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Appendix 6.G – Report on Surveys for Water Vole

NeuConnect: Great Britain to Germany Interconnector

GB Onshore Scheme

Environmental Statement

Appendix 6G – Report on Surveys for Water Vole

NeuConnect Britain Ltd

June 2019

Quality information

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1. Introduction

1.1 In 2018, AECOM undertook a Preliminary Ecological Appraisal (PEA)[1] on behalf of Neuconnect Britain Ltd (the Applicant). This PEA survey identified the need for follow-up ecological surveys to determine the potential impacts of the Neuconnect project (hereby known as the Proposed Development) on certain protected / notable species. Therefore, AECOM was instructed to undertake a survey of Water Vole Arvicola amphibius presence / absence, as recommended in the PEA report for the Proposed Development and to make any recommendations based on the results of the survey.

Proposed Development

1.2 NeuConnect (the Project) is a 1,400 megawatt (MW) interconnector between Great Britain and Germany. The Project will create the first direct electricity link between the energy networks in Great Britain and Germany. The new link will create a connection for electricity to be passed in either direction between Great Britain and Germany. The Project will be formed by approximately 700 kilometres (km) of subsea and underground High Voltage Direct Current (HVDC) cables, with an on-shore converter station at either end linking into the existing electricity grids in Great Britain and Germany.

1.3 The Proposed Development will comprise of three structures: a converter station, a sub-station and a direct current (DC) cable route (see Figure 1).

1.4 The footprint of the proposed converter station to the perimeter security fence is expected to be up to approximately 250 metres (m) by 250 metres, with a maximum height of up to 26 m.

1.5 The footprint of the proposed substation is expected to be approximately 80 m by 80 m (to the perimeter security fence), with a maximum height of 14 m.

1.6 The proposed DC cable corridor will be approximately 1.6 km long (from landfall to the converter station). The preferred installation method will be underground, which will result in a temporary loss of land during installation. The working corridor for the installation of the cable corridor will be 30 m.

1.7 Additional laydown areas will be required for construction, comprising 1.5 hectare (ha) for the converter laydown and 0.3 ha for the substation laydown.

Site Description

1.8 The Proposed Development area (the Site) is entirely within the boundary of Medway Council and is centred on the Isle of Grain located at the tip of the Hoo Peninsula between the Thames Estuary to the north and the Medway Estuary to the south. The Site is located to the west of the village of Grain, Isle of Grain, Kent at Ordnance Survey (OS) central grid reference TQ 88205 76727. Land use comprises a mix of industrial development to the south, the small settlement of Grain to the south-east and undeveloped land, much of which is designated for ecological interests, to the north (along the coastline) and to the west. Land within the Site and in the immediate vicinity has historically been used for the extraction of gravel and sand and the resultant voids used for landfill.

1.9 Figure 1 shows the site boundary (red-line), the cable corridor (purple line) and proposed location of each structure.

[1] AECOM, Neuconnect, Isle of Grain: Preliminary Ecological Appraisal Report, 2019

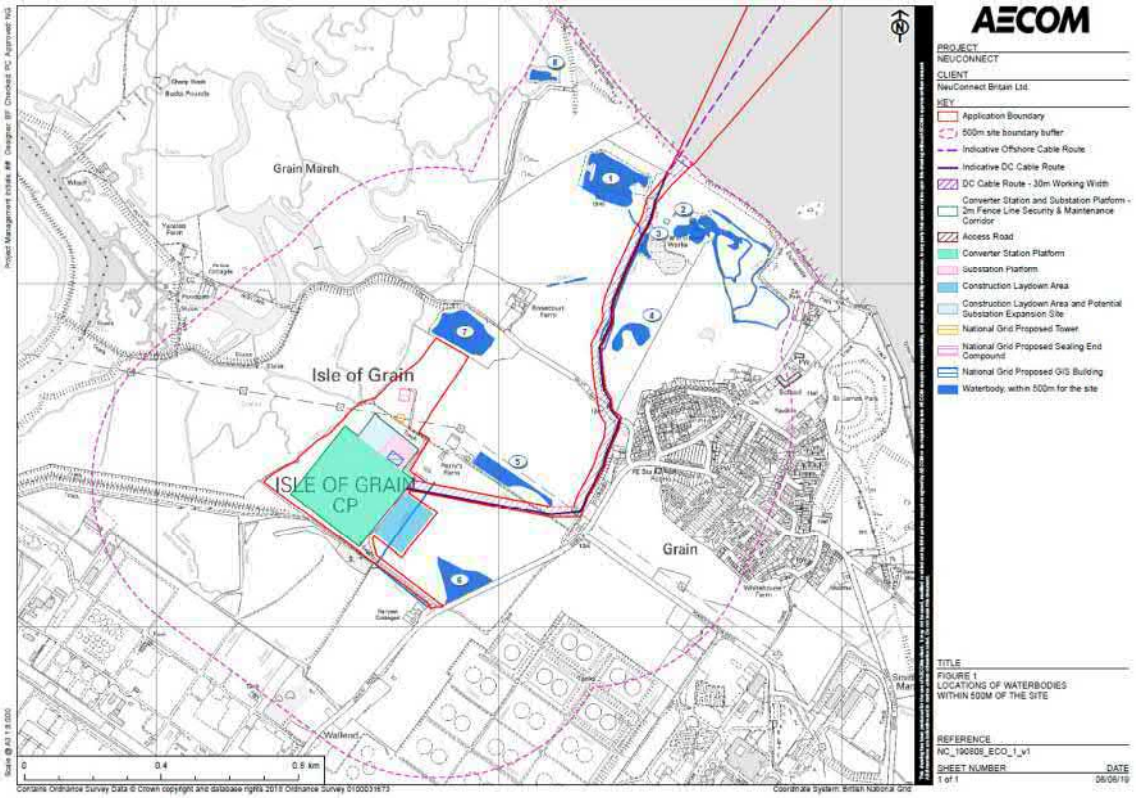

Figure 1 - Site boundary, waterbody locations and proposed locations of DC cable route, converter station and substation

Survey Area

1.10 The survey area included waterbodies and ditches within 100 m of the site boundary, considered as being potentially suitable for Water Vole.

Scope of Report

1.11 The objective of the Water Vole survey was to determine the presence / absence of Water Vole on the Site, within (and adjacent to) the Proposed Development areas, for their potential to support Water Vole and, if present, to determine the population size present and mitigation required.

2. Water Vole Ecology

2.1 The Water Vole is the UK's largest native vole, weighing between 140-350 grams (males being generally larger than females) and measuring 20 centimetres (cm) long plus a 10 cm long tail.

Habitat Requirements

2.2 Water Voles prefer sites with wide strips of vegetation along the banks or in the water which provide useful cover from predators as well as an abundant supply of food throughout the year. They require waterbodies with soft, but stable, banks for their burrows with a preference for steep, tall banks so that nest chambers can be situated above high water.

2.3 They can be found in slow moving rivers and streams, or water-bodies such as ditches, dykes, ponds and moats. While they can occur in brackish waters of coastal borrow dykes, they are not commonly found in estuarine habitat or salt marsh except where there are relatively stable, reed fringed lagoons.

2.4 Water Vole colonies have been found in the leachate ditches of landfill sites or in roadside ditches next to busy trunk roads, where rubbish and surface water runoff is regularly deposited. However, clean and good quality water should always be considered the ideal.

2.5 Where water channels dry out completely, Water Voles are exposed to increased chance of predation and may either be killed directly, or choose to relocate to more optimal habitat nearby. Rapid depopulation of dry channels is almost always a given. Water Vole are susceptible to flooding and although adults can escape from rising water, it may be impossible for mothers to remove young to safety if the whole burrow system becomes inundated.

Breeding

2.6 The Water Vole breeding season starts in March and continues until October, with the peak season being between mid-April and mid-September. Water Voles live in colonies with breeding females having territories of 30-150 m and males having larger home ranges of 60-300 m that overlap several females. Females mark their territories using discrete latrine sites, close to the burrows and at the boundaries. Latrines are flattened piles of old droppings topped up with fresh ones.

2.7 Water Voles are mostly active during the day. They do not hibernate over winter, but do spend more time in their burrows, often cohabiting with members of the same colony and so are less visible above ground.

3. Legislative and Policy Framework

Legislative Framework

3.1 The Water Vole is a fully protected species under Schedule 5 of the Wildlife & Countryside Act 1981 (as amended) and is afforded protection under Section 9 parts 9 (1)(2)(4) and (5) of the Act, making it an offence to:

- intentionally kill, injure or take these species;
- possess or control live or dead individuals of these species or their derivatives;
- intentionally or recklessly damage, destroy or obstruct access to any structure or place used for their shelter or protection;
- intentionally or recklessly disturb these species whilst occupying a structure or place of shelter used for that purpose;
- sell these species or offer or expose for sale or transport for sale; and
- publish or cause to be published any advertisement which conveys the buying or selling of these species.

3.2 It is generally regarded that a place of shelter or protection includes a network of active burrows and/or any nests that have been constructed within the burrow system or above ground amongst dense vegetation.

Natural England Licensing

3.3 A licence is required from Natural England to intentionally damage or destroy burrows or displace Water Voles from their burrows for lawful development. There is no provision for licencing development or other construction activities under the Wildlife and Countryside Act. Such works should therefore be undertaken under a conservation licence. This licence requires demonstration of a conservation benefit for Water Voles and this benefit can be achieved by delivering a net gain in the amount of habitat available to the Water Vole population.

National Planning Policy Framework

3.4 The National Planning Policy Framework (NPPF) was originally published on 27th March 2012 and detailed the Government's planning policies for England and how these are expected to be applied. The NPPF was then revised on 24th July 2018 and 19th February 2019. The NPPF states the commitment of the UK Government to minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity.

3.5 It specifies the obligations that the Local Authorities and the UK Government have regarding statutory designated sites and protected species under UK and international legislation and how this is to be delivered in the planning system. Protected or notable habitats and species can be a material consideration in planning decisions and may therefore make some sites unsuitable for particular types of development, or if development is permitted, mitigation measures may be required to avoid or minimise impacts on certain habitats and species, or where impact is unavoidable, compensation may be required.

3.6 The NPPF is clear that pursuing sustainable development includes moving from a net loss of biodiversity to achieving net gains for nature, and that a core principle for planning is that it should contribute to conserving and enhancing the natural environment and reducing pollution.

Local Planning Policy

3.7 Medway Council's local planning policy relevant to nature conservation and Water Vole is provided in detail in the Preliminary Ecological Appraisal for the Proposed Development (AECOM, 2019).

UK Post-2010 Biodiversity Framework

3.8 The UK Biodiversity Action Plan (UKBAP) was launched in 1994 and established a framework and criteria for identifying species and habitat types of conservation concern. From this list, action plans for priority species of conservation concern were published, and have subsequently been succeeded by the UK Post-2010 Biodiversity Framework (July 2012).

3.9 The UK Post-2010 Biodiversity Framework sets a broad enabling structure for action across the UK between now and 2020, including a shared vision and priorities for UK-scale activities to help deliver the Aichi targets and the EU Biodiversity Strategy. A major commitment by Parties to the Convention of Biological Diversity is to produce a National Biodiversity Strategy and/or Action Plan.

3.10 The UK Post-Development Framework is relevant in the context of Section 40 of the Natural Environment and Rural Communities (NERC Act) 2006, meaning that Priority Species and Habitats are material considerations in planning. These habitats and species are identified as those of conservation concern due to their rarity or a declining population trend.

3.11 The Natural Environment and Rural Communities (NERC) list of Species of Principal Importance is used to guide decision-makers such as public bodies, including local and regional authorities, in implementing their duty under Section 40 of the NERC Act 2006; under Section 40 every public authority (e.g. a local authority or local planning authority) must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity. In addition, with regard to those species on the list of Species of Principal Importance prepared under Section 41 (S41), the Secretary of State must:

> *"(a) take such steps as appear to the Secretary of State to be reasonably practicable to further the conservation of the living organisms and types of habitat included in any list published under this section, or*
>
> *(b) promote the taking by others of such steps."*

3.12 Water Vole is included as a Priority Species under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 and is also included as a UKUKBAP and Local Biodiversity Action Plan (LBAP) priority species.

4. Methods

Desk Study

4.1 A desk study was undertaken in July 2018 to obtain ecological records within a 2 km radius of the Proposed Development from Kent & Medway Biological Records Centre. This data request was limited to records of Water Vole recorded within the last ten years of the request date.

Field Survey

4.2 Water Voles typically inhabit slow-moving streams, canals, ditches, dykes and rivers, feeding mostly on waterside vegetation. They are active in daylight hours and leave several indications of their presence and these signs can be used to identify the presence of Water Vole and, by quantifying the presence of certain signs, can be used to estimate the population size.

4.3 Six waterbodies (labelled 1-6 on Figure 1) and a single ditch, adjacent to the proposed DC cable corridor, were identified during the PEA of the Site as being potentially suitable for Water Vole. However, due to health and safety considerations with accessing three of the waterbodies, only three waterbodies and the ditch were surveyed for Water Vole presence or absence.

4.4 The Water Vole survey involved identification of evidence of Water Vole activity up to 5 m from the bank of each of the three waterbodies and the ditch surveyed. The Water Vole survey of the waterbodies was undertaken on 16th and 17th August 2018, whilst the ditch was surveyed on the 3rd May 2019. Field surveys applied the standard methodologies as described by Strachan et al. (2011)[2] and Dean et al. (2016)[3]. Field signs searched for included:

- latrine sites – distinct piles of Water Vole droppings found near burrows, at the ranges of territorial boundaries and where the animals enter and leave the water;
- feeding stations – areas with distinct neat piles of chewed lengths of vegetation along pathways or haul out platforms along the water's edge;
- burrows – burrow entrances are typically wider than high with a diameter between 4 and 8 cm. Burrow entrances are generally located at the water's edge;
- lawns – short grazed areas at the entrances to burrows;
- prints – identifiable prints in soft margins of the watercourse; and
- runways – low tunnels that are pushed through the vegetation and often leading to burrows or feeding stations.

Survey Limitations

4.5 The following factors meant that there were limitations to the survey for Water Vole:

4.6 • Dense vegetation (including reed growth and brambles) made surveying for Water Vole field signs difficult, meaning some sections of accessed waterbodies and the ditch were not surveyed. However, these areas were considered unlikely to support Water Vole, based on professional judgement. This limitation did not impact significantly on the efficacy of the survey.

4.7 • Fluctuating water levels meant that some sections of the ditch did not contain water at the time of survey. This limitation did not considered to have an impact on the efficacy of the survey.

4.8 • There were difficulties encountered with safely accessing three of the lagoons due to steep sided banks and deep water and these were not accessed during the survey due to health and safety concerns. However, an assessment, based on professional judgment, on whether these

[2] Strachan, R, Moorhouse, Y & Gelling, M. (2011) *The Water Vole Conservation Handbook (Third Edition).*
[3] Dean, M., Strachan, R., Gow, D. and Andrews, R. (2016). *The Water Vole Mitigation Handbook* (The Mammal Society Mitigation Guidance Series). Eds Fiona Mathews and Paul Chanin. The Mammal Society, London.

were likely to support Water Vole was made at the time of surveys and has been considered within this report.

4.9 The majority of ecological data is valid only for short periods due to the inherently transient nature of the subject (CIEEM, 2019[4]). On this basis, it is recommended that the surveys for Water Vole will need repeating in two years (i.e. in 2020).

Population Size Class Assessment

4.10 The number of Water Vole latrines recorded by the survey can provide an indication of the relative population of Water Vole present (Dean et al., 2016[3]) and the survey areas can be subdivided by density which can be interpreted as follows:

Table 4.1: Estimating Populations of Water Vole (Dean et al., 2016)

Relative Population Density	Approximate number of latrines per 100 m of bankside habitat	
	Survey in first half of the season (mid-April to end of June)	Survey in second half of the season (July to September)
High	10 or more	20 or more
Medium	3 – 9	6 – 19
Low	< 2 (or none, but with other field signs)	< 5 (or none, but with other field signs)

4.11 It is not possible to make robust estimates of the number of Water Voles from latrine counts, but latrines do provide an indication of activity suitable for assessment of impacts and designing mitigation (Dean et al. (2016)).

[4] CIEEM: Advice Note on the lifespan of ecological surveys and reports https://cieem.net/wp-content/uploads/2019/04/Advice-Note.pdf (Accessed July 2019)

5. Results and Evaluation

Desk Study

5.1 The desk study returned 12 records of Water Vole, with five records received from within 1 km of the Proposed Development area (in 2012 and 2014).

Water Vole Survey Results

5.2 Three waterbodies and a single ditch on Site were surveyed for Water Vole presence or absence, the results of which are presented in the following sections of this report.

Lagoon 1

5.3 Lagoon 1 was situated in the north-west corner of the Site, approximately 25 m to the west of the proposed DC cable corridor and maintained high levels of water throughout the year. The north and west banks consisted of Common Reed, Common Reed-mace and Sea Club-rush, with areas of scrub. The east and south banks were inaccessible due to steep banks. Waterfowl were present in low numbers.

5.4 The distance between Lagoon 1 and the closest point of the Site (the proposed DC cable corridor) is 125 m.

Table 5.1: Water Vole signs found at Lagoon 1.

Point	Grid Reference	Number of Latrines	Number of Feeding Areas	Number of Burrows	Notes
A	TQ 88397 77273	1	1	0	
B	TQ 88371 77284	1	2	0	
C	TQ 88382 77286	3	2	0	Snail remains found suggesting presence of rat or water shrew
D	TQ 88395 77276	1	8	0	
E	TQ 88383 77342	0	5	0	Field vole activity
F	TQ 88364 77350	0	8	0	

Lagoon 2

5.5 Lagoon 2 was situated in the north-east corner of the Site, approximately 70 m to the east of the proposed DC cable corridor and was dominated by Common Reed, Common Reed-mace and Sea Club-rush. Only the north bank was accessible due to dense vegetation, deep water and steep banks. Fish were also present in this lagoon.

5.6 The distance between Lagoon 2 and the closest point of the Site (the proposed DC cable corridor) is 70 m.

Table 5.2: Water Vole signs found at Lagoon 2.

Point	Grid Reference	Number of Latrines	Number of Feeding Areas	Number of Burrows
A	TQ 88573 77184	3	5	0
B	TQ 88577 77166	1	0	0

Lagoon 6

5.7 Lagoon 6 was situated in the south-east corner of the Site and maintained low levels of water throughout the year with some parts of the lagoon drying completely. The lagoon was dominated by Common Reed, Common Reed-mace and Sea Club-rush, with patches of open water. Only the northern section of the lagoon was accessible due to dense vegetation, steep banks and deep water.

5.8 The distance between Lagoon 6 and the closest point of the Site (laydown areas) is 87 m. Lagoon 6 is 175 m from the proposed DC cable corridor.

Table 5.3 - Water Vole signs found at Lagoon 6.

Point	Grid Reference	Number of Latrines	Number of Feeding Areas	Number of Burrows	Notes
A	TQ 87944 76127	5	3	0	
B	TQ 87926 76136	2	3	0	
C	TQ 87912 76141	1	1	0	
D	TQ 87895 76144	0	2	0	
E	TQ 87874 76146	3	1	0	
F	TQ 87865 76148	0	2	0	
G	TQ 87856 76164	0	2	0	
H	TQ 87847 76177	1	3	0	
I	TQ 87834 76200	0	0	0	Mammal runs present

Ditch 1

5.9 This ditch runs north alongside the access track from West Lane towards the sea, is approximately 510 m in length and was ecologically and hydrologically connected to Lagoon 1. Vegetation within the ditch consisted of Common Reed, Sea Club-rush and Common Reed-mace, with steep sides covered in scrub and grasses.

5.10 The distance between this ditch and the closest point of the Site (the proposed DC cable corridor) is 1 m.

Table 5.4 - Water Vole signs found at Ditch 1

Point	Grid Reference	Number of Latrines	Number of Feeding Areas	Number of Burrows	Notes
A	TQ 88395 77066	1	0	0	
B	TQ 88381 77038	0	1	0	
C	TQ 88380 77035	2	0	0	
D	TQ 88372 77017	1	0	0	

Point	Grid Reference	Number of Latrines	Number of Feeding Areas	Number of Burrows	Notes
E	TQ 88361 76989	1	0	0	
F	TQ 88334 76904	1	1	0	
G	TQ 88340 76893	1	2	0	
H	TQ 88298 76804	1	1	0	

Population Size Class Assessment

5.11 The ditch adjacent to the proposed DC cable corridor was found to contain eight latrines. No Water Vole burrows were recorded. The population size in the ditch, using the population size class assessment as described in Section 4.4 of this report (Dean et al.), would be low, based on a total of eight latrines recorded along 510 metres of ditch (1.2 kilometres of bankside habitat).

5.12 Lagoon 5 was not surveyed for Water Vole presence or absence and is within the proposed DC cable corridor. However, based on the presence of small numbers of Water Vole that occur in lagoons 1, 2 and 6, which are of similar size and habitat quality to Lagoon 5, it is considered that Lagoon 5 supports a low population of Water Vole.

5.13 Therefore, an overall population size estimate of a low population of Water Vole present within the Proposed Development areas has formed the basis for production of the mitigation strategy that follows within this document.

6. Outline Mitigation Strategy

6.1 The outline mitigation strategy aims to minimise impacts of the Proposed Development on the identified population of Water Vole present on the Site.

6.2 The installation of the DC cable has the potential to impact on the Water Vole population through temporary habitat loss and accidental mortality or injury, in the ditch adjacent to the proposed DC cable and within Lagoon 5.

6.3 There are no waterbodies or ditches within the footprint of the proposed converter and substation and therefore, there are no predicted impacts on any Water Vole in these locations.

6.4 Mitigation, during installation of the DC cable, is required to:

- ensure compliance with relevant legislation; and
- avoid impacts that would give rise to a potential "significant effect" and would, therefore, be contrary to planning policy and the biodiversity obligations of the NERC Act 2006.

6.5 A significant effect can be considered one which supports or undermines nature conservation objectives, or changes the conservation status of a species population (CIEEM, 2016).

6.6 Whilst this mitigation strategy outlines the requirements of mitigation to protect the population of Water Vole present on the Site, the detailed methods for delivery of the strategy would be written up in a formal Method Statement, detailing the exact requirements for delivery and submitted as part of a licence application to Natural England, if required.

Potential Impacts

Ditch adjacent to the DC cable corridor

6.7 If construction works (including vegetation clearance) are required within 5 m from the ditch that runs alongside the DC cable, then the installation of the DC cable has the potential to result in the temporary displacement and accidental killing or injury of Water Voles. These impacts, however, are avoidable during construction by ensuring that the DC cable is not installed within 5 m of the top of any bankside habitat and through retention of vegetation within 5 m of the ditch.

6.8 However, if construction works involve vegetation clearance or ground works greater than 5 m from the ditch bankside habitat, then no impacts on Water Vole are likely as Water Voles and, in case any were missed in the survey, their burrows will not be affected by construction.

6.9 Where the proposed DC cable corridor crosses the ditch, the installation of the DC cable may result in the temporary displacement of Water Vole, if present in these areas, from any such crossing point.

Lagoon 5

6.10 If the construction of the DC cable is above ground and will involve habitat removal from Lagoon 5, the Proposed Development will result in the temporary loss of Water Vole habitat in Lagoon 5 and, in the absence of mitigation, has the potential to kill or injure Water Voles during the construction phase. However, should the DC cable be installed underground, therefore underneath Lagoon 5, with no impacts upon the above ground vegetation within 5 m of the lagoon, then there will be no impacts upon any Water Vole population present in this lagoon. If the installation of the DC cable underneath Lagoon 5 cannot be achieved, then relocation of Water Vole out of the Proposed Development areas, through displacement or live trapping, will be required.

6.11 Any potential for killing and injuring of Water Vole, during construction of the DC cable corridor, is avoidable through avoidance or the appropriate implementation of this strategy to prevent such incidences occurring.

Proposed Mitigation

6.12 To mitigate for any loss of Water Vole habitat and potential for incidental killing of animals, the following mitigation options are proposed:

6.13 avoidance of construction of the DC cable within 5 m of the bankside of any waterbody / ditch supporting Water Vole; and

6.14 displacement of Water Vole, through habitat reduction at any crossing (for sections less than 50 m in length).

6.15 Where these mitigation options cannot be met and the construction of the DC cable is within 5 m of the bankside habitat of the ditch or Lagoon 5, then relocation of Water Vole from affected areas (through live capture trapping) may be required, including the creation of on-site receptor habitat to receive relocated Water Vole.

7. Implementation of mitigation

Avoidance of bankside habitat

7.1 Construction of the DC cable should avoid any habitat supporting Water Vole. To avoid accidental killing or injury of Water Vole, construction of the DC cable (including ground disturbance and vegetation clearance) should be more than 5 m from the bank of Lagoon 5 and the ditch running adjacent to the DC cable route.

Displacement of Water Vole through habitat reduction

7.2 The ditch running alongside the DC cable is approximately 510 m in length and supports a low population of Water Vole. No Water Vole burrows were recorded in this ditch.

7.3 Lagoon 5 was not surveyed for Water Vole presence or absence due to health and safety concerns with accessing this area. However, based on habitat quality and the presence of Water Vole in the immediate area, a precautionary principle has been adopted and a low population of Water Vole estimated to be present within this lagoon.

7.4 Providing that the installation of the DC cable, particularly vegetation clearance and ground disturbance, is further than 5 metres from any ditch and, or lagoon that supports Water Vole and that impacts to the ditch and, or lagoon are limited to crossing points only (more than 50 m in length), then displacement of Water Vole through habitat reduction is a viable option. Where this is not possible and the installation of the DC cable is less than 5 m from the bankside habitat of the ditch or Lagoon 5, or where any crossing points would impact upon any length of habitat greater than 50 m in the ditch or Lagoon 5, then relocation of Water Vole from these areas would need to be implemented.

7.5 Displacement of Water Vole from the ditch and Lagoon 5 would be undertaken using habitat reduction measures, using the guidance as described in the Water Vole Mitigation Guidelines (Dean et al., 2016).

7.6 Prior to displacement, a brief update survey of the ditch and, if possible, Lagoon 5 will be undertaken to confirm that the population of Water Vole in these areas remains low and that there are no burrows within the affected areas. All Water Vole activity will be recorded in these areas to inform the displacement and if there is a population change and it is apparent that there are new and numerous burrows present, mitigation may have to revert to trapping and relocating. Displacement will focus on any crossing points within the ditch and Lagoon 5, or known burrows and will be undertaken and, or overseen under a Natural England Class Licence, held by a suitably licenced ecologist between 15th February and 15th April. Vegetation removal will be undertaken along the length of both banks (no more than 50 m) where the DC cable crosses the ditch / Lagoon 5 and around any Water Vole burrows. Vegetation removal can only be undertaken during appropriate weather conditions, .i.e. works will not be undertaken in very cold weather. Once vegetation removal to bare soil has taken place, the area will be left undisturbed for 5-10 days. After this, the areas where vegetation removal was undertaken will be resurveyed to check for any active signs of Water Vole presence. After this stage, where burrows were located within the areas of vegetation removal, a destructive search using an excavator will be undertaken under the watching brief of the licence holder or trained and named agents.

Relocation of Water Vole through live trapping

7.7 Where avoidance of bankside habitat or displacement is not viable during construction of the DC cable then relocation of Water Vole, through live trapping, will be undertaken and a licence will be required from Natural England in order to do this. The trapping of Water Vole can only be undertaken by licenced and experienced ecologists and at the appropriate time of year.

7.8 Relocation, through trapping, requires the capture and removal of Water Voles from within a development area and release into a suitable receptor site that is away from potential harm.

7.9 The following guidance, drawn together from the Water Vole Conservation Handbook (Strachan et.al, 2011[2]) and the Water Vole Mitigation Guidelines (Dean et al., 2016) applies for trapping and relocating Water Vole:

- the relocation of Water Vole can only be undertaken under a licence issued by Natural England;
- any receptor site(s) should be well established and suitable for Water Vole ahead of the relocation;
- relocation of Water Vole by trapping should ideally be undertaken in the spring, between 1st March and 15th April inclusive (depending on the weather, it may be appropriate to commence trapping in mid-February) or during the autumn period (between 15th September and 30th November inclusive).

7.10 No trapping of Water Vole will be undertaken between 16th April and 14th September as this is the peak breeding season and there is a high likelihood that mortality of dependent young may occur with the trapping and relocation of breeding females (Dean et al., 2016)).

7.11 The precise methods for trapping Water Vole will follow the guidelines for trapping and displacement of Water Vole, as described within the *Water Vole Mitigation Handbook* (Dean et al., 2016) and will be detailed within any supporting documents for the licence application to relocate Water Vole.

7.12 To prevent any relocated animals from returning to the capture site, Water Vole resistant fencing will be required along the length and width of the capture receptor sites. The detailed specifications for Water Vole fencing will follow those as described as Appendix 5 in the Water Vole Mitigation Handbook. This fencing will be installed after receipt of the licence to relocate Water Vole, prior to the commencement of trapping.

7.13 The chosen receptor site will be checked for the presence of American Mink Neovison vison before the relocation of Water Vole, to confirm that Mink is absent.

7.14 On site soft release pens for Water Vole will be used to allow for slow-release of Water Vole into receptor sites. Trapping will continue until a period of five days has elapsed with no captured animals and there are no field signs of water vole around the capture sites.

7.15 Water Vole trapping will avoid extreme weather conditions. Such conditions are:

- where night-time temperatures fall below 0°C;
- where day-time temperatures exceed 20°C; or
- where severe rainfall (that could cause flooding) is predicted.

7.16 Therefore, the weather forecast will be monitored daily and no trapping will occur if adverse weather is forecast.

7.17 As soon as the capture sites have been confirmed as having no remaining Water Vole, a destructive search of the area will commence. This involves the removal of vegetation and top soils from the capture site and destructive search, using excavation machinery of bankside habitat and Water Vole burrows.

Appendix 6.H – Aquatic Ecology Report

NeuConnect GB Onshore Scheme

Environmental Statement

Appendix 6H – Report on Aquatic Ecology

NeuConnect Britain Limited

September 2019

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Figures

Tables

1. Introduction

Background

1.1 In 2018, AECOM undertook a Preliminary Ecological Appraisal (PEA)[1] on behalf of Neuconnect Britain Ltd (the 'Applicant'). This PEA survey identified the need for follow-up ecological surveys to determine the potential impacts of the Neuconnect project (hereby further known as the 'Proposed Development') on aquatic ecology. Therefore, AECOM was instructed by the Applicant to undertake a River Habitat Survey (RHS) and aquatic (freshwater) invertebrate survey on an unnamed ditch (the 'Ditch') in the area required for the Proposed Development of an electricity converter station, substation and underground DC cable. The construction of the proposed underground DC cable will require a working corridor of 30 m to allow for the cable trench or duct, excavated spoil storage and plant operation. No other waterbodies outside of the footprint of the Proposed Development will be impacted upon and therefore these and the other scheme components (electricity converter station and substation) are not considered further within this report.

The Project

1.2 NeuConnect (the Project) is a 1400 megawatt (MW) interconnector between Great Britain and Germany. The Project will create the first direct electricity link between Great Britain and German energy networks. The new link will create a connection for electricity to be passed in either direction between Great Britain and Germany. The Project will be formed by approximately 700 kilometres (km) of subsea and underground High Voltage Direct Current (HDVC) cables, with on-shore converter stations linking into the existing electricity grids in Great Britain and Germany.

1.3 The Proposed Development will comprise of three structures, a Converter Station, Sub-station and a Direct Current (DC) cable route (see Figure 1).

1.4 The footprint of the proposed converter station is expected to be up to approximately 250 metres (m) by 250 metres (to the perimeter security fence), with a maximum height of up to 26 m.

1.5 The footprint of the proposed substation is expected to be approximately 80 m by 80 m (to the perimeter security fence), with a maximum height of 14 m.

1.6 The proposed DC cable corridor will be approximately 1.6 km long (from landfall to the converter station). The preferred installation method will be underground, which will result in a temporary loss of land during installation. The working corridor for the installation of the cable corridor will be 30 m.

1.7 Additional laydown areas will be required for construction, comprising 1.5 hectare (ha) for the converter laydown and 0.3 ha for the substation laydown.

Site Description

1.8 The Proposed Development areas (the 'Site') is entirely within the boundary of Medway Council and is centred on the Isle of Grain located at the tip of the Hoo Peninsula between the Thames Estuary to the north and the Medway Estuary to the south. The Site is located to the west of the village of Grain, Isle of Grain, Kent at Ordnance Survey (OS) central grid reference TQ 88205 76727. Land use comprises a mix of industrial development to the south, the small settlement of Grain to the southeast and undeveloped land, much of which is designated for ecological interests, to the north (along the coastline) and to the west. Land within the Site and in the immediate vicinity has historically been used for the extraction of gravel and sand and the resultant voids used for landfill.

1.9 Figure 1 shows the Site boundary (red-line), the cable corridor (purple line) and proposed location of each structure.

[1] AECOM, Neuconnect, Isle of Grain: Preliminary Ecological Appraisal Report, 2019

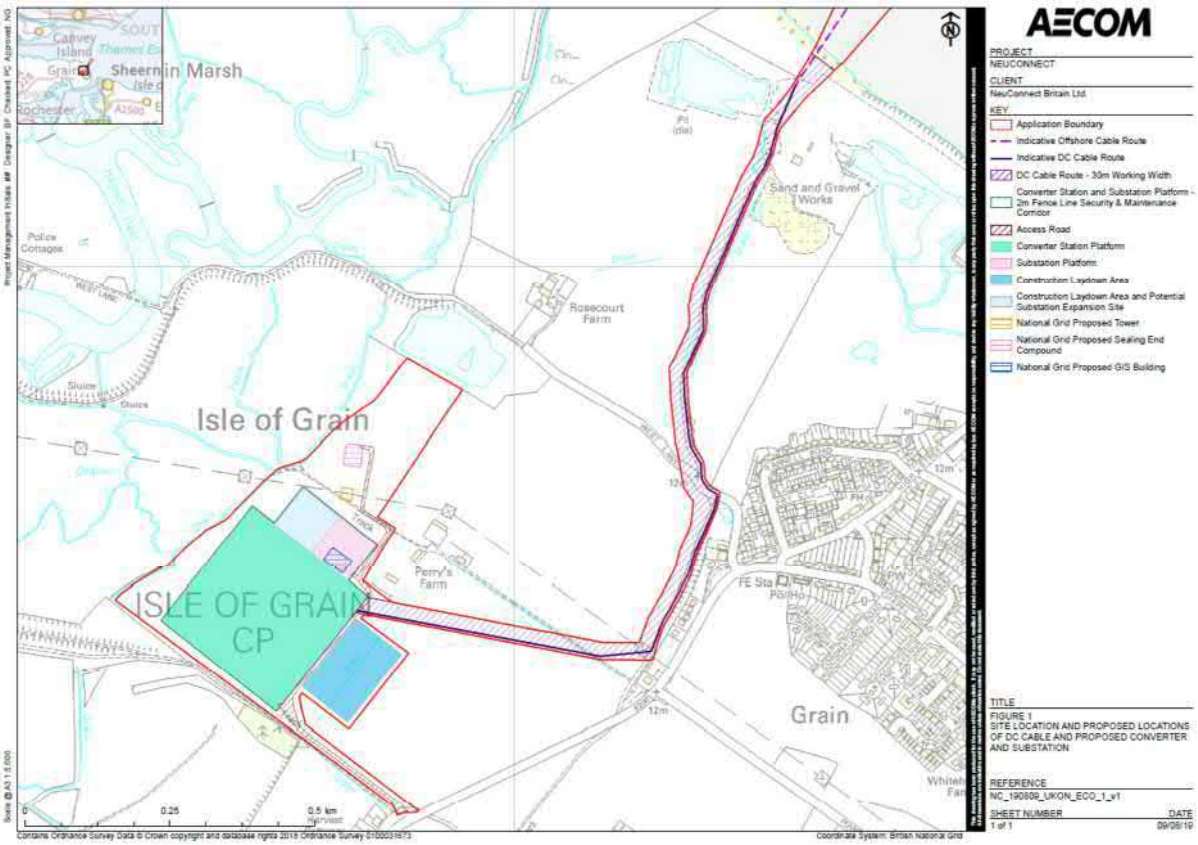

Figure 1 - Site Boundary and Proposed Locations of DC cable route, converter station and substation

Purpose and Scope of Aquatic Surveys

1.10 A desk study was carried out to identify any designated sites or records of notable freshwater species within up to 5 km of the Proposed Development. Results of the desk study and the Preliminary Ecological Appraisal (PEA) (AECOM, 2019) informed the scope of aquatic surveys that were completed at the site.

1.11 A RHS was commissioned to provide detail of the characteristics of the watercourse in terms of its physical structure, vegetation types, basic geomorphology, valley form, land use in the watercourse corridor, degree of watercourse modification, and corresponding ecological potential.

1.12 Aquatic invertebrate samples were collected to identify the conservation value of the aquatic invertebrate community within the Ditch, and to record the presence of any notable and/or protected species.

1.13 This baseline information can be used to inform options for impact avoidance, mitigation and/or compensation to be considered.

2. Methods

Desk Study

2.1 A desk study was undertaken through Kent and Medway Biological Records Centre (KMBRC) as part of the PEA (AECOM, 2019) that was completed in advance of the aquatic surveys and informed the scoping of requirements for further survey.

2.2 Desk study results of relevance to the assessment have been carried forward into this report, and where appropriate these data are presented in more detail or re-interrogated for the needs of the current assessment.

2.3 Further to this, information relevant to this assessment was sought from The Environment Agency and online resources. These were accessed to identify historical fish catches within a 5 km radius of the Site. The search radius was limited to areas of terrestrial and freshwater aquatic habitats.

River Habitat Survey

Survey Conditions

2.4 A River Habitat Survey (RHS) was carried out on the 2nd May 2019 by two experienced aquatic ecologists (Peter Cowley MSc BSc Hons ACIEEM, Environment Agency RHS accreditation code FA061, and Louise Levins BSc Hons MCIWEM) on the Ditch within the Site.

2.5 A 500 m stretch of the Ditch was surveyed from downstream of the proposed DC cable crossing to a point close to the start of the access track, where the Ditch originates.

2.6 For lowland watercourses May and June are considered optimal periods for RHS as the presence of key diagnostic features such as flowers and fruiting bodies facilitate the identification of macrophytes, but vegetation cover remains insufficient to obscure bank and channel features. Weather conditions were good during the survey (warm, overcast, breezy, dry) and flow conditions were low.

Methodology

2.7 RHS is a method designed to characterise and assess the physical structure of freshwater streams and rivers, including recognition of vegetation types and basic geomorphological principles and processes. RHS is carried out along a standard 500 m stretch of river channel, with observations made at ten equally-spaces ‘spot-checks’, with additional context provided by observations of land-use and valley form in the river corridor. Surveyor training and accreditation facilitates accurate and consistent recording of features to allow standardised conclusions to be drawn.

2.8 The RHS methodology includes a mandatory health and safety risk assessment component, stringent requirements for the recording of grid references and photographic evidence and recording of any unusual features with special notes and photographs as supporting evidence. RHS is not designed to provide the level of detail needed for specialist surveys for specific flora or fauna; however, RHS can support recommendations for and findings of surveys for aquatic invertebrates, macrophytes, fish and hydro-geomorphology.

2.9 RHS surveys may be utilised to ‘benchmark’ top quality sites based on their catchment characteristics, investigate species-habitat relationships (with fish passage as an example), contribute to Environment Impact Assessment, or as in this case to inform proposed works alongside the watercourse.

2.10 RHS methodology includes the following:

- Desk study preparatory work – maps and analysis of online data, including historic maps, provides context on landscape characteristics and river planform over time to assist in identifying historic channel management; however, this does not override field observations.

- Field survey and RHS survey form completion – the presence/absence of features, and in some cases the number and extent thereof, is recorded at ten spot checks and the whole 500 m site, including natural and artificial features, and channel measurements.
- General site information is collected on page 1 of the survey form.
- Spot check information is collected on the survey form, including predominant channel, bank and river corridor features at ten locations evenly spaced along the 500 m RHS site. This includes predominant channel substrate types (where visible), flow type, habitat features, channel and bank modifications, channel vegetation types, bank and banktop vegetation structure, and adjacent land use. Physical features are assessed using a 1 m wide transect across the channel; all other elements are assessed using a 10 m wide transect across the river.
- Sweep-up information – general information is recorded on the survey form by means of a 'sweep-up' checklist. This allows information not occurring in the spot checks to be recorded over the whole 500 m, length, thus allowing a broad picture of river character to be established.
- Channel dimensions are recorded on the survey form – these are measured at one representative location in the 500 m survey stretch, normally across a riffle, if present, otherwise a straight, uniform location with clearly defined banks. Also recorded is the presence of features of interest including nuisance plant species and alders.

2.11 The RHS locations are indicated in the Site in Appendix A.

Hydromorphological Indices

2.12 RHS data can be used to provide an assessment of habitat quality and the extent of channel modification, and this can then inform physical quality objectives for river works and restoration. Hydromorphological indices were calculated using the RHS Toolbox software (Riverdene Consultancy, 2019). These include the Habitat Modification Score (HMS) and Habitat Quality Assessment (HQA) as follows:

2.13 ***Habitat Modification Score (HMS)*** – HMS scoring criteria are derived from an earlier scoring system developed by the Environment Agency in 1998, and were developed by Riverdene Consultancy (2016). The scoring criteria indicated the degree of modification of the river habitat, with a higher score indicating a higher degree of modification. HMS results in a Habitat Modification Class (HMC) with each river stretch allocated a HMC Description ranging from Pristine/Semi-Natural to Severely Modified. The HMS scoring criteria are summarised in Table 1 below.

Table 1: HMS scoring criteria

HMS Scoring Criteria	Recorded in RHS Survey Form	HMS Score
Culverts sub-score	Spot check Channel Modification – Culverts (CV) Sweep-up Artificial Features – Culvert	+ 400, + 50 for additional criteria + 400 for each remaining feature
Bank and Bed Reinforcement sub-score	Spot check Bank Material Spot check Bank Modification – Reinforced (RI) Sweep-up Bank Profiles – Reinforced Spot check Channel Substrate Spot check Channel Modification – Reinforcement (RI)	Specific scores for bank materials + 20 for additional bank reinforcement Additional score for extensive reinforcement + 200 for artificial substrate + 200 for channel modification
Bank and Bed Re-sectioning sub-score	Spot check Bank Modification – Re-sectioned (RS) Sweep-up Bank Profiles – Re-sectioned Spot check Channel Modification – Re-sectioned (RS) Sweep-up Channel Modification – Over-deepened	+ 40-160 for re-sectioned spot check Additional score for re-sectioned sweep-up + 200 for spot check RS (channel mod.) + 40-160 for over-deepened

Berms & Embankments sub-score	Spot check Bank Modification – Berms (BM) Spot check Bank Modification – Embankments (EM) Sweep-up Bank Profiles – Artificial two-stage Sweep-up Bank Profiles – Embanked Sweep-up Bank Profiles – Set-back Embankment	+ 20 each spot check BM + 20 each spot check EM + 20-80 for artificial two-stage channel + 20-80 for embankment in sweep-up + 4-16 for set-back embankment
Weirs/Dams/Sluices sub-score	Sweep-up Artificial Features – Weirs/dams/sluices	Specific scores for impoundment by weir/dam and each weir/sluice feature
Bridges sub-score	Sweep-up Artificial Features – Bridges	+ 100-250 for each sweep-up bridge
Poaching sub-score	Spot check Bank Modification – Poaching (PC or PC(B)) Sweep-up Bank Profiles – Poached	+ 10 for each spot check PC or PC(B) + 10-40 for sweep-up poaching
Fords sub-score	Sweep-up Artificial Features – Fords	+ 40-200 for each sweep-up ford
Outfalls/Deflectors sub-score	Sweep-up Artificial Features – Outfalls Sweep-up Artificial Features – Deflectors	+ 25-100 for each sweep-up outfall + 50-150 for each sweep-up deflector
Habitat Modification Class (HMC)	**HMC Description**	**HMS Score**
1	**Pristine/semi-natural**	**0-16**
2	**Predominantly unmodified**	**17-199**
3	**Obviously modified**	**200-499**
4	**Significantly modified**	**500-1399**
5	**Severely modified**	**1400+**

2.14 ***Habitat Quality Assessment (HQA)* –** HQA provides a broad indication of river quality and habitat diversity by collating natural features assessed through the field survey. The HQA score is allocated based on features including point, side and mid-channel bars. Eroding cliffs, large woody debris, waterfalls, backwaters and floodplain wetlands. Additional points are scored for variety of channel substrata, flow-types, in-channel vegetation, and also the distribution of bank-side trees and the extent of near natural land-use adjacent to the river, resulting in a total HQA score. HQA scores can only be used to compare sites of a similar river type or character. For example, river stretches in lowland floodplains should not be compared with those in upland wooded valleys.

2.15 A more diverse site in terms of natural river habitats will result in a higher HQA score, converse to the HMS score where a higher score indicates a less natural state. Therefore, HMS and HQA in combination provide an assessment of the influences of natural variation and the extent of human intervention in the river corridor and adjacent land covered by the RHS survey.

2.16 HQA scoring criteria are summarised in Table 2 below:

Table 2 - HQA scoring criteria

HQA Scoring Criteria	Description	HQA Scoring Criteria	Description
Flow Types	Score for variety of flow types; additional sweep-up types score extra	Point Bars	Total number of un-vegetated and vegetated point bars
Channel Substrates	Score for variety of natural substrate types: bedrock, boulder, cobble, gravel/pebble, sand, silt, clay, peat	In-Stream Channel Vegetation	Score for channel vegetation grouped into six categories for scoring purposes

HQA Scoring Criteria	Description	HQA Scoring Criteria	Description
Channel Features	Natural channel features: exposed bedrock/boulders, un-vegetated mid-channel bar, vegetated mid-channel bar, mature island	Land-Use Within 50m	Score allocated on sweep-up only: broadleaf woodland (or native pinewood), moorland/heath, and wetland score
Bank Features	Score for each natural feature: eroding earth cliff, stable earth cliff, un-vegetated point bar, vegetated point bar, un-vegetated side-bar, vegetated side-bar	Trees And Associated Features	Score allocated for bankside trees, Overhanging boughs, exposed bankside roots, underwater tree roots, coarse woody debris and fallen trees
Bank Vegetation Structure	Score for banktop and bankface simple and complex vegetation structure	Special Features	Score if recorded: waterfall more than 5m high, braided or side channel, debris dams, natural open water, fen, carr, flush, bog

Notes on Table 2: Due to the nature of HQA score and within the limitations of this study, HQA scores herein have been used to provide an assessment of habitat quality in the study area only. Further interpretation of HQA scores would require comparison of the survey area against those with similar physical characteristics (*e.g.* gradient, distance from source, geology etc.) via the Environment Agency RHS Database.

Aquatic Invertebrate Survey

Field Survey

2.17 Aquatic macroinvertebrate sampling of the Ditch was carried out on 2nd May 2019 in conjunction with the River Habitat Survey.

2.18 Three macroinvertebrate samples were taken at strategic locations along the Ditch, two upstream and one downstream of the potential crossing point of the DC cable, and similarly located in relation to the crossing point of the existing access track, beneath which the Ditch is culverted. These locations were sampled to ensure that this assessment would remain relevant in case of future design changes and to ensure that the full range of habitat conditions within the Ditch were sampled. Locations of these sites are provided in Table 3 below and in Appendix A.

Table 3 Macroinvertebrate Sample Sites

Site Name	Relation to Crossing Point of current access track	National Grid Reference
Site 01	2-10 m downstream of the crossing point	TQ 88415 77143
Site 02	0-10 m upstream of the crossing point	TQ 88430 77143
Site 03	75-85 m upstream of the crossing point	TQ 88409 77091

2.19 The survey methods followed the aquatic invertebrate sampling procedures standardised by the Environment Agency (Environment Agency, 2014). These methods allow characterisation of aquatic invertebrate communities and can be used to determine whether rare or notable species or communities are present. The samples were taken using a standard FBA pattern pond net (mesh size: 1 mm). The habitats present were collected 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 the standard methods. The samples collected were subsequently preserved in Industrial Methylated Spirit (IMS) for laboratory processing.

Analysis of Aquatic Macroinvertebrate Samples

2.20 Each of the samples collected was sorted and analysed in a laboratory setting by suitably trained and experienced aquatic ecologists. Lists of the aquatic invertebrate taxa present were produced in line with Environment Agency guidance (Environment Agency, 2014). The aquatic invertebrate samples were identified to 'mixed taxon level' using stereo-microscopes. Most groups were identified to species level (where practicable), with the exception of the following:

- Mites (Hydracarina) which were identified to order;
- worms (Oligochaeta) which were identified to order;
- marsh beetles (Scirtidae) which were identified to family;
- butterfly / moth larvae (Lepidoptera), which were identified to order;
- springtails (Collembola) which were identified to order;
- truefly 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.

2.21 The survey data was then used to calculate metrics that can be used to inform an assessment of relative nature conservation value.

2.22 A Community Conservation Index (CCI) (Chadd & Extence, 2004) was calculated for each site. The CCI classifies many groups of freshwater invertebrates 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 (see Table 4). 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.

Table 4 Conservation Scores from the Community Conservation Index

Conservation Score	Conservation Status
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)

2.23 The overall CCI derived provides an indication of the conservation value of the community sampled, based on a combination of the rarity of the different aquatic invertebrate taxa present and overall community richness, as shown in Table 5 below. As indicated above, in some cases expert judgment may be needed to moderate these assessments with reference to current information on status and distribution.

Table 5 Community Conservation Index Interpretation Guidance (Chadd & Extence, 2004)

Community Conservation Index (CCI)	Expected conservation value
< 5	Low conservation value
5 to 10	Moderate conservation value
10 to 15	Fairly high conservation value
15 to 20	High conservation value
> 20	Very high conservation value

2.24 Calculations were also made to determine the proportion of sediment sensitive macroinvertebrates present using the Proportion of Sediment-sensitive Invertebrates (PSI) index (Extence et al., 2013). Using this approach, individual taxa of aquatic macroinvertebrate are assigned a Fine Sediment Sensitivity Rating (FSSR) ranging from A to D, as detailed in Appendix F. 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.

2.25 Lotic-invertebrate Index for Flow Evaluation (LIFE) indices were also calculated (Extence et al., 1999). 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. The overall LIFE score for a site 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 indicating fast flows. LIFE allows the mean flow preference of invertebrates colonising a site to be determined so that effect of habitat changes such as sediment accumulation can be monitored.

2.26 The macroinvertebrate data were analysed to generate Whalley, Hawkes, Paisley & Trigg (WHPT) indices and Average Score Per Taxon (ASPT) values (WFD-UKTAG, 2014), which provides an indication of the ecological quality in the watercourse. 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 Appendix C. 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 site-specific context, as described in this report.

Nature Conservation Evaluation Approach

2.27 An essential prerequisite step to allow ecological impact assessment of the Proposed Development is an evaluation of the relative nature conservation value of the identified ecological features (encompassing nature conservation designations, ecosystems, habitats and species).

2.28 The method of evaluation that has been utilised has been developed with reference to the Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in the UK and Ireland – Terrestrial, Freshwater and Coastal – Second Edition. These give advice on scoping and carrying out environmental assessments and place appraisal in the context of relevant policies. Data received through consultation, desk-based studies and field-based surveys are used to allow ecological features of nature conservation value or potential value to be identified, and the main factors contributing to their value described and related to available guidance. These data can also be used to identify other relevant values e.g. socio-economic or ecosystem services values, but this is beyond the remit of this report and requires the involvement of other relevant specialists.

2.29 Aquatic macroinvertebrate communities and individual macroinvertebrate species can be of nature conservation value for a variety of reasons, and their relative value should always be determined on a case

by case basis to demonstrate a robust assessment process. Value may relate, for example, to the uniqueness of the assemblage, or to the extent to which species are threatened throughout their range, or to their rate of decline. The value of the aquatic macroinvertebrate assemblages and species recorded by the survey has been defined with reference to the geographical level at which the feature being assessed is considered relevant (Table 6). Relevant published national and local guidance and criteria can be used, where available, to inform the assessment of nature conservation value and to assist consistency in evaluation. Guidance and criteria of potential relevance to the aquatic macroinvertebrate features being assessed is summarised in Table 6. The identified guidance and criteria is not definitive and other criteria have been applied as relevant and appropriate to reach a decision on relative nature conservation value. For example, the previously described CCI index has been used to inform assessment of nature conservation value.

Table 6 Geographic Scale Used to Qualify Relative Nature Conservation Value of Features

Geographic scale of value	Definition	Example supporting guidance and assessment criteria
International	Europe	Guidelines for the selection of Special Areas of Conservation (SACs) (McLeod *et al.* 2005)
National	Great Britain/ England	Guidelines for the selection of biological Sites of Special Scientific Interest (SSSIs) for Terrestrial and Freshwater Invertebrates (Curson *et al.* 2019)
Regional	South East	No specific guidance available, professional judgement is to be used. It will encompass features clearly of greater than county value but not of sufficient merit to demonstrate national value.
County	Kent	Criteria for selection and delineation for local wildlife sites in Kent (Kent Wildlife Trust, 2015).
District	North Kent	No specific guidance available, professional judgement is to be used.
Local	Below district value	No specific guidance available, professional judgement is to be used.

Limitations

2.30 There are no limitations to the work undertaken. The survey was undertaken within an optimal season for survey (spring, defined as March to May for the purpose of aquatic macroinvertebrate survey, and May-June for RHS) and during good weather conditions and low flow conditions.

2.31 Given the nature of biological survey it is not possible to be certain that all of the species present in a waterbody will be detected. Where juvenile or damaged specimens were collected, species level identification is not always possible. Not all macroinvertebrate species that use waterbodies are present at all times of year and therefore some may be overlooked when surveying. Other species that may be present at other times of year, sporadically and/or in low numbers may not have been recorded. This is not considered a limitation as standard methods were applied and the data collected is considered representative of the conditions present and appropriate for assessment of value.

2.32 The majority of ecological data is valid only for short periods due to the inherently transient nature of the subject (CIEEM, 2019[2]). On this basis, it is recommended that the surveys for Water Vole will need repeating in two years (i.e. in 2021).

[2] CIEEM: Advice Note on the lifespan of ecological surveys and reports https://cieem.net/wp-content/uploads/2019/04/Advice-Note.pdf (Accessed June 2019)

3. Results

Desk Study

3.1 There were two designated statutory sites of international importance located within 5 km of the Site. These sites are designated for ecological reasons and summarised in Table 7 below. Site designation details are summarised in Table 7 and are taken from citation documents published online by the Joint Nature Conservation Committee (JNCC) for the individual sites.

Table 7: International Statutory Nature Conservation Designated sites within 5 km of the Site

Site Name and Designation	Reason(s) for Designation	Area (ha)	Approximate distance from the Site (km)	Connectivity to the Site
Thames Estuary and Marshes Ramsar / SPA	The site supports one endangered plant species and at least 14 nationally scarce plants of wetland habitats. The site also supports more than 20 British Red Data Book invertebrate species.	5,588	0.1 West (for the purpose of freshwater aquatic habitats)	Potential for ecological connections between interest features of the Ramsar/SPA and the Site.
Medway Estuary and Marshes Ramsar / SPA	The site holds several nationally scarce plants and a total of at least twelve British Red Data Book species of wetland invertebrates. The site also holds a significant number of non-wetland British Red Data Book species.	4,696	1.5 South West	Potential for ecological connections between interest features of the Ramsar/SPA and the Site.

3.2 There were two national statutory nature conservation designated sites within 2 km of the Site and they are listed in Table 8 below.

Table 8: National statutory nature conservation designated sites within 2 km of the Site

Site Name and Designation	Reason(s) for Designation	Area (ha)	Approximate distance from the Site (km)	Connectivity to the Site
South Thames Estuary and Marshes SSSI	The diverse habitats support a number of nationally rare and scarce invertebrate species and an assemblage of nationally scarce plants.	5,449	0.1 West (for the purpose of freshwater aquatic habitats)	Potential for ecological connections between interest features of the SSSI and the Site. A section of this ditch occurs within the Impact Risk Zones for the SSSI
Medway Estuary and Marshes SSSI	The site forms the largest area of intertidal habitats which have been identified as value for nature conservation in Kent. An outstanding assemblage of plant species also occurs on site.	6,840	0.7 South West	Potential for ecological connections between interest features of the SSSI and the Site.

3.3 For this assessment, the desk study records were restricted to those collated over the last 10 years, to reflect the current (rather than historic) baseline conditions associated with the site. The only relevant species record provided by the records centre was of the Dainty Damselfly *Coenagrion scitulum*. However,

this species is thought to be extinct in Britain, but was rediscovered at a couple of sites in North Kent in 2010 and 2011, but was not recorded thereafter.

3.4 The EA provided no records of fish, while online resources recorded 3-spined stickleback *Gasterosteus aculeatus*, 9-spined stickleback *Pungitius pungitius*, smelt *Osmerus eperlanus*, perch *Perca fluviatilis* and minnow *Phoxinus phoxinus*, in low numbers 280m north east of the Site. There were no records of fish for the ditch within the Site, including no records of species that would be considered notable such as European Eel *Anguilla anguilla*.

River Habitat Survey

3.5 The River Habitat Survey forms are located in Appendix G.

General River Characteristic

3.6 The Ditch is an artificial drainage channel which originates at the border of the Site with West Lane (Ordnance Survey (OS) Grid Reference TQ 88300 76697). The Ditch flows for around 630 m before entering a large pond to the north-west of the site (approximate OS Grid Reference TQ 88379 77217). The surveyed stretch represents a lowland ditch on superficial river terrace deposits (sand and gravel) over bedrock London Clay Formation (clay and silt).

3.7 The Ditch and surrounding ponds are artificial features and a product of sand and gravel quarrying within the Site. The Ditch flows through land that is predominately formed of scrub, tall herbs and suburban/urban development. There is an expanse of open water to the eastern side of the Ditch and there are some areas utilised for rough pasture. There were no obvious valley sides and a distinct flat floodplain, typical of lowland coastal areas.

3.8 Analysis of historical maps of the Site identified that in 1988 the Ditch was a small drain which fed directly into the estuary. The channel has since been realigned and lengthened, and now feeds into a large pond. Maps prior to this show there was no drain or ditch present in this location.

River Habitat Survey Results

3.9 The RHS comprised of a 500 m stretch starting downstream of the indicative underground DC crossing point on the Ditch (approximate OS Grid Reference TQ 88419 77146), heading upstream. The survey was completed from both the left and right banks, and from within the channel. The entire 500m stretch was considered to be re-sectioned and over-deepened when compared to historical maps. The channel was homogeneous, with no riffles, pools, point bars or meanders and the substrate composed entirely of silt. There was no perceptible flow other than within a culverted section, and at spot check 9 where rippled flow was recorded through dense vegetation. Water depth was generally low (approximate average 0.1 m) but was deeper (average 0.6 m) between spot checks 1 and 2, partly due to impoundment upstream of the access track culvert.

3.10 The indicative location where the DC cable corridor crosses the Ditch is located next to a track crossing where the Ditch is culverted beneath it (see Figure 2). The culvert appeared to have been recently installed or upgraded, however historical maps show the track was present prior to construction of the Ditch. It is therefore likely the watercourse has been always had a crossing since it was created. There was very little flow through the culvert as the upstream end of the pipe invert was only partially below the water level. As a result, water was impounded upstream of the culvert and there was little flow downstream. One minor outfall was observed on the Ditch and was dry at the time of surveying.

3.11 Channel dimensions were recorded at a representative uniform section of the watercourse. Bank full width was 3 m and water width 1 m, with the right bank slightly elevated above the left bank, making the left bank top height the bankfull height; i.e. the Ditch would overtop the left bank before the right bank at this location. This was due to the presence of an embankment along the right bank top, likely as a result of previous dredging of the Ditch. Water depth was 0.1 m and the bed material was unconsolidated.

3.12 The dominant bank material was gravel and sand, with no other material types observed. Semi-continuous embankments were present on both the left and right banks. The bank profile was steep on both banks (>45o) in most locations, with stable cliffs observed at spot checks 2 and 3, and eroding cliffs present at

spot checks 8 and 9. Bank-face vegetation was generally of simple structure and dominated by herbaceous species with scrub also present (see Figures 3, 4 and 5).

3.13 The majority of the channel was choked with vegetation (see Figures 3, 4 and 5). Where emergent vegetation was absent, filamentous algae was dominant on the surface (Figure 5). Emergent reeds, sedges and rushes were the most abundant group, dominated by Slender-tufted Sedge *Carex acuta* with patches of Bulrush Typha sp., with filamentous algae, emergent broad-leaved herbs and amphibious species also present.

3.14 Land use adjacent to the bank top was dominated by scrub and shrub, with tall herbs and patches of broad-leaved woodland present. Wider land use was dominated by scrub and shrub, tall herbs, broad-leaved mixed woodland, rough pasture and suburban/urban development. The main track in the Site runs parallel to the Ditch for much of its length.

3.15 A Water Vole *Arvicola amphibius* latrine was located close to spot check 2 (TQ 88407 77108) and Marsh Frog *Pelophylax ridibundus*, a non-native species, was also observed. See the Target Notes in Appendix B for further details.

Hydromorphological Indices

3.16 Based on the criteria set out in Section 2, Table 1 and Table 2, a Habitat Modification Score (HMS) and Habitat Quality Assessment (HQA) score for the survey stretch were calculated. The Ditch is classified as severely modified with a HMS score of 3960 and HMS class of 5. The HQA score was 42.

Figure 2: Culvert beneath track crossing at spot check 1 (looking upstream)

Figure 3: The Ditch at spot check 1 with Typha sp. (looking downstream)

Figure 4: Typical example of channel chocked with vegetation and riparian scrub (looking downstream)

Figure 5: Filamentous algae cover on Ditch and adjacent body of open water (NGR TQ 88409 74102) (looking downstream)

Aquatic Invertebrates

3.17 The aquatic macroinvertebrate species recorded are detailed in Appendix H.

3.18 No aquatic macroinvertebrate species were recorded that receive specific legal protection via Schedule 5 of the Wildlife and Countryside Act 1981 (as amended), or that are listed on Section 41 of the NERC Act as being of principal importance for nature conservation in England. This does not remove the need to further assess the species assemblage and species recorded for their nature conservation importance. There are other criteria for nature conservation value (see Table 6 for example), and legal protections do not always provide a true or current reflection of all species of nature conservation concern.

Site 01

3.19 A high diversity of species was recorded (26 species) and the community is considered to be a good example of a ditch community supporting a diverse range of true bug and beetle species. The CCI score (see Section 2.3.2 of this report) was 24 indicating that this section of the ditch is of very high conservation value in terms of the CCI index. This site supported a range of species of Local[3] to Very Common status and a number of notable beetle taxa including the diving beetles, *Hygrotus parallelogrammus*, *Dytiscus circumflexus* and the water scavenger beetles *Helophorus alternans*, *Limnoxenus niger* and *Berosus affinis*. Further information on these species is provided in Table 9.

3.20 The biological water quality of the site was good (WHPT 97.3; APST 4.6). It supported three pollution-sensitive macroinvertebrates (the beetle Gyrinidae and the true flies Dixidae and Tabanidae) in addition to a range of taxa defined as having moderate tolerance to pollution. The community was dominated by taxa that are adapted to slow and/or standing waters (LIFE: 5.0) and the species present are tolerant of fine sediments (PSI: 3.2).

[3] Those species not uncommon enough to fall within any of the preceding categories (Regionally Notable to Endangered (RDB1)), but which are nonetheless of some interest. A species may qualify, for example, by being very widely distributed but nowhere common, by being restricted to a specialized habitat such as brackish pools but being a common component of this habitat, or simply by being uncommon but not uncommon enough to be Notable.
Species with few records but which are suspected of being badly under-recorded are likely to be placed in the Local category. Local species may also be Regionally Notable (Chadd & Extence, 2004)

Site 02

3.21 A high diversity of species was recorded (21 species) and the community is considered to be a good example of a ditch community supporting a diverse range of true bug, caddisfly and beetle species. The CCI score was 37.6 indicating that this section of the ditch is of very high conservation value. This site supported a range of species of Local to Very Common status and a number of notable beetle taxa including the diving beetles, *Agabus conpersus*, *Dytiscus circumflexus* and the water scavenger beetles *Helophorus alternans*, *Limnoxenus niger*, and the Great Silver Water Beetle, *Hydrophilus piceus*. Further information on these species is provided in Table 9.

3.22 The biological water quality of the site was good (WHPT 111.8; APST 4.9). It supported two pollution-sensitive macroinvertebrates (the true flies *Dixidae* and *Tabanidae*) in addition to a range of taxa defined as having moderate tolerance to pollution. The community was dominated by taxa that are adapted to slow and/or standing waters (LIFE: 5.3) and the species present are tolerant of fine sediments (PSI: 0).

3.23 Site 03

3.24 A low diversity of species was recorded (10 species) however the community is still considered to be a good example of a ditch community supporting a range of true bug and beetle species. The CCI score was 28.8 indicating that this section of the ditch is of very high conservation value. This site supported a range of species of Local to Very Common status and two notable beetle taxa, the water scavenger beetles *Limnoxenus niger* and B*erosus signaticollis*. Further information on these species is provided in Table 9.

3.25 The biological quality of the site was moderate/good (WHPT 53.4; APST 4.5). It supported a single pollution-sensitive macroinvertebrate taxon (the true fly, Tabanidae) in addition to a range of taxa defined as having moderate tolerance to pollution. The community was dominated by taxa that are adapted to slow and/or standing waters (LIFE: 5.2) and the species present are all tolerant of fine sediments (PSI: 0).

Table 9 Summary of the notable species recorded (Conservation Scores > 6)

Species	Habitat and distribution	Current Status
Great Silver Water Beetle *(Hydrophilus piceus)*	It favours permanent, vegetated drains, ponds and dykes (Foster *et al*., 2014) where its larvae feed on water snails (Foster, 2010).	Near Threatened, Regarded as RDB3 Rare (Conservation Score 8) in the CCI system, but with no statutory designation or protection.
	This species has been recorded from 50 hectads and currently has a southern distribution in the UK but appears to have contracted in range historically. It is well established in some areas, including along the coastal levels of Kent (Foster, 2010).	It is mostly threatened by habitat loss either through destruction or by poor management (Foster, 2010).
A diving beetle (*Hygrotus parallelogrammus*)	This brackish species is found around much of the coastline from the Severn to the Humber (Foster & Friday, 2011).	Regarded as Regionally Notable (Conservation Score 7) in the CCI system but with no statutory designation or protection.
A diving beetle (*Dytiscus circumflexus)*	It is found in well vegetated permanent still water sites. It has a scattered distribution and has been previously recorded along the coastal levels of Kent (Foster & Friday, 2011).	Regarded as Regionally Notable (Conservation Score 7) in the CCI system but with no statutory designation or protection.
		This species was formerly confined to coastal districts in the south and south east, however recently it has spread further north, and can now be found in south-west Scotland (Foster & Friday, 2011).
A diving beetle *(Agabus conpersus)*	This species is largely confined to brackish waters in coastal lagoons and ditches. It is found in many coastal sites all across England (Foster & Friday, 2011).	Regarded as Regionally Notable (Conservation Score 7) in the CCI system but with no statutory designation or protection.
A water scavenger beetle	This coastal species has a southern distribution (Foster *et al.*, 2014).	Regarded as Regionally Notable (Conservation Score 7) in the CCI

Species	Habitat and distribution	Current Status
(Helophorus alternans)		system but with no statutory designation or protection.
A water scavenger beetle *(Limnoxenus niger)*	This coastal species occurs in well vegetated ponds and ditches. This species has a southern distribution in the UK, with the most northerly record being Norfolk (Foster *et al*., 2014).	Regarded as Regionally Notable (Conservation Score 7) in the CCI system but with no statutory designation or protection.
A water scavenger beetle *(Berosus affinis)*	This species is found in ponds and drains with exposed sediments (Hammond, 2017). Modern records highlight that this species has a predominately southern distribution with records south of the line from the Wash to Pembrokshire (Foster *et al*., 2014).	Regarded as Regionally Notable (Conservation Score 7) in the CCI system but with no statutory designation or protection.
A water scavenger beetle *(Berosus signaticollis)*	This species is found in silty pools and ditches favouring coastal wetlands and brownfield sites. This species is predominately found south of the line between the Humber and the Wirral (Foster *et al*., 2014).	Regarded as Regionally Notable (Conservation Score 7) in the CCI system but with no statutory designation or protection. This species is believed to be expanding in range with new records within Cumbria (Hammond, 2017).

4. Nature Conservation Evaluation

4.1 This section provides an assessment of the aquatic macroinvertebrate species and assemblage recorded in association with the Ditch, to determine their relative nature conservation value using the approach detailed in Section 2.3.3 of this report. There is no reasonable likelihood of the features present being of international nature conservation importance, so this can be discounted. This is on the basis that the site does not support any species considered notable in an international context (e.g. species for which Great Britain holds a substantial part of the international population, or species which are restricted to Great Britain).

Desk Study Records

4.2 Records of Dainty Damselfly were returned by KMBRC. Although this species does not benefit from any statutory protection, it is of note given that it was previously thought extinct in the UK and recolonised a site in north Kent in 2010 and 2011, but was not recorded thereafter.

4.3 Although it was not recorded within the field samples, unidentified juveniles and damaged individuals of the family *Coenagrionidae*, of which the Dainty Damselfly is a member, were recorded and therefore its presence within the Ditch cannot be fully discounted although is considered highly unlikely to be of this species.

Aquatic Macroinvertebrate Species and Assemblages

4.4 Although slight differences were recorded between the three sites sampled, the aquatic macroinvertebrate communities are largely comparable and as such, the assemblage and species recorded are assessed together. In addition, the sampling sites are in very close proximity to each other and therefore the dispersal of species between them is likely.

4.5 A range of notable and uncommon species were recorded within the ditch. The most notable was the Great Silver Water Beetle, which is Near Threatened. However none of the species recorded are rare, threatened or legally protected. Many of the notable species recorded are species of coastal wetlands and as such they can reasonably be expected to occur wherever there are comparable habitats, which are fairly common in the wider landscape, most notably in the nearby statutorily designated sites (refer to Section 3.1). Therefore, there are no individual species present that can be considered to be of any more than Local value.

4.6 The criteria established to allow the identification of habitats and sites of county nature conservation value does not define specific thresholds for the identification of Wildlife Sites on the basis of invertebrate communities. However, given the diverse assemblage and the large number of notable species, it is possible that the Ditch may be of District value, especially given its close proximity to statutorily designated sites of similar habitats and the likely dispersal of species between the Ditch and those sites.

4.7 However, the Ditch is not considered to be of greater than District value at this time. The desk study undertaken for the PEA identified a large number of drains and other watercourses in the local area, many associated with the international and national designated sites. Therefore the Ditch associated with the site only represents a very small proportion of the available habitat resource and habitats within the wider landscape are likely to support a similar or better aquatic macroinvertebrate assemblage.

5. Conclusions and Recommendations

5.1 The River Habitat Survey classed the Ditch as severely modified which is a consequence of being an artificial drainage channel. Despite its artificial nature, the watercourse provides habitat for a variety of notable and protected species including the near threatened Great Silver Water Beetle and aquatic invertebrate assemblage of very high conservation value (according to the CCI index).

5.2 The existing culvert is impounding water upstream of the track crossing, which appears to be beneficial for aquatic ecosystem in the Ditch as it is resulting in deeper, slow-flowing water upstream of the culvert. It is likely that without impoundment the Ditch could run dry in sections, which is evidenced at its upstream extent. It is recommended that any construction works aim to maintain a similar quantity of water in the upstream section of the Ditch comparable with the current situation.

5.3 Records of Dainty Damselfly were returned by the records centre, which has only recently recolonised the UK and has a very limited distribution in the south east of the UK; its presence within the Ditch cannot be fully discounted although is highly unlikely. Given that no direct impacts to the Ditch are proposed, in the unlikely event that this species was present on Site, they would not be impacted upon by the Proposed Development.

5.4 A range of notable and uncommon species were recorded within the Ditch and CCI scores indicate that it is of very high conservation value. However none of the species recorded are rare, threatened or legally protected. Given that across the wider landscape there are a number of similar waterbodies and habitats, many within the international and national designated sites, this Ditch is considered to only represent a very small proportion of the available habitat resource and these are likely to support a similar or better aquatic macroinvertebrate assemblage. As such it is judged that the Ditch is of District value for its aquatic macroinvertebrate assemblage, and therefore the existing habitats should be protected and retained through the course of the proposed works. This will include retaining the existing culvert beneath the access track, and therefore the impoundment behind it.

5.5 If possible, works should be limited to the western side of the Ditch and access track, including excavation, spoil storage, vehicle movements etc., and thereby direct and indirect impacts to the Ditch avoided.

5.6 Due to the high biological water quality and value of the Ditch, pollution prevention measures such as temporary silt fencing, Sustainable Drainage System (SuDS) features and attenuation ponds are recommended for construction works. Further mitigation measures to limit and/or prevent any potential impacts during construction and operation will be provided in the impact assessment.

6. References

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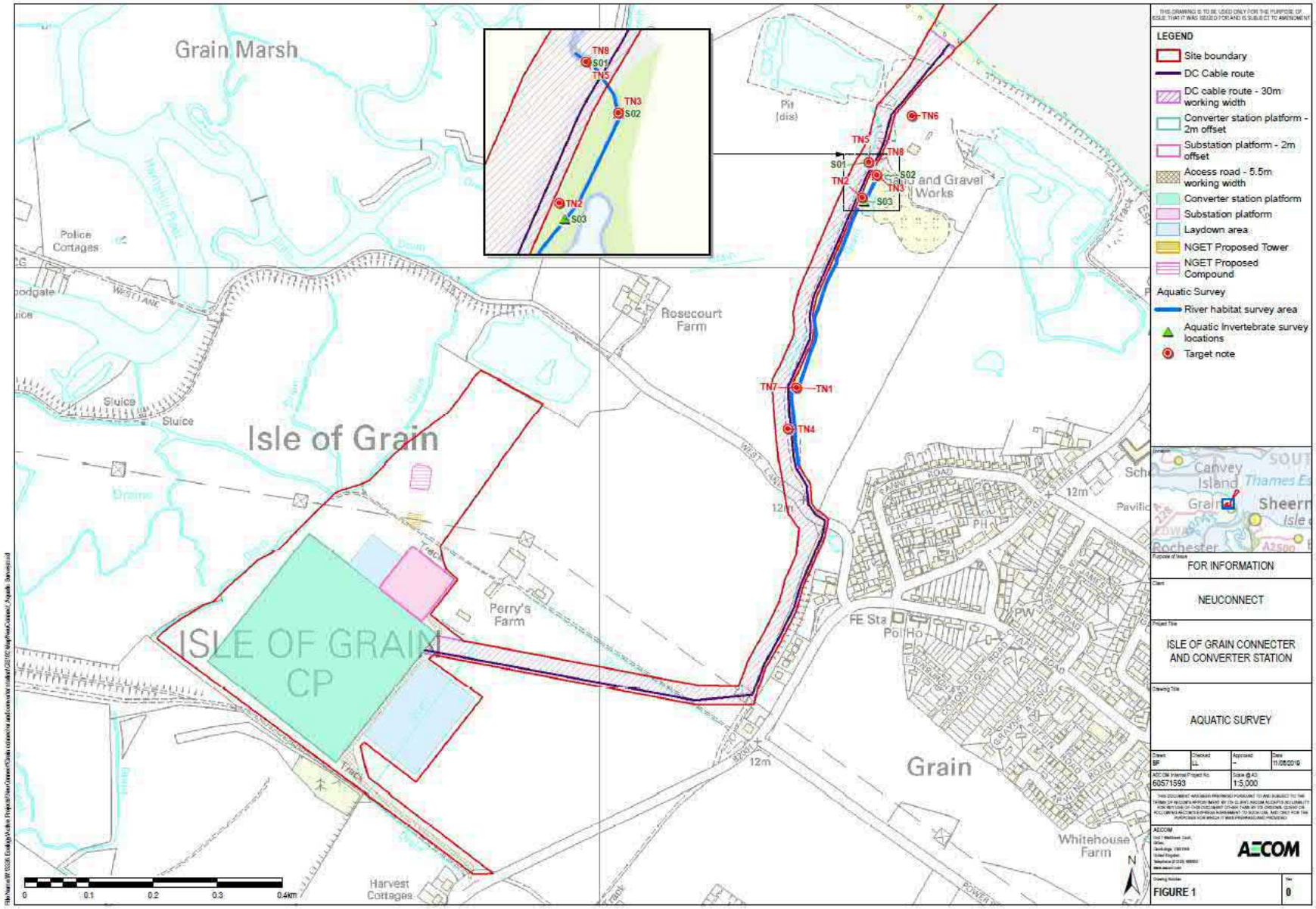
Appendix A Site Plan


Grain Marsh
Isle of Grain
ISLE OF GRAIN CP
Grain
Police Cottages
Sluice
Sluice
Rosecourt Farm
Perry's Farm
Harvest Cottages
Whitehouse Farm
Pit (dis)
Sand and Gravel Works
FE Sta
Pol Ho
TN1
TN2
TN3
TN4
TN5
TN6
TN7
TN8
S01
S02
S03
12m
0
0.1
0.2
0.3
0.4km
N
LEGEND
Site boundary
DC Cable route
DC cable route - 30m working width
Converter station platform - 2m offset
Substation platform - 2m offset
Access road - 5.5m working width
Converter station platform
Substation platform
Laydown area
NGET Proposed Tower
NGET Proposed Compound
Aquatic Survey
River habitat survey area
Aquatic Invertebrate survey locations
Target note
Canvey Island
Rochester
FOR INFORMATION
NEUCONNECT
ISLE OF GRAIN CONNECTER AND CONVERTER STATION
AQUATIC SURVEY
60571593
1:5,000
AECOM
FIGURE 1
0

Appendix B Target Notes

Target Note	Description	Grid Reference
TN1	Badger *Meles meles* sett	TQ 88305 76813
TN2	Water vole *Arvicola amphibius* latrine	TQ 88407 77108
TN3	Great silver diving water beetle *Hydrophilus piceus*	TQ 88430 77143
TN4	Common lizard *Zootoca vivipara*	TQ 88292 76749
TN5	Smooth newt *Lissotriton vulgaris*	TQ 88415 77143
TN6	Cuckoo *Cuculus canorus*	TQ 88484 77235
TN7	Reed warbler *Acrocephalus scirpaceus* nest	TQ 88305 76813
TN8	Marsh frog *Pelophylax ridibundus*	TQ 88415 77143
TN9	Dragonflies/damselflies	Various locations across the Site

Appendix C Appendix C 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 site. 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 (WFD-UKTAG, 2014) is based upon the sensitivity of macroinvertebrate families to organic pollution. It replaces the Biological Monitoring Working Party (BMWP) system (Hawkes, 1997) 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 site, 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.

Appendix D Community Conservation Index (CCI)

The Community Conservation Index (Chadd & Extence, 2004) 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 (Bratton, 1991a, 1991b; Shirt, 1987). Conservation Scores assigned to individual species vary from 1 to 10, as detailed on the Table B1 below. The derived CCI scores generally vary from 0 to > 20, as detailed in the Table B2 below. The Table B3 below provides a guide to interpreting CCI scores.

Table D1: Conservation Scores from the Community Conservation Index (from Chadd & Extence, 2004)

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 D2 - General guide to CCI scores (from Chadd & Extence, 2004)

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 importance and/or a community of very high taxon richness	Very high conservation value

Appendix E Appendix E Lotic-Invertebrate Index for 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 C1 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 C3 below. LIFE scores for a macroinvertebrate sample ranges from 1 to 12, where highest scores describe communities adapted to rapid flows.

Table E1: Flow groups used to derive LIFE scores (from Extence, Balbi and Chadd, 1999)

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 E2: Abundance categories used to derive LIFE scores (from Extence, Balbi and Chadd, 1999)

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

Table E4: A guide to interpreting LIFE scores (from Extence, Balbi and Chadd, 1999)

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

Appendix F Appendix F Proportion of sediment-sensitive invertebrates (PSI)

The Proportion of Sediment-sensitive Invertebrates (PSI) index (Extence et. Al, 2013) provides an assessment of the extent to which the river bed is composed of, or covered by, fine sediments.

Under the assessment, individual species of aquatic macroinvertebrates are assigned a Fine Sediment Sensitivity Rating (FSSR) raging from A to B, as detailed in the Table D1 below. The PSI score for a macroinvertebrate sample is then derived from individual species scores and abundances, as detailed on the Table D2 below. The PSI score corresponds to the percentage of fine sediment-sensitive taxa present in a sample. PSI score for a sample ranges from 0 to 100 where lowest scores correspond to watercourses with high fine sediment cover.

Table F1 Fine Sediment Sensitivity Rating (FSSR) groups used to derive PSI scores (from Extence et al., 2013)

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

Table F2 Abundance categories used to derive PSI scores (from Extence, et al., 2013)

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

Table F3 Interpretation of PSI scores (from Extence et al., 2013)

PSI	Description
81-100	Minimally sedimented
61-80	Slightly sedimented
41-60	Moderately sedimented
21-40	Sedimented
0-20	Heavily sedimented

Appendix G River Habitat Survey Forms

River Habitat Survey Data for Site 3

A FIELD SURVEY DETAILS

Site reference:	Isle of Grain
CoordinateSystem:	OSGB36 (British National Grid)
Spot-check 1 coordinates:	TQ8841077157
Spot-check 6 coordinates:	TQ8833276916
End of site coordinates:	TQ8830876692
Reach Reference:	Unnamed ditch
River name:	Unnamed Ditch
Date:	02/05/2019 13:11
Surveyor Name:	Pete Cowley
Surveyor code:	FA061

Project Name:

Is the site part of a river or an artificial channel?: ARTIFICIAL

Are adverse conditions affecting survey?: ○ Yes ◉ No

If yes, state:

Is bed of river visible?: PARTIALLY

Is health and safety assessment form attached?: YES

Number of photographs taken: 22

Photo references: See project folder

Site surveyed from: BOTH BANKS

B PREDOMINENT VALLEY FORM (within the horizon limit)

○ shallow vee ○ concave/bowl ◉ No obvious valley sides

○ deep vee ○ asymmetrical floodplain

○ gorge ○ U-shaped valley

Distinct flat valley bottom?: YES

Terraced valley floor?: NO

C NUMBER OF RIFFLES, POOLS AND POINT BARS (indicate total number)

Riffle(s): 0 Pool(s): 0 Unvegetated point bar(s) 0 Vegetated point bar(s) 0

D ARTIFICIAL FEATURES (indicate total number or tick appropriate box)

If none, tick box ☐

	Maior	Intermediate	Minor		Major	Intermediat	Minor
Weirs/sluices	0	0	0	Outfalls/intakes	0	0	1
Culverts	1			Fords	0	0	0
Bridges	0	0	0	Deflectors/groynes/croys	0	0	0
Other					0	0	0

Is channel obviously realigned? YES, >=33%

Is channel obviously over-deepened? YES, >=33%

Is water impounded by weir/dam? YES, <33%

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H LAND USE WITHIN 50m OF BANKTOP Use *(present) or E (> 33% banklength)

	L	R		L	R		L	R
Broadleaf/mixed woodland (semi-natural)	PRESE	EXTEN	Moorland/heath	NONE	NONE	Rock and scree	NONE	NONE
Broadleaf/mixed plantation	NONE	NONE	Artificial open water	PRESEN	PRESE	Suburban/urban development	EXTENSI	PRESE
Coniferous woodland (semi-natural)	NONE	NONE	Natural open water	NONE	NONE	Tilled land	NONE	NONE
Coniferous plantation	NONE	NONE	Rough pasture	PRESEN	NONE	Irrigated land	NONE	NONE
Scrub	EXTEN	EXTEN	Improved/semi-improved grass	NONE	NONE	Parkland or gardens	NONE	NONE
Orchard	NONE	NONE	Tall herbs rank vegetation	EXTENS	EXTEN	Not visible	NONE	NONE
Wetland (eg bog,marsh,fen)	NONE	NONE						

I BANK PROFILES Use *(present) or E (> 33% banklength)

Natural/unmodified	L	R	Artificial/modified	L	R		L	R
Vertical/undercut	NONE	NONE	Resectioned	EXTENS	EXTENSI	Embanked	EXTEN	EXTEN
Vertical + toe	NONE	NONE	Reinforced - whole bank	NONE	NONE	Set-back embankments	NONE	NONE
Steep (>45)	NONE	NONE	Reinforced - top only	NONE	NONE			
Gentle	NONE	NONE	Reinforced - toe only	NONE	NONE			
Composite	NONE	NONE	Artificial two-stage	NONE	NONE			
Natural berms	NONE	NONE	Poached	NONE	NONE			

J EXTENT OF TREES AND ASSOCIATED FEATURES (tick one box per feature) *record even if <1%

Left	Occasional clumps	Right	Semi-continuous	Shading of channel	PRESENT	* Overhanging boughs	NONE
* Exposed bankside roots	NONE	* Underwater tree roots	NONE	Fallen trees	NONE	Large woody debris	PRESENT

K EXTENT OF CHANNEL FEATURES (tick one box per feature) *record even if <1%

* Free fall	NONE	Smooth flow	PRESE	Exposed bedrock	NONE	Unvegetated side bar(s)	NONE
Chute	NONE	No perceptible flow	EXTEN	Exposed boulders	NONE	Vegetated side bar(s)	NONE
Broken standing waves	NONE	No flow	NONE	Vegetated Bedrock Or Boulders	NONE	Unvegetated Point Bar(s)	NONE
Unbroken standing waves	NONE	Marginal deadwater	NONE	Unvegetated mid-channel bar(s)	NONE	Vegetated Point Bar(s)	NONE
Rippled flow	PRESE	Eroding Cliffs	PRESE	Vegetated mid-channel bar(s)	NONE	* Discrete unvegetated silt deposit(s)	NONE
* Upwelling	NONE	Stable Cliffs	PRESE	Mature island(s)	NONE	* Discrete unvegetated sand deposit(s)	NONE
						* Discrete unvegetated gravel deposit(s)	NONE

E PHYSICAL ATTRIBUTES (to be assessed across channel within a 1m wide (transect)

Spot check 1 is at DOWNSTREAM END *Additional substrate* P, SA, CO

Description	1	2	3	4	5	6	7	8	9	10	Catch All
Left Bank Material	GS	GS	GS	GS	GS	GS	GS	GS	GS	GS	
Left Bank Modification	RS	EM	RS	RS	RS	RS	RS	RS	RS	RS	
Left Bank Modification #2	EM	RS	EM	EM	EM	EM	EM	EM			
Left Bank Modification #3											
Left Bank Modification #4											
Left Bank Features	NO	SC	NO	NO	NO	NO	NO	EC	EC	NO	
Left Bank Features #2											
Left Bank Features #3											
Channel Substrate	SI	SI	SI	SI	SI	SI	SI	SI	SI	SI	
Flow Type	NP	NP	NP	NP	NP	NP	NP	NP	RP	NP	
Channel Modification(s)	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	
Channel Modification(s) #2											
Channel Feature(s)	NO	NO	NO	NO	NO	NO	NO	RO	NO	NO	
Channel Feature(s) #2											
Channel Feature(s) #3											
Number of sub-channels											
Right Bank Material	GS	GS	GS	GS	GS	GS	GS	GS	GS	GS	
Right Bank Modification	RS	RS	RS	RS	RS	RS	RS	RS	RS	RS	
Right Bank Modification #2	EM		EM					EM	EM	EM	
Right Bank Modification #3											
Right Bank Modification #4											
Right Bank Features	EC	NO	SC	NO	NO	NO	NO	NO	NO	SC	
Right Bank Features #2											
Right Bank Features #3											
Land use within 5m of bank top (Left)	BL	TH	SH	TH	SH	SH	TH	SH	TH	SH	
Left bank-top vegetation structure	C	S	S	S	S	S	S	S	S	S	
Left bank face vegetation structure	C	S	S	S	S	S	S	U	U	S	
Right bank face vegetation structure	S	S	S	U	U	S	S	S	S	S	
Right bank-top vegetation structure	S	S	S	S	S	S	S	S	S	S	
Land use within 5m of bank top (Right)	SH	SH	SH	SH	SH	SH	SH	SH	SH	SH	
Channel Vegetation: NONE											
Bryophytes/lichens	N	N	N	N	N	N	N	N	N	N	N
Emerg broad-leaved herbs	N	N	N	N	N	N	N	N	N	N	P
Emerg reeds/sedges/rushes	E	P	E	E	E	E	E	E	E	E	E
Floating-leaved (rooted)	N	N	N	N	N	N	N	N	N	N	N
Free-floating	N	N	N	N	N	N	N	N	N	N	N
Amphibious	N	N	N	N	N	N	N	P	N	N	P
Submerged broad-leaved	N	N	N	N	N	N	N	N	N	N	N
Submerged linear-leaved	N	N	N	N	N	N	N	N	N	N	N
Submerged fine-leaved	N	N	N	N	N	N	N	N	N	N	N
Filamentous Algae	E	E	N	P	P	N	N	P	N	N	P

L CHANNEL DIMENSIONS (to be measured at one side on a straight uniform section, preferably across a riffle)

Left banktop height (m)	1.50	Bankfull width (m)	3.00	Right banktop height (m)	2.00
Left banktop height is also bankfull height? (Y or N)	YES	Water width (m)	1.00	Right banktop height is also bankfull height? (Y or N)	NO
Left embanked height (m)	0.00	Water depth (m)	0.10	*Right embanked height (m)*	0.50

If trashline lower than banktop , indicate height above water (m) *and width from bank to bank (r*

Bed material at site is consolidated ○ unconsolidated ◉ unknow ○ missing value ○

Location of measurement is: OTHER *Other state* Uniform section

M FEATURES OF SPECIAL INTEREST Use (present) or E (> 33% banklength) *record even if <1%

If none, tick box ☐

Braided channels	NONE	Very large boulders (>1m)	NONE	Backwater(s)	NONE	Marsh(es)	NONE
Side channels	NONE	* Debris dams	NONE	Floodplain boulder deposits	NONE	Flush(es)	NONE
* Waterfalls > 5m high	NONE	* Leafy debris	PRESE	Water meadow(s)	NONE	Natural open water	NONE
* Waterfalls < 5m high	NONE	Fringing reed bank(s)	NONE	Fen(s)	NONE	Other	PRESE
Natural cascade(s)	NONE	Quaking bank(s)	NONE	Bog(s)	NONE	*State:*	Artificial open water - sand and
		*Sink hole(s)	NONE	Wet woodland(s)	NONE		

N CHOKED CHANNEL (tick one box)

Is 33% or more of the channel choked with vegetation? Yes

O NOTABLE NUISANCE PLANT SPECIES

If none, tick box ☐

Hogweed banktop	NONE	Himalayan Balsam banktop	NONE	Japanese Knotweed banktop	NONE	Other banktop	NON
Hogweed bankface	NONE	Himalayan Balsam bankface	NONE	Japanese Knotweed bankface	NONE	Other bankface	NON

Other name:

P OVERALL CHARACTERISTICS (Add appropriate words)

Major impacts:	Culverting, Dredging, Embankments, Realignment
Recent management	None
Animals:	Badger, Cuckoo, Dragon/Damselflies, Frog Marsh, Great Silver Divin

COMMENTS:

Badger sett located at spot check 9. Smooth newt present at spot check 1.

Q ALDERS (tick appropriate box(es))

Alders? NONE Diseased Alders? NONE

Map Data

Altitude (m):	7
Slope (m/km):	4
Distance to source (km):	0
Height of source (m):	9
Solid geology:	
Drift geology:	
Planform:	
Tributary:	No
Navigation:	No
Qmed (cubic-m/s):	

PCA1:	-1.1622
PCA2:	-2.6785
PCA3:	0.3953
PCA4:	-0.4559

Mid-site easting:	588332
Mid-site northing:	176916
Latitude SC1:	51.46
Longitude SC1:	0.71
Latitude SC6:	51.46
Longitude SC6:	0.71
Latitude end of site:	51.46
Longitude end of site:	0.71

Photographs

Photograph File Name	Photo link	Description
Unnamed Ditch, Isle of Grain_201905	C:\River Habitat Survey\Isle of Grain\Unname	
Unnamed Ditch, Isle of Grain_201905	C:\River Habitat Survey\Isle of Grain\Unname	
Unnamed Ditch, Isle of Grain_201905	C:\River Habitat Survey\Isle of Grain\Unname	
Unnamed Ditch, Isle of Grain_201905	C:\River Habitat Survey\Isle of Grain\Unname	

RHS indices

Habitat Modification Score	
Habitat Modification Class:	5
Habitat Modification Score:	3960
HMS Culverts subscore:	400
HMS Reinforced Bank Bed subscore:	0
HMS Resectioned Bank Bed subscore:	2800
HMS Realigned subscore:	400
HMS Berms Embankments subscore:	260
HMS Weirs dams and sluices subscore:	75
HMS Bridges subscore:	0
HMS Poaching subscore:	0
HMS Fords subscore:	0
HMS Outfall/ Deflector subscore:	25

Hydromorphological Indices			
Channel Substrate Index:	-2.3280	CSI Weight:	10
Geomporphic Activity Index:	-0.4170	GAI Weight:	10
Flow Regime Index:	-1.0330	FRI Weight:	10
Chanel Vegetation Index:	-0.4170	CVI Weight:	10
Banktop Vegetation Index:	0.5300	BTV Weight:	20
Bankface Vegetation Index:	0.1320	BFV Weight:	20

Stream Power (Watts/m):	
Specific Stream Power (Watts/m2):	
Shear stress (Newtons/m2):	30.3
Width/depth ratio:	1.88

Habitat Quality Assessment	
HQA Score:	42
HQA 1994 adjusted:	39
Baseline HQA class:	
HQA class position:	
River Habitat Quality class:	
HQA flow type 95-97:	6
HQA flow type 94:	5
HQA channel substrate:	4
HQA channel features:	0
HQA bank features:	6
HQA bank vegetation structure:	12
HQA channel vegetation 95-97:	4
HQA channel vegetation 94:	3
HQA land use:	3
HQA trees:	6
HQA special features 95-97:	1

Riparian Quality Index	
Riparian Quality Index class:	2
Riparian Quality Index score:	77
Complexity subscore:	37
Naturalness subscore:	20
Continuity subscore:	20

Appendix H Aquatic Macroinvertebrate Data

Family	Species	BMWP score	WHPT score	Conservation Score	Flow group	FSSR Score	Site 01	Site 02	Site 03
Mites									
Hydracarina		-	-					1	
Mayflies									
Baetidae	Baetidae (juvenile / damaged)	4	5.5		II	A	1		
Damselflies									
Coenagrionidae	Coenagrionidae (juvenile / damaged)	6	3.5		IV	D	2	8	
Coenagrionidae	*Ischnura elegans*	6	3.5	1	IV			2	
Dragonflies									
Libellulidae	Libellulidae (juvenile / damaged)	8	4.1		IV	C		1	
True bugs									
Veliidae	Veliidae (nymph / damaged)	-	4.5		IV			3	1
Nepidae	*Nepa cinerea*	5	2.9	3	V	D	2		
Pleidae	*Plea minutissima*	5	3.3	4	IV		3	4	1
Corixidae	Corixidae (nymph / damaged)	5	3.8		IV	D	14		1
Corixidae	*Hexperocorixa linnei*	5	3.8	4	V	D		4	
Corixidae	*Sigara lateralis*	5	3.8	2	V	D	1	1	
Notonectidae	Notonectidae (nymph / damaged)	5	3.4		IV		27	10	
Notonectidae	*Notonecta glauca*	5	3.4	1	IV		4		
Beetles									
Haliplidae	*Haliplus lineaticollis*	5	3.6	1	III	C	8	1	
Haliplidae	*Haliplus ruficollis*	5	3.6	1	V	D		1	

Family	Species	BMWP score	WHPT score	Conservation Score	Flow group	FSSR Score	Site 01	Site 02	Site 03
Haliplidae	*Haliplus ruficollis* group	5	3.6						2
Gyrinidae	Gyrinidae (larvae / damaged)	5	8.2		IV		1		
Dytiscidae	Dytiscidae (larvae / damaged)	5	4.5		IV	D	9	15	5
Dytiscidae	*Liopterus haemorrhoidalis*	5	4.5	4		D		1	
Dytiscidae	*Laccophilus minutus*	5	4.5	2	IV	D	33		
Dytiscidae	*Hygrotus inaequalis*	5	4.5	2	IV	D	20		
Dytiscidae	*Hygrotus impressopunctatus*	5	4.5	4	V	D			1
Dytiscidae	*Hygrotus parallelogrammus*	5	4.5	7	V	D	2		
Dytiscidae	*Hydroporus sp.*	5	4.5			D	1		
Dytiscidae	*Hydroporus planus*	5	4.5	2	V	D	1		
Dytiscidae	*Agabus bipustulatus*	5	4.5	1	IV	D	1		
Dytiscidae	*Agabus conpersus*	5	4.5	7	V	D		1	
Dytiscidae	*Agabus nebulosus*	5	4.5	1	V	D	2		
Dytiscidae	*Ilybius fuliginosus*	5	4.5	1	IV	C	1		
Dytiscidae	*Rhantus suturalis*	5	4.5	5	V	D	1		
Dytiscidae	*Acilius sulcatus*	5	4.5	5	V		2		
Dytiscidae	*Dytiscus circumflexus*	5	4.5	7	V	D	1	1	
Noteridae	*Noterus clavicornis*	5	3.2	2		D	2	3	
Hydrophilidae	Hydrophilidae (larvae / damaged)	5	6.2		IV	D		5	
Hydrophilidae	*Helophorus sp.*	5	6.2			D	3		
Hydrophilidae	*Helophorus alternans*	5	6.2	7	V	D	12	7	
Hydrophilidae	*Helophorus grandis*	5	6.2	2	IV	D			1
Hydrophilidae	*Helophorus minutus*	5	6.2	2	V	D	33		
Hydrophilidae	*Coelostoma orbiculare*	5	6.2	5	VI	D	1	1	

Family	Species	BMWP score	WHPT score	Conservation Score	Flow group	FSSR Score	Site 01	Site 02	Site 03
Hydrophilidae	*Hydrobius fuscipes*	5	6.2	1	V	D	42	1	5
Hydrophilidae	*Limnoxenus niger*	5	6.2	7	V	D	10	3	2
Hydrophilidae	*Anacaena bipustulata*	5	6.2	5	IV	D	1	1	
Hydrophilidae	*Laccobius sp.*	5	6.2			D	13		
Hydrophilidae	*Laccobius bipunctatus*	5	6.2	2	VI	D	1		
Hydrophilidae	*Laccobius minutus*	5	6.2	2	V	D	3	7	2
Hydrophilidae	*Helochares lividus*	5	6.2	5	V	D	1		1
Hydrophilidae	*Enochrus testaceus*	5	6.2	3	IV	D		1	
Hydrophilidae	*Cymbiodita marginella*	5	6.2	5	V	D		2	1
Hydrophilidae	*Hydrophilus piceus*	5	6.2	8	V	D		1	
Hydrophilidae	*Berosus sp.*	5	6.2		V	D	13	95	
Hydrophilidae	*Berosus affinis*	5	6.2	7	V	D	7		
Hydrophilidae	*Berosus signaticollis*	5	6.2	7	V	D			1
Scirtidae	Scirtidae (larvae / damaged)	5	6.9		IV	B		1	
Curculionidae	Curculionidae	-	-				3		
Chrysomelidae	Chrysomelidae	-	-				1		
Caddisflies									
Limnephilidae	Limnephilidae (juvenile / damaged)	7	6.2		IV	B		1	
Limnephilidae	*Limnephilus sp.*	7	6.9			C		10	
Limnephilidae	*Limnephilus marmoratus*	7	6.9	2	V	C		21	
Leptoceridae	Leptoceridae (juvenile / damaged)	10	6.7		IV		1		
Leptoceridae	*Athripsodes aterrimus*	10	6.7	1	IV	D		1	
Trueflies									
Chironomidae	Chironomidae (damaged / pupea)	2	1.1				360		6

Family	Species	BMWP score	WHPT score	Conservation Score	Flow group	FSSR Score	Site 01	Site 02	Site 03
Chironomidae	Tanypodinae	2	1.1					35	83
Chironomidae	Orthocladiinae	2	1.1					138	12
Chironomidae	Chironomini	2	1.1					33	68
Tipulidae	*Tipula sp.*	5	5.9		IV	B	3		
Limoniidae	Limoniidae	5	5.9			B	26	18	6
Simuliidae	*Simulium* sp.	5				B	1		
Dixidae	*Dixella* sp.	-	7.0				4	5	
Psychodidae		-	4.4			D	1	1	
Ceratopogonidae		-	5.5					1	1
Stratiomyidae	Stratiomyidae	-	3.6			C	14	36	10
Stratiomyidae	*Stratiomys* sp.	-	3.6			D			3
Ptychopteridae	*Ptychoptera sp.*	-	6.4		II	D		1	
Tabanidae		-	7.1			D	4	21	2
Chaoboridae		-	3.0		V		6	1	
Ephydridae		-	4.4				2	4	3
Other Taxa									
Lepidoptera		-	-					1	
Collembola		-	-				1		
WHPT score							**97.3**	**111.8**	**53.4**
ASPT (WHPT)							**4.6**	**4.9**	**4.5**
PSI Score (species)							**3.2**	**0.0**	**0.0**
LIFE Score (species)							**5.0**	**5.3**	**5.2**
CCI Score							**24.0**	**37.6**	**28.8**
Total number of taxa							**50**	**45**	**23**

Family	Species	BMWP score	WHPT score	Conservation Score	Flow group	FSSR Score	Site 01	Site 02	Site 03
Total Number of species							**26**	**21**	**10**

Appendix 6.I – Report on Survey for Bats

NeuConnect: Great Britain to Germany Interconnector

GB Onshore Scheme

Environmental Statement

Appendix 6I – Report on Survey for Bats

NeuConnect Britain Ltd

September 2019

Quality information

Prepared by	Checked by	Verified by	Approved by
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Table of Contents

Figures

Tables

1. Introduction

1.1 In 2018, AECOM undertook a Preliminary Ecological Appraisal (PEA) on behalf of Neuconnect Britain Ltd (the 'Applicant'). This PEA survey identified the need for follow-up ecological surveys to determine the potential impacts of the NeuConnect project (hereafter known as the 'Proposed Development') on protected and, or notable species. Therefore, AECOM was instructed to undertake further surveys for the presence or absence of roosting bats and to determine whether the site was used by bats for foraging and, or commuting, as recommended in the PEA report (AECOM, 2019[1]). The PEA identified one building with low potential for bat roosts, an old barn (Photo 1), outside of the Proposed Development area. There were no other buildings or structures within the Proposed Development area and none of the trees were found to have bat roost potential.

Proposed Development

1.2 NeuConnect (the Project) is a 1,400 megawatt (MW) interconnector between Great Britain and Germany. The Project will create the first direct electricity link between the energy networks in Great Britain and Germanywith electricity being passed in either direction between Great Britain and Germany. The Project will be formed by approximately 700 kilometres (km) of subsea and underground High Voltage Direct Current (HVDC) cables, with an on-shore converter station at either end linking into the existing electricity grids in Great Britain and Germany.

1.3 The Proposed Development will comprise of three structures, a converter station, sub-station and a direct current (DC) cable route (see Figure 1).

1.4 The footprint of the proposed converter station to the perimeter security fence is expected to be up to approximately 250 metres (m) by 250 m, with a maximum height of up to 26 m.

1.5 The footprint of the proposed substation to the perimeter security fence is expected to be approximately 80 m by 80 m with a maximum height of 14 m.

1.6 The proposed DC cable corridor will be approximately 1.6 km long (from landfall to the converter station). The preferred installation method will be underground, which will result in a temporary loss of land during installation. The working corridor for the installation of the cable corridor will be 30 m.

1.7 Additional laydown areas will be required for construction, comprising 1.5 hectares (ha) for the converter laydown and 0.3 ha for the substation laydown.

Site Description

1.8 The Proposed Development area (the Site) is entirely within the boundary of Medway Council and is centred on the Isle of Grain located at the tip of the Hoo Peninsula between the Thames Estuary to the north and the Medway Estuary to the south. The Site is located to the west of the village of Grain, Isle of Grain, Kent, at Ordnance Survey (OS) central grid reference TQ 88205 76727. Land use comprises a mix of industrial development to the south, the small settlement of Grain to the south-east and undeveloped land to the north (along the coastline) and to the west, much of which is designated for ecological interests. Land within the Site and in the immediate vicinity has historically been used for the extraction of gravel and sand and the resultant voids used for landfill.

1.9 Figure 1 shows the site boundary (red-line), the cable corridor (purple line) and proposed location of each structure.

[1] AECOM, Neuconnect, Isle of Grain: Preliminary Ecological Appraisal Report, 2019

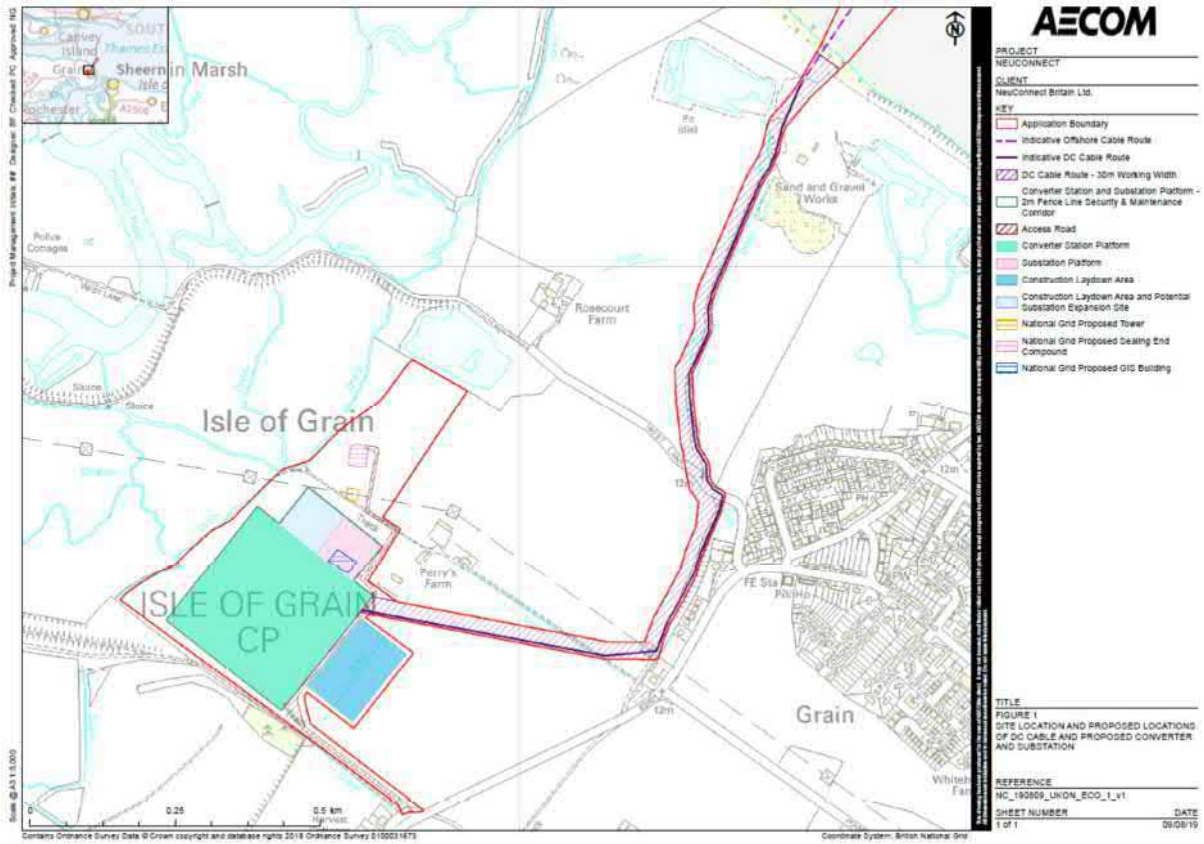

Figure 1 - Site boundary and proposed locations of DC cable corridor, converter station and substation.

Survey Area

1.10 The survey area included all habitats within the Site boundary and a 100 m buffer, considered as being potentially suitable for roosting and, or foraging and commuting bats.

Scope of Report

1.11 The objectives of the bat surveys, reported in this document, are to determine the:

- presence and assemblage of bat species within 100 m of the Site boundary;
- extent and pattern of use of the Site by roosting, commuting and foraging bat species; and
- potential impacts of the Proposed Development on bats and any subsequent mitigation.

2. Legislative and Policy Framework

Legislative Framework

2.1 All bat species and their roosts are legally protected in the UK under the Habitats Regulations, which implements the EC Directive 92/43/EEC (the Habitats Directive)[2]. In addition, Barbastelle *Barbastellus barbastellus*, Lesser Horseshoe *Rhinolophus hipposideros*, Greater Horseshoe *Rhinolophus ferrumequinum* and Bechstein's *Myotis bechsteinii* bat are listed in Annex II of the Habitats Directive, which requires sites to be designated in member states for their protection. Bats and their roosts are also protected under the Wildlife and Countryside Act 1981 (the WCA)[3].

2.2 Taken together, the Habitats Regulations and the WCA make it illegal to:

- deliberately capture or intentionally take a bat;
- deliberately or intentionally kill or injure a bat;
- be in possession or control of any live or dead bat or any part of, or anything derived from a bat;
- damage or destroy a breeding site or resting place of a bat;
- intentionally or recklessly obstruct access to any place that a bat uses for shelter or protection;
- intentionally or recklessly disturb a bat while it is occupying a structure or place that it uses for shelter or protection; and
- deliberately disturb bats, in particular any disturbance which is likely to (i) impair their ability to survive, breed, reproduce or to rear or nurture their young; or in the case of hibernating or migratory species, to hibernate or migrate; or (ii) to affect significantly the local distribution or abundance of the species to which they belong.

2.3 A bat roost is defined as any structure a bat uses for breeding, resting, shelter or protection. It is important to note that since bats tend to re-use the same roost sites, current legal opinion is that a bat roost is protected regardless of whether or not the bats are present at a specific point in time.

European Protected Species Mitigation Licences

2.4 Although the law provides strict protection to bats, it also allows this protection to be set aside (derogated) under Regulation 53 of the Habitats Regulations through the issuing of European Protected Species Mitigation Licences (EPSML) for the purpose of preserving public health, public safety, and other imperative reasons of overriding public interest, including those of a social or economic nature and beneficial consequences of primary importance for the environment. However, in accordance with the requirements of the Habitats Regulations, a licence can only be issued where the following requirements are satisfied:

- there is no satisfactory alternative; and
- the action authorised will not be detrimental to the maintenance of the population of the species concerned at a favourable conservation status in their natural range.

2.5 In England, EPSML applications are currently determined by Natural England and take up to five working days to acknowledge receipt and then at least a further 30 working days to determine. Certain types of low value roosts in structures only can be mitigated for under a Low Impact Class Licence, and involve a simpler process with a shorter determination time.

[2] Anon. (1992). The Habitats Directive. European Commission.
[3] Anon. (1981). The Wildlife & Countryside Act. HMSO, London.

National Planning Policy Framework

2.6 The National Planning Policy Framework (NPPF) was originally published on 27th March 2012 and detailed the Government's planning policies for England and how these are expected to be applied. The NPPF was then revised on 24th July 2018 and 19th February 2019. The NPPF states the commitment of the UK Government to minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity.

2.7 It specifies the obligations that the Local Authorities and the UK Government have regarding statutory designated sites and protected species under UK and international legislation and how this is to be delivered in the planning system. Protected or notable habitats and species can be a material consideration in planning decisions and may therefore make some sites unsuitable for particular types of development, or if development is permitted, mitigation measures may be required to avoid or minimise impacts on certain habitats and species, or where impact is unavoidable, compensation may be required.

2.8 The NPPF is clear that pursuing sustainable development includes moving from a net loss of biodiversity to achieving net gains for nature, and that a core principle for planning is that it should contribute to conserving and enhancing the natural environment and reducing pollution.

Local Planning Policy

2.9 Local planning policy relevant to nature conservation and bats is provided in detail in the Preliminary Ecological Appraisal for the proposed development (AECOM, 2019).

UK Post-2010 Biodiversity Framework

2.10 The UK Biodiversity Action Plan (UKBAP)[4] was launched in 1994 and established a framework and criteria for identifying species and habitat types of conservation concern. From this list, action plans for priority species of conservation concern were published, and have subsequently been succeeded by the UK Post-2010 Biodiversity Framework (July 2012)[5].

2.11 The UK Post-2010 Biodiversity Framework sets a broad enabling structure for action across the UK between now and 2020, including a shared vision and priorities for UK-scale activities to help deliver the Aichi targets and the EU Biodiversity Strategy. A major commitment by Parties to the Convention of Biological Diversity is to produce a National Biodiversity Strategy and/or Action Plan.

2.12 The UK Post-Development Framework is relevant in the context of Section 40 of the Natural Environment and Rural Communities (NERC Act 2006)[6], meaning that Priority Species and Habitats are material considerations in planning. These habitats and species are identified as those of conservation concern due to their rarity or a declining population trend.

2.13 The Natural Environment and Rural Communities (NERC) list of Species of Principal Importance is used to guide decision-makers such as public bodies, including local and regional authorities, in implementing their duty under Section 40 of the NERC Act 2006; under Section 40 every public authority (e.g. a local authority or local planning authority) must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity. In addition, with regard to those species on the list of Species of Principal Importance prepared under Section 41 (S41), the Secretary of State must:

> *"(a) take such steps as appear to the Secretary of State to be reasonably practicable to further the conservation of the living organisms and types of habitat included in any list published under this section, or*
>
> *(b) promote the taking by others of such steps."*

[4] Anon. (2008). UK Biodiversity Action Plan. HMSO
[5] Anon. (2012). UK Post-2010 Biodiversity. HMSO.
[6] Anon. (2006). The Natural Environment and Rural Communities Act. HMSO, London.

2.14 All widespread reptile species were added to the UK Biodiversity Action Plans (UKBAP) as priority species in September 2007 and subsequently are included as Species of Principal Importance in England under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 meaning that they are of material consideration in planning.

2.15 The following bat species are listed under Section 41 as being of Principal Importance for the conservation of biodiversity in England: Barbastelle, Bechstein's, Noctule *Nyctalus noctula*, Soprano Pipistrelle *Pipistrellus pygmaeus*, Brown Long-eared *Plecotus auritus*, Lesser Horseshoe and Greater Horseshoe.

Local Biodiversity Action Plan

2.16 Kent Biodiversity Action Plan[7] sets out a species action plan for the Serotine Bat *Eptesicus serotinus,* where its objectives and targets include:

- to maintain this building-dependent bat as a widespread species in Kent;
- to maintain and enhance, and where possible extend, the available feeding habitat;
- to maintain and increase opportunity for roosting in buildings; and
- to continue and extend monitoring counts at summer roosts and to develop bat detector monitoring of feeding habitat use in line with national protocols.

[7] Kent Biodiversity Action Plan Steering Group (1997). The Kent Biodiversity Action Plan.

3. Methods

Desk Study

3.1 A desk study was undertaken in July 2018 to obtain bat records within a 5 km radius of the Site from Kent Bat Group, Kent & Medway Biological Records Centre. This data request was limited to records of bats recorded within the last ten years of the request date.

Preliminary Roost Appraisal

3.2 A preliminary roost appraisal was undertaken of buildings and structures and mature trees within the Site to appraise, from ground level, potential roosting features (PRFs) for bats, following guidance as described in the Bat Conservation Trust (BCT) '*Bat Surveys for Professional Ecologists: Good Practice Guidelines 3rd Edition*' (Collins, J. (ed.), 2016[8]). An experienced ecologist surveyed all relevant buildings and structures and trees externally for their suitability for roosting bats. This survey was undertaken in July 2018.

3.3 The aim of the preliminary roost appraisal survey was to identify features on buildings and structures and trees that are suitable for roosting bats and for which further surveys were required to determine the presence or absence of bats and their roosts. .

3.4 All buildings and structures and trees were inspected from ground level, as much as possible, for evidence of bat use. Such evidence included bat droppings, 'clean' gaps that may indicate the movement of animals in and out of the space, scratch marks and staining (from animals' fur). The equipment used included binoculars, a high-powered torch and a digital camera.

3.5 All features of potential interest to bats were annotated onto paper maps and recording forms.

3.6 For reference, each building and structure and tree was assigned a label for identity and any features found on each were used to assess the roost potential and determine the likelihood of use by bats.

3.7 A grade of habitat suitability and risk was assigned to buildings and structures and trees as a whole, based on the suitability of the identified features for bats. In accordance with BCT guidance (Collins, 2016), each of the buildings and structures and trees surveyed were assigned a category of roost habitat suitability or 'risk' corresponding to the likelihood that bats could be present and this information was used to inform the need for follow-up surveys. These categories are described below:

- **Negligible roost suitability** - Negligible habitat features on site likely to be used by roosting bats
- **Low roost suitability** - A structure with one or more potential roost sites that could be used by individual bats opportunistically. However, these potential roost sites do not provide enough space, shelter, protection, appropriate conditions and/or suitable surrounding habitat to be used on a regular basis or by larger numbers of bats (i.e. unlikely to be suitable for maternity or hibernation). A tree of sufficient size and age to contain Potential Roosting Features (PRFs) but with none seen from the ground or features seen with only very limited roosting potential.
- **Moderate roost suitability** – A structure or tree with one or more potential roost sites that could be used by bats due to their size, shelter, protection, conditions and surrounding habitat but unlikely to support a roost of high conservation status.
- **High roost suitability** – A structure or tree with one or more potential roost sites that are obviously suitable for use by larger numbers of bats on a more regular basis and potentially for longer periods of time due to their size, shelter, protection, conditions and surrounding habitat.

[8] Collins, J. (ed.) (2016). Bat Surveys for Professional ecologists: Good Practice Guidelines (3rd edition). The Bat Conservation Trust, London

3.8 Where the potential presence of roosting bats was suspected, based on the features recorded and 'risk', dusk emergence and, or dawn re-entry surveys on structures / buildings and trees were then recommended. These surveys aimed to confirm presence or absence of bats, identify species, the numbers of bats and access and egress points to characterise the roost and inform any potential mitigation requirements.

Emergence Surveys

3.9 Dusk emergence and dawn re-entry surveys were undertaken in accordance with BCT guidance (Collins, 2016).

3.10 The preliminary roost appraisal identified one building, an old barn (Photo 1) south of Perry's Farm (see Figure 2), within the survey area with low potential to support roosting bats and this was surveyed using the guidance for surveys visits, based on the assessed habitat suitability and risk category of each building, structure or tree (see Table 1). As there were no other buildings or structures and all the trees had been assessed as having negligible habitat suitability, no further emergence surveys were needed.

Table 1 - Minimum number of survey visits required to determine presence / absence of roosting bats (Collins, 2016)

Low Habitat Suitability / Risk	Moderate Habitat Suitability / Risk	High Habitat Suitability / Risk
Buildings and structures - One survey visit during dusk or dawn, May to August. Trees – no further surveys required	Two separate survey visits – one dusk and one dawn, May to September (with 1 survey May to August)	Three separate survey visits – dusk or dawn (at least one dawn), May to September (with 2 of the surveys May to August)

3.11 A single emergence survey of the building with low suitability to support roosting bats was undertaken in May 2019 during appropriate weather conditions when bats are likely to be active.

3.12 The emergence surveys started approximately 15 minutes before sunset and ended 1.5 to 2 hours after sunset. The survey was undertaken during suitable weather conditions, in dry conditions, with a temperature of 10°C and a wind speed of Beaufort Scale 4.

3.13 The survey was undertaken by suitably experienced bat surveyors located at suitable viewpoints adjacent to the building / structure. Equipment used during the surveys included Bat box duet and Petterson D240x detectors connected to Edirol R05 recording devices. Sound recordings were made to allow subsequent verification of species or species groups, where required.

3.14 All bat contacts were recorded and all bats were identified to species level on site, where possible. Notes on emergence / re-entry locations (where observed) and direction of flight were recorded onto paper maps of the survey area.

Roost Types

3.15 Where bat roosts were found these were categorised as follows based on guidance in Collins, (2016):

- **Day roost** - A place where individual bats, or small groups of males, rest or shelter in the day but are rarely found by night in the summer.
- **Night roost** - A place where bats rest or shelter in the night but are rarely found in the day. May be used by a single individual occasionally or it could be used regularly by the whole colony.
- **Feeding roost** - A place where individual bats or a few individuals rest or feed during the night but are rarely present by day.

- **Transitional / occasional roost** - Used by a few individuals or occasionally small groups for generally short periods of time on waking from hibernation or in the period prior to hibernation.
- **Swarming site** - Where large numbers of males and females gather during late summer to autumn. Appear to be important mating sites.
- **Mating site** - Where mating takes place from late summer and can continue through winter.
- **Maternity roost** - Where female bats give birth and raise their young to independence.
- **Hibernation roost** - Where bats may be found individually or together during winter. They have a constant cool temperature and high humidity.
- **Satellite roost** - An alternative roost found in close proximity to the main nursery colony used by a few individual breeding females to small groups of breeding females throughout the breeding season.

Habitat Suitability for Commuting and Foraging Bats

3.16 The habitat suitability on Site was assessed in August 2017 as being of overall low suitability for commuting and foraging bats, due to the majority of the Proposed Development areas (in particular, the areas proposed for the converter and substation) comprising of arable farmland with limited connectivity to better quality habitats.

3.17 It is acknowledged that the tree and scrub along the length of the proposed DC cable corridor provides a discrete habitat feature of better quality habitat for commuting and foraging bats. However, this linear habitat is not located near known bat roosts, offers no connectivity to more suitable (woodland / lakes) habitat off-site and is likely to be used by small numbers of commuting and foraging bats only.

Bat Activity Surveys

3.18 Surveys for bat activity were based on standard methodology for bat activity transect surveys as described in the BCT guidelines (Collins, 2016) and the number of bat activity surveys required to achieve a reasonable survey effort was assessed in relation to habitat suitability, following the BCT guidelines (Collins, 2016) (see Table 2).

Table 2 - Summary of guidelines on bat activity survey effort based on suitability of habitat for bats (Collins, 2016)

Low suitability habitat for bats	Moderate suitability habitat for bats	High suitability habitat for bats
One transect survey per season (spring, summer and autumn). One static detector per transect on five consecutive nights per season	One transect survey per month (April to Oct (weather permitting)). One survey to comprise dusk and pre-dawn or dusk to dawn. Two static detectors per transect on five consecutive nights per month.	Up to two transect surveys per month (April to Oct (weather permitting)). One survey to comprise dusk and pre-dawn or dusk to dawn. Three static detectors per transect on five consecutive nights per month.

Note on Table 2: April, September and October may be weather and location-dependent. If weather conditions are unsuitable, the length of the survey season is reduced

Manual Surveys for Bat Activity

3.19 Following an evaluation of the habitat suitability for commuting and foraging bats being low, one activity survey per season (spring (April / May), summer – (June / July / August), autumn – (September / October)) was undertaken in appropriate weather conditions.

3.20 These surveys were carried out in July and September 2018 and in May 2019, with two surveys conducted each month. The number of bat activity surveys required to achieve a reasonable survey effort was assessed in relation to habitat suitability; following the BCT guidelines (Collins, 2016) (see Table 2). Bat activity is highly dependent on weather conditions and therefore surveys were undertaken in favourable weather conditions, consisting of a temperature above 8°C, wind strength of Beaufort Force 3 or less and with precipitation not exceeding light drizzle. The weather conditions were recorded during all surveys (see Table 3).

Table 3 - Transect survey dates and weather conditions

Survey number	Date	Weather conditions and temperature (°C)
1	31/07/2018	Dry, 2/8 cloud, Wind F1, 20°C
2	26/09/2018	Dry, Cloud 0/8, Wind F1, 19°C
3	02/05/2019	Dry, Cloud 6/8, Wind NW F2, 10°C

Notes on Table 3: Wind speed is shown using the Beaufort scale, which is an empirical measure of force 0-12 that relates wind speed to observed conditions. Cloud cover is shown in a scale of 0-8 where the number represents the amount of cloud cover *e.g.* 2/8 is 25% cover 4/8 is 50% etc

3.21 A single transect route was selected through the Site (see Figure 3) to cover as much of the survey area as possible. The transect route included 15 wait points located at potentially important features with regard to bat activity. The survey route was designed to include potential flight paths or foraging areas within the site, and also potential roost sites. The direction of the transect routes was altered on each visit to avoid any bias with survey data and ensure that different parts of the survey area were surveyed at different times.

3.22 The surveys were carried out by two surveyors from sunset to at least 2 hours after dusk and dawn surveys commenced two hours before sunrise, finishing at sunrise. The surveyors walked the transect route at an even pace across the length of the Site and at each wait point, surveyors stopped and recorded bat activity for three minutes before continuing along the route.

3.23 During surveys, all bat activity was noted and, where possible, all bats were identified to species level on site. The time, location, numbers, species (where possible) and direction of flight of bats were recorded for each bat pass (discrete burst of echolocation heard, or bat activity observed) during the survey. Echolocation calls that were identified by Batbox Duet and recorded on Anabat Express detectors, were then recorded onto these digital storage devices on site and then subsequently analysed when in the office using AnalookW software (version 4) computer software to confirm identification, where necessary.

3.24 A bat pass is defined as a sequence of greater than two echolocation calls made as a single bat flies past the microphone of ultrasonic equipment. Additional notes, such as the number of bats, flight height and particularly type of flight (*e.g.* commuting, foraging, fast or slow) were also recorded. The direction of flight was also recorded to help establish a picture of commuting routes and flight lines.

3.25 The foraging and commuting data collected for each species group (depending on the level of identification possible from the recordings made) was then used to assess the value of the Site for bats using a geographical frame of reference. This assessment uses a range of variables such as species, number of bats, roosts / potential roosts nearby and the type and complexity of the linear features to derive an overall geographical value of the Site for each species using guidance in Wray *et al.* (2010[9]).

[9] Wray, S. Wells, D, Long, E Mitchell-Jones, T (2010). Valuing bats in ecological impact assessment. CIEEM In Practice Issue 70 (December 2010).

Automated / Static Monitoring Surveys for Bat Activity

3.26 To provide supplementary information on bat activity across the Site, automated bat detectors were deployed following automated static monitoring techniques, as described in BCT guidelines (Collins, 2016).

3.27 Automated ultrasound recording equipment was placed in two locations on site, in areas that were likely to be used by foraging or commuting bats.

3.28 The automated detectors were placed in the same location during each survey period to allow for quantitative analysis to be undertaken. The automated detectors, when deployed, were *in-situ* for the recommended minimum five consecutive nights per season (based on the habitat quality assessment as defined in Table 2) and the locations of these detectors can be found in Figure 4.

3.29 The automated detectors were in operation for May, August and September, covering spring, summer and autumn respectively.

3.30 Each Anabat, when in operation, was set to begin recording from 30 minutes before sunset and terminate recording 30 minutes after sunrise. This time period covered the peak time bats would be commuting to and from their roosts to foraging areas, mating sites and breeding roosts. It also covered peak activity times for foraging.

3.31 Each automated detector, when in operation, was set to begin recording from sunset and terminate recording at sunrise. This time period covered the peak time bats would be commuting to and from their roosts to foraging areas, mating sites and breeding roosts. It also covered peak activity times for foraging.

3.32 Automated detectors record bat data by generating a data file each time a bat passes the device and each call was automatically recorded to a compact flash memory card with large storage capacity.

3.33 Potential call files were downloaded and extracted from data files using CFCread software. The default settings were used during this file extraction process, as the software screens all data recorded by the bat detector and extracts call files using an automatic filter. Using the default setting for this also ensures comparability between data sets.

3.34 Following downloading of the data from each automated detector, the recordings were firstly analysed for presence of bat calls, using AnalookW software (version 4), and then each bat call was subsequently analysed to identify the bat to species level, where possible, following the call parameters outlined in '*British Bat Calls, A Guide to Species Identification'* (Russ, 2013[10]).

Bat Data Analysis

Automated Data

3.35 The automated or static detector data collected were analysed to determine the total number of bat passes for each species or species group (depending on the level of identification possible from the recordings made) and then used to derive a metric - the Bat Activity Index (BAI) (see Section 3.6.2) for the bat activity at each survey location. The transect data were described in relation to species, observed behaviour, temporal and spatial trends. These analyses provide an indication of:

- seasonal variation in species activity and composition at each survey location;
- relative levels of bat activity across the Site; and
- potential roosting sites, important foraging areas and commuting routes.

[10] Russ, J. 2013. British Bat Calls, A Guide to Species Identification. Pelagic Publishing.

Bat Activity Index (BAI)

3.36 Bat activity index (BAI) values from the static monitoring surveys were calculated by averaging the number of bat passes per hour, between sunset and sunrise, for each static detector unit. The term 'pass' is defined as a single file made up of bat pulses of a single species *i.e.* this may be one bat in a file or many bats in a single file.

3.37 No guidance is available on what constitutes low, moderate or high bat activity based on number of passes. As such a relative scale is used by AECOM in this report where:

- Very Low Activity is a mean of less than 2 passes per hour (at each survey location);
- Low Activity is a mean of 2 to 25 passes per hour;
- Moderate Activity is a mean of 26 to 99 passes per hour; and
- High Activity is a mean of over 100 passes per hour.

Survey Limitations

3.38 Some sonograms recorded were too weak to identify, with confidence, to species level. Therefore these calls, where recorded, were simply identified to a species group (*e.g. Myotis.* species) unless the sonogram could be identified to species level.

3.39 The automated detector at Location 1 malfunctioned during the May survey and therefore no bats were recorded during the spring period at Location 1. However, the automated detector in Location 2 functioned properly during this period and the data recorded is considered sufficient to determine both the species assemblage present on Site in the spring season and the levels of bat activity on Site.

3.40 Bats are a group of species with a range of dynamic behaviours with patterns of behaviour changing in response to physical and environmental factors. This can result in changes to roost sites (and sporadic use of such sites) and changes in foraging and commuting areas. Surveys for bats provide a snapshot of what bats are doing at that time and given that the majority of ecological data are valid only for short periods due to the inherently transient nature of the subject. On this basis, it is recommended that the surveys will need repeating within two years.

Explanation of Abbreviations

3.41 Presented within the tables in Section 4 and the appendices, the following abbreviations for bats have been used:

- **PIP**: Common Pipistrelle Pipistrellus pipistrellus;
- **SOP**: Soprano Pipistrelle;
- **NTP**: Nathusius' Pipistrelle Pipistrellus nathusii;
- **UNPIP**: Unidentified Pipistrelle Pipistrellus species;
- **NOC**: Noctule;
- **LEI**: Leisler's Nyctalus leisleri;
- **MYO**: Unidentified Myotid Myotis species;
- **BLE**: Brown Long-eared Plecotus auritus; and
- **UN**: Unknown bat.

4. Results

Desk Study

4.1 The data search, undertaken through Kent Bat Group returned three records of flying, grounded or dead bats from within 2 km of the Site and within the last ten years. These records were:

- a dead Pipistrelle in 2015, 1.5 km to the SSW of the proposed converter station;
- a grounded Nathusius's Pipistrelle in 2016, 1.5 km to the SSW of the proposed converter station; and
- an unidentified bat, in 2014, approximately 500 m to the east of the proposed DC cable corridor.

4.2 Additionally, the data search also returned records of historical (>10 years) records of bat roosts within 2 km of the Site, the closest of which was of a Pipistrelle bat *Pipistrellus* species roost from 1995, approximately 200 m west of the proposed DC cable corridor.

Preliminary Roost Appraisal

4.3 The preliminary roost appraisal of the one building within the survey area was undertaken in July 2018. This building was an old barn (Photo 1) at approximate Ordnance Survey (OS) grid reference: TQ878765, approximately 40 m from the Site (labelled TN13 on Figure 2; see also Photo 1, Appendix C). The barn had been assessed as having low suitability for roosting bats

4.4 There were no other buildings or structures or and trees within the survey area that had been assessed as having any potential to support roosting bats.

Emergence Survey

4.5 The single emergence survey, undertaken on TN13 (see Figure 2) in May 2019 did not record any bats emerging from this structure. However, during the survey both Common and Soprano Pipistrelles were recorded flying past the structure.

Activity Surveys

4.6 Three bat species (Common Pipistrelle, Soprano Pipistrelle and Nathusius' Pipistrelle) and a myotid bat (*Myotis* species) were confirmed using the survey area during the surveys for bat activity.

4.7 The transect route and locations of wait (or listening) points are shown on Figure 3. (A wait point is a location at which the surveyor stops and listens for any bat activity.) A summary of the bat contacts recorded during the transect surveys is provided in Table 4.

4.8 Both foraging and commuting activity was recorded during the transect surveys. The level of bat activity during the surveys, using the BAI described in Section 3.6.2, was all very low.

4.9 The following tables detail the results of the activity surveys and show the number of bat contacts recorded for each species identified. It is important to note that the number of contacts does not equate to the number of individual bats, as several contacts can be generated by an individual bat flying past the survey point several times. However, the number of contacts does provide an index of bat activity and this can be used to identify areas of habitat that is of importance to bats.

Table 4 - Summary of bat contacts recorded during transect surveys of the Site

Survey number	Season / date / period	Sunset time	Time of first bat record	PIP	NTP	SOP	MYO	UN	Total Passes	Passes per hour
1	Spring, May 2019, dusk	20:21	20:47	2	1	0	0	2	5	2.5
2	Summer, July 2018, dusk	20:48	21:49	12	0	2	0	0	14	7
3	Autumn, September 2018, dusk	19:40	20:17	6	0	2	1	0	9	4.5

Static Monitoring

4.10 Three bat species, Common Pipistrelle, Soprano Pipistrelle and Noctule were confirmed through static monitoring surveys at two locations. One nyctalid bat (*Nyctalus* species) was also confirmed using the Site.

4.11 A summary of the bat contacts recorded during the static monitoring is detailed below in Tables 5 and Table 6.

Table 5 - Summary of bat contacts recorded during static monitoring of the Proposed Development from Location 1

Date	Number of Bat Contacts				
	PIP	SOP	NOC	NOC/LEI	UNPIP
16th-20th August 2018	2	136	1	1	-
26th – 30th September 2018	102	515	6	-	3
17th – 21st May 2019	0	0	0	0	0
Total	**104**	**651**	**5**	**1**	**3**

Table 6 - Summary of bat contacts recorded during static monitoring of the Proposed Development from Location 2

Date	Number of Bat Contacts				
	PIP	SOP	NOC	NOC/LEI	UNIDPIP
16th-21st August 2018	61	66	4	5	2
26th-30th September 2018	0	13	1	1	-
17th-21st May 2019	60	48	8	0	5
Total	**121**	**127**	**13**	**6**	**7**

4.12 The most numerous species of bat recorded were Soprano and Common Pipistrelle with 778 and 224 contacts respectively recorded throughout the entire survey period, at both static monitoring locations. Unidentified Pipistrelle bats were also recorded (seven contacts), but the peak frequency of calls was in the overlap (50 Khz) for both Common and Soprano Pipistrelle. As a result, these have been recorded as 'Pipistrelle species' within this report.

4.13 Noctule with a total of 18 contacts was the next most numerous species recorded. Seven contacts of a *Nyctalus* species, either Noctule or Leisler's bat, were recorded at both static locations throughout the survey period. However, due to the contacts recorded being too brief or weak on the sonograms, it was not possible to identify these sonograms to species level.

5. Evaluation

Roosting bats

5.1 No bat roosts were found within the survey area. Therefore, roosting bats do not pose a constraint on the Proposed Development.

Commuting and foraging bats

5.2 Four species of bat were recorded during the activity surveys, through a combination of transect and automated survey techniques. These species were: Common Pipistrelle, Soprano Pipistrelle, Nathusius' Pipistrelle and Noctule. One species group (*Myotis* sp.) was also recorded during transect surveys. Other contacts, belonging to the *Nyctalus* genus were also recorded but could not be identified to species level.

Species abundance

5.3 None of the nationally rarest species, with populations under 10,000 (Wray et. al., 2010[11]), (see Appendix B) were recorded within the survey area.

5.4 Three of the nationally rarer species (Noctule, Nathusius' Pipistrelle and myotid bats (*Myotis* sp), with populations between 10,000 and 100,000 (Wray et. al., 2010), were recorded within the survey area. Noctule is considered generally uncommon and declining in Kent and Nathusius' Pipistrelle is scarce, often recorded as a migrant (Kent Bat Group, 2018[12]). No formal assessment can be made on the recorded species of myotid bat as the abundance of *Myotis* bats in Kent varies between species (Kent Bat Group, 2018[13]).

5.5 Common Pipistrelle and Soprano Pipistrelle are common and widespread species, both nationally and within the county and both were, by a long way, the most recorded within the survey area.

5.6 None of the bat species recorded in the survey area is listed on the Kent Biodiversity Action Plan (Kent Biodiversity Action Plan Steering Group, 1997).

Species distribution

5.7 The transect surveys indicate that the two most commonly recorded species, Common Pipistrelle and Soprano Pipistrelle, are widely distributed across the Site and both species were recorded foraging and commuting and were mainly associated with linear landscape features.

5.8 During the static monitoring surveys, Soprano Pipistrelle was found to be more numerous within the northern section with 535 more contacts recorded at Location 1, compared to Location 2 (Figure 4). In contrast, Common Pipistrelle was found to be more numerous in the southern section, with 11 additional contacts recorded at Location 2 compared to Location 1. Noctule was also found to be more numerous at Location 2 with 12 contacts, compared to seven contacts at Location 1.

Seasonal variation

5.9 The transect surveys recorded higher levels of bat activity during summer, with seven bat passes per hour compared to 4.5 bat passes per hour in autumn and 2.5 bat passes per hour in spring.

[12] Kent Bat Group (2018). UK and Kent bats distribution table 2018. http://www.kentbatgroup.org.uk/bats-in-kent/ (accessed July 2019)
[13] Kent Bat Group (2018). UK and Kent bats distribution table 2018. http://www.kentbatgroup.org.uk/bats-in-kent/ (accessed July 2019)

5.10 The static monitoring surveys recorded higher levels of bat activity during autumn, resulting in 641 contacts in September, compared to 277 bat contacts in summer (August). Static monitoring in May resulted in 121 bat contacts.

5.11 Therefore the results of the surveys would suggest that the survey area is of more value to commuting and foraging bats during summer and autumn than in spring.

Value of commuting and foraging habitat

5.12 Overall, the BAI within the Site (see Section 3.6.2) for commuting and foraging bats ranged from no activity to low activity (see Table 7).

Table 7 - The BAI value for commuting and foraging bats within the survey area

Month	Detector Location	Total Number of Bat contacts recorded over five consecutive night	Bat Activity Index (bat passes per hour)	Bat Activity Value
May	**1**	0	0	**No Activity**
	2	121	2.64	**Low Activity**
August	**1**	140	3.38	**Low Activity**
	2	137	3.31	**Low Activity**
September	**1**	626	9.51	**Low Activity**
	2	15	0.23	**Very Low Activity**

5.13 The foraging and commuting evaluation for the survey area has been derived from the results of all the survey methods employed and has been used along with published species distribution and population trends to assess the overall value of the survey area for commuting and foraging bat species.

5.14 Overall, the habitat within the survey area is of **Local** importance to foraging and commuting bats, including Noctule, Nathusius' Pipistrelle, Common Pipistrelle and Soprano Pipistrelle, on the basis of the numbers of each species recorded, location of known roosts and the foraging and commuting habitat characteristics (See Tables 8 and 9).

Table 8 - The foraging value of habitat within the survey area

Species	National Rarity	Number of bats	Site/Nearby Roost Potential	Foraging habitat characteristics	Total Score	Value
Noctule	5	5	0	3	13	**Local**
Nathusius' Pipistrelle	5	5	0	3	13	**Local**
Common Pipistrelle	2	10	3	3	18	**Local**
Soprano Pipistrelle	2	10	3	3	18	**Local**

Table 9 - The commuting value of habitat within the survey area

Species	National Rarity	Number of bats	Site/Nearby Roost Potential	Type & Complexity of Linear Features	Total Score	Value
Noctule	5	5	0	2	12	**Local**
Nathusius' Pipistrelle	5	5	0	2	12	**Local**
Common Pipistrelle	2	10	3	2	17	**Local**
Soprano Pipistrelle	2	10	3	2	17	**Local**

6. Mitigation and Enhancement Measures

6.1 In order to reduce the potential impacts on bats, a number of measures can be included within the design of the Proposed Development. These outline measures are recommended to ensure that the impacts on the bats are minimised and it is recommended that these proposals are formalised through a Construction Environmental Management Plan (CEMP) or precautionary working method statement for the Site.

6.2 The Proposed Development will incur permanent loss of the arable fields to the south and south-west of Perry's Farm (see Figure 1). However, no bat activity was recorded in this area and therefore no foraging or commuting habitat of importance to bats will be lost.

6.3 The Proposed Development may incur temporary loss of scrub, used by commuting bats, along the extent of the DC cable corridor. Post-construction, any habitat loss within the DC cable corridor should be restored on a like for like basis and habitat creation and, or restoration should include the planting of mixed native species of trees and scrub, including Hawthorn *Crataegus monogyna* and Blackthorn *Prunus spinosa,*

6.4 No bat roosts were recorded within the survey area. However, artificial bat boxes should be provided on retained trees and in the wider area, which would provide roosting opportunities for bats.

6.5 Lighting during construction and operation of the Proposed Development should be designed sympathetically to avoid light spill into off-site habitats to avoid directly impacting on commuting and foraging bats. Being nocturnal and adapted to forage in low light conditions, increases in artificial lighting can cause disturbance to bats or disrupt existing flight paths. To minimise potential impacts from lighting, it is recommended that the Proposed Development ensures:

- no illumination of retained boundary features;
- use of light sources that emit minimal ultraviolet light and avoid white or blue wavelengths to avoid attracting lots of insects (attracting insects to lamps may reduce their abundance in darker foraging areas favoured by bats); and
- individual lamps are hooded and directed where needed to avoid unnecessary light spillage.

Appendices

Appendix A: Figures

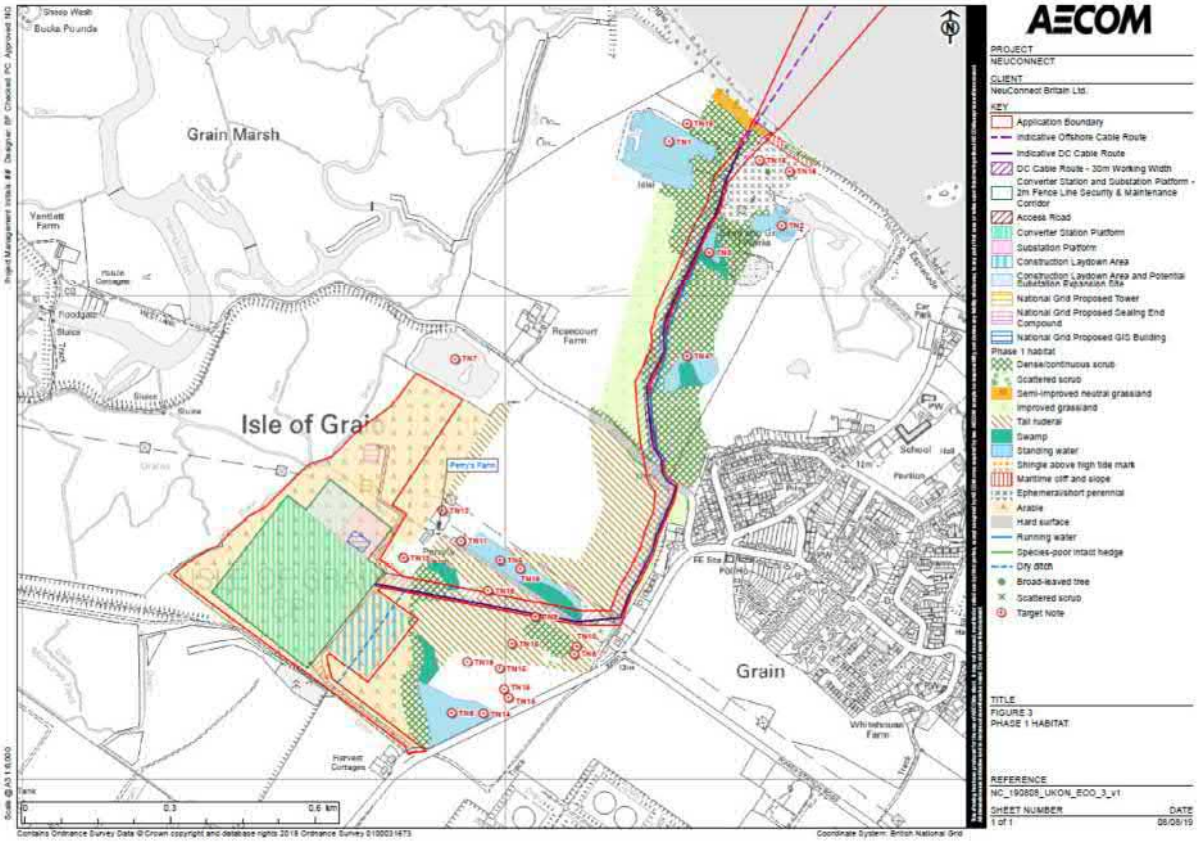

Figure 2 - Habitat within survey area and location (TN13) of surveyed barn

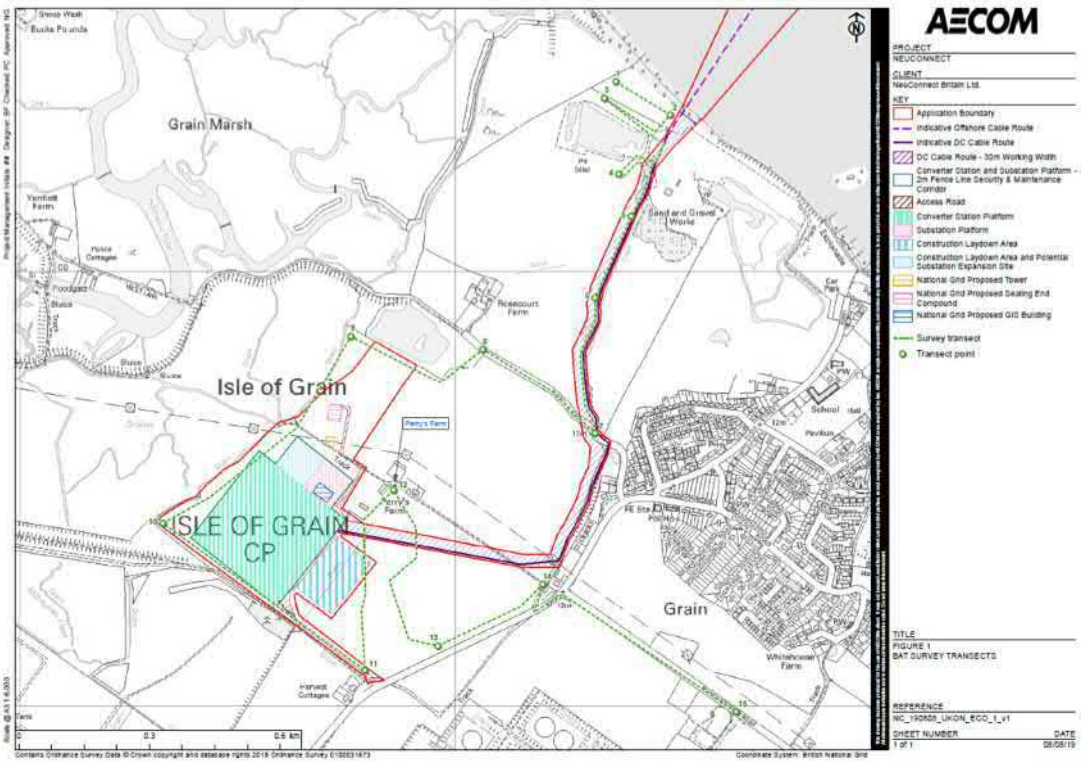

Figure 3 - Transect route and location of wait points

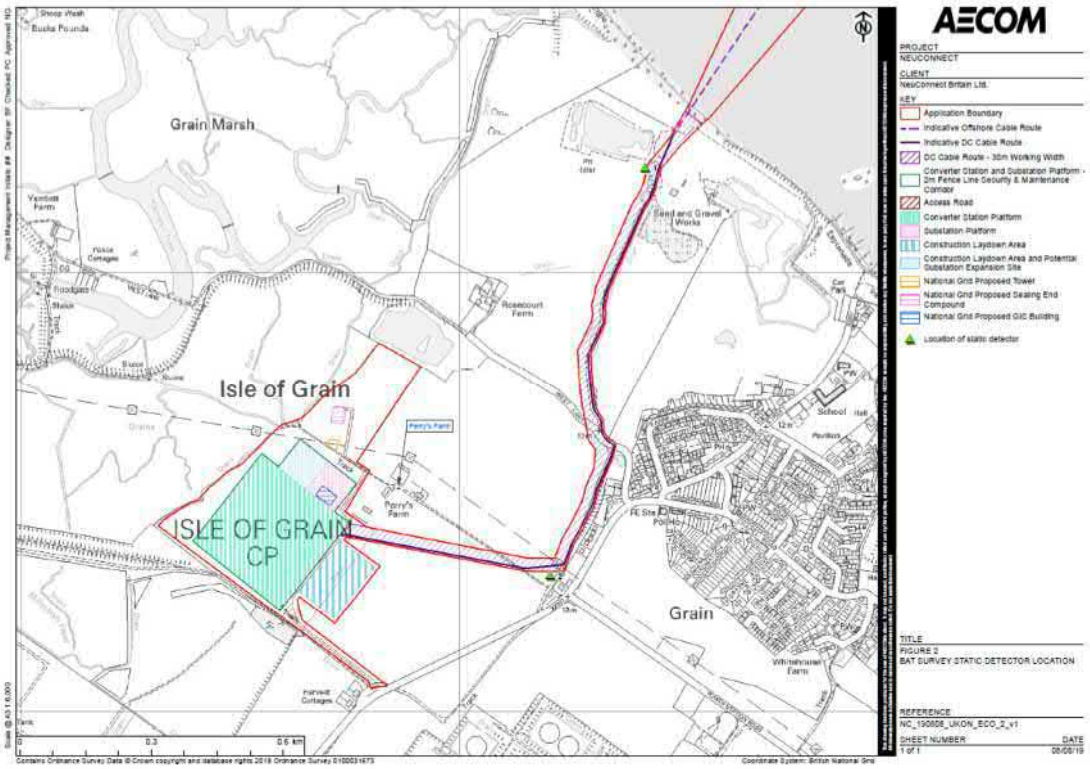

Figure 4 - Location of each static within the survey area

Appendix B: Valuing Bat Foraging Habitats

Tables and valuation method for bat roosts, foraging and commuting habitats are all taken from Wray *et al* (2010).

Categorising bats by distribution and rarity

Rarity within range	England
Rarest (population under 10,000)	Greater Horseshoe (*Rhinolophus ferrumequinum*) Bechstein's (*Myotis bechsteinii*) Alcathoe (*Myotis alcathoe*) Greater mouse-eared (*Myotis myotis*) Barbastelle (*Barbastella barbastellus*) Grey long-eared (*Plecotus austriacus*)
Rarer (population 10,000 – 100,000)	Lesser horseshoe (*Rhinolophus hipposideros*) Whiskered (*Myotis mystacinus*) Brandt's (*Myotis brandtii*) Daubenton's (*Myotis daubentonii*) Natterer's (*Myotis nattereri*) Leisler's (*Nyctalus leisleri*) Noctule (*Nyctalus noctula*) Nathusius' Pipistrelle (*Pipistrellus nathusii*) Serotine (*Eptesicus serotinus*)
Common (population over 100,000)	Common pipistrelle (*Pipistrellus pipistrellus*) Soprano pipistrelle (*Pipistrellus pygmaeus*) Brown long-eared (*Plecotus auritus*)

When valuing commuting and foraging routes (see the following tables), the rarity of the bat species involved, the approximate numbers of bats using them (based on survey data), the proximity of known roosts, and the nature and complexity of linear features in the landscape are all taken into account to put the bat activity recorded into context. One 'score' is taken from each column, depending on the 'best fit' for the situation and they are added together in order to arrive at a total score.

Valuing commuting routes

Species	Number of bats[1]	Roosts/potential roosts nearby	Type and complexity of linear features
Common (2)	Individual bats (5)	None (1)	Absence of (other) linear features (1)
		Small number (3)	Unvegetated fences/walls and large field sizes (2)
Rarer (5)	Small number of bats (10)	Moderate number/Not known (4)	Walls, gappy or flailed hedgerows, isolated well grown hedgerows, and moderate field sizes (3)
		Large number of roosts, or close to a nationally important/protected site for the species (5)	Well-grown and well-connected hedgerows/tree lines, small field sizes (4)

Species	Number of bats[1]	Roosts/potential roosts nearby	Type and complexity of linear features
Rarest (20)	Large number of bats (20)	Close to or within an internationally important/ protected site for the species(20)	Complex network of mature well-established hedgerows, tree line, small fields and rivers/streams (5)

Individual bats 1 or 2, Small numbers 3 to 10, Large numbers>10 bats

Valuing foraging areas

Species	Number of bats	Roosts/potential roosts nearby	Foraging habitat characteristics
Common (2)	Individual bats (5)	None (1)	Industrial or other site without established vegetation (1)
		Small number (3)	Suburban areas or intensive arable land (2)
Rarer (5)	Small number of bats (10)	Moderate number/Not known (4)	Isolated woodland patches, less intensive arable and/or small towns and villages (3)
		Large number of roosts, or close to a nationally important site for the species (5)	Larger or connected woodland blocks, mixed agriculture, and small villages/hamlets (4)
Rarest (20)	Large number of bats (20)	Close to or within a SAC for the species (20)	Mosaic of pasture, woodlands and wetland areas (5)

Scoring system for valuing commuting and foraging bats

Geographic frame of reference	Score
International	>50
National	41-50
Regional	31-40
County	21-30
District, local or parish	11-20
Not important	1-10

Appendix C: Potential roost feature

Photo 1: Old run down barn, south of Perry's Farm (TN13 on Figure 2)