HORIZON NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

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Wylfa Newydd Project

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Executive Summary

Jacobs UK Ltd (Jacobs) was commissioned to collect a suite of preliminary ecological data to help characterise Dalar Hir, a possible location for Associated Development as part of the Wylfa Newydd Project.

Baseline ecological surveys on representative and suitable water bodies were used to characterise the watercourses and ponds at Dalar Hir and within a 500m buffer zone where access was possible. The information gathered was used to identify and value habitats and species of conservation importance. This technical report will be used to support any future application for development at the site.

Survey work was undertaken during 2014 in an area of approximately 24 ha. This area comprises three separate sites: a large area to the north of the A55 that has been identified as a location for a Park and Ride Facility and two smaller areas south of the A55 that may receive surface water drainage from the site. The report presents the results of all freshwater surveys undertaken during 2014.

The physical habitat of the watercourses within the Dalar Hir site was characteristic of a semi-rural ditch system, where water features have been resectioned and realigned to serve as field and road drainage. The still water bodies demonstrated different levels of physical habitat modification, with some pond features recognised as part of the sustainable drainage network of ponds serving local infrastructure.

Water quality across the Dalar Hir site was typical of that found within a rural landscape close to a main transport route and varied across the site. Seven out of ten sites sampled for detailed water quality analysis (nutrients, metals and specific pollutants) failed to meet water quality standards used for main rivers (annual average Environmental Quality Standard inland surface waters or Water Framework Directive (WFD)) for one or more determinants.

Watercourses within the study area supported macroinvertebrates indicative of poor habitat diversity, sedimentation and sluggish flow. The main watercourse (D9) was surveyed in two places and was classified as Poor. Macrophyte analysis revealed that the main watercourse (D9) was classified as Good, but the number of truly aquatic groups was generally low because of the ephemeral nature of the ditch systems in the study area. No macroinvertebrates of conservation interest were reported.

Of 11 ponds visited, four were reported as being of poor quality and five were of moderate quality. When analysed with the Predictive SYstem for Multimetrics (PSYM), all ponds were classified as of moderate quality. Two ponds achieved Priority status due to the presence of nationally protected plant species of conservation importance. The PSYM plant indices demonstrate that ponds across the study area are mostly inhabited by commonly occurring, nutrient tolerant species.

Fish surveys were undertaken at three sites, with incidental sightings at a further five sites. The presence of the protected European eel (*Anguilla anguilla)* indicates that watercourses have sufficient connectivity to the sea to allow eel migration across the study area.

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1 Introduction

1.1 Overview

Horizon Nuclear Power Ltd. (Horizon) is currently planning to develop a new Nuclear Power Station on Anglesey as identified in the *National Policy Statement for Nuclear Power Generation (EN-6)* (Department of Energy and Climate Change, 2011). The Wylfa Newydd Project (the Project) will require a number of applications to be made to a variety of regulators. As a Nationally Significant Infrastructure Project under the *Planning Act 2008*, the construction and operation must be authorised by a Development Consent Order.

Jacobs UK Ltd (Jacobs) was commissioned by Horizon to undertake ecological surveys in freshwater and terrestrial environments to inform the various applications, assessments and permits that will be submitted for approval to construct and operate the Power Station and Associated Development.

This report details the current state of freshwater aquatic receptors, based upon field survey work. The report characterises the freshwater habitat at Dalar Hir, a possible location for Associated Development, and examines the species and habitats of conservation interest and current ecological quality at the site.

1.2 Site Description

The site boundary at Dalar Hir is centred on the National Grid Reference SH 32989 78381 to the north-east of Junction 4 of the A55, directly north of the Holyhead Road (A5). This is shown in Figure 1. The land available for the development covers an area of approximately 24ha and largely comprises a network of wetted ditches and ponds within the defined area. The site includes the go-kart track at Cartio Môn and the surrounding fields.

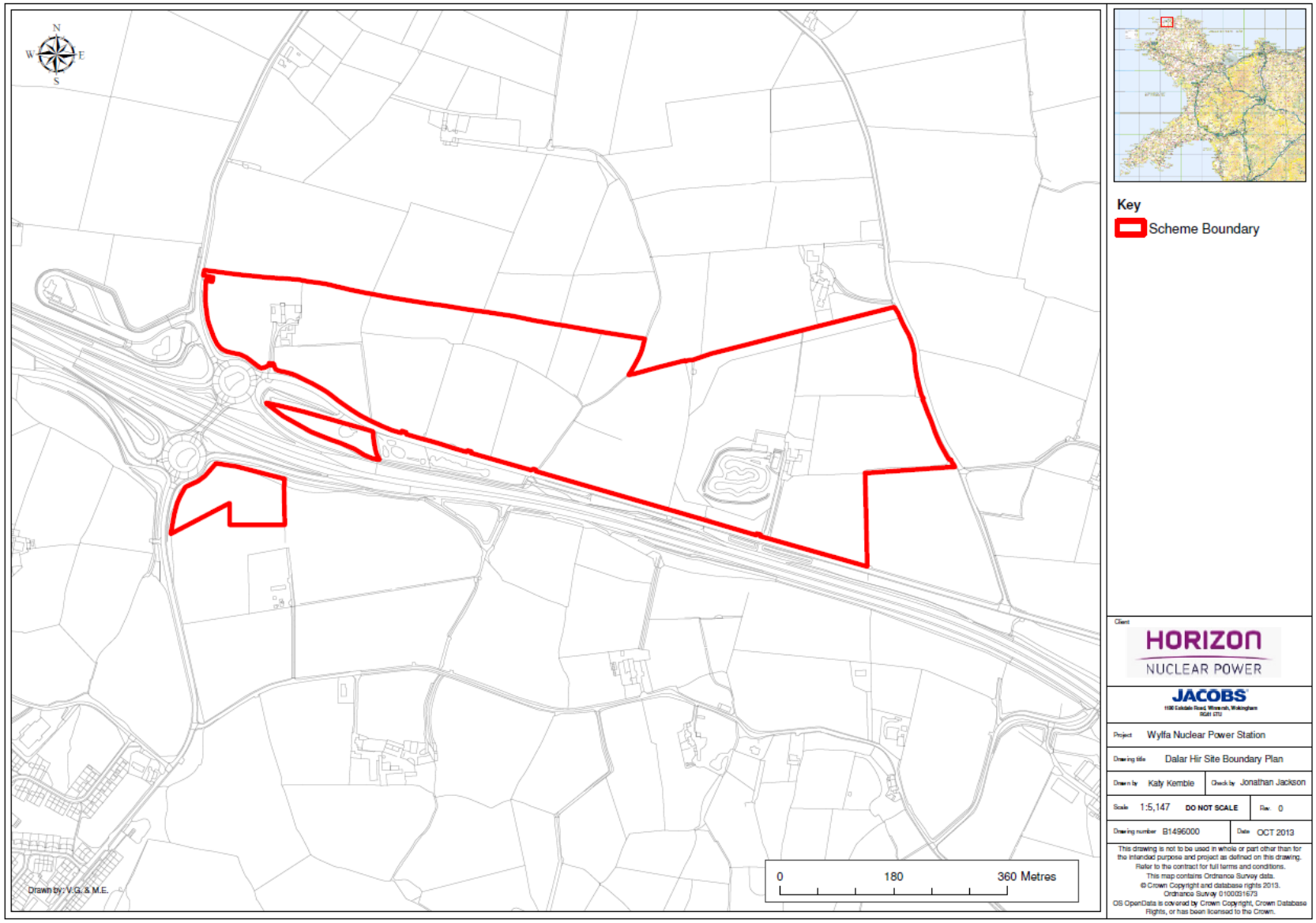

Figure 1: Outline plan of the Dalar Hir site boundary

1.3 Study Aims and Objectives

The objective of the freshwater surveys is to characterise the environment and collect baseline data to inform the various applications, assessments and permits required to construct and operate the infrastructure associated with the Project.

A baseline understanding of the ecological value of the site at Dalar Hir will help inform its potential future use for Associated Development. This report presents the findings of work undertaken during 2014.

By collecting baseline information on the freshwater aquatic receptors, assessments can be made of potential effects on freshwater habitats within the development site boundary and the species they support. Of particular interest to this survey was the presence of any key aquatic species with protected status and habitats which could be defined as protected. Baseline characterisation of the freshwater ecology will help to inform and shape and mitigation that may be considered.

1.4 Previous Work

An Extended Phase 1 Habitat survey of the site was conducted in September 2013 (Jacobs, 2013) (Application Reference Number: 6.6.17). This identified the terrestrial habitats and assessed the need for terrestrial species surveys within the site but did not make any assessment of aquatic receptors within the study area.

Surveys for great crested newt (*Triturus cristatus) and* water vole (*Arvicola amphibius)* were also carried out during 2014 and are reported in Jacobs' terrestrial baseline survey reports (Jacobs, 2014a; 2014b).

2 Methodology

2.1 Desk Study

A desk study was undertaken to gather existing aquatic ecology information and records for Dalar Hir.

The 'Water Watch Wales' interactive tool on the Natural Resources Wales (NRW) website was used to identify Water Framework Directive (WFD) watercourses in the study area and obtain the latest WFD classifications. To obtain publically available ecological information, data requests were submitted to the following organisations:

- NRW (to obtain species lists and analysis outputs of macroinvertebrates, macrophytes, fish and diatoms); and
- Cofnod Local Environmental Records Centre (LERC) (to obtain protected species records).

2.2 Summary of Approach

The desk study identified watercourses and features within the study area using maps and satellite images. From this study, a list of key ecological receptors was compiled and a survey programme developed to enable baseline data collection suitable for assessment of the receptors.

The following surveys were undertaken:

- physical habitat assessment;
- phytobenthos (diatoms);
- water quality;
- macroinvertebrates;
- macrophytes;
- fish; and
- pond surveys.

Receptors were chosen to best represent the existing ecological condition of each site. Methods were selected to be comparable with those tools used by national regulators in assessing ecological status for reporting under the WFD and are outlined in Sections 2.4.1 to 2.4.7 below. The freshwater environment supports a diverse range of floral and faunal communities with a high level of interdependency.

Where physical conditions were not suitable for a particular receptor or where sites lay in close proximity to each other and data could be shared across such sites, the full suite of receptors was not assessed. The receptors and sites have been developed over the course of the survey programme, as more was understood about fluvial connections within the site boundary.

The scope of this work did not include gathering baseline data and undertaking assessment in relation to other riparian fauna such as water vole and great crested newt; these species are considered in technical reports on the terrestrial ecology at the site (Jacobs, 2014).

2.3 Survey Area

The study area at Dalar Hir is shown in Figure 2 together with the aquatic ecology field site locations. A buffer zone of 500m was applied to the site according to Chartered Institute of Ecology and Environmental Management guidelines (IEEM, 2006). The site consists of mainly agricultural land either side of the A55 road. Only the watercourses and still waters within the boundary of the study area were surveyed for this study.

2.3.1 Survey Sites

Approximate survey locations were identified during the desk study, and the suitability of each site for the proposed receptors was assessed during the physical habitat assessment.

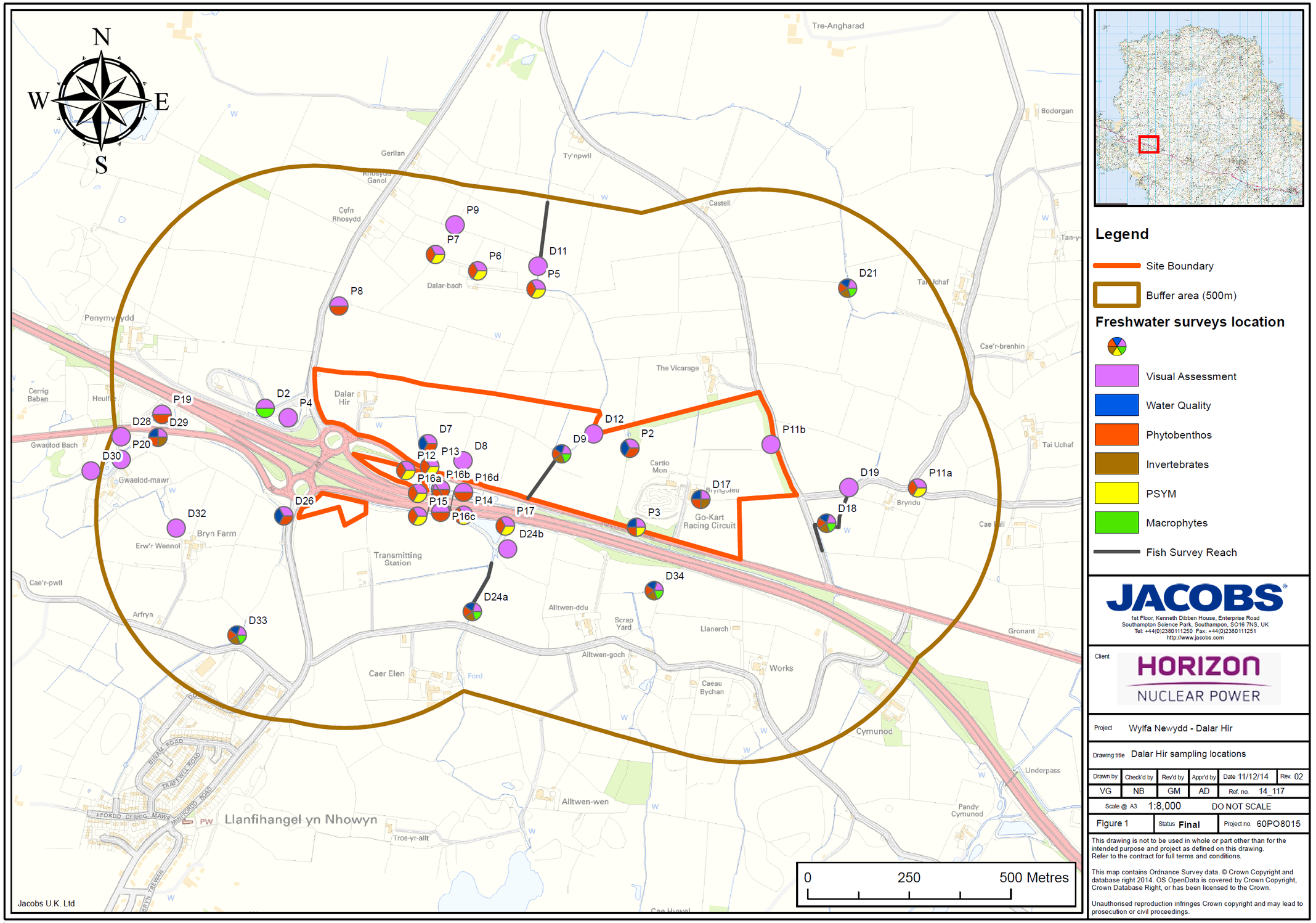

Figure 2: Dalar Hir survey site locations

2.4 Methods

A summary of methods and procedures for each of the individual survey elements is given below for each of the surveys undertaken.

2.4.1 Habitat Characterisation

Physical habitat surveys were undertaken on key reaches within watercourses to characterise the physical habitat and associated biotopes present. Habitat characterisation surveys outlined the physical processes within the channel and riparian zone that may influence aquatic habitat function and species distribution. The surveys also enhanced the understanding of the hydromorphological pressures and potential impacts exerted on the water bodies.

The baseline characteristics served to assess the vulnerability of each watercourse to any potential construction and operational impacts, in terms of:

- sediment regime;
- channel morphology; and
- natural fluvial processes such as planform evolution, or erosion and deposition.

The findings of the baseline survey will be used to inform design development, to assess potential effects in terms of sensitivity and magnitude and contribute to the identification of mitigation measures for the Project.

2.4.2 Phytobenthos (Diatoms)

Phytobenthos refers to a mostly microscopic group of nutrient sensitive organisms found attached to submerged surfaces such as stones and plant stems (WFD-UKTAG, 2014a). For the purpose of this assessment, focus has been placed on diatoms as a tool to assess the nutrient status of watercourses.

At each site, a scrape sample was taken from submerged rocks or plant stems, alongside environmental field data collection. In the majority of cases, solid stable substrate was not available, so stems of bulrush (*Typha* sp.) or rushes (*Juncus* sp.) were used. Permanently wetted, unshaded sites with clear water were chosen. Methods follow the Diatoms for Assessing River and Lake Ecological Quality (DARLEQ2) methodology (Environment Agency, 2007a; WFD-UKTAG, 2014a; 2014b). Samples were fixed using Lugol's Iodine solution and analysed to report species' relative abundance. Data were analysed using the DARLEQ2 tool for WFD classification where possible. The resulting classification was then reported with reference to the macrophyte classification from LEAFPACS2 (also indicative of nutrient status).

2.4.3 Water Quality

Water samples were collected from wetted watercourses and ponds within the study area (Figure 2). Temperature, conductivity, pH, dissolved oxygen percentage saturation and mg L^{-1} were measured *in situ*. Field measurements were collected using a YSI 556 MPS (Multiprobe System) handheld meter calibrated to manufacturer specifications. Additional water samples were collected for nutrients, metals, phenols, polycyclic aromatic hydrocarbons (PAHs) and volatiles in laboratory supplied bottles. Samples were couriered to the National Laboratory Service for analysis.

2.4.4 Macroinvertebrates

Macroinvertebrates are used to detect a range of environmental stressors, such as organic pollution, low flows and habitat quality. Surveys followed standard kick- and sweep-sampling methodology (British Standards Institute, 2012) to obtain macroinvertebrate samples from water bodies in addition to the collection of environmental and habitat data (Environment Agency, 2008; 2012). Samples were analysed to species level and the data were used to calculate the following macroinvertebrate indices.

- **Biological Monitoring Working Party (BMWP) derived indices (Hawkes, 1997):** BMWP score is based on the tolerance of different freshwater macro-invertebrates to organic pollution. The BMWP score is the total of all the scores from a given sample. This score is divided by the number of scoring taxa (NTAXA) to give the average score per taxon (ASPT). NTAXA is therefore a measure of species richness and ASPT is a measure of average pollution tolerance.
- **The Community Conservation Index (CCI) (Chadd and Extence, 2004)**: CCI represents the national rarity and diversity of species identified at a site and designates a conservation value to the sampled community based upon both a species rarity and the overall community richness.
- **Lotic-invertebrate Index for Flow Evaluation (LIFE) (Extence *et al.*, 1999)**: Each species or family within a sample is assigned to a flow group depending on its flow/velocity preference, giving two indices: LIFE (sp) and LIFE (F). A high LIFE score represents a higher number of taxa with a preference for high velocity habitats and vice versa.
- **Proportion of Sediment-sensitive Invertebrates (PSI) (Extence *et al.*, 2011):** Each macroinvertebrate family is assigned a score based on its sensitivity to sediment. The resulting PSI scores indicate how sedimented the watercourse is, from Minimally Sedimented to Heavily Sedimented.

The ecological quality of the macroinvertebrate communities was assessed using the River Invertebrate Classification Tool (RICT) (SNIFFER, 2007). This software generates Ecological Quality Ratios (EQRs) to allow comparison of the above metrics (except CCI) to a network of reference sites. There are limitations with its use, as it does not hold reference sites for manmade, non-flowing or ephemeral water bodies (such as ditches) and it is optimised for data collected in both spring and autumn.

Ponds were also surveyed for macroinvertebrates as part of the separate assessment using a different method, and as such are covered in Section 2.4.7.

2.4.5 Macrophytes

Macrophyte species lists and taxon cover values (TCVs) were compiled from a 100m length of watercourse, alongside local environment data collection. Surveys followed the methods outlined by the Environment Agency (2008b). Data collected were used to calculate a number of macrophyte metrics which support LEAFPACS2 analysis (WFD-UKTAG, 2014c):

- **River Macrophyte Nutrient Index (RMNI)**: Derived from the RMNI scores of the taxa recorded in the field survey, each species is ascribed a score based on its nutrient preferences.

- **Number of Taxa (NTAXA)**: A diversity metric (the number of scoring taxa recorded in the field survey), specifically only taxa which are considered truly aquatic.
- **Number of Functional Groups (NFG)**: A diversity metric of individual taxa which are truly aquatic (i.e. hydrophytes). These are allocated to 24 'functional groups'.
- **Cover of Green Filamentous Algae (ALG)**: This is the percentage cover of green filamentous algae over the whole of the surveyed section of river.

LEAFPACS2 is the standard analytical tool method for the characterisation of watercourses using macrophytes and is used to indicate nutrient status of a watercourse. This classification is then reported with reference to the phytobenthos classification from DARLEQ2, and the lowest result classifies the watercourse for the overall WFD receptor 'macrophytes and phytobenthos'.

2.4.6 Fish

Electric fishing surveys were conducted to identify the presence and population of freshwater fish. Fish surveys were conducted using a standard electric fishing technique (electric fishing backpack unit with single anode) following guidelines developed by the Environment Agency (Beaumont *et al*., 2002; Environment Agency, 2001; Environment Agency, 2007b) and British Standard (BS) EN 14011:2003 (water quality – sampling of fish with electricity) (British Standards Institution, 2003). All electric fishing surveys were conducted under a FR2 licence from NRW, by trained members of staff.

2.4.7 Pond Habitat Assessment

Still waters and ponds differ significantly in their hydrology, morphology and ecology from riverine habitats and, as such, require specific ecological consideration. The standard method used to survey ponds is the Predictive SYstem for Multimetrics (PSYM) assessment method, which evaluates the macroinvertebrate and aquatic plant communities (Pond Action, 2002).

Macroinvertebrate samples were analysed to species level to identify any species of conservation importance, and data were processed using the following PSYM indices:

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).

Macroinvertebrate metrics:

- **average score per taxon (ASPT)** – indicates average pollution tolerance of macroinvertebrates 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.

Observed data was compared with predicted values and used to generate Ecological Quality Indices (EQIs) by Freshwater Habitats (formerly Pond Conservation). EQIs determine the Index of Biological Integrity (IBI), which is interpreted as an overall percentage and quality class. Ponds meeting 'good' quality or above qualify as Priority Ponds, as do those which contain species of conservation concern.

2.5 Limitations

2.5.1 Seasonal Variation

The aquatic sampling regime is in part dictated by seasonal constraints, either due to optimum seasons for sampling, avoiding species-specific sensitive periods and climatic influences on water level and flow types. Standard sampling seasons for aquatic receptors are used whereby spring includes March to May, summer is June to August, autumn is September to November and winter is December to February. Sampling has been undertaken in optimal seasons where possible and timings of data collection do not present any additional limitations for the Project.

2.5.2 Access

Sampling locations were dictated by access agreements with landowners and the use of public footpaths to reach the majority of sites. Where possible, sites without land access agreements in place were assessed at distance from public ground to gain an understanding of physical habitat. Sites were removed from the sampling programme where access permission could not be obtained.

2.5.3 Methodological

As described in 2.4.4, the standard biological metric tools make a comparison between the habitat and species observed on-site, versus a 'best fit' expected condition from reference sites held within the model.

The macroinvertebrate tool has a number of basic parameters that must be met for sites to be classified using the RICT tool. The tool is designed to be used on permanently wetted, flowing watercourses and sites situated beyond 2.5km from their natural source. As a result, there are insufficient reference sites within the RICT tool for ephemeral ditch type water bodies, which are widely represented across the Dalar Hir study area. The use of the classification element of the tool has therefore only been used for the Dalar Hir stream that flows through the middle of the study area. On all other watercourses, the tool can be used to generate biological metrics which can be described in relation to other sites, but no comparison can be made to reference condition. The metrics have been used to infer watercourse value, and the lack of comparative analysis is not considered detrimental to interpretation of the results. Where data confidence is low, this has been identified in the results section.

Most monitoring tools require multiple seasons' data to meet compliance with the standard methodology. The collection of data from the Dalar Hir site is not intended to provide classification of biological metrics, but identify habitats and species that may be affected by development of the site. As a result, multiple season sampling has not been undertaken for all metrics. Where classifications have been assigned on single season data (for example phytobenthos and water quality), the limitations associated with the use of single season data have been identified and discussed within the results section. Providing these limitations are acknowledged and

accounted for in the overall confidence of data, this is not considered to be a limitation to the understanding of the ecology of the site.

3 Results

3.1 Desk Study

No designated sites were recorded within the Dalar Hir site or associated buffer area.

The desk study found that there were only small watercourses (ditches) and ponds within the study area. The study area itself consisted of mainly improved pasture and cultivated land (Jacobs, 2013) (Application Reference Number: 6.6.17).

The NRW interactive mapping tool 'Water Watch Wales' identified that none of the watercourses within the study area are classified under the WFD (NRW, 2016). Water from the study area drains south into the River Crigyll catchment, which had an overall status of Moderate in 2015.

No ecological monitoring data has been collected by NRW within the study area, but there were data available from a routine monitoring site 'At Pant Cymu' 1.5km south-east of Dalar Hir on the River Crigyll. This site is downstream of the minor watercourses in Dalar Hir, which flow into the Llyn Traffwll reservoir before an outflow joins the River Crigyll.

The most recent data from 'At Pant Cymu' in 2014 illustrates that the invertebrate community is highly diverse, with beetle, caddisfly, mayfly, stonefly and mollusc families well represented. These species are likely to occur elsewhere in the catchment where habitat is suitable. In March 2010, *Valvata macrostoma* was identified from this NRW monitoring site. *V. macrostoma* is a rare species in the UK named as a Species of Principal Importance, in accordance with Section 42 of the *Natural Environment and Rural Communities Act 2006*. It is not designated in Wales because it is thought to be absent from the country, restricted to specific habitat types in southern and eastern England (Joint Nature Conservation Committee, 2010). This record should be interpreted with care, as it may not have been verified.

Llyn Traffwll reservoir is a Site of Special Scientific Interest and lies 1km downstream of Dalar Hir. The reservoir is fed by the main tributary draining the Dalar Hir site, described in this report as the Dalar Hir Stream. Designated biological interests within Llyn Traffwll include aquatic flora typical of moderately base-rich lakes, including the uncommon eight-stamened waterwort (*Elatine hydropiper*) and flowering rush (*Butomus umbellatus*). The site is also important for overwintering wildfowl, most importantly shoveler duck (*Anas clypeata*) (Countryside Council for Wales, undated).

The data requested from Cofnod revealed no records of rare or protected species within the site boundary. However, several species of interest were found within 2km of the site to the west and south, particularly from the Llyn Dinam lake and wetland area. These include the Nationally Scarce eight-stamened waterwort (Joint Nature Conservation Committee, 2006), the Nationally Scarce riffle beetle (*Oulimnius troglodytes*) (Foster, 2010) and the flowering rush, which is not on British red lists but is listed on the Welsh Vascular Plants list as Vulnerable (Plantlife, 2008). Although these species are in the catchment of Llyn Dinam, they have potential to be present in the catchment of the River Crigyll, where habitat allows.

3.2 Habitat Characterisation

The majority of watercourses surveyed were small ditches running through rough or improved pasture with mud substrate and low flow (see Appendix A for full commentary on each site).

A number of the watercourses are linked hydrologically. Each watercourse was assigned to a sub-catchment with other interlinked watercourses. The watercourses within each sub-catchment are listed in Table 3-1 below.

Table 3-1: Sampling location assigned to each sub-catchment. Figure 2 details watercourse locations. Appendix A provides physical habitat description of each watercourse.

Sub-catchment	Sampling location
A	D20, D21
B	D18, D19
C	D14, D15, D16, D17
D	D13
E	D34
F	D9, D10, D11, D12 – Dalar Hir Stream (upstream A55)
G	D3, D6, D7, D8
H	D2
I	D1, D4
J	D23, D24 – Dalar Hir Stream (downstream A55)
K	D22
L	D26, D27
M	D33
N	D25, D28, D29
O	D30, D31, D32

Habitat assessments were not carried out at a small number of sites. No access was permitted to D1, D4 or D25 and they could not be visually assessed from a distance. D16 was not assessed, as it is a continuation D17. No aquatic feature could be located at D30 and this was therefore assumed to be dry over the 2014 survey period.

3.3 Phytobenthos (Diatoms)

Twenty-one samples were collected in spring (March) 2014. In total, 131 taxa were identified from the phytobenthos sampling. A single spring sample has been calculated in line with standard WFD classifications. Results have been calculated using average alkalinity where possible.

The results of the phytobenthos samples are shown in Table 3-2. This lists the EQR (observed/expected diatom community) and is coded to match WFD classification for each season. As per the DARLEQ2 guidance, EQR values >1.00 for rivers and >1.25 for lakes (and ponds) have been reported as 1.00 and 1.25 respectively. The minimum number of diatoms was available (minimum 300 valves) for analysis for all of the samples. Overall, the most abundant diatom taxa present were *Eunotia bilunaris* and *Planothidium lanceolatum* respectively.

Table 3-2: Diatom EQRs and ecological quality spring 2014. (Blue = high, green = good, yellow = moderate, orange = poor, red = bad, *sites not all suitable for WFD classification).

Site	Catchment	Spring	Quality*
D7	G	0.94	High
D9	F (J)	0.61	Good
D17	C	0.67	Good
D18	B	1.00	High
D21	A (J)	0.79	Good
D24a	J	0.75	Good
D26	L	1.00	High
D29	N	0.68	Good
D33	M	0.75	Good
D34	E	0.83	High
P2	-	0.54	Moderate
P3	-	0.84	Good
P6	-	0.30	Poor
P12	-	0.66	Moderate
P13	-	0.53	Moderate
P14	-	1.00	High
P15	-	1.00	High
P16a	-	0.96	High
P16b	-	1.00	High
P16c	-	1.00	High
P16d	-	0.62	Moderate

Six of the sites demonstrated a diatom community, better than predicted by the DARLEQ2 tool (EQR >1). This indicates these sites are not influenced by elevated nutrients or organic pollution. This result should be interpreted with caution, however, as the method used to derive EQRs is an alkalinity model and is not based upon physical habitat or flow variables; the presence of the local wetland areas may be influencing the condition of some sites.

Five of the 21 sites surveyed failed to meet at least good quality for diatoms. This indicates a deviation from reference condition and is indicative of environmental stress, with the most likely source being nutrient enrichment. Pond 6 was the only site to achieve poor quality. Pond 3 had the lowest diversity of phytobenthos, with only seven taxa present in the sample.

The presence of elevated concentrations of orthophosphate can affect the phytobenthos community within freshwaters, as orthophosphate is a limiting nutrient. The water quality results show that orthophosphate concentrations were elevated at three of the ten ditch sites, with concentrations of 0.234mg L^{-1} at D9, 0.145mg L^{-1} at D17 and 0.167mg L^{-1} at D24a. Other factors known to influence diatom populations include availability of suitable substrate, amount of shading, grazing/poaching pressures and stability of the substrate.

Although a number of sites failed to reach good quality, this should again be interpreted with caution since the water bodies sampled may not be suitable for WFD assessment e.g. ponds, wetlands and ditches. However, for the purposes of

baseline monitoring for Environmental Impact Assessment, this technique is considered appropriate.

3.3.1 Summary

Diatom populations varied by site with 16 sites out of 21 meeting or exceeding good quality for diatoms.

It should be noted that the tool used was not developed to classify these habitat types. Classifications from these habitat types should be interpreted with caution as a single season EQR was utilised. However, for the purposes of baseline characterisation, this technique provides a valuable tool, particularly for comparisons between seasons/years at a site.

The diatom sampling to date shows that there is a large variability in diatom populations across the site, which would be expected given the diverse range of habitat types assessed. No species of conservation interest were recorded, and community structure was typical of lowland drainage channels set in a semi-rural landscape.

3.4 Water Quality

Physio-chemical parameters were measured using a YSI 556 MPS handheld meter at ten watercourses and twelve ponds within the Dalar Hir site boundary and buffer zone. Water quality samples were collected between 18 and 20 March 2014 with temperature, conductivity, pH and dissolved oxygen measured *in situ*. Additional samples were collected at all ten watercourse sites and two pond sites and couriered to the National Laboratory Service for analysis.

Comparisons to water quality standards have not been made, as only a single survey was obtained in 2014. Classifications are made against an annual average of samples, against which national standards can be compared.

Water quality results for Dalar Hir are presented in Appendix B. Section 3.8.5 details the results of the pond surveys and further summarises the main findings of the water quality at pond sites. Watercourse water quality results are summarised below:

Physio-chemical

- **Temperature** ranged from 8.43°C to 11.6°C across the sites. All temperatures were within expected values for the type of streams sampled.
- **Conductivity** ranged from 188µS cm^{-1} at D19 to 605µS cm^{-1} at D26. Conductivity readings were within expected values for the type of streams sampled.
- **pH** ranged between 5.26 at D34 and 7.03 at D29.
- **Dissolved oxygen** varied across the study area. Dissolved oxygen percent saturation ranged from 31.1% at D17 and P3, to 107 at D29. Variation in dissolved oxygen levels between sites is likely to be largely attributed to changes in flow/water levels, water temperature, the degree of riparian vegetation and macrophyte growth.
- **Biological oxygen demand (BOD)** was either low or below laboratory Mean Reporting Value at the majority of the sites. D17 and D26 had the highest BOD readings of 13mg L^{-1} and 6.59mg L^{-1} respectively.
- **Suspended solids** varied between sample sites, ranging from <3mg L^{-1} at D19 to 733mg L^{-1} at D26.

Nutrients

- **Ammoniacal nitrogen** levels at all sites were either low or below laboratory MRV.
- **Reactive phosphorus** (orthophosphate, reactive as phosphorus) concentrations were below MRV at P3, D19, D26, D29 and D34. Concentrations were elevated at three sites with reactive phosphorus readings of 0.234mg L^{-1} at D9, 0.145mg L^{-1} at D17 and 0.167mg L^{-1} at D24a.

Metals

- **Arsenic** concentrations were low with the highest reading of 8.85µg L^{-1} detected at D26 located adjacent to Minffordd Road. The remaining sites were near or below MRV.
- **Cadmium** levels were all below laboratory MRV with the exception of Site D26 (0.225µg L^{-1}).
- **Chromium** levels were near or below MRV at D9, D18, D21, D29, D24a, D34 and D33. The highest concentrations were detected at D26 where levels were 40.4µg L^{-1}.
- **Copper** levels were low with the exception of D17 and D26, where concentrations reached 10.4µg L^{-1} and 22.9µg L^{-1} respectively.
- **Lead** concentrations were below laboratory MRV at all but two sites – D17 (6.69µg L^{-1}) and D26 (17.4µg L^{-1}).
- **Nickel** concentrations ranged between below laboratory MRV to 4.99µg L^{-1} with the exception of D26, where concentrations were elevated with a reading of 21.4µg L^{-1}.
- **Zinc** concentrations were all low except D17 with a reading of 135µg L^{-1}.
- **Iron** concentrations varied significantly between sites, from 128µg L^{-1} at D18 to 24,700µg L^{-1} at D26.
- **Manganese** was present at all sites ranging from 34.9µg L^{-1} at D18 to 6760µg L^{-1} at D26.
- **Mercury** levels were all below laboratory MRV.

Phenols

- **Phenols** were largely below laboratory MRV, with the exception of 2,4-dimethylphenol and 3-methylphenol at D7; 2-methylphenol at D7 and D17; 4-chloro-3-methylphenol at D26; and 4-methylphenol at D7, D17, D26 and D24a, which were just above MRV.

Polycyclic Aromatic Hydrocarbons (PAHs)

- **PAHs** were all below laboratory MRV.

Volatiles and Others

- **Volatiles** were all below laboratory MRV.

3.4.1 Summary

Water quality spot sampling was carried out at watercourses and ponds found within the Dalar Hir site boundary and 500m buffer zone. The watercourses were generally ephemeral, surrounded by pastoral land with limited riparian vegetation.

Dissolved oxygen saturation varied across the site. This is largely attributed to changes in flow/water levels, water temperature, riparian vegetation, macrophyte growth and the time samples were collected during the day. Dissolved oxygen concentrations vary both seasonally and diurnally due to changes in temperature,

evaporation and plant photosynthesis. The lowest dissolved oxygen concentration was recorded at Pond 6 (28%).

Suspended solids varied across the sites. The highest reading recorded at D26 of 733mg L^{-1} may be the result of the shallow water depth (5cm) at the sample site and the potential mixing of the organic matter/mud substrate into the sample during sample collection.

Nutrient levels in both the ponds and watercourses were generally low, with the exception of reactive phosphorus at D9, D17 and D24a. All these sites are located within a rural setting where there is the possibility that fertiliser application is undertaken on nearby fields. Fertiliser application can contribute to increased nutrients entering surrounding ponds and watercourses.

Metal concentrations were elevated at D17 and D26. Site D17 is located within the site boundary adjacent to a go-kart racing track and house. Although no discharge points were observed on-site, it is possible that runoff from these surrounding land uses may be contributing to slightly elevated copper, chromium and lead concentrations compared to other sites in the area. Site D26 had the highest metal concentrations of all the sites. Water depth at this site was 5cm, with only slight flow observed. This site is adjacent the roundabout connection between Minffordd Road and Holyhead Road, and to the North Wales Expressway. It is likely runoff from surrounding roads enter the watercourse and therefore contribute to metal concentrations. Across the remainder of the study area, there were elevated iron and manganese concentrations at some sites, particularly D7 and D26. Iron and manganese concentrations are often influenced by background levels associated with the local geology. Phenols, PAHs and volatiles were generally below laboratory MRV across all sites.

In summary, water quality across the Dalar Hir site is typical of that found within a rural setting close to a main transport route.

3.5 Macroinvertebrates

Six out of the eleven sites identified for macroinvertebrate surveys were sampled. The remaining five sites had insufficient water levels to collect a representative sample in July 2014. The two sites on the Dalar Hir Stream (D9 and D24a) met the minimum requirements for classification using RICT. The other sampled sites did not meet the criteria for assessment due to their ditch nature, exhibiting ephemeral flow characteristics due to being located within 2.5km of their source.

This section is divided into presentation of results for macroinvertebrate indices (see Section 3.5.1) and results for the WFD classification of eligible sites (see Section 3.5.2).

Ponds were assessed for macroinvertebrates as part of the PSYM methodology, (see Section 3.8).

3.5.1 Macroinvertebrate Indices

Indices were calculated for all sites using the following biological metrics: BMWP scoring system, LIFE, PSI and CCI (Table 3-3).

BMWP-derived scores varied slightly across the catchments surveyed. Site D24a (Dalar Hir Stream) and D34 (sub-catchment E) scored the joint highest indices, with a BMWP of 80, NTAXA of 19 and ASPT of 4.2. Site D17 (C) was the lowest scoring in general with a BMWP of 47, NTAXA of 12 and ASPT of 3.9. This indicates a very low diversity of invertebrates, and few pollution-sensitive taxa.

All sites were reported as Heavily Sedimented, supporting an invertebrate community tolerant of sedimentation. PSI reflects other invertebrate indices; for example, D17 scored the lowest BMWP and lowest PSI results. There is often an interrelationship between sedimentation, habitat and pollution levels. EQRs of 0.08 and 0.11 were calculated for D9 and D24a (Dalar Hir Stream) respectively, indicating that sedimentation is adversely affecting ecological communities at these sites.

LIFE (family level) scores indicate that the communities present across Dalar Hir are characteristic of slow flows or standing waters. LIFE (species level), which is a more accurate index, suggests that D29 and D9 are the least affected by flow stress. EQRs of 0.69 and 0.67 were generated using RICT for the Dalar Hir Stream sites, suggesting the invertebrate communities on the watercourse are affected by flow stress that would not be expected under reference conditions.

Table 3-3: Macroinvertebrate indices for six sites (and sub-catchments) at Dalar Hir.

Index	D9 (F)	D17 (C)	D24a (J)	D29 (N)	D33 (M)	D34 (E)
BMWP	77	47	80	70	67	80
NTAXA	19	12	19	16	16	19
ASPT	4.1	3.9	4.2	4.4	4.2	4.2
PSI (F)	5.1	2.9	7.3	14.3	7.7	6.8
PSI (F) interp.	Heavily Sed.	Heavily Sed.	Heavily Sed.	Heavily Sed.	Heavily Sed.	Heavily Sed.
PSI (F) O/E EQR	0.08	-	0.11	-	-	-
LIFE (sp)	5.5	4.8	5.4	6.1	5.2	5.3
LIFE (F)	5.2	5.1	5.1	5.4	5.3	5.1
LIFE (F) O/E EQR	0.69	-	0.67	-	-	-

3.5.2 Macroinvertebrate Conservation Value

CCI scores were Moderate across all sites (Table 3-4), with scores ranging from 7.4 on the Dalar Hir Stream (D24a) to 9.6 (at D17). The leech (*Erpobdella testacea*) is of local conservation interest, and was recorded in half of the sites. The white-lipped ramshorn (*Anisus leucostoma*) and horse leech (*Haemopis sanguisuga*) were both present at two sites, and the moss bladder snail (*Aplexa hypnorum*) present at one site are also of Local conservation interest.

The macroinvertebrates recorded across the site consisted mainly of widespread and common crustaceans, leeches, beetles and snails, all of which are tolerant to sedimentation, slow flow and some pollutants. The freshwater hoglouse (*Asellus aquaticus*), freshwater shrimp (*Crangonyx pseudogracilis*) and water beetle (*Helophorus brevipalpis*) were present at all sites, with five out of six sites containing the low pollution tolerant worms (Oligochaeta), flatworm (*Polycelis nigra*) and pea mussels (Sphaeriidae); see Appendix C, Table C5 for full species list.

Table 3-4: Community Conservation Index scores across all sites.

Site	CCI score	CCI value	Species of conservation interest
D9	7.5	Moderate	*Erpobdella testacea* (leech, Local)
D17	9.6	Moderate	*Anisus leucostoma* (snail, Local) *Aplexa hypnorum* (snail, Local)
D24a	7.4	Moderate	*Erpobdella testacea* (leech, Local) *Haemopis sanguisuga* (leech, Local)
D29	8.3	Moderate	*Haemopis sanguisuga* (leech, Local)
D33	9.5	Moderate	*Anisus leucostoma* (snail, Local)
D34	8.4	Moderate	*Erpobdella testacea* (leech, Local)

3.5.3 RICT Classification

RICT classification was only possible for the Dalar Hir Stream (D9 and D24a). Both sites were classified as Poor (Table 3-5), with the classification driven by poor water quality elements despite invertebrate richness achieving high quality

Table 3-5: RICT classifications for the Dalar Hir Stream (D9 and D24a).

Site	Index	EQR	Class	Probability of Class (%)
D9	ASPT	0.71	Poor	70.69
	NTAXA	1.05	High	86.72
	MINTA (Overall)		Poor	70.69
D24a	ASPT	0.72	Poor	71.15
	NTAXA	1.05	High	85.91
	MINTA (Overall)		Poor	71.15

3.5.4 Summary

Macroinvertebrate indices and species present were indicative of slow flowing, heavily sedimented water bodies, typical of managed drainage ditches in a mixed agricultural and rural setting. The main watercourse was classified as poor quality. There were two leeches and a snail of local conservation importance across the area, resulting in moderate conservation status for each site. The remaining species are ubiquitous to the observed habitat types. This supports the habitat characterisation of the Dalar Hir study area, which largely consists of field boundary ditch systems with limited numbers of plant species and flow types, and little substrate diversity.

3.6 Macrophytes

Five out of seven of the water bodies originally identified for macrophyte surveys were sampled. D18 and D21 could not be accessed under existing agreements, whilst D34 was surveyed in two places ('a' and 'b') due to differing character, leading to a total of six surveys.

A single site (D9) on the Dalar Hir Stream met the criteria for LEAFPACS2 classification. The remaining sites were not flowing, or not detailed on a 1:50000 Ordnance Survey map, both of which are prerequisites for matching to reference sites within the LEAFPACS tool.

3.6.1 Species Present

Fool's watercress (*Apium nodiflorum*), starwort (*Callitriche* sp.) and tufted forget-me-not (*Myosotis laxa*) were present at all sites. These species are characteristic of slow-flowing or standing waters, with starwort and fool's watercress demonstrating a preference for elevated nutrient levels. Species of water mint were present at five sites, with the least duckweed (*Lemna minuta*) and water plantain (*Alisma plantago-aquatica*) present at four out of six. At some sites, species such as hemlock water-dropwort (*Oenanthe crocata*) and bogbean (*Menyanthes trifoliata*) were recorded as abundant with TCVs of six or more. Canadian pondweed (*Elodea canadensis*) was recorded from D28. This species is non-native, listed on Schedule 9 of the *Wildlife and Countryside Act 1981* (as amended). There were no species of conservation importance recorded from the survey area (see Table D1 in Appendix D for full species list).

3.6.2 Macrophyte Indices

Table 3-6 contains the macrophyte indices. The RMNI is similar across all survey sites. On a numeric scale, 1 indicates no nutrient enrichment and 10 indicates high enrichment, suggesting that the communities present at Dalar Hir are reasonably tolerant of enriched nutrient levels. The Dalar Hir Stream (D9) has the highest RMNI score (7.38), which indicates nutrient enrichment, most likely as a result of surface water runoff from surrounding pasture land. All sites demonstrated similar RMNI scores, and these were typical of the watercourses bordered by, or receiving input from, lowland agricultural land.

NTAXA was low across all sites, but above the minimum of three required for LEAFPACS2 methodology. The Dalar Hir Stream recorded the highest number of scoring and non-scoring taxa, whereas D2 had the lowest species diversity.

The NFG indicates diversity of truly aquatic taxa (those that are predominantly submerged or floating), and this varied across the sites. Most of the species recorded during the surveys have emergent habits or prefer marginal areas.

The percentage cover of green filamentous algae ranged from 0 to 17.5 (the latter value was recorded at D34b with a TCV of 6 for blanket weed (*Cladophora* sp.), see Appendix D). Algae are key indicators of elevated organic nutrients such as ammoniacal nitrogen and orthophosphate.

Table 3-6: Macrophyte indices for six sites across Dalar Hir (RMNI, NTAXA, non-scoring taxa, NFG and ALG).

Site and catchment	Observed RMNI	Observed NTAXA (scorers)	Total NTAXA (inc. non-scores)	Observed NFG	Observed ALG
D2 (H)	6.94	3	10	2	0
D9 (F)	7.38	5	22	4	0.5
D24 (J)	6.90	5	20	4	0
D33 (M)	6.83	3	16	3	0
D34a (E)	7.15	5	21	5	0.05
D34b (E)	7.30	4	21	4	17.5

3.6.3 LEAFPACS2

The Dalar Hir Stream was suitable for LEAFPACS2 classification, and was classified as good quality (Table 3-7). Macrophyte communities at this site show reasonably high tolerance to nutrients, but this is not significant enough to result in a deviation from good reference conditions.

Table 3-7: The results of LEAFPACS2 classification on the Dalar Hir Stream and the percentage confidence for each class.

Site	EQR	Status	Confidence of Class				
			Bad	Poor	Moderate	Good	High
D9 (F)	0.62	Good	0	0.2	41.4	58.3	0.1

3.6.4 Summary

The macrophyte communities at all sites surveyed were relatively poor in diversity of scoring taxa and number of truly aquatic groups, and displayed a moderate tolerance for nutrient-enriched water. There were no species of conservation importance, and the communities predominantly consisted of common vascular plants with very few observations of algae and bryophytes.

3.7 Fish

Four sites within the study area were identified for fish surveys. These were the Dalar Hir Stream (D9 and D24a), D11 and D18. Of these sites, D9 was inaccessible due to thick bankside vegetation and therefore could not be surveyed; however, the landowner indicated that European eel (*Anguilla anguilla*) has previously been observed in this watercourse. Spot checks were carried out at the other three sites, as they were not suitable for quantitative sampling due to low water levels.

Sites D11 and D18 contained little water (around 5cm in depth) and no fish were observed at either site. The landowner at D18 indicated that the site had been dry for several weeks prior to heavy rain during the week of the survey.

Although water levels on the Dalar Hir Stream (D24a) were low, approximately 15cm deep, one adult European eel and one nine-spined stickleback (*Pungitius pungitius*) were observed.

3.7.1 Incidental Records

A number of three-spined stickleback (*Gasterosteus aculeatus*) and nine-spined stickleback were caught incidentally during the invertebrate sampling. These are listed in Table 3-8 below. Additionally, a European eel was among incidental records found during the terrestrial ecology surveys at pond P16d.

Table 3-8: Incidental records of fish from invertebrate kick sampling (July 2014).

Site	Species	Number caught
D9	Three-spined stickleback	1
D24a	Three-spined stickleback	8
	Nine-spined stickleback	4
D29	Three-spined stickleback	3
D33	Nine-spined stickleback	1
D34	Three-spined stickleback	2
P16d	European eel	1

3.7.2 Summary

The presence of European eel in pond P16d and the Dalar Hir stream demonstrates catchment connectivity to the sea, most likely via the Llyn Traffwll Site of Special Scientific Interest. European eels require hydrological connectivity between sea and river and prefer silt or coarse substrate into which an eel can bury (Maitland, 2007). This would suggest that eels might be present in permanently wetted watercourses in the study area. Any potential impacts on watercourses at this site would need to be assessed in terms of the effects on eel habitat. European eels are protected under *The Eels (England and Wales) Regulations 2009* and are listed as a priority species on the Section 42 list of the *Natural Environment and Rural Communities Act 2006*.

Both three-spined and nine-spined sticklebacks were observed during surveys, although only one was caught during electric fishing surveys. Sticklebacks do not have strong habitat preferences and are likely to be present in many of the watercourses throughout the site provided there is cover available and the watercourses remain permanently wetted. Sticklebacks do not receive any specific protection.

The fish species recorded during the 2014 survey are typical for the size and type of habitats surveyed. None of the watercourses within the study area are suitable for supporting salmonids, such as brown trout, which generally are not associated with slow-flowing water with silt substrate (Hendry & Cragg-Hine, 2003).

3.8 Pond Surveys

Of eleven ponds visited, nine were sampled for macroinvertebrates and plants in August 2014 (see Appendix A for a full commentary of survey sites). A number of ponds were identified during the survey season but were not considered suitable for sampling. Reasons for not sampling include lack of access, dry at time of sampling or very small in size. Ponds P4, P5, P11b, P17, P19 and P20 were assessed (see Appendix A) but not further survey was undertaken.

3.8.1 Macroinvertebrates

The majority of macroinvertebrates in the ponds across the study area belonged to pollution-tolerant beetles, molluscs, true flies, crustaceans and true bugs (see Appendix E for species lists). This type of community is characteristic of standing waters with high coverage of macrophytes, fine sediment and decomposing organic matter.

Numbers of dragonflies, damselflies and alderflies were generally low across the study area, with none recorded at three sites and a maximum diversity of 3 elsewhere. Beetles (Coleoptera (CO)) were present in every pond, with family diversity ranging from 1 to 4, but total beetle species diversity ranged from 2 to 8. Pond P15a had the highest OM and CO indices.

CCI scores varied from Moderate to Fairly High across the ponds (Table 3-9). The highest scoring macroinvertebrate community was pond P15a, due to the presence of red-veined darter (*Sympetrum fonscolombii*), a migrant dragonfly, which is shifting its range northwards. The second highest CCI score was reported from pond P16d, owing to presence of the hairy dragonfly (*Brachytron pratense*) (Local) and snail *Gyraulus laevis* (Regionally Notable). Other ponds with Fairly High conservation value featured one or two species of Local interest, and all ponds had varying numbers of Common, Frequent and Occasional species.

Table 3-9: Community Conservation Index (CCI) scores and results.

Pond	CCI score	CCI value	Species of conservation interest (Local or above)
P3	10.0	Fairly High	*Erpobdella testacea* (leech, Local)
P11a	9.0	Moderate	*Anisus leucostoma* (snail, Local)
P13	5.0	Moderate	None
P14	11.1	Fairly High	*Erpobdella testacea* (leech, Local) *Coenagrion pulchellum* (damselfly, Local)
P15	13.3	Fairly High	*Sympetrum fonscolombei* (dragonfly, Notable)
P16a	10.0	Fairly High	*Erpobdella testacea* (leech, Local)
P16b	6	Moderate	None
P16c	5.1	Moderate	None
P16d	10.9	Fairly High	*Brachytron pratense* (dragonfly, Local) *Gyraulus laevis* (snail, Regionally Notable)

3.8.2 Aquatic Pond Plants

The majority of the plants in ponds across the study area were characteristic of standing, slightly enriched waters. The most common species observed were water plantain, meadowsweet (*Filipendula ulmaria*), water mint *(Mentha aquatica*), bulrush (*Typha latifolia*) and amphibious bistort (*Persicaria amphibia*), all of which exhibit high TRSs under the PSYM methodology.

There were two species of high conservation importance recorded: tubular water-dropwort *(Oenanthe fistulosa*) and pillwort (*Pilularia globulifera*). Both occurred in pond P14, and tubular water-dropwort was also recorded from pond P16a. These plants are listed as Species of Principal Importance under Section 42 of the *Natural Environment and Rural Communities Act 2006*. Tubular water dropwort is a perennial herb of damp or wet habitat, associated with areas that flood over winter. Declines across its natural range are linked to changes in drainage and the

conversion of historic grassland to arable. Pillwort is a creeping fern with thin grass-like leaves favouring sites that are inundated in winter, and dry in the summer. It is declining across its European range, threatened by water pollution, drainage, decline in cattle grazing and land management practices.

The number of submerged and marginal plant species ranged from 10 to 25 across the study area, indicating that a variety of depths and habitats were present. The number of uncommon species ranged from 0 to 9, but on average the study area does not support many species of conservation concern. The TRS was greater than 8 at all sites, which on a scale of 1 to 10 indicates that the communities across the ponds have a high tolerance to elevated nutrient levels.

3.8.3 PSYM Quality Class

The PSYM classifications, along with observed indices and EQIs, are summarised in Table 3-10 (see Appendix E for predicted values for indices and IBI scores)

Four ponds achieved poor quality, and five achieved moderate quality, based on comparison to pristine reference sites.

The submerged and marginal plant EQIs indicate that the number of these species present was good in general, with the exception of ponds P3, P15 and P16c whose communities were considerably less diverse. Ponds P14, P16a and P16d have EQIs of above 1 and thus are supporting greater diversity than would be expected at reference conditions. The uncommon species EQIs indicate that the presence of species of conservation interest differs significantly between sites, with over half of the ponds supporting fewer than expected species. Ponds P14, P16a and P16d have EQIs of above 1 and thus are supporting more than would be expected in reference conditions. TRS-EQIs are well above 1 across the sites, indicating that significantly more nutrient-tolerant species are present than would be expected in reference conditions.

The invertebrate pollution ASPT-EQIs are similar across the sites, and indicate a general pollution tolerance within the macroinvertebrate community. In general, the number of OM and CO families recorded across the site was much lower than would be expected in an unstressed site, with the exception of pond P15a which has a CO-EQI above 1.

Table 3-10: PSYM results and classification of ponds. Observed indices in unshaded rows, and Ecological Quality Indices (EQIs) below (for all indices except TRS, EQI of ≥1 denotes a pond meeting or exceeding reference site quality – marked in bold). (PSYM quality category = IBI >75%=Good, 51-75%=Moderate, 25-50%=Poor, <25%=V Poor).

Index	P3	P11a	P13	P14	P15	P16a	P16b	P16c	P16d
No. of submerged + marginal plant species (SM)	13	19	17	24	12	25	16	10	25
EQI (SM)	0.65	0.96	0.81	**1.26**	0.63	**1.29**	0.80	0.52	**1.45**
Number of uncommon plant species (U)	1	1	1	9	0	7	2	1	5
EQI (U)	0.22	0.22	0.21	**2.10**	0.00	**1.61**	0.44	0.23	**1.30**

Index	P3	P11a	P13	P14	P15	P16a	P16b	P16c	P16d
Trophic Ranking Score (TRS)	8.1	8.95	8.3	8.33	8.30	8.30	8.13	8.58	8.35
EQI (TRS)	1.45	1.60	1.49	1.49	1.48	1.48	1.46	1.54	1.49
Average Score per Taxon (ASPT)	3.7	4.4	4.5	4.9	4.7	4.7	3.9	4.6	4.5
EQI (ASPT)	0.65	0.87	0.82	0.86	0.83	0.83	0.69	0.81	0.81
Odonata + Megaloptera (OM) families	0	0	1	2	3	2	0	2	2
EQI (OM)	0.00	0.00	0.28	0.53	0.79	0.53	0.00	0.53	0.53
Coleoptera families (CO)	2	2	3	2	4	2	1	2	3
EQI (CO)	0.57	0.50	0.83	0.60	**1.16**	0.59	0.29	0.60	0.86
Index of Biotic Integrity (%)	**28%**	**39%**	**50%**	**72%**	**56%**	**67%**	**33%**	**44%**	**72%**
PSYM quality category	**Poor**	**Poor**	**Mod.**	**Mod.**	**Mod.**	**Mod.**	**Poor**	**Poor**	**Mod.**
Priority species	0	0	0	2	0	1	0	0	0
Is this a Priority Pond?	**No**	**No**	**No**	**Yes**	**No**	**Yes**	**No**	**No**	**No**

The results of the PSYM survey demonstrate variable quality of floral and faunal communities.

3.8.4 Priority Ponds

Two ponds achieved Priority status (Section 2.4.7) due to the presence of species of conservation importance, despite being classed as moderate quality under PSYM. P14 qualified due to the presence of vascular plants tubular water-dropwort and pillwort. P16a also supported tubular water-dropwort, promoting it to Priority status.

3.8.5 Pond Water Quality

In situ water quality data (temperature, pH, dissolved oxygen and conductivity) were collected in spring and summer, and the results are summarised in Table 3-11. Temperatures varied between sites, and were typical for the time of year and differences in water depth and area. All ponds have a pH of between 5.5 and 6.5, and conductivity between the lowest recorded at pond P11a (202µS cm^{-1}) and the highest at pond P13a (571µS cm^{-1}). The reported dissolved oxygen varied between 27.2% and 70.4% (P11a and P3 respectively), linked to the water depth and water warming, amount of plant growth and water exchange (in and out flows) at each location.

Table 3-11: Water quality measurements for ponds, taken *in situ* with YSI sonde (averaged where possible from spring water quality surveys and summer PSYM surveys; *denotes spring only, **denotes summer only).

Site	Temperature (°C)	Conductivity (µS/cm)	pH	Dissolved Oxygen sat (%)	Dissolved Oxygen s (mg l^{-1})
P2*	9.26	262	5.78	35.8	4.11
P3	12.16	227	5.44	70.4	7.45
P5*	9.02	449	5.94	65.0	6.10
P6*	8.87	426	5.43	28.0	3.22
P11a**	13.22	202	5.70	27.2	2.85
P12*	9.53	388	6.31	48.5	5.53
P13	10.99	571	5.74	28.2	3.12
P14	11.67	383	6.24	55.9	6.26
P15	11.97	212	6.44	55.1	5.99
P16a	12.24	433	6.15	40.7	4.35
P16b	11.20	259	5.60	37.6	4.22
P16c	12.28	239	5.97	46.8	5.16
P16d	11.94	334	6.47	62.8	6.96

Water quality samples for further determinands (including nutrients, metals and solvents) were taken from ponds P2 and P3 in spring (samples were not programmed for ponds P5 – P16d inclusive) and the results are summarised in Table 3-12. All determinands in the P3 sample were within the WFD and Environmental Quality Standard limits for freshwater water bodies. The P2 sample failed WFD standards for iron (threshold value of 1,000µg L^{-1}). However, these values must be interpreted with caution, as the threshold values were not designed for use in classification of ponds.

Table 3-12: Additional water quality determinants for ponds P2 and P3 taken in spring.

Site	P2	P3
Alkalinity, dissolved as CaCO3 (mg L^{-1})	49.3	41.3
BOD five day ATU (Allyl thiourea) (mg L^{-1})	<2.92	<1.00
Suspended solids (mg L^{-1})	18.1	10.1
Orthophosphate, reactive as Phoshorous (mg L^{-1})	0.06	<0.02
Chloride (filtered) (mg L^{-1})	53.6	80.8
Ammoniacal nitrogen as N (mg L^{-1})	0.04	<0.03
Arsenic (µg L^{-1})	<1	<1
Cadmium (µg L^{-1})	<0.1	<0.1
Chromium (µg L^{-1})	1.06	<0.5
Copper (µg L^{-1})	4.77	1.69
Lead (µg L^{-1})	<2	<2
Nickel (µg L^{-1})	2.83	<1
Zinc (µg L^{-1})	8.89	<5
Iron (µg L^{-1})	1,040	580
Manganese (µg L^{-1})	303	90.6
Mercury (µg L^{-1})	<0.01	<0.01

3.8.6 Summary

All ponds analysed with PSYM were classified as moderate quality, with two on the moderate/good boundary. Ponds P14 and P16a achieved Priority status due to the presence of plant species of national conservation importance. The PSYM plant

indices demonstrate that ponds across the study area are mostly inhabited by commonly occurring, nutrient-tolerant species. The PSYM macroinvertebrate indices suggest that communities are typical of standing, slightly enriched waters, with fewer key indicator families than expected and a small number of species of conservation interest ranging from Local to Notable.

4 Characterisation

The physical habitat of the watercourses within Dalar Hir site was characteristic of a rural ditch system, with over-deepened and realigned slow-flowing watercourses, which are interconnected. The ponds on-site were seen as variable in the level of obvious intervention with some pond features recognised as urban drainage ponds to serve local infrastructure.

A high proportion of these watercourses are ephemeral. These have the potential to support macrophyte and macroinvertebrate communities, but due to insufficient water depth and/or their isolated nature are unlikely to support large populations of fish.

Water quality varied throughout the sites sampled, with some sites high in nutrients (phosphate) while others were found to have high levels of metals. Variation in oxygen levels was also noted, and it was thought that water depth might be a factor affecting oxygen status for the pond sites. The status of water quality in particular can be affected by prevailing weather conditions, and as such, this study should be seen as a snapshot of conditions at the time of survey, and not representative of the range of conditions experienced.

Macroinvertebrate indices and species present were generally indicative of poor habitat diversity, sedimentation and slow flow, which reflects the character of the study area (e.g. ditch systems). The main watercourse was classified as poor and possibly ephemeral in its upper reaches. The ephemeral nature of the channel, coupled with its riparian land use of improved pastures and main road, may explain the low BMWP-scoring families present. For macrophytes, although this watercourse was classified as good and exhibited a fairly diverse emergent flora, the number of truly aquatic groups was generally low because of the ephemeral nature of the ditch systems in the study area. There was very little flow diversity and substrate variety in the area, which limits the macrophyte communities, and the ditch habitat favours marginal and emergent species rather than true aquatics.

The ponds, which receive road drainage, all scored under PSYM as moderate quality. All of the sampled pond sites scored poorly in the TRS aspect, which suggests that the ponds are enriched relative to the baseline levels for Anglesey. Species distribution of the sustainable drainage systems ponds suggests that they are in unmanaged succession, which jeopardises the protected species associated with open water marginal habitats for example pillwort, lesser marshwort (*Apium inundatum*) and tubular water-dropwort.

Diatom analysis under the new DARLEQ2 system was indicative of good quality. While this does not necessarily fit the larger picture in terms of site characterisation, it could be indicative of longer-term trends, with macrophyte and invertebrate results providing a snapshot, but not the longer-term picture, or differing conditions under wet weather events.

5 Conclusions

The watercourses and ponds located at the proposed park and ride site exhibit a fairly high degree of intervention. All of the ponds received surface water runoff from the adjacent rural land and urban features, and a number of the ponds are modified to act as road drainage features. In hydromorphological terms, the watercourses occupying the Dalar Hir site are highly modified, and the existing streams, while they may historically have been natural streams, have now been resectioned and realigned around field boundaries and over-deepened to maximise capacity. This conversion to field drainage ditches has reduced the potential of these features to support important ecological communities. Despite the modification to habitat and flow, the aquatic features across the Dalar Hir site demonstrate typical aquatic flora and fauna associated with lowland ditches in a semi-rural landscape. Macrophyte and invertebrate studies were generally indicative of low species diversity, characteristic of ditch habitats.

A significant proportion of the ponds and ditches could be defined as ephemeral water bodies, and thus may not provide continuous habitat for aquatic species. Aquatic species may utilise these sites during wet seasons; however, as such, any ecological value of these sites is temporary. Ephemeral watercourses often support specific aquatic communities capable of tolerating periods of low or reduced flow; however, no specialist taxa were recorded at Dalar Hir.

Species of conservation interest within the Dalar Hir study area include the European eel, tubular water-dropwort and pillwort. Acknowledgement of these species is required during the development of mitigation for the site to protect both the existing populations and habitats that support them.

Water quality varied across the sites sampled. The large variation in dissolved oxygen levels between sites is likely to be largely attributed to changes in flow/water levels, water temperature, the degree of riparian vegetation and macrophyte growth. Nutrient levels also varied between sites, with phosphate levels exhibiting the highest variation. Nitrate levels were generally low across the sampled sites. Six of twelve sites sampled were found to have high metal content, potentially due to the proximity of roads and local amenities.

6 Glossary of technical terms and abbreviations

Acronym	Term	Definition
ALG	Cover of green filamentous algae	Macrophyte index used to calculate the percent algal cover.
ASPT	Average score per taxa	The ASPT for a given site is a calculation of the average of the tolerance scores of all macroinvertebrate families found, and ranges from 0 to 10.
BMWP	Biological Monitoring Working Party	An invertebrate scoring system which indicates the pollution tolerance of invertebrates at a given site.
BOD	Biological oxygen demand	Biochemical oxygen demand is a measure of the quantity of oxygen used by microorganisms in the oxidation of organic matter.
CCI	Community Conservation Index	CCI represents the national rarity and diversity of invertebrate species identified at a site and designates a conservation value to the sampled community based upon both a species rarity and the overall community richness.
CO	Coleoptera	Number of Coleoptera families indicates the habitat quality and diversity of a pond.
DARLEQ2	Diatoms for Assessing River and Lake Ecological Quality	Microsoft Windows® program for the assessment of river and lake ecological status using diatoms.
EQR	Ecological Quality Ratios	As per EQI above, EQR is the ratio which incorporates the key WFD requirements for ecological classification: typology, reference conditions and class boundary settings.
IBI	Index of Biological Integrity	A measure of the output from several pond habitat metrics, which is interpreted as a final percentage, and assigns a quality class.
LEAFPCAS2	n/a	A classification method that assesses macrophytes in rivers according to the requirements of the Water Framework Directive (WFD).
LIFE	Lotic-invertebrate Index for Flow Evaluation	Each macroinvertebrate species or family within a sample is assigned to a flow group depending on their flow/velocity preference, giving two indices: LIFE (sp.) and LIFE (F). A high LIFE score represents a higher number of taxa with a preference for high-velocity habitats and vice versa.
MRV	Minimum Reporting Value	The lowest concentration of a substance that is reported in any analysis. It usually represents the acceptable background concentration for a given substance according to water quality guidelines.
NFG	Number of Functional Groups	Number of functional groups is a macrophyte metric used to measure how truly aquatic the

Acronym	Term	Definition
		community is.
NRW	Natural Resource Wales	Welsh Government sponsored body that since 2013 has completed the functions of the Countryside Council for Wales, Forestry Commission Wales and the Environment Agency in Wales.
NTAXA	Number of scoring taxa	A measure of the number of species taxa present at a given site.
OM	Odonata and Megaloptera	Number of Odonata and Megaloptera families indicates long-term quality of a pond as larvae have a long aquatic life stage.
PAH	Polycyclic Aromatic Hydrocarbons	The term polycyclic aromatic hydrocarbons (PAHs) refers to a group of several hundred chemically-related environmentally persistent organic compounds of various structures and varied toxicity.
PSI	Proportion of Sediment-sensitive Invertebrates	Macro-invertebrate families within a sample are assigned a score based on their sensitivity to sediment. The resulting PSI scores indicate how sedimented the watercourse is from Minimally Sedimented to Heavily Sedimented.
PSYM	Predictive SYstem for Multimetrics	PSYM is a method for assessing the biological quality of still waters in England and Wales.
RICT	River Invertebrate Classification Tool	A method which enables the assessment of the condition of the quality element, 'benthic invertebrates', listed in Table 1.2.1 of Annex V of the Water Framework Directive.
RMNI	River Macrophyte Nutrient Index	The measure of which plants grow in the river and their association with high nutrients. RMNI is measured on a scale from 1-10.
SM	Number of submerged and marginal (not floating) species	The number of submerged and marginal (not floating) species indicates plant species richness of a site.
TCV	Taxon cover values	An estimate of the percentage cover of a particular species at a given survey site.
TRS	Trophic Ranking Score	Indicator of nutrient tolerance on a scale of 1 to 10 (10 = very tolerant).
U	Number of uncommon plant species	The number of uncommon plant species is used as a measure of conservation value of a plant community.
WFD	Water Framework Directive	EU Water Framework Directive (2000/60/EU) (WFD) 2000.

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Appendix A Physical Habitat Descriptions

Site Reference	**D2**
Grid Reference	SH 32339 78471
Access: Yes	**Wetted**: No
This site was dry at the time of survey. The average channel width is 1m with well vegetated earth banks and substrate. The ditch is within the Vehicle Operator Safety Agency compound with surrounding land use being improved pasture on the left bank and paved road on the right. The ditch has been deepened and realigned. No tributaries, inputs or further modifications are evident. **Surveys** None	 

Site Reference	**D3**
Grid Reference	SH 32454 78528
Access: Yes	**Wetted**: No
This site was dry at the time of survey. The average channel width is 30cm with well vegetated earth banks and mud substrate. The surrounding land use is damp rough pasture. The ditch is man-made. The ditch receives road drainage from an outfall.	

Surveys None	

Site Reference	**D6**
Grid Reference	SH 32714 78392
Access: Yes	**Wetted:** Damp
This site was mostly dry at the time of survey. The average channel width is 45cm with well-vegetated earth banks and mud substrate. The surrounding land use is damp rough pasture on the left bank and semi-improved pasture on the right. No tributaries or inputs were observed, but the ditch is connected to several other small ditches downstream. **Surveys** None	 

Site Reference	D7
Grid Reference	SH 32728 78335
Access: Yes	**Wetted:** Yes
Average channel width of 0.45m with well-vegetated earth banks and mud/organic substrate. There was very little flow at the time of survey with the ditch consisting of mainly standing water. Surrounding land use consists of rough damp pasture on the left bank and a dry stone wall and road on the right bank. There are lots of rushes with some young trees on both banks. The watercourse is connected to ditches downstream but will likely flood onto the left bank during high flows. D9 flows into this watercourse and it is thought that D7 is connected to the road drainage ponds (P12a–P16d). **Surveys** Water quality and diatoms	 

Site Reference	D8
Grid Reference	SH 32815 78342
Access: Yes	**Wetted:** Yes
Average channel width of 70cm and water depth of 10cm. Grassy earth banks and mud substrate. There was very little flow at the time of survey. Surrounding land use consists of rush-dominated marsh on the left bank and rough pasture on the right bank. The ditch appears to be man-	

made and it is likely that during high flows it will flood onto the left bank. **Surveys** None	

Site Reference	**D9**
Grid Reference	SH 33019 78306
Access: Yes	**Wetted:** Yes
Average channel width of 1m with earth banks that were bare at the toe but otherwise well vegetated. Substrate predominantly gravel with overlying silt and organic matter throughout. Surrounding land use is semi-improved pasture on both banks. A fence runs along both bank tops. The channel has been dredged. Obvious modifications include an embankment on the right and the dredged channel. Input is received from other small watercourses (D10 and D12). This watercourse flows into D7 at the southern field boundary. **Surveys** Water quality, diatoms, macro-invertebrates and macrophytes. This site was too overgrown to access for fish surveys.	 

Site Reference	D10
Grid Reference	SH 33006 78427
Access: Yes	**Wetted:** Standing puddles
Channel width averages 45cm with earth banks and mud substrate. Very little flow at time of survey, mostly standing puddles. The watercourse is surrounded by semi-improved pasture on both banks. The channel is man-made and may spill onto the adjacent pasture during periods of flood. No inputs were observed. **Surveys** None	 

Site Reference	D11
Grid Reference	SH 33000 78792
Access: Yes	**Wetted:** Ephemeral
Channel width averages 80cm with 20cm water depth and banks 40cm high. Silt substrate and vegetated earth banks. The watercourse is surrounded by rush pasture on both banks with scrub and hedge also present on the right. The channel has been deepened A small tributary runs into the	

watercourse. **Surveys** Fish	

Site Reference	**D12**
Grid Reference	SH 33137 78408
Access: Yes	**Wetted:** Yes
Channel width averages 50cm with vegetated earth banks and substrate comprised of mud with small amounts of gravel and organic matter. The watercourse is surrounded by semi-improved pasture on both banks. The channel has been deepened. The watercourse flows into D9. No inputs were observed. **Surveys** None	 

Site Reference	D13
Grid Reference	SH 33389 78414
Access: Yes	**Wetted:** No
This watercourse was dry at the time of survey. Channel 20cm wide with banks 25cm high. Grassy earth banks and substrate. The watercourse is surrounded by semi-improved pasture on both banks. The channel appears to be a man-made field drain and is likely to spill on to the right bank during high flows. **Surveys** None	 

Site Reference	D14
Grid Reference	SH 33429 78124
Access: Yes	**Wetted:** No
This channel appears to be dry year round. **Surveys** None	

Site Reference	D15
Grid Reference	SH 33489 78222
Access: Yes	**Wetted:** Ephemeral
This site was almost dry at time of survey. Channel width averages 30cm and 5cm deep with a silt and organic matter substrate. The channel appears to be a man-made ditch and is surrounded by improved pasture. **Surveys** None	

Site Reference	D17
Grid Reference	SH 33401 78246
Access: Yes	**Wetted:** Yes
Channel width averages 60cm with 25cm of water depth. Well-vegetated earth banks average 30cm high. Ponded flow with a silt/organic matter substrate. The watercourse is surrounded by a house and garden on the left bank and improved pasture on the right. A hedge and fence are present on the left bank. The channel is deepened but would spill onto the adjacent pasture during periods of flood. No tributaries or obvious modifications are evident. **Surveys** Water quality, diatoms and macro-invertebrates	 

Site Reference	D18
Grid Reference	SH 33710 78188
Access: Yes	**Wetted:** Ephemeral
Average channel width of 65cm, water depth of 30cm and bank height of 30–80cm. Well-vegetated earth banks with an organic material and silt substrate. Only slight flow observed. This ditch is man-made, and in the centre of the surveyed stretch a large bank has been constructed forming a double ditch (pictured). Surrounding land use is semi-improved pasture on both banks. Sections with smaller bank height are likely to flood onto adjacent pasture. No tributaries or inputs were observed. **Surveys** Water quality, diatoms and fish	 

Site Reference	D19
Grid Reference	SH 33766 78276
Access: Yes	**Wetted:** Ephemeral
Average channel width of 1m and water depth of 40cm. Well-vegetated earth banks 20cm high. Ponded flow with a mud/organic matter substrate. The watercourse is surrounded by a road on the left bank and semi-improved pasture on the right. Modifications include a field drain and two culverts, one under the field entrance and one under the road where the watercourse flows into D18. **Surveys** None	 

Site Reference	D20
Grid Reference	SH 33808 78696
Access: Yes	**Wetted:** Ephemeral
Average channel width of 40cm, with 1m high banks and 5cm water depth. Run flow type with silt/gravel/cobble substrate and well vegetated banks. The watercourse is surrounded by improved pasture on the left bank and marshy grassland on the right. The channel has been deepened. Some evidence of erosion was observed. **Surveys** None	 

Site Reference	D21
Grid Reference	SH 33763 78767
Access: Yes	**Wetted:** Yes
Average channel width of 1.5m and water depth of 10–25cm with low grassy banks. Slight/run flow type with silt/organic matter substrate. The surrounding land use is damp pasture and rush on both banks. The watercourse drains into a boggy area, which spills over into the surrounding land.	

No obvious modifications have been observed. **Surveys** Water quality and diatoms	

Site Reference	**D22**
Grid Reference	SH 32419 78231
Access: Yes	**Wetted:** Ephemeral
This site was dry at the time of survey. Channel is 30cm wide and 40cm deep with earth substrate and vegetated earth banks. The ditch is surrounded by improved pasture on the left bank and a road at the top of the right bank. The channel is a man-made urban drainage ditch, and while there is a high embankment on the right, it may overtop the left bank during high flows. **Surveys** None	 

Site Reference	D23
Grid Reference	SH 32749 78072
Access: Yes	**Wetted:** Ephemeral
This site was mostly dry at the time of survey. Channel width of 45cm and depth of 35cm. Bank and substrate comprise vegetated earth. The ditch is surrounded by semi-improved pasture on both banks with a fence and hedge on the right bank. The channel is a man-made field drain and one culvert was observed. **Surveys** None	

Site Reference	D24
Grid Reference	SH 32793 78208
Access: Yes	**Wetted:** Ephemeral
This site was mostly dry at the time of survey. Channel 25cm deep and 35cm wide. Substrate and banks both consist of vegetated earth. The ditch is surrounded by semi-improved pasture on the right bank and a vegetated embankment up to a road on the left bank. **Surveys** None	

Site Reference	D24a – Dalar Hir Stream
Grid Reference	SH 32838 77970
Access: Yes	**Wetted:** Ephemeral
Channel width averages 2m with 20cm depth of water. Well-vegetated earth banks 40cm high. Glide flow type with gravel substrate, overlain by silt and organic matter. Surrounding land use is improved pasture on both banks with a single line of trees and drystone wall on the right bank. During periods of high flow, the watercourse is likely to overtop the left bank. The watercourse is connected to several other small watercourses (D24, D24b and D9) and input from a field drain was observed. **Surveys** Water quality, diatoms, macro-invertebrates, macrophytes and fish	 

Site Reference	D24b
Grid Reference	SH 32925 78156
Access: Yes	**Wetted:** Ephemeral
Channel 1.5m wide with 25cm water depth and bank height of 45cm. Glide flow type with silt and organic matter substrate and vegetated earth banks. Improved pasture surrounds the channel on both banks, with a hedgerow also on the right bank. The watercourse receives drainage from the pasture.	

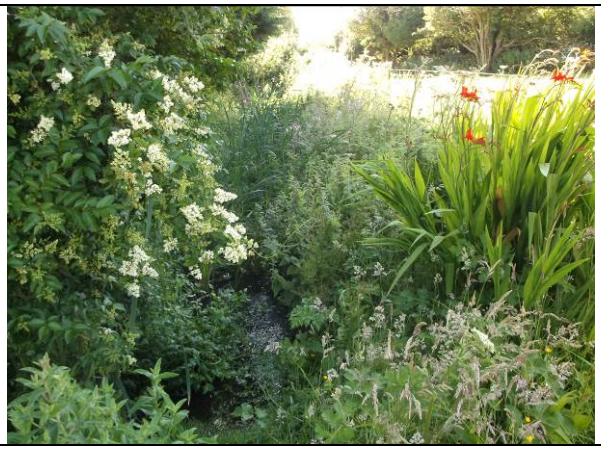
Surveys None	

Site Reference	**D26**
Grid Reference	SH 32372 78206
Access: Yes	**Wetted:** Ephemeral
Channel width averages 40cm with well-vegetated banks with organic matter/mud substrate. Water depth of 5cm, with slight flow. Surrounding land use is improved pasture on the left bank and a grass slope adjacent to the road on the right bank. A buffer of thick bramble is present on both banks. The watercourse is culverted under the field entrance and a field drain into the watercourse was observed. **Surveys** Water quality and diatoms	

Site Reference	D27
Grid Reference	SH 32381 78149
Access: Yes	**Wetted:** Ephemeral
This channel was mostly dry at the time of survey. The channel is around 30cm wide and 30cm deep. The substrate and banks consist of grassy earth. The surrounding land use is a grass slope leading up to a road on the right bank and a dry stone wall and rush/semi-improved pasture on the left. The channel appears to be a man-made urban drainage ditch. **Surveys** None	

Site Reference	D28
Grid Reference	SH 31972 78396
Access: Yes	**Wetted:** Yes
Average channel width of 4m and depth of 40cm. Grassy earth banks and silt substrate. Channel is choked with Canadian pondweed. The surrounding land use is improved pasture on both banks and the banks are subject to moderate poaching by livestock. An ornamental bridge with twin culverts is present, along with a small weir (both pictured). The watercourse is also culverted under the property access road. The watercourse flows into a large garden pond (Pond 20) on the opposite side of the access road. **Surveys** None	 

Site Reference	D29
Grid Reference	SH 32063 78409
Access: Yes	**Wetted:** Yes
Average channel width of 75cm with water depth of 40cm. Well-vegetated banks 35cm high. Run flow type with a silt/organic matter substrate. Surrounding land use is rush and semi-improved pasture on both banks. During periods of high flow, the watercourse will spill into adjacent ditches. One field drain was observed flowing into the watercourse, which is culverted under the road. **Surveys** Water quality, diatoms and macro-invertebrates	 

Site Reference	D31
Grid Reference	SH 31898 78317
Access: Yes	**Wetted:** Yes
Average channel width of 1m with water depth of 10cm and run and glide flow types. Well-vegetated earth banks and silty gravel substrate. Surrounding land use is improved pasture on the right bank and a private garden on the left. The watercourse has been deepened and straightened and is	

culverted under the property access track. Input is received from a large garden pond (Pond 20). **Surveys** None	

Site Reference	**D32**
Grid Reference	SH 32108 78176
Access: Yes	**Wetted:** Yes
Channel 30cm wide and 25cm deep with 5cm of water. The substrate is silt and organic matter and the banks are well-vegetated earth. The ditch is surrounded by semi-improved pasture on both banks with scrub also present on the right bank. No inputs were observed. Substantial amounts of sewage fungus were present. **Surveys** None	 

Site Reference	D33
Grid Reference	SH 32190 77883
Access: Yes	**Wetted:** Yes
Average channel width of 45cm with water depth of 15cm. Well-vegetated banks average 30cm in height. Slow slight flow with a mud/organic substrate. Surrounding land use comprises improved pasture on both banks with areas of scrub/hedge on the left bank. In periods of high flow, it is likely that the channel will overtop into the adjacent pasture. There are no obvious tributaries but a field drain was observed. **Surveys** Water quality, diatoms, macrophytes and macro-invertebrates	 

Site Reference	D34
Grid Reference	SH 33286 78022
Access: Yes	**Wetted:** Yes
Average channel width of 60cm and depth of 30cm. Banks 20cm high composed of earth. Slight flow with mud substrate. In April, surrounding land use comprised severely poached mud/grass on the left bank with areas of hedge and pasture on the right bank. When re-visited in July, the surrounding land had	

recovered to become a grassland/meadow (bottom photograph). The channel has been dredged through the centre of the field. There are no obvious tributaries or inputs, but the surrounding field drains into the channel. The ditch is culverted in the centre of the field. **Surveys** Water quality, diatoms, macro-invertebrates and macrophytes	

Site Reference	**P2**
Grid Reference	SH 33226 78373
Access: Yes	**Wetted:** Ephemeral
This feature is more of a field ditch than a pond. The channel is approximately 40cm wide, with a water depth of 10cm with mud substrate and earth banks. The surrounding land use is plantation woodland. This feature looks to be man-made. **Surveys** Water quality and diatoms	 

Site Reference	P3
Grid Reference	SH 33242 78178
Access: Yes	**Wetted:** Yes
Roadside pond of 8m x 3m dimensions. Water depth of 15cm with organic matter substrate and well-vegetated earth banks. The pond is surrounded by improved pasture/lawn on one side and a dry stone wall and road on the other. This pond receives input from the adjacent road and field. There is also litter present in the pond. **Surveys** Water quality, diatoms and PSYM	 

Site Reference	P4
Grid Reference	SH 32399 78475
Access: No	**Wetted:** Ephemeral
This site was dry at the time of survey. Pond of 10m x 10m dimensions with earth substrate. The pond is within an area of rough pasture with tall herbs/rank vegetation. This area is enclosed by the Vehicle and Operator Safety Agency (VOSA) checkpoint to the north and the property access track to the south. The pond appears to be a man-made retention basin. **Surveys** None	

Site Reference	P6
Grid Reference	SH 32852 78811

Access: Yes	**Wetted:** Yes
Large pond of dimensions 25m x 15m with well-vegetated earth banks of 70cm height. Substrate comprised organic matter and silt overlying bedrock. Surrounding land use is predominantly woodland but also includes derelict buildings and pasture. The pond appears to be man-made but no inputs could be detected due to vegetation. **Surveys** Diatoms	

Site Reference	**P11a**
Grid Reference	SH 33935 78275
Access: Yes	**Wetted:** Yes
Pond 15m x 5m in size in field corner. Estimated depth of 40cm with mud and organic matter substrate. Grassy earth banks with some bare areas. The pond borders the road for half of its length and is otherwise surrounded by semi-improved pasture. No obvious modifications were observed but poaching was evident on the bank of the pasture. **Surveys** Diatoms and PSYM	

Site Reference	**P11b**
Grid Reference	SH 33574 78382
Access: Yes	**Wetted:** Yes

Pond of dimensions 4m x 2m with soft mud substrate. The surrounding land use is rough pasture although the pond is heavily shaded by a stand of broadleaved trees. There are no obvious modifications to this pond. **Surveys** None	

Site Reference	**P12**
Grid Reference	SH 32674 78318
Access: Yes	**Wetted:** Ephemeral
Urban drainage pond 12m x 12m in size with steep sloping well-vegetated banks. Substrate composed of silt and organic matter but the depth of the pond is unclear. Surrounding land use is rough grassland, scrub and road. **Surveys** Diatoms	

Site Reference	**P13**
Grid Reference	SH 32733 78305
Access: Yes	**Wetted:** Yes
Urban drainage pond 3m x 4m in size, 25cm deep with low banks and organic matter substrate. The surrounding land is tall wetland ruderal vegetation and scrub and the pond is bordered by the A55 to the south and A5 to the north. It is possible that this pond is connected to several others in the area but this is unclear. **Surveys** Diatoms and PSYM	

Site Reference	P14
Grid Reference	SH 32746 78286
Access: Yes	**Wetted:** Yes
Urban drainage pond (28m x 18m) greater than 1m deep. Low, well-vegetated banks and a silt and organic matter substrate. The area comprises tall wetland ruderal vegetation and scrub. The pond is bordered by the A55 to the south and A5 to the north. The pond is connected to at least one other pond in the area (Pond 16a). **Surveys** Diatoms and PSYM	

Site Reference	P15
Grid Reference	SH 32745 78286
Access: Yes	**Wetted:** Yes
Urban drainage pond 8m x 15m in size and around 70cm deep. Organic matter and silt substrate with low well-vegetated banks. The pond is surrounded by tall wetland ruderal vegetation and scrub and bordered by the A55 to the south and A5 to the north. Possibly connected to other surrounding ponds but this is unclear. **Surveys** Diatoms and PSYM	

Site Reference	P16a
Grid Reference	SH 32743 78295
Access: Yes	**Wetted:** Yes
Urban drainage pond 20m x 8m in size and over 1m deep. Silt and organic matter substrate with low well-vegetated banks. The pond is surrounded by tall wetland ruderal vegetation and scrub and bordered by the A55 and A5. This pond receives input from Pond 14 and may also be connected to other ponds in the area. **Surveys** Diatoms and PSYM	

Site Reference	P16c
Grid Reference	SH 32793 78268
Access: Yes	**Wetted:** Yes
Urban drainage pond 8m x 8m in size, depth unknown. Silt and organic matter substrate with low well-vegetated banks. The pond is surrounded by tall wetland ruderal vegetation and scrub and bordered by the A55 and A5. **Surveys** Diatoms and PSYM	

Site Reference	P16d
Grid Reference	SH 32816 78265
Access: Yes	**Wetted:** Yes
Very large urban drainage pond 100m x 15m in size and 1m deep. Silt and organic matter substrate with low well-vegetated banks. The pond is surrounded by tall wetland ruderal vegetation and scrub and bordered by the A55 and A5. This pond is likely to both spill onto and receive input from the surrounding marsh. **Surveys** PSYM	

Site Reference	P17
Grid Reference	SH 32919 78181
Access: No	**Wetted:** Yes
Large triangular urban drainage pond of approximately 180m^2. Access was not possible so depth and substrate are unknown. The pond is surrounded by semi-improved pasture and scrubland, and bordered by the A55 on the north. Inputs are unknown. **Surveys** None	

Site Reference	P19
Grid Reference	SH 32089 78441
Access: No	**Wetted:** Yes
This is a large urban drainage pond between the A55 and the A5. Access was not possible so was characterised from a distance. The land surrounding the pond is heavily vegetated and no inputs were observed. **Surveys** None	

Site Reference	P20
Grid Reference	SH 31972 78345
Access: Yes	**Wetted:** Yes
Large man-made garden pond of dimensions 35m x 15m with mud substrate. The surrounding land use is private garden. D28 flows into the pond and D30 flows out of it. **Surveys** None	

Appendix B Laboratory Analysis Results

Physio-chemical

Compound	*Units*	*MRV*	P2a	P3	D7	D9	D17	D19	D21	D24a	D26	D29	D33	D34
Conductivity : *In situ*	µS cm^{-1}		262	272	603	326	555	188	275	326	605	433	364	380
Oxygen, Dissolved : I/S as O2	%		36.1	31.1	44.4	87	31.1	71	55.7	91.1	72.5	107	74.9	64.5
Temperature of Water	°C	n/a	9.26	8.43	10.5	11.6	10.6	9.28	9.58	10.4	9.65	10.9	9.85	9.21
pH	pH Units	n/a	5.78	5.7	6.12	6.86	6.2	6.01	6.15	6.68	6.36	7.03	6.09	5.26
Alkalinity to pH 4.5 as CaCO3	mg L^{-1}	5	50	41	141	92	167	46	83	94	207	98	119	46
Alkalinity, Dissolved as CaCO3	mg L^{-1}	5	49.3	41.3	141	91.8	171	43.8	79.8	92.4	211	96.4	116	40.4
BOD 5 Day ATU	mg L^{-1}	1	<2.92	<1.00	5.35	<1.00	13	<1.00	1.78	<2.92	6.59	<1.00	<2.92	<1.00
Chemical Oxygen Demand {COD}	mg L^{-1}	10	41	20	73	24	143	14	25	26	220	<10.0	28	11
Solids, Suspended at 105˚ C	mg L^{-1}	3	18.1	10.1	83.3	5.23	108	<3	22.1	39.8	733	9.3	12.2	4.92

Nutrients

Compound	*Units*	*MRV*	P2a	P3	D7	D9	D17	D19	D21	D24a	D26	D29	D33	D34
Orthophosphate as P (filtered)	mg L^{-1}	0.02	0.045	<0.0200	0.081	0.204	0.398	<0.0200	0.052	0.146	0.032	<0.0200	0.054	<0.0200
Orthophosphate, reactive as P	mg L^{-1}	0.02	0.059	<0.0200	0.099	0.234	0.145	<0.0200	0.076	0.167	<0.0200	<0.0200	0.073	<0.0200
Ammoniacal Nitrogen as N	mg L^{-1}	0.03	0.041	<0.0300	0.045	0.067	<0.0300	<0.0300	<0.0300	<0.0300	0.221	<0.0300	0.058	<0.0300
Ammoniacal Nitrogen as N (filtered)	mg L^{-1}	0.03	0.042	<0.0300	0.08	0.11	0.181	<0.0300	<0.0300	0.032	0.165	<0.0300	0.069	<0.0300
Ammonia un-ionised as N	mg L^{-1}	0.2	0.00000443	<0.000002 47	0.0000204	0.000167	0.0000558	<0.00000539	<0.00000761	0.0000293	0.0000683	<0.0000639	0.0000156	<0.000000 953

Metals

Compound	*Units*	*MRV*	P2a	P3	D7	D9	D17	D19	D21	D24a	D26	D29	D33	D34
Arsenic	µg L^{-1}	1	<1	<1	1.32	<1	1.97	<1	<1	<1	8.85	<1	<1	<1
Cadmium	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.225	<0.1	<0.1	<0.1
Chromium	µg L^{-1}	0.5	1.06	<0.5	2.12	<0.5	4.52	<0.5	0.53	1.09	40.4	1.03	0.952	<0.5
Copper	µg L^{-1}	1	4.77	1.69	3.97	2.66	10.4	<1	1.83	2.78	22.9	2.8	4.5	1.2
Lead	µg L^{-1}	2	<2	<2	<2	<2	6.69	<2	<2	<2	17.4	<2	<2	<2
Nickel	µg L^{-1}	1	2.83	<1	2.05	1.01	4.99	<1	1.21	1.43	21.4	1.29	1.5	1.03
Zinc	µg L^{-1}	5	8.89	<5	13.3	<5	135	<5	5.6	7.04	73.7	<5	10.4	7.1
Iron	µg L^{-1}	30	1040	580	12500	464	4950	128	1060	1300	24700	491	995	314
Manganese	µg L^{-1}	10	303	90.6	1480	344	579	34.9	473	425	6760	212	444	88.4
Mercury	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Phenols

Compound	*Units*	*MRV*	P2a	P3	D7	D9	D17	D19	D21	D24a	D26	D29	D33	D34
2,3,5,6-Tetrachlorophenol	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2,3-Dichlorophenol	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2,3-Dimethylphenol :- {2,3-Xylenol}	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2,4,5-Trichlorophenol	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2,4,6-Trichlorophenol	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2,4-Dichlorophenol	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2,4-Dimethylphenol :- {2,4-Xylenol}	µg L^{-1}	0.02	<0.02	<0.02	0.96	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2,5-Dichlorophenol	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2,5-Dimethylphenol :- {2,5-Xylenol}	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2,6-Dichlorophenol	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2,6-Dimethylphenol :- {2,6-Xylenol}	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2-Chlorophenol	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2-Ethylphenol	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2-Methylphenol :- {o-Cresol}	µg L^{-1}	0.02	<0.02	<0.02	0.0271	<0.02	0.0321	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
3,4-Dimethylphenol :- {3,4-Xylenol}	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
3,5-Dimethylphenol :- {3,5-Xylenol}	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
3-Chlorophenol	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
3-Methylphenol :- {m-Cresol}	µg L^{-1}	0.02	<0.02	<0.02	0.0337	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4-Chloro-2-methylphenol :- {p-Chloro-o-cresol}	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4-Chloro-3,5-dimethylphenol :- {PCMX}	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Compound	*Units*	*MRV*	P2a	P3	D7	D9	D17	D19	D21	D24a	D26	D29	D33	D34
4-Chloro-3-methylphenol :- {p-Chloro-m-cresol}	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.0413	<0.02	<0.02	<0.02
4-Chlorophenol	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
4-Methylphenol :- {p-cresol}	µg L^{-1}	0.02	<0.02	0.0323	2.14	<0.02	0.453	<0.02	<0.02	0.0207	0.0469	<0.02	<0.02	<0.02
Pentachlorophenol	µg L^{-1}	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phenol	µg L^{-1}	0.05	0.0796	0.0703	0.423	0.0504	0.356	<0.05	<0.05	<0.05	2.69	0.0611	0.0739	<0.05

PAHs

Compound	*Units*	*MRV*	P2a	P3	D7	D9	D17	D19	D21	D24a	D26	D29	D33	D34
Hydrocarbons Screen >C5 - C44	mg L^{-1}	0.01	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Acenaphthene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthylene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Anthracene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)anthracene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(a)pyrene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(e)pyrene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(ghi)perylene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(k)fluoranthene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chrysene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dibenz(a,h)anthracene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluoranthene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fluorene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Indeno(1,2,3-cd)pyrene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Perylene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenanthrene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Pyrene	µg L^{-1}	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Volatiles and Others

Compound	*Units*	*MRV*	P2a	P3	D7	D9	D17	D19	D21	D24a	D26	D29	D33	D34
1,1,1,2-Tetrachloroethane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,1,1-Trichloroethane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,1,2,2-Tetrachloroethane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,1,2-Trichloroethane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,1-Dichloroethane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,1-Dichloroethylene :- {1,1-Dichloroethene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,1-Dichloropropylene :- {1,1-Dichloropropene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,2,3-Trichlorobenzene	µg L^{-1}	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-Trichloropropane	µg L^{-1}	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-Trimethylbenzene	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,2,4-Trichlorobenzene	µg L^{-1}	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,2-Dibromo-3-chloropropane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,2-Dibromoethane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,2-Dichlorobenzene	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,2-Dichloroethane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,2-Dichloropropane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,2-Dimethylbenzene :- {o-Xylene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,3,5-Trichlorobenzene	µg L^{-1}	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene :- {Mesitylene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,3-Dichlorobenzene	µg L^{-1}	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichloropropane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,4-Dichlorobenzene	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2,2-Dichloropropane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2-Chlorotoluene :- {1-Chloro-2-methylbenzene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
3-Chlorotoluene :- {1-Chloro-3-methylbenzene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4-Chlorotoluene :- {1-Chloro-4-methylbenzene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Compound	*Units*	*MRV*	P2a	P3	D7	D9	D17	D19	D21	D24a	D26	D29	D33	D34
4-Isopropyltoluene :- {4-methyl-Isopropylbenzene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzene	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bromobenzene	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bromochloromethane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bromodichloromethane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bromoform :- {Tribromomethane}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Carbon Disulphide	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Carbon tetrachloride :- {Tetrachloromethane}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorobenzene	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorodibromomethane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chloroform :- {Trichloromethane}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chloromethane :- {Methyl Chloride}	µg L^{-1}	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromomethane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dichloromethane :- {Methylene Dichloride}	µg L^{-1}	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dimethylbenzene : Sum of isomers (1,3-1,4-) : {m+p xylene}	µg L^{-1}	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Ethyl tert-butyl ether :- {ETBE}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Hexachlorobutadiene	µg L^{-1}	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachloroethane	µg L^{-1}	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Isopropylbenzene	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
MTBE :- {Methyl tert-butyl ether}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	µg L^{-1}	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Styrene :- {Vinylbenzene}	µg L^{-1}	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethylene :- {Perchloroethylene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene :- {Methylbenzene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	0.23	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1
Trichloroethylene :- {Trichloroethene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Trichlorofluoromethane	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vinyl Chloride :- {Chloroethylene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
cis-1,2-Dichloroethylene :- {cis-1,2-Dichloroethene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
cis-1,3-Dichloropropylene :- {cis-1,3-Dichloropropene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
n-Butylbenzene :- {1-Phenylbutane}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
n-Propylbenzene :- {1-phenylpropane}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
sec-Butylbenzene :- {1-Methylpropylbenzene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
tert-Amyl methyl ether :- {TAME}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
tert-Butylbenzene :- {(1,1-Dimethylethyl)benzene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
trans-1,2-Dichloroethylene :- {trans-1,2-Dichloroethene}	µg L^{-1}	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
trans-1,3-Dichloropropylene :- {trans-1,3-Dichloropropene}	µg L^{-1}	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-D :- {2,4-Dichlorophenoxyacetic acid}	µg L^{-1}	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Mecoprop	µg L^{-1}	0.005	0.014	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloride (Filtered)	mg L^{-1}	1	53.6	80.8	119	47.1	89.6	38.7	37.6	52	118	79.8	60.6	93.2
Chlorine Free as Cl2	mg L^{-1}	0.05	0.12	0.07	0.13	0.15	0.13	0.06	0.05	0.08	0.12	0.05	0.17	0.07

Appendix C Macroinvertebrate Raw Data

Raw Macroinvertebrate Data

Table C1: List of macroinvertebrate species recorded across survey sites, July 2014.

Species	D9 (F)	D17 (C)	D24a (J)	D29 (N)	D33 (M)	D34 (F)
Agabus bipustulatus			1		14	3
Agabus didymus	1					
Agabus sp.					3	5
Anacaena globulus		2				
Anacaena lutescens					5	
Anisus leucostoma		936			1	
Anisus vortex	214		449	1		
Aplexa hypnorum		281				
Asellus aquaticus	320	81	270	247	124	504
Beraea pullata				1	1	
Ceratopogonidae					1	
Chaetopteryx villosa	1					
Chelifera sp.				6		
Chironomidae	758		508	1171	394	367
Corixidae	1		7		1	21
Crangonyx pseudogracilis	253	989	148	36	1997	135
Dixidae			1			
Dytiscidae	2		1			
Dytiscus sp.			1			
Elmis aenea				4		
Empididae						1
Eristalis sp.		7				
Erpobdella octoculata	4		3			1
Erpobdella testacea	2		2			3
Galba truncatula					1	
Gerridae		1				
Glossiphonia complanata			4	9	1	1
Glyphotaelius pellucidus						1
Gyrinus caspius				1		
Gyrinus sp.	2			3		
Gyrinus substriatus	2			5		1
Haemopis sanguisuga			1	1		
Haliplus fluviatilis			1	8		
Haliplus lineatocollis	1		2			
Haliplus ruficollis			5			
Haliplus sp.	1		4			14
Helobdella stagnalis		1	2			
Helophorus aequalis			1			1
Helophorus brevipalpis	15	1	10	1	755	78
Helophorus grandis					6	

Species	D9 (F)	D17 (C)	D24a (J)	D29 (N)	D33 (M)	D34 (F)
Hesperocorixa linnaei						1
Hesperocorixa sahlbergi						3
Hydracarina	2		6			
Hydrobius fuscipes		9				
Hydrophilidae		8				7
Hydroporus palustris		35				
Hydroporus planus		2			3	
Hydroporus pubescens					33	
Hydroporus sp.					1	1
Ilybius ater						1
Ilybius fuliginosus			1		3	1
Ilybius sp.						2
Ischnura elegans	3		1			4
Laccobius bipunctatus	2				1	
Laccobius sp.						2
Limnephilus lunatus	29		19	27	8	1
Notonecta sp.			14			16
Oligochaeta	2	351	18		150	286
Ostracoda	159		3	12	1	
Pericoma sp.		19			3	
Physa fontinalis				17		
Physella heterostropha					25	1398
Pisidium sp.		1				
Planariidae				1		
Polycelis nigra	152	1	18		67	12
Potamopyrgus antipodarum	600		391	2168	1794	
Proasellus meridianus	35	393	20	3		
Psychodidae						1
Radix balthica	10		36	6		1363
Sialis lutaria	9		12	11		
Sigara nigrolineata					3	
Sphaeriidae	85		134	1414	86	2
Stagnicola palustris	2				2	
Stictotarsus duodecimpustulatus				1		
Succinea sp.				5		
Succineidae	1					
Sympetrum striolatum			1			
Theromyzon tessulatum						1
Tipula sp.		2				
Tipulidae						12
INCIDENTAL SIGHTINGS						
Libellula quadrimaculata						1

Appendix D Macrophyte Raw Data

Raw Macrophyte Data

Table D1: List of macrophyte species recorded across survey sites, July 2014.

Date	Summer 2014					
Site	**D2**	**D9**	**D24**	**D33**	**D34 (a)**	**D34 (b)**
Total Vegetative Cover (%)	100	100	-	98	80	95
Taxon Cover Value	TCV	TCV	TCV	TCV	TCV	TCV
Macroalgae / Bryophytes						
Cladophora glomerata/Rhizoclonium hieroglyphicum agg.		2			1	6
Riccardia sp. *chamaedryfolia / multifida*		1				
Vascular Plants						
Alisma plantago-aquatica		3	5		3	7
Apium inundatum						
Apium nodiflorum	2	6	7	6	4	2
Callitriche sp.	1	2	6	7	4	5
Caltha palustris			2			
Eleocharis palustris						2
Equisetum fluviatile	1		5			
Glyceria fluitans agg.				7		6
Iris pseudacorus			2		3	
Lemna minuta		2	6		2	7
Lotus pedunculatus		2				
Lythrum salicaria		2	2			
Mentha sp.	1	3		2	3	2
Mentha aquatica					3	6
Menyanthes trifoliata			6			
Myosotis laxa	1	3	2	1	2	3
Oenanthe crocata	1	8	6			
Persicaria amphibia			2			
Persicaria hydropiper		2			2	
Phalaris arundinacea					4	6
Ranunculus sp. (*Batrachium* sp.)						
Ranunculus hederaceus					2	1
Rorippa nasturtium-aquaticum agg.	1	5			3	
Sparganium erectum		5	6			

Date	Summer 2014					
Site	**D2**	**D9**	**D24**	**D33**	**D34 (a)**	**D34 (b)**
Total Vegetative Cover (%)	100	100	-	98	80	95
Taxon Cover Value	TCV	TCV	TCV	TCV	TCV	TCV
Spirodela polyrhiza						4
Typha latifolia	1		5			
Veronica beccabunga		1				
Other Taxa						
Alopecarus geniculatus				2		2
Epilobium ciliatum		3		1	5	2
Epilobium hirsutum	3		3	1		
Filupendula ulmaria	6	2	4	3		
Galeopsis tetrahit					2	
Galium mollugo				3		4
Hypericum tetrapterum		2				
Juncus acutifolius				2		
Juncus acutus						4
Juncus bulbosus					1	3
Juncus effusus			2	1		2
Lophocolea bidentata		1				
Lunularia sp.					1	
Lychnis flos-cuculi			1			
Lycopus europaeus			4			
Ranunculus lingua						4
Ranunculus repens				5		2
Rumex conglomeratus		2	2			
Rumex crispus		1				
Sagina procumbens					1	
Samolus sp. (*Brookweed*)		1				
Scrophularia auriculata					1	
Solanum dulcamara					5	
Stachys palustris		2				
Stellaria alsine				2		
Total LEAFPACS scoring taxa	3	5	5	3	5	4
Overall total taxa (including those not on LEAFPACS list)	10	22	20	16	21	21

Appendix E PSYM Raw Data

PSYM Raw Output Data

Table E.1: PSYM results and classification of ponds. Observed indices in unshaded rows and Ecological Quality Indices (EQIs) below (EQI of ≥1 denotes a pond meeting or exceeding reference site quality – marked in bold). (PSYM quality category = IBI >75%=Good, 51-75%=Moderate, 25-50%=Poor, <25%=V Poor).

	P3	P11	P13	P14	P15	P16a	P16b	P16c	P16d
No. of submerged + marginal plant species (SM)	13	19	17	24	12	25	16	10	25
Predicted (SM)	20.0	19.8	21.1	19.1	19.1	19.4	20.1	19.2	17.2
EQI (SM)	0.65	0.96	0.81	1.26	0.63	1.29	0.80	0.52	1.45
IBI (SM)	2	3	3	3	2	3	3	2	3
Number of uncommon plant species (U)	1	1	1	9	0	7	2	1	5
Predicted (U)	4.5	4.5	4.8	4.3	4.3	4.4	4.5	4.3	3.9
EQI (U)	0.22	0.22	0.21	2.10	0.00	1.61	0.44	0.23	1.30
IBI (U)	0	0	0	3	0	3	1	0	3
Trophic Ranking Score (TRS)	8.1	8.95	8.3	8.33	8.30	8.30	8.13	8.58	8.35
Predicted (TRS)	5.58	5.59	5.58	5.59	5.60	5.60	5.58	5.59	5.60
EQI (TRS)	1.45	1.60	1.49	1.49	1.48	1.48	1.46	1.54	1.49
IBI (TRS)	0	0	0	0	0	0	0	0	0
Average Score per Taxon (ASPT)	3.7	4.4	4.5	4.9	4.7	4.7	3.9	4.6	4.5
Predicted (ASPT)	5.61	5.01	5.54	5.69	5.61	5.65	5.65	5.70	5.61
EQI (ASPT)	0.65	0.87	0.82	0.86	0.83	0.83	0.69	0.81	0.81
IBI (ASPT)	1	3	2	3	2	2	1	2	2
Odonata + Megaloptera (OM) families	0	0	1	2	3	2	0	2	2
Predicted (OM)	3.67	2.61	3.53	3.77	3.78	3.78	3.75	3.77	3.78
EQI (OM)	0.00	0.00	0.28	0.53	0.79	0.53	0.00	0.53	0.53
IBI (OM)	0	0	1	2	3	2	0	2	2
Coleoptera families (CO)	2	2	3	2	4	2	1	2	3
Predicted (CO)	3.52	4.04	3.62	3.33	3.46	3.39	3.44	3.32	3.47
EQI (CO)	0.57	0.50	0.83	0.60	1.16	0.59	0.29	0.60	0.86
IBI (CO)	2	1	3	2	3	2	1	2	3
Sum of Individual Metrics	**5**	**7**	**9**	**13**	**10**	**12**	**6**	**8**	**13**
Index of Biotic Integrity (%)	**28%**	**39%**	**50%**	**72%**	**56%**	**67%**	**33%**	**44%**	**72%**
PSYM quality category	**Poor**	**Poor**	**Mod.**	**Mod.**	**Mod.**	**Mod.**	**Poor**	**Poor**	**Mod.**

	P3	P11	P13	P14	P15	P16a	P16b	P16c	P16d
Priority species	0	0	0	2	0	1	0	0	1
Is this a Priority Pond?	**No**	**No**	**No**	**Yes**	**No**	**Yes**	**No**	**No**	**Yes**

PSYM Macroinvertebrate Species List

Table E.2: Raw species abundance data from PSYM macroinvertebrate surveys.

Species	Site								
	P3	P11	P13	P14	P15	P16a	P16b	P16c	P16d
Acroloxus lacustris			112						
Aeshnidae						1			
Agabus bipustulatus	2	2	3		1				
Agabus sp.		1					11		
Agabus sturmii		2							
Anacaena globulus			1		2				
Anacaena lutescens	3	1							
Anisus leucostoma		539							
Anisus vortex									601
Asellus aquaticus	15	230	73	34	129	152	13	34	44
Athripsodes aterrimus				3					
Athripsodes sp.								2	
Brachytron pratense									2
Ceratopogonidae				1	2				
Chironomidae	62	27	102	93	98	194	160	70	72
Coenagrion pulchellum				2					
Collembola	1								
Copepoda									22
Corixidae			1	160	150	16	4	30	16
Crangonyx pseudogracilis	957	922	147	23	45	60	97	17	177
Culicidae		10	8						
Culicoides sp.	6								
Dendrocoelum lacteum									1
Dixella sp.		9				2			2
Dixidae			2	2	2		1	3	
Dugesia lugubris						19			
Dugesia polychroa						15			
Dugesiidae						7			
Dytiscidae			3	13	13		4	10	
Dytiscus marginalis								1	
Enochrus testaceus					1				
Erpobdella sp.								1	
Erpobdella testacea	1			5		4			

Species	Site								
	P3	P11	P13	P14	P15	P16a	P16b	P16c	P16d
Ferrissia wakteri		3		9	6		61		
Galba truncatula	1		64		4		3	4	
Gerridae			1		3			1	
Gerris lacustris				57				1	1
Gyraulus albus					1			2	
Gyraulus laevis									9
Gyrinus substriatus					1				
Haliplus ruficollis			3	1				19	
Haliplus sp.				2	6			13	5
Helius sp.				1	5		12	1	
Helobdella stagnalis						1			
Helophorus brevipalpis	1				1				1
Hesperocorixa castanea								1	
Hesperocorixa linnaei			2	31	2	5	3		2
Hesperocorixa sahlbergi		4	3					3	
Hippeutis complanatus				96	86	1		9	38
Hydrobius fuscipes	2		1		1				
Hydrometra gracilenta									1
Hydroporus palustris				1					
Hydroporus sp.		1							
Hygrotus inaequalis				5					
Hyphydrus ovatus						1			3
Ilybius ater	1								
Ilybius sp.	5					3			2
Ischnura elegans			8	128	14	42		10	
Laccobius bipunctatus	5				9				
Leptoceridae								6	
Libellula quadrimaculata				2					
Mystacides longicornis						1			
Nepa cinerea								1	1
Noterus clavicornis			3	2	42	6		36	26
Notonecta glauca		5		4	4		3	1	16
Notonecta sp.							1	1	
Oligochaeta	16						1		
Planariidae					6				
Plea leachi				5					
Polycelis felina							1		7
Polycelis nigra	6	25							3
Polycelis sp.			2					3	
Potamopyrgus antipodarum	68								191
Proasellus meridianus	2								1
Pyrrhosoma nymphula				2					7
Radix balthica		97		40		144	231	2	1
Sialis lutaria					1			2	

Species	Site								
	P3	P11	P13	P14	P15	P16a	P16b	P16c	P16d
Sigara dorsalis					1				
Sigara sp.					2				
Sphaeriidae	671		657	383	151	142	526	57	42
Sphaerium corneum				4	1		3		
Stagnicola palustris		12							1
Sympetrum fonscolombei					1				
Tipulidae	6					13			5
Triaenodes bicolor						10		2	
Valvata piscinalis									2
INCIDENTAL SIGHTINGS									
Sympetrum striolatum								1	

PSYM Aquatic Plant Species List

Table E.3: Raw species presence data from PSYM aquatic plant surveys at nine ponds.

Site	P3	P11	P13	P14	P15	P16a	P16b	P16c	P16d
Achillea ptarmica				✓			✓		
Agrostis stolonifera		✓							
Alisma lanceolatum				✓					
Alisma plantago-aquatica		✓	✓	✓	✓	✓	✓	✓	✓
Alopecarus geniculatus		✓							
Apium inundatum				✓					
Apium nodiflorum				✓				✓	
Anagallis tenella				✓					
Angelica sylvestris	✓								✓
Berula erecta				✓		✓			✓
Callitriche sp.	✓	✓					✓		✓
Caltha palustris							✓		
Carex elata				✓					
Eleocharis palustris	✓		✓	✓	✓				✓
Epilobium ciliatum									
Epilobium hirsutum	✓		✓	✓	✓	✓			✓
Equisetum parviflorum	✓					✓			
Fillipendula ulmaria			✓	✓	✓	✓	✓		✓
Galium palustre		✓	✓				✓	✓	✓
Glyceria fluitans agg		✓							
Gnaphalium uliginosum		✓							

Site	P3	P11	P13	P14	P15	P16a	P16b	P16c	P16d
Hydrocotyle vulgaris						✓			
Iris pseudacorus			✓				✓		✓
Juncus acutiflorus	✓	✓	✓	✓	✓	✓	✓	✓	✓
Juncus bufonius agg		✓							
Juncus conglomeratus			✓						
Juncus effusus	✓	✓	✓	✓		✓	✓		
Juncus inflexus									✓
Lemna gibba	✓	✓	✓			✓	✓	✓	✓
Lemna minuta		✓							✓
Lotus pedunculatus	✓		✓	✓	✓	✓	✓	✓	✓
Lychnis flos-cuculi						✓			✓
Lycopus europaeus			✓	✓	✓				✓
Lythrum salicaria						✓			
Mentha aquatica			✓	✓	✓	✓	✓	✓	✓
Montia fontana		✓							
Myosotis laxa	✓	✓	✓	✓	✓	✓		✓	✓
Myriophyllum verticillatum				✓		✓			
Oenanthe crocata	✓					✓			✓
Oenanthe fistulosa				✓		✓			
Persicaria amphibia			✓	✓	✓	✓	✓	✓	✓
Persicaria hydropiper		✓							
Persicaria maculosa		✓							
Pilularia globulifera				✓					
Potamogeton berchtoldii								✓	✓
Potamogeton natans				✓		✓			✓
Potamogeton obtusifolius							✓		✓
Potentilla palustris						✓			
Ranunculus lingua				✓		✓			
Ranunculus sp. (+ *Batrachium* sp.)	✓		✓		✓		✓		
Rumex hydrolapathum						✓			
Solanum dulcamara		✓							
Schoenoplectus lacustris						✓			
Schoenoplectus tabernaemontani									✓
Sparganium erectum		✓				✓			
Typha latifolia	✓	✓	✓	✓	✓	✓	✓	✓	✓