



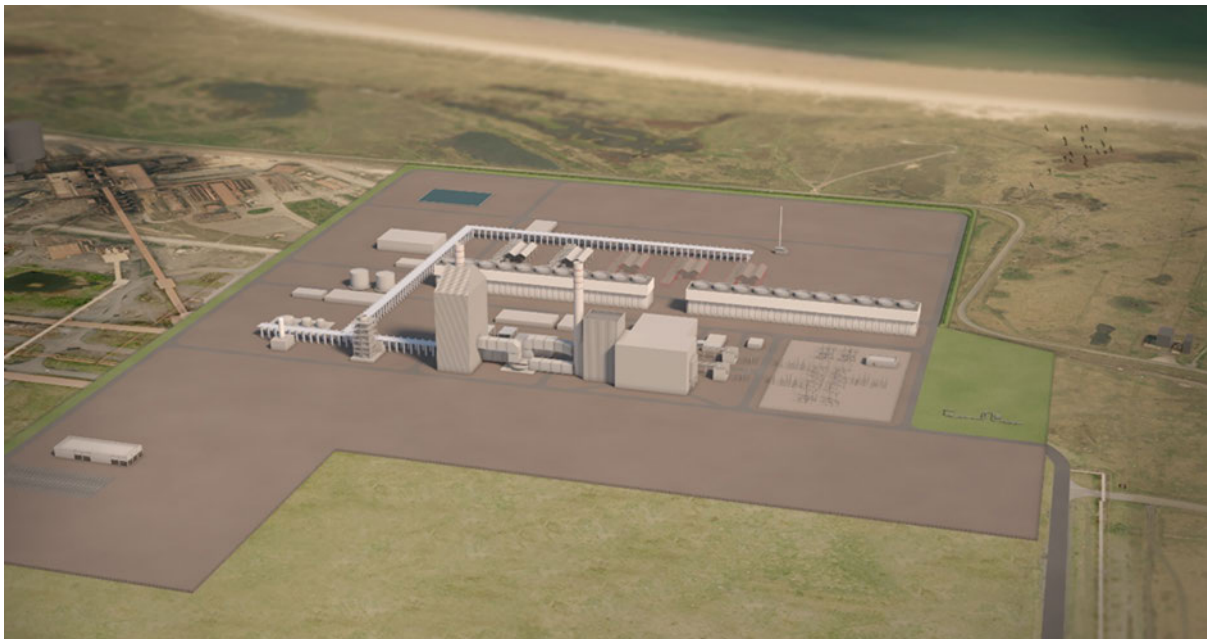
Net Zero Teesside – Environmental Statement

Planning Inspectorate Reference: EN010103

Volume III – Appendices

Appendix 12F: Terrestrial Invertebrate Survey Report

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended)



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Terrestrial Invertebrate Survey, Land within Redcar
Steelworks, Teesside

AECOM Ltd

November 2018

Notice

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Table of contents

Chapter	pages
Executive Summary	i
1 Introduction	1
1.1 Background	1
1.2 Study Site	1
1.3 Survey Limitations	4
2 Legislation	5
2.1 Legislation	5
2.2 Policy	5
3 Methodology	6
3.1 Desk Study	6
3.2 Field Survey	6
3.3 Evaluation Methodologies	6
3.4 Personnel	8
4 Results and Interpretation	9
4.1 Desk Study	9
4.2 Field Survey	10
4.3 Invertebrate Assemblage Analysis	13
5 Nature Conservation Evaluation	15
5.1 Habitat Assemblages	15
6 Recommendations	18
6.1 Further Survey	18
6.2 Mitigation Hierarchy	18
7 References	19

Tables

Table 1: Breakdown and description of land parcels within the former Redcar Steelworks (2018).	2
Table 2: Location of static traps.	6
Table 3: Invertebrate taxa recorded within 1 km buffer of the study site as supplied by ERIC to AECOM (2018).	9
Table 4: Weather conditions for survey visits and description of survey activity	10
Table 5: Taxonomic diversity recorded within study site. Red numbers in parentheses equate to species with a formal NCS. Excludes species no longer considered to meet NCS criteria(see text for explanation).	11
Table 6: Species recorded with an NCS.	11
Table 7: Distribution of NCS species within study site by land parcel.	16
Table 8: Invertebrate assemblage assessment for the former Redcar Steelworks.	17

Appendix

- | | | |
|----|---|---|
| A. | Appendix A: Locations of pitfall traps and areas surveyed during 2018 | A |
| B. | Appendix B: Site Photographs | C |
| C. | Appendix C: Terrestrial Invertebrate Species List (2018) | E |
| D. | Appendix D: Stenotopic Species Recorded within the study site in 2018 | P |

Executive Summary

- AECOM Ltd commissioned Richard Wilson Ecology Limited to undertake a terrestrial invertebrate survey on land within the former Redcar Steelworks, Teesside (vice-county 62: North-East Yorkshire).
- The study site is located within the former Redcar Steelworks, located close to Middlesbrough and Redcar at the mouth of the River Tees, within an industrial landscape juxtaposed with coastal habitats including nationally important sand dune and saltmarsh communities, known to include important invertebrate assemblages.
- The study site for the purposes of the terrestrial invertebrate survey has been divided in to eight land parcels, in two separate areas, referred to as the Teardrop and SSI. The dominant habitats present are grassland swards of differing structure and floristic diversity which have developed on compacted made ground, with some scattered scrub and wetland vegetation associated with shallow waterbodies.
- This report presents the results of a four-visit terrestrial invertebrate survey completed between early May and mid-July 2018, and evaluates the assemblages. It makes no reference to detailed mitigation which is outside the scope of this report, but provides some initial generic recommendations.
- A wide range of taxa were collected, resulting in 318 species being identified. Twelve species of invertebrate, representing approximately 4% of the assemblage, are considered to warrant a nature conservation status (NCS).
- A total of 24 species (approximately 8% of the species recorded) are reliant on the vegetation communities present to complete their lifecycle; three having an NCS. Most are associated with the open habitat biotopes, principally the rich flower resource within the open short swards and bare ground mosaics.
- The invertebrate assemblage has been evaluated as being of **County Nature Conservation Value**, taking in to account the study site's context with the adjacent coastal sand dunes and the constraints imposed by the prolonged dry weather experienced from June 2018 onwards that is considered potentially to have diminished invertebrate behaviour and populations.
- Further surveys are recommended if the development extends north, above ground, in to the statutorily protected sand dunes, which should then include the land parcels surveyed in 2018 to enable contemporary comparisons. No further surveys are considered necessary within the study site on the assumption that the proposed above ground development proceeds. The results presented in this report are considered valid for a period of three years (i.e. up to and including the 2021 survey season).
- Existing connectivity with the adjacent coastal sand dunes should be maintained through appropriate soft landscaping. Where bramble is creeping through the grass swards, there is an opportunity to enhance these habitats through careful pruning or strimming back of these invading stems and smaller clumps to preserve the important open habitat biotopes. However, bramble scrub is also providing important shelter in otherwise exposed environments, and an important nectar resource. More extensive stands should be retained.
- Areas disturbed during the construction process but forming part of the soft landscaping during the operational phase should ideally be left to colonise naturally, or seeded with a low density appropriate seed mix in consultation with Natural England to ensure no damaging contamination to the natural vegetation communities in the adjacent sand dunes.

1 Introduction

1.1 Background

OCGI Investments plan to redevelop part of the now disused Sahaviriya Steel Industries (SSI) Steel Works Site north of Redcar, Cleveland, an area of land adjacent to the SSI referred to as “Teardrop” and further areas of associated land for use as a clean gas power station with connections through the surrounding areas proposed for electrical, gas and CO₂ overhead lines and pipelines (referred to as Electricity, Gas and CO₂ connection corridors respectively). A Preliminary Ecological Appraisal (PEA) has been undertaken by AECOM (2018), which has described the habitats and potential for protected species within the SSI site and wider development area. Further to this a series of species / taxon-specific baseline ecology studies have also been undertaken where suitable habitats exist that could be impacted by the proposed development.

Richard Wilson Ecology Limited was commissioned in mid-April 2018 by AECOM Limited (hereafter referred to as ‘AECOM’) to undertake a terrestrial invertebrate survey on eight land parcels or “plots” (described in Table 1) within the SSI and Teardrop areas. For the purposes of the terrestrial invertebrate surveys and this report, the eight plots are collectively referred to as ‘the study site’ and this includes the SSI site on which the clean gas power station is proposed plus part of the electricity connection directly connected to the Teardrop. The connection corridors are indicative at this stage and only the CO₂ export corridor, which would connect to infrastructure offshore, intersects potentially valuable invertebrate habitat within the dune systems to the north of the SSI and Teardrop areas. However this would be constructed via tunnelling northwards beneath the sand dunes, thereby eliminating the potential for impacts on this habitat. The above ground development’s footprint therefore is not expected to affect any notable invertebrate habitats outside of the SSI and Teardrop areas and the invertebrate surveys have accordingly been focused exclusively in these areas.

The baseline data presented herein will inform a planning application for the proposed development.

1.1.1 Previous Invertebrate Surveys

To the best of Richard Wilson Ecology Limited’s understanding, no previous invertebrate surveys have been undertaken within the land parcels, or within the wider steelworks site. However, the adjacent sand dunes, outwith the steelworks, which form part of a network of designated sites, and other undesignated land parcels on the north bank of Teesmouth within c. 2 km of the steelworks have been surveyed by Andy Godfrey (2015) (see Section 3.4). Reference to his report has been made as appropriate when considering the results of this study.

1.2 Study Site

The study site (¹c. 62.1 ha) is located on the eastern side of the former Redcar Steelworks (NZ 572 248), a large industrial complex on the south bank of the River Tees (Teesmouth), approximately 3 km west of Redcar and 8.8 km north-east of Middlesbrough city centre (Town Hall), on the north-east coast of North Yorkshire (vice-county 62: North-east Yorkshire). The study site’s vegetation has been mapped with target notes as part of the PEA by AECOM (2018). Based on this, with supplementary information conveyed from site photographs, Table 1 provides a description of the various land parcels surveyed in the study site during 2018, and a summary of the habitats present, with particular plants recorded by AECOM mentioned for their nectar resources. These land parcels are illustrated in Appendix A, with examples of site photographs in Appendix B.

¹ Areas are approximate and have not excluded structures, roads or tracks that fall within or pass over (e.g. conveyor belts) each land parcel. Therefore, the areas are likely to differ from those conveyed in the PEA, or other reports associated with the wider environmental studies.

Table 1: Breakdown and description of land parcels within the former Redcar Steelworks (2018).

Land Parcel	National Grid Reference (centroid)	Description
Teardrop (Plot 1) (c. 8 ha)	NZ 5732 2437	An area of abandoned hard standing that has developed a 50:50 ratio of short vegetation with bare ground; and rough grassland / tall ruderal mosaics. A variety of flowering species including common mouse-ear-hawkweed (<i>Pilosella officinarum</i>), common bird's-foot-trefoil (<i>Lotus corniculatus</i>), and wild carrot (<i>Daucus carota</i>). Some scattered hawthorn (<i>Crataegus monogyna</i>) and sea buckthorn (<i>Hippophae rhamnoides</i>) scrub present. Corresponds to Target Note 7 of the PEA.
Teardrop (Plot 2) (c. 16.2 ha)	NZ 5737 2477	Structurally diverse grassland and scrub mosaics with bramble (<i>Rubus fruticosus</i> agg.) invading the sward. Shorter vegetation comprises biting stonecrop (<i>Sedum acre</i>) that has developed in to taller grasslands in places. A wide range of flowering species including viper's bugloss (<i>Echium vulgare</i>), common bird's-foot trefoil, weld (<i>Reseda lutea</i>) and common knapweed (<i>Centaurea nigra</i>) occur in the more open habitats; and for example, hogweed (<i>Heracleum sphondylium</i>) and wild carrot in taller swards. Scattered hawthorn scrub and dog rose (<i>Rosa canina</i> agg.) is also present on substantial earthworks related to previous steelworks processes that have remained undisturbed for some time. Corresponds to Target Note 8 of the PEA.
Teardrop (Plot 3) (c. 3.8 ha)	NZ 5743 2510	Similar habitat as described for Teardrop (Plot 2) but lacking scrub; not target noted by AECOM (2018).
² SSI (Plot 1) (c. 7.3 ha)	NZ 5673 2516	Area of rough grassland, approximately 30 % grass; 70 % forbs. Considered likely to have been sown in the past. Diverse range of flowering species including kidney vetch (<i>Anthyllis vulneraria</i>). Corresponds to Target Note 4 of the PEA.
SSI (Plot 2) (c. 10.1 ha)	NZ 5708 2501	Diverse flora within a sown grassland, on stony soil substrate but with a taller sward compared to SSI (Plot 1). Wide range of nectar resources including yarrow (<i>Achillea millefolium</i>), kidney-vetch, common knapweed, greater knapweed (<i>Centaurea scabiosa</i>), rough hawk's-beard (<i>Crepis biennis</i>), wild carrot and ox-eye daisy (<i>Leucanthemum vulgare</i>). Corresponds to Target Note 5 of the PEA.
SSI (Plot 3) (c. 5.8 ha)	NZ 5713 2527	Area of rough grassland, likely seeded at some point, with patches of stony bare earth, and short perennial vegetation with mounds of rubble, some of which have become vegetated themselves. Corresponds to Target Note 1 of the PEA.
SSI (Plot 4) (c. 2.3 ha)	NZ 5706 2448	Area created for wildlife. Includes a small waterbody whose surface area is dominated by emergent plants such as sea clubrush (<i>Bolboschoenus maritimus</i>), common reed (<i>Phragmites australis</i>), bulrush (<i>Typha latifolia</i>) and yellow iris (<i>Iris pseudacorus</i>). Terrestrial habitat surrounding the pond includes scattered scrub and bramble (<i>Rubus fruticosus</i> agg.), with a herb-rich grassland that includes purple loose-

² SSI is an abbreviation of Sahaviriya Steel Industries, the Thai multi-national steel-making company that previously owned the steelworks at Redcar. This should not be confused with an identical abbreviation for biological non-statutory sites (Site of Scientific Interest) which is used by some Councils.

Land Parcel	National Grid Reference (centroid)	Description
		strife (<i>Lythrum salicaria</i>), cowslip (<i>Primula veris</i>), primrose (<i>Primula vulgaris</i>), red campion (<i>Silene dioica</i>), nettle (<i>Urtica dioica</i>), wild marjoram (<i>Origanum vulgare</i>), meadowsweet (<i>Filipendula ulmaria</i>), ox-eye daisy (<i>Leucanthemum vulgare</i>) and cuckoo flower (<i>Cardamine pratensis</i>).
Connection Section (c. 8.1 ha)	NZ 5704 2415	Continuation of habitats described in Teardrop (Plot 1). Surveys undertaken in 2018 combined data with Teardrop (Plot 1)

The study site is situated within the ³Tees Lowlands National Character Area (NCA) which forms a generally flat, low lying landscape associated with the River Tees. The land use associated with the immediate River Tees corridor, including the estuary at Teesmouth, is characterised by an industrial landscape that is juxtaposed with coastal habitats, including internationally important sand dunes, saltmarshes and intertidal mudflats. Within these industrial complexes are land parcels that have developed an early successional open habitat biotope (e.g. grasslands and shorter vegetation) and scattered scrub that are recognised as being of high biodiversity value (Natural England, 2014). Unfortunately, the Tees Lowlands NCA provides no information on the extent of Open Mosaic Habitat on Previously Developed Land (OMH) within the region, despite this being a Habitat of Principal Importance (HoPI); and there would appear to be no readily available alternative reference sources (e.g. Buglife) that can provide even an approximation. Potential analogous habitats based on physical attributes are the coastal sand dunes and grasslands, including dune slacks, which collectively fall under the Coastal Sand Dunes Biodiversity Action Plan (Maddock, 2008). The NCA states there are 332 ha of coastal sand dunes, though this will include the embryonic and mobile zone on the seaward side, through to fixed dune grasslands on the landward side. However, a recent survey of the Teesside Sand Dunes to inform the statutory site review states that the total resource in the NCA is c. 180 ha (Natural England, 2018).

The sand dune systems to the north of the study site, abutting the steelworks themselves, but separated from the study site boundary (by between c. 225 m and c. 360 m) were formally designated as part of the South Gare and Coatham Sands Site of Special Scientific Interest (SSSI) for their considerable flora, invertebrate and bird interest. Since July 2018, this SSSI, in combination with others associated with the Tees have been ⁴proposed to be consolidated in to a single entity, referred to as the Teesmouth and Cleveland Coast SSSI. Based on the South Gare and Coatham Sands SSSI citation, these sand dunes are known to support important invertebrate assemblages associated with sand dunes, including the ground beetle *Brosicus cephalotes*, and the Nationally Rare and Vulnerable money-spider, *Silometopus incurvatus*.

Whilst semi-natural habitats considered to be of high nature conservation value, such as those within internationally or nationally designated sites, account for less than 4 % of the NCA's total area (Natural England, 2014), these are all located within the coastal edge associated with Teesmouth, where the study site is located. The habitats within the study site have some similarities with the sand dunes; particularly the fixed dune zone on the landward side as described by Natural England (2018). Whilst there are also differences, such as the NVC communities, both locations support a floristically diverse open habitat biotope with nectar resources that potentially complement each other, free-draining substrates and bare ground resource. This may be reflected in the invertebrate assemblages (and species composition) present.

³ Available on-line here: <http://publications.naturalengland.org.uk/publication/9860030?category=587130>; last accessed on the 10th October 2018.

⁴ The consultation process runs until 30th November 2018 (see <https://consult.defra.gov.uk/natural-england-marine/teesmouth-and-cleveland-coast-potential-sp/> for details and links to relevant documents, including maps. Website last accessed on the 10th October 2018. For the purposes of this report, it is assumed that the Teesmouth and Cleveland SSSI will be formally designated; and that the SSSI compartments (known as Units) adjacent to Redcar Steelworks reflect the description contained in South Gare and Coatham Sands SSSI's citation.

1.3 Survey Limitations

Field work extended from early May until mid-July 2018, which came on the back of an unsettled late winter and early spring. Spring temperatures in the north-east of England (as defined by the Meteorological Office) were slightly above the long term average, but rainfall was above average, resulting in a generally wet spring that was delayed following an extended winter season. Weather conditions settled from after May and the summer was warmer, sunnier and considerably drier when compared to the long-term average (⁵Meteorological Office 2018 weather summaries website). Anecdotal evidence available at the time of writing, and following discussions with other entomologists, would suggest that the late onset of spring is perceived to have delayed emergence of many of our spring fauna; but the subsequent more settled and warmer weather during the summer is considered to have resulted in the appearance of both spring and summer faunas in a narrower timeframe than typically occurs. The exceptionally dry summer is also considered to have resulted in many species passing through the adult stage of their lifecycle more rapidly, i.e. population peaks were more 'pointed' as opposed to 'plateaus', and faunas rapidly died off, or became less active and harder to record. The impression formed is that surveys from late June / early July onwards experienced lower diversity than otherwise may have been anticipated. The use of pitfall traps may have mitigated the effects of this unusual seasonal phenology but only for ground-dwelling faunas. Flying insects were largely sampled through active techniques (e.g. sweeping) and therefore only the assemblages present on each visit were recorded.

A requirement of the contract was to have a site operative escort the entomologist for safety purposes during the surveys. On the first visit (early May 2018), the operative was under the misunderstanding that the visit was going to last a couple of hours, as opposed to a whole day. This resulted in the site visit being curtailed by approximately four hours; and it is considered likely that spring faunas may have been under-recorded, particularly Diptera (flies) and Hymenoptera (e.g. bees and wasps).

The implications of these constraints are discussed in this report. No other constraints were imposed or encountered.

⁵ Monthly and seasonal summaries taken from the Met Office website: <https://www.metoffice.gov.uk/climate/uk/summaries/2018>; last accessed on the 7th September 2018.

2 Legislation

2.1 Legislation

Sixteen species of invertebrate present in the UK are protected through international law; largely arising from the European Union's Habitats Directive and transposed into domestic legislation by the Conservation of Habitats and Species Regulations 2017.

Approximately 50 species of invertebrate are included in Schedule 5 of the Wildlife and Countryside Act 1981 (as amended).

Section 40 of the Natural Environment and Rural Communities Act 2006 requires all local authorities to consider biodiversity when undertaking their public duty. In achieving this, the Government has published a list of Species of Principal Importance (SoPI), which includes invertebrates.

A full list of all species covered by legislation and policy is available via the Buglife ⁶website.

2.2 Policy

Tees Valley Nature Partnership has published a regional list of locally important ⁷species, of which there are 11 invertebrate species (excluding moths) comprising two bees, six butterflies, two spiders, and one wasp (though it is considered this has been listed erroneously as the species, *Cerceris quinquefasciata* has no known populations in north-east England; and it is not considered further in this report). A list of 41 moth species is also included, though only seven are considered to be genuinely scarce (the forester *Adscita statices*, crescent striped *Apamea oblonga*, fen wainscot *Arenostola phragmitidis*, lyme grass *Longalatedes elymi*, Blomer's rivulet *Venusia blomeri*, shore wainscot *Mythimna litoralis*, and large red-belted clearwing *Synanthedon culiciformis*). The remainder are included as species for research purposes only, to allow funding, if available, to be applied for.

Of these 17 genuine scarce species, large garden bumblebee (*Bombus ruderatus*); four butterflies (small heath *Coenonympha pamphilus*, dingy skipper *Erynnis tages*, grayling *Hipparchia semele* and wall *Lasiommata megera*, a spider (*Silometopus incurvatus*) and one moth (the forester) are considered to be potentially present within the study site based on the habitats described by AECOM (2018). The crescent striped, lyme grass and shore wainscot are potentially present in the sand dunes adjacent to the study site.

The National Pollinator Strategy is also potentially relevant and emphasises:

Government policy on planning. The National Planning Policy Framework (2012) requires planning authorities to promote the preservation, restoration and re-creation of priority habitats, ecological networks and the protection and recovery of priority species populations. It prescribes that local plans should have a clear strategy for enhancing the natural, built and historic environment and supporting wider biodiversity networks, including planning at a landscape scale across local authority boundaries and supporting Nature Improvement Areas (Defra, 2014; Section 5).

⁶ See https://www.buglife.org.uk/sites/default/files/Policy%20and%20legislation%20summary%20final%202014_0.pdf; last accessed on the 31st October 2016.

⁷ Available on-line here: <https://teesvalleynaturepartnership.org.uk/wp-content/uploads/2018/09/TV-Local-Biodiversity-species-list.pdf>; last accessed on the 10th October 2018.

3 Methodology

3.1 Desk Study

AECOM forwarded species data covering the study site plus a radius of 1km dating back to 2008, received from the Environmental Records Information Centre – North East (ERIC). The data have been interrogated to place the 2018 survey results in context. Further consultation with ERIC has been undertaken to establish if they have reports relating to previous invertebrate surveys associated with the study site or similar brownfield sites within 1 km.

A series of invertebrate surveys undertaken on various sites around Teesside, commissioned by Natural England, and reported by Godfrey (2015) has been reviewed. Furthermore, an attempt has been made to obtain a report on Buglife's work on the ⁸Teesside Stepping Stones project, which is a collaboration between industry. Reference has also been made to Buglife's ⁹Important Invertebrate Areas map.

3.2 Field Survey

The purpose of the work is to undertake an appraisal of the study site's nature conservation value for terrestrial invertebrates and this report is therefore not intended to provide an exhaustive list of invertebrate taxa present. In achieving this, the surveys followed the methodologies described in Drake *et al.* (2007) using a variety of techniques to record and collate specimens, including sweeping vegetation, aerial netting for flying invertebrates using a light-weight butterfly net, as well as a more heavy duty sweep-net to collect invertebrates within the field layer. This was supplemented by vacuum sampling using a commercially available modified garden blow-vac.

Survey effort was not strictly uniform in each land parcel as the primary purpose was to assess the study site as a whole; but invertebrates were collected by various means in each land parcel on each visit. Note that the connection section and Teardrop (Plot 1) were surveyed as a single unit. A species list for each land parcel is provided in Appendix C. Two sets of pitfall traps were set within open habitat biotopes. Each pitfall trap consisted of a plastic drinking cup half-filled with c. 50 % monopropylene glycol as a preservative and these were serviced on each visit. Details on their precise location and habitats are provided in Table 2. The location of static traps is provided in the table below.

Table 2: Location of static traps.

Trap	Location (centroid)	Habitat
Pitfall traps (x10)	NZ 5716 2448	Teardrop (Plot 1). Flat post-industrial habitat dominated by short grassland, bare ground, occasional ruderal and woody scrub, etc.
Pitfall traps (x10)	NZ 5659 2552	SSI (Plot 1) Power Station Pond. Permanent pond with bankside vegetation including mature willows, reeds and sedges.

Specimens collected were either identified in the field or retained for subsequent microscopic identification. Surveys paid particular attention to those groups most likely to include species of nature conservation interest, typically Diptera (flies), aculeate Hymenoptera (bees, wasps and ants), Araneae (spiders), Coleoptera (beetles) and Hemiptera (bugs). However, a wide range of invertebrate orders were recorded.

3.3 Evaluation Methodologies

There is currently no standard frame of reference to evaluate the nature conservation value of invertebrate assemblages for the purposes of Ecological Impact Assessment (EclA). The various

⁸ See <https://www.buglife.org.uk/campaigns-and-our-work/habitat-projects/teesside-stepping-stones>

⁹ See <https://www.buglife.org.uk/important-invertebrate-areas-0>

methods available have been designed for specific purposes such as condition monitoring on statutory sites (Drake *et al.*, 2007); or assigning a measure of 'rarity' based on formal NCS' such as Red Data Book (RDB) or Nationally Scarce etc. (Colin Plant Associates (CPA), undated). Reliance is also placed on professional judgement of the surveyor and associates. Each methodology has its advantages and disadvantages, so for the purposes of this study, more than one approach is used to draw a conclusion, which also incorporates professional judgement. A summary of evaluation methods applied is provided below.

Since April 2017, the Invertebrate Species-habitat Information System (ISIS) developed by Derek Lott and referenced in Drake *et al.*, (2007) has been updated and advanced by Pantheon (Webb *et al.*, 2018). Pantheon is a database tool developed by Natural England and the Centre for Ecology & Hydrology to analyse invertebrate sample data. It incorporates ISIS but takes the analysis further by attaching associated habitats and resources, habitat fidelity scores and other ecological information against each species. This is based on approximately 11,000 invertebrate species out of an estimated 37,000 species known from the UK. The taxa primarily used for this analysis are Coleoptera, Diptera, Hemiptera, Lepidoptera, aculeate Hymenoptera and Araneae; hence the focus on these groups for survey. As for the original ISIS, some caution has to be applied as strictly speaking, survey effort would normally require standardisation such as timed sweeps. Nevertheless, Pantheon can at least inform which invertebrate assemblages recorded are of particular importance within a site, such as those associated with wood decay, floristically rich habitats or both. A positive aspect of this approach is that attention is given to assemblages rather than solely relying on the national status of individual species, though the latter can also be indicative, especially as a proportion of the total species recorded.

Pantheon interrogates the composition of the terrestrial invertebrate assemblage in terms of biotopes, habitats, and the distribution of stenotopic species i.e. those terrestrial invertebrates with very specific and restricted habitat requirements and have an intrinsic nature conservation value; referred to as Species Assemblage Types (SAT) (Webb *et al.*, 2018). The limitations of Pantheon as a tool have been considered, and professional judgement has been applied where necessary to assist robust valuation. Pantheon can identify only whether a site is in favourable or unfavourable condition expected for SSSIs, and condition is not strictly analogous with value. However, if favourable condition is concluded then this can, taking into account other factors, provide evidence that objectives for sites of national value (SSSIs) are being met and this seems a reasonable proxy in this instance for national value. However, use of unfavourable condition is more problematic and requires a degree of caution and application of professional judgement to determine the appropriate geographic scale of nature conservation value. In addition, as the survey did not strictly comply with methods described in Drake *et al.* (2007), such as timed sweeps, a degree of caution and professional judgement is likewise necessary to accommodate for any bias (detracting or enhancing) within the analysis that might introduce subjectivity into the evaluation. Species active later in the season (i.e. from June to August / September onwards) and which have not been recorded would have also been unavailable to contribute to the analysis.

In an attempt to inject some objectivity into the use of Pantheon SATs to inform evaluation of nature conservation value and to counteract some of the caveats given above, the threshold limits for each of the SATs has been noted with the intention of providing a reasonable judgement. This can be made in terms of the Proportion to Threshold (PtT) achieved for each SAT identified. The threshold referred to is the number of species within a SAT expected to be present if a site is considered to be in favourable condition (FC). Thus, if a SAT records or exceeds the expected threshold, the PtT will be 100 % or greater and this is taken as the basis for considering assigning national value. In the absence of other guidance, where the PtT is < 100 %, professional judgement is used to place the nature conservation value of the invertebrate assemblage in a sub-national context (i.e. regional, county, district, local, or within site). The further away from the threshold, the lower the nature conservation value the SAT is in geographical terms. Other factors taken into account when determining the value include species diversity, proportion of NCS species in the assemblage, proportion of county rarities or significant records (where known), and site context within the landscape (i.e. availability and connectivity to similar semi-natural habitat, whether statutorily protected or not). Thus, whilst Pantheon remains a useful guide when assessing the nature conservation value for each of the land parcels for terrestrial invertebrates, professional judgement incorporating other evidence is necessary to come to a defensible evaluation.

The CPA (undated) approach, which has been used by consultants in the past is no longer considered valid and has not been applied in this report. This is based on the greater suitability of Pantheon, and the limitations inherent to the CPA approach. The latter relies on the number of species recorded

within the defined study area that have a formal nature conservation status, whilst recognising that professional judgement is also needed as the status of invertebrate species, or our understanding of this where data has been limited previously, can change over time. The method has a significant disadvantage in that it does not take into account survey effort. For example, a long-term survey in a typical lowland garden in south-east England has yielded sufficient rare species for it to be considered nationally important, yet the location itself is no different from other un-surveyed gardens within the vicinity. Common sense would therefore suggest that the value applied to such a garden would not be correct or defensible.

3.4 Personnel

The invertebrate survey (field visits) was undertaken by Andy Godfrey MCIEEM FRES. Andy is an experienced entomologist, widely recognised as a technical specialist in Diptera and aculeate Hymenoptera; but covers other frequently encountered taxa. Assisting Andy, beetles were identified by Mike Denton; and spiders by Richard Wilson CEnv MCIEEM (a ¹⁰ recognised arachnid specialist but who is also familiar with a wider range of invertebrate taxonomic groups).

¹⁰ Richard is the Yorkshire Naturalists Union's spider recorder; the Yorkshire, County Durham and Northumberland recorder for the national spider recording scheme; and sits on the conservation committee of the British Arachnological Society.

4 Results and Interpretation

4.1 Desk Study

The data set supplied by ERIC includes 80 species of terrestrial invertebrate that have an NCS and recorded within one kilometre of the former steelworks. However, of the 44 moth species included in ERIC's dataset, based on Pantheon (Webb *et al.*, 2018): 35 species are 'Research Only'; six are no longer considered to merit an NCS; and one has not been formally assessed. Of the two remaining species records (both micro-moths in the family Gelechiidae), one is considered by Pantheon to be out of date and no longer reliable. Thus, only one species is considered to be genuinely rare (*Monochroa tetragonella*). This species mines sea-milkwort (*Glaux maritima*) and it is assumed to be absent within the study site as the plant was not recorded when completing the study site's PEA (AECOM, 2018).

Two species of beetle, the variegated ladybird (*Hippodamia variegata*) and the weevil *Gymnetron villosulum*, are no longer considered to be genuinely Nationally Scarce (Webb *et al.*, 2018) and these, along with all bar the aforementioned gelechiid moth are excluded from the 80 species conveyed by ERIC. The taxonomic breakdown is provided in Table 3.

Table 3: Invertebrate taxa recorded within 1 km buffer of the study site as supplied by ERIC to AECOM (2018).

Taxonomic Group	Number of Species (ERIC dataset)
Coleoptera (beetles)	9 species
Diptera (flies)	17 species
Hymenoptera (bees, wasps, ants etc.)	2 species
Lepidoptera (butterflies)	4 species
Lepidoptera (moths)	1 species
Molluscs (snails and slugs)	1 species

Of the 34 species considered to be genuine NCS species, using Pantheon has identified those having potential to be present within the study site, based on their association with short sward and bare ground habitat. These are all Diptera: *Tetanops myopinus* (Ulidiidae), *Eutropha fulvifrons* (Chloropidae), *Colliniella meijerei* (Ephydriidae), and *Phthiria pulicaria* (Bombyliidae).

Further consultation with ERIC in October 2018 as part of this study established that they hold no additional relevant invertebrate data.

Godfrey (2015) surveyed eight areas associated with the Teesside National Nature Reserve to provide a review of protected sites; and whether any of these, or undesignated sites selected, should be notified for their invertebrate interest. Whilst none of the sites studied were brownfield, the results confirmed that the sand dune and other terrestrial habitats supported noteworthy invertebrate assemblages, including 29 species (in 2015) which had a NCS. The relevance of Andy Godfrey's survey work to this study is that it confirmed that habitats, including those not within statutorily designated land parcels (at the time), supported nationally scarce or rare invertebrates, despite the industrial landscape within which they were located. By extension, this would suggest that the terrestrial habitats within the study site had the potential to support similarly important invertebrate assemblages.

Buglife were contacted to obtain, if available, a report detailing their Teesside Stepping Stone project which surveyed various brownfield sites in the region. At the time of writing, no response was received. However, their species records are held by ERIC, so any NCS species recorded by Buglife during this project have been included in Table 3.

4.2 Field Survey

4.2.1 Survey Conditions

Four site visits were completed during reasonable to optimal weather conditions for the time of year. Details are conveyed in Table 4, including activities undertaken for each visit. A complete list of all species recorded in 2018 is provided in Appendix C.

Table 4: Weather conditions for survey visits and description of survey activity

Date	Weather	Notes
7 th May 2018	Sunny warm and dry.	Site walkover to scope the various land parcels and install pitfall traps. Distinctive species were recorded in the field.
1 st June 2018	Cool with slight wind and 95 % cloud cover at the start of the survey. 10 % cloud cover by mid-afternoon.	Sweep netting on all sites and portable vacuum sampling (all sites except Power Station Pond). Emptying and recharging of the pitfall traps. Distinctive species (butterflies, bumblebees, etc.) were recorded in the field.
19 th June 2018	Cloudy with 90 % cloud cover and a slight breeze at the start of the survey. Cloud started lifting during the morning but then clouded over again.	Sweep netting on all sites and portable vacuum sampling (all sites except Power Station Pond). Emptying and recharging of the pitfall traps. Distinctive species (butterflies, bumblebees, etc.) were recorded in the field.
16 th July 2018	Dry with 90 % cloud cover at the start of the survey, becoming 100 % with spells of drizzle and rain. Vegetation was extremely dry due to long hot spell of weather.	Sweep netting on all sites and portable vacuum sampling (all sites except Power Station Pond). Emptying and recharging of the pitfall traps. Distinctive species (butterflies, bumblebees, etc.) were recorded in the field.

Survey work focussed on the open habitats within representative habitats in land parcels Teardrop 1, Teardrop 2 and SSI (Plots 1, 2, 3 & 4) located within the former steelworks.

4.2.2 Summary of Survey Results and Notable Species

A total of 318 species were recorded within the study site between mid-May and late July 2018. Table 5 summarises the distribution of the main taxonomic groups identified with a breakdown of those species considered to have a nature conservation status (NCS) recorded within the study site during 2018. The NCS assigned to each species has been taken from Webb *et al.* (2018), but cross-referencing with the various Species Status Reviews (SSR) co-ordinated by the Joint Nature Conservation Committee (JNCC). This is necessary as there remain errors within, and there is a time lag between, recently published SSRs and Pantheon's database. Where there has been a requirement to amend a species' NCS, this has been referenced.

Table 5: Taxonomic diversity recorded within study site. Red numbers in parentheses equate to species with a formal NCS. Excludes species no longer considered to meet NCS criteria(see text for explanation).

Taxonomic Group	Number of Species
Araneae (Spiders)	24 (0) species
Coleoptera (Beetles)	40 (0) species
Diptera (Flies)	179 (7) species
Hemiptera (bugs, including 'hoppers)	20 (0) species
Hymenoptera (Bees, wasps, ants etc.)	20 (2) species
Lepidoptera (Butterflies & moths)	17 (3) species
Other Groups	18 (0) species

Twelve species are considered to warrant an NCS based on their known restricted range (Nationally Scarce or Nationally Rare) and / or threat status (i.e. Red Data Book or List status). This has included reference to Falk *et al.* (2016), Falk and Pont (2017), and Drake (2018) to update status' as there are a number of fly species that Pantheon has not revised. Pantheon's analysis is influenced by this inaccuracy, though it is not possible to know to what extent this has occurred. The up to date NCS for each species is presented in Appendix C.

The cinnabar moth (*Tyria jacobaea*) was recorded within the study site, and is included in a list of approximately 70 species of moth as SoPI (Research Only). The species is widespread in the UK, including north-east Yorkshire, and is included in this list due to population declines.

The twelve species considered to have a formal NCS are listed in Table 6. These represent c. 4 % of the total number of species recorded within the study site.

Table 6: Species recorded with an NCS.

Species	Status	Ecology
Diptera, Anthomyiidae <i>Botanophila sonchi</i>	pNationally Scarce	A widespread species throughout England, though becoming scarcer in the north. The larvae mine the leaves of sow-thistles (<i>Sonchus</i> spp.) and records seem to be associated with calcareous grasslands; or on recently disturbed ground (Falk <i>et al.</i> , 2016). This would appear to represent the first Yorkshire record (Grayson, 2015).
Diptera, Chloropidae <i>Lasiambia palposa</i>	pNationally Scarce	A widely scattered species associated with dry grasslands on brownfield sites and coastal dunes. On the continent, larvae have been recorded as grasshopper egg-pod predators; though they have not been reared in Britain (Falk <i>et al.</i> , 2016). There are only ten sites where this species has been recorded after 1960 (<i>ibid.</i>). This represents a new vice-county record for north-east Yorkshire (VC 62) (Grayson, 2015).
Diptera, Chloropidae <i>Siphonella oscinina</i>	pNationally Scarce	Records are generally from dry heath and dry grasslands, including early successional vegetation communities from brownfield sites throughout England, with a single reported record in Scotland, and a couple in Wales (Falk, Ismay and Chandler, 2016). The supposed association with pine cones is considered erroneous by Andy Godfrey. This represents a new vice-county record for north-east Yorkshire (VC 62) (Grayson, 2015).

Species	Status	Ecology
Diptera, Chloropidae <i>Speccafrons halophila</i>	pNationally Scarce	There are scattered records in southern Britain from a range of wetlands including fens and coastal marshes. One record specifies <i>Typha</i> , although other plant assemblages may also be involved. Reared from a spider's egg cocoon from a site in Oxfordshire. There is some evidence that spiders inhabiting reedbeds may be hosts. This represents a new vice-county record for north-east Yorkshire (VC 62) (Grayson, 2015).
Diptera, Muscidae <i>Helina calceata</i>	pNationally Scarce	A widespread but sparse 'house-fly' whose ecology is poorly known. Records are associated with a range of dry and damp habitats; the larvae may develop amongst moss, or humus soils (Falk and Pont, 2017). This represents a new vice-county record for north-east Yorkshire (VC 62) (Grayson, 2015).
Diptera, Muscidae <i>Helina subvittata</i>	pNationally Scarce	A northern British species of 'house-fly' that would appear to be associated with moors and heaths above the tree-line; though there are occasional records associated with wooded habitats. This is possibly a wanderer from the North York Moors or nearest wooded habitat (Falk and Pont, 2017). This represents a new vice-county record for north-east Yorkshire (VC 62) (Grayson, 2015).
Diptera, Opomyzidae <i>Geomyza subnigra</i>	pNationally Scarce	Widely scattered throughout England, this species would appear to be associated with grass-tussocks, where the adults, as is typical of this family, are epigeic (ground-dwelling). This represents a new vice-county record for north-east Yorkshire (VC 62) (Grayson, 2015).
Hymenoptera, Crabronidae <i>Argogorytes fargeii</i>	Nationally Scarce (Na)	This is a scarce solitary wasp associated with open habitats, including coastal sand dunes, as far north as Yorkshire. The wasp stocks its nest with froghopper nymphs.
Hymenoptera, Andrenidae <i>Andrena similis</i>	Nationally Scarce (Nb)	A late spring and early summer species of solitary bee; associated with a wide range of habitats, including chalk grassland, open deciduous woodland and coastal habitats. The species is scattered in England and Wales, south of a line between the Mersey and the Humber estuaries; there is a single record from Yorkshire (Else and Edwards, 2018; p. 605).
Lepidoptera, Hesperidae <i>Erynnis tages</i> (dingy skipper [butterfly])	VU; SoPI	A species associated with short grasslands where its food plants (common bird's-foot trefoil <i>Lotus corniculatus</i> , greater bird's-foot trefoil <i>L. pedunculatus</i> or horseshoe vetch <i>Hippocrepis comosa</i>) are frequent. The species has declined significantly based on long-term trends (Fox <i>et al.</i> , 2015) and has been evaluated as Vulnerable against ¹¹ IUCN criteria.
Lepidoptera, Nymphalidae <i>Coenonympha pamphilus</i> (small heath [butterfly])	NT; SoPI	Although a widespread species in the UK, this otherwise common species has experienced a substantial decline in both abundance and occurrence (Fox <i>et al.</i> , 2015), hence its classification as Near Threatened.

¹¹ Taken from IUCN website: http://www.iucnredlist.org/static/categories_criteria_3_1; last accessed on 17th September 2018.

Species	Status	Ecology
Lepidoptera, Nymphalidae <i>Hipparchia semele</i> (grayling [butterfly])	VU; SoPI	Within Yorkshire, this is more or less a coastal species, associated with a range of open habitats. It has similarly experienced significant declines comparable to the dingy skipper.
<p>Key</p> <p>pNationally Scarce: Provisionally Nationally Scarce. Applied to lesser known and less well-recorded invertebrates in the UK where sufficient data are not available to undertake a robust assessment against IUCN criteria.</p> <p>Nationally Scarce: Taxa which are recorded in 16-100 hectads (10km squares) but not included in one of the Red List Categories. These taxa have been assessed against IUCN threat criteria.</p> <p>Nationally Scarce (Nb): Taxa which are recorded in 16-100 hectads (10km squares) but not included in one of the Red List Categories. These taxa have yet to be assessed against the IUCN threat criteria.</p> <p>Nationally Scarce (Na): Taxa which are recorded in 1-15 hectads (10km squares) but not included in one of the Red List Categories. These taxa have yet to be assessed against the IUCN threat criteria.</p> <p>Red Data Book 2 (RDB 2): Taxa that are considered to be Vulnerable and likely to be moved in to the Endangered category in the near future if causal factors continue operating. Species that are declining throughout their range; in vulnerable habitats and / or where populations are low.</p> <p>VU (Vulnerable): Taxa that have been assessed against IUCN criteria and are considered threatened.</p> <p>NT (Near Threatened): Taxa that have been assessed against IUCN criteria and which following assessment, came close to, but failed to qualify as a Threatened species. However, it is considered that if the factors influencing its assessment continue, it is likely to move in to one of the threat categories; and thus it acts as a watching brief.</p> <p>Species of Principal Importance (SoPI): Taxa listed under section 41 of the Natural Environment and Rural Communities Act 2006. Formerly UK Priority Species / UK Biodiversity Action Plan species.</p>		

Three of the Tees Valley Nature Partnership species (small heath, dingy skipper and grayling) were recorded within the study site.

4.3 Invertebrate Assemblage Analysis

The species list for the study site has been analysed using Pantheon to identify the habitat associations and dependencies of the terrestrial invertebrate assemblages present. The analysis first considers stenotopic species i.e. those terrestrial invertebrates with very specific and restricted habitat requirements. They are considered to have an intrinsic nature conservation value as stenotopic species are generally only recorded on sites that are of nature conservation value. The analysis then considers the habitat affinities of the wider assemblage.

A total of 24 stenotopic species (see Appendix D) were recorded, representing approximately 8 % of the total terrestrial invertebrate fauna identified within the study site, of which 22 species are associated with rich flower resource, open short swards with bare ground, bare sand and chalk, and scrub edge habitats (SAT codes prefixed with an 'F'). Note that two of these species (a wasp *Ectemnius continuus* and a solitary bee *Hylaeus hyalinatus*), are also co-dependent on the presence of bark and sapwood decay (prefixed with an 'A'). Both these species nest in small cavities in dead wood and forage in open habitats for prey (the wasp) or pollen (the bee). Two more stenotopic species, *Dicranomyia chorea* (a crane fly) and *Tetanocera arrogans* (a snail-killing fly) are dependent on the wetland features associated with the waterbodies present within and adjacent to the study site. *D. chorea* requires seepage zones where water trickles over a substrate for its larval stage; and *T. arrogans* requires emergent wetland vegetation with a plentiful supply of its hosts. Therefore, whilst the dry, open grasslands are the dominant habitat feature, the presence of scrub and waterbodies in relatively close proximity to each other provide a mosaic of terrestrial habitats for the invertebrate assemblages recorded.

Three of the stenotopic species associated with open habitat biotopes also have an NCS, and are variously restricted to open short swards (small heath), rich flower resources (the solitary bee *Andrena similis*), or patchy vegetation equating to bare sand and chalk (grayling). The aforementioned species, in combination with four provisionally Nationally Scarce species (the flies *Botanophila sonchi*, *Lasiambia palposa* and *Siphonella oscinina*; and the solitary wasp *Argogorytes fargeii*) further highlight the relative importance of the open short swards within the study site.

The species assemblage also suggests that there is some interest associated with the wetland vegetation present, as in addition to *D. chorea* and *T. arrogans*, the provisionally Nationally Scarce *Speccafrons halophila* and *Helina calceata* (both flies), from what is understood about their ecology, are believed to have an affinity with wetland habitats.

Allied to rarity is fidelity i.e. how restricted species are to a habitat. A total of 10 species show a ¹² moderate (3 species) or low (7 species) fidelity to calcareous grasslands (Alexander, 2003), though the importance within the study site is possibly related to the friability of the substrate (excellent for burrowing), floristic richness, and potentially higher concentrations of certain nutrients; factors which are believed to be important on naturally occurring calcareous soils (Alexander, 2003). Whilst the botanical survey has identified a predominantly neutral grassland community (with some calcareous influences), it is the abiotic factors as opposed to calcicolous flora that are important. Species that are classified as having a moderate fidelity are *Micrargus subaequalis* (a money-spider), *Silpha tristis* (a carrion beetle) and *Myrmica sabuleti* (an ant), which Alexander (2003) defines as those that are mostly recorded on such habitats across the majority of their range. One species of facultative xylophage, the crane fly *D. chorea* has been recorded. Godfrey (2003) defined a facultative xylophage as a species whose larvae are aquatic and feed on micro-organisms, probably fungi, in submerged (or wet) wood. Submerged woody detritus in the waterbodies present are probably providing the necessary conditions for this species within the study site.

In summary, approximately 8 % of the terrestrial invertebrate fauna recorded within the study site are dependent on the open habitat, wetland and tree-associated biotopes, and twelve species with an NCS (c. 92 %) are also associated with this biotope. The combination of these biotopes is essential to maintain the ecological integrity of the terrestrial invertebrate assemblages associated with them.

¹² Alexander (2003) defined moderate in this context as a species that is routinely recorded from calcareous grasslands, but also from semi-natural open habitats on freely-draining soils over all or part of their geographical area of distribution; and low as species frequently recorded in numbers from calcareous grasslands, but predominantly associated with other types of open habitats over all their British area of distribution.

5 Nature Conservation Evaluation

5.1 Habitat Assemblages

The relative value of the terrestrial invertebrate assemblages relates to both the importance and uniqueness of the habitats present, and the characteristics of the assemblage itself. Following assessment of this, as explained in more detail below, the study site is considered to support an assemblage of terrestrial invertebrates that is of county nature conservation value.

5.1.1 Landscape context

The study site sits entirely within the Lowland Tees NCA, which is dominated by urban development around the River Tees, and agricultural land to the south. There is very limited good quality semi-natural terrestrial habitat (estimated to be less than 3 % of the NCA) (Natural England, 2014; page 22). Unfortunately, there has been no survey that has evaluated OMH or other brownfield habitat within the NCA, so it is not possible to place the open habitat biotopes (swards and bare ground) in direct context. Structurally, these open habitat biotopes share some features with coastal sand dunes that abut the study site; for example, being free-draining and floristically diverse. There is some suggestive evidence that supports this comparison in that ¹³four of the fourteen species of scarce and threatened invertebrates known from Seaton Dunes SSSI, and the South Gare and Coatham Dunes SSSI (Natural England, 2018; Table 8, page 24) have been recorded within the study site. Added to this is the description of the Coatham Dunes that lie adjacent to the study site, which includes reference to them being [botanically] rich, including damp depressions (dune slacks) and varied vegetation representing examples of saltmarsh and swamp, in addition to more typical sand dune communities (Natural England, 2018; page 15). Natural England (2018) also states, “An interesting feature, perhaps expressed more strongly here than in other less modified dunes, is that the precise scale and sequence of vegetation types is the result of an interplay between anthropogenic (both historic and continuing) and ongoing natural influences. For example, in some areas tipped slag has been colonised by a sparse cover of plants, which due to the base-rich nature of the iron slag often includes a number of calcicoles such as yellow-wort *Blackstonia perfoliata* and blue fleabane *Erigeron acer* [sic]”. The Coatham sand dunes extend for approximately 129.5 ha; of which the fixed dune element, which is considered to be most similar to the open habitat biotopes in the study site, accounts for c. 80 ha.

Thus, in the absence of any published resource enabling comparison with brownfield habitats, and acknowledging that this is a broad-brush approach, the open habitat biotope within the study site, which covers an estimated area of just over 60 ha, would appear to be an uncommon habitat within the NCA. However, given the total resource (80 ha) excludes grasslands associated with brownfield sites elsewhere, caution has to be applied.

Nevertheless, some invertebrate species recorded from the adjacent coastal sand dunes would appear to utilise the open habitat biotopes within the study site. As such, the open habitat biotopes within the study site can potentially be viewed as an extension of the sand dune vegetation communities that have developed within the various land parcels studied after their operational use has ceased.

However, whilst the open habitats within the study site may provide a functional extension of the designated sand dune communities, the relatively low proportion (c. 4 %) of NCS species within the total assemblage recorded in 2018, ¹⁴even taking in to consideration the location of the study site on the north-east English coast, is less, in the author’s opinion, than what would be expected for a site approaching regional or national significance for its terrestrial invertebrate assemblages. However, the survey limitations described in Section 1.3 may have reduced the number of species recorded and consequently, any other NCS species that may actually be present may have been under-recorded. It is

¹³ The Natural England consultation report includes *Medetera truncorum* (Diptera, Dolichopodidae) as Data Deficient. However, the very recently published (October 2018) Species Status Review for the Dolichopodidae has downgraded this to Least Concern (Drake, 2018).

¹⁴ As a rule of thumb, if approximately 10 % of the fauna is identified as having an NCS, this is suggestive of a nationally important assemblage. However, this is generally biased towards southern England. A comparable threshold taking in to account distributions of invertebrates reaching central or northern England, plus climatic and other differences (e.g. effect of the Gulf Stream) would likely require thresholds to be reduced. However, even taking in to account these (unknown) reduced thresholds, the 4 % proportion recorded at the study site still falls below what might reasonably be considered as nationally important.

unknown whether this is likely to have had a disproportionate effect on the proportion of rare species occurring within the total sample, but rarer species are by definition typically harder to record. Given the lack of ecological barriers, if the habitats are comparable in value to the sand dunes, and knowing that there are NCS species in adjacent communities, it might be expected that a higher proportion of NCS species would have been recorded as was the case when Godfrey (2015) surveyed the adjacent Coatham Dunes (part of the South Gare and Coatham Sands SSSI).

5.1.2 NCS Species

Species with a NCS have been recorded in all land parcels with the exception of SSI (Plot 4) (see Table 7); none of these were recorded by pitfall trapping. Seven of the twelve NCS species have been recorded in multiple land parcels. The proportion of NCS species in each land parcel (excluding SSI (Plot 4)) when measured against total species diversity ranges between 2 % and 7.1 %; but this reveals two outliers: Teardrop (Plot 3) and SSI (Plot 2). The former is closest to the adjacent sand dunes, known to support important invertebrate assemblages, whilst the latter is in the northern half of the study site and abuts Teardrop (Plot 3). This said, SSI (Plot 3) also lies close to the sand dunes but its proportion of NCS species is similar to the other land parcels which recorded a lower proportion of NCS species. That SSI (Plot 4) recorded no NCS species in 2018 is unexpected and cannot be readily explained without further survey effort and may simply be a chance occurrence.

Table 7: Distribution of NCS species within study site by land parcel.

Species	National Status	Teardrop Plots			SSI Plots			
		1	2	3	1	2	3	4
<i>Geomyza subnigra</i>	pNationally Scarce	X		X				
<i>Lasiambia palposa</i>	pNationally Scarce			X		X		
<i>Siphonella oscinina</i>	pNationally Scarce				X			
<i>Speccafrons halophila</i>	pNationally Scarce				X			
<i>Botanophila sonchi</i>	pNationally Scarce			X	X			
<i>Helina calceata</i>	Nationally Scarce	X						
<i>Helina subvittata</i>	pNationally Scarce	X			X	X		
<i>Argogorytes fargei</i>	Nationally Scarce (Na)			X				
<i>Andrena similis</i>	Nationally Scarce (Nb)				X			
<i>Erynnis tages</i>	VU; SoPI	X	X					
<i>Coenonympha pamphilus</i>	NT; SoPI		X	X	X	X		
<i>Hipparchia semele</i>	VU; SoPI			X	X	X	X	
Number of NCS species		4	2	6	7	4	1	0
¹⁵ Overall species diversity		102	44	85	201	69	49	71
Proportion		3.9 %	4.5 %	7.1 %	3.5 %	5.8 %	2 %	0 %
Refer to Table 6 for the key								

The data presented in Table 7 suggests that invertebrates are likely to move throughout the study site between land parcels and there is suitable habitat to support populations in each. Whilst Teardrop (Plot 3) and SSI (Plot 2) are outliers when it comes to the proportion of NCS species, overall species diversity is higher in others, even when excluding the use of pitfall traps. Therefore, no one land parcel should be considered to be more important than another. This seems a reasonable evaluation given the lack of ecological barriers, and it is concluded that there is highly likely interchange between

¹⁵ Note that overall species diversity is significantly higher in Teardrop (Plot 1) and SSI (Plot 1) can partly be explained by the presence of pitfall traps in these land parcels.

land parcels of noteworthy species and assemblages. The habitat descriptions and mapping also supports this view.

5.1.3 Stenotopic Species

The relative value of the notable habitats present for terrestrial invertebrate species can be interrogated in more detail with regard to the stenotopic species recorded by the survey. As explained in Section 4, stenotopic species are dependent on quite specific and restricted habitat conditions that are rarely encountered in the wider landscape. Therefore stenotopic species are considered to have an intrinsic nature conservation value and generally only occur in association with sites of relatively high nature conservation importance.

Following review of the number of stenotopic species recorded and the thresholds published in Drake *et al.* (2007), as conveyed in Table 8, it is evident that none of the invertebrate assemblages have reached or passed the thresholds considered to represent 'favourable conservation status' (FCS). Indeed, the PtT ranges for each of the SATs have fallen short (range of between 17 % and 60 % for the open habitats biotopes SATs; and 10 % and 20 % for the others), such that the nature conservation significance of the stenotopic invertebrate assemblages recorded in the study site falls significantly short of the national threshold.

Table 8: Invertebrate assemblage assessment for the former Redcar Steelworks.

Broad biotope	Habitat	SAT	No. of species	¹⁶ FCS Threshold	Proportion to Threshold (PtT)	Species with NCS
Open habitats	Various	Rich flower resource	7	14	50 %	1
Open habitats	Various	Scrub edge	6	10	60 %	0
Open habitats	Short-sward & bare ground	Open short-sward	6	12	50 %	2
Open habitats	Short-sward & bare ground	Bare sand & chalk	3	18	17 %	1
Tree-associated	Decaying wood	Bark & sapwood decay	2	19	11 %	0
Wetland	Running water	Seepage	1	5	20 %	0
Wetland	Peatland	Reed-fen & pools	1	10	10 %	0

The weather leading up to, and experienced during the 2018 survey season is considered to have influenced the species assemblage recorded (see Section 1.3) in that the prolonged dry conditions are likely to have reduced invertebrate numbers and suppressed activity. Invertebrates, particularly flies, can be intolerant of extended periods of dry weather as they can easily suffer water loss. When compared to the known faunas associated with the adjacent sand dunes, including Coatham Sands which were surveyed by Godfrey (2015), there is a noticeable reduction in the quality of the species assemblages recorded; for example the number of NCS.

This assessment therefore has taken in to account the influence of the weather conditions, which are considered to have suppressed the assemblage recorded and potentially biased the analysis. On this basis, it therefore seems reasonable and defensible to conclude that the study site is evaluated to be of **County Nature Conservation Value** for its invertebrate assemblage.

¹⁶ The Favourable Conservation Status (FCS) threshold is the number of species recorded in an assemblage necessary to meet 'favourable' status.

6 Recommendations

6.1 Further Survey

No surveys were considered necessary within the sand dunes (Coatham Sands) during 2018 as the current development proposals are for the connection works to be tunnelled sufficiently deep enough that no changes to hydrology or accretion processes will be experienced within the statutory sites. Should this change, or the approach be reconsidered, then further detailed surveys between April and August will be necessary. It would be advisable that surveys should include, in addition to the corridor affected (construction zone plus a reasonable buffer), areas away from the development to allow comparisons with the invertebrate fauna in the wider area. Reference to detailed botanical surveys undertaken as part of the consultation process to inform the proposed Teesmouth and Cleveland Coast SSSI would aid identification of zones within the sand dune system. If these additional surveys are necessary, it would be advantageous to include the land parcels surveyed in 2018 to provide contemporary data that can be compared, to further enhance the analysis.

Despite the challenges imposed by weather during 2018, no further surveys for terrestrial invertebrates are considered necessary providing the footprint of the proposed development remains within the Teardrop and SSI land parcels. The results are considered valid for approximately three years. This relatively short validity window is because the habitats within the study site are likely to be dynamic and subject to change, more so than in more stable communities. Furthermore, the influence of the weather conditions experienced in 2018 justifies, in the opinion of the author, a slightly more cautious approach. If delays to the application mean that re-submission is necessary after the 2021 survey season, it is advised that a scoping survey, ideally in spring (i.e. April or no later than early May) is undertaken by a competent entomologist furnished with the 2018 survey report for invertebrates and the PEA (AECOM, 2018) to determine if additional surveys are appropriate.

6.2 Mitigation Hierarchy

No details have been provided on the proposed layout, including construction footprint, of the development being proposed, so only generic mitigation has been provided.

The surveys in 2018 have identified that the invertebrate assemblages of most importance are those associated with the open habitat biotopes, particularly the open short sward, scrub edge and rich flower resources. There is no meaningful difference between land parcels. It is considered that these open habitat biotopes offer similar features that can be present in the fixed dune habitats within adjacent sand dune systems and that there is a degree of interchange between the invertebrate assemblages associated with them.

Soft landscaping should aim to maintain this connectivity by initially avoiding disturbance to the existing grasslands where construction is not essential such as within the development's footprint and construction working area (including storage, compounds and temporary access routes). Consideration should be given to enhancing areas outwith these footprints by clearing back invading bramble where this is creeping through grassland; but noting that bramble patches provide valuable shelter in an otherwise exposed environment, and nectar resource. As a rule of thumb, if the bramble is 'snaking' its way through the grassland, these stems and small clumps should be trimmed back and removed to maintain the open grasslands.

At the time of writing, it is not known what is being proposed for areas that are disturbed during the construction phase but that will be part of the soft landscaping. Ideally, substrates disturbed in this situation should be left to colonise naturally, or seeded with a low density appropriate seed mix in consultation with Natural England to ensure no damaging contamination to the natural vegetation communities in the adjacent sand dunes.

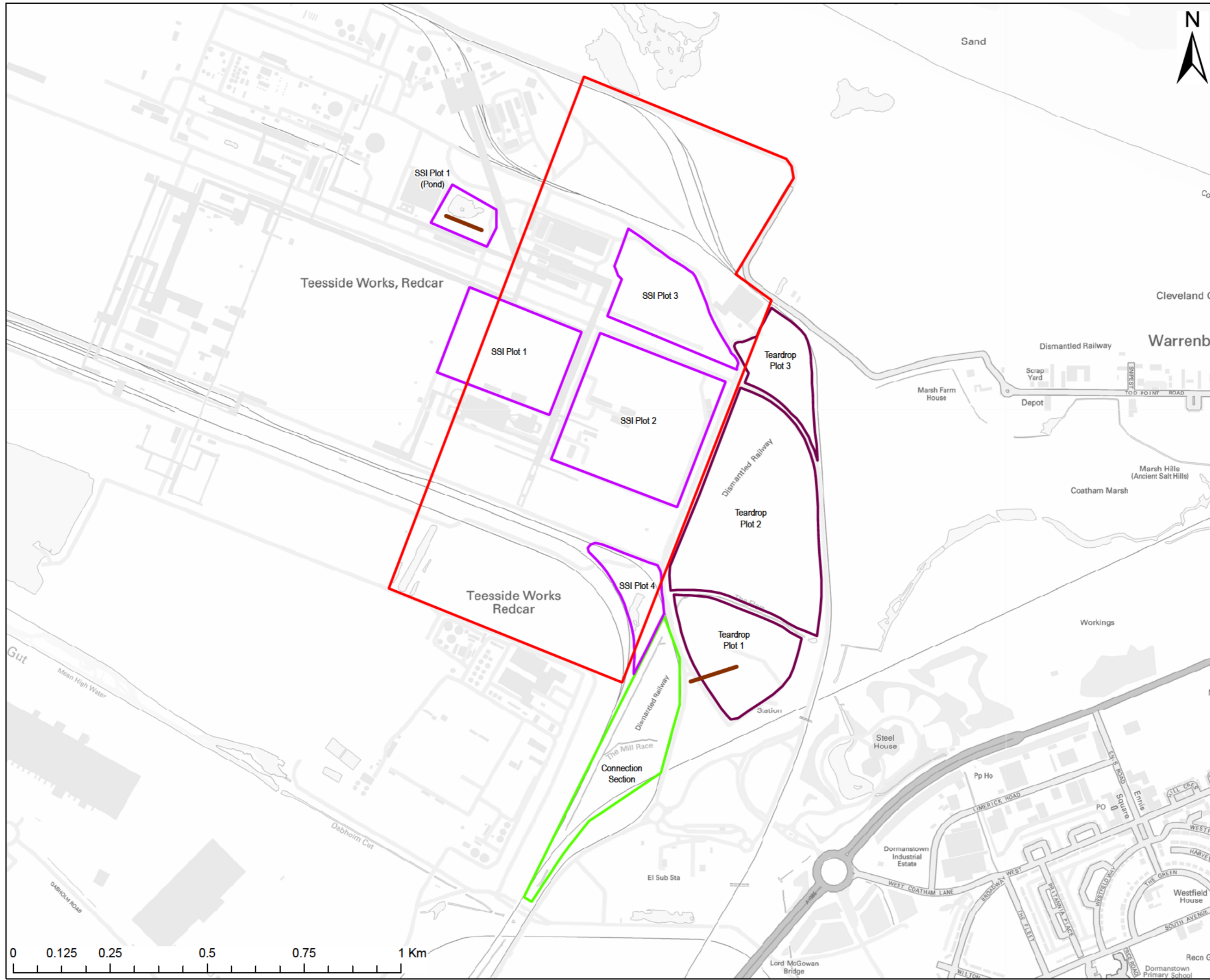
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A. Appendix A: Locations of pitfall traps and areas surveyed during 2018



Project Title:
 CLEAN GAS PROJECT

Client:
 OGCI
 CLIMATE INVESTMENTS

Location Inset:



LEGEND

- SSI Boundary
- SSI Plot
- Teardrop Plot
- Pitfall Transect
- Connection Section

Copyright:
 Source: © Crown copyright and database rights 2018
 Ordnance Survey 0100031673
 Projection: British National Grid

AECOM Internal Project No:
 60559231

Drawing Title:
 LOCATIONS OF PITFALL TRAPS AND AREAS SURVEYED DURING 2018

Scale at A3: 1:9,000
Drawing No: APPENDIX A
Rev: 01
Drawn: Chk'd: App'd: Date:
 AG RW RW 15/11/18

B. Appendix B: Site Photographs

Photograph 1: Teardrop Plot 1 looking along the pitfall transect to the south. (The pitfall traps are not visible in the photo). © Andy Godfrey



Photograph 2: Teardrop Plot 2 to the left of the track. The view is looking west. © Andy Godfrey



**C. Appendix C: Terrestrial Invertebrate Species List
(2018)**

Class	Order	Family	Taxon	Vernacular	National Status	Teardrop (Plot 1) & Connection Section	Teardrop (Plot 2)	Teardrop (Plot 3)	SSI (Plot 1)	SSI (Plot 2)	SSI (Plot 3)	SSI (Plot 4)
Arachnida	Araneae	Theridiidae	<i>Robertus lividus</i>						P			
Arachnida	Araneae	Linyphiidae	<i>Walckenaeria acuminata</i>						P			
Arachnida	Araneae	Linyphiidae	<i>Gongylidiellum vivum</i>						X			
Arachnida	Araneae	Linyphiidae	<i>Micrargus herbigradus sens. str.</i>						P			
Arachnida	Araneae	Linyphiidae	<i>Micrargus subaequalis</i>						X			
Arachnida	Araneae	Linyphiidae	<i>Erigonella hiemalis</i>						P			
Arachnida	Araneae	Linyphiidae	<i>Centromerus sylvaticus</i>						P			
Arachnida	Araneae	Linyphiidae	<i>Centromerita concinna</i>			P						
Arachnida	Araneae	Linyphiidae	<i>Diplostyla concolor</i>						P			
Arachnida	Araneae	Linyphiidae	<i>Tenuiphantes tenuis</i>						P			
Arachnida	Araneae	Lycosidae	<i>Pardosa palustris</i>			P						
Arachnida	Araneae	Lycosidae	<i>Pardosa pullata</i>			P			P			
Arachnida	Araneae	Lycosidae	<i>Pardosa nigriceps</i>			P						
Arachnida	Araneae	Lycosidae	<i>Alopecosa pulverulenta</i>			P			p			
Arachnida	Araneae	Pisauridae	<i>Pisaura mirabilis</i>						X			
Arachnida	Araneae	Dictynidae	<i>Dictyna arundinacea</i>			X	X		X	X	X	X
Arachnida	Araneae	Gnaphosidae	<i>Drassodes cupreus</i>			P						
Arachnida	Araneae	Gnaphosidae	<i>Haplodrassus signifer</i>			P						
Arachnida	Araneae	Gnaphosidae	<i>Zelotes latreillei</i>			P						
Arachnida	Araneae	Philodromidae	<i>Tibellus oblongus</i>						X			
Arachnida	Araneae	Thomisidae	<i>Xysticus cristatus</i>			X					X	
Arachnida	Araneae	Salticidae	<i>Heliophanus flavipes</i>			X					X	X
Arachnida	Araneae	Salticidae	<i>Euophrys frontalis</i>			P						
Arachnida	Araneae	Theridiidae	<i>Enoplognatha ovata sens. lat.</i>					X				
Bivalvia	Unionoida	Unionidae	<i>Anodonta anatina</i>	Duck Mussel					X			
Gastropoda	Pulmonata	Discidae	<i>Discus rotundatus</i>	Rounded Snail		X						
Gastropoda	Pulmonata	Helicidae	<i>Cepaea nemoralis</i>	Brown-lipped Snail		X	X	X	X	X	X	X
Gastropoda	Pulmonata	Helicidae	<i>Cornu aspersum</i>	Garden Snail		X	X	X	X	X	X	X
Gastropoda	Pulmonata	Hygromiidae	<i>Candidula intersepta</i>	Wrinkled Snail			X					
Gastropoda	Pulmonata	Hygromiidae	<i>Ceruella virgata</i>	Striped Snail				X	X		X	X
Gastropoda	Pulmonata	Hygromiidae	<i>Trichia hispida</i>	Hairy Snail					X			X
Insecta	Coleoptera	Carabidae	<i>Nebria brevicollis</i>			P						
Insecta	Coleoptera	Carabidae	<i>Pterostichus madidus</i>			P			P			
Insecta	Coleoptera	Carabidae	<i>Pterostichus strenuus</i>						P			

Class	Order	Family	Taxon	Vernacular	National Status	Teardrop (Plot 1) & Connection Section	Teardrop (Plot 2)	Teardrop (Plot 3)	SSI (Plot 1)	SSI (Plot 2)	SSI (Plot 3)	SSI (Plot 4)
Insecta	Coleoptera	Carabidae	<i>Calathus fuscipes</i>			P						
Insecta	Coleoptera	Carabidae	<i>Amara lunicollis</i>			P						
Insecta	Coleoptera	Carabidae	<i>Harpalus latus</i>			P						
Insecta	Coleoptera	Leiodidae	<i>Nargus wilkinei</i>						P			
Insecta	Coleoptera	Leiodidae	<i>Sciodrepoides fumatus</i>						P			
Insecta	Coleoptera	Leiodidae	<i>Catops fuliginosus</i>						P			
Insecta	Coleoptera	Silphidae	<i>Silpha tristis</i>			P						
Insecta	Coleoptera	Silphidae	<i>Nicrophorus vespillo</i>						P			
Insecta	Coleoptera	Staphylinidae	<i>Omalium rivulare</i>						P			
Insecta	Coleoptera	Staphylinidae	<i>Tachinus rufipes</i>						P			
Insecta	Coleoptera	Staphylinidae	<i>Habrocerus capillaricornis</i>						P			
Insecta	Coleoptera	Staphylinidae	<i>Callicerus rigidicornis</i>						P			
Insecta	Coleoptera	Staphylinidae	<i>Liogluta microptera</i>						P			
Insecta	Coleoptera	Staphylinidae	<i>Microdota indubia</i>						P			
Insecta	Coleoptera	Staphylinidae	<i>Aleochara bipustulata</i>						P			
Insecta	Coleoptera	Staphylinidae	<i>Aleochara curtula</i>						P			
Insecta	Coleoptera	Staphylinidae	<i>Rugilus rufipes</i>						P			
Insecta	Coleoptera	Staphylinidae	<i>Philonthus decorus</i>						P			
Insecta	Coleoptera	Staphylinidae	<i>Ocypus brunnipes</i>						P			
Insecta	Coleoptera	Staphylinidae	<i>Tasgius melanarius</i>			P						
Insecta	Coleoptera	Staphylinidae	<i>Tasgius winkleri</i>			P						
Insecta	Coleoptera	Staphylinidae	<i>Quedius mesomelinus</i>			P						
Insecta	Coleoptera	Staphylinidae	<i>Quedius curtipennis</i>			P			P			
Insecta	Coleoptera	Staphylinidae	<i>Quedius semiobscurus</i>			P			P			
Insecta	Coleoptera	Staphylinidae	<i>Othius punctulatus</i>						P			
Insecta	Coleoptera	Staphylinidae	<i>Xantholinus elegans</i>			P						
Insecta	Coleoptera	Staphylinidae	<i>Xantholinus linearis</i>			P			P			
Insecta	Coleoptera	Elateridae	<i>Agriotes acuminatus</i>			P						
Insecta	Coleoptera	Elateridae	<i>Agriotes obscurus</i>			P			P			
Insecta	Coleoptera	Elateridae	<i>Dalopius marginatus</i>			P			P			
Insecta	Coleoptera	Cantharidae	<i>Rhagonycha fulva</i>					X	X			
Insecta	Coleoptera	Coccinellidae	<i>Harmonia axyridis</i>	Harlequin Ladybird					X			
Insecta	Coleoptera	Latridiidae	<i>Cartodere nodifer</i>			X						
Insecta	Coleoptera	Oedemeridae	<i>Oedemera lurida</i>			X	X	X	X	X	X	X
Insecta	Coleoptera	Curculionidae	<i>Otiorhynchus rugosostriatus</i>			P						

Class	Order	Family	Taxon	Vernacular	National Status	Teardrop (Plot 1) & Connection Section	Teardrop (Plot 2)	Teardrop (Plot 3)	SSI (Plot 1)	SSI (Plot 2)	SSI (Plot 3)	SSI (Plot 4)
Insecta	Coleoptera	Curculionidae	<i>Phyllobius oblongus</i>	Brown Leaf Weevil					P			
Insecta	Coleoptera	Curculionidae	<i>Barypeithes pellucidus</i>						P			
Insecta	Dermaptera	Forficulidae	<i>Forficula auricularia</i>	Common Earwig		X						
Insecta	Diptera	Tipulidae	<i>Nephrotoma appendiculata</i>						X			
Insecta	Diptera	Tipulidae	<i>Nephrotoma flavescens</i>						X			
Insecta	Diptera	Tipulidae	<i>Nephrotoma flavipalpis</i>						X			
Insecta	Diptera	Tipulidae	<i>Tipula vernalis</i>			X	X		X			X
Insecta	Diptera	Tipulidae	<i>Tipula oleracea</i>						X			
Insecta	Diptera	Tipulidae	<i>Tipula lateralis</i>						X			
Insecta	Diptera	Pediciidae	<i>Tricyphona immaculata</i>				X					
Insecta	Diptera	Limoniidae	<i>Symplecta hybrida</i>			X	X					
Insecta	Diptera	Limoniidae	<i>Phylidorea ferruginea</i>						X			
Insecta	Diptera	Limoniidae	<i>Dicranomyia chorea</i>						X			
Insecta	Diptera	Limoniidae	<i>Rhipidia maculata</i>									X
Insecta	Diptera	Bibionidae	<i>Bibio marci</i>			X						
Insecta	Diptera	Scatopsidae	<i>Colobostema triste</i>									X
Insecta	Diptera	Rhagionidae	<i>Rhagio lineola</i>						X			
Insecta	Diptera	Tabanidae	<i>Haematopota pluvialis</i>						X			
Insecta	Diptera	Stratiomyidae	<i>Beris vallata</i>						X			
Insecta	Diptera	Stratiomyidae	<i>Chorisops tibialis</i>			X						
Insecta	Diptera	Therevidae	<i>Thereva nobilitata</i>					X	X			
Insecta	Diptera	Asilidae	<i>Leptogaster cylindrica</i>			X	X	X	X	X		
Insecta	Diptera	Hybotidae	<i>Hybos culiciformis</i>						X			
Insecta	Diptera	Hybotidae	<i>Platypalpus flavicornis</i>						X			
Insecta	Diptera	Hybotidae	<i>Platypalpus longiseta</i>						X			
Insecta	Diptera	Hybotidae	<i>Platypalpus minutus sens. str.</i>				X		X			X
Insecta	Diptera	Hybotidae	<i>Platypalpus notatus</i>				X		X			
Insecta	Diptera	Hybotidae	<i>Platypalpus pallidiventris</i>			X	X		X	X		
Insecta	Diptera	Hybotidae	<i>Platypalpus pseudofulvipes</i>						X			
Insecta	Diptera	Empididae	<i>Empis caudatula</i>				X					X
Insecta	Diptera	Empididae	<i>Empis livida</i>						X			
Insecta	Diptera	Empididae	<i>Empis punctata</i>						X			
Insecta	Diptera	Empididae	<i>Hilara anglo danica</i>				X					
Insecta	Diptera	Empididae	<i>Hilara cornicula</i>						X			
Insecta	Diptera	Empididae	<i>Hilara pilosa</i>									X

Class	Order	Family	Taxon	Vernacular	National Status	Teardrop (Plot 1) & Connection Section	Teardrop (Plot 2)	Teardrop (Plot 3)	SSI (Plot 1)	SSI (Plot 2)	SSI (Plot 3)	SSI (Plot 4)
Insecta	Diptera	Dolichopodidae	<i>Chrysotus gramineus</i>						X			
Insecta	Diptera	Dolichopodidae	<i>Dolichopus clavipes</i>						X			
Insecta	Diptera	Dolichopodidae	<i>Dolichopus griseipennis</i>						X			X
Insecta	Diptera	Dolichopodidae	<i>Dolichopus latilimbatus</i>						X			
Insecta	Diptera	Dolichopodidae	<i>Dolichopus nubilus</i>						X			
Insecta	Diptera	Dolichopodidae	<i>Dolichopus unguatus</i>			X			X			
Insecta	Diptera	Dolichopodidae	<i>Hercostomus cupreus</i>						X			
Insecta	Diptera	Dolichopodidae	<i>Medetera micacea</i>			X		X	X	X	X	X
Insecta	Diptera	Dolichopodidae	<i>Medetera petrophiloides</i>									X
Insecta	Diptera	Dolichopodidae	<i>Medetera truncorum</i>				X		X			X
Insecta	Diptera	Dolichopodidae	<i>Micromorphus albipes</i>			X				X		
Insecta	Diptera	Dolichopodidae	<i>Sympycnus desoutteri sens. lat.</i>						X			
Insecta	Diptera	Lonchopteridae	<i>Lonchoptera furcata</i>			X		X	X			X
Insecta	Diptera	Lonchopteridae	<i>Lonchoptera lutea</i>					X	X			
Insecta	Diptera	Syrphidae	<i>Melanostoma mellinum</i>						X			X
Insecta	Diptera	Syrphidae	<i>Platycheirus angustatus</i>						X			
Insecta	Diptera	Syrphidae	<i>Platycheirus clypeatus</i>						X			
Insecta	Diptera	Syrphidae	<i>Platycheirus scutatus sens. str.</i>						X			
Insecta	Diptera	Syrphidae	<i>Pyrophaena rosarum</i>						X			
Insecta	Diptera	Syrphidae	<i>Paragus haemorrhous</i>				X	X			X	X
Insecta	Diptera	Syrphidae	<i>Episyrphus balteatus</i>					X	X			
Insecta	Diptera	Syrphidae	<i>Eupeodes corollae</i>				X	X	X		X	
Insecta	Diptera	Syrphidae	<i>Melangyna compositarum</i>					X				
Insecta	Diptera	Syrphidae	<i>Sphaerophoria scripta</i>			X		X	X	X		X
Insecta	Diptera	Syrphidae	<i>Syrphus ribesii</i>						X			
Insecta	Diptera	Syrphidae	<i>Neoascia tenur</i>						X			
Insecta	Diptera	Syrphidae	<i>Helophilus pendulus</i>						X			
Insecta	Diptera	Syrphidae	<i>Syritta pipiens</i>				X					
Insecta	Diptera	Syrphidae	<i>Tropidia scita</i>						X			
Insecta	Diptera	Pipunculidae	<i>Verrallia aucta</i>						X			
Insecta	Diptera	Pipunculidae	<i>Tomosvaryella nigrifula</i>					X	X		X	
Insecta	Diptera	Micropezidae	<i>Micropeza corrigiolata</i>						X			
Insecta	Diptera	Conopidae	<i>Sicus ferrugineus</i>									X
Insecta	Diptera	Ulidiidae	<i>Herina longistylata</i>					X	X			
Insecta	Diptera	Tephritidae	<i>Urophora stylata</i>						X	X		X

Class	Order	Family	Taxon	Vernacular	National Status	Teardrop (Plot 1) & Connection Section	Teardrop (Plot 2)	Teardrop (Plot 3)	SSI (Plot 1)	SSI (Plot 2)	SSI (Plot 3)	SSI (Plot 4)
Insecta	Diptera	Tephritidae	<i>Paroxyna plantaginis</i>									X
Insecta	Diptera	Tephritidae	<i>Tephritis conura</i>					X			X	
Insecta	Diptera	Tephritidae	<i>Tephritis leontodontis</i>							X		X
Insecta	Diptera	Tephritidae	<i>Tephritis neesii</i>			X	X		X	X		X
Insecta	Diptera	Tephritidae	<i>Tephritis ruralis</i>							X		
Insecta	Diptera	Tephritidae	<i>Trupanea stellata</i>								X	
Insecta	Diptera	Tephritidae	<i>Chaetostomella cylindrica</i>									X
Insecta	Diptera	Tephritidae	<i>Xyphosia miliaria</i>						X			
Insecta	Diptera	Tephritidae	<i>Trypeta artemisiae</i>						X			
Insecta	Diptera	Lauxaniidae	<i>Meiosimyza decipiens</i>						X			
Insecta	Diptera	Lauxaniidae	<i>Meiosimyza subfasciata</i>						X			
Insecta	Diptera	Lauxaniidae	<i>Minettia tabidiventris</i>			X			X	X	X	
Insecta	Diptera	Lauxaniidae	<i>Minettia fasciata (=rivosa)</i>			X		X	X	X		X
Insecta	Diptera	Lauxaniidae	<i>Minettia tubifer</i>			X		X	X	X		
Insecta	Diptera	Lauxaniidae	<i>Sapromyza quadripunctata</i>			X	X	X	X	X		X
Insecta	Diptera	Chamaemyiidae	<i>Chamaemyia aridella</i>			X	X	X	X	X	X	X
Insecta	Diptera	Helcomyzidae	<i>Helcomyza ustulata</i>								X	
Insecta	Diptera	Sciomyzidae	<i>Pherbellia cinerella</i>			X	X	X	X	X	X	X
Insecta	Diptera	Sciomyzidae	<i>Coremacera marginata</i>			X			X			
Insecta	Diptera	Sciomyzidae	<i>Euthycera fumigata</i>			X						
Insecta	Diptera	Sciomyzidae	<i>Pherbina coryleti</i>						X			
Insecta	Diptera	Sciomyzidae	<i>Tetanocera arrogans</i>						X			
Insecta	Diptera	Sciomyzidae	<i>Tetanocera ferruginea</i>						X			
Insecta	Diptera	Sepsidae	<i>Sepsis cynipsea</i>			X		X	X	X		X
Insecta	Diptera	Sepsidae	<i>Sepsis duplicata</i>							X		
Insecta	Diptera	Sepsidae	<i>Sepsis fulgens</i>									X
Insecta	Diptera	Sepsidae	<i>Sepsis orthocnemis</i>						X			X
Insecta	Diptera	Sepsidae	<i>Sepsis punctum</i>			X						
Insecta	Diptera	Agromyzidae	<i>Ophiomyia curvipalpis</i>				X					
Insecta	Diptera	Agromyzidae	<i>Cerodontha denticornis</i>			X	X		X	X		X
Insecta	Diptera	Opomyzidae	<i>Geomyza subnigra</i>		pNationally Scarce	X		X				
Insecta	Diptera	Opomyzidae	<i>Opomyza florum</i>						X			
Insecta	Diptera	Opomyzidae	<i>Opomyza germinationis</i>						X			
Insecta	Diptera	Anthomyzidae	<i>Anthomyza collini</i>						X			
Insecta	Diptera	Anthomyzidae	<i>Anthomyza dissors</i>									X

Class	Order	Family	Taxon	Vernacular	National Status	Teardrop (Plot 1) & Connection Section	Teardrop (Plot 2)	Teardrop (Plot 3)	SSI (Plot 1)	SSI (Plot 2)	SSI (Plot 3)	SSI (Plot 4)
Insecta	Diptera	Anthomyzidae	<i>Anthomyza gracilis</i>						X	X		X
Insecta	Diptera	Anthomyzidae	<i>Stiphrosoma sabulosum</i>			X		X		X		X
Insecta	Diptera	Asteiidae	<i>Asteia concinna</i>			X		X	X			
Insecta	Diptera	Chloropidae	<i>Chlorops pumilionis</i>						X			
Insecta	Diptera	Chloropidae	<i>Chlorops speciosus</i>						X			
Insecta	Diptera	Chloropidae	<i>Cryptonevra flavitarsis</i>						X			
Insecta	Diptera	Chloropidae	<i>Meromyza femorata</i>					X	X	X		
Insecta	Diptera	Chloropidae	<i>Meromyza nigriventris</i>					X				
Insecta	Diptera	Chloropidae	<i>Meromyza saltatrix</i>			X	X	X	X	X		
Insecta	Diptera	Chloropidae	<i>Meromyza triangulina</i>							X		
Insecta	Diptera	Chloropidae	<i>Thaumatomyia glabra</i>					X	X		X	
Insecta	Diptera	Chloropidae	<i>Thaumatomyia hallandica</i>			X	X	X	X	X	X	X
Insecta	Diptera	Chloropidae	<i>Thaumatomyia notata</i>			X			X			
Insecta	Diptera	Chloropidae	<i>Calamoncosis minima</i>							X		
Insecta	Diptera	Chloropidae	<i>Dicraeus vagans</i>			X		X	X	X		X
Insecta	Diptera	Chloropidae	<i>Elachiptera cornuta</i>						X			
Insecta	Diptera	Chloropidae	<i>Lasiambia palposa</i>		pNationally Scarce			X		X		
Insecta	Diptera	Chloropidae	<i>Oscinella frit</i>			X		X	X	X	X	
Insecta	Diptera	Chloropidae	<i>Oscinomorpha minutissima</i>			X		X		X	X	
Insecta	Diptera	Chloropidae	<i>Siphonella oscinina</i>		pNationally Scarce				X			
Insecta	Diptera	Chloropidae	<i>Speccafrons halophila</i>		pNationally Scarce				X			
Insecta	Diptera	Chloropidae	<i>Tricimba cincta</i>					X				
Insecta	Diptera	Sphaeroceridae	<i>Lotophila atra</i>						X			
Insecta	Diptera	Drosophilidae	<i>Scaptomyza pallida</i>					X	X	X		
Insecta	Diptera	Diastatidae	<i>Diastata costata</i>						X			
Insecta	Diptera	Ephydriidae	<i>Paracoenia fumosa</i>						X			
Insecta	Diptera	Ephydriidae	<i>Parydra coarctata</i>						X			
Insecta	Diptera	Ephydriidae	<i>Lamproscatella sibilans</i>			X						
Insecta	Diptera	Ephydriidae	<i>Limnella quadrata</i>					X				X
Insecta	Diptera	Ephydriidae	<i>Scatella tenuicosta</i>					X	X			X
Insecta	Diptera	Ephydriidae	<i>Hydrellia griseola</i>			X				X	X	X
Insecta	Diptera	Ephydriidae	<i>Hydrellia maura</i>					X	X			
Insecta	Diptera	Ephydriidae	<i>Hyadina guttata</i>					X				
Insecta	Diptera	Ephydriidae	<i>Philygria flavipes</i>					X				X
Insecta	Diptera	Ephydriidae	<i>Philygria interstincta</i>			X					X	

Class	Order	Family	Taxon	Vernacular	National Status	Teardrop (Plot 1) & Connection Section	Teardrop (Plot 2)	Teardrop (Plot 3)	SSI (Plot 1)	SSI (Plot 2)	SSI (Plot 3)	SSI (Plot 4)
Insecta	Diptera	Ephydriidae	<i>Philygria stictica</i>			X	X				X	X
Insecta	Diptera	Ephydriidae	<i>Philygria vittipennis</i>			X				X		X
Insecta	Diptera	Scathophagidae	<i>Scathophaga suilla</i>						X			
Insecta	Diptera	Anthomyiidae	<i>Anthomyia liturata</i>			X		X	X	X		
Insecta	Diptera	Anthomyiidae	<i>Anthomyia procellaris</i>						X			
Insecta	Diptera	Anthomyiidae	<i>Botanophila seneciella</i>			X	X			X		
Insecta	Diptera	Anthomyiidae	<i>Botanophila sonchi</i>		pNationally Scarce			X	X			
Insecta	Diptera	Anthomyiidae	<i>Delia florilega</i>					X				
Insecta	Diptera	Anthomyiidae	<i>Delia platura</i>			X		X	X			X
Insecta	Diptera	Anthomyiidae	<i>Heterostylodes pilifer</i>							X		
Insecta	Diptera	Anthomyiidae	<i>Subhylemyia longula</i>			X		X	X	X	X	
Insecta	Diptera	Anthomyiidae	<i>Zaphne divisa</i>						X			
Insecta	Diptera	Anthomyiidae	<i>Pegoplata infirma</i>						X			
Insecta	Diptera	Fanniidae	<i>Fannia armata</i>					X				
Insecta	Diptera	Fanniidae	<i>Fannia fuscua</i>						X			
Insecta	Diptera	Fanniidae	<i>Fannia hamata</i>						X			
Insecta	Diptera	Muscidae	<i>Coenosia infantula</i>			X	X	X	X	X	X	X
Insecta	Diptera	Muscidae	<i>Coenosia mollicula</i>				X		X			X
Insecta	Diptera	Muscidae	<i>Coenosia pedella</i>			X	X		X			X
Insecta	Diptera	Muscidae	<i>Coenosia tigrina</i>						X			
Insecta	Diptera	Muscidae	<i>Dexiopsis lacteipennis</i>						X			
Insecta	Diptera	Muscidae	<i>Schoenomyza litorella</i>			X			X			
Insecta	Diptera	Muscidae	<i>Muscina levida</i>						X			
Insecta	Diptera	Muscidae	<i>Helina calceata</i>		Nationally Scarce	X						
Insecta	Diptera	Muscidae	<i>Helina impuncta</i>						X			
Insecta	Diptera	Muscidae	<i>Helina lasiophthalma</i>						X			
Insecta	Diptera	Muscidae	<i>Helina reversio</i>					X	X	X		X
Insecta	Diptera	Muscidae	<i>Helina subvittata</i>		pNationally Scarce	X			X	X		
Insecta	Diptera	Muscidae	<i>Phaonia atriceps</i>						X			
Insecta	Diptera	Muscidae	<i>Phaonia tuguriorum</i>						X			
Insecta	Diptera	Calliphoridae	<i>Bellardia viarum</i>						X			
Insecta	Diptera	Calliphoridae	<i>Calliphora vicina</i>						X			
Insecta	Diptera	Calliphoridae	<i>Melanomyia nana</i>									X
Insecta	Diptera	Calliphoridae	<i>Melinda viridicyanea</i>					X				
Insecta	Diptera	Calliphoridae	<i>Pollenia rudis</i>						X			

Class	Order	Family	Taxon	Vernacular	National Status	Teardrop (Plot 1) & Connection Section	Teardrop (Plot 2)	Teardrop (Plot 3)	SSI (Plot 1)	SSI (Plot 2)	SSI (Plot 3)	SSI (Plot 4)
Insecta	Diptera	Sarcophagidae	<i>Sarcophaga pumila</i>							X		
Insecta	Diptera	Sarcophagidae	<i>Sarcophaga setipennis</i>					X				
Insecta	Diptera	Sarcophagidae	<i>Sarcophaga teretirostris</i>					X	X			X
Insecta	Diptera	Sarcophagidae	<i>Sarcophaga nigriventris</i>			X	X	X	X	X		X
Insecta	Diptera	Sarcophagidae	<i>Sarcophaga incisilobata</i>					X	X			
Insecta	Diptera	Tachinidae	<i>Eriothrix rufomaculata</i>					X		X	X	
Insecta	Diptera	Tachinidae	<i>Siphona geniculata</i>						X			
Insecta	Hemiptera, Auchenorrhyncha	Aphrophoridae	<i>Philaenus spumarius</i>			X	X	X	X	X	X	X
Insecta	Hemiptera, Auchenorrhyncha	Aphrophoridae	<i>Neophilaenus lineatus</i>			X		X			X	
Insecta	Hemiptera, Auchenorrhyncha	Cicadellidae	<i>Eupelix cuspidata</i>			X	X	X	X	X		X
Insecta	Hemiptera, Heteroptera	Anthocoridae	<i>Anthocoris nemoralis</i>						X			
Insecta	Hemiptera, Heteroptera	Anthocoridae	<i>Anthocoris nemorum</i>			X			X			
Insecta	Hemiptera, Heteroptera	Lygaeidae	<i>Ischnodemus sabuleti</i>						X			
Insecta	Hemiptera, Heteroptera	Miridae	<i>Adelphocoris lineolatus</i>			X					X	
Insecta	Hemiptera, Heteroptera	Miridae	<i>Calocoris roseomaculatus</i>								X	
Insecta	Hemiptera, Heteroptera	Miridae	<i>Deraeocoris ruber</i>						X			
Insecta	Hemiptera, Heteroptera	Miridae	<i>Dicyphus annulatus</i>			X		X			X	X
Insecta	Hemiptera, Heteroptera	Miridae	<i>Grypocoris stysi</i>					X				
Insecta	Hemiptera, Heteroptera	Miridae	<i>Leptopectera dolabrata</i>			X		X	X	X		X
Insecta	Hemiptera, Heteroptera	Miridae	<i>Lygocoris pabulinus</i>						X			
Insecta	Hemiptera, Heteroptera	Miridae	<i>Notostira elongata</i>					X				
Insecta	Hemiptera, Heteroptera	Miridae	<i>Orthops campestris</i>					X				
Insecta	Hemiptera, Heteroptera	Miridae	<i>Stenodema calcarata</i>						X			
Insecta	Hemiptera, Heteroptera	Miridae	<i>Stenodema laevigata</i>			X	X				X	X
Insecta	Hemiptera, Heteroptera	Pentatomidae	<i>Dolycoris baccarum</i>	Hairy Shieldbug		X				X	X	
Insecta	Hemiptera, Heteroptera	Pentatomidae	<i>Pentatoma rufipes</i>	Red-legged Shieldbug					X			
Insecta	Hemiptera, Heteroptera	Rhopalidae	<i>Myrmus miriformis</i>			X		X		X	X	
Insecta	Hymenoptera	Bethylidae	<i>Bethylus fuscicornis</i>	a solitary wasp							X	
Insecta	Hymenoptera	Chrysididae	<i>Chrysis angustula</i>	a cuckoo wasp				X				
Insecta	Hymenoptera	Formicidae	<i>Formica fusca</i>	an ant		X	X	X	X	X	X	X
Insecta	Hymenoptera	Formicidae	<i>Lasius niger sens. str.</i>	an ant		X	X					
Insecta	Hymenoptera	Formicidae	<i>Myrmica ruginodis</i>	an ant				X				X
Insecta	Hymenoptera	Formicidae	<i>Myrmica sabuleti</i>	an ant		X						
Insecta	Hymenoptera	Formicidae	<i>Myrmica scabrinodis</i>	an ant			X	X		X	X	X
Insecta	Hymenoptera	Crabronidae	<i>Argogorytes fargei</i>	a digger wasp	Nationally Scarce			X				

Class	Order	Family	Taxon	Vernacular	National Status	Teardrop (Plot 1) & Connection Section	Teardrop (Plot 2)	Teardrop (Plot 3)	SSI (Plot 1)	SSI (Plot 2)	SSI (Plot 3)	SSI (Plot 4)
					(Na)							
Insecta	Hymenoptera	Crabronidae	<i>Ectemnius continuus</i>	a digger wasp				X				
Insecta	Hymenoptera	Crabronidae	<i>Trypoxylon attenuatum</i>	Slender Wood Borer Wasp					X			
Insecta	Hymenoptera	Andrenidae	<i>Andrena similis</i>	a mining bee	Nationally Scarce (Nb)				X			
Insecta	Hymenoptera	Apidae	<i>Bombus lapidarius</i>	Large Red Tailed Bumble Bee				X		X	X	
Insecta	Hymenoptera	Apidae	<i>Bombus lucorum</i>	White-tailed Bumble Bee								X
Insecta	Hymenoptera	Apidae	<i>Bombus pascuorum</i>	Common Carder Bee						X		
Insecta	Hymenoptera	Apidae	<i>Bombus terrestris</i>	Buff-tailed Bumble Bee		X			X	X		X
Insecta	Hymenoptera	Colletidae	<i>Hylaeus hyalinatus</i>	a solitary bee				X				
Insecta	Hymenoptera	Halictidae	<i>Lasioglossum albipes</i>	a mining bee				X				
Insecta	Hymenoptera	Halictidae	<i>Lasioglossum cupromicans</i>	a mining bee							X	X
Insecta	Hymenoptera	Ichneumonidae	<i>Diplazon laetatorius</i>	an ichneumon				X	X	X	X	
Insecta	Hymenoptera	Tenthredinidae	<i>Pontania proxima</i>	a sawfly					X			
Insecta	Lepidoptera	Hepialidae	<i>Korscheltellus fuscobulosa</i>	Map-winged Swift								X
Insecta	Lepidoptera	Momphidae	<i>Mompha raschkiella</i>	a moth		X		X				
Insecta	Lepidoptera	Zygaenidae	<i>Zygaena filipendulae</i>	Six-spot Burnet					X		X	X
Insecta	Lepidoptera	Zygaenidae	<i>Zygaena lonicerae</i>	Narrow-bordered Five-spot Burnet						X		
Insecta	Lepidoptera	Hesperiidae	<i>Erynnis tages</i>	Dingy Skipper	VU; SoPI	X	X					
Insecta	Lepidoptera	Hesperiidae	<i>Thymelicus sylvestris</i>	Small Skipper		X						
Insecta	Lepidoptera	Pieridae	<i>Pieris napi</i>	Green-veined White				X	X			
Insecta	Lepidoptera	Nymphalidae	<i>Coenonympha pamphilus</i>	Small Heath	NT; SoPI		X	X	X	X		
Insecta	Lepidoptera	Nymphalidae	<i>Aphantopus hyperantus</i>	Ringlet					X			
Insecta	Lepidoptera	Nymphalidae	<i>Maniola jurtina</i>	Meadow Brown		X			X	X	X	
Insecta	Lepidoptera	Nymphalidae	<i>Hipparchia semele</i>	Grayling	VU; SoPI			X	X	X	X	
Insecta	Lepidoptera	Lycaenidae	<i>Aricia agestis</i>	Brown Argus			X					
Insecta	Lepidoptera	Lycaenidae	<i>Polyommatus icarus</i>	Common Blue		X	X	X	X	X	X	X
Insecta	Lepidoptera	Geometridae	<i>Epirrhoe alternata</i>	Common Carpet						X		
Insecta	Lepidoptera	Erebidae	<i>Tyria jacobaeae</i>	Cinnabar					X	X	X	
Insecta	Lepidoptera	Noctuidae	<i>Autographa gamma</i>	Silver Y			X			X	X	X
Insecta	Lepidoptera	Noctuidae	<i>Pyrrhia umbra</i>	Bordered Sallow				X				
Insecta	Neuroptera	Chrysopidae	<i>Chrysopa perla</i>						X			
Insecta	Neuroptera	Chrysopidae	<i>Dichochrysa prasina</i>						X			
Insecta	Odonata	Calopterygidae	<i>Calopteryx splendens</i>	Banded Demoiselle					X			
Insecta	Odonata	Coenagriidae	<i>Pyrrhosoma nymphula</i>	Large Red Damselfly								X

Class	Order	Family	Taxon	Vernacular	National Status	Teardrop (Plot 1) & Connection Section	Teardrop (Plot 2)	Teardrop (Plot 3)	SSI (Plot 1)	SSI (Plot 2)	SSI (Plot 3)	SSI (Plot 4)
Insecta	Odonata	Coenagriidae	<i>Ischnura elegans</i>	Blue-tailed Damselfly					X			
Insecta	Odonata	Coenagriidae	<i>Enallagma cyathigerum</i>	Common Blue Damselfly						X		
Insecta	Orthoptera	Acrididae	<i>Chorthippus brunneus</i>	Common Field Grasshopper				X		X	X	
Insecta	Orthoptera	Acrididae	<i>Myrmeleotettix maculatus</i>	Mottled Grasshopper				X	X	X	X	X
Malacostraca	Isopoda	Philosciidae	<i>Philoscia muscorum</i>	Common Striped Woodlouse			X			X		
Malacostraca	Isopoda	Armadillidiidae	<i>Armadillidium vulgare</i>	Common Pill Woodlouse		X						
Number of Species			318			102	44	85	201	69	49	71

X = recorded by sweeping , vacuum sampling or direct observation

P = recorded in pitfall trap

pNationally Scarce: Provisionally Nationally Scarce. Applied to lesser known and less well-recorded invertebrates in the UK where sufficient data are not available to undertake a robust assessment against IUCN criteria.

Nationally Scarce: Taxa which are recorded in 16-100 hectads (10km squares) but not included in one of the Red List Categories. These taxa have been assessed against IUCN threat criteria.

Nationally Scarce (Nb): Taxa which are recorded in 16-100 hectads (10km squares) but not included in one of the Red List Categories. These taxa have yet to be assessed against the IUCN threat criteria.

Nationally Scarce (Na): Taxa which are recorded in 1-15 hectads (10km squares) but not included in one of the Red List Categories. These taxa have yet to be assessed against the IUCN threat criteria.

Red Data Book 2 (RDB 2): Taxa that are considered to be Vulnerable and likely to be moved in to the Endangered category in the near future if causal factors continue operating. 5 species that are declining throughout their range; in vulnerable habitats and/or where populations are low.

VU (Vulnerable): Taxa that have been assessed against IUCN criteria and are considered threatened.

NT (Near Threatened): Taxa that have been assessed against IUCN criteria and which following assessment, came close to, but failed to qualify as a Threatened species. However, it is considered that if the factors influencing its assessment continue, it is likely to move in to one of the threat categories; and thus it acts as a watching brief.

Species of Principal Importance (SoPI): Taxa listed under section 41 of the Natural Environment and Rural Communities Act 2006. Formerly UK Priority Species/ UK Biodiversity Action Plan species.

D. Appendix D: Stenotopic Species Recorded within the study site in 2018

Order	Family	Species	Status	SAT Code & Title
Lepidoptera	Lycaenidae	<i>Aricia agestis</i>		F112 Open Short Sward
Hemiptera	Miridae	<i>Calocoris roseomaculatus</i>		F112 Open Short Sward
Pulmonata	Hygromiidae	<i>Candidula intersecta</i>		F112 Open Short Sward
Pulmonata	Hygromiidae	<i>Cernuella virgata</i>	DD	F112 Open Short Sward
Lepidoptera	Nymphalidae	<i>Coenonympha pamphilus</i>	NT; SoPI	F112 Open Short Sward
Hemiptera	Miridae	<i>Dicyphus annulatus</i>		F112 Open Short Sward
Hymenoptera	Halictidae	<i>Lasioglossum albipes</i>		F112 Open Short Sward
Hymenoptera	Crabronidae	<i>Ectemnius continuus</i>		F001 - Scrub edge
Diptera	Empididae	<i>Empis caudatula</i>		F001 - Scrub edge
Hymenoptera	Formicidae	<i>Formica fusca</i>		F001 - Scrub edge
Araneae	Salticidae	<i>Heliophanus flavipes</i>		F001 - Scrub edge
Araneae	Lycosidae	<i>Pardosa nigriceps</i>		F001 - Scrub edge
Hymenoptera	Crabronidae	<i>Trypoxylon attenuatum</i>		F001 - Scrub edge
Hymenoptera	Andrenidae	<i>Andrena similis</i>	Nb	F002 Rich Flower Resource
Hymenoptera	Apidae	<i>Bombus lapidarius</i>		F002 Rich Flower Resource
Hymenoptera	Apidae	<i>Bombus lucorum</i>		F002 Rich Flower Resource
Hymenoptera	Apidae	<i>Bombus terrestris</i>		F002 Rich Flower Resource
Hymenoptera	Colletidae	<i>Hylaeus hyalinatus</i>		F002 Rich Flower Resource
Hymenoptera	Halictidae	<i>Lasioglossum cupromicans</i>		F002 Rich Flower Resource
Diptera	Muscidae	<i>Coenosia lacteipennis</i>		F111 - Bare sand & chalk
Lepidoptera	Nymphalidae	<i>Hipparchia semele</i>	VU; SoPI	F111 - Bare sand & chalk
Araneae	Lycosidae	<i>Pardosa palustris</i>		F111 - Bare sand & chalk
Hymenoptera	Crabronidae	<i>Ectemnius continuus</i>		A212 - Bark & sapwood decay
Hymenoptera	Colletidae	<i>Hylaeus hyalinatus</i>		A212 - Bark & sapwood decay
Diptera	Limoniidae	<i>Dicranomyia chorea</i>		W126 - Seepage
Diptera	Sciomyzidae	<i>Tetanocera arrogans</i>		W314 - Reed-fen & pools

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