Cottam Parkway Railway Station

Aquatic Ecology Survey and Assessment Report

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Cottam Parkway Railway Station

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Contents

Executive Summary

Jacobs UK Ltd was commissioned by Lancashire County Council (LCC) to undertake a range of ecological surveys to inform the Cottam Parkway Railway Station scheme (hereafter referred to as the 'scheme'). The scheme will serve the North West Preston Strategic Housing Location. It will comprise a new road to the proposed railway station connecting from Cottam Link Road with a bridge over the Lancaster Canal and a car park to serve the railway station.

To inform the scheme, Jacobs have completed a number of aquatic ecology surveys. The primary purpose of the survey and assessment was to establish an ecological baseline for aquatic habitat within the study area and to inform the Environmental Impact Assessment for the scheme. This includes providing sufficient information to inform scheme design options, an assessment of potential impacts on aquatic habitat and to develop appropriate mitigation requirements and opportunities for enhancement where possible. This information is to be included within the Environmental Statement (ES) which will be submitted for planning consideration in 2022.

A total of three watercourses (one stream and two ditches) were targeted for freshwater macro-invertebrate surveys because they were considered likely to be directly or indirectly affected by the scheme (i.e. within the study area defined as within 250m of the scheme boundary). Freshwater macro-invertebrate communities were surveyed in autumn 2020 and spring 2021 and have been evaluated as of **less than Local** importance.

The Lancaster Canal and 15 ponds were targeted for Predictive SYstem for Multimetrics (PSYM) survey within the study area. Surveys were conducted in September 2020. Freshwater macro-invertebrate communities from all surveyed ponds and the canal have been evaluated as of **less than Local** value. Macrophyte communities from all ponds have also been assessed of **less than Local** value.

River Habitat Surveys were included in the commission for the aquatic ecology surveys; however, watercourses within the study area did not meet the criteria which qualified them for assessment using this survey methodology.

A robust assessment of the potential impacts on aquatic ecology associated with the scheme will be detailed within the Ecology Chapter (Chapter 6) of the ES, along with any prescribed avoidance, mitigation and compensation measures, opportunities for enhancement, requirements for pre and/or post construction monitoring and an assessment of residual impacts (where appropriate).

1. Introduction

1.1 Background

Jacobs UK Ltd (Jacobs) was commissioned by Lancashire County Council (LCC) to provide ecological services to inform the proposed Cottam Parkway Railway Station scheme (hereafter referred to as "the scheme").

The scheme comprises (but not exhaustively): a road connecting to Cottam Link Road at the Sidgreaves junction roundabout; a bridge over the Lancaster Canal connecting to the railway station; station platforms; buildings and associated structures; a footbridge over the railway; a 250/500 space car park; and bridge approach embankments and earthworks. This development is related to the permitted road schemes of Preston Western Distributor (PWD) and the East West Link Road (EWLR) including Cottam Link Road.

A range of ecological surveys were required to establish an accurate baseline against which impacts of the scheme (both temporary and permanent) could be assessed in line with the Chartered Institute of Ecology and Environmental Management (CIEEM) guidelines for Ecological Impact Assessment in the UK and Ireland; Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2018). This report presents the results of aquatic ecology surveys and assessment undertaken by Jacobs' ecologists in September 2020 and March 2021.

The surveys and assessment were undertaken in consideration of the proposed scheme boundary (site area) provided by LCC (LCC Drawing CLM07-DEV-010-01; Dated 10-01-2020) and the walkover notice area/survey exclusion area drawing provided by LCC (LCC Drawing CLM07-DEV-010-03: Dated 16-12-2019). Further information on the scheme design was not available at the time of survey/assessment. The defined study area comprised all land within the scheme and a 250m buffer area from the scheme boundary. This study area is shown in Figure 1 (Appendix A) and Figure 2 (Appendix B).

1.2 Site Context

The scheme is proposed to be located within a semi-rural area approximately 4km north-west of central Preston and to the immediate south-west of the largely residential area of Cottam. The central grid reference for the scheme is SD 48714 31645[1]. Land use within the scheme comprises pasture land used for grazing and/or fodder production. This land is bound by a network of hedgerows and tree lines with occasional woodlands, small watercourses, ponds, farmsteads and dwellings. Both the Lancaster Canal and the Preston to Blackpool rail line run east to west through the study area. Sidgreaves Lane leading to Darkinson Lane runs north to south through the centre of the study area.

Pasture land dominates much of the wider area, particularly to the west of the scheme. The east boundary of the scheme is bordered by Lea Road with Westleigh Conference Centre and sports pitches further eastwards; to the south is pasture land with Ashton and Lea Golf Club further beyond. To the north is pasture land with both existing and new housing developments further northwards. In addition, the construction of the PWD scheme was also underway along the west and north boundaries of the main scheme area at the time of survey (September 2020 and March 2021).

1.3 Aims and Objectives

The primary aim of the aquatic ecology survey and assessment was to provide baseline information of the extent and ecological importance of aquatic habitat within the study area in accordance with the relevant good practice

[1] Ordnance Survey National Grid reference system used throughout the report.

survey guidance, planning policies and legislative framework. Freshwater macro-invertebrate surveys were undertaken on watercourses (streams and ditches) in the study area. Ponds and canals found within the study area were surveyed using Predictive SYstem for Multimetrics (PSYM) surveys to assess their ecological quality. River Habitat Surveys (RHS) were included in the commission for the aquatic ecology surveys however watercourses within the study area did not meet the criteria which qualified them for assessment using this survey methodology (Environment Agency, 2003). As a result, River Habitat Surveys have not been considered any further for assessment.

The key objectives of surveys and assessment are listed below:

- Identify freshwater macro-invertebrate community composition in watercourses in the study area;
- Assess freshwater macro-invertebrate and macrophyte communities in ponds within the study area and freshwater macro-invertebrate communities in canals within the study area;
- Provide an evaluation for the freshwater macro-invertebrate populations in waterbodies (streams, ditches, ponds and canals) and macrophyte communities in ponds in the study area based on guidance from CIEEM (CIEEM, 2018) and Highways England's Design Manual for Roads and Bridges LA 108 Biodiversity (Highways England *et al.*, 2020); and
- Provide sufficient information to inform both the project design and an assessment of potential impacts on surveyed freshwater macro-invertebrate and macrophytes communities associated with the scheme so that the appropriate mitigation hierarchy can be followed and opportunities for enhancement can be developed.

1.4 Legislation, Planning Policy and Biodiversity Framework Background

A summary of the legislation and policy framework for aquatic ecology receptors is summarised below.

1.4.1 Legislation and planning policy

The following legislation is considered relevant to the scheme in relation to aquatic ecology receptors:

- The Conservation of Habitats and Species Regulations 2017 and The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (The Habitats Directive);
- Wildlife and Countryside Act 1981 (as amended);
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017;
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive (WFD)); and
- Natural Environment and Rural Communities (NERC) Act 2006 (as amended).

The Habitats Directive (as amended) lists several aquatic macro-invertebrates and macrophytes. Several freshwater macro-invertebrate and macrophyte species are also listed under various schedules of the Wildlife and Countryside Act. This protects the species cited against being taken, killed or intentionally disturbed.

The WFD aims to prevent the deterioration of ecological status of watercourses from existing conditions and put in place measures to ensure waterbodies reach "good ecological status" (or "good ecological potential" in highly modified waterbodies). Freshwater macro-invertebrate populations form part of the biological quality elements which are routinely assessed to determine the ecological status of waterbodies.

The National Planning Policy Framework (NPPF) (MHCLG, 2019) and the NERC Act 2006 places a duty on all public bodies including local planning authorities to have regard to habitats and species of Principal Importance listed in Section 41 of the NERC Act and Priority Species/Habitats within Biodiversity Action Plans when

considering a planning application. They are also required to consider the conservation of biodiversity in England, when carrying out their normal functions (the biodiversity duty). Several priority species under the act are aquatic, further information is provided in Section 1.4.2

1.4.2 Biodiversity Framework

a) The Natural Environment and Rural Communities Act 2006

Section 41 of the NERC Act 2006 requires the Secretary of State to publish a list of habitats and species which are of principal importance for the conservation of biodiversity in England. There are 56 habitats and 943 species of principal importance which were initially identified as requiring conservation action under the UK Biodiversity Action Plan (BAP) (Department of the Environment,1994) and which continue to be regarded as priorities under the UK Post-2010 Biodiversity Framework (JNCC and Defra, 2012). The Section 41 list is used to guide decision-makers such as public bodies, including local and regional authorities, in implementing their duty under Section 40 of the NERC Act 2006 "to have regard" to the conservation of biodiversity in England, when carrying out their normal functions.

b) Lancashire Biodiversity Action Plan

Local BAPs integrate the conservation measures provided in the UK BAP to enhance biodiversity at the local and regional level. The Lancashire BAP (Lancashire Biodiversity Partnership, undated) contains 11 habitat and 39 species action plans. Six aquatic species are listed under the Lancashire LBAP (see Table 1.1).

Table 1.1 Freshwater macro-invertebrates and macrophyte species listed on the Lancashire BAP.

Scientific name	Common name
Hottonia palustris	Water-violet
Calamagrostis stricta	Narrow small-reed
Blysmus compressus	Flat-sedge
Austropotamobius pallipes	White-clawed crayfish
Margaritifera (Margaritifera) margaritifera	Freshwater pearl mussel
Prostoma jenningsi	Croston worm

2. Methodology

2.1 Desk Study

An initial desk study exercise was undertaken to identify watercourses, ponds and canals which lie within the study area using OS mapping. One stream (a small tributary of the Savick Brook), two ditches, 15 ponds and the Lancaster Canal were identified.

2.1.1 Freshwater macro-invertebrates

The Ecology and Fish Data Explorer (Environment Agency, 2021) was used to identify if any Environment Agency freshwater macro-invertebrate data had been collected within the study area between 2010 to 2021.

2.1.2 Pond and canal (PSYM)

A species record search was completed on data provided by the Lancashire Environment Record Network (LERN) to identify records of freshwater macro-invertebrates in ponds within the study area and the reach of the Lancaster Canal that lies within the study area (2010-2021).

2.1.3 Desk study limitations

The accuracy of data collected from LERN has not been verified.

Species presence and distribution information is relevant to the period that information was collected, and it is acknowledged that colonisation and movement of species can occur at any time during or after this period. Although the data provided by the consultees is the most complete set of species data available, the absence of records should not be taken as an indication of absence of species. Species may be present in any given area but not necessarily recorded or recognised.

2.2 Field Survey

2.2.1 Freshwater macro-invertebrates

Macro-invertebrates are used to detect a range of environmental stressors, such as organic pollution, low flows and habitat quality. All watercourses within the study area were surveyed for macro-invertebrates in September 2020 and March 2021. Sample locations were chosen so that they were within the study area and in an area representative of the habitat within the reach.

Surveys followed standard kick sampling methodology to obtain macro-invertebrate samples from watercourses in addition to the collection of environmental and habitat data (Environment Agency, 2012). Samples were analysed to species level and the data were used to calculate the following macro-invertebrate indices:

- Whalley, Hawkes, Paisley & Trigg (WHPT) metric, Average Score Per Taxon (WHPT ASPT) and Number of Taxa (WHPT NTAXA) (WFD-UKTAG, 2014);
- Community Conservation Index (CCI) (Chadd & Extence, 2004);
- Proportion of Sediment sensitive Invertebrates (PSI) (Extence *et al.,* 2011);
- Lotic-invertebrate Index for Flow Evaluation (LIFE) (Extence *et al*., 1999); and
- River Invertebrate Classification Tool (RICT) and WFD classifications.

The WHPT metric assesses macro-invertebrates in rivers in relation to general degradation, including organic pollution under the WFD (WFD-UKTAG, 2014). Scores are assigned to macro-invertebrate families based on tolerance to pollution, with the final WHPT score taking into account the abundance of each of the families. WHPT ASPT scores are calculated by dividing the WHPT score by the number of scoring taxa (WHPT ASPT) to give an average score per taxon. WHPT and WHPT ASPT scores are used as a measure of water quality; WHPT NTAXA is used as a measure of diversity. In 2014, the WHPT scoring system replaced the Biological Monitoring Working Party (BMWP) scoring system; the WHPT metric is abundance weighted and scores have been revised to be more representative of the family as a whole and reflect general pollution rather than just organic pressures. The BMWP scores are still used within the CCI.

The CCI (Chadd and Extence, 2004) represents the national rarity and diversity of species identified within a site and designates a conservation value to the sampled community. A conservation score based upon each species national rarity is applied to each species. The CCI is calculated from the sum of Conservation Scores divided by the number of contributing species to obtain the mean value. This is then multiplied by the Community Score, derived either from the rarest taxon present or the BMWP score, whichever is higher. The CCI value tends to fall in a range of between 0 and 40 (see Table 2.1). Revised CCI scores used within the Environment Agency have been used, the update includes removal of non-native species scores, updates to reflect change in status and new species not previously included.

Table 2.1 CCI conservation classes (Chadd and Extence, 2004).

Conservation class	Score	Description
Low	<5.0	Site supporting common species and low taxon richness.
Moderate	5.0 to 10.0	Site supporting at least one species with limited distribution or moderate taxon richness.
Fairly High	10.0 to 15.0	Site supporting at least one uncommon species or several of limited distribution or high taxon richness.
High	15.0 to 20.0	Site supporting several uncommon species, one of which may be nationally rare or high taxon richness.
Very High	>20.0	Site supporting several rare species or very high taxon richness.

The PSI scoring system is used to assess the impact of fine sediment accumulation on macro-invertebrate communities (Extence *et al.*, 2011). Species are assigned a score based on their sensitivity to sediment. Calculation of the PSI score takes into account abundances of each scoring taxa. The resulting PSI scores indicate how sedimented the watercourse is; producing a numerical value to quantify a range from minimal sediment/unsedimented to heavily sedimented (see Table 2.2).

Table 2.2 PSI score interpretation (Extence *et al.*, 2011).

PSI	River bed condition
81 - 100	Minimally sedimented/unsedimented
61 - 80	Slightly sedimented
41 - 60	Moderately sedimented
21 - 40	Sedimented
0 - 20	Heavily sedimented

The LIFE (Extence *et al.*, 1999) is used to link macro-invertebrates to flow conditions. Freshwater macro-invertebrates have precise requirements for flow conditions and can be used to determine not only predominant flow types but also changes in flow character. Each species or family within a sample is assigned to a flow group depending on their flow/velocity preference. A high LIFE score represents a higher number of taxa with a preference for high velocity habitats and vice versa.

The RICT is used to classify macro-invertebrate data under the WFD. RICT determines the ecological condition of a given location based on a comparison of macro-invertebrate communities observed at each study site, with macro-invertebrate communities observed in a network of reference sites. Reference site selection is based on the similarity of physical attributes with the study site (for example, width, depth, substrate composition, altitude, distance from source and alkalinity).

The RICT reference sites are deemed to be as close as possible to pristine and not impacted by environmental stressors such as pollution, habitat modification or flow stress. Reference sites provide an expected (E) macro-invertebrate community score for that river type. The observed macro-invertebrate community score (O) at a given study site is divided by the expected (E) community score. Reference and bias adjustments are then applied to obtain the Ecological Quality Ratio (EQR).

An EQR score of 1 indicates that the abundance and species richness of the macro-invertebrate community at the subject site is comparable to the reference site, and therefore is not demonstrating environmental stress. The greater the variance of the EQR scores from 1, the greater the environmental stress at the subject site. The EQR scores are assigned to a category from Poor to High, as set out under the WFD. The WFD uses the pollution sensitivity/general degradation (WHPT ASPT) and diversity (WHPT NTAXA) EQR scores to determine whether a watercourse meets Good Ecological Status (GES), or Good Ecological Potential (GEP) for designated heavily modified waterbodies, as required under the Directive. For WFD classification the lower scoring of the WHPT ASPT and WHPT NTAXA EQR scores determines the macro-invertebrate classification of a given site.

2.2.2 Ponds and canal (PSYM)

Canals and ponds differ significantly in their hydrology, morphology and ecology from riverine habitats and, as such, require specific ecological consideration. The desk study found 15 ponds and the Lancaster Canal within the study area. All were targeted for assessment using the standard method for ponds and canals, the Predictive System for Multimetrics (PSYM) assessment method. For canals freshwater macro-invertebrate communities are assessed (Pond Action, 2002). In ponds both freshwater macro-invertebrate and freshwater macrophyte communities are assessed. Further information on macrophytes identified from the Lancaster Canal can be found in the Extended Phase 1 Habitat Survey Report (Jacobs, 2020a).

In both canal and pond PSYM surveys macro-invertebrate sampling consisted of 3-minute hand-net sweeps within each meso-habitat (e.g., flooded marginal grasses or gravel bottomed shallows) present. A further minute was spent searching the water surface and under stones and logs in marginal areas. Samples of macro-invertebrates were identified to family level in the field.

In addition to the above, pond surveys included identification of all wetland plants present within the outer edge of each pond were recorded. A pond net or grapnel was used to sample deeper areas. Where possible, plants were identified to species in the field. Where this was not possible, plants were photographed or bagged and identified in the laboratory.

The following PSYM indices were calculated:

Ponds

Plant metrics:

- Number of submerged and marginal (not floating) species (SM) – indicates species richness of a site;
- Number of uncommon plant species (U) – measures conservation value of a community; and
- Trophic Ranking Score (TRS) – indicates nutrient tolerance on a scale of 1 to 10 (10 = very tolerant).

Macro-invertebrate metrics:

- Average score per taxon (ASPT) – indicates average pollution tolerance of macro-invertebrates within a community;
- Number of Odonata and Megaloptera families (OM) – indicates long-term quality of a pond as larvae have a long aquatic life stage; and
- Number of Coleoptera families (CO) – indicates the habitat quality and diversity of a pond.

For pond surveys observed data was compared with predicted values and used to generate Ecological Quality Indices (EQIs) by the Freshwater Habitats Trust (formerly Pond Conservation). The EQIs determine the Index of Biological Integrity (IBI), which is interpreted as an overall percentage and quality class. Ponds meeting 'High' quality or above qualify as Habitats of Principal Importance under the UK BAP, as do those which contain Species of Principal Importance.

Canals

Macro-invertebrate metrics:

- ASPT;
- Number of Ephemoptera, Plecoptera and Trichoptera (EPT) – indicates water quality as species from these groups are generally intolerant to pollution;
- Number of Coleoptera families (CO); and
- Number of invertebrate families – indicates the diversity of the macro-invertebrate community.

The Freshwater Habitats Trust does not currently undertake canal PSYM analysis because reliable data on key predictive variables, particularly canal boat-traffic, are no longer publicly available to them. As a result, no quality class can be produced for canal PSYM surveys however the macro-invertebrate metrics listed above can be calculated.

2.2.3 Field study limitations

At the time of survey, the PWD/EWLR construction was underway and certain access exclusion zones were pre-determined prior to survey. In addition to this, the narrow linear section of the scheme boundary formed a haul road and construction area for the PWD/EWLR scheme; therefore, no land along this linear section was accessed. Pond 21 could not be accessed for PSYM survey as the construction related area blocked safe access (Figure 2, Appendix B).

The analysis of data using RICT requires conductivity readings taken in the field at the time of sampling. Conductivity readings were not taken in March 2021 due to instrument failure. The value for conductivity taken from September 2021 was used for the RICT analysis of data from both September 2021 and March 2021. The September 2021 values are typical of the type of watercourse identified and there is no reason to suggest that these readings would not be representative of March 2021 conditions.

The PSYM method developed by the Freshwater Habitat Trust (Pond Action, 2002) is designed for use in June, July and August however PSYM surveys completed as part of this study were completed slightly outside of this window between the 1st and 3rd September 2020. This is not considered to represent a significant deviation from the preferred survey window.

The Freshwater Habitats Trust does not currently undertake canal PSYM analysis because reliable data on key predictive variables, particularly canal boat-traffic, are no longer publicly available to them. As a result, no quality class can be produced for canal PSYM surveys.

Species presence and distribution information for the field study is relevant to the period that information was collected, and it is acknowledged that colonisation and movement of species can occur at any time during or after this period. Species may be present in any given area but not necessarily recorded or recognised during surveys.

The limitations to the surveys do not represent a significant constraint to adequately assessing the value of aquatic habitats for the purposes of undertaking an appropriate ecological impact assessment, with high confidence in the outcome. Where limitations are known, they are acknowledged in the evaluation of the results.

The findings of this report represent the professional opinion of qualified ecologists and do not constitute professional legal advice. This report should be read in full and excerpts may not be representative of the findings. The client may wish to seek professional legal interpretation of the relevant wildlife legislation cited in this document. This report has been prepared exclusively for Jacobs' client and no liability is accepted for any use or reliance on the report by third parties.

2.3 Evaluation

Ecological Impact Assessment uses a hierarchical geographic framework to assign importance to ecological features. This is based on an understanding of how the ecological feature may contribute to the conservation status or distribution of the species or habitat at a particular geographic scale. It involves an assessment of the biodiversity importance of ecological features and also involves consideration of other factors that can be attached to ecological features including ecosystem services and natural capital (CIEEM, 2018). The evaluation is based on professional judgement[1] using up-to-date survey information, local knowledge and available data sources. Opinions may differ slightly between professionals as to the value of ecological features/biodiversity resources; therefore, a clear explanation is provided to justify how the evaluation category has been assigned.

The new Design Manual for Roads and Bridges (DMRB) LA 108 Biodiversity (formerly Volume 11, Section 3, Part 4 Ecology and Nature Conservation and IAN 130/10) guidance (Highways England *et al.*, 2020) and the Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in the UK and Ireland; Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2018) recommends that the value/importance of a biodiversity resource/ecological feature be considered within a defined geographical context. The geographic categories stated in the two sets of guidance differ slightly but are largely comparable. Therefore, the value/importance of biodiversity resources within the study area were assessed according to the following defined geographical framework as per current CIEEM (2018) and Highways England *et al.* (2020) guidance[2]:

- International and European (International or European);

[1] Professional judgement requires a trained and appropriately experienced individual to apply their skills and knowledge to reach an informed decision, as per British Standard 42020:2013. Biodiversity - Code of practice for planning and development (The British Standards Institution, 2013).

[2] The CIEEM (2018) value is given first with the corresponding Highways England (2020) value given in brackets where applicable.

- National (UK or National);
- Regional (Regional) e.g. North-West England;
- Metropolitan, County, Vice County or other local authority-wide area (County or equivalent authority) e.g. Lancashire;
- River Basin District (CIEEM only). District is used herein as a geographic frame of reference e.g. Preston;
- Estuary System/Coastal cell (CIEEM only); and
- Local (Local) (e.g., within 2km of the scheme).

3. Results

3.1 Desk Study

3.1.1 Freshwater macro-invertebrates

No Environment Agency freshwater macro-invertebrate sampling locations were identified from watercourses within the study area (Ecology and Fish data explorer, 2021).

3.1.2 Ponds and canal (PSYM)

Fifteen ponds were identified as suitable for PSYM survey within the study area.

No macro-invertebrate or macrophyte species records were found from ponds or the reach of the Lancaster Canal within the study area from the LERN data between 2010 and 2021.

3.2 Field Study

3.2.1 Freshwater macro-invertebrates

Freshwater macro-invertebrates were sampled in spring and autumn at three survey locations (Stream, Ditch 1 and Ditch 2 see Figure 1, Appendix A). The surveyed reach of the stream was straight, approximately 1m wide and 6-10cm deep. The channel flows through agricultural fields and is sporadically tree lined on both banks. The habitat consisted of areas of riffle and run with substrate comprising mostly of cobbles, pebbles, gravel and silt. Heavy filamentous algae coverage was observed during both site visits suggesting that the watercourse receives a high nutrient input, likely from the surrounding agricultural landscape which was primarily being used for arable farming.

Both ditches surveyed were observed to be straight, agricultural field drains which were approximately 0.5m wide and 5-15cm deep. The substrate in both ditches consisted entirely of silt and clay. For ditch 1, on the right riparian zone the construction of the PWD scheme was underway at the time of survey and the left riparian zone consisted of improved pasture. Ditch 2 flowed through fields of improved pasture.

Biological metrics were calculated for all samples and are provided in Table 3.1. Across the study area WHPT scores ranged between 25.3 – 57.6. WHPT ASPT scores ranged between 3.01 - 3.94; suggesting species more tolerant of poor water quality were prevalent. WHPT NTAXA scores varied at each of the three sites ranging from 8 – 12 at the stream site and 11 – 15 at the ditch sites. Biological scores were typical of poor-quality lowland freshwater stream and ditch habitats.

The macro-invertebrate communities sampled in 2020 and 2021 have LIFE scores which ranged from 5.64 – 7.6 with slightly higher LIFE scores in the stream sampled when compared to those from the ditches. Higher LIFE scores indicate a higher number of taxa with a preference for faster flows.

The PSI scores across the study area ranged from 0.00 to 28.57. Macro-invertebrate communities at all sites indicate a heavily sedimented environment. One exception was the stream in March 2021 which was classed as sedimented. This indicates that that macro-invertebrate communities at the surveyed sites are typical of a sediment dominated habitat.

The CCI scores ranged from low to moderate across the study area and no species of conservation interest were recorded.

Table 3.1 Biological metrics for freshwater macro-invertebrates sampled in 2020 and 2021.

Site	Grid reference	Survey date	WHPT	WHPT NTAXA	WHPT ASPT	LIFE (sp)	PSI (sp)	CCI
Stream	SD 48867 31515	Autumn 2020	36.1	12	3.01	7	11.76	5.25
		Spring 2021	25.3	8	3.16	7.6	28.57	6
Ditch 1	SD 48506 31500	Autumn 2020	57.6	15	3.84	6.67	19.05	5
		Spring 2021	48.2	13	3.71	6	17.39	4
Ditch 2	SD 48867 31515	Autumn 2020	43.3	11	3.94	5.64	0.00	6.00
		Spring 2021	50.9	13	3.92	6.25	9.52	4.29

RICT was performed on the data collected from the stream sampling location; Table 3.2 provides the EQRs and WFD Classifications. Both samples failed to meet WFD Good status; in autumn 2020 the macro-invertebrate community was classed as Poor status and in spring 2021 Bad status. This indicates the composition of the freshwater macro-invertebrate community significantly deviated from reference conditions and reflects the potential nutrient enrichment from adjacent land.

Table 3.2 EQR scores and WFD classifications for macro-invertebrate communities in the stream surveyed in 2020 and 2021.

Site	Grid reference	Survey date	Index	EQR	Class	Confidence of class	Overall Classification
Stream	SD 48867 31515	Autumn 2020	WHPT ASPT	0.52	Bad	100	Poor
			WHPT NTAXA	0.55	Poor	100	
		Spring 2021	WHPT ASPT	0.51	Bad	100	Bad
			WHPT NTAXA	0.42	Bad	100	

RICT was not performed on data collected from the ditches as RICT does not contain any reference sites for this habitat type.

Full freshwater macro-invertebrate survey data is shown in Appendix C.

3.2.2 Ponds and canal (PSYM)

The pond PSYM surveys were undertaken on 12 ponds within the study area. Other ponds were dry or inaccessible at the time of survey (see Figure 2, Appendix B). The pond PSYM classification and key outputs are summarised in Table 3.3. Full PSYM output data is presented in Appendix D.

Table 3.3 Summary of pond PSYM results.

Pond	Grid reference	Survey date	Index of Biotic Integrity (%)	PSYM quality category
Pond 1	SD 49626 31598	02/09/20	11	Very poor
Pond 4	SD 49860 31308	02/09/20	11	Very poor
Pond 6	SD 49770 31305	02/09/20	17	Very poor

Pond	Grid reference	Survey date	Index of Biotic Integrity (%)	PSYM quality category
Pond 7	SD 49713 31346	02/09/20	39	Poor
Pond 9	SD 49478 31340	02/09/20	28	Poor
Pond 11	SD 49205 31490	02/09/20	11	Very poor
Pond 12	SD 49107 31535	02/09/20	17	Very poor
Pond 17	SD 49330 31093	02/09/20	28	Poor
Pond 20	SD 48772 31940	01/09/20	11	Very poor
Pond 23	SD 48640 31440	01/09/20	33	Poor
Pond 24	SD 48970 31520	01/09/20	33	Poor
Pond 25	SD 48483 31180	03/09/20	33	Poor

The overall IBI was low for the majority of the ponds surveyed, and these ponds demonstrated a lack of Odonata and Megaloptera (alderfly and dragonfly families), and the number of Coleoptera (beetle families) observed was generally much lower than expected. The PSYM classification for all ponds was Poor or below.

A single canal PSYM survey was undertaken on the Lancaster Canal. The metrics produced from the canal PSYM are summarised in Table 3.4. The ASPT score suggests that the macro-invertebrate community present consisted of families which are less pollution sensitive. No Ephemoptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) families were recorded and one Coleoptera (beetle) family was recorded. Overall, 10 freshwater macro-invertebrate species were recorded during the survey.

Table 3.4 Summary of Canal PSYM metrics

Metric	Value
Average score per taxon (ASPT)	4.4
Number of Ephemoptera, Plecoptera and Trichoptera (EPT)	0
Number of Coleoptera families (CO)	1
Number of invertebrate families	10

4. Evaluation

4.1.1 Freshwater macro-invertebrates

Many of the observed species were ubiquitous to aquatic habitats with indistinct habitat preferences. No species of conservation interest were identified. Using the CIEEM guidelines for Ecological Impact Assessment (CIEEM, 2018) and DMRB LA 108 – Biodiversity (Highways England *et al.*, 2020) the macro-invertebrate communities at the stream and both ditches surveyed have been evaluated as of **less than Local** importance.

4.1.2 Ponds and canal (PSYM)

All ponds surveyed using the PSYM methodology were classified as Poor or below and no macro-invertebrate or macrophyte species of conservation interest were found. Using the CIEEM guidelines for Ecological Impact Assessment (CIEEM, 2018) and DMRB LA 108 – Biodiversity (Highways England *et al.*, 2020) macro-invertebrate and macrophyte communities identified from all surveyed ponds within the study area have been evaluated as of **less than Local** importance. It is noted that ponds within the study area have been reported to be used by species of principal importance (NERC Act, 2006) such as great created newt (*Triturus cristatus*) and common toad (*Bufo bufo*) (Jacobs, 2020b). As a result, the collective pond network within the survey area is considered to be of **Local** importance for biodiversity.

The Freshwater Habitats Trust is not currently undertaking analysis of canal PSYM data and therefore the classification of the surveyed site on the Lancaster Canal indicating ecological quality is not known. Macro-invertebrate metrics calculated indicated that the community had a low ASPT score and low number of invertebrate families. Using the CIEEM guidelines for Ecological Impact Assessment (CIEEM, 2018) and DMRB LA 108 – Biodiversity (Highways England *et al.*, 2020) the macro-invertebrate community identified from the reach of the Lancaster Canal within the study area has been evaluated as of **less than Local** importance. Despite this it is acknowledged that the Lancaster Canal is designated as a Biological Heritage Site (BHS) for a variety of botanical, invertebrate, bird and bat interests and as a result, the canal is considered to be of **County** importance (further information can be found in the Extended Phase 1 Habitat Survey Report (Jacobs, 2020a).

5. Conclusions and Recommendations

The main conclusions drawn from the aquatic ecology assessment are as follows:

- A total of three watercourses (one stream, two ditches) were subject to freshwater macro-invertebrate community assessment;
- Many of the freshwater species were ubiquitous to aquatic habitats with indistinct habitat preferences. Pollution tolerant species were prevalent in the community, and no macro-invertebrate conservation species of interest were identified;
- The macro-invertebrate communities at the stream and both ditches surveyed have been evaluated as of **less than Local** importance;
- Twelve ponds were subject to PSYM survey. All ponds were classified as Poor or below;
- Macro-invertebrate and macrophyte communities at all surveyed ponds have been evaluated as of **less than Local** importance;
- It is noted the network of waterbodies present within the survey area are considered to provide suitable habitat for species of conservation importance such as great crested newt and the common toad and therefore overall ponds are evaluated as of **Local** importance.
- The Lancaster Canal was subject to PSYM survey. Although classification of the ecological status of the canal was not possible the results available suggest that macro-invertebrate community present was comprised of families which are tolerant to pollution ;
- The macro-invertebrate community identified from the reach of the Lancaster Canal within the study area has been evaluated as of **less than Local** importance; and
- It is noted that the Lancaster Canal is a BHS and as a result is considered to achieve an overall value of **County** importance.

A robust assessment of the potential effects on aquatic habitats associated with the scheme is to be detailed within the Ecology Chapter (Volume 2. Chapter 6) of the ES, along with any prescribed avoidance, mitigation and compensation measures, opportunities for enhancement, requirements for pre and/or post construction surveys and an assessment of residual impacts (where appropriate).

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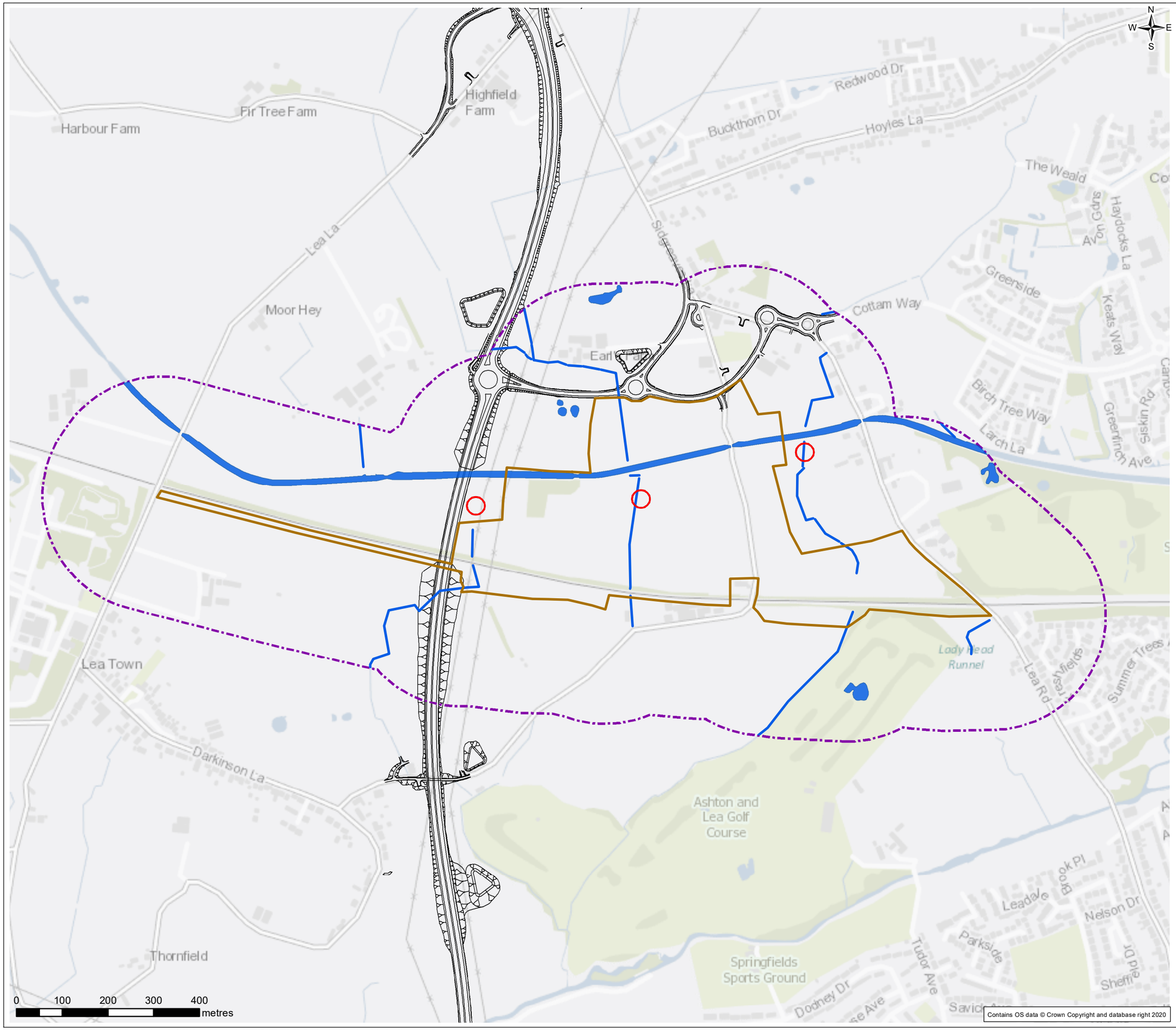
Appendix A. Figure 1 Freshwater macro-invertebrate survey locations

FIGURE 1



Legend

- PWD Route
- Site Area
- Study Area
- Watercourse
- Freshwater Macro-invertebrate Survey Location

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	01/04/2021	Initial Issue	RW	AP	RK	PH

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Drawing Title: FRESHWATER MARCO-INVERTEBRATE SURVEY LOCATIONS

FINAL

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Jacobs No.	B2327FEF	

B2327FEF-JAC-EBD-00-DR-ENV-0030

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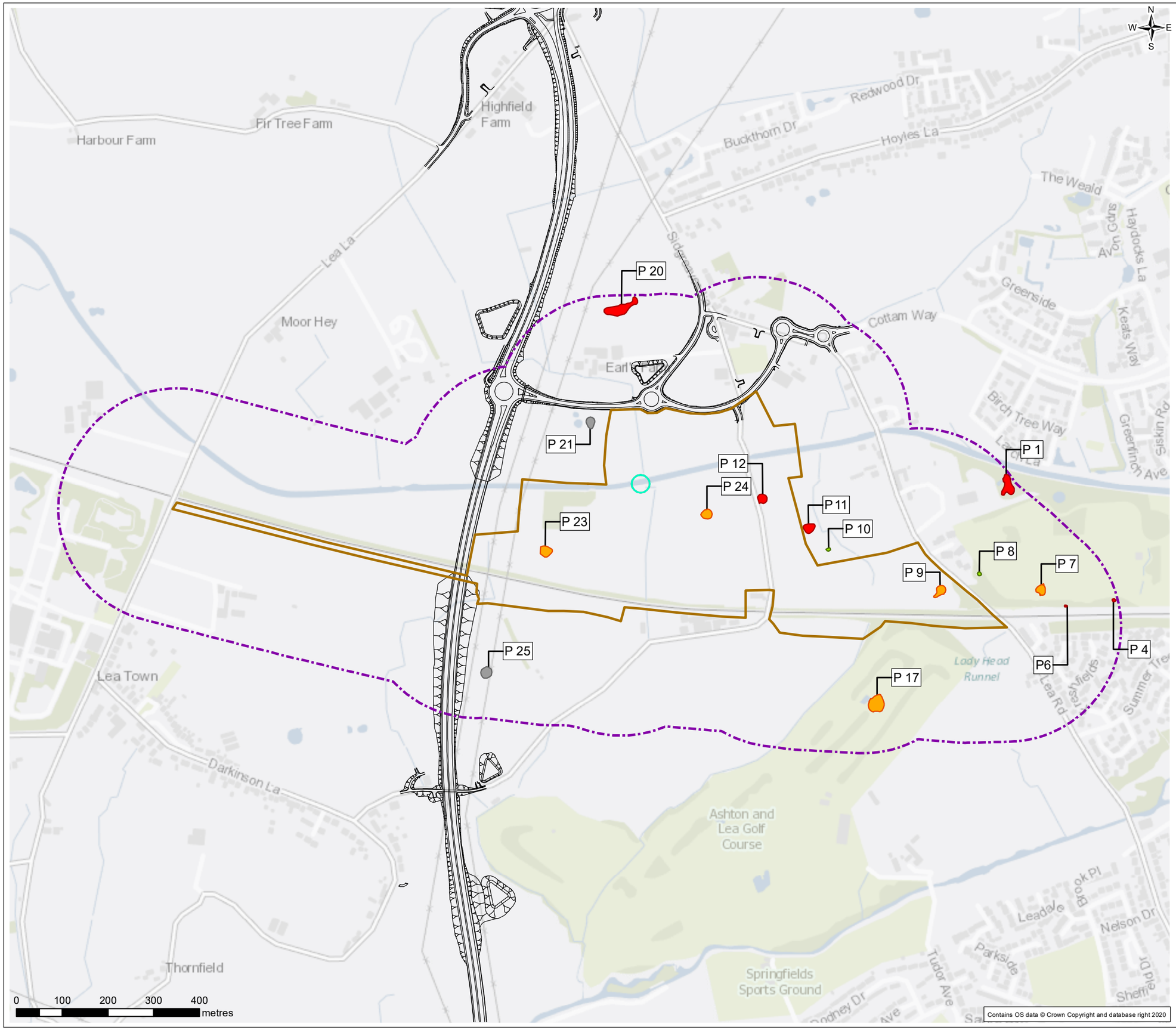
Appendix B. Figure 2 PSYM survey results

FIGURE 2

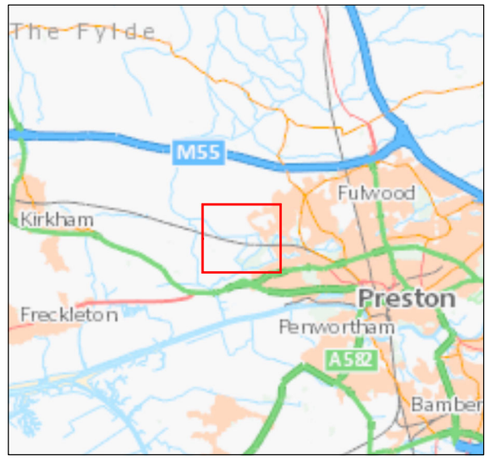


Legend

- PWD Route
- Site Area
- Study Area
- Canal PSYM Survey Location

Pond PSYM Results

- Dry
- Poor
- Very Poor
- Not Surveyed



Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	01/04/2021	Initial Issue	RW	AP	RK	PH

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Appendix C. Freshwater macro-invertebrate survey data

Species	Stream	Stream	Ditch 1	Ditch 1	Ditch 2	Ditch 2
	01-Sep-20	04-Mar-21	01-Sep-20	04-Mar-21	02-Sep-20	04-Mar-21
	SD 48867 31515		SD 48506 31500		SD 48506 31500	
Agabus bipustulatus	0	0	0	0	1	0
Agabus sp.	2	0	0	0	13	0
Anacaena globulus	0	0	0	0	0	1
Anacaena sp.	0	0	0	0	28	0
Asellus aquaticus	10	8	466	1052	91	52
Baetis rhodani	0	2	0	0	0	0
Baetis rhodani/atlanticus	4	2	0	0	0	0
Baetis sp.	1	0	0	0	0	0
CERATOPOGONIDAE	0	1	0	12	0	5
Chelifera sp.	0	0	2	0	0	0
Chironomidae	185	533	1214	107	56	184
CORIXIDAE	0	0	1	0	0	0
Crangonyx pseudogracilis/floridanus	1	0	4	0	2	3
Dicranota sp.	0	0	1	6	0	0
Diptera	0	1	0	1	1	1
Dugesia lugubris/polychroa	0	0	0	0	1	0
DYTISCIDAE	0	0	0	0	5	0
ERPOBDELLIDAE	0	0	3	0	0	0
Galba truncatula	0	0	0	2	0	1

Gammarus fossarum/pulex agg	0	0	46	409	0	3
Gammarus pulex	0	0	130	394	0	1
Helobdella stagnalis	2	0	0	0	0	0
Helophorus brevipalpis	0	0	0	0	0	1
Helophorus grandis	0	0	2	0	2	0
Helophorus sp.	0	0	0	1	0	0
Hemerodromia sp.	0	0	0	40	0	0
Hydrobius fuscipes	0	0	0	0	9	0
HYDROPHILIDAE	0	0	0	0	2	0
Hydroporus memnonius	0	0	0	0	1	0
Hydroporus planus	0	0	0	0	3	0
Hydroporus sp.	0	0	1	0	0	0
Ilybius fuliginosus	0	0	0	0	1	0
Limnephilus lunatus	0	0	0	1	0	0
Oligochaeta	762	1139	2	10	68	11
Oribati	0	0	2	0	0	0
Ostracoda	2	0	3	435	0	0
Pericoma sp.	0	0	0	9	0	0
Physa fontinalis	17	0	0	0	0	1
Pilaria sp.	0	0	0	1	0	1
Pisidium sp.	9	1	5	30	79	205
Plectrocnemia conspersa	0	0	0	0	0	1
Polycelis nigra/tenuis	0	0	3	31	1	0
Polycelis sp.	0	0	0	0	0	1

Potamopyrgus antipodarum	1	0	0	0	0	0
Proasellus meridianus	0	0	0	0	1	0
PSYCHODIDAE	0	0	6	0	0	0
Radix balthica	0	0	1	0	0	0
Sialis lutaria	0	0	0	1	0	0
SIMULIIDAE	2349	251	7	0	0	0
SPHAERIIDAE	0	1	0	0	0	0
SUCCINEIDAE	0	0	2	0	20	0
TIPULIDAE	0	0	0	0	2	0
Tricladida	0	0	0	0	1	0
Trocheta subviridis	6	1	1	0	1	0

Appendix D. Pond PSYM survey results

Site Name	Pond 1	Pond 4	Pond 6	Pond 7	Pond 9	Pond 11	Pond 12	Pond 17	Pond 20	Pond 23	Pond 24	Pond 25
Survey date	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	01-Sep-20	01-Sep-20	01-Sep-20	03-Sep-20
Grid reference	SD 49626 31598	SD 49860 31308	SD 49770 31305	SD 49713 31346	SD 49478 31340	SD 49205 31490	SD 49107 31535	SD 49330 31093	SD 48772 31940	SD 48640 31440	SD 48970 31520	SD 48483 31180
No. of submerged + marginal plant species (not including floating leaved)	0	1	1	2	3	3	3	2	0	4	0	3
Number of uncommon plant species (U)	0	0	0	0	0	0	0	1	0	0	0	0
Trophic Ranking Score (TRS)	0	8.75	10.00	8.50	9.50	10.00	9.67	8.55	0.00	8.83	9.00	8.43
ASPT	3.50	3.80	4.29	3.70	4.14	4.00	3.86	3.90	3.63	4.00	5.00	4.29
Odonata + Megaloptera (OM) families	0	0	0	1	0	0	0	1	0	1	0	3
Coleoptera families	1	0	1	1	3	0	1	0	0	2	2	1
Altitude (m)	20	20	24	15	22	25	21	16	25	22	21	20
Easting	3496	3498	3497	3497	3494	3492	3491	3493	3487	3486	3489	3484
Northing	4315	4313	4313	4313	4313	4314	4315	4310	4319	4314	4315	4311
Shade (%)	40	0	5	40	0	0	10	10	30	10	0	10
Inflow (0/1)	0	0	0	1	0	0	0	0	0	0	0	0
Grazing (%)	0	0	0	0	100	30	80	0	50	50	100	25
pH	7.42	7.87	7.8	7.82	7.5	7.43	7.74	7.95	6.95	8.13	8.8	7.47

Site Name	Pond 1	Pond 4	Pond 6	Pond 7	Pond 9	Pond 11	Pond 12	Pond 17	Pond 20	Pond 23	Pond 24	Pond 25
Survey date	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	01-Sep-20	01-Sep-20	01-Sep-20	03-Sep-20
Emergent plant cover (%)	0	30	5	5	95	70	5	10	1	20	0	5
Base clay (1-3)	3	3	3	3	3	3	2	3	3	3	3	3
Base sand, gravel, cobbles (1-3)	1	1	1	1	1	1	2	1	1	1	1	1
Base peat (1-3)	1	1	1	1	1	1	1	1	1	1	1	1
Base rock (1-3)	1	1	1	1	1	1	1	1	1	1	1	1
Area (m^2)	314	28	78	314	78	706	201	1300	5026	706	314	314
Predicted (SM)	17.6	16.5	16.8	17.5	18.1	18.5	16.7	20.3	21.8	19.2	17.4	18.1
Actual (SM)	0.0	1.0	1.0	2.0	3.0	3.0	3.0	2.0	0.0	4.0	0.0	3.0
EQI (SM)	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.0	0.2	0.0	0.2
IBI (SM)	0	0	0	0	0	0	0	0	0	0	0	0
Predicted (U)	3.1	3.3	3.3	3.0	3.8	3.9	2.9	3.7	4.2	3.4	3.0	3.7
Actual (U)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
EQI (U)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
IBI (U)	0	0	0	0	0	0	0	1	0	0	0	0
Predicted (TRS)	7.95	6.61	6.85	8.17	6.23	6.38	7.91	7.64	7.34	7.77	8.08	6.74
Actual (TRS)	0.00	8.75	10.00	8.50	9.50	10.00	9.67	8.55	0.00	8.83	9.00	8.43
EQI (TRS)	0.00	1.32	1.46	1.04	1.52	1.57	1.22	1.12	0.00	1.14	1.11	1.25
IBI (TRS)	0	0	0	3	0	0	0	1	0	1	1	0
Predicted (ASPT)	5.10	5.07	5.07	5.17	5.11	5.09	5.05	5.13	5.14	5.09	5.06	5.09
Actual (ASPT)	3.50	3.80	4.29	3.70	4.14	4.00	3.86	3.90	3.63	4.00	5.00	4.29

Site Name	Pond 1	Pond 4	Pond 6	Pond 7	Pond 9	Pond 11	Pond 12	Pond 17	Pond 20	Pond 23	Pond 24	Pond 25
Survey date	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	02-Sep-20	01-Sep-20	01-Sep-20	01-Sep-20	03-Sep-20
EQI (ASPT)	0.69	0.75	0.85	0.72	0.81	0.79	0.76	0.76	0.71	0.79	0.99	0.84
IBI (ASPT)	1	2	2	2	2	2	2	2	2	2	3	2
Predicted (OM)	3.24	3.17	3.07	3.32	3.38	3.12	3.02	3.15	3.19	3.10	3.02	3.10
Actual (OM)	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	3.00
EQI (OM)	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.32	0.00	0.32	0.00	0.97
IBI (OM)	0	0	0	1	0	0	0	1	0	1	0	3
Predicted (CO)	3.76	3.72	3.72	3.83	3.76	3.75	3.72	3.78	3.79	3.75	3.72	3.74
Actual (CO)	1.00	0.00	1.00	1.00	3.00	0.00	1.00	0.00	0.00	2.00	2.00	1.00
EQI (CO)	0.27	0.00	0.27	0.26	0.80	0.00	0.27	0.00	0.00	0.53	0.54	0.27
IBI (CO)	1	0	1	1	3	0	1	0	0	2	2	1
Sum of Individual Metrics	**2**	**2**	**3**	**7**	**5**	**2**	**3**	**5**	**2**	**6**	**6**	**6**
Index of Biotic Integrity (%)	**11%**	**11%**	**17%**	**39%**	**28%**	**11%**	**17%**	**28%**	**11%**	**33%**	**33%**	**33%**
PSYM quality category (IBI >75%=Good, 51-75%= Moderate, 25-50%=Poor, <25%=V Poor)	**Very Poor**	**Very Poor**	**Very Poor**	**Poor**	**Poor**	**Very Poor**	**Very Poor**	**Poor**	**Very Poor**	**Poor**	**Poor**	**Poor**
Is this a Priority Pond? (Good quality category)	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**