The Table C2 below provides a guide to interpreting CCI scores.

Table C1: Conservation Scores from the Community Conservation Index (from Ref 3)

Conservation Score	Relation to Red Data Books
10	RDB1 (Endangered)
9	RDB2 (Vulnerable)
8	RDB3 (Rare)
7	Notable (but not RDB status)
6	Regionally notable
5	Local
4	Occasional (species not in categories 10-5, which occur in up to 10% of all samples from similar habitats)
3	Frequent (species not in categories 10-5, which occur in up to >10-25% of all samples from similar habitats)
2	Common (species not in categories 10-5, which occur in up to >25-50% of all samples from similar habitats)
1	Very common (species not in categories 10-5, which occur in up to >50-100 % of all samples from similar habitats)

Table C2: General guide to CCI scores (from Ref 3)

CCI Score	Description	Interpretation
0 to 5.0	Sites supporting only common species and/or community of low taxon richness	Low conservation value
> 5.0 to 10.0	Sites supporting at least one species of restricted distribution and/or a community of moderate taxon richness	Moderate conservation value
> 10.0 to 15.0	Sites supporting at least one uncommon species, or several species of restricted distribution and/or a community of high taxon richness	Fairly high conservation value
> 15.0 to 20.0	Sites supporting several uncommon species, at least one of which may be nationally rare and/or a community of high taxon richness	High conservation value
> 20.0	Sites supporting several rarities, including species of national	Very high conservation value

CCI Score	Description	Interpretation
	importance and/or a community of very high taxon richness	

Annex C. Lotic-Invertebrate Index of Flow Evaluation (LIFE)

The Lotic-Invertebrate Index for Flow Evaluation (LIFE) provides an assessment of the impact of variable flows on benthic macroinvertebrate communities. Under the assessment, individual species of aquatic macroinvertebrates are assigned to a flow group varying from I to VI, as detailed on the Table D1 below. The LIFE score for a macroinvertebrate sample is then derived (mean of individual scores) from individual species scores and abundances, as detailed on the Table D3 below. LIFE scores for a macroinvertebrate sample ranges from 1 to 12, where highest scores describe communities adapted to rapid flows.

Table D1: Flow groups used to derive LIFE scores (from Ref 6)

LIFE score Group	Description	Mean current velocity
I	Taxa primarily associated with rapid flows	Typically > 100 $cm.s^{-1}$
II	Taxa primarily associated with moderate to fast flows	Typically 20 to 100 $cm.s^{-1}$
III	Taxa primarily associated with slow or sluggish flows	Typically < 20 $cm.s^{-1}$
IV	Taxa primarily associated with (usually slow) and standing waters	
V	Taxa primarily associated with standing waters	
VI	Taxa frequently associated with drying or drought impacted sites	

Table D2: Abundance categories used to derive LIFE scores (from Ref 6)

Abundance category	Description
A	1 to 9
B	10 to 99
C	100 to 999
D	1000 to 9999
E	> 10000

Table D3: A guide to interpreting LIFE scores (from Ref 6)

Flow groups	Abundance categories			
	A	B	C	D/E
I	9	10	11	12
II	8	9	10	11
III	7	7	7	7
IV	6	5	4	3
V	5	4	3	2
VI	4	3	2	1

Annex D. Proportion of Sediment-sensitive Invertebrates (PSI)

The Proportion of Sediment-sensitive Invertebrates (PSI) index allows an assessment of the extent to which a water body is composed of, or covered by, fine sediments. This follows the method stated in Ref 7. Under this system, individual species of aquatic macroinvertebrates are assigned a Fine Sediment Sensitivity Rating (FSSR) as detailed in Table E1, and abundance rating based on LIFE scores as detailed in Table E2. The PSI score for the aquatic macroinvertebrate sample is then derived from the individual species scores and abundances, as detailed in Table E3. The PSI score corresponds to the percentage of fine sediment-sensitive taxa present in a sample and ranges from 0 to 100, with low scores corresponding to water bodies with high fine sediment cover.

Table E1: Fine Sediment Sensitivity Rating (FSSR) groups used to derive PSI scores

FSSR group	Description
A	Highly sensitive
B	Moderately insensitive
C	Moderately insensitive
D	Highly insensitive

Table E2: Abundance categories used to derive PSI scores

FSSR group	Abundance			
	1-9	10-99	100-999	>999
A	2	3	4	5
B	2	3	4	5
C	1	2	3	4
D	1	2	3	4

Table E3: Interpretation of PSI scores

PSI	Description
81-100	Minimally sedimented
61-80	Slightly sedimented
41-60	Moderately sedimented

21-40	Sedimented
0-20	Heavily sedimented

Annex E. Whalley, Hawkes, Paisley & Trigg (WHPT) Metric

There are approximately 4,000 species of aquatic macroinvertebrates in the British Isles. To simplify the analysis of the samples and the data we do not identify individual species but only the major types (taxa), mostly at the family taxonomic level. A key piece of information is the number of different taxa at a Reach. A fall in the number of taxa indicates ecological damage, including pollution (organic, toxic and physical pollution such as siltation, and damage to habitats or the river channel).

The WHPT scoring system (Ref 17) is based upon the sensitivity of macroinvertebrate families to organic pollution. It replaces the Biological Monitoring Working Party (BMWP) system (Ref 9) previously used in the UK.

The WHPT system assigns a numerical value to about 100 different taxa (known as the WHPT-scoring taxa) according to their sensitivity to organic pollution. In addition to the presence of macroinvertebrate taxa at a sampling Reach, as in the BMWP scoring system, the WHPT system also uses another type of information, this being the abundances of different scoring taxa.

Taxa abundances are classified in four categories (Class 1: 1 to 10 individuals, Class 2: 11 to 100 individuals, Class 3: 101 to 1,000 individuals, and Class 4: > 1,000 individuals). A score (Pressure Sensitivity Scores (PSs) is then assigned to each taxa, depending of the taxa sensitivity and abundances recorded.

The total WHPT score for a sample corresponds to the sum of PSs of scoring taxa recorded. The Average Score Per Taxon (ASPT) values are calculated as the Sum PSs divided by the number of scoring taxa (NTAXA). As such, three metrics are calculated:

- WHPT score
- NTAXA
- ASPT

Some animals are more susceptible to organic pollution than others, and the presence of sensitive species indicates good water quality. This fact is taken into account by the WHPT metrics.

The most useful way of summarising the biological data was found to be one that combined the number of taxa and the ASPT. The best quality is indicated by a diverse variety of taxa, especially those that are sensitive to pollution. Poorer quality is indicated by a smaller than expected number of taxa, particularly those that are sensitive to pollution. Organic pollution sometimes encourages an increased abundance of the few taxa that can tolerate it. However, maximum achievable values will vary between geological regions. For example, pristine lowland streams in East Anglia will always score lower than pristine Welsh mountain streams because they are unable to support many of the high-scoring taxa associated with fast flowing habitat. WHPT scores and ASPT for different types watercourse are dependent on the quality and diversity of habitat, natural water chemistry (associated with geology, distance

from source etc.), altitude, gradient, time of year the sample was taken and other factors.

Annex F. Macroinvertebrate Taxa List

Table F1: Macroinvertebrate taxa list for Tributary 1 of Padmoor Drain, Seymour Drain and Ditch 3 from surveys undertaken in September 2022 and Cow Pasture Lane and Marton Drain in November 2022

Family	Species	Conservation Score	Trib. 1 of Padmoor Drain	Seymour Drain	Ditch 3	Cow Pasture Lane	Marton Drain
Flatworms							
Planariidae	*Polycelis nigra / tenuis*	1		1			
Dugesiidae	*Schmidtea polychroa*	2					5
Snails							
Lymnaeidae	*Ampullaceana balthica*	1	13	327	54	48	9
Valvatidae	*Valvata cristata*	2					1
Valvatidae	*Valvata piscinalis*	1	13	368			6
Tateidae	*Potamopyrgus antipodarum*	1	241	64	247	81	1
Bithyniidae	*Bithynia tentaculata*	1					3
Bithyniidae	*Bithynia leachi*	5		290			17
Physidae	*Physa fontinalis*	1		94			1
Planorbidae	*Planorbarius corneus*	4					1
Planorbidae	*Planorbis planorbis*	1		193	83		20
Planorbidae	*Anisus vortex*	1		69	138		3
Planorbidae	*Anisus leucostoma*	4				6	
Planorbidae	*Bathyomphalus contortus*	2					5
Limpets and mussels							
Sphaeriidae	*Sphaerium corneum*	1					4
Sphaeriidae	*Pisidium sp.*			73	19	41	3
Worms							
Oligochaeta	Oligochaeta		3	25	83	5	8
Leeches							
Glossiphoniidae	*Glossiphonia complanata*	1	1	38	131		
Erpobdellidae	Erpobdellidae (juvenile / damaged)			8			
Erpobdellidae	*Erpobdella sp.*		2	1			

Family	Species	Conservation Score	Trib. 1 of Padmoor Drain	Seymour Drain	Ditch 3	Cow Pasture Lane	Marton Drain
Erpobdellidae	*Erbodella octoculata*	1		9	6		2
Mites							
Hydracarina	Hydracarina					21	
Crustaceans							
Ostracoda				30			
Gammaridae	*Gammarus pulex/fossarum agg.*	1					1
Gammaridae	*Gammarus pulex*	1	15	160	10		3
Crangonyctidae	Crangonyx sp. (floridanus/pseudogracilis)						109
Asellidae	Asellidae						
Asellidae	*Asellus aquaticus*	1		236	213		28
Asellidae	*Proasellus meridianus*	3					
Mayflies							
Baetidae	Baetidae (juvenile / damaged)		1				
Baetidae	*Baetis sp.*			76			120
Baetidae	*Cloeon dipterum*	1		3			108
Damselflies							
Coenagrionidae	Coenagrionidae (juvenile / damaged)						
Dragonflies							
Libellulidae	*Libellula sp.*					5	
True bugs							
Veliidae	*Velia caprai*	2					1
Nepidae	*Nepa cinerea*	3	1		1		
Pleidae	*Plea minutissima*	4		3			3
Corixidae	*Cymatia cleopatra*	5					3
Corixidae	*Corixa punctata*	1		1			
Corixidae	*Sigara dorsalis*	1					10
Notonectidae	*Notonecta glauca*	1		1			
Beetles							
Haliplidae	*Haliplus sp.*			2			2
Haliplidae	*Haliplus fluviatilis*	1					18

Family	Species	Conservation Score	Trib. 1 of Padmoor Drain	Seymour Drain	Ditch 3	Cow Pasture Lane	Marton Drain
Haliplidae	*Haliplus lineaticollis*	1	8	126	2	1	17
Hygrobiidae	*Hygrobia hermanni*	4					2
Dytiscidae	Dytiscidae (larvae / damaged)		1		6		
Dytiscidae	*Hyphydrus ovatus*	2					1
Dytiscidae	*Hydroporus palustris*	1	1				5
Dytiscidae	*Graptodytes pictus*	3				2	
Dytiscidae	*Nebrioporus assimilis*	5					7
Dytiscidae	*Nebrioporus elegans*	1	3	3			5
Dytiscidae	*Scarodytes halensis*	7	1				
Dytiscidae	*Agabus bipustulatus*	1			1		
Dytiscidae	*Agabus didymus*	1	1				
Dytiscidae	*Agabus guttatus*	4	1				
Hydrophilidae	*Hydrobius fuscipes*	1					
Hydrophilidae	*Anacaena globulus*	1		3	7		
Hydrophilidae	*Laccobius colon*	5		1	1		
Hydrophilidae	*Helochares lividus*	5		1			
Dryopidae	*Dyops sp.*				3		
Elmidae	*Elmis aenea*	1	7				
Elmidae	*Oulimnius sp.*		1				
Alderflies							
Sialidae	Sialidae (juvenile / damaged)						
Sialidae	*Sialis lutaria*	1	2		24		
Caddisflies							
Hydropsychidae	Hydropsyche sp.		1				
Limnephilidae	Limnephilidae (juvenile / damaged)		1				2
Limnephilidae	*Limnephilus sp.*					1	
Limnephilidae	*Limnephilus lunatus*	1	1		1		
Trueflies							
Chironomidae	Chironomidae (damaged / pupea)		1	4			
Chironomidae	Tanypodinae		2	8	17	16	1
Chironomidae	Orthocladiinae			2	4		2

Family	Species	Conservation Score	Trib. 1 of Padmoor Drain	Seymour Drain	Ditch 3	Cow Pasture Lane	Marton Drain
Chironomidae	Chironomini		3	2			
Chironomidae	Prodiamesinae				1		
Limoniidae	Limoniidae				3	3	
Dixidae	*Dixa nebulosa*	4	1				
Psychodidae					7		1
Culicidae	Culicidae					15	

Annex G. Macrophyte Taxa List

Table G1: Macrophyte taxa list for Tributary 1 of Padmoor Drain, Seymour Drain and Ditch 3 from surveys undertaken in September 2022

Scientific name	Common name	Trib. 1 Padmoor Drain	Seymour Drain	Ditch 3
Apium nodiflorum	Fool's watercress	6		3
Callitriche spp.	Starwort	2	4	1
Cladophora glomerata/Rhizoclonium hieroglyphicum	Blanketweed		7	
Elodea canadensis	Canadian pondweed		2	
Elodea nuttallii	Nuttall's pondweed		9	
Epobium hirsutum	great willowherb	1		
Equisetum arvense	Field horsetail			1
Filamentous green algae	Algae	8		
Glyceria maxima	Reed sweet-grass		3	
Iris pseudacorus	Yellow iris	2		
Myostis scorpiodes	Water forget-me-not	1		
Lemna gibba	Fat duckweed	2	9	1
Persicaria amphibia	Amphibious bistort		1	
Phalaris arundinacea	Reed canary grass		5	1
Potamogeton crispus	Curly-leaf pondweed		1	
Potamogeton friesii	Flat-stalk pondweed		1	
Potamogeton pectinatus	Sago pondweed		1	
Ranunculus sceleratus	Celery-leaf buttercup			
Rorippa nasturtium-aquaticum agg.	Watercress	5	1	3
Rumex hydrolapathum	Water dock		1	
Scrophularia sp	Figwort	1		
Solanum dulcamara	Bittersweet			
Sparganium erectum	Branched bur-reed	2		1
Veronica beccabunga	Brooklime	1		

Table J2: Taxon cover values (TCV)

TCV	Percentage cover for the macrophyte species
C1	<0.1%
C2	0.1 to 1%
C3	1 to 2.5%
C4	2.5 to 5%
C5	5 to 10%
C6	10 to 25%
C7	25 to 50%
C8	50 to 75%
C9	>75%

Table J3: Water Framework Directive boundary values for macrophytes in rivers

Ecological Quality Ratio	WFD Ecological Status for
≥ 0.80	High
≥ 0.60	Good
≥ 0.40	Moderate
≥ 0.20	Poor
< 0.20	Bad

Annex H. Notable aquatic species sightings identified by Greater Lincolnshire Nature Partnership within a 2km radius of the Site

Taxon name	Common name	Grid reference	Year	Protected/Invasive
Anguilla anguilla	European Eel	SK852859	2011	Protected
Anguilla anguilla	European Eel	SK852859	2010	Protected
Anguilla anguilla	European Eel	SK863855	1995	Protected
Anguilla anguilla	European Eel	SK863855	1995	Protected
Anguilla anguilla	European Eel	SK878846	1997	Protected
Anguilla anguilla	European Eel	SK878846	1997	Protected
Anguilla anguilla	European Eel	SK882842	1994	Protected
Anguilla anguilla	European Eel	SK882842	1994	Protected
Anguilla anguilla	European Eel	SK863855	1995	Protected
Anguilla anguilla	European Eel	SK878846	1997	Protected
Anguilla anguilla	European Eel	SK882842	1994	Protected
Anguilla anguilla	European Eel	SK863855	1995	Protected
Anguilla anguilla	European Eel	SK882842	1994	Protected
Anguilla Anguilla	European Eel	SK878846	1997	Protected
Lissotriton vulgaris	Smooth Newt	SK88G	1976	Protected
Lissotriton vulgaris	Smooth Newt	SK88T	1976	Protected
Lissotriton vulgaris	Smooth Newt	SK8381	2005	Protected
Lissotriton vulgaris	Smooth Newt	SK830848	2016	Protected
Oenanthe fistulosa	Tubular Water-dropwort	SK8286	1988	Protected
Oenanthe fistulosa	Tubular Water-dropwort	SK8286	1988	Protected
Oenanthe fistulosa	Tubular Water-dropwort	SK8286	1990	Protected
Triturus cristatus	Great Crested Newt	SK88G	1976	Protected
Triturus cristatus	Great Crested Newt	SK88T	1976	Protected
Triturus cristatus	Great Crested Newt	SK8485	2013	Protected
Triturus cristatus	Great Crested Newt	SK88G	2013	Protected

Taxon name	Common name	Grid reference	Year	Protected/Invasive
Triturus cristatus	Great Crested Newt	SK829854	2017	Protected
Crangonyx pseudogracilis/floridanus sens. lat.	Crangonyx pseudogracilis/floridanus	SK872835	2013	Invasive
Crangonyx pseudogracilis/floridanus sens. lat.	Crangonyx pseudogracilis/floridanus	SK872835	2013	Invasive
Crangonyx pseudogracilis/floridanus sens. lat.	Crangonyx pseudogracilis/floridanus	SK879846	2002	Invasive
Crangonyx pseudogracilis/floridanus sens. lat.	Crangonyx pseudogracilis/floridanus	SK872835	2016	Invasive
Crangonyx pseudogracilis/floridanus sens. lat.	Crangonyx pseudogracilis/floridanus	SK872835	2016	Invasive
Dreissena polymorpha	Zebra Mussel	SK879846	2007	Invasive
Dreissena polymorpha	Zebra Mussel	SK879846	2007	Invasive
Dreissena polymorpha	Zebra Mussel	SK879846	2007	Invasive
Elodea canadensis	Canadian Waterweed	SK8381	1985	Invasive
Elodea canadensis	Canadian Waterweed	SK838858	1976	Invasive
Elodea canadensis	Canadian Waterweed	SK834813	2004	Invasive
Elodea canadensis	Canadian Waterweed	SK836812	1985	Invasive
Elodea nuttallii	Nuttall's Waterweed	SK834813	2004	Invasive
Elodea nuttallii	Nuttall's Waterweed	SK8381	2006	Invasive
Fallopia japonica	Japanese Knotweed	SK8286	1976	Invasive
Impatiens capensis	Orange Balsam	SK88F	1989	Invasive
Impatiens capensis	Orange Balsam	SK8282	1997	Invasive
Impatiens capensis	Orange Balsam	SK833816	1989	Invasive
Impatiens capensis	Orange Balsam	SK833816	1984	Invasive
Impatiens capensis	Orange Balsam	SK834814	1985	Invasive
Impatiens capensis	Orange Balsam	SK833815	2008	Invasive
Impatiens capensis	Orange Balsam	SK834814	1984	Invasive
Impatiens capensis	Orange Balsam	SK8381	2020	Invasive
Impatiens capensis	Orange Balsam	SK8381	2020	Invasive
Impatiens glandulifera	Himalayan Balsam	SK88F	2006	Invasive

Taxon name	Common name	Grid reference	Year	Protected/Invasive
Impatiens glandulifera	Himalayan Balsam	SK8284	1974	Invasive
Impatiens glandulifera	Himalayan Balsam	SK8284	1979	Invasive
Impatiens glandulifera	Himalayan Balsam	SK8284	1980	Invasive
Impatiens glandulifera	Himalayan Balsam	SK8284	1982	Invasive
Impatiens glandulifera	Himalayan Balsam	SK8284	1979	Invasive
Impatiens glandulifera	Himalayan Balsam	SK8285	1988	Invasive
Impatiens glandulifera	Himalayan Balsam	SK8284	1979	Invasive
Impatiens glandulifera	Himalayan Balsam	SK8284	1977	Invasive
Impatiens glandulifera	Himalayan Balsam	SK820855	1988	Invasive
Impatiens glandulifera	Himalayan Balsam	SK827846	1984	Invasive
Impatiens glandulifera	Himalayan Balsam	SK827845	1979	Invasive
Impatiens glandulifera	Himalayan Balsam	SK827846	2015	Invasive
Impatiens glandulifera	Himalayan Balsam	SK827846	1984	Invasive
Impatiens glandulifera	Himalayan Balsam	SK8282	2018	Invasive
Lemna minuta	Least Duckweed	SK831825	2005	Invasive
Lemna minuta	Least Duckweed	SK8382	2018	Invasive