HORIZON NUCLEAR POWER

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HORIZON NUCLEAR POWER

Wylfa Newydd Project

Freshwater Baseline Surveys 2011-2014 Report

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	Originated by	Checked by	Reviewed by	
ORIGINAL	NAME **Niamh Burke**	NAME **Evonne Maxwell / Liza Inglis**	NAME **Matt Robson**	
Approved by	NAME **Robert Bromley**	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**		INITIALS [redacted]
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REVISION	NAME	NAME	NAME	
v0.2	**Liza Inglis**	**Anastasia Charalampopoulou**	**Jon Barnes**	
Approved by	NAME **Robert Bromley**	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**		INITIALS [redacted]
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REVISION	NAME	NAME	NAME	
v0.3	**Liza Inglis**	**Jon Barnes**	**Jon Barnes**	
Approved by	NAME **Robert Bromley**	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**		INITIALS [redacted]
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REVISION	NAME	NAME	NAME	
v0.4	**Liza Inglis**	**Matt Robson**	**Matt Robson**	
Approved by	NAME **Robert Bromley**	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**		INITIALS [redacted]
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Executive Summary

The Wylfa Peninsula on Anglesey, north Wales has been listed as an approved site for the construction of a new nuclear facility in the National Policy Statement (NPS) for Nuclear Power Generation (EN-6), published in 2011 (Department of Energy and Climate Change, 2011).

Jacobs UK Ltd (Jacobs) was commissioned by Horizon Nuclear Power Wylfa Limited (Horizon) to undertake an ecological survey programme within the vicinity of the proposed new nuclear power station (the Wylfa Newydd Generating Station) on north Anglesey. This work has included gathering of baseline data for fish, diatoms (phytobenthos), macrophytes, macroinvertebrates, pond and stream habitat and water quality.

Survey work has been undertaken since 2011 to identify species and habitats of conservation interest and characterise the freshwater environment. An area approximately 7km^2, principally to the south and south-west of the Existing Power Station and including Wylfa Head, was identified for survey. This report presents the results of all freshwater surveys undertaken up to the end of 2014.

The site contains a diverse range of aquatic habitats including ponds, streams, ditches, wetland, coastal headland pools and seepages, many of which are ephemeral waterbodies. Habitats have been characterised with habitat descriptions updated over the survey period to provide a seasonal understanding. The physical habitat of the watercourses varied between natural streams to drainage ditches or streams that have been historically over-deepened and lost much of their natural character. Many of the alterations to watercourses are associated with field boundaries and are typical of the local area. Flow types varied, ranging between riffle/run in the more natural sections to sluggish flow chiefly within the ditch habitats. The ponds within the site ranged from artificial drainage ponds, to natural groundwater fed ponds, some with ephemeral characteristics.

Environmental condition as determined by diatom populations, varied by site and season. Changes in diatom populations seen between 2012 and 2014 are likely to be a result of changes in water levels and velocity. Inter-annual comparison of the 2011 to 2014 datasets showed that the quality of most sites has remained constant with respect to their phytobenthos communities. The diatom sampling to date shows that there is a large variability in diatom populations across the study area, which would be expected given the diverse range of habitat types assessed.

Water quality data showed a general trend of low dissolved oxygen levels in the ditch, wetland and standing water habitats, with the exception of Porth Wylfa Pond and Penyrorsedd Pond. Metal concentrations were generally low across all sites in 2012 and 2013 with the exception of mercury at Power Station Junction in 2013. During 2014, a number of the new pond sites indicated elevated metal concentrations on some sampling occasions. Suspended solid levels varied spatially and inter-annually, but generally suggested a stable system with limited sediment mobilisation. Nutrient levels (reactive phosphorus and ammonia) were generally fairly low although higher levels were often noted within the ponds.

The majority of macroinvertebrate species identified in the study area belonged to families of moderate to high pollution tolerance, which typically reflects pressures from agricultural land use (mainly improved pastures, where livestock often have

access to the waterbodies). In general, the macroinvertebrate communities across the study area were dominated by the more pollutant tolerant families such as leeches, crustaceans, beetles and molluscs, but well vegetated, flushed sites such as at Porth-y-pistyll and Porth Wylfa supported families of stoneflies and mayflies. The Cae Gwyn Site of Special Scientific Interest (SSSI) and Tre'r Gof SSSI areas were particularly valuable for rare beetle species, supporting their designation as important wetland areas.

Macrophyte communities tended to lack diversity and there was some evidence of nutrient enrichment. However, the majority of sites demonstrated good ecological quality. The surveys identified that the macrophyte communities are dominated by higher vascular plants, with a smaller presence of macro-algae and bryophytes. There were no species of conservation importance identified in the surveys.

Electric fishing surveys were conducted under licence at ten sites across seven waterbodies. Species recorded included the protected European eel (*Anguilla anguilla),* indicating sufficient connectivity to the marine environment in a number of the watercourses to allow eel migration across the study area. Brown trout (*Salmo trutta)*, was recorded on the Cafnan watercourse, which has potential breeding habitat for this species. Three-spined stickleback (*Gasterosteus aculeatus*) has been widely recorded, with nine-spined stickleback (*Pungitius pungitius*) being recorded in smaller numbers. The presence of migratory species suggests the watercourses in the study area could provide an important resource for both diadromous and potadromous species.

To ease interpretation of the habitat quality, this report presents baseline data for the individual receptors categorised according to the main watercourses. The main Wygyr catchment has been subdivided starting in the west of the site and progressing eastwards.

The main catchments presented in this report are the following: the Cemlyn stream that outflows to Cemlyn lagoon at the west of the study area, the Cafnan watercourse, the Tre'r Gof catchment and the Cemaes watercourse in the east, flowing north to Cemaes Bay. The remaining survey sites which were not deemed to be hydrologically part of any catchment were classed as 'others' and are described individually in Sections 7 and 8.

Of the four main catchments, the Cafnan catchment was shown to exhibit the highest quality habitat in terms of fish and macroinvertebrates. Trout and European eel were caught during the surveys and potential spawning habitat was identified along the main stem of the river. The tributary stream exhibited lower habitat quality with the exception of the wetland areas at the Cae Gwyn SSSI and Groes-fechan wetland, where some species of conservation interest were found.

The Cemlyn catchment to the west showed evidence of historical realignment, with some sedimentation stress and low levels of nutrient enrichment via diffuse pollution. Apart from European eel, no species of conservation interest were identified.

The Tre'r Gof catchment exhibited little fish habitat, although incidental sightings of European eel were recorded. Low to moderate quality habitat was observed as evident from macrophyte, phytobenthos and macroinvertebrate surveys. The moss beetle *Hydraena palustris* was found in 2014 and is a Near Threatened species.

Aquatic habitats in the Cemaes catchment were influenced by low levels of nutrient enrichment via diffuse pollution, low flows and variable water quality. Apart from the European eel, no other species of conservation interest were recorded during the surveys.

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Acronym	Acronym representation	Definition
ALG	Percent algal cover	Macrophyte index used to calculate the percent algal cover.
ASPT	Average Score per Taxon	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
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	Number of Coleoptera families	Number of Coleoptera families indicates the habitat quality and diversity of a pond.
DARLEQ2	Diatom Assessment of River and Lake Ecological Quality	Microsoft Windows® program for the assessment of river and lake ecological status using diatoms.
EQI	Ecological Quality Indices	The ratio of observed to expected values (O/E) of each biotic receptor.
EQR	Ecological Quality Ratio	As per EQI above, EQR is the ratio that incorporates the key WFD requirements for ecological classification: typology, reference conditions and class boundary settings.
LEAFPACS2	N/A	A classification method that assess 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.
LIFE (F)	Lotic-invertebrate Index for Flow Evaluation – Family level	Each macroinvertebrate family within a sample is assigned to a flow group depending on their flow/velocity preference. A higher score represents a higher number of taxa with a preference for high velocity habitats, and vice versa.
LIFE (sp)	Lotic-invertebrate Index for Flow Evaluation – Species level	Each macroinvertebrate species within a sample is assigned to a flow group depending on their flow/velocity preference. A higher score represents a higher number of taxa with a preference for high velocity habitats, and vice versa. The species index is more accurate than the family level as it accounts for variable flow preference of species within a family group.
MINTA	Minimum Taxa	Represents the defining class based on the minimum of either NTAXA or ASPT indices and is used to attribute an EQR classification to the study site in question

Acronym	Acronym representation	Definition
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 community is.
NGR	National Grid Reference	Ordnance Survey National Grid reference system is a system of geographic grid references used in Great Britain.
NTAXA	Number of Taxa	A measure of the number of species taxa present at a given site
OM	Number of Odonata and Megaloptera families	Number of Odonata and Megaloptera families indicates long-term quality of a pond as larvae have a long aquatic life stage.
PSI	Proportion of Sediment-sensitive Invertebrates	Macro-invertebrates 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.
PSI (F)	Proportion of Sediment-sensitive Invertebrates (Family)	Macro-invertebrate families within a sample are assigned a score based on their sensitivity to sediment. Predicted values are generated and compared to the observed, producing an EQR indicating how sedimented the watercourse is. It is interpreted as minimally, slightly, moderately or 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 that 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 and 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 Value	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.

1 Introduction

1.1 Overview

The Wylfa Peninsula on Anglesey, north Wales has been listed as an approved site for the construction of a new nuclear facility in the National Policy Statement (NPS) for Nuclear Power Generation (EN-6), published in 2011 (Department of Energy and Climate Change, 2011). The Wylfa Newydd Development Area (the indicative areas of land and sea, including the Power Station Site[1], the Wylfa NPS Site and the surrounding areas that would be used for the construction and operation of the Power Station) comprises a 380 hectare area of land to the south and east of the existing Magnox power station (the Existing Power Station).

Horizon Nuclear Power Wylfa Limited (here after referred to as Horizon) is a UK energy company developing a new generation of nuclear power station to help meet the country's need for stable and sustainable low carbon energy.

Horizon is proposing to construct and operate the Wylfa Newydd Project (the Project). The Project comprises the proposed new nuclear power station, including the reactors, associated plant and ancillary structures and features, together with all of the development needed to support its delivery, such as highway improvements, worker accommodation and specialist training facilities.

The Project will require a number of applications to be made under different legislation to different 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 a full ecological survey programme within the Wylfa Newydd Development Area and a buffer zone. This work has included the gathering of baseline data to inform the various applications, assessments and permits that will be submitted for approval to construct and operate the Project.

This report details the current state of freshwater aquatic receptors within the Wylfa Newydd Development Area, based upon field survey work and identifies species and habitats of conservation interest and current ecological status.

This report uses a number of technical terms and abbreviations. Key terms are capitalised and explained with their acronyms in the glossary. References to legislation are to that legislation as in force at the time of the publication of this report.

1.2 Site Description

The Wylfa Newydd Development Area is bounded to the north by the coast and the Existing Power Station. To the east, it is separated from Cemaes by a narrow corridor of agricultural land and a minor, unnamed tributary. The A5025 and residential properties define part of the south-east boundary, with a small parcel of land spanning the road to the north-east of Tregele. To the south, the area abuts agricultural land, and to the west it adjoins the coastal hinterland.

[1] The indicative area of land and sea within which the majority of the permanent Power Station buildings, plant and structures would be situated.

The Wylfa Newydd Development Area includes the headland south of Mynydd y Wylfa candidate local wildlife site. There is one designated site for nature conservation within the Wylfa Newydd Development Area: the Tre'r Gof Site of Special Scientific Interest (SSSI). It is also within 1km of the Cae Gwyn SSSI, Cemlyn Bay Special Area of Conservation (SAC) and the Ynys Feurig, the Skerries and Cemlyn Bay Special Protection Area (SPA) and SSSI.

Tre'r Gof is a small basin mire adjacent to the Existing Power Station, west of Cemaes. The area receives mineral-enriched waters from the surrounding boulder clay leading to the development of notable botanics, which is the reason for the designation (fen rich habitat in north-west Wales) of the site as a SSSI.

Cae Gwyn SSSI is located immediately to the south of the Wylfa Newydd Development Area and to the west of Llanfechell. The SSSI comprises two wetland areas separated by an outcrop of rock with heathland vegetation. The southern wetland is confined by a rock basin and is dominated by bog moss (*Sphagnum* spp.) and a wide variety of common wetland herbs. The northern wetland has a different flora containing denser areas of willow (*Salix* spp.) and common reed (*Phragmites communis*).

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 Wylfa Newydd Generating Station.

As part of the Environmental Impact Assessment and Habitats Regulations Assessment, the need for detailed temporal and spatial data on freshwater habitats has been identified. This report presents the findings of the baseline monitoring work between 2011 and 2014.

1.4 Previous Work

A number of other surveys have been carried out, either prior to or concurrently with this one, with some relevance to freshwater ecology. These include:

- Phase 1 surveys (Jacobs, 2013);
- Protected species surveys for bats; great crested newts (*Triturus cristatus*); reptiles; water voles (*Arvicola amphibious*) and otters (*Lutra lutra*); breeding birds and overwintering birds (Jacobs, 2015a; Jacobs, 2015b; Jacobs, 2015c; Jacobs, 2015d; Jacobs, 2015e);
- Fluvial geomorphology report (Jacobs, 2015f); and
- Hydrological baseline report (Jacobs, 2016 - *in draft).*

2 Methodology

2.1 Approach

A walkover of the survey area in 2011 identified the main watercourses and pond/lake waterbodies within the study area. Key ecological receptors were identified and survey programmes developed to characterise and quantify the freshwater ecology within the Wylfa Newydd Development Area and the buffer zone.

The following surveys were undertaken:

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

Ecological receptors were chosen to best represent the existing ecological condition of each waterbody. Further details on the methodologies for each of the survey elements are outlined in Sections 2.3.1 to 2.3.7 below.

Any incidental sightings of invasive species or of species of conservation importance were also recorded.

2.2 Survey Area

Impacts beyond the boundary of the Wylfa Newydd Development Area were identified at an early stage. These included for example impacts from noise, dust and increased human activity affecting species and habitats within the surrounding area, fragmentation of species' commuting/migration routes and potential for hydrological changes. As a result, a buffer zone was added to the study area of approximately 500m where additional surveys were undertaken. As per Chartered Institute of Ecology and Environmental Management (CIEEM) guidelines (IEEM, 2006), this buffer adopts a precautionary approach but is considered to be the area over which significant effects can reasonably be thought to have the potential to occur. At this stage, a common boundary across the range of receptors has been chosen to enable baseline data collection and environmental assessment to be consistent.

Only those waterbodies that fall within the study area and associated buffer were assessed. A walkover of the area in summer 2011 identified the main watercourses and pond/lake waterbodies within the study area. The Afon Cafnan, flowing into Porth-y-pistyll is the main freshwater feature within the study area. A number of smaller tributaries join this watercourse. There are also small networks of streams to the west and east of the study area flowing into Cemlyn lagoon and Cemaes Bay respectively. For the purposes of this report, the survey sites have been grouped according to the main watercourses (catchments) as listed in Table 2-1. Additionally, there are a number of other aquatic habitats located across the study area including wetlands, flushes and coastal headland pools. These are listed in Table 2-1 as 'others' because they are not seen as within the defined catchments.

2.2.1 Study Sites

Baseline data from waterbodies across the study area has been collected since 2011. Sites have been added to the programme since the original surveys due to changes in access agreements and extension of the survey programme. Table 2-1 presents the list of monitoring sites which have been surveyed at least once and Figure 2-1 shows the spatial extent of surveys within the study area. For the purposes of baseline characterisation and assessment, the sampling sites have been grouped according to catchment based on survey site groupings for the larger watercourses and ponds. Sites that were not seen as hydrologically connected were classed as 'others'.

Table 2-1: Freshwater site survey locations (2011 – 2014)[2].

Catchment	Site	NGR	Physical Habitat Characterisation	Fish	Macrophytes	Pond Habitat (PSYM[3])	Diatom	Water Quality	Macroinvertebrates
Cemlyn	Penyrorsedd Pond	SH 33039 92547	✓	-	-	✓	✓	✓	-
	Penyrorsedd	SH 33184 92626	✓	✓	✓	-	✓	✓	✓
	Nanner	SH 33501 92154	✓	-	-	-	✓	-	-
	U/S Neuadd	SH 33602 92287	✓	✓	✓	-	✓	✓	✓
	Neuadd	SH 33404 92747	✓	-	✓	-	✓	✓	✓
Cafnan	West of A5025 junction	SH 34148 91385	✓	No access	-	-	-	-	-
	A5025 crossing	SH 34405 91396	✓	No access	-	-	-	-	-
	Hafnan	SH 33916 92170	✓	✓	✓	-	✓	✓	✓
	Hafnan - Caerdegog Isaf	SH 34299 92385	✓	-	-	-	✓	✓	✓
	Caerdegog Isaf Pond	SH 34698 92496	✓	-	-	-	-	-	✓
	Caerdegog Isaf	SH 34882 92538	✓	✓	✓	-	✓	✓	✓
	Cae Gwyn SSSI – Caerdegog Isaf	SH 35035 92298	✓	-	-	-	-	-	✓
	Groes-fechan Wetland	SH 35090 92176	✓	-	-	-	-	-	✓
	Groes-fechan	SH 34974 92072	✓	✓	✓	-	✓	✓	✓
	Cae Gwyn SSSI	SH 34749 91786	✓	-	✓	-	✓	✓	✓
	Groes-fechan	SH 34805	✓	One-off	-	-	-	-	-

[2] Colour coding delineates the major watercourses (catchments) within the site boundary and the survey site included within each.
[3] Predictive SYstem for Multimetrics: PSYM is a method for assessing the biological quality of still waters in England and Wales.

Catchment	Site	NGR	Physical Habitat Characterisation	Fish	Macrophytes	Pond Habitat (PSYM^3)	Diatom	Water Quality	Macroinvertebrates
	Tributary	91738		access					
	Groes-fechan Ponds	SH 34737 91625	✓		-	-	-	-	-
	Cafnan – Hafnan	SH 34162 92705	✓	-	-	-	-	-	✓
	Cafnan	SH 34214 93070	✓	✓	✓	-	✓	✓	✓
	Felin Gafnan East	SH 34261 93143	✓	-	✓	-	✓	✓	-
	Pont Cafnan Wetland	SH 34077 93158	✓	-	-	-	-	-	✓
	Felin Gafnan West	SH 34301 93218	✓	-	-	-	-	-	-
	Felin Gafnan Confluence	SH 34491 93361	✓	-	-	-	✓	✓	✓
	Tregele Pond	SH 35361 92575	✓	-	-	✓	✓	✓	-
	Rhwng Dau Fynydd	SH 35052 92810	-	-	-	-	-	✓	✓
	Tan-yr-allt Pond	SH 34963 93047	✓	-	-	-	-	✓	✓
Tre'r Gof	Power Station Junction	SH 35542 93189	✓	-	✓	-	✓	✓	✓
	Wylfa Hall Pond	SH 35542 93751	✓	-	-	-	-	✓	✓
	Tyddyn-Goronwy	SH 35915 93316	✓	-	-	-	-	✓	-
	Power Station Pond	SH 35495 93113	✓	✓	-	✓	✓	✓	✓
	Porth Wylfa Pond	SH 35792 93489	✓	-	-	✓	-	✓	✓
	Porth Wylfa	SH 35936 93700	✓	✓	✓	-	✓	✓	✓
	Tre'r Gof SSSI	SH 35896 93567	✓	-	-	-	✓	✓	✓
Cemaes	Fowl Fawr	SH 35580 92209	✓	-	✓	-	✓	✓	✓
	Gwyddelyn Bach	SH 35948 92672	✓	✓	✓	-	✓	✓	✓
	Tre'r-gof-isaf	SH 36861 93613	✓	-	✓	-	✓	✓	✓
Other minor watercourses	Porth-pistyll	SH 34808 93645	✓	✓	✓	-	✓	✓	✓
	Penrhyn	SH 36624 93750	✓	-	-	-	✓	✓	✓
	Tan-yr-allt ditch (site 2)	SH 34909 93222	✓	-	✓	-	-	✓	✓
	Tan-yr-allt ditch (site 3)	SH 34889 93342	✓	-	✓	-	-	✓	✓
Other ponds	National Trust Pools	SH 34215 93569	✓	-	-	-	-	-	✓

Catchment	Site	NGR	Physical Habitat Characterisation	Fish	Macrophytes	Pond Habitat (PSYM3)	Diatom	Water Quality	Macroinvertebrates
	Wylfa Head Pools	SH 35418 94549	✓	-	-	-	-	-	✓
	The Firs Pond	SH 35227 92976	✓	-	-	-	-	-	✓
	Bwlch Pond	SH 35246 91598	✓	-	-	-	-	-	-
	Nantorman Pond	SH 36231 93325	✓	-	-	-	-	-	✓

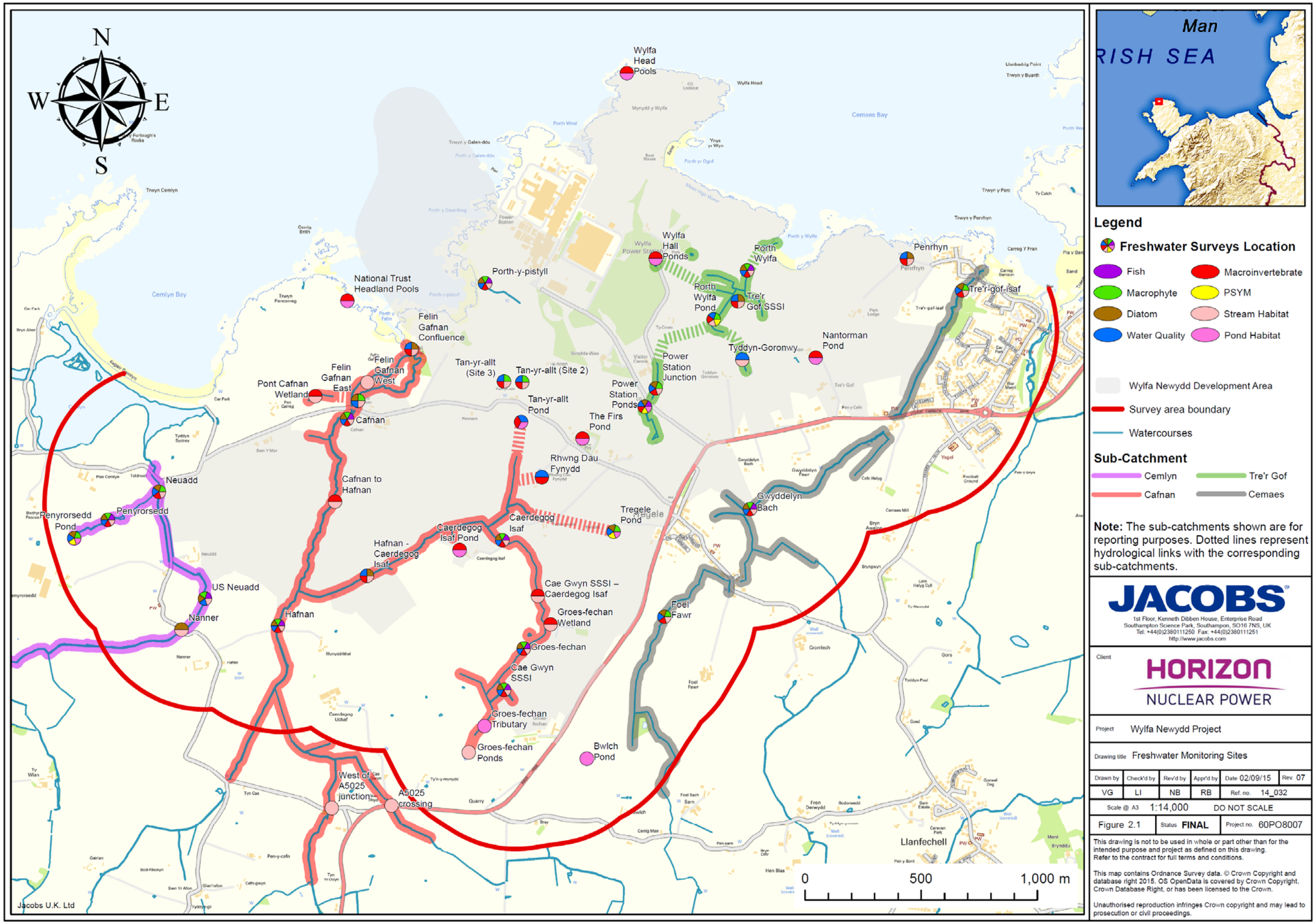


Figure 2-1: Outline plan of Wylfa Newydd Development Area site, with catchment delineations, site locations and details of survey type undertaken at each site.

2.3 Methods

2.3.1 Habitat Characterisation

Physical habitat surveys were carried out on key reaches within watercourses to characterise the physical habitat and associated biotopes present. These 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 increased understanding of the hydromorphological pressures and potential impacts exerted on the waterbodies.

Appendix A provides details and photographs of the habitat characteristics of each of the survey sites. Further details on the geomorphology of the channels and catchment characteristics within the Wylfa Newydd Development Area can be found in the Jacobs Fluvial Geomorphology Report (Jacobs, 2015f).

2.3.2 Water Quality

Spot-water quality sampling has been undertaken in accordance with Environment Agency methods (Environment Agency, 2010) with samples analysed by the National Laboratory Service since 2012. Over the three-year sampling period, the number of sites has increased as further access has been secured. Table 2-2 outlines sampling occasions and the number of sites sampled on each occasion. Samples for physico-chemical determinands and specific pollutants, nutrients and priority substances were taken on a quarterly basis in 2013 to encompass seasonal variations. For full water quality results refer to Appendix B.

Table 2-2: Water quality sampling programme including season, sample date and number of sites.

Season	Sample date	Number of sites sampled
Winter 2012	28/02/2012	5
Spring 2012	09/05/2012	5
Summer 2012	07/08/2012	5
Winter 2013	12/03/2013	10
Spring 2013	24/04/2013 – 25/04/2013	14
Summer 2013	15/08/2013	13
Autumn 2013	29/10/2013 – 30/10/2013	16
Winter 2014	18/02/2014 – 19/02/2014	14
Spring 2014	6/05/2014 – 8/05/2014	21
Summer 2014	26/08/2014	2
Autumn 2014	14/10/2014 - 15/10/2014	22

Field measurements were collected using a YSI 556 MPS (Multiprobe System) handheld meter calibrated to manufacture specifications. Physico-chemical data collected *in situ* included temperature, conductivity, pH and dissolved oxygen (percent saturation and mg L^{-1}) at each site.

The original determinands list in 2012 (Jacobs, 2013) included numerous total petroleum hydrocarbons, polychlorinated biphenyls and polycyclic aromatic hydrocarbons. These were recorded at low levels and the majority were recorded below the Minimum Reported Values (MRV) during the initial surveys; as a result, the determinand list was revised and reduced for the following surveys.

2.3.3 Phytobenthos (Diatoms)

Phytobenthos as noted under the WFD refers to a mostly microscopic group of organisms called algae 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 ecological status of phytobenthos.

At each site, a scrape sample was taken from submerged rocks or plant stems. In the majority of cases, stems of *Typha* sp. or *Juncus* sp. were used. Permanently wetted, unshaded sites with clear water were chosen. Methods followed the Diatoms for Assessing River and Lake Ecological Quality (DARLEQ2) methodology (Kelly *et al*., 2005; Environment Agency, 2007a; WFD-UKTAG, 2014a).

Samples were fixed using Lugol's Iodine Solution in a sample bottle covered with foil to avoid light penetration. Samples were transported to the laboratory for sample preparation and subsequent analysis.

Diatoms were collected over three seasons for 2014, with 12 samples collected in winter (February), 21 in spring (May) and 15 in autumn (October). Results were analysed using the updated DARLEQ2 classification, which uses known tolerances of diatom species to nutrients.

Previous diatom data from 2011 to 2013 were also used to detect annual trends in diatom communities. Results were updated by entering them into DARLEQ2 software to allow inter-annual variation to be compared. Annual averages (encompassing four seasons where possible) have been calculated in-line with standard WFD classifications, and results calculated using annual average alkalinity where possible.

2.3.4 Macroinvertebrates

Between 2011 and 2013, macroinvertebrate surveys were undertaken by Rachel Hacking Ecology Ltd using an exhaustive sampling approach where ponds are netted until no new macroinvertebrates are caught (Rachel Hacking Ecology, 2011; 2012 and 2013). Sampling was carried out in accordance with the guidelines in the Natural England Research Report 'Surveying terrestrial and freshwater invertebrates for conservation evaluation' (Drake *et al*., 2007). Samples were analysed to species level. Results were used to report species richness and identify species of conservation concern under the Community Conservation Index (CCI) (but not to calculate conservation scores) (Chadd and Extence, 2004).

In 2014, surveys followed standard kick- and sweep-sampling (BS EN ISO 10870:2012) used to obtain macroinvertebrate samples from waterbodies in addition to the collection of environmental and habitat data (Environment Agency, 2008; 2012). Samples were analysed to species level and data were used to calculate the following macroinvertebrate indices (see the glossary for explanation of indices acronyms):

- **Biological Monitoring Working Party (BMWP)-derived indices (see Hawkes, 1997):** BMWP score is based on the tolerance of different freshwater macroinvertebrates to organic pollution. The **BMWP score** is the sum of all the scores from a given sample, where 1 is tolerant and 10 is the most sensitive. 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 taxa richness and ASPT is a measure of average pollution tolerance.

- The minimum of the NTAXA and ASPT Ecological Quality Ratios (EQR) **(MINTA)** classification is used to attribute an EQR classification to the study site in question.
- **The Community Conservation Index (see 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) (see Extence *et al.*, 1999)**: Each 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.
- **Proportion of Sediment-sensitive Invertebrates (PSI) (see Extence *et al*. 2011):** Each macroinvertebrate family is 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.

Where applicable, the ecological quality of the macroinvertebrate communities was inferred using the River Invertebrate Classification Tool (RICT) (see SNIFFER, 2008). This tool generates classifications and EQRs to allow comparison of observed site data to reference sites and expected standards. There are limitations with its application: it does not hold reference sites for man-made, non-flowing or ephemeral waterbodies (such as ditches), it holds few coastal reference sites nor reference sites for watercourses within 2.5km of their headwater and it is optimised for data collected in both spring and autumn.

Ponds were also surveyed for macroinvertebrates as part of a separate assessment outlined in Section 2.3.7.

2.3.5 Macrophytes

Macrophyte surveys were completed along 100m reaches of each watercourse with species lists and Taxon Cover Values (TCVs) recorded alongside data on the local environment. Results were used to calculate a number of macrophyte indices (see glossary for explanation of indices acronyms):

- River Macrophyte Nutrient Index (RMNI), which indicates nutrient enrichment;
- Number of scoring Taxa (NTAXA) which indicates species richness;
- Number of Functional Groups (NFG) which is a measure of how truly aquatic the community is; and
- percentage algal cover (ALG).

In flowing watercourses, the classification method LEAFPACS2 was used to characterise ecological condition. This standard method for the characterisation of watercourses using macrophytes (WFD-UKTAG, 2014b) was used as an indicator of eutrophication within a given watercourse.

2.3.6 Fish

Electric fishing surveys were conducted to identify the presence and species of fish. Fish surveys were conducted using a standard electric fishing technique (E-fish back pack unit with single anode) following guidelines developed by the

Environment Agency (Beaumont *et al.*, 2002; Environment Agency, 2001; Environment Agency, 2007b) and in accordance with British Standard (BS) EN 14011:2003 (water quality – sampling of fish with electricity) (British Standards Institution, 2003). All electric fishing surveys were conducted under an FR2 licence from Natural Resources Wales by trained members of staff.

Where conditions allowed, a three-run catch-depletion survey was conducted over a 100m stretch of each watercourse. Where a clear 100m stretch could not be accessed, qualitative spot checks were carried out, giving an indication of the species present within the watercourse.

2.3.7 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. Two methods have been used to gather the baseline dataset for ponds: an exhaustive macroinvertebrate survey and the Predictive SYstem for Multimetrics (PSYM).

Between 2011 and 2013, macroinvertebrate surveys were undertaken by Rachel Hacking Ecology Ltd (Rachel Hacking Ecology, 2011; 2013 and 2013) using an exhaustive sampling approach where ponds are netted until no new macroinvertebrates are caught (Drake *et al.*, 2007). Samples were analysed to species level. Results were used to report species richness and identify species of conservation concern under the CCI (but not to calculate conservation scores) (Chadd and Extence, 2004).

The second method, the PSYM, evaluates the macroinvertebrate and aquatic plant communities in ponds (Pond Action, 2002) and was used to assess eligible ponds in 2012 and 2014. Plants were identified in the field (taking samples for later identification where necessary), and macroinvertebrate samples were taken and analysed to species level as above. Results were processed using the following PSYM indices (see glossary for explanation of indices acronyms):

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** – indicates average pollution tolerance of macroinvertebrates within a community;
- **number of Odonata and Megaloptera families (OM)** – indicate long-term quality of a pond as larvae have a long aquatic life stage; and
- **number of Coleoptera families (CO)** – indicate the habitat quality and diversity of a pond.

Observed data were compared with predicted values generated by analysts at Freshwater Habitats (formerly Pond Conservation) to calculate Ecological Quality Indices (EQIs). These EQIs are then used to inform 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. Data were also used to calculate CCI scores and identify species of conservation importance.

2.3.8 Limitations

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.

Surveys required for each aquatic receptor were identified prior to the field campaign. Where necessary, additional sampling has been undertaken outside of optimum monitoring period either to increase the resolution of data collected or as a result of other limitations such as the preceding weather conditions. Resulting data should be treated with caution. Regulator consent was granted, enabling fisheries survey work to be undertaken outside of standard survey periods.

A number of watercourses within the study area were not permanently wetted (ephemeral) throughout the survey period. Standard analytical tools are poorly equipped to deal with temporary waterbodies and care is required in interpretation of resulting data; however, they contain species unique to this habitat type and therefore their inclusion in the baseline assessment is necessary.

Sampling locations were accessed on agreement with landowners, and through 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.

For diatom sampling, a minimum number of diatoms are required per sample for impact assessment baseline purposes. A minimum of 300 valves is generally needed for statistically robust analysis. Minimum sample requirements were met for most of the samples with the exception of three sites in 2013.

3 Baseline Conditions – Cemlyn Catchment

3.1 Habitat Characterisation

The Cemlyn Tributary is where the Neuadd, Penyrorsedd and Nanner sites are located. Evidence of livestock poaching has been noted along the watercourse and some siltation of gravels is evident. Channel straightening has been implemented in sections to follow field/road boundaries; however, some areas with good gravel substrate and a diverse range of macrophytes were observed. The catchment is dominated by improved pasture resulting in agricultural runoff entering the watercourse. Refer to Appendix A for habitat characterisation descriptions.

3.2 Water Quality

The following section summarises water quality data collected between 2013 and 2014 within the Cemlyn catchment. Table 3-1 presents ranges for selected physico-chemical, biochemical and nutrient parameters. For full results, refer to Appendix B (note this section refers to results from Cemlyn catchment only).

Physico-chemical and biochemical results can be summarised as follows:

- The highest temperatures were recorded in summer 2013 at the Neuadd and U/S Neuadd sites, recording 20.36˚C and 17.59˚C respectively. During spring, autumn and winter, temperatures ranged between 9.12˚C and 13.4˚C. All water temperature results were within the expected range of values for the waterbody types sampled.
- Conductivity readings were within expected values for the type of waterbodies sampled, ranging between 0.240mS cm^{-3} (U/S Neuadd winter 2014) and 0.513mS cm^{-3} (U/S Neuadd spring 2014).
- Dissolved oxygen (percent saturation) at the running water sites ranged between 57.7% in autumn 2014 at Penyrorsedd and 104% at Neuadd in spring 2014. Penyrorsedd Pond recorded the highest dissolved oxygen of all sites, reaching 124.9% in spring 2014.
- pH ranged from 6.41 to 8.02 and was within the expected range of values for the watercourse types sampled.
- Suspended sediment concentrations varied between sites with the majority of the measurements below 20mg L^{-1}. Two elevated concentrations were recorded at the Penyrorsedd Pond site in spring 2014 (91.10mg L^{-1}) and the Penyrorsedd site in autumn 2014 (72.70mg L^{-1}).
- Biological oxygen demand was generally low with many sites below MRV (see glossary for acronyms definitions). The highest biological oxygen demand was recorded at Penyrorsedd Pond in spring 2014 (18.1 mg L^{-1}).

Nutrient results can be summarised as follows:

- Orthophosphate concentrations were low although an elevated measurement was noted at Penyrorsedd Pond in spring 2014 (0.824mg L^{-1}). All other measurements ranged between 0.02mg L^{-1} and 0.337mg L^{-1} over the sampling period.
- Ammoniacal nitrogen concentrations were low across all sites with the exception of Penyrorsedd where two elevated measurements were recorded in spring and autumn 2014 (0.313mg L^{-1} and 0.491mg L^{-1} respectively).

Table 3-1: Maximum and minimum physico-chemical, biochemical and nutrient results for the Cemlyn Catchment over the 2013-2014 sampling period.

Parameter	Range	Penyrorsedd Pond	Penyrorsedd	U/S Neuadd	Neuadd
Temperature ˚C	Max	13.4	12.6	17.6	20.4
	Min	9.2	9.7	9.1	10.7
Conductivity mS cm^{-3}	Max	0.513	0.452	0.407	0.310
	Min	0.358	0.326	0.240	0.242
Dissolved oxygen %	Max	124.9	90.8	101.1	104.0
	Min	92.6	57.7	68.1	80.0
pH	Max	7.6	6.5	7.7	8.0
	Min	6.7	6.4	6.7	6.8
Suspended solids mg L^{-1}	Max	91.1	72.7	11.3	22.0
	Min	5.2	18.6	3.5	3.3
Biological oxygen demand mg L^{-1}	Max	18.1	2.9	1.1	2.0
	Min	<1.0	<1.0	<1.0	<1.0
Orthophosphate (reactive as P) mg L^{-1}	Max	0.824	0.146	0.038	0.098
	Min	0.247	0.076	<0.02	<0.02
Ammoniacal nitrogen as N mg L^{-1}	Max	0.245	0.491	0.052	0.067
	Min	<0.03	0.062	0.042	<0.03

Metals can be summarised as follows:

- Cadmium, nickel, lead, chromium and mercury concentrations were near or below MRV across all sites.
- Arsenic readings were generally low with the majority of the measurements below laboratory MRV. Values ranged between <1µg L^{-1} to 3.23µg L^{-1}.
- Copper was highest at Penyrorsedd Pond with concentrations ranging between 3.56µg L^{-1} and 10.40µg L^{-1}. All other sites were below 3.30µg L^{-1}.
- Zinc concentrations were below MRV across all sites with the exception of Neuadd in autumn in 2013, when a measurement of 8.77µg L^{-1} was recorded.
- Iron concentrations ranged between <30µg L^{-1} and 273µg L^{-1} and varied between sites and sampling years.
- Manganese concentrations ranged between 14µg L^{-1} and 438µg L^{-1} and varied between sites and sampling years.

Selected other compounds can be summarised as follows:

- Toluene and trichloroethylene levels were low across all sites with reading below the laboratory MRV of 0.1µg L^{-1}.
- Di(-2-ethylhexyl) phthalate (DEHP) levels were low across all sites with levels below or close to the laboratory MRV of 0.2µg L^{-1}. Values ranged between a maximum of 0.73µg L^{-1} and <0.2µg L^{-1} at Neuadd.
- Hydrocarbon Screens (C5 - C44) levels were low across all sites with levels below or close to the laboratory MRV of 0.2µg L^{-1}.
- Chloride levels were low across the catchment.

Water quality conditions reported for the Cemlyn catchment are typical of a catchment dominated by rural land use, including agricultural land for grazing.

3.3 Diatoms

Diatom surveys have been undertaken between 2011 and 2014, with at least one sample taken from the main Cemlyn waterbody or the Penyrorsedd tributary. The diatoms reported from the diatom surveys are typical of lowland coastal streams, demonstrating a dominance of common species with tolerances to low or moderate nutrient enrichment.

Table 3-2 lists the diatom EQR (observed/expected diatom community – see glossary for definitions) in each of the sampling years and is colour coded to indicate WFD classification. 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.

Table 3-2: Diatom EQRs and ecological status 2011 - 2014 (blue= high, green = good, yellow= moderate, orange = poor).

Site	2011	2012	2013	2014
Nanner	0.69			
U/S Neuadd			0.83	0.6
Penyrorsedd Pond				0.28
Penyrorsedd				0.66
Neuadd		0.62	0.83	0.75

With the exception of Penyrorsedd Pond in 2014, diatom EQRs indicate that phytoplankton communities are similar to those predicted at near reference condition, based upon physical habitat attributes. The main Cemlyn waterbody sites in 2013 reached reference condition, indicating no environmental stress on phytobenthic communities, with minor deviations observed in the preceding and following years.

It is likely that all of the watercourses within the Cemlyn catchment are prone to nutrient enrichment as a result of land management practices such as the application of fertilisers on grazing/arable land. Stock access was not restricted from the watercourse at any of the sample sites. There were also no appreciable buffer zones observed on the limited arable land in the catchment. Mild nutrient enrichment can be identified in the taxonomic composition of diatoms, with the presence of species such as *Planothidium lanceolatum* and *Reimeria sinuata* indicative of mild to moderate enrichment conditions. Variability between years is considered minor, and likely to be a facet of improved surface drainage facilitating increased nutrient release into the watercourses.

The value of diatom features in the Cemlyn catchment is considered negligible, with the species present typical of a lowland coastal stream. The Cemlyn catchment is anticipated to provide a minor resource to diatom across the Wylfa Newydd Development Area.

3.4 Macroinvertebrates

Three sites have been sampled for macroinvertebrates within the Cemlyn catchment, two on the main stem of the river and a single site on the tributary (Table 3-3). Sites within the Cemlyn catchment were not sampled for macroinvertebrates until 2014 following the extension of the site buffers.

Sixty-nine invertebrate taxa were reported from the Cemlyn catchment: 41 from Neuadd, 35 from Penyrorsedd and 29 from U/S Neuadd. Biological scores from the Cemlyn catchment indicate the sites support macroinvertebrate communities which are relatively sensitive to organic pollution (BMWP) and exhibit species diversity (NTAXA) typical for this river type.

Table 3-3: Macroinvertebrate indices for three sites on the Cemlyn catchment. See the glossary and section 2.3.4for explanation of indices acronyms.

Site	BMWP	NTAXA (scoring)	ASPT	PSI (F) interpretation	PSI (F) EQR	LIFE (sp)	LIFE (F)	LIFE (F) EQR
Neuadd	112	23	4.9	Moderately sedimented	0.85	7.4	6.7	0.89
U/S Neuadd	109	23	4.7	Moderately sedimented	0.87	7.5	6.7	0.89
Penyrorsedd Stream	87	20	4.4	Sedimented	-	5.9	5.7	-

The Cemlyn catchment was reported as sedimented or moderately sedimented. A significant proportion of taxa present in these watercourses are tolerant of sedimentation. EQRs indicate that the sediment sensitivity of the communities exceeded expected levels when compared with reference sites (EQR >0.82).

Analysis of the invertebrate community indicates taxa sensitive to flow within the main Cemlyn watercourse (LIFE (F) EQR >0.89). This includes relatively high numbers of freshwater shrimp (*Gammarus pulex*), riffle beetles (*Elmis aenea* and *Limnius volckmari*), cased caddisfly larvae (*Sericostoma personatum* and *Hydropsyche angustipennis*) and mayfly larvae (*Serratella ignita*). The Penyrorsedd Stream demonstrates a community typical of a lower energy flow environment, with evidence of species potentially dropping out of the pond at the head of the stream.

In general, the macroinvertebrates recorded across the Cemlyn catchment consisted of widespread and common species. Community conservation scores ranged from Low to Moderate, with the lowest scoring community at Penyrorsedd Stream (4.1), and the highest at U/S Neuadd (7.4). Despite the Moderate CCI values on the Neuadd tributary, no species of conservation importance (local or above) were identified in 2014 (Table 3-4).

Table 3-4: Macroinvertebrate indices for 2014 sites in the Cemlyn catchment. See glossary for acronym definitions.

Site	CCI score	CCI value	Species of conservation importance (Local or above)
Neuadd	6.6	Moderate	None
Penyrorsedd Stream	4.1	Low	None
U/S Neuadd	7.4	Moderate	None

RICT classification was possible for two of the sample sites on the Cemlyn watercourse, with both sites reaching Moderate status (Table 3-5). Both sites were classified as reaching High status based upon predicted diversity, while the reduction in overall status was as a result of water quality variables.

Table 3-5: RICT classifications for two compliant sites in the Cemlyn catchment. Highlighted cells represent the overall classification for the site in question.

Site	Index	EQR	Class	Probability of Class (%)
Neuadd	ASPT	0.82	Moderate	77.57
	NTAXA	0.95	High	72.95
	MINTA	-	**Moderate**	77.57
U/S Neuadd	ASPT	0.80	Moderate	66.03
	NTAXA	0.95	High	74.33
	MINTA	-	**Moderate**	66.03

The Moderate status observed at the Neuadd and U/S Neuadd sites indicates that the community observed is significantly different from that predicted (based upon physical habitat characteristics). The difference between observed and predicted class is anticipated to be due to a combination of factors, including agricultural pressures and modified river habitat. Penyrorsedd Stream was particularly stagnant and poached by grazing livestock, which has the potential to result in fine sediments entering a watercourse and affecting the macroinvertebrate community. Neuadd and U/S Neuadd offered some good habitat with a variety of flow types and substrate sizes.

The value of macroinvertebrate features in the Cemlyn catchment is considered low, with the species present typical of lowland streams in coastal plains. The absence of species of conservation interest is indicative of its generally low value and habitat quality.

3.5 Macrophytes

Three sites on the Cemlyn catchment were suitable for macrophyte survey in 2014 and could be assessed using the LEAFPACS2 tool. Of these, Neuadd and U/S Neuadd were also surveyed in 2013. Due to an update in assessment tool, the outputs from these surveys are not directly comparable; however, data can be used to assess trends.

Sixteen taxa were recorded in total from the Cemlyn catchment. Fool's watercress (*Apium nodiflorum*), hemlock water dropwort (*Oenanthe crocata*) and water-starwort (*Callitriche* spp.) were the only taxa recorded at all three sites within the Cemlyn catchment. Several species of macroalgae were also present including blanket weed (*Cladophora glomerata/Rhizoclonium hieroglyphicum*). There were no species of conservation importance identified in the surveys.

Table 3-6 shows the individual indices calculated from LEAFPACS2.

Table 3-6: Macrophyte indices for sites along the Cemlyn watercourse prior to LEAFPACS2 classification (RMNI, NTAXA, non-scoring taxa, NFG and ALG). See glossary for acronym definitions.

Site	Observed RMNI	Observed NTAXA (scorers)	Total NTAXA (inc. non-scores)	Observed NFG	Observed ALG
U/S Neuadd	6.89	3	6	2	0
Neuadd	7.16	3	8	2	0

Penyrorsedd	7.18	6	10	4	1.00

The RMNI gives an indication of nutrient enrichment with scores ranging from 1 (low) to 10 (high). The RMNI scores do not vary considerably between the sites, suggesting that there is a moderate degree of nutrient enrichment throughout all sites. This would be expected given the connectivity between agricultural land use and the riverine environment and is typical of watercourses within this landscape.

The NTAXA gives an indication of diversity within the macrophyte community, with Penyrorsedd having the highest (six) of the surveyed watercourses within the catchment.

LEAFPACS2 classification was performed on the three sites within the Cemlyn watercourse, with all sites classified as Good or Moderate (Table 3-7). The macrophyte community at U/S Neuadd and Penyrorsedd Stream exhibit only a small deviation from reference conditions, whist the Neuadd site may be affected by an environmental stress, such as variable flow or elevated nutrient condition.

Table 3-7: The results of LEAFPACS2 classification at the Cemlyn sites in 2014. Highlighted cells represent the overall EQR classification for the site in question

Site	EQR	Status
U/S Neuadd	0.606	Good
Neuadd	0.591	Moderate
Penyrorsedd	0.692	Good

The Neuadd and U/S Neuadd sites were sampled in 2013 using the previous iteration of LEAFPACS2. Although not directly comparable due to changes in the application of the tool, Neuadd was classified as Moderate, scoring a slightly lower EQR to the 2013 result, whilst U/S Neuadd was given Poor status, with a very low EQR. This indicates an inherent degree of variability between sampling seasons, and suggests that short-term factors, such as seasonal differences in channel shading, poaching by cattle or the application of fertilisers on adjacent agricultural land may play a role in determining macrophyte communities. Habitats are unlikely to have undergone significant change between survey years.

The value of macrophyte receptors on the Cemlyn catchment is considered low due chiefly to the absence of species of conservation interest. The Cemlyn catchment is anticipated to provide a minor resource to macrophytes across the Wylfa Newydd Development Area.

3.6 Fish

Fish surveys were undertaken at U/S Neuadd during 2013 and Penyrorsedd during 2014 (Appendix E).

Low numbers of European eel and three-spined stickleback have been recorded at U/S Neuadd during the study period. The watercourse at this site is shallow with glide and pool flow types dominant. The riverbed substrate is a mix of unconsolidated gravels and silt, with marginal vegetation heavily shading both banks. The presence of European eel indicates connectivity of the watercourse between the sea and this site. During 2013, a grey heron (*Ardea cinerea*) was

disturbed from fishing at the shallow upstream end of this site, indicating the potential presence of fish within this site.

Spot checks were carried out at Penyrorsedd Stream in 2014. No fish were caught and eel was the only species observed. During the spring macroinvertebrate kick sampling, three-spined stickleback were observed at this site; however, this species was not recorded during the electric fishing surveys. This may have been due to the use of the spot check methodology and the heavy macrophyte cover at the time of survey affecting efficiency. No cyprinid or salmonid species were observed at this site during any of the surveys. The habitat is unlikely to support salmonids due to its shallow depth and silt substrate. There is very limited marginal habitat providing cover to the stream, resulting in poor instream habitat for fish species.

The value of fish receptors on the Cemlyn catchment is considered low due to the low density of fish, including European eel. The Cemlyn catchment is anticipated to provide a small overall resource to freshwater fish within the Wylfa Newydd Development Area.

3.7 Pond Quality Assessment

A single pond was assessed in the Cemlyn catchment using the PSYM methodology. Penyrorsedd Pond forms the head of Penyrorsedd Stream and lies within improved pastureland. Macroinvertebrates recorded during the 2014 pond survey were characteristic of standing waters with a high coverage of macrophytes, fine sediments and decomposing organic matter.

3.7.1 PYSM

The PSYM plant index indicates that Penyrorsedd Pond supports commonly occurring, nutrient tolerant species, which confirms the observed elevated phosphorus and ammonia levels.

The PSYM classifications, along with observed indices and EQIs for Penyrorsedd Pond are summarised in Table 3-8.

Beetles are an indicator of habitat quality and the Coleoptera index is only slightly lower than expected, suggesting that Penyrorsedd Pond provides acceptable resources for macroinvertebrates. The Odonata index shows that the pond is limited by variation in water level and ephemeral effects, because ponds fell significantly short of the expected number of dragon/damselfly and alderfly families.

The Community Conservation Index for Penyrorsedd Pond was 9.6, indicating Moderate conservation value owing to the presence of *Erpobdella testacea* (leech), *Notonecta maculata* (backswimmer) and *Corixa panzeri* (water boatman), all of which are of Local conservation importance.

Table 3-8: PSYM results and classification of Penyrorsedd Pond. Observed indices in unshaded rows, and EQIs in shaded rows below (PSYM quality category = IBI >75%=Good, 51-75%=Moderate, 25-50%=Poor, <25%=V Poor). See glossary / methods for explanation of acronyms.

Penyrorsedd Pond	
No. of submerged + marginal plant species (SM)	11
EQI (SM)	0.73
Number of uncommon plant species (U)	2

Penyrorsedd Pond	
EQI (U)	0.79
Trophic Ranking Score (TRS)	10
EQI (TRS)	1.25
Average Score Per Taxon	3.8
EQI (ASPT)	0.74
Odonata + Megaloptera (OM) families	0
EQI (OM)	0
Coleoptera families (CO)	2
EQI (CO)	0.53
Index of Biotic Integrity (%)	50%
PSYM quality category	Moderate
Priority species	0
Meet Priority Pond criteria?	No

Penyrorsedd Pond does not meet the criteria for Priority Pond status recognised under the UK Post-2010 Biodiversity Framework (formerly the UK Biodiversity Action Plan).

Water quality data for the pond is summarised in the water quality section (Section3.2). *In situ* water quality data varied as expected between seasons. The maximum orthophosphate measurement recorded over the three-year sampling period was 0.824mg L^{-1}.

Pond habitats are considered of low value in the Cemlyn catchment. Monitoring of Penyrorsedd Pond did not identify receptors of conservation interest and as such, pond habitats are considered to provide a minor resource to the overall pond habitat across the Wylfa Newydd Development Area.

3.8 Summary

Sites surveyed within the Cemlyn catchment indicate biological and water quality scores typical of lowland coastal streams, receiving variable seasonal discharge in close connectivity with surrounding land management.

Beyond the obvious historic channel modification that have allowed streams to take on land boundaries and local road lay out, land use appears to apply the greatest environmental stress on the Cemlyn watercourses. Flowing through a rural catchment, used primarily for livestock grazing and low intensity agriculture, the aquatic habitats are influenced by low levels of nutrient enrichment via diffuse pollution as demonstrated in the diatom and macrophyte community analysis.

Water levels within the catchment are influenced by prevailing climatic conditions; however, both the main watercourse and tributary sustain permanent flows, albeit with localised declines in flow energy during dry periods. There is no evidence to suggest that the decreases in flow type are affecting the significance of the aquatic habitats or the communities they support.

Despite seasonal variation in flow, the Cemlyn watershed supports a functioning ecological community, including European eel, which received legal protection to promote connectivity through the catchment and habitat suitability. The presence of the European eel indicates connectivity of the Cemlyn freshwater catchment with the

downstream lagoon (and coastal environment). No invasive species were recorded within the catchment.

Aquatic habitats and species identified within the Cemlyn catchment are of low quality and reflect existing and historical rural land management practices in the area. Species found within the catchment are common and widespread, and include low numbers of the nationally important European eel.

4 Baseline Conditions – Cafnan Catchment

4.1 Habitat Characterisation

The Cafnan watercourse exhibited mainly natural planform and stream cross-sections, with moderate sinuosity, good flow diversity and a dominant gravel-cobble substrate. The tributary stream exhibited some sectioning and over-deepening. However, discrete areas of good flow diversity, gravel substrate and riparian vegetation provide habitat potential. Areas of channel modification through channelisation and realignment are present within the mid to upper catchment.

The tributary stream that joins the main stem channel at Hafnan is an over-deepened gravel bed stream that is largely tree or shrub lined. The riparian vegetation creates a shaded waterway for most of its length between Groes-fechan and Caerdegog Isaf. A straightened section runs between Caerdegog Isaf and Hafnan which has also been deepened to increase channel capacity and conveyance. This section of the tributary is very silted in places.

The Cae Gwyn SSSI is located in the head reaches of this tributary which joins the main stem channel near Hafnan. The SSSI comprises a large, botanically species-rich wetland area bordered by improved grassland and gorse scrub. The two basin mires associated with the wetland held water throughout most of the survey season.

The northern basin mire comprises botanical species such as meadowsweet (*Filipendula ulmaria)*, common spike-rush (*Eleocharis palustris)*, cross-leaved heath (*Erica tetralix)*, common cottongrass (*Eriophorum angustifolium)*, water mint, broad-leaved pondweed (*Potamogeton natans)*, marsh St. John's-wort (*Hypericum elodes)* and creeping willow (*Salix repens).* The southern basin mire comprises all of the above species plus others including cranberry (*Vaccinium oxycoccos)* and marsh fern (*Thelypteris palustris).*

The main stem channel from Hafnan to Cafnan exhibits a medium gravel bed substrate with good flow diversity. The gravel substrate, relatively natural channel planform and occasional shading provide good habitat opportunities for fish and other wildlife and potential spawning habitat for the native brown trout. Refer to Appendix A for habitat characterisation descriptions.

4.2 Water Quality

The following section summarises the water quality data collected between 2012 and 2014 within the Cafnan catchment. Table 4-1 presents ranges for selected physico-chemical, biochemical and nutrient parameters. For full results, refer to Appendix B (note this section refers to results from the Cafnan catchment only).

Physico-chemical and biochemical results can be summarised as follows:

- The highest temperature of 20.08˚C was recorded in summer 2013 at Cafnan. The lowest temperature of 3.13˚C was recorded at the same site in winter 2013. All water temperature readings were within the expected range of values for the waterbody types sampled.
- Conductivity readings were within the expected values for the waterbody types sampled, ranging between 0.112mS cm^{-3} (Tan-yr-allt Pond spring 2014) and 0.492mS cm^{-3} (Cafnan summer 2013).

- Dissolved oxygen (percent saturation) was generally lower at the pond sites compared to the stream sites. Rhwng Dau Fynydd, Tregele Pond, Tan-yr-allt Pond and Cae Gwyn SSSI recorded levels <50%. Dissolved oxygen at the stream sites ranged between 55.0% and 108.0%, the majority falling between 80.0% and 100.0%.
- pH levels were within the expected range of values for the habitat types sampled. pH ranged from 5.37 at Tan-yr-allt Pond to 8.55 at Felin Gafnan confluence. Lower pH levels were generally recorded at pond sites.
- Suspended sediment concentrations varied between sites with concentrations generally below 20mg L^{-1}. Higher concentrations were recorded at the pond sites, with Tan-yr-allt Pond recording 88mg L^{-1} in spring 2014.
- Biological oxygen demand was generally low with many sites below MRV. The highest measurements recorded were at Rhwng Dau Fynydd Pond and Tan-yr-allt Pond in autumn 2014 (>18.7mg L^{-1} and 17.3mg L^{-1} respectively).

Nutrient results can be summarised as follows:

- Orthophosphate concentrations were low at the stream/river sites. Elevated measurements were recorded at Rhwng Dau Fynydd Pond and Tan-yr-allt Pond (1.08mg L^{-1} and 1.12mg L^{-1} respectively). All other measurements ranged between approximately 0.02mg L^{-1} and 0.382mg L^{-1} over the course of the sampling period.
- Ammoniacal nitrogen concentrations were low across most sites (<0.311mg L^{-1}), although elevated measurements were recorded at Rhwng Dau Fynydd Pond and Tan-yr-allt Pond (1.78mg L^{-1} and 1.08mg L^{-1} respectively).

Metals can be summarised as follows:

- Cadmium concentrations were all below the MRV with the exception of levels recorded at Rhwng Dau Fynydd Pond and Tregele Pond in autumn 2014 (0.389µg L^{-1} and 0.125µg L^{-1} respectively).
- Chromium concentrations were near or just above the MRV across most sites. In spring 2014, an elevated reading of 7.79µg L^{-1} was recorded at Tan-yr-allt Pond.
- Arsenic concentrations were generally near or below the MRV. In autumn 2014, Rhwng Dau Fynydd Pond, Tregele Pond and Tan-yr-allt Pond recorded levels of 8.18µg L^{-1}, 2.73µg L^{-1} and 2.04µg L^{-1} respectively.
- Copper concentrations were highest at Rhwng Dau Fynydd Pond and Tregele Pond, with levels reaching between 33.2µg L^{-1} and 8.46µg L^{-1}. All other sites recorded levels below 5.85µg L^{-1}.
- Lead concentrations were all below the MRV with the exception of levels at Rhwng Dau Fynydd Pond and Tan-yr-allt Pond in autumn 2014 (9.75µg L^{-1} and 2.42µg L^{-1} respectively).
- Nickel concentrations ranged between <1µg L^{-1} and 2.06µg L^{-1} at all stream/river sites. Rhwng Dau Fynydd Pond, Tregele Pond and Tan-yr-allt Pond all had slightly elevated levels in autumn 2014 (9.88µg L^{-1}, 2.14µg L^{-1} and 5.72µg L^{-1} respectively).
- Zinc concentrations ranged between 31.7µg L^{-1} recorded at Rhwng Dau Fynydd (autumn 2014) and <5µg L^{-1} (MRV).
- Mercury concentrations were near or below the MRV across all sites with the exception of Rhwng Dau Fynydd Pond in autumn 2014 (0.088 µg L^{-1}).
- Iron concentrations ranged between 67µg L^{-1} and 401µg L^{-1} at the stream/river sites. Elevated levels of iron were reported at Rhwng Dau

Fynydd Pond and Tan-yr-allt Pond (24,400µg L^{-1} and 23,900µg L^{-1} respectively) in autumn 2014. Levels reported for all ponds ranged between 348µg L^{-1} and 2,680µg L^{-1}.

- Manganese concentrations varied between sites and sampling years, levels ranging between 25µg L^{-1} and 1,470µg L^{-1}.

Selected other compounds can be summarised as follows:

- Toluene and trichloroethylene concentrations were low across all sites, with levels below the MRV (0.1µg L^{-1}).
- DEHP concentrations were generally low across all sites, with levels below or close to the MRV (0.2µg L^{-1}). Elevated levels were noted at Felin Gafnan East in summer 2012 (1.37µg L^{-1}), and at Felin Gafnan Confluence (2.04µg L^{-1}) and Groes-fechan (1.77µg L^{-1}) in winter 2013.
- Hydrocarbon Screens (C5 - C44) concentrations were low across all sites with levels below or close to the MRV (0.2µg L^{-1}).
- Chloride concentrations were low across the site.

Water quality conditions varied between the pond and stream/lake sites in the catchment, with conditions generally poorer in the ponds. Rhwng Dau Fynydd Pond had generally poor water quality with elevated concentrations of metals and low dissolved oxygen levels. This site is a small pond located along a farm track with limited inflow, which is reflected in the poor water quality conditions.

Elevated nutrient concentrations in the watercourses are considered to be attributable to the rural setting, with land use practices such as the use of fertilizers and management of livestock contributing to the nutrient loads entering ponds and watercourses.

Table 4-1: Maximum and minimum physico-chemical, biochemical and nutrient results for the Cafnan Catchment over the 2012-2014 sampling period.

Parameter	Range	Rhwng Dau Fynydd	Tregele Pond	Tan-yr-allt Pond	Cae Gwyn SSSI	Groes-fechan	Caerdegog Isaf	Caerdegog Isaf – Hafnan	Hafnan	Cafnan	Felin Gafnan East	Felin Gafnan confluence
Temperature ˚C	Max	12.50	11.90	11.90	11.60	17.04	17.53	19.66	17.81	20.08	17.59	17.53
	Min	12.50	7.28	6.70	5.94	4.27	10.14	8.12	9.54	3.13	3.59	3.55
Conductivity mS cm^{-3}	Max	0.366	0.38	0.45	0.27	0.445	0.487	0.422	0.4	0.492	0.412	0.411
	Min	0.366	0.266	0.112	0.218	0.153	0.268	0.134	0.223	0.212	0.214	0.208
Dissolved oxygen %	Max	29.1	45.6	57.8	79.7	113.7	104.8	96	104.2	105.8	103.9	108.0
	Min	29.1	32.3	45.9	39.5	55.0	77.5	69.5	72.9	62.4	69.5	88.0
pH	Max	-	6.09	5.69	7.22	7.45	7.82	7.58	7.54	7.45	7.51	8.55
	Min	-	5.74	5.37	5.82	6.44	6.42	6.43	6.16	6.23	6.54	6.73
Suspended solids mg L^{-1}	Max	26.9	52.0	88.0	9.42	13.1	11.2	12	35.2	73.1	54.2	23.1
	Min	26.9	16.7	60.4	<3.0	<3.0	<3.0	4.7	8.0	8.8	5.2	6..
Biological oxygen demand mg L^{-1}	Max	>18.7	6.74	17.3	2.04	1.16	1.54	6.45	1.84	2.57	1.78	<1.6
	Min	>18.7	3.2	<2.92	<1.0	<1.0	<1.0	<1.0	1.11	<1.0	<1.0	<1.0
Orthophosphate (reactive as P) mg L^{-1}	Max	1.080	0.382	1.120	0.077	0.043	0.120	0.118	0.152	0.079	0.118	0.108
	Min	1.080	0.126	0.031	<0.02	<0.02	<0.02	<0.02	0.042	0.020	0.020	0.020
Ammoniacal nitrogen as N mg L^{-1}	Max	1.780	0.092	1.080	0.068	0.038	0.066	0.311	0.068	0.084	0.147	0.072
	Min	1.780	0.048	0.053	<0.03	<0.03	<0.03	<0.03	0.044	<0.03	<0.03	<0.03

4.3 Diatoms

Table 4-2 lists the diatom EQR (observed/expected diatom community) in each of the sampling years and is colour coded to indicate WFD classification. 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.

Table 4-2: Cafnan catchment diatom EQRs and ecological status 2011–2014 (blue = high, green = good, yellow = moderate, orange = poor).

Site	2011	2012	2013	2014
Cafnan	0.46	0.5	0.56	0.57
Hafnan			0.77	0.69
Caerdegog - Hafnan			0.78	1.00
Caerdegog Isaf			0.81	0.67
Groes-fechan			0.86	0.94
Cae Gwyn SSSI				0.82
Felin Gafnan East	0.57	0.55	0.71	0.59
Felin Gafnan Confluence	0.46	0.49	0.61	0.8
Tregele Pond				0.5

The number of sites sampled increased between 2011 and 2014. In 2014, six of the nine sites sampled achieved EQRs of good or above. Cafnan, Felin Gafnan and Feline Gafnan Confluence, which are geographically close to one another, recorded the lowest scores. This may be attributable to high nutrient loading and road runoff in the immediate vicinity of the watercourses. The land use immediately upstream of these sites was grazing pasture, where livestock have free access to the river at certain points and there was evidence of extensive bank poaching.

Tregele Pond showed a moderate EQR result which is in line with the other ponds in the area, which also tended to score low to moderate on the EQR scale.

Some annual variability was observed in the diatom index scores with the biggest change seen at Felin Gafnan Confluence. The variability in EQR scores between years may result from seasonal flows affecting the channel's wetted area, flow and aquatic habitat. Additionally, the effect of low flows during one year has the potential to affect ecological communities in following years.

Sample failures where not enough diatoms could be collected in the field for further analysis, occurred on three occasions during the 2013 monitoring period. This was as a result of a lack of diatoms being present despite suitable substrate being available. No differences in the physical characteristics of the sites which could account for the lack of diatoms were observed during sample collection. The most likely cause for this result is thought to be high flows prior to sampling.

Overall, the Cafnan catchment diatom community is characteristic of a lowland rural area with some evidence of mild to moderate nutrient input.

4.4 Macroinvertebrates

4.4.1 Exhaustive Surveys 2011 to 2013

During 2011 to 2013, sampling was undertaken using the exhaustive survey method, whilst in 2014, sites were sampled using the standard kick-sample methodology. Data from qualifying sites in 2014 were assessed using the RICT analysis tool, but all other sites were not assessed due to limitations in the RICT methodology.

The exhaustive number of species recorded at the Cafnan watercourse is shown in Table 4-3. The exhaustive number of species is not directly comparable between sites as the number of visits differed due to seasonal variation, weather and access constraints. Some of the sites had multiple sampling locations from which data were pooled into one exhaustive number of species (e.g. Cafnan to Hafnan). Data provides an indication of the diversity of species recorded within a survey area each year. This exhaustive methodology is not consistent with use of the RICT tool but provides information on general species diversity and the presence of species of conservation interest.

Table 4-3: Exhaustive number of species per year at nine sites within the Cafnan catchment in varying seasons, 2011-2013, adapted from Jacobs' (2013) *Consultancy Report: Wylfa Freshwater Baseline Surveys 2011-2013*.

Site	Exhaustive number of species		
	2011	2012	2013
Caerdegog Isaf Pond	-	32	9
Tan-yr-allt Pond	-	33	21
The Firs Pond	1	-	-
Cae Gwyn SSSI	-	-	66
Groes-fechan Wetland*	-	-	79
Caerdegog Isaf	-	16	9
Cafnan to Hafnan*	26	31	26
Felin Gafnan Confluence	3	6	5
Pont Cafnan Wetland	3	29	36

* marks a site where multiple locations were surveyed and results pooled.

The majority of macroinvertebrates identified during these surveys belonged to families of beetles, molluscs, crustaceans and true bugs with moderate pollution tolerance.

There is significant variation in the number of species across sites, with the lowest diversity recorded at sites very close to the coast such as Felin Gafnan Confluence. The Cae Gwyn SSSI and Groes-fechan Wetland areas in the south-west of the study area are particularly species rich, with 66 and 79 species recorded, respectively, in 2013.

In 2011, the beetles *Agabus bipustulatus* and *Helophorus brevipalpis* occurred in more than half of sites along with the flatworm *Polycelis nigra/tenuis*, shrimps (*Gammarus* spp.) and the hoglouse (*Asellus aquaticus*). The most widespread species recorded in 2012 were *Planorbis planorbis* (snail), *Polycelis nigra/tenuis* (flatworm) and *Asellus aquaticus*, all occurring in more than half of the sites.

In 2013, the most widespread species were again *Planorbis planorbis* (snail), *Polycelis nigra/tenuis* (flatworm) and *Asellus aquaticus*, with the addition of the beetles *Gyrinus substriatus* and *Agabus bipustulatus*.

In all years, a good diversity of true bugs (mainly water-boatman species) and snails occurred. Most of the species recorded were characteristic of slow-flowing waters with good macrophyte cover and fine sediments, and are generally tolerant of organic pollution.

In all years, there were a few isolated records of pollution sensitive mayflies, stoneflies and occasionally caddisflies, mainly occurring at the faster flowing stream sites.

4.4.2 Macroinvertebrate Species and Conservation Value

There were a number of beetles, leeches, snails and true bugs of conservation importance recorded using the exhaustive survey method (see Table 4-4). Cae Gwyn SSSI recorded the highest number of conservation species. The site was particularly rich in beetles, supporting 12 species of conservation importance. The water scavenger beetle *Coelostoma orbiculare* (Regionally Notable), and predaceous diving beetle *Ilybius guttiger* (Nationally Scarce), occurred in four out of six sites. Half of the sites surveyed supported snails of Local conservation importance, and a third contained a leech of Local conservation importance.

Table 4-4: Years where species of conservation importance (under CCI) were recorded at six sites within the Cafnan catchment, collected in 2011-2013 by using the exhaustive method; 2014 data collected using standard kick-sample methodology is also presented.

Species	Conservation status	Cae Gwyn SSSI	Groes-fechan Wetland*	Caerde gog Isaf	Cafnan to Hafnan*	Pont Cafnan Wetland	Cafnan
Ilybius chalconatus	Nationally Scarce^					2013	
Agabus unguicularis	Nationally Scarce^					2012, 2013	
Coelostoma orbiculare	Regionally Notable^	2013	2013	2011	2012		
Enochrus coarctatus	Nationally Scarce^	2013			2012		
Enochrus ochropteras	Nationally Scarce^	2013					
Graptodytes granularis	Nationally Scarce^	2013					
Helochares lividus	Nationally Scarce^		2013				
Helochares punctatus	Nationally Scarce	2013	2013				

Species	Conservation status	Cae Gwyn SSSI	Groes-fechan Wetland*	Caerde gog Isaf	Cafnan to Hafnan*	Pont Cafnan Wetland	Cafnan
Hydroglyphus pusillus	Nationally Scarce^	2013					
Hydroporus obscurus	Local	2013				2013	
Hydroporus tristis	Local	2013					
Hygrotus impressopunctatus	Local					2012, 2013	
Ilybius guttiger	Nationally Scarce^	2013	2013		2012	2012, 2013	
Ilybius montanus	Local	2013					
Ilybius quadriguttatus	Local					2012	
Rhantus grapii	Nationally Scarce^	2013				2012, 2013	
Rhantus suturalis	Nationally Scarce^		2013				
Erpobdella testacea	Local		2013				
Haemopis sanguisuga	Local		2013			2013	
Anisus leucostoma	Local	2013					
Aplexa hypnorum	Local	2013	2013			2012, 2013	
Hesperocorixa moesta	Regionally Notable	2013					
Microvelia reticulata	Local	2013			2012	2013	
Paracymus scutellaris (Beetle)	Notable	2014					
Sigara semistriata (Water boatman)	Local						2014
Total number of CCI ≥Local species found across four years		**16**	**8**	**1**	**4**	**10**	**1**

*denotes a site where multiple locations were surveyed and results pooled. ^denotes beetle species which are designated a lower conservation classification in Foster (2010).

There were several occurrences of the pollution sensitive cased caddisflies (Beraeidae and Sericostomatidae), whilst a caseless caddisfly (Hydropsychidae) was recorded at Felin Gafnan Confluence, which exhibits fast flowing water conditions.

CCI scores ranged from Low to Fairly High (Table 4-5), with the lowest scoring community at Caerdegog Isaf (3.3) and the highest at Cae Gwyn SSSI (12.2). The majority of sites were of Low conservation importance. Cae Gwyn SSSI qualifies for Fairly High conservation value due to the presence of the Notable water scavenger beetle, *Paracymus scutellaris,* supported by a wider species-rich community. The water boatman, *Sigara semistriata,* was present at Cafnan, which is of Local conservation importance.

Table 4-5: Macroinvertebrate CCI scores for 2014 sites within the Cafnan catchment.

Site	CCI score	CCI value	Species of conservation importance (Local or above)
Cae Gwyn SSSI	12.2	Fairly High	*Paracymus scutellaris* (Beetle, Notable)
Caerdegog Isaf	3.3	Low	None
Cafnan	6.8	Moderate	*Sigara semistriata* (Water boatman, Local)
Felin Gafnan Confluence	7.2	Moderate	None
Groes-fechan	3.6	Low	None
Hafnan	4.3	Low	None
Hafnan – Caerdegog Isaf	4.6	Low	None

4.4.3 Macroinvertebrate Indices

Hafnan - Caerdegog Isaf had a low BMWP score of 56, while the Cafnan and Felin Gafnan sites scored 93 and 106 respectively (Table 4-6). The Felin Gafnan Confluence had the highest ASPT score of 5.0, suggesting the community is less tolerant to pollution compared with the other sites. The number of taxa recorded was variable across sites, ranging from 14 taxa at Hafnan - Caerdegog Isaf to 21 taxa at both Cafnan and Felin Gafnan.

PSI (F) was interpreted as ranging from Slightly Sedimented to Heavily Sedimented across the catchment. The Caerdegog Isaf tributary site indicated that a significant proportion of taxa present in this watercourse were more tolerant of sedimentation. Ditch-like sites such as Hafnan – Caerdegog Isaf were assessed as being Heavily Sedimented.

LIFE (F) scores varied between sites. Felin Gafnan Confluence (7.3) and Caerdegog Isaf (6.6) appear least impacted by flow stress. Cae Gwyn SSSI (5.4) recorded an invertebrate community characteristic of slow flowing or standing water, which reflected the fen/wetland nature of the site. EQR scores of 0.78 or above were generated for three sites, suggesting there are few flow-stressors at these sites (all along the main stem Cafnan watercourse) that would not be present in pristine reference conditions.

Table 4-6: Macroinvertebrate indices for seven sites on the Cafnan catchment. * denotes spring only

Site	BMWP	NTAXA	ASPT	PSI (F)	PSI (F) interp.	PSI (F) EQR	LIFE (sp)	LIFE (F)	LIFE (F) EQR
Cae Gwyn SSSI*	83	20	4.2	19.0	Heavily sedimented	-	5.7	5.4	-
Caerdegog Isaf*	72	16	4.5	62.1	Slightly sedimented	-	7.9	6.6	-
Cafnan*	93	21	4.4	24.1	Sedimented	0.34	6.4	6	0.78
Felin Gafnan Confluence	106	21	5.0	71.1	Slightly sedimented	1.04	8.0	7.3	0.99
Groes-fechan *	68	15	4.5	60.0	Moderately sedimented	-	7.4	6.3	-
Hafnan*	61	15	4.1	50.0	Moderately sedimented	0.91	7.1	6.3	0.87
Hafnan – Caerdegog Isaf*	56	14	4.0	16.0	Heavily sedimented	-	5.7	5.5	-

Three sites within the catchment were candidates for RICT classification (Table 4-7). Hafnan, Cafnan and Felin Gafnan Confluence were classified as Poor, Poor and Moderate respectively.

Table 4-7: RICT classifications for three sites in the Cafnan catchment. The highlighted cells represent the overall EQR classification for the given site.

Site	Index	EQR	Class	Probability of Class (%)
Cafnan	ASPT	0.73	Poor	71.47
	NTAXA	1.07	High	90.51
	MINTA	-	**Poor**	71.47
Felin Gafnan Confluence	ASPT	0.84	Moderate	79.29
	NTAXA	0.94	High	68.10
	MINTA	-	**Moderate**	79.29
Hafnan	ASPT	0.75	Poor	60.80
	NTAXA	0.76	Moderate	38.72
	MINTA	-	**Poor**	60.80

Both Cafnan and Felin Gafnan Confluence achieved an individual NTAXA classification of High, which indicates that the overall MINTA classification of moderate is being influenced by the ASPT score (Table 4-7). The low ASPT is normally indicative of water quality issues rather than habitat availability, because the community pollution tolerance is higher than would be expected.

4.5 Macrophytes

Four of the six macrophyte surveys carried out on the Cafnan catchment were suitable for LEAFPACS2 classification (Appendix D). The remaining two were unsuitable either because they were not visible on a 1:50,000 ordnance survey map (a prerequisite of LEAFPACS2) or the sites had a survey length of less than 40m.

Fool's watercress (*Apium nodiflorum*), water mint (*Mentha aquatica*), hemlock water dropwort (*Oenanthe crocata*), reed canary grass (*Phalaris arundinacea*) and watercress (*Rorippa nasturtium-aquaticum agg*.) are LEAFPACS2 scoring taxa and were present at the majority of the sites surveyed. The taxon cover values (TCVs) varied between sites.

Willowherb (*Epilobium hirsutum*), meadowsweet (*Filipendula ulmaria*), common rush (*Juncus effuses*) and the greater birds-foot trefoil (*Lotus pedunculatus*) are all non-scoring LEAFPACS2 taxa and were present at the majority of sites.

One species of macroalgae, *Vaucheria* sp., was also recorded at Cafnan. It is particularly tolerant of elevated nutrient levels. There were no species of conservation importance identified in the surveys.

Table 4-8 shows the individual indices calculated from LEAFPACS2 prior to classification (four were suitable for classification).

Table 4-8: Macrophyte indices for sites along the Cafnan watercourse prior to LEAFPACS2 classification (RMNI, NTAXA, non-scoring taxa, NFG and ALG). Refer to glossary for acronym definitions.

Site	Observed RMNI	Observed NTAXA (scorers)	Total NTAXA (inc. non-scores)	Observed NFG	Observed ALG
Groes-fechan	6.78	6	20	5	0
Cafnan	7.83	5	13	5	17.50
Hafnan A	6.51	4	7	3	0
Cae Gwyn SSSI	6.44	4	16	4	0
Caerdegog Isaf	6.61	3	12	2	0
Hafnan B	7.31	2	8	2	0

The RMNI score gives an indication of nutrient enrichment, with scores ranging from 1 (low) to 10 (high). The RMNI scores did not vary considerably between the sites suggesting a moderate degree of nutrient enrichment across all sites.

The NTAXA score gives an indication of diversity within the macrophyte community. Groes-fechan recorded the highest score (six), whilst Hafnan B the lowest score (2).

Observed algal cover gives a percentage cover value of green filamentous algae. The whole survey area, with the exception of Cafnan (17.5%), recorded an algal percentage cover of less than 1%. The NFG scores were poor across all sites.

LEAFPACS2 classification was performed on four sites within the Cafnan catchment, with all sites except for Cafnan (Moderate) scoring Good status (Table 4-9).

Table 4-9: The results of LEAFPACS2 classification at the Cafnan catchment sites. Highlighted cells represent the EQR status category defined.

Site	EQR	Status
Groes-fechan	0.660	Good

Cafnan	0.428	Moderate
Hafnan	0.699	Good
Cae Gwyn SSSI	0.663	Good

There was one record of the non-native species *Gunnera manicata* at the Felin Gafnan Confluence.

4.6 Fish

The Cafnan site has been surveyed on seven occasions over the 2011-2014 period. Brown trout, European eel, three-spined stickleback and nine-spined stickleback have been recorded. A single nine-spined stickleback was recorded in autumn 2011; however, it has not been observed since. All other species were present between 2011 and 2014 with the number of individuals varying over time. Brown trout ranged from single individuals caught in summer and autumn 2013 to eight individuals caught in autumn 2011. European eel ranged from two individuals in autumn 2013 to 14 individuals in spring 2012. The three-spined stickleback was the most numerous species with up to 57 individuals recorded in autumn 2011.

The Hafnan site was surveyed three times during 2013 and once in 2014. Over this period, brown trout and European eel have been recorded in addition to a large number of three-spined stickleback and three nine-spined sticklebacks. In 2013, all of the eel recorded were over 200mm in length whereas in 2014 only two of the 10 eels caught were over 200mm (the remainder 70mm–120mm). In 2014, a single brown trout (200mm) was recorded. Hafnan provides limited suitable habitat for brown trout with large sections being too shallow for adults over a silt substrate, in addition to little cover. Stickleback and European eels are able to utilise the cover provided by macrophytes or by burying into the silt (eels only).

The Caerdegog Isaf site was surveyed twice in 2013, with a single three-spined stickleback being recorded. No fish were recorded during the 2014 survey. Available data suggest that the low water levels at the site do not facilitate a permanent fish population. It is likely that under high flow conditions stickleback and eel may temporarily enter the site.

The Groes-fechan site was surveyed once in spring 2013 and once in summer 2014: no fish were caught or observed on either occasion. The channel is heavily vegetated, so it is possible that fish are present but have not been encountered during the surveys. The Groes-fechan site is upstream of Caerdegog Isaf, which does not appear to support a population of fish either. Hence, it is possible that this upstream section of the catchment as a whole does not support a viable fish population.

The fish fauna observed on the Cafnan catchment is typical of a small coastal stream, with connectivity to the marine environment allowing eel to move freely into and within the catchments. Given the size of watercourses, with many prone to choking from macrophytes or seasonal drying, many sites are not suitable for cyprinid species of fish. However, the larger watercourses have been shown to support populations of brown trout. Sticklebacks were been recorded at most sites. Their tolerance of reduced oxygen conditions and very shallow water environments provide them with the greatest potential range of the species encountered. Habitat suitability for fish varied between sites, although areas of mixed substrates, varying flow types and riparian and in-stream cover provide some good habitat diversity within the catchment.

4.7 Pond Quality Assessment

Pond Quality Assessments were carried out at four ponds within the catchment (see Appendix A). Exhaustive macroinvertebrate surveys were carried out at two ponds in 2012 and 2013 to identify species richness and conservation value. A PSYM survey was undertaken at one pond (Tregele Pond) in 2014. The PSYM survey was undertaken to classify the pond using a series of indices while assessing the quality and conservation importance of the macroinvertebrate and aquatic plant communities. The remaining pond site (Groes-fechan ponds 1 and 2) was found to be ephemeral and was not considered further.

4.7.1 Macroinvertebrates

(a) Exhaustive surveys 2011–2013

The number of species recorded at each pond is detailed in Table 4-10. The exhaustive number of species is not directly comparable between sites as the number of visits differed due to ponds drying out, access constraints or adverse weather; however, data provides an indication of the diversity of species recorded each year.

Table 4-10: Exhaustive number of species per year at two ponds in varying seasons, 2011-2013

Site	Exhaustive number of species		
	2011	2012	2013
Caerdegog Isaf Pond	-	32	9
Tan-yr-allt Pond	-	33	21

Caerdegog Isaf Pond and Tan-yr-allt Pond recorded a species list of over 30 taxa during 2012. The majority of macroinvertebrates identified during these surveys belonged to pollution tolerant families of beetles, molluscs, crustaceans and true bugs. The most common species recorded in the ponds were the water beetle (*Agabus bipustulatus*), the flatworm (*Polycelis nigra/tenuis*) and the hoglouse (*Asellus aquaticus*). All three species were recorded in more than half of ponds surveyed. In 2011, the beetles *Agabus bipustulatus* and *Helophorus* spp. were recorded in more than half of the sites surveyed, along with the flatworm *Polycelis nigra/tenuis,* the water skaters *Gerris* spp. and the hoglouse *Asellus aquaticus*. These species are characteristic of standing waters with a high coverage of macrophytes, fine sediments and decomposing organic matter.

(b) Species of Conservation Importance

A number of beetles, leeches, snails and true bugs of conservation importance were recorded between 2011 and 2014 (see Table 4-11). Caerdegog Isaf Pond was particularly rich in beetles, supporting seven species of conservation importance, out of a total of 13 recorded from the entire study area. Caerdegog Isaf pond had the highest number of rare species across the study period, with four considered Nationally Scarce, two Regionally Notable and the remainder in the Local conservation category. Tan-yr-allt Pond had three Nationally Scarce species, with two of Local significance. *Omphiscola glabra* was found in Tregele Pond in 2014. *Omphiscola glabra* is declining in range in the UK and is named as a priority species under Section 42 of the Natural Environment and Rural Communities (NERC) Act, Wales, 2006. *O. glabra* is also on the Red List International Union for Conservation

of Nature (IUCN) as Near Threatened. In total, 42 individuals were recorded in the sample, indicating that there is a significant population living in the pond.

CCI conservation scores were not calculated for 2011–2013 data because the exhaustive survey method does not provide a quantitative sample collection.

Table 4-11: Years where species of conservation importance (under CCI) were recorded at three ponds within the Cafnan catchment, collected in 2011–2013 by using exhaustive method; 2014 data collected using standard kick-sample methodology is also presented.

Species	Conservation Importance (Local or above)	Caerdegog Isaf Pond	Tan-yr-allt Pond	Tregele Pond
Coelostoma orbiculare	Regionally Notable*	2012		
Cymbiodyta marginella	Local		2012, 2013	2014
Dytiscus circumflexus	Nationally Scarce*		2012	
Enochrus coarctatus	Nationally Scarce*	2012, 2013		
Enochrus ochropteras	Nationally Scarce*	2013		
Helochares punctatus	Nationally Scarce	2012		
Ilybius guttiger	Nationally Scarce*	2013	2012	
Ilybius quadriguttatus	Local	2012		
Ochthebius marinus	Nationally Scarce*		2012	
Haemopis sanguisuga	Local	2012		
Anisus leucostoma	Local		2012	
Aplexa hypnorum	Local	2012		
Hesperocorixa moesta	Regionally Notable	2012		
Omphiscola glabra	Near Threatened			2014
Total number of CCI ≥Local species found across four years		**9**	**5**	**2**

*denotes beetle species which are designated a lower conservation classification in Foster (2010).

4.7.2 PSYM

Tregele Pond was assessed using the PYSM method (indicator results detailed in Table 4-12). The composition of the macroinvertebrates community was similar across the study period. The Coleoptera index was only slightly lower than expected, suggesting that the pond provide acceptable habitat for beetle species. The Odonata index indicated that the pond community was limited by variations in water level and ephemeral effects. Numbers of dragon/damselfly and alderfly

families (which require permanently wetted sites for the long larval stage of their life cycle) were below expected.

Table 4-12: PSYM results and classification of Tregele Pond. Observed indices in unshaded rows, and EQIs below in shaded rows (PSYM quality category = IBI >75%=Good, 51-75%=Moderate, 25-50%=Poor, <25%=V Poor). Refer to glossary for acronym definitions.

Index	Tregele Pond
No. of submerged + marginal plant species (SM)	8
EQI (SM)	0.41
Number of uncommon plant species (U)	1
EQI (U)	0.23
Trophic Ranking Score (TRS)	9.25
EQI (TRS)	1.59
Average Score Per Taxon (ASPT)	3.6
EQI (ASPT)	0.70
Odonata + Megaloptera (OM) families	0
EQI (OM)	0.00
Coleoptera families (CO)	3
EQI (CO)	0.80
Index of Biotic Integrity (%)	28%
PSYM quality category	Poor
Priority species	1
Meet Priority Pond criteria?	Yes

The low ASPT (3.6) was largely due to the absence of high BMWP-scoring families such as caddisflies and mayflies. This potentially reflects the water quality pressures from agricultural land use which mainly consists of improved pastures, where livestock often have access to the waterbodies).

Tregele Pond recorded the highest scoring macroinvertebrate community within the Wylfa Newydd Development Area (Very High, 29.6) due to the presence of the mud snail (Table 4-13).

Table 4-13: CCI scores and results from data collected during PSYM surveys in 2014 (and one survey in 2012).

Pond	CCI score	CCI value	Species of conservation importance (Local or above)
Tregele Pond	29.6	Very High	*Omphiscola glabra* (Mud snail, Red List IUCN Near Threatened) *Cymbiodyta marginella* (beetle, Local)

The PSYM plant indices indicate that Tregele Pond supports commonly occurring, nutrient tolerant species, which supports the observed elevated phosphorus and ammonia levels. In addition, the TRS (9.25) indicates that the communities within the pond have a very high tolerance to elevated nutrient levels.

Overall, Tregele Pond is classed as Poor under the PSYM methodology, largely due to its relatively low diversity (macroinvertebrates and macrophyte) and poor trophic ranking score. However, the presence of Red List IUCN Near Threatened species in 2014 led to the classification of the site as of Very High conservation value and consequently achieved Priority Status.

4.8 Summary

The Cafnan data are indicative of a rural catchment with mild to moderate nutrient enrichment as evidenced by the water quality, diatom and macrophyte indices. General habitat quality is good along the main stem stream between the Hafnan and Cafnan sites. Habitat quality is generally lower along the tributary stream where the Caerdegog Isaf site is located.

Macroinvertebrate indices indicated a range of habitats of between low and good quality. The ditch-like habitat around Caerdegog Isaf was typical of low habitat quality. The wetland areas around Groes-fechan and Cae Gwyn exhibited high species diversity and were indicative of higher habitat quality. There was one record of the no-native species *Gunnera manicata* at the Felin Gafnan Confluence.

Fish data indicates that trout are the dominant species within the main stem of the Cafnan. European eel was also present at the main stem sites. The reaches upstream of Caerdegog exhibited poorer habitat for fish, with extensive siltation and low water levels. Habitat suitability for fish is varied between the sites, although areas of mixed substrates, varying flow types and riparian and in-stream cover provide some good habitat diversity.

Species found within the catchment are common and widespread and reflect existing and historical rural land management practices in the area. The national important European eel was present within the catchment although in low numbers, along with the near threatened mud sail found in Tregele Pond. As a result, aquatic habitats and species within the Cafnan catchment can be considered of moderate quality.

5 Baseline Conditions - Tre'r Gof Catchment

5.1 Habitat Characterisation

The Tre'r Gof catchment is located to the south-east of the Existing Power Station. The catchment includes four pond sites and three running water sites. The Tre'r Gof SSSI is located within the catchment and is recognised for its rich-fen habitat. The SSSI wetland area is wetted all year round and ensures a permanently wetted channel around its margin.

The catchment land use is largely agricultural with evidence of livestock access to the watercourse noted in some areas. There is evidence of historical channel modification to allow the watercourse to flow along field boundaries. Some sections of the upper catchment are ephemeral, drying out during the summer months. Refer to Appendix A for habitat characterisation descriptions.

5.2 Water quality

The following section summarises water quality data collected between 2012 and 2014 within the Tre'r Gof catchment. Table 5-1 details the results for selected physico-chemical, biochemical and nutrient parameters. For full results, refer to Appendix B (note this section refers to results from the Tre'r Gof catchment only).

Physico-chemical and biochemical results can be summarised as follows:

- Water temperatures ranged between 1.94˚C (Power Station Pond, winter 2013) to 18.5˚C (Porth Wylfa Pond, spring 2014). All water temperature results were within the expected range of values for the waterbody types and time of the year.
- Conductivity readings ranged between 0.185mS cm^{-3} (Power Station Pond, winter 2013) and 0.640mS cm^{-3} (Tre'r Gof SSSI, autumn 2014), and were within the expected range of values for the waterbody type.
- Dissolved oxygen (percent saturation) varied significantly across the catchment and across sampling years. Values ranged between 20%, recorded in spring 2013 (Power Station Pond), and 135%, recorded in winter 2014 (Porth Wylfa Pond).
- pH ranged from 5.58 to 8.57, with all results within the expected range of values for the habitat types sampled.
- Suspended sediment concentrations varied between sites and sampling occasions. The highest suspended solid concentration (307mg L^{-1}) was recorded in autumn 2014 at Tyddyn-Goronwy, which was characterised as an ephemeral stream. Water levels at the time of sampling were low, resulting in the possible resuspension of sediment during the collection of the sample.
- Biological oxygen demand was generally low. The highest level (18.8mg L^{-1}) was recorded at Wylfa Hall Pond in autumn 2014.

Nutrient results can be summarised as follows:

- Orthophosphate concentrations were generally low across the site. Concentrations ranged between MRV (<0.01mg L^{-1}) and 0.595mg L^{-1} over the sampling period.

- Ammoniacal nitrogen concentrations were generally low, varying slightly between sites. Elevated readings were noted at Porth Wylfa Pond (1.59mg L^{-1}) and Power Station Pond (0.385mg L^{-1}) in spring 2014, and Power Station Junction (0.509mg L^{-1}) in autumn 2014.

Table 5-1: Maximum and minimum physico-chemical, biochemical and nutrient results for the Tre'r Gof catchment over the 2012-2014 sampling period.

Parameter	Range	Power Station Junction	Wylfa Hall Pond	Tyddyn-Goronwy	Power Station Pond	Porth Wylfa Pond	Porth Wylfa	Tre'r Gof SSSI
Temperature ˚C	Max	11.90	13.30	12.10	13.60	18.50	15.60	12.70
	Min	5.80	8.03	12.10	1.94	10.20	2.55	8.62
Conductivity mS cm^{-3}	Max	0.336	0.632	0.495	0.361	0.501	0.595	0.640
	Min	0.266	0.219	0.495	0.185	0.372	0.349	0.356
Dissolved oxygen %	Max	83.2	104.9	52.6	65.9	135	81	73.5
	Min	45.6	37.8	52.6	20.0	68.0	52.7	55.8
pH	Max	6.48	8.15	-	6.07	8.57	8.57	8.46
	Min	6.09	5.58	-	5.58	6.7	6.13	6.38
Suspended solids mg L^{-1}	Max	27.2	22.4	307.0	173.0	69.6	52.5	121.0
	Min	<3.0	5.9	307.0	3.0	13.9	5.1	6.9
Biological oxygen demand mg L^{-1}	Max	5.55	18.80	12.20	7.91	3.79	2.50	4.64
	Min	<1.0	<1.0	12.20	1.45	<1.0	<1.0	<1.0
Orthophosphate (reactive as P) mg L^{-1}	Max	0.595	0.221	0.061	0.09	0.178	<0.020	<0.020
	Min	<0.020	0.022	0.061	0.021	0.035	<0.010	<0.010
Ammoniacal nitrogen as N mg L^{-1}	Max	0.509	0.218	0.209	0.385	1.590	0.063	0.037
	Min	<0.030	<0.030	0.209	0.081	0.108	<0.030	<0.030

Metals can be summarised as follows:

- Cadmium, nickel, lead, chromium and mercury concentrations were low or below the MRV across all sites.
- Arsenic was generally low, with values ranging between MRV (<1.0µg L^{-1}) and 1.81µg L^{-1}.
- Copper concentrations were generally below 4.51µg L^{-1}, although a level of 6.41µg L^{-1} was recorded at Wylfa Hall Pond in autumn 2014.
- Zinc concentrations varied across the catchment and sampling season. Levels ranged between 22µg L^{-1} recorded at Power Station Pond in autumn 2013 and below the MRV (5µg L^{-1}).
- Iron concentrations varied between sites and sampling years, and ranged between <30µg L^{-1} and 7470µg L^{-1}.
- Manganese concentrations varied between sites and sampling years, and ranged between 58µg L^{-1} and 4240µg L^{-1} (Tre'r Gof SSSI, spring 2014).

Selected other compounds can be summarised as follows:

- Toluene and trichloroethylene levels were low across all sites with levels below the MRV (0.1µg L^{-1}).
- DEHP levels were elevated at Porth Wylfa in winter 2012 (1.05µg L^{-1}) and summer 2012 (0.65µg L^{-1}). All other sites recorded low levels below or close to the MRV (0.2µg L^{-1}).
- Hydrocarbon Screens (C5 - C44) levels were low across all sites with levels below or close to the MRV (0.2µg L^{-1}).

- Chloride levels were low across the site.

Water quality conditions within the Tre'r Gof catchment are typical of a catchment dominated by rural land use, including livestock grazing. Occasional elevated metal concentrations have been detected over the 2012–2014 sampling period.

5.3 Diatoms

Diatom surveys were undertaken between 2011 and 2014. Table 5-2 lists the diatom EQR (observed/expected diatom community) in each of the sampling years and is colour coded to indicate WFD classification. 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.

Table 5-2: Diatom EQRs and ecological status 2011–2014 for the Tre'r Gof catchment (blue= high, green = good, yellow= moderate, orange = poor).

Site	2011	2012	2013	2014
Porth Wylfa	0.89	0.96	1.00	1.00
Power Station Pond		0.55	0.8	0.73
Power Station Junction			0.8	0.56
Wylfa Hall Pond				0.69
Tre'r Gof SSSI				1.00
Porth Wylfa Pond				0.63

As a key indicator of elevated nutrients, the diatoms indices indicate that environmental stressors (including nutrients) are having a small impact upon the observed communities at Power Station Pond, Power Station Junction, Wylfa Hall Pond and Porth Wylfa Pond. The indices indicate that the phytoplankton communities are similar to those predicted for the watercourse typologies, based upon physical habitat attributes. The indices indicate that Porth Wylfa and Tre'r Gof SSSI are at High quality.

The variability in the diatom community at Power Station Pond and Power Station Junction indicates a degree of environmental stress. Low flows through the catchment may be affecting the diatom community. In addition, the heavy channel shading present through most of the catchment may also be contributing to the diatom EQR scoring.

The diatom taxa reported from the 2011 and 2014 sampling of the Tre'r Gof catchment are generally common taxa, with low to medium nutrient tolerance. As a result, the value of diatom communities in the Tre'r Gof catchment are considered low, with the species present forming a small resource when considering the wider Wylfa Newydd Development Area.

5.4 Macroinvertebrates

Macroinvertebrate samples have been collected between 2011 and 2014 in the Tre'r Gof catchment. During 2011 to 2013, two sites were sampled using the exhaustive survey method; whilst in 2014, three sites were sampled using the standard kick-sample methodology. No samples were collected at Tyddyn-Goronwy, as the site is ephemeral and was dry at the time of sampling.

5.4.1 Exhaustive Surveys 2011 to 2013

The resulting is not directly comparable between sites as the number of visits differed due to seasonal variation, weather and access constraints. Both sites had multiple sampling locations from which data was pooled. Data provides an indication of the diversity of species recorded each year (Table 5-3).

Table 5-3: Exhaustive number of species per year at two sites within the Tre'r Gof catchment in varying years and seasons, 2011-2013, adapted from Jacobs' (2013) *Consultancy Report: Wylfa Freshwater Baseline Surveys 2011-2013*.

Site	Exhaustive number of species		
	2011	2012	2013
Porth Wylfa/Tre'r Gof SSSI*	33	46	45
Power Station Pond/Junction*	-	28	10

*marks a site where multiple locations were surveyed and results pooled.

The lowest diversity was recorded at Power Station Pond/Junction (10 species) in 2013. Porth Wylfa/Tre'r Gof SSSI recorded 46 and 45 species respectively in 2012 and 2013. The majority of macroinvertebrates identified during these surveys were individuals from the families of beetles, molluscs, crustaceans and true bugs with moderate pollution tolerance (see Rachel Hacking Ecology, 2011, 2012 and 2013 for species lists).

5.4.2 Macroinvertebrate Species and Conservation Value

There were a number of beetles, leeches, snails and true bugs of conservation importance recorded using the exhaustive survey method in all years (see Table 5-4). The highest number of CCI species found was at the Porth Wylfa site (15 species). The Tre'r Gof SSSI, which was only sampled as a site in its own right in 2014, had a low species count, largely as a result of changes in the sampling methodology.

Table 5-4: Years when species of conservation importance (under CCI) were recorded at three sites within the Tre'r Gof catchment, collected in 2011-2013 by using exhaustive method; 2014 data collected using standard kick-sample methodology is also presented.

Species	Conservation Importance (Local or above)	Porth Wylfa/ Tre'r Gof SSSI*	Tre'r Gof SSSI	Power Station Pond/Junction *
Cercyon tristis	Nationally Scarce^	2012, 2013		
Coelostoma orbiculare	Regionally Notable^	2011, 2012, 2013		2012, 2013
Cymbiodyta marginella	Local	2011		2011
Enochrus coarctatus	Nationally Scarce^	2012, 2013		2011, 2012, 2013
Enochrus ochropteras	Nationally Scarce^	2012		
Helochares lividus	Nationally Scarce^			2011, 2012
Helochares punctatus	Nationally Scarce	2013		2011

Species	Conservation Importance (Local or above)	Porth Wylfa/ Tre'r Gof SSSI*	Tre'r Gof SSSI	Power Station Pond/Junction *
Hydroporus tristis	Local			2012
Hygrotus impressopunctatus	Local	2013		
Ilybius guttiger	Nationally Scarce^	2011, 2012		
Ilybius quadriguttatus	Local	2011		
Rhantus frontalis	Nationally Scarce	2013		
Rhantus grapii	Nationally Scarce^	2013		
Erpobdella testacea	Local	2012, 2013	2014	2011
Haemopis sanguisuga	Local	2013		
Anisus leucostoma	Local	2011, 2012, 2013		2012
Aplexa hypnorum	Local	2012, 2013		2012
Sigara limitata	Local			
Microvelia reticulata	Local			2011
Total number of CCI ≥Local species found across four years		**15**	**1**	**10**

*denotes a site where multiple locations were surveyed and results pooled. ^denotes beetle species which are designated a lower conservation classification in Foster (2010).

In general, the macroinvertebrates recorded across the site consisted of common crustaceans, true flies, leeches, beetles and molluscs, all of which are tolerant to sedimentation, slow flow and some pollutants (see Appendix C for 2014 species lists). Stoneflies were recorded at the Porth Wylfa site.

CCI scores which could be calculated for 2014 data ranged from Low to Moderate (Table 5-5), with the lowest scoring community at Porth Wylfa (4.6) and the highest at Tre'r Gof SSSI (8.6). The locally important leech, *Erpobdella testacea,* was present at Tre'r Gof SSSI.

Table 5-5: Macroinvertebrate indices for 2014 at sites within the Tre'r Gof catchment.

Site	CCI score	CCI value	Species of conservation importance (Local or above)
Porth Wylfa	4.6	Low	None
Tre'r Gof SSSI	8.6	Moderate	*Erpobdella testacea* (Leech, Local)

5.4.3 Macroinvertebrate Indices

The BMWP score (53) for the Power Station Junction site (Table 5-6) was significantly lower than the score (84) for the Porth Wylfa site. The number of taxa recorded was also variable, with 14 recorded in the ditch-like habitats of Power Station Junction compared to 19 at Porth Wylfa.

PSI (F) was interpreted as Sedimented or Heavily Sedimented, indicating that a significant proportion of taxa present in these watercourses are tolerant of sedimentation. Ditch-like sites such as Power Station Junction were Heavily Sedimented.

LIFE (F) scores were similar between sites with scores of 5.1 to 5.8 indicating that these invertebrate communities are characteristic of slow flowing or standing waters, reflecting the fen/wetland nature of these sites.

Table 5-6: Macroinvertebrate indices for Tre'r Gof catchment sites.

Site	BMWP	NTAXA	ASPT	PSI (F)	PSI (F) interp.	PSI (F) EQR	LIFE (sp)	LIFE (F)	LIFE (F) EQR
Porth Wylfa	84	19	4.4	31.6	Sedimented	-	6.0	5.8	-
Power Station Junction*	53	14	3.8	16.1	Heavily sedimented	-	5.8	5.6	-
Tre'r Gof SSSI	65	16	4.1	24.3	Sedimented.	-	5.7	5.1	-

*autumn only.

5.5 Macrophytes

Two sites were suitable for macrophyte survey with individual indices shown in Table 5-7. The RMNI (measure of nutrient enrichment) does not vary considerably between the sites, implying there may be a moderate degree of nutrient enrichment across the sites.

The NTAXA gives an indication of diversity within the macrophyte community. Porth Wylfa recorded the highest NTAXA score (4), compared to the Power Station Junction site score (2). The NFG was poor at both sites.

Several species of macroalgae were also present at Porth Wylfa including the blanket weed (*Cladophora glomerata/Rhizoclonium hieroglyphicum*) and *Vaucheria* sp., both of which are particularly tolerant of elevated nutrient levels.

Table 5-7: Macrophyte indices for two sites within the Tre'r Gof catchment (RMNI, NTAXA, non-scoring taxa, NFG and ALG).

Site	Observed RMNI	Observed NTAXA (scorers)	Total NTAXA (inc. non-scores)	Observed NFG	Observed ALG
Porth Wylfa	6.68	4	13	4	0.05
Power Station Junction	7.68	2	6	2	0

5.6 Fish

Fish surveys have been undertaken at two sites within the Tre'r Gof catchment between 2012 and 2013 (Appendix E). Spot sampling was undertaken at Power Station Pond and at Porth Wylfa. No fish were captured at either site during the surveys.

In 2013 and 2014, incidental records were made of European eel at Porth Wylfa. In 2014, an additional incidental record of European eel was made at the Tre'r Gof SSSI.

Given the natural head drop between the Porth Wylfa site and beach, there is limited access for fish to the catchment. There is limited potential to sample other fish species via the electro-fishing method in this watercourse due to the shallow water, limited connectivity under normal flow conditions and choked nature of the watercourse during the macrophyte-growing season.

The value of fish receptors in the Tre'r Gof catchment is considered low.

5.7 Pond Quality Assessment

PSYM surveys were undertaken in 2012 (one pond) and 2014 (two ponds) in order to assess the quality and conservation importance of macroinvertebrate and aquatic plant communities, and to classify each pond using a series of indices.

5.7.1 Macroinvertebrates

(a) Exhaustive surveys 2011–2013

The exhaustive survey methodology is not directly comparable between sites as the number of visits differed due to ponds drying out, access constraints or adverse weather; however, data provides an indication of the diversity of species recorded within the particular survey area each year (Table 5-8).

Table 5-8: Exhaustive number of species score per year at two ponds within the Tre'r Gof catchment in varying seasons, 2011-2013.

Site	Exhaustive number of species		
	2011	2012	2013
Porth Wylfa Pond	-	21	-
Power Station Pond	39	28	28

Power Station Pond recorded 39 taxa in 2011, with slightly lower diversities being recorded in other years (28 species). Porth Wylfa Pond recorded 21 species in 2012. The majority of macroinvertebrates identified during these surveys were of the pollution tolerant families of beetles, molluscs, crustaceans and true bugs (see Rachel Hacking Ecology, 2011, 2012 and 2013 for species lists).

(b) Species of Conservation Importance

There were a number of beetles, leeches, snails and true bugs of conservation importance recorded using the exhaustive survey methodology (Table 5-9). Power Station Pond was particularly rich in beetles. The water scavenger beetles, *Coelostoma orbiculare* (Regionally Notable) and *Cymbiodyta marginella* (Local), and

the snail species, *Anisus leucostoma* and *Aplexa hypnorum,* occurred in both ponds. Power Station Pond recorded the highest number of rare species across all years (14). The remaining species were all of Local conservation categorisation. The lowest number of rare species was identified at Wylfa Hall Pond.

Table 5-9: Years where species of conservation importance (under CCI) were recorded at three ponds, collected in 2011-2014.

Species	Conservation Importance (Local or above)	Porth Wylfa Pond	Power Station Pond/Junct.*	Wylfa Hall Pond
Coelostoma orbiculare	Regionally Notable^	2012	2012, 2013	
Cymbiodyta marginella	Local	2012, 2014	2011	
Enochrus coarctatus	Nationally Scarce^		2011, 2012, 2013	
Helochares lividus	Nationally Scarce^	2014	2011, 2012	
Helochares punctatus	Nationally Scarce		2011	
Hydroporus tristis	Local		2012	
Hygrotus impresso-punctatus	Local	2012, 2014		
Erpobdella testacea	Local		2011	
Haemopis sanguisuga	Local	2012	2014	2013
Anisus leucostoma	Local	2012	2012	2013
Aplexa hypnorum	Local	2012, 2013	2012	2012, 2013
Microvelia reticulata	Local		2011	
Sigara scotti (water-boatman, Local)	Local		2014	
Gyraulus laevis (snail, Local)	Local	2014	2014	
Hydraena palustris	Near Threatened (Foster, 2010)		2014	
Rhantus grapii	Notable	2014		
Total number of CCI ≥Local species found across four years		**9**	**14**	**3**

*denotes a site where multiple locations were surveyed and results pooled. ^denotes beetle species which are designated a lower conservation classification in Foster (2010).

CCI conservation scores were not calculated for 2011–2013 data because the exhaustive survey method does not provide a quantitative sample, thus excluding Wylfa Hall Pond. CCI scores varied from Fairly High to Very High across the other ponds (Table 5-10).

The highest CCI score was from Power Station Pond in 2014 (Very High, 28.4), owing to presence of the minute moss beetle (*Hydraena palustris*). In 2014, Porth

Wylfa Pond had the greatest number of species of Local conservation importance or above, with four beetle species and a one species of snail.

Table 5-10: CCI scores and results from data collected during PSYM surveys in 2014 (and one survey in 2012).

Pond	CCI score	CCI value	Species of conservation importance (Local or above)
Power Station Pond (2012)	10.3*	Fairly High*	*Haemopis sanguisuga* (leech, Local) *Sigara scotti* (water-boatman, Local)
Power Station Pond	28.4	Very High	*Gyraulus laevis* (snail, Local) *Hydraena palustris* (beetle, Near Threatened) *Sigara scotti* (water-boatman, Local)
Porth Wylfa Pond	16.2	High	*Gyraulus laevis* (snail, Local) *Rhantus grapii* (beetle, Notable) *Helochares lividus* (beetle, Notable) *Hygrotus impressopunctatus* (beetle, Local) *Cymbiodyta marginella* (beetle, Local)

* denotes limitations to score and value (only selected taxa were analysed to species level/abundance counted)

5.7.2 PSYM

The majority of the macroinvertebrates identified during the PSYM surveys belonged to pollution tolerant families of beetles, molluscs, true flies, crustaceans and true bugs. This type of community is characteristic of standing waters with a high coverage of macrophytes, fine sediments and decomposing organic matter. The macroinvertebrates recorded in 2014 were very similar in composition to those of 2011-2013.

Beetles are an indicator of habitat quality and the Coleoptera index was only slightly lower than expected, suggesting that the ponds provide a good habitat resource for macroinvertebrates. The Odonata index indicates that the pond communities are limited by fluctuations in water level and ephemeral effects, as the ponds fell significantly short of the expected number of dragon/damselfly and alderfly families (which require permanently wetted sites for the long larval stage of their life cycle).

The ASPT scores ranged from 3.8 to 3.9 due to the absence of high BMWP-scoring families such as caddisflies and mayflies, which reflects the water quality pressures from agricultural land use mainly consisting of improved pastures, where livestock often have access to the waterbodies). Dragonflies, damselflies and alderflies (Odonata and Megaloptera (OM)) were largely absent, with the exception of one family being recorded at the Power Station Pond and Porth Wylfa Pond sites. Beetles (Coleoptera (CO)) were present in every pond surveyed.

The PSYM plant indices indicate that the ponds are supporting commonly occurring, nutrient tolerant species, which ties in with the observed elevated phosphorus and ammonia levels.

The plant communities were characteristic of slow flowing/standing, slightly enriched waterbodies (see species lists in Appendix F). The most commonly observed species typically exhibited a high TRS under the PSYM methodology.

The number of submerged and marginal plant species (SM) ranged from seven to 16 within the Tre'r Gof catchment, indicating that a variety of depths and habitats were present. Few uncommon species were recorded. The TRS was greater than

9.0 at all sites, which on a scale of 1 to 10 indicates that the communities across the ponds have a very high tolerance to elevated nutrient levels.

The invasive water fern (*Azolla filiculoides*) was present at Power Station Pond. The presence of water fern at the Power Station Pond may be having a detrimental effect on water quality, as the species forms thick layers on the water surface, suffocating other plant growth and limiting sunlight penetration. It also has a nutrient fixing ability, which could be further enriching the ponds and leading to anoxia particularly in summer months.

The PSYM classifications, along with observed indices and EQIs, are summarised in Table 5-11. The full output (including predicted values for indices and IBI values) is provided in Appendix F. Power Station Pond achieved Poor status based on comparison to pristine reference sites, whilst Porth Wylfa Pond achieved Moderate status.

The SM-EQIs indicate that the number of plant species present was poor at Power Station Pond and the communities were considerably less diverse than expected. The U-EQIs are generally low, with no uncommon species recorded in Porth Wylfa Pond. TRS-EQIs are well above 1.0 across all of the sites, indicating that significantly more nutrient-tolerant species are present than would be expected under reference conditions.

ASPT-EQIs are similar across all of the ponds, and suggest that the pollution tolerance of the macroinvertebrate communities is slightly higher than would be expected under reference conditions. The OM-EQI is particularly low across the sites, with the Power Station Pond sites having none of the predicted number of families, suggesting that the ponds are not suitable for these taxa. The CO-EQIs indicate that the number of beetle families observed across the ponds is slightly fewer than would be expected under reference conditions.

Table 5-11: PSYM results and classification of ponds within the Tre'r Gof catchment. Observed indices in unshaded rows, and EQIs in shaded rows below (PSYM quality category = IBI >75%=Good, 51-75%=Moderate, 25-50%=Poor, <25%=V Poor).

Index	Power Station Pond 2012	Power Station Pond 2014	Porth Wylfa Pond 2014
No. of submerged + marginal plant species (SM)	7	11	16
EQI (SM)	0.38	0.59	0.86
Number of uncommon plant species (U)	0	1	0
EQI (U)	0	0.24	0.00
Trophic Ranking Score (TRS)	9.25	10.00	9.33
EQI (TRS)	1.51	1.74	1.63
Average Score Per Taxon (ASPT)	3.9	3.9	3.8
EQI (ASPT)	0.76	0.76	0.73
Odonata + Megaloptera (OM) families	1	0	1
EQI (OM)	0.29	0.00	0.29
Coleoptera families (CO)	3	3	3
EQI (CO)	0.8	0.79	0.80
Index of Biotic Integrity (%)	39%	39%	50%

Index	Power Station Pond 2012	Power Station Pond 2014	Porth Wylfa Pond 2014
PSYM quality category	Poor		Moderate
Priority species	0	1	0
Meet Priority Pond criteria?	Yes		No

The Power Station Pond met the criteria for Priority Pond status due to the presence of species of conservation importance, despite being classed as Poor quality under PSYM. Power Station Pond qualified due to the presence of the minute moss beetle (*Hydraena palustris*). There was only one individual recorded in 2014, suggesting the population is small and probably vulnerable to changes in the pond's quality. Priority Ponds are recognised under the UK Post-2010 Biodiversity Framework (formerly the UK Biodiversity Action Plan), which aims to continue the monitoring and conservation of species and habitats of priority conservation value.

Water quality data for the ponds are summarised in the water quality chapter (Table 5-1). *In situ* water quality data varied as expected between seasons. Of particular note are the nutrient levels, which are generally much higher in ponds across the site than in flowing watercourses.

5.8 Summary

The biological and water quality condition of the sites surveyed within the Tre'r Gof catchment indicate a typical lowland coastal stream and wetland environment, receiving variable seasonal discharge in close connectivity with the rural land use.

Flowing through a rural catchment, used primarily for livestock grazing and low intensity agriculture, the aquatic habitats are influenced by low levels of nutrient enrichment via diffuse pollution, as demonstrated in diatom and macrophyte community analysis. Although no fish were recorded in the catchment, incidental observations were made of European eel.

Pond habitats are considered of low value in the Tre'r Gof catchment with pond quality typically classed as Moderate to Low. The survey at Power Station Pond identified the minute moss beetle and has therefore met the criteria for a Priority Pond with Very High conservation value. A number of Nationally Scarce macroinvertebrates were also identified in the watercourses and ponds across the catchment.

Aquatic habitats and species identified within the Tre'r Gof catchment are of low quality and reflect existing and historical rural land management practices in the area. Typically, species found within the catchment are common and widespread. Species include the nationally important European eel and near threatened minute moss beetle which was identified in Power Station Pond.

6 Baseline Conditions - Cemaes Catchment

6.1 Habitat Characterisation

The Cemaes watercourse exhibited the most managed and historically altered planform and cross-sections. The main sites on this watercourse showed evidence of realignment around either field boundaries or urban development, with evidence of over deepening in some reaches. Improved flow diversity and substrate was observed towards the lower sections of the catchment, despite evidence of historical channel realignment. The watercourse receives runoff from improved pasture and suburban settlements in Cemaes Bay. Refer to Appendix A for habitat characterisation descriptions.

6.2 Water Quality

The following section summarises water quality data collected between 2012 and 2014 within the Cemaes catchment. Table 6-1 presents data for selected physico-chemical, biochemical and nutrient parameters for the Cemaes catchment. For full results, refer to Appendix B (note this section refers to results from the Cemaes catchment only).

Physico-chemical and biochemical results can be summarised as follows:

- Water temperature ranged between 4.65˚C (Tre'r-gof-isaf, winter 2013) to 16.95˚C (Gwyddelyn Bach, summer 2013). All of the water temperatures recorded were within the expected range of values for the waterbody types sampled.
- Conductivity readings ranged between 0.228mS cm^{-3} (Fowl Fawr, winter 2014) and 0.591mS cm^{-3} (Gwyddelyn Bach, autumn 2013) and were within the expected range of values for the waterbody type sampled.
- Dissolved oxygen (percent saturation) varied significantly across sites and across sampling years. Values ranged between 53.1% (Gwyddelyn Bach, summer 2013) and 106.5% (Tre'r-gof-isaf, spring 2014).
- pH vales ranged from 6.27 to 8.59 and were within the expected range of values for the habitat types sampled.
- Suspended sediment concentrations varied between sample sites and sample occasions. The highest suspended solid concentration was recorded in autumn 2014 at Fowl Fawr (102mg L^{-1}).
- Biological oxygen demand was generally low, with most sites recording values below the MRV. The highest value was recorded at the Fowl Fawr site in autumn 2014 (4.12mg L^{-1}).

Nutrient results can be summarised as follows:

- Orthophosphate concentrations were generally low across the Cemaes catchment. Concentrations ranged between 0.032mg L^{-1} and 0.17mg L^{-1}.
- Ammoniacal nitrogen concentrations were low ranging between MRV (<0.03mg L^{-1}) and 0.163mg L^{-1}.

Table 6-1: Maximum and minimum physico-chemical, biochemical and nutrient results for the Cemaes catchment over the 2012-2014 sampling period.

Parameter	Range	Fowl Fawr	Gwyddelyn Bach	Tre'r-gof-isaf
Temperature ˚C	Max	11.90	16.95	16.48

Parameter	Range	Fowl Fawr	Gwyddelyn Bach	Tre'r-gof-isaf
	Min	8.64	5.03	4.65
Conductivity mS cm^{-3}	Max	0.271	0.591	0.516
	Min	0.228	0.292	0.305
Dissolved oxygen %	Max	89.3	84.4	106.5
	Min	58.6	53.1	78.5
pH	Max	8.00	8.04	8.59
	Min	6.27	6.82	7.07
Suspended solids mg L^{-1}	Max	102.00	28.10	106.00
	Min	5.95	5.98	4.47
Biological oxygen demand mg L^{-1}	Max	3.22	1.51	4.12
	Min	<1.00	<1.00	<1.00
Orthophosphate (reactive as P) mg L^{-1}	Max	0.100	0.17	0.134
	Min	0.032	0.059	0.049
Ammoniacal nitrogen as N mg L^{-1}	Max	0.052	0.146	0.163
	Min	0.03	0.057	<0.03

Metals can be summarised as follows:

- Arsenic, cadmium, nickel, lead, chromium and mercury concentrations were all low or below the MRV across all sites.
- Copper concentrations were generally below 5.13µg L^{-1}, with the highest levels recorded at the Gwyddelyn Bach site in autumn 2013 (6.60µg L^{-1}).
- Zinc concentrations were below the MRV (5µg L^{-1}), with the exception of autumn 2013 where levels ranged between 5.27µg L^{-1} and 7.65µg L^{-1}.
- Iron ranged between 73µg L^{-1} and 483µg L^{-1}, and varied between sites and sampling years.
- Manganese ranged between 52µg L^{-1} and 986µg L^{-1}, and varied between sites and sampling years. The highest reading was recorded at Tre'r-gof-isaf in spring 2014.

Selected other compounds can be summarised as follows:

- Toluene and trichloroethylene levels were low across all sites with levels below the MRV (0.1µg L^{-1}).
- DEHP levels were generally below the MRV (0.2µg L^{-1}) although in summer 2013 the Gwyddelyn Bach and Tre'r-gof-isaf sites recorded levels of 0.38µg L^{-1} and 0.34µg L^{-1} respectively.
- Hydrocarbon Screens (C5 - C44) levels were low across all sites with levels below the MRV (0.2µg L^{-1}).
- Chloride levels were low across the site.

Water quality conditions within the Cemaes catchment are typical of waterbody types sampled.

6.3 Diatoms

Table 6-2 lists the diatom EQR (observed/expected diatom community) output for the Cemaes catchment and is colour coded to indicate WFD status.

Table 6-2: Diatom EQRs and ecological status 2013–2014 (blue=high, green=good, yellow=moderate).

Site	2013	2014
Tre'r-gof-isaf	0.87	0.65
Gwyddelyn Bach	0.74	0.68

Site	2013	2014
Foel Fawr	0.54	0.61

As a key indicator of elevated nutrients, the diatoms indices indicate that environmental stressors (including nutrients) are having a small impact upon the observed community. The indices indicate that the phytoplankton communities are similar to those predicted for these watercourse typologies, based upon physical habitat attributes. Diatoms at both the Tre'r-gof-isaf and Gwyddelyn Bach sites demonstrate only a minor deviation from reference conditions. The variability in the diatom community at Foel Fawr indicates a degree of environmental stress. Low flows through the catchment may be affecting the diatom community, as will the heavy channel shading present through most of the catchment.

The diatom taxa reported from the 2013 and 2014 sampling of the Cemaes catchment are generally common taxa, with low to medium nutrient tolerance. As a result, the value of the diatom communities on the Cemaes catchment are considered low, with the species recorded forming a small resource when considering the wider Wylfa Newydd Development Area.

6.4 Macroinvertebrates

Tre'r-gof-isaf and Gwyddelyn Bach were surveyed in 2013 for the first time. During 2014, samples were not collected from the Gwyddelyn Bach site as water levels were too low to obtain a representative sample.

6.4.1 Exhaustive Surveys 2011 to 2013

The exhaustive number of species recorded at each watercourse is shown in Table 6-3. The output of the exhaustive surveys is not directly comparable between sites as the number of visits differed due to seasonal variation, weather and access constraints. Both sites had multiple sampling locations from which data were pooled into one exhaustive number of species. Results provide an indication of the diversity of species recorded for each representative year.

Table 6-3: Exhaustive number of species per year at two sites within the Cemaes catchment in varying seasons, 2011-2013, adapted from Jacobs' (2013) *Consultancy Report: Wylfa Freshwater Baseline Surveys 2011-2013*.

Site	Exhaustive number of species		
	2011	2012	2013
Gwyddelyn Bach	-	-	21
Tre'r-gof-isaf	-	-	6

Six species were recorded at Tre'r-gof-isaf and 21 species were recorded at Gwyddelyn Bach. The majority of macroinvertebrates identified during these surveys were assigned to families of beetles, molluscs, crustaceans and true bugs, and indicate moderate pollution tolerance (see Rachel Hacking Ecology, 2011, 2012 and 2013 for species lists).

6.4.2 Macroinvertebrate Species and Conservation Value

In 2014, no species of conservation interest were recorded at the Foel Fawr site resulting in a Low conservation status being assigned. Two species of conservation interest were reported from the lower catchment: a Nationally Scarce whirligig beetle (*Gyrinus urinator*) and a Local caddisfly larvae (*Tinodes assimilis*). The presence of

these two species elevates the conversation value of the Tre'r-gof-Isaf site to Fairly High (Chadd and Extence, 2004). In 2013, four species of local importance were reported from the Gwyddelyn Bach site (Table 6-4).

Table 6-4: Years where species of conservation importance (under CCI) were recorded at two sites within the Cemaes catchment, collected in 2011-2013 by using exhaustive method; 2014 data collected using standard kick-sample methodology is also presented.

Species	Conservation importance	Tre'r-gof-Isaf	Gwyddelyn Bach
Hygrotus impressopunctatus	Local		2013
Erpobdella testacea	Local		2013
Anisus leucostoma	Local		2013
Aplexa hypnorum	Local		2013
Gyrinus urinator	Nationally Scarce*	2014	
Tinodes assimilis	Local	2014	
Total number of CCI ≥Local species found across four years		**2**	**4**

*denotes beetle species which are designated a lower conservation classification in Foster (2010).

CCI scores calculated from 2014 data ranged from Low to Fairly High (Table 6-5), with the lowest scoring community at Foel Fawr (3.4) and the highest at Tre'r-gof-Isaf (10.7).

Table 6-5: Macroinvertebrate indices for 2014 Cemaes catchment sites.

Site	CCI score	CCI value	Species of conservation importance (Local or above)
Foel Fawr	3.4	Low	None
Tre'r-gof-isaf	10.7	Fairly High	*Gyrinus urinator* (beetle, Nationally Scarce) *Tinodes assimilis* (caddisfly, Local)

6.4.3 Macroinvertebrate Indices

In both 2013 and 2014, the macroinvertebrates recorded across the Cemaes catchment consisted of widespread and common species, all of which are tolerant to sedimentation, sluggish flows and organic pollution (Table 6-6).

Table 6-6: Macroinvertebrate indices for Cemaes catchment sites sampled in 2014.

Site	BMWP	NTAXA	ASPT	PSI (F)	PSI (F) interp.	PSI (F) EQR	LIFE (sp)	LIFE (F)	LIFE (F) EQR
Foel Fawr	61	14	4.4	50.0	Moderately Sedimented	-	7.1	5.8	-
Tre'r-gof-isaf	111	23	4.8	59.5	Moderately Sedimented	0.92	7.8	6.8	0.9

In 2014, only the Tre'r-gof-isaf site was considered suitable for assessment using current WFD classification tools (SNIFFER, 2008). The upper catchment was not

deemed suitable for assessment due to non-compliant physical habitat parameters, making any assessment of the site prone to significant error. The macroinvertebrate community at the Tre'r-gof-isaf site was reported as failing to meet predicted reference conditions, indicating potential environmental stress on the faunal community (Table 6-7). Interrogation of the metrics indicate that water quality is not considered a limiting factor at this site; however, the diversity or richness of the community, often used as an indicator of habitat, is not matching the predicted metrics.

Table 6-7: RICT classifications for seven sites at Tre'r-gof-isaf. The highlighted cell indicates the overall EQR classification for the site.

Site	Index	EQR	Class	Probability of Class (%)
Tre'r-gof-isaf	ASPT	0.81	Moderate	73.15
	NTAXA	0.94	High	70.19
	MINTA	-	**Moderate**	73.15

Macroinvertebrates within the Cemaes catchment are considered of low value, with the macroinvertebrates contributing a minor resource to macroinvertebrates across the wider Wylfa Newydd Development Area.

6.5 Macrophytes

All three sites on the Cemaes catchment were assessed for macrophytes in 2013, with a repeat survey carried out at the Foel Fawr site in 2014 (Table 6-8). Full surveys were possible at both Foel Fawr and Gwyddelyn Bach, whilst the heavy shading at Tre'r-gof-isaf only allowed spot sampling to be undertaken. Previously, macrophyte surveys on the Cemaes catchment demonstrated poor diversity, largely attributed to the historic modification of the channel, heavy riparian shading and low flows.

In 2014, no species of conservation value were reported at the Foel Fawr site and, as in 2013, the macrophyte community exhibited limited diversity and a dominance of common species. A single invasive (Giant rhubarb, *Gunnera tinctoria*) species was recorded at Tre'r-gof-isaf in 2013.

Table 6-8: Macrophyte indices for Foel Fawr within the Cemaes catchment in 2014.

Site	Observed RMNI	Observed NTAXA (scorers)	Total NTAXA (inc. non-scorers)	Observed NFG	Observed ALG	EQR	Status
Foel Fawr	7.69	3	8	2	0	0.407	**Moderate**

Based upon physical habitat and physico-chemical conditions, the observed macrophyte community at Foel Fawr does not meet the community composition expected. The failure of the Foel Fawr site to match the expected conditions indicates there are environmental stresses affecting macrophyte condition.

The value of macrophyte communities within the Cemaes catchment is considered low with the species present typical of lowland coastal streams. The Cemaes catchment is anticipated to provide a minor resource to macrophytes across the wider Wylfa Newydd Development Area.

6.6 Fish

Fish surveys have been undertaken at two sites on the Cemaes catchment between 2011 and 2014 (Appendix E). Spot sampling was undertaken at Gwyddelyn Bach, in the middle of the catchment, and at Tre'r-gof-isaf above the tidal limit at Cemaes Bay.

Low numbers of eel and stickleback were recorded at Gwyddelyn Bach in 2013, with no fish reported from the Tre'r-gof-isaf site. The low abundance of fish from the Cemaes catchment is likely to be a result of the low water levels experienced throughout the catchment during the survey periods. Visits to Foel Fawr and Gwyddelyn Bach indicated very low water levels unlikely to sustain fish populations; although, under high flows it may provide a resource for migratory species, depending on connectivity through the lower catchment.

Macrophyte growth at Gwyddelyn Bach was dense, with very shallow water depths observed on each visit. Soft sediments provide sub-optimal habitats for fish, although sticklebacks may persist in deeper pooled sections during low-flow periods. At the Tre-gof-isaf site, water depths generally remained stable throughout the year, supporting largely suboptimal habitat for fish with homogenous flow and substrate types.

A single European eel was observed at the Tre-gof-isaf site in 2013. This indicates that migratory species are able to enter the lower catchment and utilise available habitats. Above Gwyddelyn Bach, water depth and dense macrophyte growth is likely to restrict access to the higher parts of the catchment by migratory species.

The value of fish receptors on the Cemaes catchment is considered low. The presence of eel is important; however, there is limited habitat for this species within the upper catchment due to channel modification and low flows.

6.7 Pond Quality Assessment

No ponds were identified within the Cemaes catchment, either online or within the floodplain. As a result, pond quality has not been given an indicative value within the Cemaes catchment.

6.8 Summary

Sites surveyed within the Cemaes catchment indicate biological and water quality scores typical of a lowland coastal stream, receiving variable seasonal discharge affected by riparian land management and use.

Land management appears to be having the greatest influence on the Cemaes catchment. Flowing through a predominantly rural upper catchment, and a semi-urban lower catchment, the watercourses are influenced by low levels of nutrient enrichment via diffuse pollution, low flows and variable water quality.

Water levels within the catchment are influenced by prevailing climatic conditions, with the channel only remaining flowing as a functional aquatic feature through its lower reaches. The mid to upper catchment demonstrates localised reductions in flow during drier periods, which may affect the quality and distribution of aquatic habitats. Despite seasonal variation in flow, the Cemaes catchment supports a functioning ecological community, including European eel. Although ubiquitous to similar aquatic habitats, the presence of the European eel indicates connectivity of

the Cemaes catchment with Cemaes Bay. The degree of connectivity within the catchment is likely to rely on seasonal flow variation.

Aquatic habitats and species identified within the Cemaes catchment are of low quality and reflect existing and historical rural land management practices in the area. Species found within the catchment are common and widespread, and include low numbers of the nationally important European eel.

7 Baseline Conditions – Other minor watercourses

7.1 Habitat Characterisation

7.1.1 Porth-y-pistyll

The stream at Porth-y-pistyll runs in a northerly direction along the western boundary of the Existing Power Station through boggy wet grassland. The stream first emerges to the surface from a culvert structure adjacent to the Existing Power Station gates, where a drain cover suggests a modified subterranean watercourse. The channel is wetted for approximately 200m south of the shoreline in autumn, drying in the upper reaches over summer. A tributary 75m upstream from the shoreline and flowing from elevated gorse and tall shrub contributes a significant proportion of total summer flow.

With the exception of the lower 75m of the watercourse there is no defined channel, with an increase in wetland species (emergent rush and reed) marking the extent of the channel. The channel appears unmodified, following an undefined channel form. Wetland species dominate the left hand bank margins.

The lower section of the watercourse deepens, but heavy vegetation (95% cover) results in flow types being limited to slack and very low energy, depositional glides. The channel is choked year round by terrestrial grasses and a mix of wetland and semi-aquatic plant species throughout its length. Wetted depth is less than 10cm and channel width variable, but rarely more than 50cm. The stream discharges over the shingle foreshore into Porth-y-pistyll bay.

The ditch at Tan yr Allt, (sites 2 and 3) runs into the Porth-y-pistyll watercourse. Sites 2 and 3 are located approximately 100m apart and consist of a short drainage channel which is fed by a ditch and pond upstream of an unnamed access road. It is an ephemeral waterbody which changes from a shaded, shallow field boundary channel to an undefined watercourse. It apparently flows over and through the ground before reforming as a channel near its confluence with Porth-y-pistyll.

7.1.2 Penrhyn

The Penrhyn site consists of a wetland area into which groundwater emerges from a concreted spring on the Penrhyn coastal headland. A small pool has formed and is surrounded by wetland vegetation; water then flows down towards the scree and rocks, where it joins the beach. The flush is well vegetated with abundant brooklime (*Veronica beccabunga*), marsh arrow-grass (*Triglochin palustris*), cuckooflower (*Cardamine palustris*) and watercress (*Nasturtium officinale*).

The water depth at the time of survey was approximately 10cm. No directional flow was perceived and no defined channel exists within the site area.

7.2 Water Quality

Table 7-1 presents data for selected physico-chemical, biochemical and nutrient parameters for the Penrhyn, Tan-yr-allt ditch and Porth-y-pistyll sites. For full results, refer to Appendix B (note this section refers to results from Penrhyn, Tan-yr-allt ditch and Porth-y-pistyll sites only).

Physico-chemical and biochemical results can be summarised as follows:

- Water temperature ranged between 7.75˚C (Porth-y-pistyll, winter 2013) to 14.79˚C (Porth-y-pistyll, summer 2013). All of the water temperatures recorded were within the expected range of values for the waterbody types sampled.
- Conductivity readings were within the expected range of values for the waterbody type, ranging between 0.231mS cm^{-3} and 0.603mS cm^{-3}.
- Dissolved oxygen (percent saturation) levels varied significantly across sites. Lower concentrations were recorded at Penrhyn (40% - 98.4%) compared to Tan-yr-allt ditch (75% - 92.5%) and Porth-y-pistyll (71.8% - 117.3%).
- pH ranged from 6 to 7.57, with all readings within the expected range of values for the waterbody types sampled.
- Suspended sediment concentrations varied between sample sites and sample occasions, with the highest levels recorded in autumn 2013 at Penrhyn (65.7mg L^{-1}).
- Biological oxygen demand levels were generally low across the sites.

Nutrient results can be summarised as follows:

- Orthophosphate concentrations were generally low across the sites, ranging between MRV (<0.0100mg L^{-1}) and 0.022mg L^{-1}.
- Ammoniacal nitrogen concentrations were low ranging between MRV (<0.03mg L^{-1}) and 0.062mg L^{-1}.

Table 7-1: Maximum and minimum physico-chemical, biochemical and nutrient results for the Penrhyn, Tan-yr-allt ditch and Porth-y-pistyll sites over the 2012-2014 sampling period.

Parameter	Range	Penrhyn	Tan-yr-allt Ditch (Site 2)	Tan-yr-allt Ditch (Site 3)	Porth-y-pistyll
Temperature ˚C	Max	11.80	14.20	11.70	14.79
	Min	10.10	12.20	11.70	7.75
Conductivity mS cm^{-3}	Max	0.578	0.388	0.27	0.603
	Min	0.442	0.333	0.27	0.231
Dissolved oxygen %	Max	98.4	92.5	75.0	117.3
	Min	40.0	83.3	75.0	71.8
pH	Max	7.57	7.25	6.53	7.57
	Min	6.0	6.95	6.53	6.63
Suspended solids mg L^{-1}	Max	65.7	55.8	16.2	32.6
	Min	3.47	11.0	16.2	3.32
Biological oxygen demand mg L^{-1}	Max	<2.92	2.92	2.26	2.74
	Min	<1.00	1.35	2.26	<1.00
Orthophosphate (reactive as P) mg L^{-1}	Max	<0.020	0.030	0.020	0.022
	Min	<0.010	0.020	0.020	<0.010
Ammoniacal nitrogen as N (total ammonia as Nitrogen) mg L^{-1}	Max	0.030	0.030	<0.030	0.062
	Min	<0.030	<0.030	<0.030	<0.030

Metals can be summarised as follows:

- Arsenic, cadmium, nickel, lead and mercury concentrations were low or below the MRV across all sites.
- Chromium levels were below the MRV, with the exception of Tan-yr-allt ditch (Site 2), which recorded a level of 1.24µg L^{-1} in summer 2014.
- Copper at Penrhyn was below the laboratory MRV on all sample occasions.

Copper at Porth-y-pistyll varied between 1.69µg L^{-1} and 4.52µg L^{-1}. Tan-yr-allt ditch Sites 1 and 2 ranged between 3.42µg L^{-1} and 5.91µg L^{-1}.

- Zinc concentrations were generally below the MRV (5µg L^{-1}). A level of 11.1µg L^{-1} was recorded at Porth-y-pistyll in summer 2013 and 10.1µg L^{-1} at Tan-yr-allt ditch (Site 2) in summer 2014.
- Iron concentrations were generally below the MRV (<30 µg L^{-1}). An elevated measurement was recorded at Tan-yr-allt ditch (Site 2) in summer 2014 (2,130µg L^{-1}).
- Manganese concentrations at Penrhyn were below the MRV. Levels ranged between 17µg L^{-1} and 79µg L^{-1} at Porth-y-pistyll, and a level of 293µg L^{-1} was recorded at Tan-yr-allt (Site 2) in summer 2014.

Selected other compounds can be summarised as follows:

- Toluene levels were low across all sites with levels generally below the MRV (0.1µg L^{-1}).
- Trichloroethylene levels were below the MRV (0.1µg L^{-1}) at all sites except Porth-y-pistyll. Levels at Porth-y-pistyll ranged between <0.1µg L^{-1} and 3.33µg L^{-1}.
- DEHP levels were generally below the MRV. On occasion, DEHP reached a detectable level at Porth-y-pistyll, Tan-yr-allt ditch site 2 and Penrhyn. The highest level recorded was 1.71µg L^{-1} at Porth-y-pistyll in summer 2012.
- Hydrocarbon Screens (C5 - C44) levels were low across all sites with levels below or close to the MRV (0.2µg L^{-1}).
- Chloride levels were low across the site.

Water quality conditions at the Penrhyn, Tan-yr-allt ditch (Site 1 and 2) and Porth-y-pistyll sites were typical of a catchment dominated by rural land use.

7.3 Diatoms

Diatom surveys were undertaken between 2011 and 2014 at Porth-y-pistyll and between 2013 and 2014 at Penrhyn. No diatom surveys have been completed at Tan-yr-allt ditch. Table 7-2 details the diatom EQR (observed/expected diatom community) in each of the sampling years and is colour coded to indicate WFD classification. 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.

Table 7-2: Diatom EQRs and ecological status 2011 – 2014 for the Penrhyn and Porth-y-pistyll (blue=high, green=good, yellow=moderate, orange=poor).

Site	2011	2012	2013	2014
Porth-y-pistyll	0.95	0.95	0.92	0.93
Penrhyn			1.00	1.00

As a key indicator of elevated nutrients, the diatoms indices indicate high quality diatom communities. The high quality diatom communities are representative of ‘reference’ conditions and therefore indicate little evidence of environmental stress. The indices indicate that the phytoplankton communities are similar to those predicted for these watercourse typologies, based upon physical habitat attributes.

7.4 Macroinvertebrates

Macroinvertebrate samples have been collected between 2011 and 2014 at the other minor watercourses. Between 2011 and 2013, two sites were sampled using the exhaustive survey methodology. In 2014, three sites were sampled using standard kick-sample methodology.

7.4.1 Exhaustive Surveys 2011 to 2013

The exhaustive number of species is not directly comparable between sites as the number of visits differed due to seasonal variation, weather and access constraints. The results provide an indication of the diversity of the species recorded each year (Table 7-3).

Table 7-3: Exhaustive number of species per year at Penrhyn and Porth-pistyll in varying years and seasons, 2011-2013, adapted from Jacobs' (2013) *Consultancy Report: Wylfa Freshwater Baseline Surveys 2011-2013*.

Site	Exhaustive number of species		
	2011	2012	2013
Penrhyn	-	6	9
Porth-y-pistyll	21	10	13

The lowest diversity was recorded at Penrhyn in 2012 (six species), and the highest at Porth-y-pistyll in 2011 (21 species). The majority of the macroinvertebrate species identified during the surveys belonged to families of beetles, molluscs, crustaceans and true bugs, with moderate pollution tolerance (see Rachel Hacking Ecology, 2011, 2012 and 2013 for species lists).

7.4.2 Macroinvertebrate Species and Conservation Value

There were two beetles and a water boatman of conservation importance recorded at Porth-y-pistyll using the exhaustive survey method (see Table 7-4). No species of conservation importance were identified during the 2014 survey. CCI conservation scores were not calculated for the exhaustive number of species data, due to the exhaustive survey method not providing a standardised dataset (as opposed to BMWP or PSYM).

Table 7-4: Years where species of conservation importance (under CCI) were recorded at Porth-y-pistyll, collected in 2011-2013 by using exhaustive method; 2014 data collected using standard kick-sample methodology for Tan-yr-allt ditch (Site 3) is also presented.

Species	Conservation Importance (Local or above)	Porth-y-pistyll	Tan-yr-allt ditch (Site 3)
Coelostoma orbiculare	Regionally Notable*	2011, 2012	
Ilybius quadriguttatus	Local	2011	
Sigara limitata	Local	2011	
Beraea pullata	Occasional		2014
Total number of CCI ≥Local species found across four years		**3**	**1**

*denotes beetle species which are designated a lower conservation classification in Foster (2010).

In general, the macroinvertebrate species recorded across the sites consisted of widespread and common crustaceans, true flies, leeches, beetles and molluscs, all of which are tolerant to sedimentation, sluggish flows and some pollutants (see Appendix C for species lists).

Both parts of the Tan-yr-allt ditch, despite being surveyed in different seasons, were very similar. Site 2 had similar taxa to that of the downstream stretch, sharing populations of silt-tolerant dipteran larvae, molluscs and crustaceans. Many of the snails and pea-mussels in the samples were encrusted with silt deposits.

CCI scores calculated from 2014 data ranged from Low to Moderate (Table 7-5), with the lowest scoring community at Tan-yr-allt ditch (Site 2) (4.7), and the highest at Porth-y-pistyll (8.1). The CCI classification for Tan-yr-allt ditch (Site 3) is Moderate due to presence of a caddisfly (*Beraea pullata*). The other species recorded across both of the sites were common or occur frequently. One species of Local conservation importance, the leech, *Erpobdella testacea,* was recorded in autumn at Porth-y-pistyll. This has resulted in a Fairly High CCI classification for autumn, and Moderate overall for the year.

Table 7-5: Macroinvertebrate indices for 2014 sites for the Penrhyn, Tan-yr-allt ditch and Porth-y-pistyll sites.

Site	CCI score	CCI value	Species of conservation importance (Local or above)
Penrhyn	6.4	Moderate	None
Porth-y-pistyll	8.1	Moderate	*Erpobdella testacea* (leech, Local)
Tan-yr-allt ditch (Site 2)	4.7	Low	None
Tan-yr-allt ditch (Site 3)	7.2	Moderate	*Beraea pullata* (caddisfly, Occasional)

7.4.3 Macroinvertebrate Indices

Tan-yr-allt ditch recorded low BMWP scores of 45 and 42 (Table 7-6). In contrast, Porth-y-pistyll recorded a score of 118. The number of taxa recorded was also variable, with 10 recorded in the ditch-like habitats of Tan-yr-allt compared to 24 at Porth-y-pistyll.

PSI (F) was interpreted as sedimented or moderate sedimented, indicating that a significant proportion of the taxa present in the watercourses are tolerant of sedimentation.

LIFE (F) scores were similar between Penrhyn and Porth-y-pistyll with scores of 5.7 and 6.7, respectively, indicating that the macroinvertebrate communities are characteristic of slow flowing or standing waters, reflecting the fen/wetland nature of these sites.

Table 7-6: Macroinvertebrate indices for the Penrhyn, Tan-yr-allt ditch and Porth-y-pistyll sites.

Site	BMWP	NTAXA	ASPT	PSI (F)	PSI (F) interp.	PSI (F) EQR	LIFE (sp)	LIFE (F)	LIFE (F) EQR

Penrhyn	84	17	4.9	35.7	Sedimented	-	6.2	5.7	-
Porth-y-pistyll*	118	24	4.9	42.1	Moderately Sedimented	0.82	6.7	6.1	0.86
Tan-yr-allt ditch (site 2)	45	10	4.5	26.9	Sedimented	N/A	N/A	N/A	N/A
Tan-yr-allt ditch (site 3)	42	10	4.2	25.0	Sedimented	N/A	N/A	N/A	N/A

* denotes spring, summer and autumn.

RICT classification was carried out on Porth-y-pistyll data owing to the good quality habitat which incorporates macrophyte-rich running and standing waters, with bog mire and clean flushes (Table 7-7). Species typical of cleaner waters such as stoneflies and some caddisflies were recorded, contributing to the achievement of Good status.

Table 7-7: RICT classifications for Porth-y-pistyll. The highlighted cell indicates the overall EQR classification for the site.

Site	Index	EQR	Class	Probability of Class (%)
Porth-y-pistyll	ASPT	0.90	Good	52.64
	NTAXA	0.98	High	85.18
	MINTA	-	**Good**	52.64

The value of the macroinvertebrate features varied between the other sites, with Port-y-pistyll recording Good quality communities compared to the Tan-yr-allt ditch site, which recorded macroinvertebrate features of low to moderate quality.

7.5 Macrophytes

Porth-y-pistyll and Tan y Allt ditch were suitable for macrophyte survey. Table 7-8 details the individual indices calculated.

Table 7-8: Macrophyte indices for Porth-y-pistyll and Tan y Allt ditch (RMNI, NTAXA, non-scoring taxa, NFG and ALG).

Site	Observed RMNI	Observed NTAXA (scorers)	Total NTAXA (inc. non-scores)	Observed NFG	Observed ALG
Porth-y-pistyll	7.51	5	13	4	0.05
Tan-yr-allt ditch	7.66	2	3	2	0

The RMNI gives an indication of nutrient enrichment with scores ranging from 1 (low) to 10 (high). The RMNI scores do not vary considerably between the sites, and indicate that there may be a moderate degree of nutrient enrichment.

The NTAXA gives an indication of diversity within the macrophyte community. The site with the highest NTAXA was Porth-y-pistyll (5), compared to the Tan-yr-allt ditch site (2). The NFG was particularly poor at all sites surveyed.

7.6 Fish

Spot check surveys were undertaken in 2013 at Porth-y-pistyll. The site was located immediately upstream of the shoreline where water was deep enough to allow fishing and macrophyte cover sufficiently reduced to allow efficient fishing. Further upstream, fishing was impossible due to macrophytes choking the stream and restricting. European eel were present within the watercourse with eight individuals found in summer 2013 and five individuals in autumn 2013. Eel are likely to have entered the stream over the shoreline at Porth-y-pistyll. Due to the small size of the watercourse, and since connectivity to the sea across the beach at Porth-y-pistyll is limited, other migratory fish species would not be expected.

7.7 Summary

Monitoring at the Penrhyn, Tan-yr-allt ditch and Porth-y-pistyll sites has been carried out intermittently between 2012 and 2014. The biological and water quality condition of sites surveyed indicate a typical lowland coastal stream and wetland environment.

The diatom condition at Penrhyn and Porth-y-pistyll show the presence of communities similar to reference condition, indicating little environmental stress. This is also reflected in the low nutrient levels observed during the water quality sampling.

Macroinvertebrate communities at Porth-y-pistyll represent Good quality under the RICT classification. Tan-yr-allt ditch and Penrhyn have CCI values of Low to Moderate. European eel has been identified at Porth-y-pistyll.

Aquatic habitats and species identified within the other minor watercourses are of low quality and reflect existing and historical rural land management practices in the area. Species found within the catchment are common and widespread, and include low numbers of the nationally important European eel.

8 Baseline Conditions – Other Ponds

8.1 Habitat Characterisation

Individual ponds and wetland areas that were not considered to be part of the predefined catchments were classed as other ponds. These included the National Trust Pools, Wylfa Head Pools, The Firs Pond and Bwlch Pond. Of the four ponds listed, the National Trust Pools and Wylfa Head Pools are brackish coastal ponds. All four of the ponds were considered to be temporary or ephemeral in nature, and were dropped from the survey programme at the end of 2012 due to their temporary nature and low species diversity. A description of the individual waterbodies is provided in Appendix A.

8.2 Macroinvertebrates

Macroinvertebrates have been assessed at the other pond sites in 2011 and 2012 using the exhaustive survey methodology. The total number of species recorded at each pond over the sampling period is shown in Table 8-1. The exhaustive survey methodology is not directly comparable between sites as the number of visits differed due to ponds drying out, access constraints or adverse weather. Data provides an indication of the diversity of species recorded each year.

Table 8-1: Exhaustive number of species per year at four ponds in varying seasons, 2011-2012, adapted from Jacobs' (2013) *Consultancy Report: Wylfa Freshwater Baseline Surveys 2011-2013*.

Site	Exhaustive number of species	
	2011	2012
Nantorman Pond	13	-
National Trust Pools	1	4
The Firs Pond	1	-
Wylfa Head Pools	6	2

Very low species diversity was observed at The Firs Pond and National Trust Pools. National Trust Pools and Wylfa Head Pools are both located in very close proximity to the shoreline. These four monitoring sites were dropped from the survey programme at the end of 2012 as sufficient data had been collected.

The majority of the macroinvertebrates species identified during these surveys belonged to pollution tolerant families of beetles, molluscs, crustaceans and true bugs (see Rachel Hacking Ecology, 2011 and 2012 for species lists).

8.3 Summary

Data collected indicates low biological value at all of the other pond sites. The ponds are typical of sites within a rural, agricultural land-use dominated catchment.

9 Summary

Many of the watercourses in the study area have undergone a varying degree of human intervention. Interventions include areas of channel straightening, over-deepening or realignments, as well as changes to the riparian habitat through agricultural activities such as provision of livestock access to the watercourse.

There are a high proportion of ephemeral watercourses found across the study area. These have the potential to support diverse macrophyte and macroinvertebrate communities, but due to insufficient water depth and/or their isolated nature, they are unlikely to support large populations of fish. Where watercourses remain wetted year round, a diverse mix of aquatic habitats can be observed across the study area, including wetlands, ditches, ponds and free flowing variable depth watercourses. These habitats also support a variety of fish, macroinvertebrate and macrophyte species.

The best quality freshwater habitats are generally located towards the western and central part of the study area, in and around the Cafnan watercourse, where water depths are greater. Porth Wylfa, downstream of Tre'r Gof SSSI, also provides good quality freshwater habitat with wetland characteristics.

The characterisation of the four main watercourses within the study area can be summarised as follows:

The Cemlyn Tributary watercourse is where the Neuadd, Penyrorsedd and Nanner sites are located. Evidence of poaching has been noted along the watercourse and some siltation of gravels is evident. Channel straightening has been implemented in sections to follow field/road boundaries; however, some areas with good gravel substrate and a diverse range of macrophytes were observed. The catchment is dominated by improved pasture resulting in agricultural runoff entering the watercourse.

Macrophytes at the downstream Neuadd site were of moderate quality, using current WFD tools; while further upstream at Penyrorsedd, they were of good quality. Diatoms were representative of good quality across the catchment. The condition of macroinvertebrate communities within the Cemlyn tributary achieved moderate quality. The only fish species found to be present within the Cemlyn watercourse were European eel. Water quality conditions were within the expected range of values for the waterbody type sampled.

The Afon Cafnan exhibited a mainly natural planform and stream cross-sections, with moderate sinuosity, good flow diversity and a dominant gravel-cobble substrate. The tributary stream exhibited some sectioning and over-deepening. However, some discrete areas of good flow diversity, gravel substrate and riparian vegetation provide good habitat potential. Some areas of channel modification through channelisation and realignment are present within the mid to upper catchment.

Macrophytes and diatoms were present within the Cafnan watercourse with some areas of dense growth. The results of the macrophyte and diatom assessments for the Cafnan watercourse are typical for a watercourse of this size flowing through pasture land. Ecological condition was observed to improve in the higher areas of the catchment. The condition of macroinvertebrate communities within the Cafnan watercourse was poor overall due to the absence of pollution intolerant species. The diversity of fish within the Cafnan watercourse was the highest of all surveyed

watercourses and included brown trout, European eel, three-spined stickleback and nine-spined stickleback. Water quality conditions were within the expected range of values for the waterbody type sampled.

The Tre'r Gof catchment was found to be influenced by low levels of nutrient enrichment via diffuse pollution, as demonstrated in the diatom and macrophyte community analysis. Although no fish were caught in the catchment, incidental observations were made of the presence of European eel. Pond habitat within the Tre'r Gof catchment was typically classed as Moderate to Low. The survey at Power Station Pond identified the minute moss beetle and thus met the criteria for Priority Pond status.

The condition of the macroinvertebrate communities within the Cemaes watercourse achieved Moderate ecological status in 2014. Diatoms at this site in 2013 were consistent with High status decreasing to Good status in 2014. The only fish species found to be present within the Cemaes watercourse was European eel. Water quality conditions were within the expected range of values for the waterbody type sampled.

For the other sites that were not included within the main catchment areas, Penrhyn and Porth-y-pistyll scored favourably for water quality and diatom communities, which were close to reference condition.

Macroinvertebrate communities at Porth-y-pistyll represent Good quality using the RICT classification methodology. CCI values of Low to Moderate were found at Tan-yr-allt ditch and Penrhyn sites. European eel was recorded at the Porth-y-pistyll site.

Aquatic habitats within the other minor watercourses can be considered of generally low value, as can the ecological flora and fauna they support.

Habitat quality at the other ponds not deemed part of a major catchment was generally Low. Very low species diversity was observed at The Firs Pond and National Trust Pools. The National Trust Pools and Wylfa Head Pools are both located in very close proximity to the shoreline and thus are not representative of typical freshwater environments. The majority of macroinvertebrates identified during these surveys belonged to pollution tolerant families of beetles, molluscs, crustaceans and true bugs.

10 Conclusions

The watercourses within the Wylfa Newydd Development Area footprint contain a range of aquatic habitats. The majority are typical of rural coastal streams, most of which demonstrate evidence of modification to some extent to serve as drainage to the predominantly rural landscape. Stream substrate varies spatially dependant on flow type, between sites and seasons, with a number of the sites being ephemeral in nature. Therefore, the quality of habitat across the whole study area is closely related to the amount and duration of water flow each watercourse receives. Permanently wetted watercourses may also be influenced by seasonal variation in flow type, which conversely affects both water quality (dilution or transmission of pollutants and nutrients from surrounding land) and aquatic habitats.

Of the four main catchments, the Cafnan catchment was shown to exhibit the highest quality habitat in terms of fish and macroinvertebrates. There were trout and European eel caught during the surveys and potential spawning habitat was identified along the main stem of the river. Habitat for trout and European eel within the Cafnan catchment is anticipated to form only a small component of the overall available resource on Anglesey. The tributary stream exhibited lower habitat quality, with the exception of the wetland areas at Cae Gwyn SSSI and Groes-fechan wetland where some species of conservation interest were found.

The Cemlyn catchment showed evidence of historical realignment, with some sedimentation stress and low levels of nutrient enrichment via diffuse pollution. Apart from European eel, no other species of conservation interest were found here.

The Tre'r Gof catchment had little available fish habitat – although eel were sighted incidentally. Moderate to low quality habitat was observed, as evident from macrophyte, diatom and macroinvertebrate surveys, although the moss beetle *Hydraena palustris* was found in 2014 and is a Near Threatened species.

Aquatic habitats in the Cemaes catchment were influenced by low levels of nutrient enrichment via diffuse pollution, low flows and variable water quality. Apart from the European eel, no other species of conservation interest were found during the surveys.

Habitat variation supports a range of species, which is evident from the fish, macrophyte, diatom and macroinvertebrate surveys. A number of key species of conservation interest have been recorded during baseline data collection. These include:

- European eel – Cafnan, Hafnan, Porth-y-pistyll, Tre'r-gof-isaf, Tre'r Gof SSSI, Felin Gafnan Confluence, Porth Wylfa.
- mud snail – Tregele Pond.
- minute moss beetle – Power Station Pond.

The majority of sites contained species of Local or greater conservation importance, including three Nationally Scarce species of aquatic beetle (Coleoptera) (*Enochrus coarctatus*, *Helochares punctatus* and *Rhantus frontalis*) and two Regionally Notable species: the aquatic beetle (Coleoptera) *Coelostoma orbiculare* and the true bug (Hemiptera) *Hesperocorixa moesta.* Caerdegog Isaf Pond and Power Station Pond

were particularly rich in beetles, each supporting seven species of conservation importance, out of a total of 13 recorded from the study area.

Water quality overall was moderate to good, with evidence of possible nutrient input linked to the use of agricultural land for livestock grazing. Occasional elevated metal concentrations were also detected. Diatom analysis revealed variability in environmental condition and species diversity throughout the study area between 2011 and 2014. There was evidence of localised nutrient enrichment, principally at some of the pond sites.

The 2011 to 2014 monitoring programme has developed a good baseline for the use in assessing any potential impacts that the development of the Project may have on the freshwater environment. The baseline dataset can be used to detect impacts from the construction and operational phases of the development and determine suitable mitigation should this be deemed necessary.

References

Beaumont, W.R.C., Taylor, A.A.L., Lee, M.J. and Welton, J.S. (2002). *Guidelines for Electric-fishing Best Practice*. Environment Agency R and D Technical Report W2-054/TR. Bristol, Environment Agency.

British Standards Institution. (2003). BS EN 14011:2003 *Water Quality Sampling of Fish with Electricity*. London, BSI.

British Standards Institution. (2012). BS EN ISO 10870:2012. Water quality. Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters. London, BSI.

Chadd, R. and Extence, C. (2004). The conservation of freshwater macro-invertebrate populations: a community based classification scheme. *Aquatic Conservation: Mar Beaumont ne and Freshwater Ecosystems*. 14: pp. 597–624.

Department of Energy and Climate Change. 2011. National Policy Statement for Nuclear Power Generation (EN-6). Presented to Parliament by the Secretary of State for Energy and Climate Change pursuant to section 5(9) of the Planning Act 2008. ISBN: 9780108510823.

Drake, C.M., Lott, D.A., Alexander, K.N.A. and Webb, J. (2007). *Surveying terrestrial and freshwater invertebrates for conservation evaluation*. Natural England Research Report NERR005. Natural England, Peterborough.

Environment Agency. (2001). *Electric-fishing Code of Practice*. EAS/6100/4/02. Environment Agency. Bristol.

Environment Agency. (2007a). *Technical reference material: sampling diatoms from rivers and lakes. Operational instruction*.

Environment Agency (2007b) *Technical reference material: WFD electric-fishing in rivers. Operational instruction*. Document no. 144_03

Environment Agency. (2008). *Freshwater macro-invertebrate analysis of riverine samples*. Document no. 024_08.

Environment Agency. (2010). *Chemical and microbiological sampling of water*. Operational instruction 19_09. [Online]. [Accessed 19 December 2014]. Available from: http://www.environment-agency.gov.uk/static/documents/Business/19_09(1).pdf.

Environment Agency. (2012). *Freshwater macro-invertebrate sampling in rivers. Operational instruction.* Document no. 018_08.

Extence, C., Balbi, D. and Chadd, R. (1999). River flow indexing using British benthic macroinvertebrates: a framework for setting hydroecological objectives. *Regulated Rivers: Research & Management*. 15 (6). pp 545–574.

Extence, C.A. Chadd, R.P. England, J. Dunbar, M.J. Wood, P.J. Taylor, E.D. (2011). The assessment of fine sediment accumulation in rivers using macro-invertebrate community response. *River Research and Applications* 29, (1). pp. 17–55, January 2013.

Foster, G.N. (2010). A review of the scarce and threatened Coleoptera of Great Britain Part (3): Water beetles of Great Britain. *Species Status* 1. Joint Nature Conservation Committee, Peterborough.

Hawkes, H.A. (1997). Origin and development of the biological monitoring working party score system. *Water Resources* 23: pp. 964-968.

Institute of Ecology and Environmental Management (IEEM). (2006). *Guidelines for ecological impact assessment in the United Kingdom*. [Online]. [Accessed 19 December 2014]. Available from http://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/EcIA_Guidelines/TGSEcIA-EcIA_Guidelines-Terestrial_Freshwater_Coastal.pdf.

IUCN. (2015). *The IUCN Red List of Threatened Species*. Version 2015.1. [Online] [Accessed on 22 June 2015]. Available from: http://www.iucnredlist.org.

Jacobs. (2013). *Consultancy Report: Wylfa Freshwater Baseline Surveys (Year 1)*, unpublished report on behalf of Horizon Nuclear Power Wylfa Limited. Document reference: w202.01-s5-pac-rep-00011.

Jacobs. (2015a). *Consultancy Report: Great Crested Newt Survey Report 2014*, unpublished report on behalf of Horizon Nuclear Power Wylfa Limited. Document reference: wn03.01.01-s5-pac-rep-00007.

Jacobs. (2015b). *Consultancy Report: Bat Monitoring 2013*, unpublished report on behalf of Horizon Nuclear Power Wylfa Limited. Document reference: wn03.01.01-s5-pac-rep-00011.

Jacobs. (2015c). *Consultancy Report: Reptile Technical Summary Report*, unpublished report on behalf of Horizon Nuclear Power Wylfa Limited. Document reference: WN034-JAC-PAC-REP-00007.

Jacobs. (2015d). *Consultancy Report: Breeding Birds Surveys 2014*, unpublished report on behalf of Horizon Nuclear Power Wylfa Limited. Document reference: WN03.01.01-S5-PAC-REP-00012.

Jacobs. (2015e). *Consultancy Report: Otter and Water Vole Surveys 2014*, unpublished report on behalf of Horizon Nuclear Power Wylfa Limited. Document reference: wn03.01.01-s5-pac-rep-00008.

Jacobs. (2015f). *Consultancy Report: Wylfa Newydd Fluvial Geomorphology Baseline Report - 2014*, unpublished report on behalf of Horizon Nuclear Power Wylfa Limited. Document reference: WN03.03.01-S5-PAC-REP-00021.

Jacobs. (2016). *Consultancy Report: Wylfa Newydd Development Area Hydrological Baseline Report,* unpublished report on behalf of Horizon Nuclear Power Wylfa Limited. Document reference: in draft.

JNCC and Defra (on behalf of the Four Countries' Biodiversity Group). 2012. *UK Post-2010 Biodiversity Framework*. July 2012. Available from: http://jncc.defra.gov.uk/page-6189.

Kelly, M.G., Yallop, M.L., Hirst, H. and Bennion, H. (2005). Sample collection. Version 2.1. Unpublished DARES/DALES protocol. [Online]. [Accessed: 20 October 2014]. Available from: http://craticula.ncl.ac.uk/dares/methods.htm.

Natural Environment and Rural Communities (NERC) Act (2006) Available from: http://www.legislation.gov.uk/ukpga/2006/16/contents.

Planning Act 2008. Available from: http://www.legislation.gov.uk.

Pond Action. (2002). *A guide to monitoring the ecological quality of ponds and canals using PSYM.* Pond Conservation Trust, Oxford Brookes University, Oxford and the Environment Agency, West Midlands.

Rachel Hacking Ecology. (2011). *Wylfa Invertebrate Survey 2011 – Interim Report, Freshwater Invertebrates.* Issued by Ove Arup & Partners Limited, to Horizon Nuclear Power.

Rachel Hacking Ecology. (2012) *Wylfa Invertebrate Survey 2012 – Interim Report, Freshwater Invertebrates.* Issued by Ove Arup & Partners Limited, to Horizon Nuclear Power.

Rachel Hacking Ecology. (2013). *Wylfa Invertebrate Survey 2013 – Freshwater Invertebrates.* Issued by Ove Arup & Partners Limited, to Horizon Nuclear Power.

SNIFFER. (2008). *River Invertebrate Classification tool*. SNIFFER Project WFD72C. Scotland. United Kingdom.

Water Framework Directive – United Kingdom Technical Advisory Group (WFD-UKTAG). (2014a). *UKTAG Rivers Assessment Methods*. Macrophytes and Phytobenthos. Phytobenthos – Diatom Assessment for River and Lake Ecological Status (River DARLEQ2). WFD-UKTAG. Edinburgh. United Kingdom.

Water Framework Directive – United Kingdom Technical Advisory Group (WFD-UKTAG). (2014b). *UKTAG River Assessment Method Macrophytes and Phytobenthos: Macrophytes* (River LEAFPACS2). WFD-UKTAG. Stirling. United Kingdom.

Wildlife and Countryside Act 1981 Schedule 9. Available from: http://www.legislation.gov.uk/ukpga/1981/69/schedule/9.

Appendix A Physical Habitat Reach Descriptions

Site ref	A5025 Crossing (Cafnan watercourse)
Grid ref	SH 34405 91396
Access	No
Wetted	Yes

Reach Characteristics and Management Issues

Upstream of the A5025 the watercourse was damp, with no water observed or perceivable flow (top photo). Aquatic and semi-aquatic macrophytes dominate the channel form. The channel runs alongside improved pasture and bordered along the left bank by the field margin. It is expected that this channel will fill in wetter months and contribute to the flow observed downstream.

The watercourse is culverted under the A5025, the stream then flows north through woodland which heavily shades the channel. The dominant flow types were run and glide. The substrate is silt deposited over coarser substrate. Diverse substrate composition results in habitat heterogeneity despite the low energy flow recorded. The stream follows field boundaries (stone walls); other than the road culvert there is no evidence of recent management or modifications.

The downstream reach appeared suitable for fisheries, macrophyte and water quality assessment but no access has been granted and this survey site is now outside of the Wylfa Newydd Development Area and 500m buffer boundary.

Surveys:
Habitat Characterisation
Summer 2011 – undertaken from public access areas only.

Summer 2011 upstream of A5025

Summer 2011 downstream of A5025

Site ref	Cae Gwyn SSSI (Cafnan watercourse)
Grid ref	SH 34749 91786
Access	Yes (except autumn 2014)
Wetted	Seasonal

Reach Characteristics and Management Issues

Cae Gwyn is a large, botanically species-rich wetland area bordered by improved grassland and gorse scrub. The basin mires held water throughout most of the survey seasons.

The northern basin mire comprises botanical species such as meadowsweet (*Filipendula ulmaria)*, common spike-rush (*Eleocharis palustris)*, cross-leaved heath (*Erica tetralix)*, common cottongrass (*Eriophorum angustifolium)*, water mint, broad-leaved pondweed (*Potamogeton natans)*, marsh St. John's-wort (*Hypericum elodes)* and creeping willow (*Salix repens).* The southern basin mire comprises all of the above species plus others including cranberry (*Vaccinium oxycoccos)* and marsh fern (*Thelypteris palustris).*

A small area of marsh was also surveyed at the northern limit of Cae Gwyn. This had a similar floristic composition to the northern basin. This area was dry by late summer.

Surveys:
Habitat Characterisation
Winter 2014
Macroinvertebrates
April 2013, June/July 2013, August 2013, Spring 2014
Diatom
Feb 2014, May 2014
Water Quality
Feb 2014, May 2014
Macrophytes
July 2014


2013 Northern basin mire


2013 Southern basin mire

Site ref	Cae Gwyn SSSI to Caerdegog Isaf including Groes-fechan (Cafnan watercourse)
Grid ref	SH 34993 92084 to SH 34897 92525
Access	Yes (except autumn 2014)
Wetted	Yes

Reach Characteristics and Management Issues

The stream at the Groes-fechan site is narrow with steep, high (approximately 2m) channel banks. The stream marks a field boundary with sheep pasture on the right bank and gorse scrub on the left bank. The channel is heavily shaded in its uppermost reaches with a cobble-gravel substrate. The flow is mainly run-riffle and is typically very shallow (<20cm). Upstream, the stream passes through a short culvert.

Around 50m downstream, the channel broadens and the gradient decreases, with silt deposits and slower flow. In-stream macrophytes, predominantly fool's watercress, are present.

Mid-reach, the channel is open with little shading. Both banks are pasture with some arable land use. Flow is slow and the reach process is depositional. Substrate consists of silt and fine gravels. The mid-section has unfenced sections open to poaching. Macrophytes are more prevalent in this section, with fool's watercress and water forget-me-not (*Mysotis scorpiodes)* covering up to 60% of the water surface.

Further downstream, the channel continues to be slow-flowing and depositional, contained within dry stone walls in places. This reach is almost entirely shaded under dense gorse. A small weir (approximately 40cm) exists towards the lower end of the reach as the channel approaches a track near the Caerdegog Isaf site.

Throughout the entire reach, there is evidence of channel realignment around field boundaries and channelisation with dry stone walls. Over-deepening was also evident in places.

The channel passes under a small road bridge and into the Caerdegog Isaf site where the flow increases and the substrate consists of fine and coarse gravels under overhanging trees.

Surveys:
Fish
Spring 2013, August 2014
Diatom
Quarterly since Spring 2013
Water Quality
Quarterly since Spring 2013
Habitat Characterisation
Winter 2012/2013
Macroinvertebrates
May 2014, April 2013, June/July 2013, August 2013, May 2014
Macrophytes – July 2014


Spring 2013 upstream


Spring 2013 upstream, facing upstream


Spring 2013 downstream, facing downstream


Spring 2013 downstream end

Site ref	Caerdegog Isaf and Hafnan – Caerdegog Isaf (Cafnan watercourse)
Grid ref	SH 34897 92525 to SH 34005 92318
Access	Yes (except autumn 2014)
Wetted	Yes

Reach Characteristics and Management Issues

Caerdegog Isaf - The stream at the Caerdegog Isaf site is narrow (approximately 1m) and steep-sided, with high channel banks, a straight planform and evidence of realignment and re-sectioning. The substrate consists of coarse and fine gravels and the channel is heavily shaded by bramble and hawthorn for the first 100m of the reach. Flow type in the section is run/riffle with very shallow depths (approximately 5cm).

The channel turns west along a field boundary and becomes increasingly depositional, with a wider cross-section and a slower flow due to the reduced gradient. Channelisation (and possibly dredging) is evident here and the channel is contained in places by dry stone walls. Land use along both banks is cattle pasture allowing stock access to the watercourse in places. Macrophytes, predominantly fool's watercress, are present mid-stream.

Hafnan - Caerdegog Isaf - Further downstream, through the Hafnan - Caerdegog Isaf site, macrophyte growth becomes denser and more diverse with water-starwort, unbranched bur-reed *(Sparganium emersum),* water forget-me-not and marginal reeds all present. Poaching is evident in the unfenced sections further downstream. The channel retains its ditch-like nature with deep silt deposits down to the confluence.

At the confluence, the channel is completely obscured by vegetation.

Caerdegog Isaf surveys:
Fish
Spring 2013, autumn 2013, August 2014
Diatom
Quarterly since spring 2013
Water Quality
Quarterly since spring 2013
Habitat Characterisation
Winter 2012/2013
Macroinvertebrates
May 2012, June/July 2013, May 2014
Macrophytes – July 2014

Hafnan – Caerdegog Isaf surveys:
Diatom
Quarterly since spring 2013
Water Quality
Quarterly since spring 2013
Habitat Characterisation


Spring 2013 upstream


Spring 2013 mid–reach (looking downstream)


Autumn 2013 downstream of Hafnan - Caerdegog Isaf, looking downstream


Spring 2013 downstream towards confluence

Winter 2012/2013 **Macroinvertebrates** May 2014	

Site ref	**Caerdegog Isaf Pond**
Grid ref	SH 34698 92496
Access	Yes (until 2014)
Wetted	Yes

Reach Characteristics and Management Issues

This small pond is surrounded by scrub and grassland and is largely unshaded.

The pond has recently been created by the landowners but has established high macrophyte coverage.

Aquatic plant species include marsh pennywort (*Hydrocotyle vulgaris)*, water horsetail (*Equisetum fluviatile)*, lesser spearwort (*Ranunculus flammula)*, water-plantain (*Alisma plantago-aquatica)* and common duckweed (*Lemna minor).*

Surveys:
Habitat Characterisation
Spring 2012
Macroinvertebrates
April 2012, May 2012, July 2012, June/July 2013.

Spring 2012

Site ref	Cafnan (Cafnan watercourse)
Grid ref	SH 34155 93015 to SH 34252 93096
Access	Yes (until autumn 2014)
Wetted	Yes

Reach Characteristics and Management Issues

The watercourse flows north through the grounds of Cafnan Farmhouse. This includes an area of improved grassland on the right hand bank utilised as a caravan and camping area, with broadleaf woodland along the left bank.

The watercourse displays historic channel modification through this reach, especially along the right bank with the section adjacent to the farmyard exhibiting tipped material in the bank and a straightened planform. A small footbridge crosses the watercourse at the downstream end of the reach before the watercourse flows under the access road and north towards Felin Gafnan East and Porth-y-pistyll Bay.

Substrates within this reach are a mix of consolidated cobble and gravel with isolated areas of bedrock through the middle section. Sediment deposition was recorded throughout the reach, particularly at the upstream end where silt deposits are deep.

Macrophytes were absent from the middle section due to high levels of shading, trees in the riparian strip providing shade, exposed tree roots and leaf litter. Macrophytes were more abundant at the up and downstream ends of the reach.

Surveys:

Fish
Autumn 2011 & 2013, Spring 2012 & 2013, Summer 2012 & 2013, summer 2014

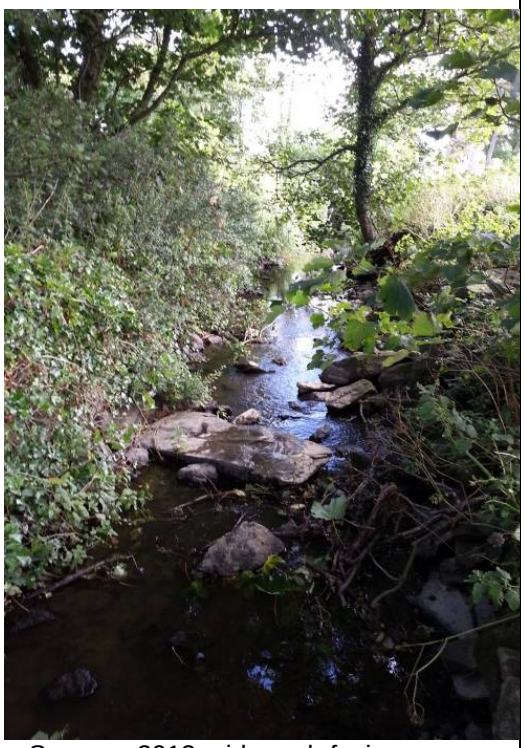
Macrophytes
Annually since summer 2012

Diatom
Summer 2011 and quarterly since spring 2012

Water Quality
Quarterly since winter 2011/2012

Habitat Characterisation
Summer 2011

Macroinvertebrates
Spring 2014



Summer 2013 mid-reach facing downstream

Summer 2013 upstream facing downstream

Site ref	Felin Gafnan Confluence (Cafnan watercourse)
Grid ref	SH 34491 93361
Access	Yes
Wetted	Yes

Reach Characteristics and Management Issues

The Felin Gafnan tributaries flow through private land and re-join each other before flowing into Porth-y-pistyll above the beach. Immediately above the beach, the watercourse flows through a private ornamental garden, with large, herbaceous riparian species shading the left bank and ferns dominating the steeper right bank. Large stands of non-native *Gunnera sp.* are present. Substrates are compacted bedrock and cobbles, whilst flow types are high energy run and cascade from the steep gradient discharge onto the foreshore.

The watercourse flows out of the tall herb and woodland area behind the beach and over the rock foreshore into the bay. Tidal intrusion up to the footbridge is evident with fucoid macroalgae *Enteromorpha sp.* observed from the bridge; however, physico-chemical analysis of the water indicates a dominant freshwater source. Despite this, some marine invertebrates have been recorded in the macroinvertebrate surveys such as brackish-water shrimps and marine isopods.

Surveys:
Diatom
Quarterly since summer 2011
Water Quality
Quarterly since winter 2011/2012
Macroinvertebrates
September 2011, May 2012, June/July 2013, spring and autumn 2014
Habitat Characterisation
Summer 2011

Summer 2011 downstream near beach, facing upstream

Autumn 2013 upstream, facing upstream

Autumn 2013 downstream, facing downstream

Site ref	Felin Gafnan East (Cafnan watercourse)
Grid ref	SH 34253 93109 to SH 34354 93194
Access	Yes
Wetted	Yes

Reach Characteristics and Management Issues

Immediately downstream of the Cemlyn road bridge, the channel is very shallow with run flow types over a gravel, cobble and silt bed. There is evidence of poaching along the right bank where cattle have access to the watercourse. The channel appears largely unmodified below the road crossing and follows a sinuous path north. Heavy shading is evident along the wooded and shrub dominated left bank whilst the right bank is open to pasture providing sufficient sunlight for macrophyte growth. The stream flows north into dense woodland where macrophyte cover reduces due to riparian shading.

The channel demonstrates good flow and substrate diversity and supports a varied macrophyte assemblage.

Surveys (none in 2014):
Macrophytes
Annually since summer 2012
Diatom
Quarterly since autumn 2011
Water Quality
Quarterly since winter 2011/2012
Macroinvertebrates
Included in Cafnan to Hafnan stretch
Habitat Characterisation
Summer 2011

Summer 2011 upstream at road bridge, facing downstream

Site ref	Felin Gafnan West (Cafnan watercourse)
Grid ref	SH 34234 93151
Access	Yes
Wetted	Barely

Reach Characteristics and Management Issues

This channel runs adjacent to the Felin Gafnan access road down to nature reserve. Upstream, the watercourse splits into two just south of the Cemlyn road. However, all of the flow appears to continue through Felin Gafnan East. The Felin Gafnan West watercourse is likely to have been a historic modification to allow milling in the lower catchment. There is evidence of a mill on this site since 1352, although the present mill house is thought to date back to the 1840s. The watercourse is dry throughout its length, although in the autumn 2013 survey, the channel was damp in isolated patches due to recent heavy rainfall.

The upstream end is shallower, shaded along the right bank with trees, the left bank open to a grass verge and access road. The stream bed is predominantly terrestrial grasses and herb (bottom photo).

The downstream end is over-deepened and straightened and dominated by a terrestrial grass sward (top photo).

No further access for habitat assessment was possible before the channel re-joined the Felin Gafnan East tributary.

Surveys (none in 2014):
Habitat Characterisation
Summer 2011

Summer 2011 downstream end facing upstream

Summer 2011 upstream end facing upstream

Summer 2013 upstream end facing upstream

Site ref	Foel Fawr (Cemaes watercourse)
Grid ref	SH 35459 91910 - SH 35748 92410
Access	Yes
Wetted	Yes

Reach Characteristics and Management Issues

The stream at the Foel Fawr site is narrow (approximately 1m) and steep-sided with high channel banks, a straight planform and evidence of realignment and re-sectioning.

Substrate consists of fine-medium gravels overlain by silt and the channel is heavily shaded by bramble and hawthorn from the right bank, and overhanging marginal vegetation, for the entire 100m of the reach. Flow type in the section is slow glide with low depths of approximately 10cm.

Land use along both banks is cattle pasture, but the watercourse is fenced which prevents stock accessing the channel. Macrophytes (dominated by fool's watercress, reed sweet-grass and great willow herb) are present mid-stream, but overall, macrophyte cover is limited due to heavy shading. In-channel habitats are limited due to the low macrophyte cover and low of substrate and flow heterogeneity.

Fencing is present along the left bank and managed hawthorn-hedge runs the length of the stream along the right hand bank. The stream flows through grazed pasture and continues north where it becomes heavily realigned as it passes to the east of Tregele village.

Surveys:
Macrophytes
Summer 2013 & 2014
Diatom
Since Autumn 2013
Water Quality
Since Autumn 2013
Habitat Characterisation
Summer 2013
Macroinvertebrates
Spring and autumn 2014

Summer 2013 upstream (looking downstream)

Summer 2013 mid-reach (looking upstream)

Summer 2013 downstream (looking upstream).

Site ref	Groes-fechan Tributary (Cafnan watercourse)
Grid ref	SH 34833 91641 – SH 34778 91634
Access	Yes
Wetted	Slight

Reach Characteristics and Management Issues

The field drain at Groes-fechan runs in a westerly direction, alongside the southern side of a field boundary. The drain arises via a culvert and the channel is approximately 50m long in total. At the downstream end, the field drain enters a culvert that takes it north into another field. Here it loses its defined channel and forms an area of wetland.

The drain is narrow with banks approximately 1m high at the upstream end and 0.5m high towards the mid-reach and downstream end. The bed consists of silt/clay with some medium to coarse gravel and cobbles. The water depth was extremely shallow at the time of survey, approximately 1cm deep. At the upstream end, a very small amount of flow could be seen, but the rest of the drain had no perceivable flow.

The channel has little shading from bankside trees. However, soft-rush covers approximately 80% of the channel.

Sheep pasture is present on both sides of the drain and sheep access is possible from the southern side, although no evidence of poaching was observed.

The channel appears to be a former stream that has been straightened to form a field drain. During wetter periods, the channel may have a greater flow.

Surveys:
Habitat Characterisation
Summer 2013

Summer 2013 upstream (looking west)

Summer 2013 mid-reach (looking west)

Summer 2013 downstream (looking northwest)

Site ref	Groes-fechan Ponds (Cafnan watercourse)
Grid ref	SH 34923 91667 and SH 34737 91625
Access	Yes
Wetted	Pond 1 – dry. Pond 2 – damp

Reach Characteristics and Management Issues

Pond 1 (SH 34923 91667) was entirely dry. The presence of soft-rush indicates that the pond may become wetter during winter and spring. Terrestrial grasses comprised the rest of the flora within the dry pond, indicating prolonged periods of drying of this feature. An adult common frog (*Rana temporaria)* was recorded within the dry pond; frogs are typically terrestrial, residing in or near damp areas outside the breeding season. Due to the annual drying, the pond is unlikely to be of any significant ecological value.

Pond 2 (SH 34737 91625) had no open standing water but was boggy in places. Species included bog bean (*Menyanthes trifoliata)*, water forget-me-not, horsetail, northern bedstraw (*Galium boreale)*, sedges *Carex* spp., lesser bulrush (*Typha angustifolia)*, buttercup (*Ranunculus* sp.), water mint, marsh cinquefoil (*Potentilla palustris)*, marsh pennywort, ragged robin (*Lychnis flos-cuculi)* and willow. This pond is likely to be wetter in the winter and, given the greater proportion of aquatic or water dependent species, this pond may hold water longer than Pond 1.

Pond 1 is unlikely to be of any significant aquatic ecological value due to its prolonged annual drying. Pond 2 was slightly wetted and had a large variety of semi-aquatic and aquatic macrophytes, none of which are unique to this site or of conservation value. If, as expected, the pond became wetter during winter, further surveys in winter are unlikely to increase the understanding of the ecology of this location due to macrophyte die back and macroinvertebrate population decline during colder months. The ecological value of these drying ponds could be characterised by studying other ephemeral aquatic features on site.

It was noted that the areas of wetland surrounding Pond 2 and the main Groes-fechan watercourse supported a wide variety of wetland flora species and may form an important terrestrial habitat area.

Surveys:
Habitat Characterisation
Summer 2013

Summer 2013 pond 1

Summer 2013 pond 2

Site ref	Groes-fechan Tributary (Cafnan watercourse)
Grid ref	SH 34758 91686 to SH 34842 91800
Access	No; observed from Mr Biddlecombe's land
Wetted	Slight

Reach Characteristics and Management Issues

The stream at the Groes-fechan site runs in a north-easterly direction, joining the main stream that drains from Groes-fechan towards Caerdegog Isaf.

It is narrow with steep, high (approximately 1.5m) channel banks. The stream runs along a field boundary with sheep pasture on the left bank and wetland vegetation and scrub on the right bank. A fence runs alongside the stream, which prevents sheep access into the channel. At the upstream end, there is no defined channel, but an area of wetland is present. Where the channel becomes defined, the substrate is peaty. Towards the downstream end of the surveyed reach, where visible, the channel comprises a bedrock or boulder cobble substrate. There was no flow at the time of survey, although the substrate was damp. Water depth was less than 1cm.

The channel is almost entirely shaded, predominately by gorse but also willow, bracken, bramble and hawthorn (*Crataegus monogyna)*. Water mint is present in places and horsetail is abundant. Towards the upstream section where the channel turns into wetland, horsetail, bulrush and smooth rush are abundant.

Throughout the reach, there is evidence of channel realignment alongside the field boundary.

Surveys:
Habitat Characterisation
Summer 2013


Summer 2013 upstream (looking west)


Summer 2013 mid-reach (looking southwest)


Summer 2013 mid-reach (looking south)


Summer 2013 downstream (looking north)

Site ref	Groes-fechan Wetland Area (Cafnan watercourse)
Grid ref	SH 35090 92176
Access	Yes
Wetted	Yes

Reach Characteristics and Management Issues

Whilst examining the pre-planned Groes-fechan site, a water-body was observed entering the main watercourse from the right bank. Largely obscured by emergent reed and rush species in the surrounding wetland and rough pasture, this tributary appears to be a wide and shallow wetland area. While wetted during winter, the tributary was supporting wildfowl and significant submerged and emergent macrophyte growth.

The planform of the channel suggest artificial straightening (see photo); however, the wide channel is unlikely to have been cut for drainage or wet fencing.

The habitat assessment could not determine whether this side channel was flowing (no perceivable flow) or identify a source. This wetland area may be a backwater or low lying wetland that had become submerged with winter rainfall.

This could provide an important resource for aquatic ecology (especially invertebrates and plants), particularly if it remains wetted throughout the drier months. This represents a habitat not widely reported from the survey area (potentially present at the Tre'r Gof SSSI).

Surveys (none in 2014):
Habitat Characterisation
Winter 2012/2013
Macroinvertebrates
April 2013, June/July 2013, August 2013.


Winter 2013


Spring 2013

Site ref	Gwyddelyn Bach (Cemaes watercourse)
Grid ref	SH 35922 92646 – SH 35980 92694
Access	Yes (except spring and summer 2014)
Wetted	Yes

Reach Characteristics and Management Issues

Downstream of Foel Fawr is Gwyddelyn Bach. This section also receives water from a tributary 200m upstream, arising from the west of Llanfechell village. Gwyddelyn Bach forms a field boundary between improved pasture land and shows signs of historic straightening. The watercourse is bordered by reed and emergent rush, which in summer choke the watercourse. Shading is minimal although overhanging trees and shrubs are present both up and downstream of the survey site. The watercourse is fenced along the right bank and the left bank is open to grazing; however, there were no signs of poaching.

The channel was 1m wide and up to 0.15m deep over a soft silt substrate. Flow types were slow glides with marginal slacks giving the watercourse a ditch typology. The silt substrate and ditch like character limits habitat types; however, the presence of macrophytes provide suitable refuge for invertebrates and small fish species.

Surveys:

Fish
Spring 2013, autumn 2013

Macrophytes
July 2013

Diatom
Quarterly since winter 2012/2013 (except spring and summer 2014)

Water Quality
Quarterly since winter 2012/2013 (except spring and summer 2014)

Habitat Characterisation
Winter 2012/2013

Macroinvertebrates
April 2013, June/July 2013

Spring 2013 facing downstream

Spring 2013 facing downstream

Spring 2013 looking upstream at Llanfechell tributary

Site ref	Hafnan, and Cafnan – Hafnan (Cafnan watercourse)
Grid ref	SH 33936 92212 - SH 34014 92361 (Hafnan) and SH 34014 92361 - SH 34155 93015 (Cafnan to Hafnan)
Access	Yes (except autumn 2014)
Wetted	Yes

Reach Characteristics and Management Issues

Hafnan - The watercourse runs in a south to north direction and is connected to a network of field ditches along its length on both banks. The site at Hafnan sits just downstream of the access track to Mynydd Ithel and flows through grazing pasture. It displays a natural planform with cobble-gravel bed and marginal silt deposits in the upper 100m. Channel width varies between 2m and 3m–4m (where poaching was also evident) with water depths up to 1m in pools. The banks are steep, approximately 1m in height; the right bank is vegetated with scrub and the left bank is sheep and cattle pasture with no fencing. Bank collapse is evident in places, which may be exacerbated by poaching. Tree cover and shading is largely absent; despite this, macrophyte growth is also very limited, perhaps due to disturbance by livestock. In-stream macrophytes consist chiefly of sparse water-starwort with some emergent branched bur-reed in the margins. Areas of extensive common duckweed cover were recorded in the area sampled for macroinvertebrates in 2011 but this was not seen in subsequent visits. The dominant flow type along this section is a glide.

Cafnan – Hafnan - Downstream of the Hafnan site, a tributary joins from the east, creating a slightly wider channel. Downstream towards the Cafnan – Hafnan site, the slope increases slightly through the mid-section, with increased flow diversity and some riffle-run flow types between pools. However, the issue of poaching, associated bank collapse and sediment input to the stream persists, with high siltation of gravels. The channel may have been deepened historically and an embankment of 1m height was recorded along the right bank from this mid-section down to the Cafnan site. The stream forms a border between two landowners. This border appears to switch banks down the length of the watercourse and the ecological functioning of the channel is significantly influenced by which bank access is open. Sections open to the left bank demonstrate considerable maintenance and a regular maintenance regime with the watercourse open (over-widened, deepened and clear of macrophyte growth). It appears that riparian cover has also been removed from the left bank and banks modified to allow cattle access to the stream. Where the watercourse is accessed from the right bank, the watercourse is unmodified, appearing significantly narrower and shallower than the managed sections. In the non-managed sections, the watercourse is choked throughout its length, with submerged and

Spring 2013 upstream at Hafnan (looking downstream)

Spring 2013 mid-reach (looking downstream)

Spring 2013 downstream of Cafnan – Hafnan (looking upstream)

Spring 2013 at Cafnan facing downstream (end of reach)

emergent macrophytes covering the channel. Areas of extensive common duckweed cover were recorded in 2011. The lower end of the reach, towards Cafnan, is straighter and deeper, suggesting historical channel realignment and re-sectioning. Flow is slow and silt substrate dominates. Land use remains as cattle pasture along both banks. Emergent branched bur-reed occupies the marginal areas here.	
Surveys: **Fish (Hafnan only)** Quarterly since spring 2013 (only summer in 2014) **Macrophytes(Hafnan only)** Summer 2013 & 2014 **Diatom (Hafnan only)** Quarterly since spring 2013 (except autumn 2014) **Water Quality (Hafnan only)** Quarterly since spring 2013 (except autumn 2014) **Habitat Characterisation** Autumn 2011, spring 2013 **Macroinvertebrates (Cafnan to Hafnan)** September 2011, May 2012, June/July 2013. May 2014	

Site ref	**Nanner (Cemlyn tributary stream)**
Grid ref	SH 33477 92132 to SH 33501 92154
Access	No
Wetted	Yes
Reach Characteristics and Management Issues	
The stream flows west to east before flowing through a culvert under Cemlyn Road at the Nanner site (SH 33497 92147). It then turns north towards the U/S Neuadd site. During 2011, the stream was barely flowing, with approximately 15m wetted immediately upstream of the road culvert. Upstream of this point, the channel appeared damp, but not wetted and heavily obscured by hedgerow and bramble shading the channel. Where wetted, the channel was 50cm wide and 5cm deep, dominated by soft silt indicative of a low energy, depositional habitat. Submerged and floating macrophytes cover the stream up to the road culvert, where water deepens slightly. Surrounding land use is low intensity grazing land and there is no indication of channel or planform modification	
Surveys: **Diatom** Summer 2011 **Habitat Characterisation** Autumn 2011	

Summer 2011 taken upstream of road culvert, facing downstream

Site ref	Nantorman Pond
Grid ref	SH 36231 93325
Access	Yes
Wetted	Yes
Reach Characteristics and Management Issues	
The pond at Nantorman is a lined garden pond with submerged and emergent aquatic vegetation The water surface is covered in common duckweed. Two Wildlife and Countryside Act 1981 Schedule 9 plants were recorded: curly waterweed (*Lagarosiphon major*) and New Zealand pigmy weed (*Crassula helmsii*).	
Surveys: **Habitat Characterisation** Summer 2011 **Macroinvertebrates** June 2011	

June 2011

Site ref	National Trust Headland Pools
Grid ref	SH 34215 93569
Access	Yes
Wetted	Yes
Reach Characteristics and Management Issues	
Numerous brackish pools are present on the headland owned by the National Trust north of Felin Gafnan. The pools are above high tide mark and appear to be fed by freshwater flushes, but will be affected at times by sea spray. The ponds are within the rocky outcrops on the cliffs. The majority of the pools did not contain any macrophytes, although some contained sea rush (*Juncus maritimus*).	
Surveys: **Habitat Characterisation** Summer 2011 **Macroinvertebrates** September 2011 and April 2012	

Spring 2012

Site ref	Neuadd (Cemlyn tributary stream)
Grid ref	SH 33408 92762 to SH 33449 92453
Access	Variable
Wetted	Partial
Reach Characteristics and Management Issues	
At Neuadd, the stream is straightened and split alongside the east and west sides of the Cemlyn Road. Most of the flow is in the westerly channel, which supports a small covering of macrophytes. The westerly channel is confined to the right bank by a field boundary and dry stone wall. It is no more than 0.75m wide and 10cm deep, and flows in riffles and runs over a predominantly gravel substrate. It is bordered and shaded by gorse shrub in a few places, particularly in the downstream reach just before its confluence with the Penyrorsedd Stream. Both east and west channels lie adjacent to improved pasture, with little stream shading. Further upstream, the watercourse turns east under the Cemlyn Road, broadens and flows through improved grassland fields.	
Surveys: **Diatom** Winter 2011/2012 and quarterly since winter 2012/2013 **Water Quality** Quarterly since winter 2012/2013 **Habitat Characterisation** Autumn 2011 **Macroinvertebrates** Spring and autumn 2014 **Macrophytes** Summer 2014	

Winter 2013 eastern channel facing upstream

Winter 2013 western channel facing upstream

Site ref	Penrhyn
Grid ref	SH 36617 93767
Access	Yes
Wetted	Yes
Reach Characteristics and Management Issues	
The Penrhyn site consists of a wetland area into which groundwater emerges from a concreted spring on the Penrhyn coastal headland. A small pool has formed and is surrounded by wetland vegetation; water then flows down towards scree and rocks to join the beach. The flush is well vegetated with abundant brooklime (*Veronica beccabunga*), marsh arrow-grass (*Triglochin palustris*), cuckooflower (*Cardamine palustris*) and watercress (*Nasturtium officinale*). The water depth is approximately 10cm. No directional flow was perceived and no defined channel exists within the site area.	

Summer 2013

Surveys: **Diatom** Autumn 2013, winter/spring/autumn 2014 **Water Quality** Summer 2013, autumn 2013, winter/spring/autumn 2014 **Habitat Characterisation** Summer 2013 **Macroinvertebrates** May 2012, April 2013, June/July 2013, May and October 2014	 Winter 2014

Site ref	**Pont Cafnan Wetland**
Grid ref	SH 34077 93158
Access	Yes
Wetted	Yes
Reach Characteristics and Management Issues	

An area of fen and marshy grassland is present to the west of Pont Cafnan. The fen is fed by a small, temporary stream.

Water levels in the fen are variable; during wetter periods, the area has areas of shallow open water but can dry out.

The fen is similar to Tre'r Gof SSSI, with common reed and a similar flora in the low-lying marshy areas, albeit not as species-rich. Species include gipsywort, marsh cinquefoil and marsh bedstraw.

Surveys (no survey programme 2014):
Habitat Characterisation
September 2011
Macroinvertebrates
September 2011, April 2012, July 2012, June/July 2013, August 2013.


Spring 2012


Summer 2013

Site ref	Porth Wylfa, Porth Wylfa Pond, Tre'r Gof SSSI)
Grid ref	SH 35994 93798 to SH 35698 93695
Access	Yes
Wetted	Yes

Reach Characteristics and Management Issues

Porth Wylfa:
This watercourse flowing into Porth Wylfa runs through the Tre'r Gof SSSI. The SSSI wetland area is wetted all year round and ensures a permanently wetted channel around its margin. The watercourse flows from west to east across the south of the SSSI before turning north to Porth Wylfa.

The watercourse is silt dominated, approximately 80cm wide and 10cm deep in summer 2012. Previous visits have seen significant variation in the wetted channel width and depth, with corresponding change in macrophyte cover, both aquatic and semi-aquatic. Rush and reed dominate the aquatic flora and extend into the terrestrial environments of the wetland area along the left bank. Tree shading is particularly obvious along the right bank, shading out much of the channel for long periods, which reduces in-channel macrophyte growth. The channel is well defined at the upstream and downstream ends, but the central part is less defined with very shallow ditch flow types (slack/backwater) and areas of marshy grassland.

It is likely that the watercourse has been historically modified to follow the field boundary, with evidence in summer 2011 of channel maintenance (weed cut/dredge) at the downstream end. During 2011, a hydrometry station was positioned in the stream, and a cutting regime undertaken on the higher ground beyond the wetland SSSI. Although not observed, the riparian zone may be affected by grazing as, during the course of 2012, several dead sheep were recorded in, or adjacent to, the channel.

The sampling site was moved from the 2011 site during the 2012 and 2013 monitoring due to a more representative and deeper water site being identified which would aid sample collection. This should have no impact on the validity of data collected. The 2011 samples (SH 35698 93695) were taken approximately 200m upstream of the 2012/2013 site (SH 35994 93798).

Tre'r Gof SSSI: Comprises many freshwater habitats including a number of ditches, a stream, pond and marshy area.

The stream flows from east to west across the centre of the site. The marshy area is in the western part of the SSSI. Aquatic macrophytes species included bog pondweed (*Potamogeton polygonifolius*), marsh marigold (*Caltha palustris*), yellow iris (*Iris pseudacorus*), water mint, lesser water-parsnip (*Berula erecta*) and marsh pennywort.

Summer 2013 facing upstream


Winter 2013 facing upstream


Spring 2012 Marshy area at Tre'r Gof SSSI


Spring 2012 Porth Wylfa Pond in Tre'r Gof SSSI

Porth Wylfa Pond: A large pond is present within the western boundary of the SSSI. The pond is fed by a ditch and is retained as an open area of shallow water by cattle poaching. Macrophytes included soft-rush, floating sweet-grass and yellow iris.	
Porth Wylfa surveys: **Fish** Autumn 2013 **Macrophytes** Summer 2012 & 2013 **Diatom** Quarterly since summer 2011 **Water Quality** Quarterly since winter 2011/2012 **Habitat Characterisation** Summer 2011 **Macroinvertebrates** Spring and autumn 2014 **Tre'r Gof SSSI surveys:** **Habitat Characterisation** Winter 2014 **Macroinvertebrates** June 2011, April 2012, May 2012, July 2012, April 2013, June/July 2013, Aug 2013, spring and autumn 2014 **Diatom** Spring and autumn 2014 **Water Quality** Spring and autumn 2014 **Porth Wylfa Pond surveys:** **Habitat Characterisation** Winter 2014 **PSYM** – summer 2014 **Macroinvertebrates** April 2012, June/July 2013. **Diatom** Spring and autumn 2014 **Water Quality** Spring and autumn 2014	

Site ref	Porth-y-pistyll
Grid ref	SH 34786 93651 to SH 34967 93555
Access	Yes
Wetted	Ephemeral

Reach Characteristics and Management Issues

The stream runs northerly along the western boundary of the Existing Power Station through boggy wet grassland. The stream originates from a culvert structure adjacent to the Existing Power Station gates, where a drain cover suggests a modified subterranean watercourse. In summer, this part of the stream is dry and covered in dense bramble and gorse.

The channel is wetted for approximately 200m south of the shoreline in autumn, drying in the upper reaches over summer. A tributary 75m upstream from the shoreline and flowing from elevated gorse and tall shrub contributes a significant proportion of total summer flow.

With the exception of the downstream 75m there is no defined channel, with an increase in wetland species (emergent rush and reed) marking the extent of the channel. The channel appears unmodified, following an undefined channel form. Wetland species dominate the left hand bank margin.

The downstream end of the watercourse deepens but heavy vegetation (95% cover) causes flow types to be limited to slack and very low energy, depositional glides. The channel is choked year round by terrestrial grasses and a mix of wetland and semi-aquatic plant species throughout its length. Wetted depth is less than 10cm and channel width variable, but rarely more than 50cm. The stream disappears into a culvert immediately above the beach and runs over the shingle foreshore lower down.

Signage present in summer 2011 warned of the presence of the invasive species *Azolla filiculoides*. The sign was taken down by autumn 2012 and no evidence of this species was observed during any of the surveys.

Surveys:

Fish
Summer and autumn 2013

Macrophytes
Annually since summer 2012 (not 2014)

Diatom
Quarterly since summer 2011

Water Quality
Quarterly since winter 2011/2012

Habitat Characterisation
Summer 2011

Macroinvertebrates
June 2011, August 2011, May 2012, April 2013, spring/summer/autumn 2014

Autumn 2011 facing upstream

Winter 2012 facing upstream

Spring 2013

Site ref	Power Station Junction
Grid ref	SH 35542 93189
Access	Yes
Wetted	Ephemeral

Reach Characteristics and Management Issues

On previous surveys, this site had been recorded as dry. During the winter 2012/2013 surveys of Power Station Pond, an outflow was seen to flow (via a culvert) under the Existing Power Station access road resulting in flow (north to south) at the Power Station Junction site.

This site is a very shallow ephemeral field drain. There was evidence that the watercourse has been wetted over winter; silt was observed mid channel, as well as the semi-aquatic rush *Juncus* sp. and isolated reed species. Terrestrial grasses and rush still dominate the stream flora and the watercourse was sampled for diatoms from submerged reed bases.

The wetted width was <1m whilst water depth was <0.1m with a silt bed. Slow glide and slack flow types were recorded resulting in deposition of silt. The site is unlikely to support species of conservation interest.

Grazing and poaching pressure from sheep was evident along the improved grassland on the right bank. The left bank was constrained by a low brick wall and tarmac road.

Surveys:
Diatom
Winter 2012/2013, spring 2013, autumn 2014
Water Quality
Winter 2012/2013, spring 2013, autumn 2014
Habitat Characterisation
Winter 2012
Macroinvertebrates
April 2012, May 2012, April 2013, autumn 2014
Macrophytes
August 2014

Summer 2011 downstream, facing upstream

Summer 2011 upstream, facing downstream

Winter 2012 upstream, facing downstream

Site ref	Power Station Ponds
Grid ref	SH 35495 93113
Access	Yes
Wetted	One wet, one dry

Reach Characteristics and Management Issues

Two ponds (1 and 2) were identified to the west of the main road leading to the Existing Power Station.

The pond nearest the station (1) was wetted in all seasons and covered in submerged macrophytes (see photo). The pond was surrounded by tall herb and rough grassland, leading to marginal stands of rush and reed. In summer, the pond margins show evidence of seasonal reduction in water levels and the exposure of soft sediments. There were no obvious signs of modification to the pond or recent management and, other than the linkage to the second pond, this water-body appeared offline from a riverine input.

Shallow through the margins (0.1m) the pond deepens to 1.5m in its centre over a soft silt bed. In summer, submerged macrophytes choke (>90%) of the pond. The presence of water fern *Azolla filiculoides*, a non-native invasive species, was noted throughout the survey period (2011–2013), which had seasonal changes in coverage.

The second pond (2), linked to the first by a ditch both of which were dry in 2011, is dominated by terrestrial grasses and rush *Juncus* sp., associated with damp ground and marginal aquatic habitats. The pond, ditch and marshy area were wetted in 2012 and included in the macroinvertebrate survey area. In 2014, the pond was 20cm deep and thickly grown over with duckweed *Lemna minuta* and *Azolla filiculoides.* Pale galingale *Cyperus eragrostis* was also present – a non-native (but not invasive) species.

Surveys (Power Station Pond 1):

Fish
Spring 2012, summer 2012

Diatom
Spring 2012 & 2013, winter 2012/2013, autumn 2013

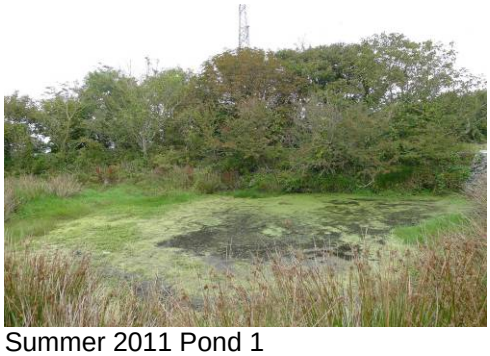
Water Quality
Winter 2012/2013, spring 2013, autumn 2013

Habitat Characterisation
Summer 2012

Macroinvertebrates
June 2011, August 2011, April 2012, May 2012, April 2013, Aug 2013

PSYM surveys (Pond 1)
Summer 2012 and 2014

PSYM surveys (Pond 2)
Summer 2014


Summer 2011 Pond 1


Spring 2013 marshy area


Summer 2013 Pond 1


Autumn 2013 Pond 1


August 2014 Pond 2

Site ref	Tan-yr-allt Ditch
Grid ref	SH 34909 93222 (site 2) SH 34889 93342 (site 3)
Access	Yes
Wetted	Seasonally

Reach Characteristics and Management Issues

The Tan-yr-allt ditch is a short drainage channel, which is fed by a ditch and pond upstream of an unnamed access road. It is an ephemeral waterbody (it flows seasonally and is dry for much of the year). Approximately 100m upstream from its confluence with Porth-y-pistyll (the main watercourse flowing into Porth-y-pistyll Bay), it changes from a shaded, shallow field boundary channel to an undefined course. It is suspected to flow over and through ground before reforming as a channel near its confluence with Porth-y-pistyll.

Surveys:

Habitat Characterisation
August 2014
Water Quality
Summer and autumn 2014
Macroinvertebrates
October 2014.
Macrophytes
Summer 2014

Tan-yr-allt ditch - site 2

Tan-yr-allt ditch - site 3 (100m downstream of site 2)

Site ref	Tan-yr-allt Pond
Grid ref	SH 34963 93047
Access	Yes
Wetted	Seasonally

Reach Characteristics and Management Issues

A large pond situated at a topographical low on a field boundary between two pasture fields.

An ephemeral ditch bordered by a hedge runs along the field boundary. The ditch spills over into the depression during wet periods, forming the pond. It is also hydrologically connected to the Tan-yr-allt ditch downhill to the north (under the road) during high water levels, which ultimately flows into Porth-y-pistyll.

The pond is generally species-poor, dominated by floating sweet-grass *Glyceria fluitans*. Prior to summer 2014, it was heavily poached by cattle and often had a completely earthen/mud substrate. Since the cattle were removed (due to construction of haulage roads), the pond has been fully vegetated.

Surveys:
Water Quality
Spring and autumn 2014
Habitat characterisation
Summer 2014
Diatom
Winter and summer 2014
Macroinvertebrates
April 2012, July 2012, June/July 2013


Spring 2012


Summer 2013

Site ref	Tre'r-Gof-Isaf (Cemaes watercourse)
Grid ref	SH 36860 93614 to SH 36918 93668 and SH 36596 93084 to SH 36641 93167
Access	Yes
Wetted	Yes

Reach Characteristics and Management Issues

The watercourse is a modified straightened channel. At the upstream end, the right bank is heavily shaded by shrub backing onto residential properties, contributing some leaf litter to the stream. The left bank is open to improved grassland and a private track. Upstream of this, the watercourse runs alongside the A5025, with a small weir structure and is culverted beneath the road. Further downstream, the marginal scrub prevents access to the stream whilst the private road crosses the watercourse by a clear span bridge.

The mid section of the reach has not been assessed due to lack of land access.

The downstream section of the reach, towards Cemaes Bay, is over-deepened, straightened and situated within residential land-use. The channel is heavily shaded by riparian scrub. Large stands of non-native *Gunnera sp.* are present at the downstream end.

The channel is approximately 1m wide, with 0.15m water depth. The flow types recorded were predominantly run and glide. The watercourse is erosional and has a semi-consolidated cobble and pebble bed material.

In spring 2014, there was a large quantity of residential debris (sofa cushions) in the waterbody.

Surveys (At the downstream end):
Macrophytes
Summer 2013 & 2014
Diatom
Quarterly since winter 2012/2013
Water Quality
Quarterly since winter 2012/2013
Habitat Characterisation
Ongoing since winter 2012/2013
Macroinvertebrates
June/July 2013, spring and autumn 2014

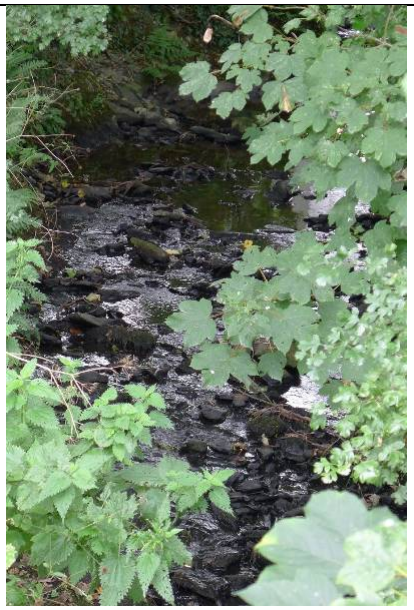

Winter 2013 facing upstream towards road


Winter 2013 100m downstream from A5025, facing upstream


Spring 2013 100m upstream from Cemaes Bay discharge, facing downstream


Spring 2013 100m upstream from Cemaes Bay discharge, facing upstream

Site ref	West of A5025 junction with Cemlyn road (Cafnan watercourse)
Grid ref	SH 34148 91385
Access	No
Wetted	Yes
Reach Characteristics and Management Issues	
Upstream of the access road, the watercourse appears wetted and characteristic of lowland Welsh rivers with run and pool flow types. Aquatic and semi-aquatic macrophytes dominate the channel form. The channel runs alongside improved pasture and bordered along the left bank by the field margin. It is expected that this channel will fill in wetter months and contribute to the flow observed downstream. Bridged over the access road, the stream disappears into residential garden with the channel heavily shaded by marginal and ornamental plants. Access was not permitted; however, the modified nature of this watercourse through this garden section would make it unsuitable for further survey. This survey site is now out of the Wylfa Newydd Development Area and 500m buffer boundary.	
Surveys: **Habitat Characterisation** Summer 2011 – undertaken from public access areas only	



Summer 2011 looking south of Cemlyn road, facing downstream

Summer 2011 looking north of Cemlyn road, facing downstream

Site ref	U/S Neuadd (Cemlyn tributary stream)
Grid ref	SH 33467 92440 to SH 33588 92242
Access	Yes
Wetted	Yes

Reach Characteristics and Management Issues

The stream at the U/S Neuadd site is narrow with channel banks of approximately 1m–2m in height. The stream forms a field boundary with rough pasture on the right bank and improved grassland (hay meadow) on the left bank side. The channel is heavily shaded throughout and has a cobble-gravel substrate. Flow is mainly run-riffle and was very shallow (<20cm) at time of survey (summer 2013).

Throughout the entire reach, there is evidence of channel realignment around field boundaries and channelized with dry stone walls on one or other bank. Over-deepening was also evident in places.

Both banks are steep for most of the reach (except at the downstream end) and realignment and over-deepening has probably taken place to increase stream capacity and defend against flooding of farmland.

The reach is unfenced along the right bank but bordered by hawthorn hedges and is fenced along the left bank. A dry stone wall is present along the left bank at the downstream end of the reach. Macrophytes are present throughout, covering up to 10% of the water surface.

Towards the downstream end of the reach, the channel broadens slightly and there is a decrease in marginal cover. The channel continues to be shallow with a gravel-cobble substrate and continues to run through pasture.

Surveys:

Fish
Summer 2013, autumn 2013

Macrophytes
Summer 2013

Diatom
Summer 2013, autumn 2013, winter/spring/autumn 2014

Water Quality
Summer 2013, autumn 2013 winter/spring/autumn 2014

Habitat Characterisation
Summer 2013

Macroinvertebrates
Spring and autumn 2014

Summer 2013 general view of channel location


Summer 2013 upstream, looking downstream

Summer 2013 mid-reach, looking upstream

Site ref	Wylfa Hall Pond
Grid ref	SH 35542 93751
Access	Yes
Wetted	Yes

Reach Characteristics and Management Issues

Two temporary ponds are situated either side of the road leading to Wylfa Hall car park.

The ponds appear to be fed from the network of ditches leading from Tre'r Gof SSSI. Both ponds are shaded.

The western pond has a mud substrate and supports great willow herb. This pond has a low macrophyte cover.

The eastern pond has high macrophyte coverage with yellow iris, common water-starwort and floating sweet-grass.

Surveys:
Macroinvertebrates
April 2012 and April 2013.
Habitat Characterisation
Winter 2014**Water quality**
Winter/spring/autumn 2014
Diatom
Winter/spring 2014


Spring 2012 western pond


Spring 2012 eastern pond

Site ref	Wylfa Head Pools
Grid ref	SH 35418 94549
Access	Yes
Wetted	Yes

Reach Characteristics and Management Issues

Numerous brackish pools are present on the rocky outcrops on the Wylfa headland.

These are small, shallow, temporary pools situated above the high tide mark but will be affected at times by sea spray.

The pools are mostly unshaded and do not support aquatic macrophytes.

Surveys:
Macroinvertebrates
September 2011 and April 2012
Habitat Characterisation
Winter 2014


Spring 2012

Site ref	Bwlch Pond
Grid ref	SH 35246 91598
Access	From summer 2014
Wetted	No

Reach Characteristics and Management Issues

This is a 20m x 10m depression at the boundary of an arable field and pasture. At the time of characterisation, it was dry with boggy areas. The substrate is composed of silt/earth/organic matter. The landowner confirms that the area is wetted in winter, and the waterline is roughly indicated by the rush-border in the pasture.

The topography of the land is sloping, and the pond is likely to receive run-off principally from the arable land use due to bare soils (barley, in summer 2014).

The pond was largely dominated by floating sweet-grass *Glyceria fluitans*, with borders and patches of rushes *Juncus effusus* and *J. acutiflorus*. There was a small patch of water fern *Azolla filiculoides* growing on bare mud near the field boundary, near to isolated plants of watercress *Rorippa nasturtium-aquaticum* and fool's watercress *Apium nodiflorum.*

The pond has no particular riparian buffer, and is likely to be affected by poaching by livestock when wetted.

Surveys:
Habitat characterisation
Summer 2014

Summer 2014 (*Azolla* below)

Site ref	Tyddyn-Goronwy
Grid ref	SH 35915 93316
Access	From May 2014
Wetted	Ephemeral

Reach Characteristics and Management Issues

This is an ephemeral ditch, which runs alongside a banked field boundary. It begins in an adjacent field to the east, and halfway down the bank it crosses into the pasture on the west.

The channel is up to 1.5m wide, with low banks where it borders pasture. Its substrate is earth and plant matter, and the channel is well bordered by tall rush margins and gorse in places. The land use on both sides is rough sheep pasture. The connectivity with the floodplain is good; after rainfall events, boggy patches would form in the rush areas. OS maps suggest the ditch is fed by a small pond, but this was not obvious in the field and, as such, the ditch is more likely to receive drainage from the gently sloping pastures.

There is very little riparian buffer apart from rush margins and the high-shrub bank running down the first half of the field.

The channel vegetation consists largely of rushes *Juncus sp.*, and patches of fool's watercress *Apium nodiflorum* amongst terrestrial grasses and willowherb *Epilobium sp*.

Surveys:
Habitat characterisation
May 2014
Water quality
October 2014

Spring 2014

Site ref	Penyrorsedd (Cemlyn tributary stream)
Grid ref	SH 33184 92626
Access	From Feb 2014
Wetted	Yes

Reach Characteristics and Management Issues

This is a permanently wetted ditch, which runs alongside a dry stone wall field boundary. It is fed by Penyrorsedd Pond (in an adjacent field) and drains the surrounding pastures.

The channel is up to 2m wide, and 40cm deep, with 30cm–40cm high banks where it borders the pasture. In places, the banks are heavily poached and slope gently to the watercourse. In the middle of the reach, there is a large ponded area with stands of *Typha latifolia* and tall rushes. Throughout there is a very soft silt and organic matter substrate, and the water is usually turbid with few plants except patches of rushes *Juncus sp.* and starwort *Callitriche sp.*

Towards the end of the reach, near its confluence with the Cemlyn tributary stream, it becomes narrower and heavily shaded by gorse, with a firmer substrate of gravel and cobbles. The stream is then culverted under the road before discharging to Cemlyn lagoon.

Surveys:
Habitat characterisation
Feb 2014
Diatom
Feb, May & October 2014
Water quality
Feb, May & October 2014
Macroinvertebrates
May & October 2014
Fish
Summer 2014
Macrophytes
Summer 2014

Winter 2014 looking downstream

Winter 2014 widened ponded area of Penyrorsedd ditch

Site ref	Penyrorsedd Pond (Cemlyn tributary stream)
Grid ref	SH 33039 92547
Access	From May 2014
Wetted	Yes

Reach Characteristics and Management Issues

This is a large 15m x 8m permanently wetted pond, bordered by a high dry stone wall for 55% of its margin and improved pasture for the remainder. The earthen banks are roughly 25cm high and heavily poached, as it is a watering hole for cattle. The pond is unshaded and very turbid, with high levels of suspended green algae, and the depth is greater than 45cm. The substrate is mostly silt and mud with small marginal areas of gravel.

There were sparse macrophytes present at the water edges – mainly *Callitriche sp.* and marginal *Juncus sp.* with small patches of *Lemna minuta.*

It has a small outflow under the dry stone wall which feeds the Penyrorsedd Stream.

Surveys:
Habitat characterisation
May 2014
Diatom
May & October 2014
Water quality
May & October 2014
PSYM
August 2014

May 2014 PSYM survey

Site ref	Tregele Pond
Grid ref	SH 35361 92575
Access	From Feb 2014
Wetted	Ephemeral

Reach Characteristics and Management Issues

This pond is roughly 15m x 3m, rectangular and dominated by greater reedmace *Typha latifolia* and duckweed *Lemna minuta.* It is at the top of a hillock and is bordered by shrubs and a rubble road/recently demolished property. The substrate is made up of silt and decayed plant matter, and the water depth has varied from 5cm to 20cm. It is partly shaded in summer by overhanging trees/shrubs.

It does not appear to have any in/outflows, but the water level seems to be very responsive: the pond fills quickly after rainfall, drying out to puddles in summer.

Surveys:
Habitat characterisation
Feb 2014
Diatom
May & October 2014
Water quality
May & October 2014
PSYM
August 2014

Feb 2014

Table AB–1: Water temperature (°C) data from freshwater sites surveyed, 2012-2014

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	5.8	9.77	-	-	-	-	-	11.90
	Wylfa Hall Pond	-	-	-	-	-	-	-	8.03	13.30	-	11.50
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	12.10
	Power Station Pond	-	-	-	1.94	10.48	-	10.74	-	10.50	-	13.60
	Porth Wylfa Pond	-	-	-	-	-	-	-	10.20	18.50	-	13.50
	Porth Wylfa	9.62	10.07	15.6	2.55	6.66	-	10.23	-	14.10	-	11.80
	Tre'r Gof SSSI	-	-	-	-	-	-	-	8.62	12.70	-	11.80
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	12.50
	Tregele Pond	-	-	-	-	-	-	-	7.28	-	-	11.90
	Tan-yr-allt Pond	-	-	-	-	-	-	-	6.7	11.30	-	11.90
	Cae Gwyn SSSI	-	-	-	-	-	-	-	5.94	11.60	-	-
	Groes-fechan	-	-	-	4.27	10.91	17.04	10.60	6.02	10.60	-	-
	Caerdegog Isaf	-	-	-	-	10.14	17.53	10.90	-	11.30	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	12.70	19.66	10.6	8.12	12.50	-	-
	Hafnan	-	-	-	-	11.74	17.81	9.54	-	12.60	-	-
	Cafnan	9.86	12.79	13.42	3.13	9.86	20.08	10.23	7.64	10.40	-	-
	Felin Gafnan East	9.65	11.19	16.86	3.59	13.44	17.59	9.76	-	-	-	-
	Felin Gafnan Confluence	9.75	10.74	16.24	3.55	12.14	17.53	9.67	-	10.60	-	11.10
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	9.21	12.80	-	13.40
	Penyrorsedd	-	-	-	-	-	-	-	9.72	11.20	-	12.60
	US Neuadd	-	-	-	-	-	17.59	10.60	9.12	12.70	-	12.10
	Neuadd	-	-	-		13.19	20.36	10.70	-	11.60	-	12.00
Cemaes	Foel Fawr	-	-	-	-	-	-	10.13	8.64	11.60	-	11.90
	Gwyddelyn Bach	-	-	-	5.03	12.06	16.95	9.81	-	-	-	11.50
	Tre'r-gof-isaf	-	-	-	4.65	6.42	16.48	10.98	-	10.50	-	12.10
Other	Penrhyn	-	-	-	-	-	10.83	11.4	10.60	10.10	-	11.80
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	14.20	12.20
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	11.70
	Porth-y-pistyll	10.12	10.86	13	7.75	9.86	14.79	12.23	-	10.70	13.70	12.90

Table AB–2: Conductivity (mS cm^{-3}) data from freshwater sites surveyed, 2012-2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	0.286	0.336	-		-	-	-	0.266
	Wylfa Hall Pond	-	-	-	-	-	-	-	0.632	0.347	-	0.219
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	0.495
	Power Station Pond	-	-	-	0.185	0.361	-	0.298	-	0.319	-	0.272
	Porth Wylfa Pond	-	-	-	-	-	-	-	0.372	0.443	-	0.501
	Porth Wylfa	0.381	0.466	0.595	0.349	0.443	-	0.380	-	0.539	-	0.514
	Tre'r Gof SSSI	-	-	-	-	-	-	-	0.356	0.582	-	0.640
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	0.366
	Tregele Pond	-	-	-	-	-	-	-	0.380	-	-	0.266
	Tan-yr-allt Pond	-	-	-	-	-	-	-	0.242	0.112	-	0.45
	Cae Gwyn SSSI	-	-	-	-	-	-	-	0.270	0.218	-	-
	Groes-fechan	-	-	-	0.245	0.283	0.445	0.228	0.153	0.337	-	-
	Caerdegog Isaf	-	-	-	-	0.285	0.487	0.268	-	0.325	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	0.353	0.422	0.293	0.134	0.365	-	-
	Hafnan	-	-	-	-	0.251	0.400	0.223	-	0.300	-	-
	Cafnan	0.250	0.281	-	0.217	0.252	0.492	0.212	0.217	0.294	-	-
	Felin Gafnan East	0.251	0.273	0.362	0.223	0.280	0.412	0.214	-	-	-	-
	Felin Gafnan Confluence	0.252	0.273	0.364	0.221	0.271	0.411	0.208	-	0.297	-	0.229
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	0.358	0.513	-	0.486
	Penyrorsedd	-	-	-	-	-	-	-	0.326	0.382	-	0.452
	US Neuadd	-	-	-	-	-	0.407	0.246	0.240	0.320	-	0.304
	Neuadd	-	-	-	0.242	0.310	-	0.244	-	0.308	-	0.302
Cemaes	Foel Fawr	-	-	-	-	-	-	0.23	0.228	0.271	-	0.268
	Gwyddelyn Bach	-	-	-	0.292	0.311	0.498	0.591	-	-	-	0.340
	Tre'r-gof-isaf	-	-	-	0.310	0.363	0.516	0.319	-	0.393	-	0.305
Other	Penrhyn	-	-	-	-	-	0.475	0.578	0.442	0.459	-	0.484
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	0.388	0.333
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	0.270
	Porth-y-pistyll	0.438	0.231	0.603	0.446	0.451	0.526	0.412	-	0.412	0.440	0.425

Table AB–3: Dissolved oxygen (%) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	83.2	80.5	-	-	-	-	-	45.6
	Wylfa Hall Pond	-	-	-	-	-	-	-	53.5	104.9	-	37.8
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	52.6
	Power Station Pond	-	-	-	51.8	20.0	-	49.6	-	65.9	-	53.0
	Porth Wylfa Pond	-	-	-	-	-	-	-	135.0	68.0	-	97.7
	Porth Wylfa	69.8	65.1	52.7	78.2	65.6	-	66.8	-	81.0	-	68.8
	Tre'r Gof SSSI	-	-	-	-	-	-	-	73.5	61.3	-	55.8
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	29.1
	Tregele Pond	-	-	-	-	-	-	-	32.3	-	-	45.6
	Tan-yr-allt Pond	-	-	-	-	-	-	-	45.9	57.8	-	53.2
	Cae Gwyn SSSI	-	-	-	-	-	-	-	39.5	79.7	-	-
	Groes-fechan	-	-	-	79.6	76.9	77.2	55.0	79.2	113.7	-	-
	Caerdegog Isaf	-	-	-	-	77.5	80.4	82.0	-	104.8	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	89.7	71.3	69.5	86.1	96.0	-	-
	Hafnan	-	-	-	-	91.7	72.9	87.1	-	104.2	-	-
	Cafnan	88.6	104.4	62.4	96.6	99.3	81.4	80.9	95.6	105.8	-	-
	Felin Gafnan East	92.5	102.0	70.7	97.4	103.9	69.5	79.1	-	-	-	-
	Felin Gafnan Confluence	90.1	103.8	93.9	102.3	96.6	93.0	88.0	-	108.0	-	102.0
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	92.6	124.9	-	94.9
	Penyrorsedd	-	-	-	-	-	-	-	90.8	86.8	-	57.7
	US Neuadd	-	-	-	-	-	71.0	74.8	101.0	101.1	-	68.1
	Neuadd	-	-	-	102.0	99.9	-	89.8	-	104.0	-	80.0
Cemaes	Foel Fawr	-	-	-	-	-	-	70.6	86.2	89.3	-	58.6
	Gwyddelyn Bach	-	-	-	84.4	81.8	53.1	61.5	-	-	-	71.2
	Tre'r-gof-isaf	-	-	-	91.0	96.4	78.7	87.3	-	106.5	-	78.5
Other	Penrhyn	-	-	-	-	-	47.5	40.0	69.5	98.4	-	63.6
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	92.5	83.3
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	75.0
	Porth-y-pistyll	94.6	99.5	81.1	96.2	104.5	89.4	87.3	-	117.3	71.8	87.7

Table AB–4: pH data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	6.48	6.26	-	-	-	-	-	6.09
	Wylfa Hall Pond	-	-	-	-	-	-	-	5.58	6.85	-	8.15
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	-
	Power Station Pond	-	-	-	5.50	6.07	-	5.95	-	5.97	-	5.87
	Porth Wylfa Pond	-	-	-	-	-	-	-	6.70	6.89	-	8.57
	Porth Wylfa	6.79	6.9	7.13	6.13	6.66	-	7.27	-	7.03	-	8.57
	Tre'r Gof SSSI	-	-	-	-	-	-	-	6.38	6.39	-	8.46
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	-
	Tregele Pond	-	-	-	-	-	-	-	5.74	-	-	6.09
	Tan-yr-allt Pond	-	-	-	-	-	-	-	5.37	5.69	-	5.59
	Cae Gwyn SSSI	-	-	-	-	-	-	-	7.22	5.82	-	-
	Groes-fechan	-	-	-	6.66	6.50	7.45	7.02	7.16	6.44	-	-
	Caerdegog Isaf	-	-	-	-	6.42	7.82	6.98	-	7.25	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	6.85	7.58	6.68	6.43	7.15	-	-
	Hafnan	-	-	-	-	6.89	7.54	6.16	-	7.20	-	-
	Cafnan	6.93	7.33	7.09	6.45	6.23	7.45	6.96	6.52	6.75	-	-
	Felin Gafnan East	6.92	7.25	7.10	6.54	7.05	7.51	7.18	-	-	-	-
	Felin Gafnan Confluence	7.06	7.28	7.48	6.73	7.22	8.55	7.42	-	7.24	-	8.41
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	6.74	7.60	-	7.48
	Penyrorsedd	-	-	-	-	-	-	-	6.48	6.48	-	6.41
	US Neuadd	-	-	-	-	-	7.69	6.91	6.68	7.07	-	6.78
	Neuadd	-	-	-	6.75	7.54	8.02	7.1	-	7.74	-	7.05
Cemaes	Foel Fawr	-	-	-	-	-	-	6.88	6.27	6.83	-	8.00
	Gwyddelyn Bach	-	-	-	6.82	7.00	7.47	7.51	-	-	-	8.04
	Tre'r-gof-isaf	-	-	-	7.07	7.42	8.59	7.32	-	7.22	-	8.50
Other	Penrhyn	-	-	-	-	-	6.68	6.42	6.04	6.00	-	7.57
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	7.25	6.95
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	6.53
	Porth-y-pistyll	6.91	7.57	7.01	6.63	6.69	6.93	7.16	-	6.86	6.9	7.14

Table AB–5: Suspended solid concentrations (mg L^{-1}) from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	<3.00	4.85	-	-	-	-	-	27.20
	Wylfa Hall Pond	-	-	-	-	-	-	-	5.85	22.40	-	7.93
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	307.00
	Power Station Pond	-	-	-	3.03	6.75	-	173.00	-	81.80	-	46.90
	Porth Wylfa Pond	-	-	-	-	-	-	-	13.90	69.60	-	15.10
	Porth Wylfa	-	21.30	6.18	19.90	29.70	52.50	26.60	-	13.40	-	5.13
	Tre'r Gof SSSI	-	-	-	-	-	-	-	121.00	81.20	-	6.93
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	26.90
	Tregele Pond	-	-	-	-	-	-	-	52.00	-	-	16.70
	Tan-yr-allt Pond	-	-	-	-	-	-	-	63.40	88.00	-	60.40
	Cae Gwyn SSSI	-	-	-	-	-	-	-	<3.00	9.42	-	-
	Groes-fechan	-	-	-	<3.00	13.10	10.10	4.32	3.05	<3.00	-	-
	Caerdegog Isaf	-	-	-	-	11.20	7.52	8.18	-	<3.00	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	7.60	-	4.68	7.55	12.00	-	-
	Hafnan	-	-	-	-	18.70	35.20	7.95	-	12.60	-	-
	Cafnan	-	19.60	8.83	21.30	36.60	17.20	11.40	11.00	73.10	-	-
	Felin Gafnan East	-	5.17	7.18	13.80	54.20	5.77	18.80	-	-	-	-
	Felin Gafnan Confluence	-	10.40	6.38	21.50	23.10	7.07	8.42	-	7.70	-	6.28
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	5.15	91.10	-	18.40
	Penyrorsedd	-	-	-	-	-	-	-	18.60	20.00	-	72.70
	US Neuadd	-	-	-	-	-	6.77	3.53	4.05	8.30	-	11.30
	Neuadd	-	-	-	21.20	11.40	22.00	3.28	-	9.05	-	6.20
Cemaes	Foel Fawr	-	-	-	-	-	-	7.42	5.95	9.17	-	102.00
	Gwyddelyn Bach	-	-	-	13.70	28.10	13.70	9.02	-	-	-	5.98
	Tre'r-gof-isaf	-	-	-	7.50	13.60	4.47	7.33	-	106.00	-	17.90
Other	Penrhyn	-	-	-	-	-	3.47	65.70	6.60	5.62	-	28.00
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	55.80	11.00
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-		16.20
	Porth-y-pistyll	-	22.00	5.18	3.33	32.60	17.30	3.32	-	7.85	3.70	22.60

Table AB–6: Biological oxygen demand (mg L^{-1}) at freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	<2.92	<1.0	-	-	-	-	-	5.55
	Wylfa Hall Pond	-	-	-	-	-	-	-	<1.00	3.22	-	18.80
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	12.20
	Power Station Pond	-	-	-	<2.92	1.45	-	6.79	-	7.91	-	4.90
	Porth Wylfa Pond	-	-	-	-	-	-	-	<1.00	3.79	-	3.42
	Porth Wylfa	<1.00	2.50	1.00	<2.92	1.54	1.46	1.86	-	1.21	-	<1.00
	Tre'r Gof SSSI	-	-	-	-	-	-	-	2.68	4.64	-	<1.00
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	>18.70
	Tregele Pond	-	-	-	-	-	-	-	3.20	-	-	6.74
	Tan-yr-allt Pond	-	-	-	-	-	-	-	<2.92	8.19	-	17.30
	Cae Gwyn SSSI	-	-	-	-	-	-	-	<1.00	2.04	-	-
	Groes-fechan	-	-	-	<2.92	<1.00	<1.00	1.16	<1.00	<1.00	-	-
	Caerdegog Isaf	-	-	-	-	1.22	1.54	<2.92	-	<1.00	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	1.05	4.43	<2.92	<1.00	6.45	-	-
	Hafnan	-	-	-	-	1.35	1.84	<2.92	-	1.11	-	-
	Cafnan	<1.00	1.50	1.30	<2.92	1.26	1.89	1.20	1.01	2.57	-	-
	Felin Gafnan East	<1.00	<1.0	1.30	<2.92	1.78	1.20	1.78	-	-	-	-
	Felin Gafnan Confluence	<1.00	1.20	1.40	<2.92	1.48	1.12	1.44	-	1.10	-	1.60
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	<1.0	18.10	-	4.63
	Penyrorsedd	-	-	-	-	-	-	-	<1.0	1.46	-	2.93
	US Neuadd	-	-	-	-	-	<1.00	<2.92	<1.00	<1.00	-	1.05
	Neuadd	-	-	-	<2.92	1.15	2.00	<2.92	-	<1.00	-	1.4
Cemaes	Foel Fawr	-	-	-	-	-	-	1.26	<1.00	<1.00	-	3.22
	Gwyddelyn Bach	-	-	-	<2.92	1.04	1.51	1.42	-	-	-	<1.00
	Tre'r-gof-isaf	-	-	-	<2.92	<1.00	1.00	<2.92	-	4.12	-	2.26
Other	Penrhyn	-	-	-	-	-	<1.00	<2.92	<1.00	<1.00	-	1.28
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	2.92	1.35
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	2.26
	Porth-y-pistyll	<1.00	<1.00	1.10	<2.92	<1.00	<1.00	<1.00	-	2.74	1.14	2.04

Table AB–7: Orthophosphate (reactive as P) (mg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	<0.020	0.022	-	-	-	-	-	0.595
	Wylfa Hall Pond	-	-	-	-	-	-	-	0.022	0.035	-	0.221
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	0.061
	Power Station Pond	-	-	-	0.021	0.069	-	0.066	-	0.09	-	0.048
	Porth Wylfa Pond	-	-	-	-	-	-	-	0.035	0.178	-	0.123
	Porth Wylfa	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	-	<0.02	-	<0.010
	Tre'r Gof SSSI	-	-	-	-	-	-	-	<0.02	<0.02	-	<0.010
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	1.080
	Tregele Pond	-	-	-	-	-	-	-	0.126	-	-	0.382
	Tan-yr-allt Pond	-	-	-	-	-	-	-	0.031	0.189	-	1.120
	Cae Gwyn SSSI	-	-	-	-	-	-	-	<0.020	0.077	-	-
	Groes-fechan	-	-	-	<0.020	<0.020	0.043	<0.020	<0.020	<0.020	-	-
	Caerdegog Isaf	-	-	-	-	<0.020	0.120	0.037	-	<0.02	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	<0.020	0.118	0.038	0.024	<0.02	-	-
	Hafnan	-	-	-	-	0.043	0.152	0.091	-	0.042	-	-
	Cafnan	-	0.033	0.079	0.020	0.030	0.046	0.065	0.054	0.030	-	-
	Felin Gafnan East	-	0.118	0.090	0.020	0.034	0.105	0.073	-	-	-	-
	Felin Gafnan Confluence	-	0.031	0.088	0.020	0.028	0.108	0.069	-	0.039	-	0.043
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	0.247	0.824	-	0.337
	Penyrorsedd	-	-	-	-	-	-	-	0.146	0.077	-	0.076
	US Neuadd	-	-	-	-	-	0.038	0.023	<0.020	0.029	-	0.031
	Neuadd	-	-	-	<0.020	<0.020	0.098	0.027	-	0.027	-	0.052
Cemaes	Foel Fawr	-	-	-	-	-	-	0.100	0.063	0.032	-	0.048
	Gwyddelyn Bach	-	-	-	0.059	0.100	0.139	0.170	-	-	-	0.091
	Tre'r-gof-isaf	-	-	-	0.049	0.079	0.124	0.107	-	0.134	-	0.094
Other	Penrhyn	-	-	-	-	-	<0.020	<0.020	<0.020	<0.020	-	<0.010
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	0.030	0.020
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	0.020
	Porth-y-pistyll	-	<0.020	0.022	<0.020	<0.020	<0.020	0.021	-	<0.020	<0.020	<0.010

Table AB–8: Ammoniacal Nitrogen as N (total ammonia as Nitrogen mg L^{-1}) from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	<0.030	<0.030	-	-	-		-	0.509
	Wylfa Hall Pond	-	-	-	-	-	-	-	<0.030	0.117	-	0.218
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	0.209
	Power Station Pond	-	-	-	0.092	0.092	-	0.095	-	0.385	-	0.081
	Porth Wylfa Pond	-	-	-	-	-	-	-	0.108	1.59	-	0.112
	Porth Wylfa	<0.030	<0.030	<0.030	0.035	<0.030	<0.03	<0.03	-	0.063	-	0.037
	Tre'r Gof SSSI	-	-	-	-	-	-	-	<0.030	0.037	-	<0.03
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	1.780
	Tregele Pond	-	-	-	-	-	-	-	0.048	-	-	0.092
	Tan-yr-allt Pond	-	-	-	-	-	-	-	0.053	0.08	-	1.08
	Cae Gwyn SSSI	-	-	-	-	-	-	-	<0.030	0.068	-	-
	Groes-fechan	-	-	-	0.038	0.033	<0.03	<0.030	0.036	0.030	-	-
	Caerdegog Isaf	-	-	-	-	<0.030	0.066	<0.030	-	0.030	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	0.034	0.311	0.041	<0.030	0.128	-	-
	Hafnan	-	-	-	-	0.063	0.044	0.045	-	0.068	-	-
	Cafnan	0.045	0.083	0.037	0.084	0.053	<0.03	0.045	0.076	<0.030	-	-
	Felin Gafnan East	0.039	0.121	<0.030	0.080	0.147	0.081	0.066	-	-	-	-
	Felin Gafnan Confluence	<0.030	0.072	0.037	0.065	0.043	<0.03	0.055	-	<0.030	-	0.039
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	<0.030	0.18	-	0.245
	Penyrorsedd	-	-	-	-	-	-	-	0.062	0.313	-	0.491
	US Neuadd	-	-	-	-	-	<0.03	0.042	<0.030	0.048	-	0.052
	Neuadd	-	-	-	0.057	0.036	<0.03	<0.030	-	<0.03	-	0.067
Cemaes	Foel Fawr	-	-	-	-	-	-	0.052	0.032	0.03	-	0.043
	Gwyddelyn Bach	-	-	-	0.146	0.057	0.108	0.077	-		-	0.079
	Tre'r-gof-isaf	-	-	-	0.084	<0.030	<0.03	<0.030	-	0.104	-	0.163
Other	Penrhyn	-	-	-	-	-	<0.03	<0.030	<0.030	0.030	-	<0.030
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	0.030	<0.030
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	<0.030
	Porth-y-pistyll	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	-	0.044	0.030	0.062

Table AB–9: Toluene (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	<0.1	<0.1	-	-	-	-	-	<0.1
	Wylfa Hall Pond	-	-	-	-	-	-	-	<0.1	<0.1	-	<0.1
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	<0.1
	Power Station Pond	-	-	-	<0.1	<0.1	-	<0.5	-	<0.1	-	<0.1
	Porth Wylfa Pond	-	-	-	-	-	-	-	<0.1	<0.1	-	<0.1
	Porth Wylfa	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1
	Tre'r Gof SSSI	-	-	-	-	-	-	-	<0.1	<0.1	-	<0.1
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	<0.1
	Tregele Pond	-	-	-	-	-	-	-	<0.1	-	-	<0.1
	Tan-yr-allt Pond	-	-	-	-	-	-	-	<0.1	0.11	-	<0.1
	Cae Gwyn SSSI	-	-	-	-	-	-	-	<0.1	<0.1	-	-
	Groes-fechan	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
	Caerdegog Isaf	-	-	-	-	<0.1	<0.1	<0.1	-	<0.1	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
	Hafnan	-	-	-	-	<0.1	<0.1	<0.1	-	<0.1	-	-
	Cafnan	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
	Felin Gafnan East	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-
	Felin Gafnan Confluence	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	<0.1	<0.1	-	<0.1
	Penyrorsedd	-	-	-	-	-	-	-	<0.1	<0.1	-	<0.1
	US Neuadd	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	-	<0.1
	Neuadd	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1
Cemaes	Foel Fawr	-	-	-	-	-	-	<0.1	<0.1	<0.1	-	<0.1
	Gwyddelyn Bach	-	-	-	<0.1	<0.1	<0.1	<0.1	-	-	-	<0.1
	Tre'r-gof-isaf	-	-	-	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1
Other	Penrhyn	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	-	<0.1
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	<0.1	<0.1
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	<0.1
	Porth-y-pistyll	<0.1	0.11	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1

Table AB–10: Trichloroethylene (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	<0.10	<0.10	-	-	-	-	-	<0.10
	Wylfa Hall Pond	-	-	-	-	-	-	-	<0.10	<0.10	-	<0.10
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	<0.10
	Power Station Pond	-	-	-	<0.10	<0.10	-	<0.50	-	<0.10	-	<0.10
	Porth Wylfa Pond	-	-	-	-	-	-	-	<0.10	<0.10	-	<0.10
	Porth Wylfa	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	-	<0.10
	Tre'r Gof SSSI	-	-	-	-	-	-	-	<0.10	<0.10	-	<0.10
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	<0.10
	Tregele Pond	-	-	-	-	-	-	-	<0.10	-	-	<0.10
	Tan-yr-allt Pond	-	-	-	-	-	-	-	<0.10	<0.10	-	<0.10
	Cae Gwyn SSSI	-	-	-	-	-	-	-	<0.10	<0.10	-	-
	Groes-fechan	-	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	-
	Caerdegog Isaf	-	-	-	-	<0.10	<0.10	<0.10	-	<0.10	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	<0.10	<0.10	<0.10	<0.10	<0.10	-	-
	Hafnan	-	-	-	-	<0.10	<0.10	<0.10	-	<0.10	-	-
	Cafnan	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	-
	Felin Gafnan East	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	-	-	-
	Felin Gafnan Confluence	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	-	<0.10
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	<0.10	<0.10	-	<0.10
	Penyrorsedd	-	-	-	-	-	-	-	<0.10	<0.10	-	<0.10
	US Neuadd	-	-	-	-	-	<0.10	<0.10	<0.10	<0.10	-	<0.10
	Neuadd	-	-	<0.1	<0.1	<0.1	<0.10	<0.10	-	<0.10	-	<0.10
Cemaes	Foel Fawr	-	-	-	-	-	-	<0.10	<0.10	<0.10	-	<0.10
	Gwyddelyn Bach	-	-	-	<0.1	<0.1	<0.10	<0.10	-	-	-	<0.10
	Tre'r-gof-isaf	-	-	-	<0.1	<0.1	<0.10	<0.10	-	<0.10	-	<0.10
Other	Penrhyn	-	-	-	-	-	<0.10	<0.10	<0.10	<0.10	-	<0.10
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	<0.10	<0.10
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	<0.10
	Porth-y-pistyll	1.27	2.02	1.45	1.44	1.83	3.33	0.94	-	0.57	<0.10	0.18

Table AB–11: DEHP (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	<0.20	<0.20	-	-	-	-	-	0.21
	Wylfa Hall Pond	-	-	-	-	-	-	-	<0.20	<0.20	-	<0.20
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	<0.20
	Power Station Pond	-	-	-	<0.20	<0.20	-	<0.20	-	<0.20	-	0.32
	Porth Wylfa Pond	-	-	-	-	-	-	-	<0.20	<0.20	-	0.32
	Porth Wylfa	1.05	<0.20	0.65	<0.20	<0.20	<0.20	<0.20	-	0.24	-	<0.20
	Tre'r Gof SSSI	-	-	-	-	-	-	-	<0.20	<0.20	-	<0.20
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	<0.20
	Tregele Pond	-	-	-	-	-	-	-	<0.20	-	-	<0.20
	Tan-yr-allt Pond	-	-	-	-	-	-	-	<0.20	<0.20	-	0.42
	Cae Gwyn SSSI	-	-	-	-	-	-	-	<0.20	<0.20	-	-
	Groes-fechan	-	-	-	1.77	0.44	<0.20	<0.20	<0.20	<0.20	-	-
	Caerdegog Isaf	-	-	-	-	<0.20	0.42	<0.20	-	<0.20	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	<0.20	0.33	<0.20	<0.20	<0.20	-	-
	Hafnan	-	-	-	-	0.80	<0.20	<0.20	-	<0.20	-	-
	Cafnan	0.45	<0.20	<0.20	<0.20	<0.20	0.52	<0.20	<0.20	<0.20	-	-
	Felin Gafnan East	1.14	<0.20	1.37	<0.20	0.39	0.34	<0.20	-	-	-	-
	Felin Gafnan Confluence	0.42	1.28	0.36	2.04	<0.20	<0.20	<0.20	-	<0.20	-	<0.20
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	<0.20	<0.20	-	0.50
	Penyrorsedd	-	-	-	-	-	-	-	<0.20	<0.20	-	<0.20
	US Neuadd	-	-	-	-	-	0.22	<0.20	<0.20	<0.20	-	0.22
	Neuadd	-	-	0.73	<0.20	<0.20	-	<0.20	-	<0.20	-	0.25
Cemaes	Foel Fawr	-	-	-	-	-	-	<0.20	<0.20	<0.20	-	<0.20
	Gwyddelyn Bach	-	-	-	<0.20	<0.20	0.38	<0.20	-		-	<0.20
	Tre'r-gof-isaf	-	-	-	<0.20	<0.20	0.34	<0.20	-	<0.20	-	<0.20
Other	Penrhyn	-	-	-	-	-	0.23	<0.20	<0.20	<0.20	-	<0.20
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	-	<0.20
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	0.22
	Porth-y-pistyll	0.53	<0.20	1.71	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	0.25

Table AB–12: Arsenic Dissolved (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	<1	<1	-	-	-	-	-	<1
	Wylfa Hall Pond	-	-	-	-	-	-	-	<1	<1	-	1.02
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	<1
	Power Station Pond	-	-	-	<1	<1	-	<1	-	<1	-	<1
	Porth Wylfa Pond	-	-	-	-	-	-	-	<1	1.81	-	<1
	Porth Wylfa	<1	<1	<1	<1	<1	-	<1	-	<1	-	<1
	Tre'r Gof SSSI	-	-	-	-	-	-	-	<1	<1	-	<1
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	8.18
	Tregele Pond	-	-	-	-	-	-	-	<1	-	-	2.73
	Tan-yr-allt Pond	-	-	-	-	-	-	-	<1	<1	-	2.04
	Cae Gwyn SSSI	-	-	-	-	-	-	-	<1	<1	-	-
	Groes-fechan	-	-	-	<1	<1	<1	-	<1	<1	-	
	Caerdegog Isaf	-	-	-	-	<1	1.1	<1	-	<1	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	<1	1.45	<1	<1	<1	-	-
	Hafnan	-	-	-	-	<1	1.04	<1	-	<1	-	-
	Cafnan	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-
	Felin Gafnan East	<1	<1	<1	-	<1	<1	<1	-	-	-	-
	Felin Gafnan Confluence	<1	<1	<1	-	<1	<1	<1	-	<1	-	<1
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	<1	3.23	-	1.31
	Penyrorsedd	-	-	-	-	-	-	-	<1	<1	-	<1
	US Neuadd	-	-	-	-	-	1.09	<1	<1	<1	-	<1
	Neuadd	<1	-	-	<1	<1	1.23	<1	-	<1	-	<1
Cemaes	Foel Fawr	-	-	-	-	-	-	<1	<1	<1	-	<1
	Gwyddelyn Bach	-	-	-	<1	<1	<1	<1	-	-	-	<1
	Tre'r-gof-isaf	-	-	-	<1	<1	<1	<1	-	<1	-	<1
Other	Penrhyn	-	-	-	-	-	<1	<1	<1	<1	-	<1
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	<1	<1
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	<1
	Porth-y-pistyll	<1	<1	<1	<1	<1	<1	<1	-	<1	<1	<1

Table AB–13: Cadmium dissolved (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	<0.1	<0.1	-	-	-	-	-	<0.1
	Wylfa Hall Pond	-	-	-	-	-	-	-	<0.1	<0.1	-	<0.1
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	<0.1
	Power Station Pond	-	-	-	<0.1	<0.1	-	0.106	-	<0.1	-	<0.1
	Porth Wylfa Pond	-	-	-	-	-	-	-	<0.1	<0.1	-	<0.1
	Porth Wylfa	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	-	<0.1
	Tre'r Gof SSSI	-	-	-	-	-	-	-	<0.1	<0.1	-	<0.1
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	0.389
	Tregele Pond	-	-	-	-	-	-	-	<0.1	-	-	0.125
	Tan-yr-allt Pond	-	-	-	-	-	-	-	<0.1	<0.1	-	<0.1
	Cae Gwyn SSSI	-	-	-	-	-	-	-	<0.1	<0.1	-	-
	Groes-fechan	-	-	-	<0.1	<0.1	<0.1	-	<0.1	<0.1	-	-
	Caerdegog Isaf	-	-	-		<0.1	<0.1	<0.1	-	<0.1	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
	Hafnan	-	-	-		<0.1	<0.1	<0.1	-	<0.1	-	-
	Cafnan	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
	Felin Gafnan East	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	-	-	-	-
	Felin Gafnan Confluence	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	-	<0.1	-	<0.1
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	<0.1	<0.1	-	<0.1
	Penyrorsedd	-	-	-	-	-	-	-	<0.1	<0.1	-	<0.1
	US Neuadd	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	-	<0.1
	Neuadd	<0.1	-	-	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1
Cemaes	Foel Fawr	-	-	-	-	-	-	<0.1	<0.1	<0.1	-	<0.1
	Gwyddelyn Bach	-	-	-	<0.1	<0.1	<0.1	<0.1	-	-	-	<0.1
	Tre'r-gof-isaf	-	-	-	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1
Other	Penrhyn	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1	-	<0.1
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	<0.1	<0.1
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	<0.1
	Porth-y-pistyll	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1

Table AB–14: Chromium dissolved (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	<0.5	<0.5	-		-	-	-	<0.5
	Wylfa Hall Pond	-	-	-	-	-	-	-	<0.5	<0.5	-	<0.5
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	<0.5
	Power Station Pond	-	-	-	<0.5	<0.5	-	<0.5	-	<0.5	-	<0.5
	Porth Wylfa Pond	-	-	-	-	-	-	-	<0.5	<0.5	-	<0.5
	Porth Wylfa	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	<0.5
	Tre'r Gof SSSI	-	-	-	-	-	-	-	<0.5	<0.5	-	<0.5
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	2.19
	Tregele Pond	-	-	-	-	-	-	-	<0.5	-	-	<0.5
	Tan-yr-allt Pond	-	-	-	-	-	-	-	<0.5	7.79	-	1.72
	Cae Gwyn SSSI	-	-	-	-	-	-	-	<0.5	<0.5	-	-
	Groes-fechan	-	-	-	<0.5	<0.5	<0.5		<0.5	<0.5	-	-
	Caerdegog Isaf	-	-	-		<0.5	<0.5	<0.5	-	<0.5	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	<0.5	<0.5	0.58	<0.5	<0.5	-	-
	Hafnan	-	-	-		<0.5	<0.5	0.71	-	<0.5	-	-
	Cafnan	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
	Felin Gafnan East	<0.5	<0.5	<0.5		<0.5	<0.5	0.53	-	-	-	-
	Felin Gafnan Confluence	<0.5	<0.5	<0.5		<0.5	<0.5	0.52	-	<0.5	-	<0.5
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	<0.5	<0.5	-	<0.5
	Penyrorsedd	-	-	-	-	-	-	-	<0.5	<0.5	-	<0.5
	US Neuadd	-	-	-	-	-	<0.5	0.53	<0.5	<0.5	-	<0.5
	Neuadd	<0.5	-	-	<0.5	<0.5	<0.5	<0.5	-	<0.5	-	<0.5
Cemaes	Foel Fawr	-	-	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5
	Gwyddelyn Bach	-	-	-	<0.5	<0.5	<0.5	0.74	-	-	-	0.58
	Tre'r-gof-isaf	-	-	-	<0.5	<0.5	<0.5	0.88	-	<0.5	-	0.53
Other	Penrhyn	-	-	-	-	-	<0.5	<0.5	<0.5	<0.5	-	<0.5
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	1.24	0.52
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	<0.5
	Porth-y-pistyll	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5

Table AB–15: Copper dissolved (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	1.52	1.59	-		-	-	-	4.41
	Wylfa Hall Pond	-	-	-	-	-	-	-	2.09	2.19	-	6.41
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	1.03
	Power Station Pond	-	-	-	1.09	<1	-	4.02	-	<1	-	3.12
	Porth Wylfa Pond	-	-	-	-	-	-	-	1.79	<1	-	4.51
	Porth Wylfa	1.09	1.23	<1	<1	<1	-	1.23	-	<1	-	<1
	Tre'r Gof SSSI	-	-	-	-	-	-	-	1.34	<1	-	<1
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	33.20
	Tregele Pond	-	-	-	-	-	-	-	1.79	-	-	8.46
	Tan-yr-allt Pond	-	-	-	-	-	-	-	2.15	<1	-	5.85
	Cae Gwyn SSSI	-	-	-	-	-	-	-	1.23	1.29	-	-
	Groes-fechan	-	-	-	3.52	3.83	2.06	-	4.15	3.24	-	-
	Caerdegog Isaf	-	-	-	-	2.60	2.20	3.22	-	1.64	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	1.37	1.78	5.40	2.04	2.99	-	-
	Hafnan	-	-	-	-	1.82	1.94	3.13	-	1.46	-	-
	Cafnan	1.62	1.46	1.49	1.26	1.58	1.43	2.53	1.71	1.50	-	-
	Felin Gafnan East	1.73	1.46	1.66	-	1.65	1.56	3.12	-	-	-	-
	Felin Gafnan Confluence	1.84	1.69	1.66	-	1.55	1.66	3.04	-	1.66	-	2.10
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	5.21	3.56	-	10.40
	Penyrorsedd	-	-	-	-	-	-	-	3.30	1.28	-	1.79
	US Neuadd	-	-	-	-	-	<1	2.78	1.82	1.09	-	2.05
	Neuadd	1.93	-	-	1.24	1.71	1.21	3.27	-	1.14	-	2.07
Cemaes	Foel Fawr	-	-	-	-	-	-	5.13	2.66	1.80	-	4.20
	Gwyddelyn Bach	-	-	-	1.50	1.69	1.96	6.60	-	-	-	3.70
	Tre'r-gof-isaf	-	-	-	1.32	1.63	2.08	4.47	-	2.09	-	3.24
Other	Penrhyn	-	-	-	-	-	<1	<1	<1	<1	-	<1
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	5.91	3.42
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	3.62
	Porth-y-pistyll	2.33	1.69	3.12	2.03	2.11	1.77	3.35	-	2.52	2.11	4.52

Table AB–16: Lead dissolved (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	<2	<2	-	-	-	-	-	<2
	Wylfa Hall Pond	-	-	-	-	-	-	-	<2	<2	-	<2
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	<2
	Power Station Pond	-	-	-	<2	<2	-	<2	-	<2	-	<2
	Porth Wylfa Pond	-	-	-	-	-	-	-	<2	<2	-	<2
	Porth Wylfa	<2	<2	<2	<2	<2	-	<2	-	<2	-	<2
	Tre'r Gof SSSI	-	-	-	-	-	-	-	<2	<2	-	<2
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	9.75
	Tregele Pond	-	-	-	-	-	-	-	<2	-	-	<2
	Tan-yr-allt Pond	-	-	-	-	-	-	-	<2	<2	-	2.42
	Cae Gwyn SSSI	-	-	-	-	-	-	-	<2	<2	-	-
	Groes-fechan	-	-	-	<2	<2	<2	-	<2	<2	-	-
	Caerdegog Isaf	-	-	-	-	<2	<2	<2	-	<2	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	<2	<2	<2	<2	<2	-	-
	Hafnan	-	-	-	-	<2	<2	<2	-	<2	-	-
	Cafnan	<2	<2	<2	<2	<2	<2	<2	<2	<2	-	-
	Felin Gafnan East	<2	<2	<2	-	<2	<2	<2	-	-	-	-
	Felin Gafnan Confluence	<2	<2	<2	-	<2	<2	<2	-	<2	-	<2
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	<2	<2	-	<2
	Penyrorsedd	-	-	-	-	-	-	-	<2	<2	-	<2
	US Neuadd	-	-	-	-	-	<2	<2	<2	<2	-	<2
	Neuadd	<2	-	-	<2	<2	<2	<2	-	<2	-	<2
Cemaes	Foel Fawr	-	-	-	-	-	-	<2	<2	<2	-	<2
	Gwyddelyn Bach	-	-	-	<2	<2	<2	<2	-	-	-	<2
	Tre'r-gof-isaf	-	-	-	<2	<2	<2	<2	-	<2	-	<2
Other	Penrhyn	-	-	-	-	-	<2	<2	<2	<2	-	<2
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	<2	<2
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	<2
	Porth-y-pistyll	<2	<2	<2	<2	<2	<2	<2	-	<2	<2	<2

Table AB–17: Nickel dissolved (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	<1	<1	-	-	-	-	-	1.95
	Wylfa Hall Pond	-	-	-	-	-	-	-	<1	1.17	-	1.56
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	<1
	Power Station Pond	-	-	-	<1	<1	-	1.54	-	1.18	-	1.14
	Porth Wylfa Pond	-	-	-	-	-	-	-	1.55	1.06	-	2.32
	Porth Wylfa	<1	<1	<1	<1	<1	-	<1	-	<1	-	<1
	Tre'r Gof SSSI	-	-	-	-	-	-	-	<1	<1	-	<1
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	9.88
	Tregele Pond	-	-	-	-	-	-	-	1.05	-	-	2.14
	Tan-yr-allt Pond	-	-	-	-	-	-	-	<1	1.3	-	5.72
	Cae Gwyn SSSI	-	-	-	-	-	-	-	1.04	1.19	-	-
	Groes-fechan	-	-	-	1.09	1.16	<1	-	1.2	<1	-	-
	Caerdegog Isaf	-	-	-		1.2	1.19	1.08	-	<1	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	<1	1.62	1.46	<1	<1	-	-
	Hafnan	-	-	-		1.2	1.2	2.06	-	<1	-	-
	Cafnan	1.2	1.03	1.4	1.17	1.18	<1	1.44	1.28	<1	-	-
	Felin Gafnan East	1.05	1.25	1.39	-	1.1	1.13	1.76	-	-	-	-
	Felin Gafnan Confluence	1.13	1.1	1.44	-	1.09	1.12	1.77	-	<1	-	1.33
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	1.38	2.88	-	2.43
	Penyrorsedd	-	-	-	-	-	-	-	1.35	<1	-	1.26
	US Neuadd	-	-	-	-	-	<1	1.2	<1	<1	-	1.07
	Neuadd	<1	-	-	<1	<1	<1	1.16	-	<1	-	1.02
Cemaes	Foel Fawr	-	-	-	-	-	-	1.61	1.18	<1	-	1.19
	Gwyddelyn Bach	-	-	-	1.46	1.32	1.48	1.98	-	-	-	1.57
	Tre'r-gof-isaf	-	-	-	1.27	1.05	<1	1.95	-	<1	-	1.23
Other	Penrhyn	-	-	-	-	-	<1	<1	<1	<1	-	<1
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	1.93	<1
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	<1
	Porth-y-pistyll	<1	<1	<1	<1	<1	2.64	<1	-	<1	<1	<1

Table AB–18: Zinc dissolved (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	5.38	<5	-	-	-	-	-	19.70
	Wylfa Hall Pond	-	-	-	-	-	-	-	6.07	<5	-	17.40
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	<5
	Power Station Pond	-	-	-	6.22	<5	-	22.00	-	<5	-	21.80
	Porth Wylfa Pond	-	-	-	-	-	-	-	<5	<5	-	<5
	Porth Wylfa	<5	<5	<5	<5	<5	-	<5	-	10.50	-	<5
	Tre'r Gof SSSI	-	-	-	-	-	-	-	<5	<5	-	<5
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	31.70
	Tregele Pond	-	-	-	-	-	-	-	5.52	-	-	15.10
	Tan-yr-allt Pond	-	-	-	-	-	-	-	11.70	5.90	-	21.40
	Cae Gwyn SSSI	-	-	-	-	-	-	-	<5	<5	-	
	Groes-fechan	-	-	-	<5	<5	<5	-	<5	<5	-	-
	Caerdegog Isaf	-	-	-	-	<5	<5	<5	-	<5	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	<5	<5	5.63	<5	29.90	-	-
	Hafnan	-	-	-	-	5.24	<5	8.10	-	<5	-	-
	Cafnan	<5	<5	<5	<5	<5	5.28	<5	<5	24.50	-	-
	Felin Gafnan East	<5	<5	<5	-	<5	<5	<5	-	-	-	-
	Felin Gafnan Confluence	<5	<5	<5	-	<5	<5	<5	-	<5	-	<5
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	<5	<5	-	<5
	Penyrorsedd	-	-	-	-	-	-	-	<5	<5	-	<5
	US Neuadd	-	-	-	-	-	<5	<5	<5	<5	-	<5
	Neuadd		-	-	<5	<5	<5	8.77	-	<5	-	<5
Cemaes	Foel Fawr	-	-	-	-	-	-	6.38	<5	<5	-	<5
	Gwyddelyn Bach	-	-	-	<5	<5	<5	7.65	-	-	-	<5
	Tre'r-gof-isaf	-	-	-	<5	<5	<5	5.27	-	<5	-	<5
Other	Penrhyn	-	-	-	-	-	<5	<5	<5	<5	-	<5
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	10.10	<5
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	<5
	Porth-y-pistyll	<5	<5	6.26	<5	<5	11.10	<5	-	8.55	<5	6.43

Table AB–20: Iron (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	45	144	-	-	-	-	-	7470
	Wylfa Hall Pond	-	-	-	-	-	-	-	<30	332	-	197
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	45
	Power Station Pond	-	-	-	85	330	-	787	-	1840	-	373
	Porth Wylfa Pond	-	-	-	-	-	-	-	33	637	-	337
	Porth Wylfa	81	98	95	87	170	-	154	-	143	-	130
	Tre'r Gof SSSI	-	-	-	-	-	-	-	<30	68	-	86
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	24400
	Tregele Pond	-	-	-	-	-	-	-	706	-	-	370
	Tan-yr-allt Pond	-	-	-	-	-	-	-	348	2680	-	23900
	Cae Gwyn SSSI	-	-	-	-	-	-	-	383	579	-	-
	Groes-fechan	-	-	-	250	401	221	-	233	277	-	-
	Caerdegog Isaf	-	-	-	-	193	189	236	-	80	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	347	381	315	165	88	-	-
	Hafnan	-	-	-	-	122	215	185	-	89	-	-
	Cafnan	124	92	269	106	144	135	212	113	78	-	-
	Felin Gafnan East	128	82	322	-	123	188	217	-	-	-	-
	Felin Gafnan Confluence	124	73	321	-	129	153	216	-	67	-	142
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	<30	273	-	72
	Penyrorsedd	-	-	-	-	-	-	-	76	62	-	157
	US Neuadd	-	-	-	-	-	188	154	141	174	-	120
	Neuadd	110	-	-	118	186	41	104	-	127	-	78
Cemaes	Foel Fawr	-	-	-	-	-	-	368	252	163	-	206
	Gwyddelyn Bach	-	-	-	424	483	193	369	-	-	-	185
	Tre'r-gof-isaf	-	-	-	161	270	73	262	-	137	-	109
Other	Penrhyn	-	-	-	-	-	<30	<30	<30	<30	-	<30
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	2130	<30
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	38
	Porth-y-pistyll	<30	<30	<30	30	53	<30	<30	-	<30	123	<30

Table AB–21: Manganese (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	83	170	-	-	-	-	-	-
	Wylfa Hall Pond	-	-	-	-	-	-	-	105	58	-	-
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	-
	Power Station Pond	-	-	-	251	260	-	1520	-	785	-	-
	Porth Wylfa Pond	-	-	-	-	-	-	-	70	753	-	-
	Porth Wylfa	-	575	125	971	923	-	374	-	505	-	-
	Tre'r Gof SSSI	-	-	-	-	-	-	-	108	4240	-	-
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	-
	Tregele Pond	-	-	-	-	-	-	-	231	-	-	-
	Tan-yr-allt Pond	-	-	-	-	-	-	-	109	1470	-	-
	Cae Gwyn SSSI	-	-	-	-	-	-	-	178	675	-	-
	Groes-fechan	-	-	-	165	188	407	-	83	201	-	-
	Caerdegog Isaf	-	-	-	-	67	169	78	-	25	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	333	1140	155	85	36	-	-
	Hafnan	-	-	-	-	143	584	73	-	171	-	-
	Cafnan	-	235	258	150	156	688	95	98	131	-	-
	Felin Gafnan East	-	84	93	-	152	189	65	-	-	-	-
	Felin Gafnan Confluence	-	74	140	-	144	138	62	-	54	-	-
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	14	438	-	-
	Penyrorsedd	-	-	-	-	-	-	-	128	175	-	-
	US Neuadd	-	-	-	-	-	357	58	77	305	-	-
	Neuadd	-	-	-	188	101	333	17	-	137	-	-
Cemaes	Foel Fawr	-	-	-	-	-	-	52	122	109	-	-
	Gwyddelyn Bach	-	-	-	261	223	230	76	-	-	-	-
	Tre'r-gof-isaf	-	-	-	176	93	124	93	-	986	-	-
Other	Penrhyn	-	-	-	-	-	<10	<10	<10	<10	-	-
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	293	-
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	-
	Porth-y-pistyll	-	44	18	41	79	61	28	-	17	21	-

Table AB–22: Mercury dissolved (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	0.265	0.012	-	-	-	-	-	<0.01
	Wylfa Hall Pond	-	-	-	-	-	-	-	<0.01	<0.01	-	<0.01
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	<0.01
	Power Station Pond	-	-	-	0.023	<0.01	-	<0.01	-	<0.01	-	0.010
	Porth Wylfa Pond	-	-	-	-	-	-	-	<0.01	<0.01	-	<0.01
	Porth Wylfa	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	-	<0.01	-	<0.01
	Tre'r Gof SSSI	-	-	-	-	-	-	-	<0.01	<0.01	-	<0.01
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	0.088
	Tregele Pond	-	-	-	-	-	-	-	<0.01	-	-	<0.01
	Tan-yr-allt Pond	-	-	-	-	-	-	-	<0.01	<0.01	-	0.022
	Cae Gwyn SSSI	-	-	-	-	-	-	-	<0.01	<0.01	-	-
	Groes-fechan	-	-	-	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	-
	Caerdegog Isaf	-	-	-	-	<0.01	<0.01	<0.01	-	<0.01	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
	Hafnan	-	-	-	-	<0.01	<0.01	<0.01	-	<0.01	-	-
	Cafnan	<0.01	<0.01	<0.01	0.019	<0.01	<0.01	0.028	<0.01	<0.01	-	-
	Felin Gafnan East	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	-	-	-	-
	Felin Gafnan Confluence	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	-	<0.01	-	<0.01
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	<0.01	<0.01	-	<0.01
	Penyrorsedd	-	-	-	-	-	-	-	<0.01	<0.01	-	<0.01
	US Neuadd	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01	-	0.063
	Neuadd	<0.01	-	-	0.195	<0.01	<0.01	<0.01	-	<0.01	-	<0.01
Cemaes	Foel Fawr	-	-	-	-	-	-	0.013	<0.01	<0.01	-	<0.01
	Gwyddelyn Bach	-	-	-	<0.01	<0.01	<0.01	<0.01	-	-	-	<0.01
	Tre'r-gof-isaf	-	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01	-	<0.01
Other	Penrhyn	-	-	-	-	-	<0.01	<0.01	<0.01	<0.01	-	<0.01
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	<0.01	<0.01
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	<0.01
	Porth-y-pistyll	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01

Table AB–23: Hydrocarbons Screen (C5 - C44) (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	0.31	<0.2	-	-	-	-	-	<0.2
	Wylfa Hall Pond	-	-	-	-	-	-	-	<0.2	<0.2	-	<0.2
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	<0.2
	Power Station Pond	-	-	-	<0.2	<0.2	-	<0.2	-	<0.2	-	<0.2
	Porth Wylfa Pond	-	-	-	-	-	-	-	<0.2	<0.2	-	<0.2
	Porth Wylfa	-	0.233	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.2	-	<0.2
	Tre'r Gof SSSI	-	-	-	-	-	-	-	<0.2	0.22	-	<0.2
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	<0.2
	Tregele Pond	-	-	-	-	-	-	-	<0.2	-	-	<0.2
	Tan-yr-allt Pond	-	-	-	-	-	-	-	<0.2	0.24	-	<0.2
	Cae Gwyn SSSI	-	-	-	-	-	-	-	<0.2	<0.2	-	-
	Groes-fechan	-	-	-	<0.2	<0.2	<0.2	-	<0.2	<0.2	-	-
	Caerdegog Isaf	-	-	-	-	<0.2	<0.2	<0.2	-	<0.2	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
	Hafnan	-	-	-	-	<0.2	<0.2	<0.2	-	<0.2	-	-
	Cafnan	-	0.277	<0.2	<0.2	<0.2	-	<0.2	<0.2	<0.2	-	-
	Felin Gafnan East	-	0.23	<0.2	<0.2	<0.2	<0.2	-	-	-	-	-
	Felin Gafnan Confluence	-	0.25	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.2	-	<0.2
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	<0.2	<0.2	-	<0.2
	Penyrorsedd	-	-	-	-	-	-	-	<0.2	<0.2	-	<0.2
	US Neuadd	-	-	-	-	-	<0.2	<0.2	<0.2	<0.2	-	<0.2
	Neuadd	-	-		<0.2	<0.2	<0.2	<0.2	-	<0.2	-	<0.2
Cemaes	Foel Fawr	-	-	-	-	-	-	<0.2	<0.2	<0.2	-	<0.2
	Gwyddelyn Bach	-	-	-	<0.2	<0.2	<0.2	-	-	-	-	<0.2
	Tre'r-gof-isaf	-	-	-	<0.2	<0.2	<0.2	<0.2	-	<0.2	-	<0.2
Other	Penrhyn	-	-	-	-	-	<0.2	<0.2	<0.2	<0.2	-	<0.2
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	<0.2	<0.2
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	<0.2
	Porth-y-pistyll	-	0.271	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.2	<0.2	<0.2

Table AB–22: Chloride (µg L^{-1}) data from freshwater sites surveyed, 2012–2014.

Catchment	Site	Winter 2012	Spring 2012	Summer 2012	Winter 2013	Spring-2013	Summer 2013	Autumn 2013	Winter 2014	Spring 2014	Summer 2014	Autumn 2014
Tre'r Gof	Power Station Junction	-	-	-	63.8	72.3	-	-	-	-	-	52.6
	Wylfa Hall Pond	-	-	-	-	-	-	-	64.5	59.8	-	30.2
	Tyddyn-Goronwy	-	-	-	-	-	-	-	-	-	-	82.4
	Power Station Pond	-	-	-	67.3	58.4	-	21.4	-	54.6	-	49.3
	Porth Wylfa Pond	-	-	-	-	-	-	-	45.1	43.4	-	53.4
	Porth Wylfa	66.5	59.5	51.7	53.3	57.4	57.3	47.9	-	58	-	72.9
	Tre'r Gof SSSI	-	-	-	-	-	-	-	65.8	93	-	119
Afon Cafnan	Rhwng Dau Fynydd	-	-	-	-	-	-	-	-	-	-	
	Tregele Pond	-	-	-	-	-	-	-	136	-	-	40.5
	Tan-yr-allt Pond	-	-	-	-	-	-	-	56.1	28.3	-	45.0
	Cae Gwyn SSSI	-	-	-	-	-	-	-	50.5	35.0	-	-
	Groes-fechan	-	-	-	51.0	48.8	53.2	40.1	46.4	51.7	-	-
	Caerdegog Isaf	-	-	-		50.1	48.0	45.4	-	47.9	-	-
	Hafnan - Caerdegog Isaf	-	-	-	-	40.9	53.3	39.4	40.6	37.4	-	-
	Hafnan	-	-	-	-	37.5	53.9	35.3	-	42.1	-	-
	Cafnan	45.2	43.9	42.6	42.1	37.5	64.7	35.0	40.1	40.6	-	-
	Felin Gafnan East	45.7	44.3	42.2	42.7	37.8	47.5	34.2	-	-	-	-
	Felin Gafnan Confluence	45.6	45.7	41.5	43.2	40.0	48.2	37.6	-	41.1	-	38.6
Cemlyn	Penyrorsedd Pond	-	-	-	-	-	-	-	49.6	95.2	-	68.9
	Penyrorsedd	-	-	-	-	-	-	-	53.7	48.2	-	79.4
	US Neuadd	-	-	-	-	-	38.7	34.4	39.9	35.0	-	42.1
	Neuadd	44.8	-	-	37.2	37.1	39.7	34.2	-	34.5	-	41.9
Cemaes	Foel Fawr	-	-	-	-	-	-	36.4	39.3	34.5	-	40.4
	Gwyddelyn Bach	-	-	-	40.6	37.8	50.6	38.4	-	-	-	44.9
	Tre'r-gof-isaf	-	-	-	42.5	38.8	47.9	41.2	-	39.3	-	37.1
Other	Penrhyn	-	-	-	-	-	62.7	118	88.5	66.4	-	78.2
	Tan-yr-allt Ditch (Site 2)	-	-	-	-	-	-	-	-	-	35.1	35.7
	Tan-yr-allt Ditch (Site 3)	-	-	-	-	-	-	-	-	-	-	40.2
	Porth-y-pistyll	95.4	83.4	82.2	101	97.8	97.7	67.9	-	71.2	68.8	68.1

Appendix C Macroinvertebrates

Table AC-1: List of macroinvertebrate species recorded across survey sites, 2014

Species	Cae Gwyn SSSI	Caerdegog Isaf	Cafnan	Felin Gafnan Conf.		Foel Fawr		Groes-fechan	Hafnan	Hafnan-Caerd Isaf	Neuadd		Penrhyn		Penyrorsedd Stream		Porth Wylfa		Porth-y-pistyll			Power St. Junct.	Tre'r-gof-isaf		Tre'r-Gof SSSI		U/S Neuadd	
	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Su	Au	Au	Sp	Au	Sp	Au	Sp	Au
Agabus bipustulatus																		1				1						
Agabus sp.																				8						10		
Agabus sturmii																		1										
Agapetus fuscipes		11		10	257			4			7								3				101	26			46	
Agapetus sp.				1								1																
Alainites muticus					1																							
Anacaena globulus	9		1				1																1					
Ancylus fluviatilis		14	5	1					2															4			33	
Asellus aquaticus	442	4	177	10		4	12	148	15	130		3			1		60	138					2	10	211	425	4	17
Asellidae									2	74							79								87			
Baetidae								1				4								1								
Baetis rhodani		100		676	5	1		5	45		618	15							114				143	4			34	
Baetis sp.					7																							
Bathyomphalus contortus	68									52								2				2			53	134		
Beraea pullata													6															
Caenis luctuosa											133	103								1								
Caenis sp.																				1								
Callicorixa praeusta															1													
Ceratopogoninae	3					1					5	1	1		2				24		3	6			1			

Species	Cae Gwyn SSSI	Caerdegog Isaf	Cafnan	Felin Gafnan Conf.		Foel Fawr		Groes-fechan	Hafnan	Hafnan-Caerd Isaf	Neuadd		Penrhyn		Penyrorsedd Stream		Porth Wylfa		Porth-y-pistyll			Power St. Junct.	Tre'r-gof-isaf		Tre'r-Gof SSSI		U/S Neuadd	
	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Su	Au	Au	Sp	Au	Sp	Au	Sp	Au
Chaetopteryx villosa									1																			
Chelifera sp.										1																		
Chironomidae	230	8	469	144	4	181	159	139	121	1396	40	488	99	344	240	14	142	7	306	1703	169	76	29	10	256	53	153	
Cloeon dipterum															24													
Coenagrionidae	5												2					1								3		
Coleoptera																						1						
COLYMBETINAE	16														10										1			
Copelatus haemorrhoidalis																										1		
Copepoda sp.																					5							
Corixidae															31													
Crangonyx pseudogracilis																	2	2							17	69		
Culicidae																		28				183				2		
Curculionidae																1												
Dicranota sp.		26	3	1		27		4	35		18												24	3			11	
Diptera	3		1	2									1		24		1	1					1		3		2	
Dixella aestivalis																					1							
Dixella sp.																					11				1	23		
Dolichopodidae																			1									
Drusus annulatus			1																									
Dytiscidae	2									5					1										1			
Elmis aenea		175	8	138	30	24	1	9	6		242	41						1	10			2	410	40			377	18
Elodes sp.	21	5	1			41		91	1	1	6		11		1												13	

Species	Cae Gwyn SSSI	Caerdegog Isaf	Cafnan	Felin Gafnan Conf.		Foel Fawr		Groes-fechan	Hafnan	Hafnan-Caerd Isaf	Neuadd		Penrhyn		Penyrorsedd Stream		Porth Wylfa		Porth-y-pistyll			Power St. Junct.	Tre'r-gof-isaf		Tre'r-Gof SSSI		U/S Neuadd	
	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Su	Au	Au	Sp	Au	Sp	Au	Sp	Au
Eloeophila sp.		16				7		8			1												2				4	
Empididae																				6								
Ephydridae																			3				1					
Erpobdella octoculata	1		9	6					3	2	21	1			2	3	29	3	5	36			6	1	5	3	1	2
Erpobdella sp.																		7						14				
Erpobdella testacea																					10					13		
Ferrissia walteri	2																											
Galba truncatula	1								1	2	1		1	4			7	3				9				2	2	
Gammarus duebeni				100	52																							
Gammarus pulex	41	698	94			1174	167	448	1636	10	701	696			260	1141	215	52	743	112	713		901	180	98	6	987	228
Gammarus sp.					35									1											178			
Gammarus zaddachi				620	433																							
Gerris lacustris										1																		
Glossiphonia complanata	2	7	1			3	1	4	2		4	3			1	1	2	1	3	72	12		6	29	2	2		4
Glossiphoniidae																										1		
Glossosomatidae		14									3																	
Gyraulus albus			21								1																	
Gyraulus crista	7		2		1					2										7						38		
Gyrinidae			2							1					6													
Gyrinus urinator																							1					
Halesus radiatus								2	1														2					
Haliplidae														2														

Species	Cae Gwyn SSSI	Caerdegog Isaf	Cafnan	Felin Gafnan Conf.		Foel Fawr		Groes-fechan	Hafnan	Hafnan-Caerd Isaf	Neuadd		Penrhyn		Penyrorsedd Stream		Porth Wylfa		Porth-y-pistyll			Power St. Junct.	Tre'r-gof-isaf		Tre'r-Gof SSSI		U/S Neuadd	
	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Su	Au	Au	Sp	Au	Sp	Au	Sp	Au
Haliplus lineatocollis													3									1						
Haliplus sp.															2													
Helius sp.	5																1	1				1				3		1
Helobdella stagnalis			1								18	2			4	6	5	4	1	156	4		1		6	2		
Helophorus aequalis																			1									
Helophorus brevipalpis	1						5			2				18	3		2				1	2				1		1
Helophorus grandis										8				2														
Helophorus sp.																			4									
Hemiclepsis marginata																									1			
Hydracarina	1		16			1		1	1	1	1	1		4					74	9	12	4	5					
Hydroporinae	1														2													
Hydroptilidae																			9									
Hydropsyche angustipennis					1						111	15												4				
Hydropsyche siltalai				54																			158	43				
Hydropsyche sp.												6																
Hydrophilidae							1									1								1				
Hydroporus angustatus															2													
Hydroporus incognitus																	2											
Hydroporus nigrita														2														
Hydroporus palustris										1																		
Hydroporus sp.														1			2								1			
Hydroporus tesselatus										1				7			1								1			

Species	Cae Gwyn SSSI	Caerdegog Isaf	Cafnan	Felin Gafnan Conf.		Foel Fawr		Groes-fechan	Hafnan	Hafnan-Caerd Isaf	Neuadd		Penrhyn		Penyrorsedd Stream		Porth Wylfa		Porth-y-pistyll			Power St. Junct.	Tre'r-gof-isaf		Tre'r-Gof SSSI		U/S Neuadd	
	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Su	Au	Au	Sp	Au	Sp	Au	Sp	Au
Hydroptila sp.														1														
Ilybius ater																									1			
Ischnura elegans	3		2										1		1										1			
Janiridae					78																							
Leuctridae																				1								
Limnephilidae		4					1		1				11	2	3			14		1	11	15			10	3		1
Limnephilus hirsustus													4															
Limnephilus lunatus	8	2	6			7		1	2	3	25		27		6		9		5				4		18			
Limnephilus sp.	11					16																	1			3		
Limnius volckmari				19	12						23	1	1										156	29				
Limoniidae				1								1																
Lonchopteridae																					1							
Lymnaea sp.																									2			
Lymnaeidae																1												
Lype reducta																												3
Microcara sp.	28																											
Micropterna sequax		10																						3				
Neolimnophila sp.		3				7		1			1								15				2					
Nemouridae																	4											
Nemurella pictetii																		3			34							
Notonecta sp.															2													
Nepa cinerea	1																											
Oligochaeta	131	34	8	12	3	1		8	27	6	13	77	9	105	146	678	92	214	70	122	25	155	28	36	17	2		

Species	Cae Gwyn SSSI	Caerdegog Isaf	Cafnan	Felin Gafnan Conf.		Foel Fawr		Groes-fechan	Hafnan	Hafnan-Caerd Isaf	Neuadd		Penrhyn		Penyrorsedd Stream		Porth Wylfa		Porth-y-pistyll			Power St. Junct.	Tre'r-gof-isaf		Tre'r-Gof SSSI		U/S Neuadd	
	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Su	Au	Au	Sp	Au	Sp	Au	Sp	Au
Ostracoda													1		42	19	6	5	2	57	8					1		
Oulimnius tuberculatus											1																	
Oxyethira sp.															1													
Paracymus scutellaris	13																											
Paracymus sp.	44																											
Pediciidae																				1								
Pericoma sp.	1	1					1						1		2													
Physa fontinalis																						38						
Pisidium sp.	103	61	20	4	1	155	1	26	12	9	93	46	12	167	1	22	6	23	4			12	4	15				71
Planariidae																						22						
Planorbidae																									2			
Planorbis carinatus			12							4													2					
Planorbis planorbis	59																					1			5	3		
Platambus maculatus	3																1											
Plectrocnemia conspersa		2		2				38			6		1				1				1		1	1	8			1
Plectrocnemia sp.												2																
Polycelis felina			1										3						112		49		12	18		1		1
Polycelis nigra/tenuis	137	11	12	2		1		3	2	25	2	1			94	14	22	13	3	30	77		2		34			1
Polycelis sp.							2															6				16		1
Polycentropodidae						1												1										
Potamopyrgus antipodarum	1	1348	2	48	1207						689	6	1774	458					1243	75	1023	74	2578	825	3			3
Proasellus meridianus							3			15	23	28			198	105		150	42	34	26	56			2			4

Species	Cae Gwyn SSSI	Caerdegog Isaf	Cafnan	Felin Gafnan Conf.		Foel Fawr		Groes-fechan	Hafnan	Hafnan-Caerd Isaf	Neuadd		Penrhyn		Penyrorsedd Stream		Porth Wylfa		Porth-y-pistyll			Power St. Junct.	Tre'r-gof-isaf		Tre'r-Gof SSSI		U/S Neuadd	
	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Su	Au	Au	Sp	Au	Sp	Au	Sp	Au
Psychodidae												2	1			1				1	14	13						
Psychomyiidae			1																									
Ptychoptera sp.						1						5								1								3
Pyrrhosoma nymphula																		1										
Radix balthica																					6	12						
Rhyacophila dorsalis				17																								
Rhyacophilidae				2																								
Scirtidae							85							4				7										6
Sericostoma personatum				1	2						8	5												6				1
Serratella ignita				2							43																	
Sialis lutaria	5		1																									
Sigara dorsalis			32												3													
Sigara semistriata			6																									
Silo pallipes					8																							
Simuliidae				96	2			7			13	3					1		2	12			1					
Simulium lundstomi																					5							
Sphaerium sp.										1																		10
Stagnicola palustris	1																											
Succinea sp.	46		1							6							4		2	3					4			
Sympetrum striolatum																				1								
Tinodes assimilis																							1					
Tipulidae	1													7				4		3				3				

Species	Cae Gwyn SSSI	Caerdegog Isaf	Cafnan	Felin Gafnan Conf.		Foel Fawr		Groes-fechan	Hafnan	Hafnan-Caerd Isaf	Neuadd		Penrhyn		Penyrorsedd Stream		Porth Wylfa		Porth-y-pistyll			Power St. Junct.	Tre'r-gof-isaf		Tre'r-Gof SSSI		U/S Neuadd	
	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Sp	Sp	Sp	Au	Sp	Au	Sp	Au	Sp	Au	Sp	Su	Au	Au	Sp	Au	Sp	Au	Sp	Au
Valvata cristata					1																				172	30		
Velia caprai											1			1														
Velia sp.			2							2	2		3						3				2		1			
Total annual species number (not NTAXA)	**38**	**22**	**31**	**30**		**26**		**20**	**20**	**27**	**41**		**34**		**35**		**39**		**50**			**23**	**39**		**47**		**29**	

Appendix D Macrophyte Raw Data

Table AD-1: List of macrophyte species recorded across survey sites, Summer 2014.

Date	Summer 2014								Summer 2014						
	Viable for LEAFPACS2								Not viable for LEAFPACS2						
Site	Groes-fechan	U/S Neuadd	Neuadd	Cafnan	Hafnan A	Penyrorsedd	Cae Gwyn SSSI	Foel Fawr	Pyp-Wylfa	Tan-yr-allt ditch	Caerdegog Isaf	Tre'r Gof	Hafnan B	Porth Wylfa	Power Station Junction
Total vegetative cover (%)	100	100	100	80	55	95	100	99	99	100	100	95	99	99	100
Taxon Cover Value (TCV)	TCV	TCV	TCV	TCV	TCV	TCV	TCV	TCV	TCV	TCV	TCV	TCV	TCV	TCV	TCV
Alisma plantago-aquatica	2			1			1								
Apium nodiflorum	8	2	7	1	1	7	6	6	7		7	4		4	9
Butomus umbellatus				3											
Callitriche spp.	2	1	5	5	7	5	2								
Caltha palustris														2	
Carex aquatilus														6	
Carex riparia	1														
Carex rostrata	3						2								
Catabrosa aquatica									2					5	3
Cladophora glomerata/Rhizoclonium hieroglyphicum						2			1			1		1	
Eleocharis palustris	2														
Equisetum fluviatile	2					2	4		2		7			5	
Glyceria fluitans agg	2					5			4	6	3		**2**		4
Glyceria maxima			1												
Hildenbrandia rivularis					1							1			
Iris pseudoacorus			2			4	1					2		3	
Juncus articulatus	3				1		5				2				
Juncus bulbosus	1														
Lemna gibba	2					4									

Lemna minor							2		3						
Lemna minuta										5				1	2
Lythrum salicaria	2			1				4			3	1	4	2	
Mentha aquatica	4	1		2	2		7	2			6	1	3		
Myosotis laxa	2		5	1			3		2		5	1		1	
Nitella sp.														1	
Oenanthe crocata	2	9	7		1	7		6	6		5	5	5		
Pelia epiphylla												1			
Persicaria amphibia	2			2			1	4	4	6	4		3		
Persicaria hydropiper				2	3							1	3		
Phalaris arundinacea	7	3		3			7	6	5		5	2	7		
Ranunculus flammula	2						2								
Ranunculus hederaceus															4
Rorippa nasturtium-aquaticum agg.		1	6	5			3	7	7		3	1		1	2
Sparganium erectum	3			8			3	2	4		5	4	8		
Typha latifolia	8						3							6	
Vaucheria sp(p)				6											
Veronica beccabunga			6			5			4						
Zygnematalean alga						2						1			

Additional Species (P = present)

Agrostis semiverticillata	2										3				
Agrostis stolonifera									2					1	
Alopecurus geniculatus					3	2			2						1
Angelica sylvestris							2								
Carex hirsuta									1						
Carex otrubae									1						
Cardamine flexuosa					2						1				
Cirsium palustre							1								

Conacephalum conicum		3										2			
Deschampsia cespitosa											2				
Epilobium hirsutum	3	5	6	2		2		5	3	1	5	5	5	6	
Epilobium palustre							2								1
Epilobium tetragonum	1		2		2	2	2	2			2	3	1		
Eranthemum roseum									1						
Equisetum arvense								2				2			
Eupatorium cannabium														4	
Filipendula ulmaria	2	2		2	3		3	4	1		6	5	4	5	
Hypericum tetraterum							1				1	2			
Galeopsis tetrahit										1					
Galium palustre	2	1	5				4			3				2	
Galium mollugo										4					
Geranium robertianum												1			
Glechoma hederacea			2												
Gnaphalium ulginosum				1											P
Juncus acutiflorus									<1						
Juncus bufonius				2											2
Juncus effusus	6		6	1	4	4	6		2	6	7		2		3
Juncus subnudulosus														2	
Lotus pedunculatus	2		1		2	1	2	3	P	4	2	1	2	1	2
Lunularia cruciata				2	3							1			
Lychnis flos-cuculi							1								
Lycopus europaeus												2			
Mentha sp.		1		4					2						
Mentha spicata				4											
Persicaria maculosa															2
Phleum pratense											1				
Polygonum avicularie					1										
Potentilla anserina							1		4	3	2			2	
Potentilla repens										5					

Prunella vulgaris									<1						
Ranunculus lingua										3					
Ranunculus repens	1		3		3	2	2	3	1		2	2			1
Rumex conglomeratus	3	1	2			2	2	1	1		5	4		2	
Rumex crispus	1			1					1		3	1		1	
Sagina procumbens					3							1			
Salix cinerea sub. Oleifolia											3				
Salix sp.												4			
Samolus valerandi									<1						
Solanum dulcamara				6								3		1	
Solanum nigra					1								4		
Sonchus arvensis									1						
Stachys palustris		1										1			
Stellaria alsine					1										2
Stellaria graminea						3		2							
Stellaria holostea				1											
Torillis japonica												1			
Ulva lactuca									1						

Appendix E Fish Results

Table AD-1: Routine monitoring electric-fishing results 2011 to 2014. Table shows total abundance from each survey (runs are combined to give a total) and survey method used including run length (Q = quantitative, SC = spot check). 3-SS = three-spined stickleback. 9-SS = nine-spined stickleback.

Site	Grid Reference	Species	Abundance (range of lengths (mm))						
			Autumn 2011	Spring 2012	Summer 2012	Spring 2013	Summer 2013	Autumn 2013	Summer 2014
Porth-y-pistyll	SH 34785 93652 - SH 34834 93613	Survey method					SC (30m)	SC (30m)	
		European eel					8 (110–210)	5 (140–275)	
		Brown trout					-	-	
		3-SS					-	-	
Porth Wylfa	SH 35922 92647 - SH 35941 93689	Survey method						SC (5m)	
		European eel						1 (200)	
		Brown trout						-	
		3-SS						-	
Power Station Pond	SH 35497 93109	Survey method			SC	SC			
		European eel			-	-			
		Brown trout			-	-			
		3-SS			-	-			
Gwyddelyn Bach	SH 35927 92645 - SH 35974 92691	Survey method				Q (70m)		Q (20m)	
		European eel				5 (260–590)		-	
		Brown trout				-		-	
		3-SS				13 (35–60)		-	
Cafnan	SH 34159 93035 - SH 34227 93081	Survey method	Q (65m)	Q	Q (80m)	Q (90m)	Q (90m)	Q (65m)	Q (90m)
		European eel	3 (110–650)	14 (130–650)	4 (350–550)	8 (100-640)	10 (105–550)	2 (330–400)	9 (65-500)
		Brown trout	8 (100–380)	7 (160–270)	6 (170–240)	3 (160-300)	1 (165)	1 (90)	6 (194 - 257)
		3-SS	57 (20–55)	30 (25–55)	3 (45)	2 (40-45)	35 (15–50)	11 (20–45)	5(23-54)
		9-SS	1 (25)	-	-	-	-	-	-
Hafnan	SH 33930 92212 - SH 33984 92274	Survey method				Q (100m)	Q (100m)	Q (100m)	Q (100m)
		European eel				2 (250–320)	3 (205-500)	-	10 (70-400)
		Brown trout				1 (135)	-	-	-
		3-SS				2 (25-55)	76 (15–70)	115 (20–50)	-
		9-SS				-	3 (30–45)	-	-
U/S Neuadd	SH 33517 92157 - SH 33603 92295	Survey method					SC (290m)	SC (150m)	
		European eel					10 (110–500)	4	
		Brown trout					-	-	

Site	Grid Reference	Species	Abundance (range of lengths (mm))						
			Autumn 2011	Spring 2012	Summer 2012	Spring 2013	Summer 2013	Autumn 2013	Summer 2014
		3-SS					2 (35–40)	1 (35)	
Caerdegog Isaf	SH 34876 92546 - SH 34864 92545	Survey method				SC (50m)		SC (30m)	SC (30m)
		European eel				-		-	-
		Brown trout				-		-	-
		3-SS				-		1 (40)	-
Groes-fechan	SH 35071 92163 - SH 34997 92087	Survey method				SC (125m)			SC (125m)
		European eel				-			-
		Brown trout				-			-
		3-SS				-			-
Penyrorsedd	SH 33184 92626	Survey method							SC (100m)
		European eel							-
		Brown trout							-
		3-SS							-

Appendix F PSYM Classification Output, and Raw Data

Table AF-1: PSYM raw output: results and classification of ponds (PSYM quality category = IBI >75%=Good, 51-75%=Moderate, 25-50%=Poor, <25%=V Poor).

Site name	Power Station Pond 2012	Power Station Pond 2014	Penyrorsedd Pond	Tregele Pond	Porth Wylfa Pond
No. of submerged + marginal plant species (SM)	7	11	11	8	16
Predicted (SM)	18.5	18.7	15.1	19.5	18.6
EQI (SM)	0.38	0.59	0.73	0.41	0.86
IBI (SM)	1	2	2	1	3
Number of uncommon plant species (U)	0	1	2	1	0
Predicted (U)	3.9	4.1	2.5	4.3	4.1
EQI (U)	0	0.24	0.79	0.23	0.00
IBI (U)	0	0	3	0	0
Trophic Ranking Score (TRS)	9.25	10.00	10.00	9.25	9.33
Predicted (TRS)	6.14	5.76	8.02	5.83	5.72
EQI (TRS)	1.51	1.74	1.25	1.59	1.63
IBI (TRS)	0	0	0	0	0
Average Score Per Taxon (ASPT)	3.88	3.89	3.79	3.56	3.75
Predicted (ASPT)	5.11	5.12	5.11	5.10	5.10
EQI (ASPT)	0.76	0.76	0.74	0.70	0.73
IBI (ASPT)	2	2	2	1	2
Odonata + Megaloptera (OM) families	1	0	0	0	1
Predicted (OM)	3.47	3.46	3.35	3.50	3.49
EQI (OM)	0.29	0.00	0.00	0.00	0.29
IBI (OM)	1	0	0	0	1
Coleoptera families (CO)	3	3	2	3	3
Predicted (CO)	3.76	3.78	3.75	3.75	3.75
EQI (CO)	0.8	0.79	0.53	0.80	0.80
IBI (CO)		3	2	3	3
Sum of Individual Metrics	7	7	9	5	9
Index of Biotic Integrity (%)	39%	39%	50%	28%	50%
PSYM quality category	Poor	Poor	Moderate	Poor	Moderate
Priority species	0	1	0	1	0
Meets Priority Pond Criteria?	Yes		No	Yes	No

PSYM Macroinvertebrate Species List

Table AF-2: Raw species abundance data from PSYM macroinvertebrate surveys in 2012 and 2014. * denotes sites where only selected taxa were analysed and counted in laboratory

Species	Site				
	Power Station Pond 2012*	Power Station Pond 2014	Penyrorsedd Pond	Tregele Pond	Porth Wylfa Pond
Agabus bipustulatus		2	1	1	2
Agabus nebulosus		1			
Agabus sp.		2			
Agabus sturmii		3			
Anacaena globulus	1			24	
Asellus aquaticus		55	160	34	10
Asellidae					3
Baetidae		5			
Bathyomphalus contortus		23			
Ceratopogonidae					10
Chironomidae	1	151	15	4	36
Cloeon dipterum	3				
Colymbetes fuscus	1				
Corixidae		1	8		
Corixa sp.	2				1
Corixa panzeri			1		
Cucurlionidae		2			
Culicidae					32
Cymbiodyta marginella				1	37
Erpobdella testacea			3		
Erpobdella octoculata		1	3		7
Erpobdellidae			52		
Galba truncatula		7		3	
Gerridae					2
Gerris sp.	1	1			
Gerris lacustris					1
Glossiphonia complanata	1		4		
Glossiphonidae			23		
Gyraulus crista		9			
Gyraulus laevis		258			1496
Gyrinus substriatus					
Haemopis	1				

Species	Site				
	Power Station Pond 2012*	Power Station Pond 2014	Penyrorsedd Pond	Tregele Pond	Porth Wylfa Pond
sanguisuga					
Haliplus confinis					5
Haliplus fluviatilis				7	
Haliplus lineatocollis					3
Haliplus ruficollis	2			11	
Haliplus sp.		3		38	
Helobdella stagnalis		2	28		2
Helochares lividus					1
Helophorus brevipalpis		4	3		7
Helophorus sp.			25		
Hydracarina		1			
Hydraena palustris		1			
Hydrobius fuscipes	2		1	2	1
Hydrophilidae				2	
Hydroporus planus			1		
Hydroporus sp.	1				
Hydroporinae	2				
Hydrometra sp.		1			
Hydrophilus sp.		2			
Hydroporus sp.		12			
Hydroporus angustatus				8	
Hydroporus memnonius				2	
Hydroporus nigrita				1	
Hydroporus palustris				6	
Hydroporus striola				3	
Hydroporus tessellatus		1			
Hygrotus inaequalis		3			30
Hygrotus impressopunctatus					5
Laccobius bipunctatus		1			2
Laccobius	1				2

Species	Site				
	Power Station Pond 2012*	Power Station Pond 2014	Penyrorsedd Pond	Tregele Pond	Porth Wylfa Pond
minutus					
Laccophilus sp.			1		
Libellula quadrimaculata					
Lymaeidae	1			61	
Noterus clavicornis					12
Notonecta glauca		2	2		1
Notonecta maculata			1		
Oligochaeta	1	46	777	303	24
Omphiscola glabra				42	
Ostracoda			8		2
Paracorixa concinna			6		
Pericoma sp.			2		
Physa fontinalis					4
Planorbis carinatus			52		
Planorbis planorbis	2				204
Planorbis sp.	1				
Plea leachi	1	4			
Polycelis nigra/tenuis	2				
Polycelis sp.		3			
Potamopyrgus antipodarum	1	3		175	2
Proasellus meridianus	2	195			2
Pyrrhosoma nymphula	2				
Psychodidae		5			
Radix balthica		18	171		14
Rhantus grapii					1
Sigara lateralis					2
Sigara sp.			16		10
Sigara scotti	1	1			
Syrphidae		3			1
Tipulidae			2	1	
Theromyzon tessulatum	1	1			
Tricladida		5			
Veliidae			1		

PSYM Aquatic Plant Species List

Table AF-3: Raw species presence data from PSYM aquatic plant surveys at four ponds (species in bold with a rarity score of 2 or more).

Site	Porth-y-Wylfa Pond	Tregele Pond	Penyrorsedd Pond	Power Station Pond
Agrostis stolonifera	✓		✓	✓
Alopecarus geniculatus			✓	
Angelica sylvestris	✓			
Apium nodiflorum	✓			✓
Azolla filiculoides				✓
Callitriche sp.		✓	✓	✓
Cardamine pratensis		✓		
Carex eurta/hirta				✓
Eleocharis palustris	✓			
Epilobium hirsutum		✓		
Erpilobium palustre	✓			
Equisetum fluviatile	✓			
Filipendula ulmaria	✓			
Galium palustre				✓
Glyceria declinata		✓	✓	✓
Glyceria fluitans agg	✓		✓	
Glyceria maxima				✓
Gnaphalium uliginosum				
Iris pseudacorus	✓			
Juncus bufonius	✓		✓	
Juncus effusus	✓	✓	✓	✓
Lemna minuta	✓	✓	✓	✓
Lotus pedunculatus	✓			✓
Mentha aquatica	✓			
Persicaria hydropiper	✓			
Ranunculus hederaceus			✓	
Ranunculus sp. *(+ Batrachium* sp.*)*	✓			
Rorippa nasturtium-aquaticum agg.		✓		✓
Sagina procumbens			✓	
Solanum dulcamara	✓			
Typha latifolia		✓		
Veronica beccabunga			✓	