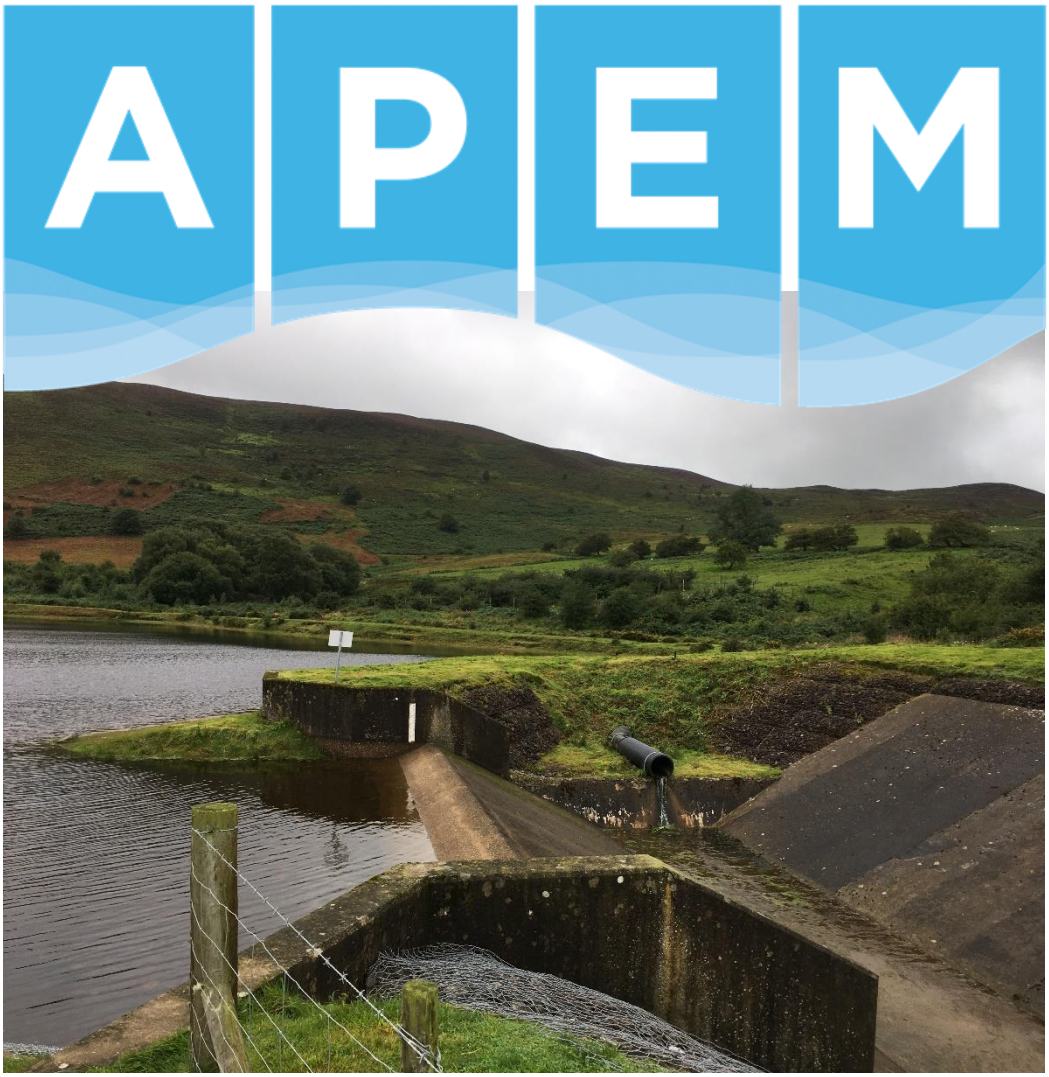

Cilcain Reservoirs Compensation Flow Repeal

Water Framework Directive Assessment

Dŵr Cymru Welsh Water

APEM Ref: P00004875

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Harvey Walsh, Rob Moore, Louise Levins

Client:	**Dŵr Cymru Welsh Water**
Address:	**Pentwyn Road, Nelson, Treharris, CF46 6LY**
Project reference:	**P00004875**
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Project Director:	**Nicola Teague**
Project Manager:	**Harvey Walsh**
Other:	Adam Sutcliffe, Rob Moore, Dan Cadman, Louise Levins

APEM Ltd
Riverview
A17 Embankment Business Park
Heaton Mersey
Stockport
SK4 3GN

Tel: 0161 442 8938
Fax: 0161 432 6083

Registered in England No. 02530851

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1	25/11/2020			First draft for DCWW review	HW

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1. Introduction

1.1 Background

Dŵr Cymru Welsh Water (DCWW) wish to explore the potential effects of repealing the provision of statutory compensation flows from the Cilcain impounding reservoirs, a complex of four reservoirs at the head of the Nant Gain watercourse, forming part of the Alwen-Dee Water Resource Zone. The Nant Gain is not currently classified by Natural Resources Wales (NRW) under the Water Framework Directive. The closest downstream water body is the Alyn – upstream Dolfechlas Brook (GB1110670521710) which is currently at Good ecological status (Cycle 2, 2018 interim). The water body is not designated as a Heavily Modified Water body (HMWB) in the 2018 Cycle 2 preliminary classifications.

The reservoirs and the associated water treatment works (WTW) were abandoned some years ago but they were retained for possible use in the event of a severe drought. There is a statutory requirement for a compensation water release from the reservoirs. The reservoirs complex is partly owned/ partly leased by DCWW, and a local fishing club, Cilcain Fly Fishing Association, has exclusive fishing rights at all four reservoirs.

All four reservoirs are identified in the abstraction licence, as well as the Mill Pool (sometimes referred to as Reservoir no 5) by the redundant WTW. Under the licence DCWW can abstract up to 4.5 Ml/d in any combination from these reservoirs (annual limit of 1363.8 Ml), but there is also an individual limit on the Mill Pool abstraction of 1.86 Ml/d and 142 Ml/a. Further to this there is a linking clause with the Brithdir Mawr abstraction licence, which limits the total annual abstraction from both Brithdir and Cilcain sources to 1400 Ml.

The abstraction licence refers to the Central Flintshire Water Board Order 1964. This Order refers to the Hawarden and District Waterworks Act 1883 which specifies (in Section 45) the need for continuous compensation water releases into Garth Brook of two hundred and fifty thousand gallons per day (1.14 Ml/d). The Act also seems to specify (in Section 46) that the release needs to be made from Reservoir No.1, but in practice the release has been made from Reservoirs 3 and 4 for many years, with the weir at the Mill Pool used as the measurement point. Reservoirs 2, 3 and 4 were built sequentially after No.1, but it is not clear if this was authorised under the Hawarden Act or by other means. Reservoir 4 lies upstream of 1 and 2 and these lie in the same catchment that flows into the Mill Pool. Reservoir No. 3 lies in a separate catchment, the flows from which join Garth Brook (or Nant Gain) just downstream of the Mill Pool. A pipe from reservoir No. 3 to the Mill Pool allows compensation releases to be made from No 3 in addition to flows from the main catchment – see map in Section 2.1 table.

The catchment areas and maximum reservoir storage values are shown in Table 1.1. However, during the dry summer of 2011, Natural Resources Wales (NRW) received complaints of low water levels in the reservoirs and in 2012 DCWW agreed with NRW that the compensation flow could be reduced to 0.69 Ml/d, on the basis that the reservoirs were unable to sustain flows of 1.14 Ml/d during a dry summer. A 1.14 Ml/d release equates to ~Q95 at the gauging weir downstream of the Mill Pool.

Table 1.1 Reservoir catchment area and maximum storages

Reservoir	Catchment area (Km^2)	Storage (Ml)
No 1	1.50 (including no 2)	3.85
No 2	See above	20.36
No 4 (Garth or Moel Dywyll)	1.50	98.00
No 5 (Mill Pool)	1.40	N/A
Total to Mill Pool	4.40	122.21
No 3 (Cae Newydd)	0.9	32.50
Total catchment storage		154.71

1.2 Catchment

The Nant Gain flows in a general east-north-east direction for approximately 1.5 km before joining the Afon Alyn near Pont-Newydd. The Nant Gain loses water to fissures and swallow holes in the limestone aquifer downstream of Pentre (Bissell, 2011). During prolonged dry periods (typically summer months) the Nant Gain is understood to dry altogether. The Afon Alyn also runs dry for several kilometres between Loggerheads and Rhydymwyn gauging station. Data from the National River Flow Archive (NRFA, accessed September 2020) shows Rhydymwyn gauging station, catchment area 77.8 km-sq, to dry around 50% of the time, mostly, but far from exclusively, in the summer months.

1.3 Water Framework Directive

The WFD was transposed into law in England and Wales by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003. The Directive requires that Environmental Objectives be set for all surface and ground waters to enable them to achieve Good Status (or Good Ecological Potential for Heavily Modified and Artificial Water Bodies) by a defined date. These Environmental Objectives are listed below:

- prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters;
- aim to achieve at least good status for all water bodies by 2015. Where this is not possible and subject to the criteria set out in the Directive, aim to achieve good status by 2021 or 2027;

- meet the requirements of Water Framework Directive Protected Areas[1];
- promote sustainable use of water as a natural resource;
- conserve habitats and species that depend directly on water;
- progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment;
- progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants; and
- contribute to mitigating the effects of floods and droughts.

1.4 Scope

This WFD assessment aims to determine the effects of the proposed repeal of the compensation releases on the downstream water body ecological quality (as well as supporting hydromorphology and water quality), identifying any potential impacts that could cause deterioration in the status of the water body or could hinder the water body from meeting its WFD objectives.

The Cilcain reservoirs, which discharge into the Nant Gain watercourse (a tributary of the Afon Alyn) relate to one surface water body which may be affected by repealing the provision of the statutory compensation flows. This is:

- Alyn – upstream Dolfechlas Brook water body (Water body ID: GB111067051810).

[1] Water bodies with an existing designation under another EU Directive

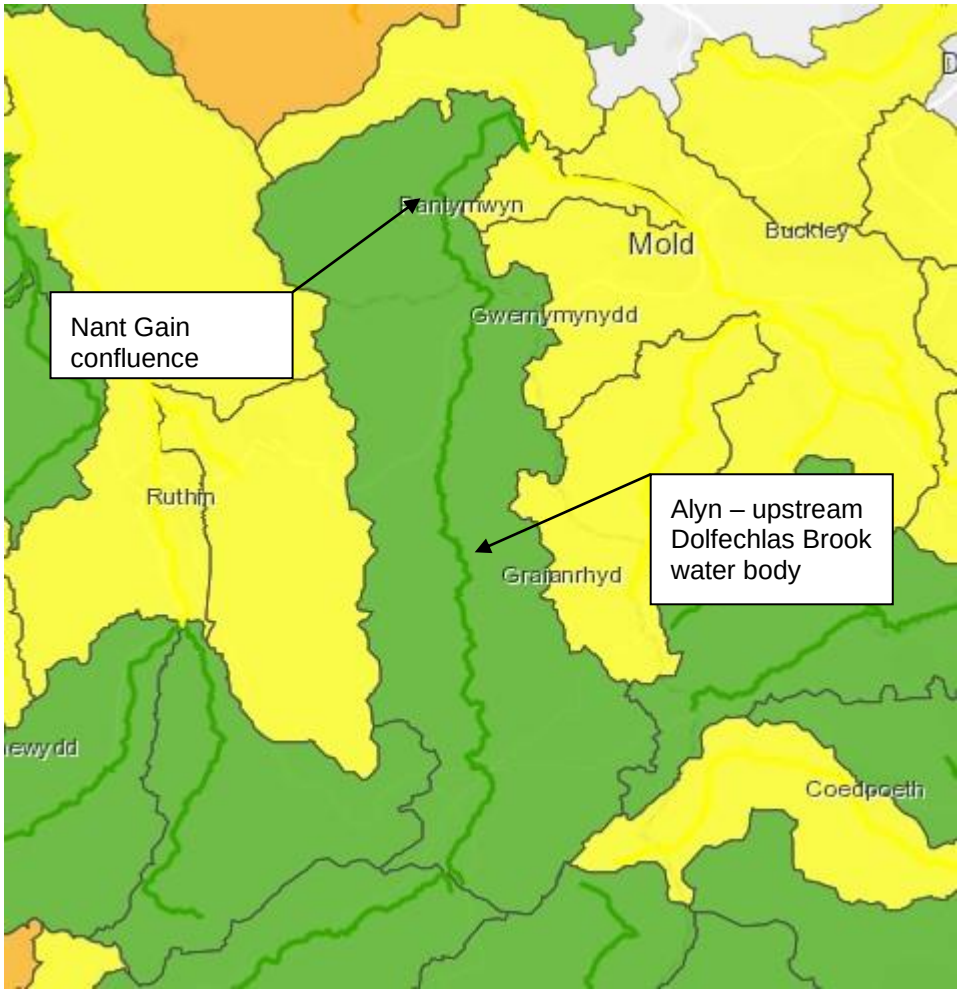


Figure 1.1 Alyn – upstream Dolfechlas Brook water body location

The water body is not designated as a Heavily Modified Water body (HMWB) in the 2018 Cycle 2 preliminary classifications.

To assess the potential impacts of repealing the provision of statutory compensation flows from the Cilcain impounding reservoirs, an investigation of the potential impacts on Cilcain Reservoirs, Nant Gain and Afon Alyn was required, including:

1. A WFD assessment to ensure there would be no deterioration to the water bodies which are currently impacted by the releases from the reservoir, including an assessment of the impacts to fish;

2. An assessment of the potential impact on existing users of the watercourses downstream of the release, including any requirements for dilution;

3. An assessment of the effect on swallow holes and discernible flow paths and whether a reduced flow may have an impact at any other location;

Whilst river flows will become more natural after the repeal of statutory compensation flows, it is DCWW's responsibility to show that the proposed changes will not impact the ecology after the compensation flows are removed, possibly resulting in a deterioration in the ecological status of the downstream water body (Alyn – upstream Dolfechlas Brook) under the WFD.

1.5 This report

The purpose of this report is to assess whether repealing the provision of statutory compensation flows from the Cilcain reservoirs is likely to cause a deterioration in the ecological status of the downstream water body and detrimental impacts to downstream protected sites and species.

1.6 Report format

The report is produced following the template of the EA's WFD Compliance Assessment procedure (Operational instruction 488_10 Issued 09/11/10). Following the Preliminary Assessment the Detailed Assessment has four stages:

1. Stage 1 – The collation of baseline data;
2. Stage 2 – Scoping;
3. Stage 3 – Detailed assessment;
4. Stage 4 – Assessment summary and conclusion.

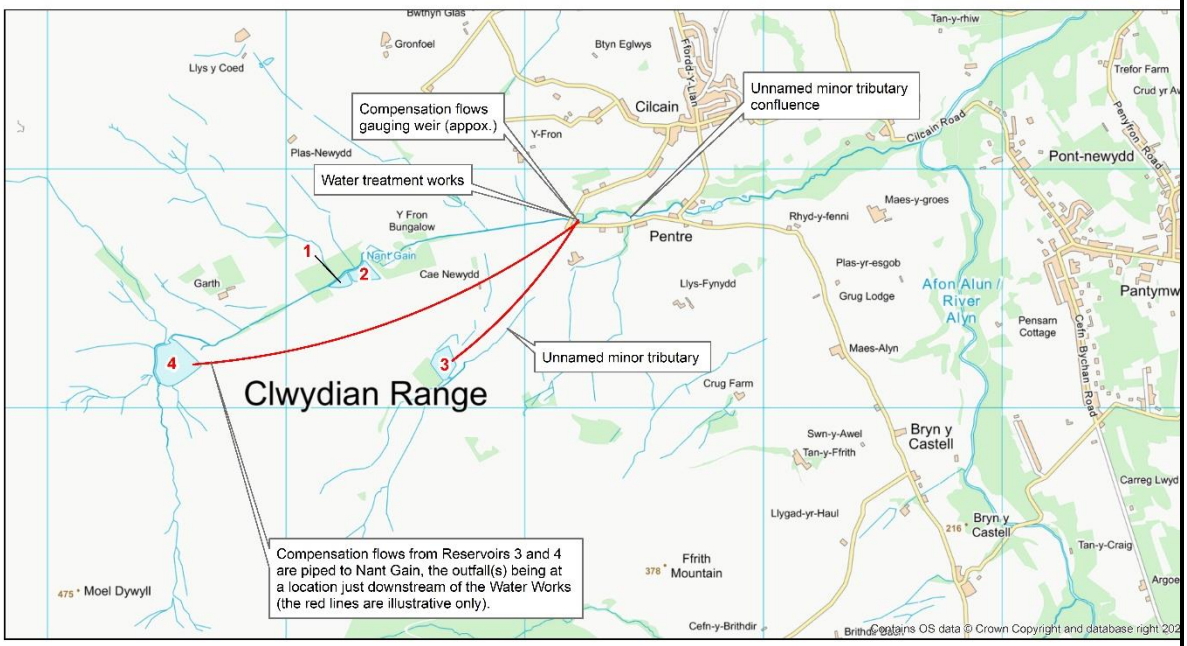
2. Preliminary Assessment

2.1 Water Framework Directive Scoping information

Project details	
Project title	Cilcain Reservoirs compensation repeal WFD Assessment
Project description	Dŵr Cymru Welsh Water (DCWW) wish to repeal the provision of statutory compensation flows from the Cilcain impounding reservoirs, a complex of four reservoirs forming part of the Alwen-Dee Water Resource Zone. The reservoirs lie within the Alyn – upstream Dolfechlas Brook water body (GB111067051810), which is not designated as a Heavily Modified Water body (HMWB) in the 2018 Cycle 2 preliminary classifications. A statutory compensation flow is currently required at the Cilcain Reservoirs under the Hawarden and District Waterworks Act 1883 (hereinafter referred to as the 'Act') and Central Flintshire Water Board Order (1964). According to the Act DCWW must release a minimum of 1.14 Ml/d (as per the Act, two hundred and fifty thousand gallons) to the Nant Gain downstream. However, with the consent of NRW, in 2012 this was temporarily reduced to 0.69 Ml/d. The expectation is now that DCWW will release the full 1.14 Ml/d although NRW understand that this will not be possible during prolonged periods of dry weather, without detrimentally drawing down the reservoirs and potentially impacting on the fish stocks. Hence the reason for this investigation. Whilst river flows will become more natural after the repeal of statutory compensation flows, DCWW need to prove that removing the compensation release will not result in a deterioration in the ecological status of the downstream water body (Alyn – upstream Dolfechlas Brook) under the WFD and on designated sites. The purpose of this report is to assess whether repealing the provision of statutory compensation flows from the Cilcain impounding reservoirs is likely to cause a deterioration in the ecological status of the downstream water body and detrimental impacts to downstream protected sites and species.
Activity type/s	Removal of compensation flows
Location of the works	National Grid References, looking downstream, for each reservoir are below. Cilcain No. 4 — Left Bank NGR: SJ 15520 64290 — Right bank NGR: SJ 15645 64177

	Cilcain No. 3	SJ 16682 64130	SJ 16678 64124
	Cilcain No. 2	SJ 16324 64617	SJ 16394 64544
	Cilcain No. 1	SJ 16257 64566	SJ 16277 64525
	However, compensation flows are released only from Reservoirs no.'s 3 and 4 and are piped to the Nant Gain; the outfall(s) are just downstream of the Water Treatment Works at NGR SJ 17228 64795.		

Site map



Map outlining the Cilcain reservoirs and the study reach

Water body/ies affected	Water body name	Water body ID
	Alyn – upstream Dolfechlas Brook	GB111067051810
Length of water body/ies affected	Approx 3 km, from Nant Gain/ Afon Alyn confluence to Alyn at Rhydymwyn flow gauging station (National River Flow Archive ref: 67009). Discharge at the gauging station is frequently zero due to flow entering swallow holes in limestone upstream of the site, between Maeshafn (approx. 7 km upstream of the Nant Gain/ Afon	

	Alyn confluence, at NGR SJ 19345 61069) and Rhydymwyn.
Proposed timing of the works	Once licence changes have been agreed with NRW
Proposed duration of the works	Permanent (Flows to return to a more natural regime)

Are the works on the exemption list? Yes ☐ No ☑

Are the works temporary? Yes ☐ No ☑

Are the works likely to cause deterioration in water body status or prevent the achievement of good ecological potential/status in the future, and therefore is further assessment required? Yes ☑ No ☐

If the scheme requires further assessment, please proceed to Further Assessment. Otherwise, please justify your conclusion that the works are not likely to cause deterioration in water body status, nor prevent the achievement of good ecological potential/status in the future.

Justification for conclusion of no risk to WFD objectives	
N/A. Although it is not considered likely that the cessation of compensation flows and a return to more natural flow conditions for the Nant Gain will cause deterioration in water body status (Alyn – upstream Dolfechlas Brook), following NRW advice it is assumed that the scheme requires further assessment.	

2.2 Designated sites potentially affected by the project

A GIS based search using the site boundaries published on MAGIC (www.magic.gov.uk) has identified that the following sites may be affected by the Cilcain Reservoirs compensation flow repeal:

- Alyn Valley Woods/ Coedwigoedd Dyffryn Alyn SAC begins approximately 1.3 km upstream from the Nant Gain/ Afon Alyn confluence and extends approximately 4 km downstream;
- Alyn Valley Woods and Alyn Gorge Caves SSSI covers the same extent as the Alyn Valley Woods/ Coedwigoedd Dyffryn Alyn SAC along the Afon Alyn corridor, but additionally away from the river includes the Alyn Gorge Caves system.

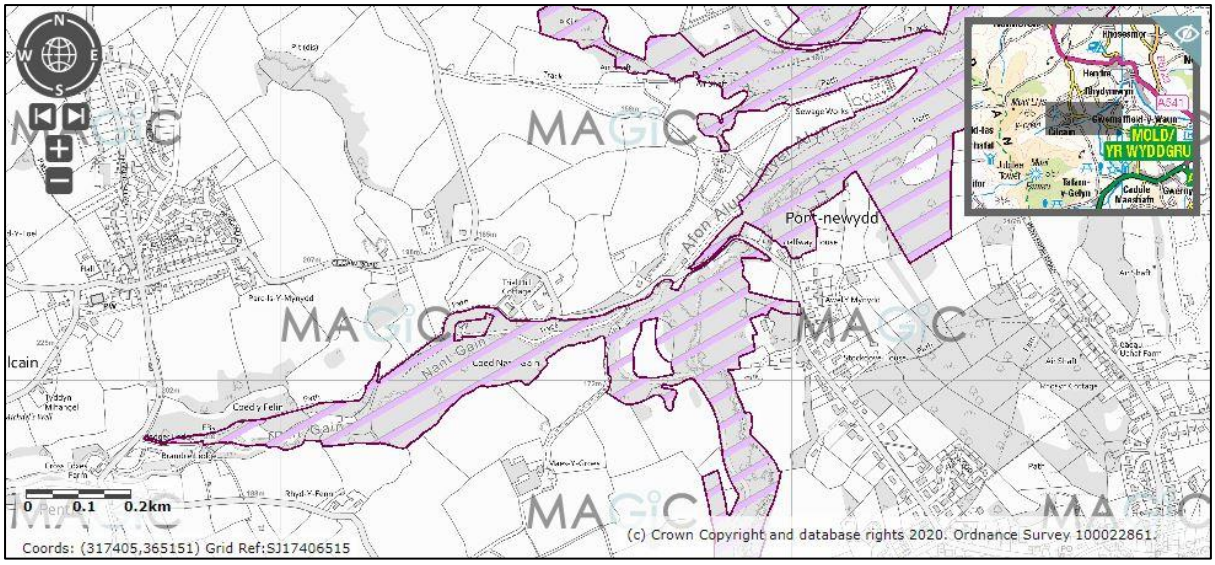


Figure 2.1 Alyn Valley Woods/ Coedwigoedd Dyffryn Alyn SAC extent

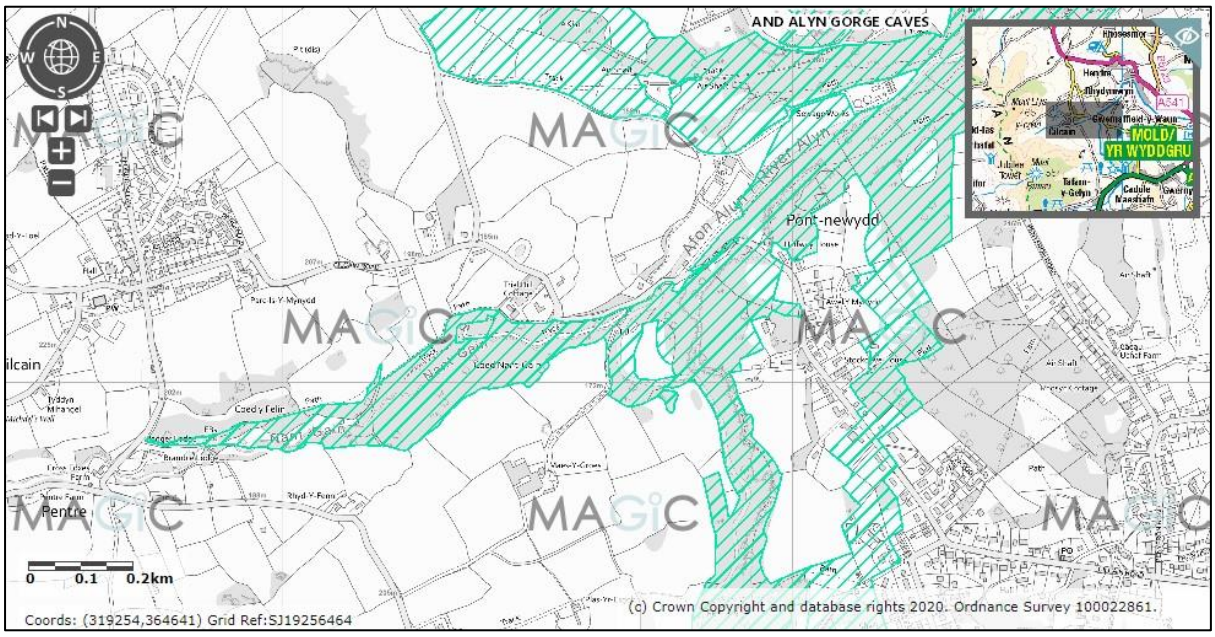


Figure 2.2 Alyn Valley Woods and Alyn Gorge Caves SSSI extent

2.2.1 Alyn Valley Woods/ Coedwigoedd Dyffryn Alyn SAC

The site predominantly occupies the steep Carboniferous Limestone escarpment alongside the Afon Alyn, together with adjoining areas. The site supports a large stand of semi-natural broadleaved woodland.

The Alyn Valley Woods/ Coedwigoedd Dyffryn Alyn SAC has been selected for the presence of one interest feature that qualifies under Annex I of the Habitats Directive (92/43/EEC). The primary reason for designation is the presence of the Annex I habitat “Tilio-Acerion forests of slopes, screes and ravines”.

Further two Annex I habitats are present as qualifying features, but not a primary reason for site selection are “Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites)” and “Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)”.

2.2.2 Alyn Valley Woods and Alyn Gorge Caves SSSI

The Alyn Valley Woods and Alyn Gorge Caves SSSI is located 4 km west and north-west of Mold. The site predominantly occupies the steep Carboniferous Limestone escarpment alongside the Afon Alyn between Loggerheads and Rhydymwyn but also includes the subsidiary wooded valleys of the Aber Eilun and Nant Gain to its west. The site is of special interest for its geomorphology, the Alyn Gorge Caves and its semi-natural broadleaved woodlands including their size and specific types of woodland vegetation, its calcareous and mesotrophic grasslands, its scarce plant assemblage, its population of wayfaring tree *Viburnum lantana* and its population of the grizzled skipper butterfly.

Alyn Gorge Caves site comprises three cave systems: Ogof Hesp Alyn, Ogof Hen Ffynhonau and Ogof Nadolig. Ogof Hesp Alyn and Ogof Hen Ffynhonau lie behind resurgences in the Alyn Gorge, and both represent relatively recent phases in the development of the gorge. Many of the cave passages were drained as a result of local mining activities, and now provide excellent examples of both shallow and deep phreatic drainage systems within the limestone.

Collectively, the cave systems contain an impressive range of solutional and erosional features along with extensive sediment sequences characteristic of a range of water-flow regimes and climatic conditions. They provide an important three-dimensional example of underground landform development.

As noted above, part of the site is classified as the Alyn Valley Woods/ Coedwigoedd Dyffryn Alun SAC.

Following consultation between DCWW and NRW on the scope of the project, it was noted by NRW that the likely impacts on habitats downstream of the Cilcain reservoirs, which may be reliant on flows in the Nant Gain, should be taken into account. Additionally, it was noted by NRW that the Alyn Gorge Caves underlying the SSSI were also a geological feature of the SSSI and that potential impacts on these features needed inclusion in the assessment.

3. Detailed Assessment

3.1 Stage 1 WFD classification

Stage 1	WFD Classification

Water bodies that may be affected by the proposed activity.

Water body name	Water body ID	Water body type	A/HMWB?	Current status/ potential
Alyn – upstream Dolfechlas Brook	GB111067051810	River	N/A.	Good

A list of water quality elements and their status for the affected water body.

Quality element	Current status
Hydromorphological Supporting Elements	
Hydrological regime	Good
Morphology	Good
Physico-chemical quality elements	
Ammonia (Phys-Chem)	High
Dissolved oxygen	High
pH	High
Phosphate	Good
Temperature	High
Biological quality elements	
Fish	Good
Invertebrates	Good
Macrophytes and Phytobenthos Combined	Good
Chemical	High

Morphological mitigation measures for the affected water body.

Morphological mitigation measure	Status
N/A.	

3.2 Stage 2 Scoping

NRW provided the following scope on the different quality elements that are likely to be affected and which should be considered in the WFD compliance assessment:

- Assess impacts on the physico-chemical quality elements;
- What will the impact of repealing the compensation flows be on the invertebrate communities on the Nant Gain and the downstream Alyn – upstream Dolfechlas Brook

(GB1110670521710) water body, which is currently at Good ecological status (Cycle 2, 2018 interim)?

- What will the impact of repealing the compensation flows on downstream habitats and species be?
- An assessment of the potential impact on existing users of the watercourses downstream of the release, including requirements for dilution;
- An assessment of the effect on the underlying SSSI (Alyn Gorge Caves system).

The scope of the assessment was agreed with NRW, by DCWW, through email consultations in May 2020.

Stage 2	**Scoping**

Activity:		
Quality element	Scoped in or out?	Justification for scoping
Hydrological regime	Out	Removing the compensation flows is unlikely to cause flows not to be compliant with the NRW's Environmental Flow Indicator and a more natural flow regime is consistent with meeting the objectives of the WFD.
Ammonia	In	The removal of the compensation flows represent a return towards a more natural flow regime and might result in an improvement in water quality. However possible improvement needs to be considered in relation to existing water quality upstream and the possible influence of reduced flows on water quality.
Dissolved oxygen	In	As per ammonia.
Phosphate	In	As per ammonia.
Invertebrates	In	The removal of the compensation flows represent a return towards a more natural flow regime and might result in an improvement in water quality, which may lead to an improvement in macroinvertebrate status. However, a sudden reduction in flows might cause a shock to the macroinvertebrate population of the affected reach in the short term, and this may risk a deterioration in WFD status.
Fish	In	Although the removal of the compensation flows represent a return towards a more natural flow regime, a sudden reduction in flows might cause a shock to any fish populations of the affected reach in the short term, and this may risk deterioration of WFD status.
Macrophytes and	In	Although the removal of the compensation flows represent a return towards a more natural flow regime and may result in an improvement in water quality,

	Phytobenthos combined		which may lead to an improvement in macrophytes and phytobenthos populations, a sudden reduction in flows might cause a shock to populations of the affected reach in the short term, and this may risk deterioration of WFD status.	

3.3 Stage 3 Detailed Assessment

3.3.1 Overview of data collection

A data request was made to NRW also regarding relevant literature sources for the Nant Gain and/ or Afon Alyn and potentially impacted stakeholders e.g. abstraction licences. A number of papers and references were received but information on stakeholders was not received.

Macroinvertebrate, water quality and flow gauging data were collected as shown in

Table 3.1. The sampling locations are also mapped and shown in Appendix 2 . The data is discussed in detail in the following sections.

The site numbering progresses from upstream to downstream i.e. site 1 is the most upstream site, just below Reservoir No. 2. Site 2 is on the minor tributary just downstream of Reservoir No. 3. No macroinvertebrate samples were collected at Site 5 in spring 2019 (30/05/2019) and spring 2020 (30/05/2020) as the Nant Gain was dry at that location. On the 30/05/2020 a sample was collected from a location just downstream of the Nant Gain/ Afon Alyn confluence, on the Afon Alyn (named Site 5B).

Flow gauging was completed at seven sites on 30/10/2020 to estimate an accretion profile along the Nant Gain. Gauging locations differed from macroinvertebrate and water quality sampling locations where necessitated by different survey requirements, for example the need to gauge at locations compliant with BS EN ISO 748:2007.

A habitat walkover survey was completed of the relevant watercourses to gain an understanding of the habitat functionality and morphology. The watercourses surveyed were:

- Nant Gain – from outfall of reservoir No. 4 to confluence with Afon Alyn;
- Unnamed tributary from outfall of Reservoir No. 2 to confluence with Nant Gain;
- Afon Alyn – from Nant Gain confluence to Rhydymwyn flow gauging station.

Not all sections of the watercourses could be accessed, most notably along the Nant Gain through the Alyn Valley Woods just upstream of the Afon Alyn confluence and further sections along the Afon Alyn. The habitat walkover maps are shown in Appendix 4 .

Table 3.1 Overview of data collection

Location	NGR	Description	Macroinvertebrate			Water Quality	Flow gauging
			30/05/2019	30/05/2020	30/10/2020	30/10/2020	30/10/2020
Site 1	SJ 17170 64789	Most upstream site, approx. 800 m downstream of Reservoir No. 2	Yes	Yes	Yes	Yes	Yes
d/s WTW	SJ 17245 64777	Taken at weir at WTW					Yes
Site 2	SJ 16869 64268	On unnamed tributary, approx. 360 m downstream of Reservoir No. 3	Yes	Yes	Yes		
u/s minor tributary	SJ 17430 64824	Upstream of minor tributary (from Reservoir No. 3)/ Nant Gain confluence					Yes
Site 3	SJ 17649 64833	Upstream of ponds near Cilcain village	Yes	Yes	Yes	Yes	Yes
Site 4	SJ 17910 64879	Downstream of ponds near Cilcain village	Yes	Yes	Yes	Yes	Yes
Site 5	SJ 18658 65117	Just upstream of Afon Alyn confluence	Dry. No sample.	Dry. No sample.	Yes	Yes	
Site 5A (u/s Alyn)	SJ 18665 65105	On Afon Alyn, just upstream of Nant Gain confluence					Yes
Site 5B (d/s Alyn)	SJ 18679 65136	On Afon Alyn, just downstream of Nant Gain confluence		Yes		Yes	Yes
Site 6	SJ 17916 61254	Control site on unnamed minor tributary near village of Llanferres	Yes	Yes	Yes		

3.3.2 Macroinvertebrates

3.3.2.1 Background

The Nant Gain is not currently classified by NRW under the Water Framework Directive. The closest downstream water body is the Alyn – upstream Dolfechlas Brook (GB1110670521710) which is currently at Good ecological status (Cycle 2, 2018 interim). Invertebrate status the Alyn water body is classified as Good, however, the confidence in this classification is uncertain.

3.3.2.2 Data analysis

Macroinvertebrate samples were collected at five locations on Nant Gain and at one control site in spring 2019 and autumn 2020. In spring 2020 macroinvertebrate samples were collected at four locations on Nant Gain, at one site on the Afon Alyn just downstream of the Nant Gain/ Alyn confluence as the Nant Gain was dry, and at one control site.

Biological indices were calculated for each site to assess the baseline condition in terms of water quality, low flow stress and degree of sedimentation.

- Whalley Hawkes Paisley Trigg (WHPT) method (UKTAG 2014) is an index of overall biological quality using macroinvertebrates similar to the BMWP index. WHPT responds to the same environmental pressures as BMWP unlike BMWP it is abundance-weighted and because of this it can detect moderate changes in water quality that would previously have been undetected. WHPT NTAXA also responds to the same environmental pressures as BMWP NTAXA. WHPT and WHPT NTAXA are the current indices used to determine WFD status during classifications for macroinvertebrates and are useful for distinguishing the direct effects of water abstraction from the effects of water pollution.

- Lotic Invertebrate index for Flow Evaluation (LIFE; Extence et al., 1999) is the average of abundance-weighted flow groups that indicate the preferences of each taxon for higher water velocities and clean gravel/cobble substrata or slow/still water velocities and finer substrata. LIFE is used to index the effect of flow variations on macroinvertebrate communities.

- Proportion of Sediment-sensitive Invertebrates (PSI; Extence et al., 2011) gives further insight into potential impacts associated with fine sediment inputs and is considered potentially useful in describing the baseline condition of the river.

Expected scores for unimpacted reference conditions at each sampling location have been calculated using the River InVertebrate Prediction and Classification System (RIVPACS) IV model (Clarke *et al.*, 2002) within the River Invertebrate Classification Tool (RICT). Observed:Expected (O/E) WHPT ASPT, WHPT NTAXA, LIFE and PSI ratios were calculated for all samples and used to provide indicative status classifications for each site. However, it should be noted that RICT may under-predict Expected scores in calcareous environments. Reference has therefore also been made to a local control site.

Macroinvertebrate data are summarised in Table 3.2, which represent indicative status classifications for individual samples collected in 2019 and 2020.

Table 3.2 Macroinvertebrate indicative ecological status classifications

Location	Date	WHPT ASPT Status	WHPT NTAXA Status	LIFE Status	PSI Status
Site 1 (NG-01)	30/05/19	High	High	Unimpacted	Unimpacted
	30/05/20	Good	High	Unimpacted	Unimpacted
	29/10/20	High	High	Unimpacted	Unimpacted
Site 2 (NG-02)	30/05/19	Good	High	Unimpacted	Unimpacted
	30/05/20	Good	High	Unimpacted	Unimpacted
	29/10/20	High	High	Unimpacted	Unimpacted
Site 3 (NG-03)	30/05/19	High	High	Unimpacted	Unimpacted
	30/05/20	High	High	Unimpacted	Unimpacted
	29/10/20	High	High	Unimpacted	Unimpacted
Site 4 (NG-04)	30/05/19	Good	High	Unimpacted	Unimpacted
	30/05/20	High	High	Unimpacted	Unimpacted
	29/10/20	High	High	Unimpacted	Unimpacted
Site 5 (NG-05)	30/05/19	-	-	-	-
	30/05/20	Good	Moderate	Unimpacted	Unimpacted
	29/10/20	Moderate	Bad	Unimpacted	Unimpacted
Site 6 control (CC-06)	30/05/19	High	High	Unimpacted	Unimpacted
	30/05/20	High	High	Unimpacted	Unimpacted
	29/10/20	High	High	Unimpacted	Unimpacted

Macroinvertebrate charts are presented in Figure 3.1, which shows the O/E ratios for the biological indices at each site. Site 5 was dry during the spring 2019 survey, therefore no classifications are presented.

Macroinvertebrate data from Nant Gain in 2019 and 2020 suggest Sites 1-4 are generally not impacted by water quality pressures and WHPT ASPT and NTAXA O/E ratios were indicative of either Good or High WFD status for Sites 1-4. Data were generally comparable to the control site, Site 6. At Site 5, which was dry in spring 2019, NTAXA O/E was indicative of Moderate to Bad WFD Status and ASPT O/E was indicative of Moderate WFD status. The species assemblage at Site 5 in spring 2020 was dominated by taxa tolerant of disturbance and poor water quality (with Chironomidae and Oligochaetes comprising 79% of individuals recorded), while the autumn 2020 sample recorded an overall low abundance and diversity of macroinvertebrates. Filamentous algae was recorded at Site 5 as covering 20% and 70% of the survey area in spring and autumn respectively, indicating that the site may be impacted by poor water quality or nutrient enrichment, potentially confounding the issue of low flow stress.

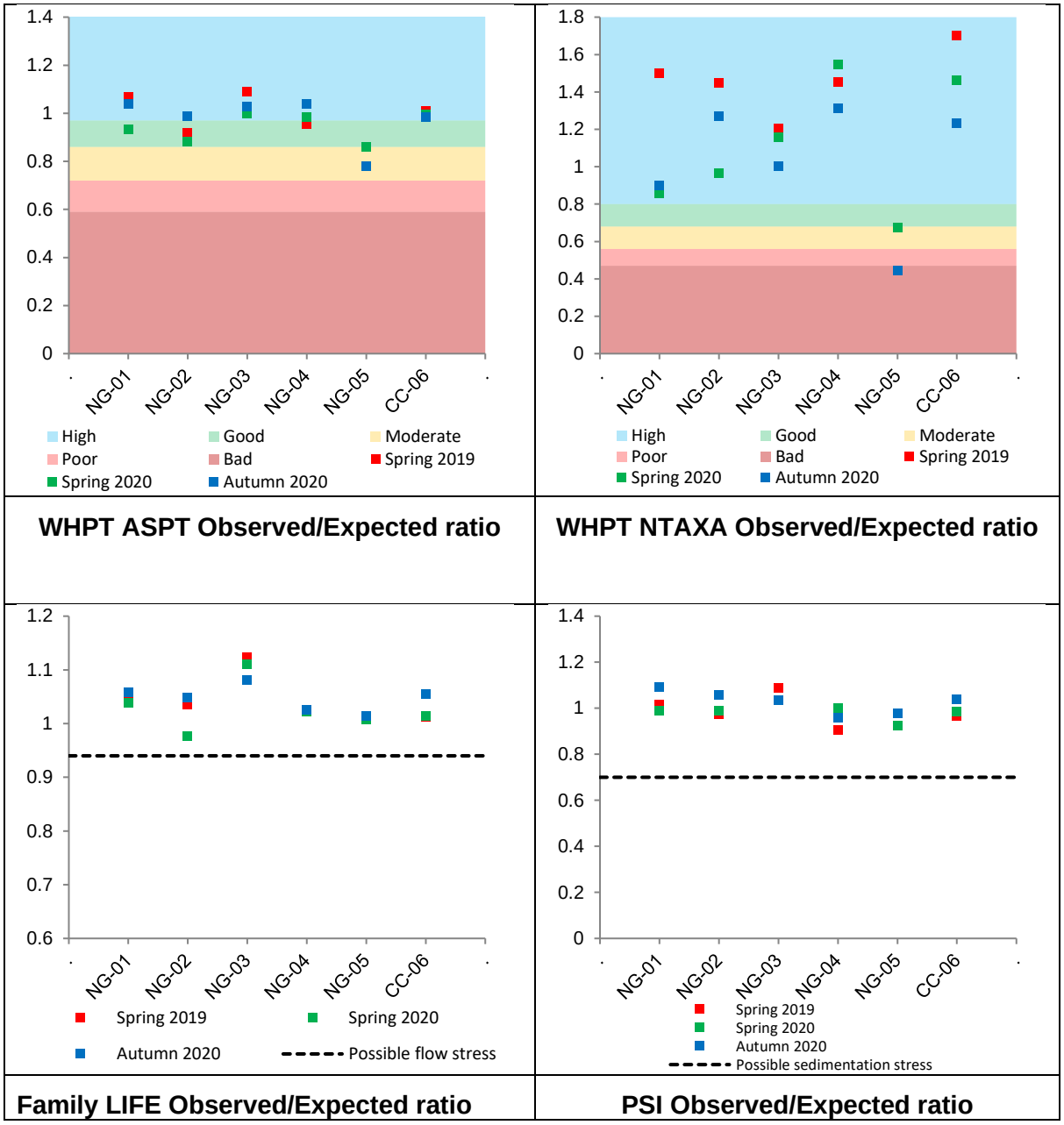


Figure 3.1 Ecological quality indices

Ecological quality indices (ASPT, NTAXA, LIFE and PSI) and WFD ecological status classes (High, Good, Moderate and Poor). Data present were collected from the Nant Gain in 2019 and 2020

The data indicate that macroinvertebrate communities in Nant Gain are not impacted by low flow stress or excessive fine sediment deposition based on the O/E ratios for LIFE and PSI, and data were largely comparable to the control site. The majority of taxa recorded at Sites 1-5 were associated with moderate to fast flows such as *Baetis atlanticus/rhodani* and *Elmis aenea*. A smaller number of taxa associated with rapid flows were recorded and include *Isoperla grammatica* and *Odontocerum albicorne*. While LIFE O/E ratios at Site 5 are not indicative of low flow stress, it should be noted that few taxa were recorded at Site 5 that are associated with rapid flows, possibly as a response to periodic drying at the site. The

community at Site 5 is of low diversity (low NTAXA) and largely comprises disturbance-tolerant species, likely a further reflection of periodic drying at this site.

3.3.2.3 Summary

It should be acknowledged that data used in this assessment span a relatively short period, and that expected scores may be underestimated in calcareous watercourses. Even so, the available data indicate that the macroinvertebrate communities of Nant Gain are not significantly impacted by water quality, low flow stress or excessive fine sediment deposition, and data were comparable to the adjacent control site. The exception to this was Site 5, which displayed a low diversity macroinvertebrate community dominated by disturbance-tolerant species, likely a response to episodic drying at this site.

Nant Gain is not currently classified under the WFD; however, macroinvertebrate data would suggest that macroinvertebrate communities in the watercourse are consistent with Good status, in line with the downstream water body Alyn – upstream Dolfechlas Brook.

3.3.3 Water quality

Water quality samples were collected at four locations on Nant Gain and one location on the Afon Alyn just downstream of the Nant Gain/ Alyn confluence, on one sampling occasion on 29/10/2020. Sample data have been compared to the relevant WFD Environmental Quality Standards (EQS), and for parameters with no associated WFD standards we have compared the results to standards from older (now repealed) European Directives.

The WFD standards for some determinands are based on factors which include the site's altitude and alkalinity, therefore some of the standards will be site specific and have been determined using supporting WFD compliance assessment calculator tools. A full list of the standards is shown in Appendix 3 . It should be noted, however, that the WFD standards are intended to be used with long term datasets collected at monthly or quarterly intervals and over several years. Therefore, the assessment presented here is for indicative purposes only and does not address potential seasonal variability, or indeed intermittent inputs that may not be captured by spot sampling regimes.

Water quality results are summarised in Table 3.3, which represent indicative status classifications for individual sites and determinands. Water quality data was also collected in the field using hand held equipment, for parameters such as dissolved oxygen, pH, temperature etc. Figure 3.2 shows the dissolved oxygen data results, taken during the three macroinvertebrate sampling visits.

Table 3.3 Water quality results and status classifications

Determinands	Units	Site 1	Site 3	Site 4	Site 5	Site 5B
Biochemical Oxygen Demand	mg/l	1.3	1.3	1.4	1.5	1.1
Ammoniacal Nitrogen	mg/l	0.21	0.18	0.10	0.10	0.24
pH	-	7.7	7.6	7.3	7.3	7.4
Suspended Solids	mg/l	14	17	14	< 5	< 5
Orthophosphate	mg/l	0.05	0.04	0.03	0.03	0.08
Nitrate	mg/l	5.4	2.6	3.5	3.6	7.5
Copper, dissolved	µg/l	0.5	0.5	0.6	7.8	0.6
Lead, dissolved	µg/l	0.14	0.22	0.14	0.58	0.63
Zinc, dissolved	µg/l	48	41	41	20	49

Key:

WFD status
High
Good
Moderate
Poor

WFD status (for nitrate, pH, suspended solids and metals)
Pass
Fail

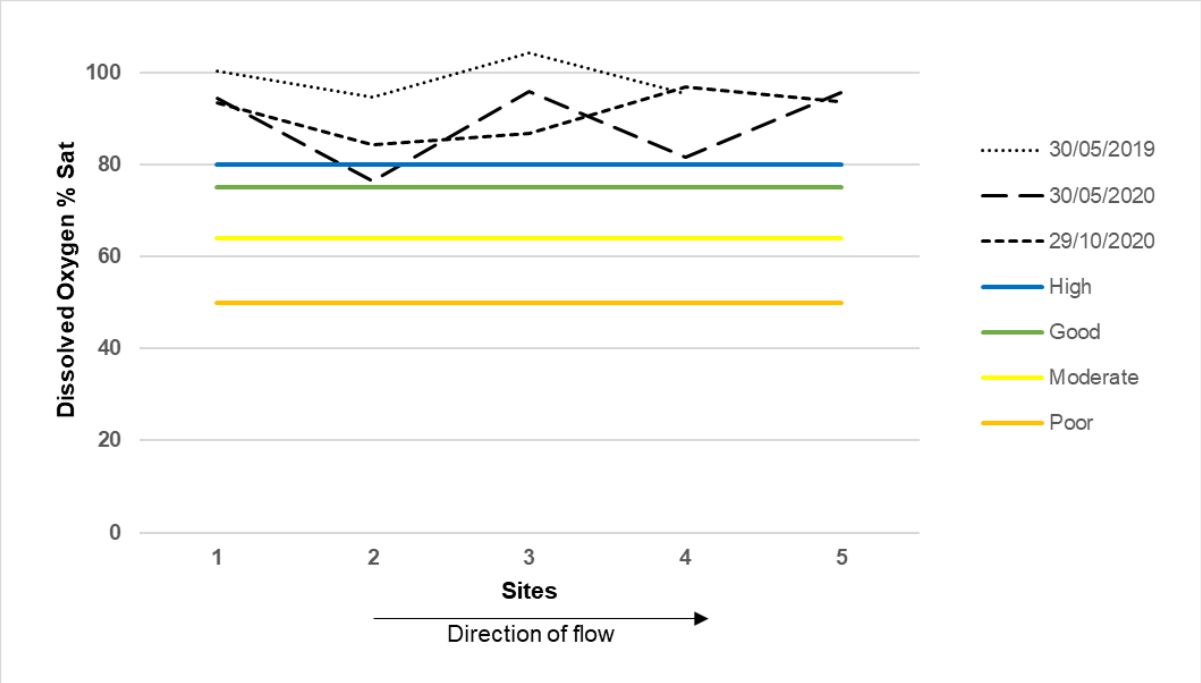


Figure 3.2 Water quality results for dissolved oxygen

3.3.3.1 Summary

Nant Gain is not currently classified under the WFD, however, the limited water quality data suggests that the watercourse is in a generally good condition for most determinands. The data indicates that only orthophosphate and dissolved zinc are currently not complying with WFD objective of meeting good ecological status and this applies to all five sampling sites. It should be acknowledged that data used in this assessment is temporally very limited.

3.3.4 Habitat walkover

Information on the river morphology and in-river habitats was collected on 27th to 28th August and 21st to 25th September 2020. The walkover survey was conducted in an upstream to downstream direction covering a total of approximately 6 km of the Nant Gain and Afon Alyn, from the outflow from Reservoir No. 4 to Rhydymwyn flow gauging station. In addition, the approximate 1 km distance of the unnamed tributary, from the outflow of Reservoir No. 3 to the confluence with the Nant Gain, was also surveyed. Not all sections of the watercourses could be accessed, most notably along the Nant Gain through the Alyn Valley Woods just upstream of the Afon Alyn and some section further downstream, on the Afon Alyn.

Flow rates during the time of the survey were considered ‘low but normal’, in-keeping with the sporadic flows in the watercourses due to losses to the underlying limestone system. The walkover characterised the Nant Gain with particular focus on functional habitat availability and the documenting of potential barriers to fish movement. Although the walkover extended along the Afon Alyn (to Rhydymwyn flow gauging station), the main focus was to assess the potential impact to the Nant Gain habitats as it was considered any likely effects of repealing the compensation flow requirement would only extend as far as the Nant Gain/ Afon Alyn confluence; however it was also considered useful to understand the habitat functionality along the Afon Alyn in the reach immediately downstream of the Nant Gain.

3.3.4.1 Walkover outputs

The digitised habitat walkover maps are shown in Appendix 4 .

Table 3.4 provides a summary of the total available area and relative contribution of key habitat and flow types recorded, with the complete percentage coverage of habitat types shown in Figure 3.3.

Almost half (40%) of the reach surveyed was dry, because of the hydraulic continuity with (losses to) the karstic limestone system and 15% of the reach was inaccessible; 6% was recorded as standing water, reflecting the relatively high number of ponds in the upper part of the reach (Nant Gain); only a very small percentage (3.6%) was classed as potential fry and/ or parr habitat and 5% as potential mixed juvenile habitat. Overall the walkover survey demonstrated a lack of habitat heterogeneity in the wetted and accessible parts of the surveyed reach.

Due to the lack of habitat likely to host flow-dependent fish species along the Nant Gain, and a consequent lack of sensitive or representative locations, it was decided not to capture additional transect data (cross-sectional channel data to allow predictions of hydraulic changes based upon channel geometry).

Table 3.4 Summary of walkover survey, key habitat categories

Habitat Type	% Total Area
Dry	40.54
Run	20.38
Other	23.15
Standing water	6.00
Glide	5.41
Fry, parr habitat	3.56
Pool	0.50
Riffle	0.32
Cascade	0.14

The complete percentage coverage of habitat types is shown in Figure 3.3.

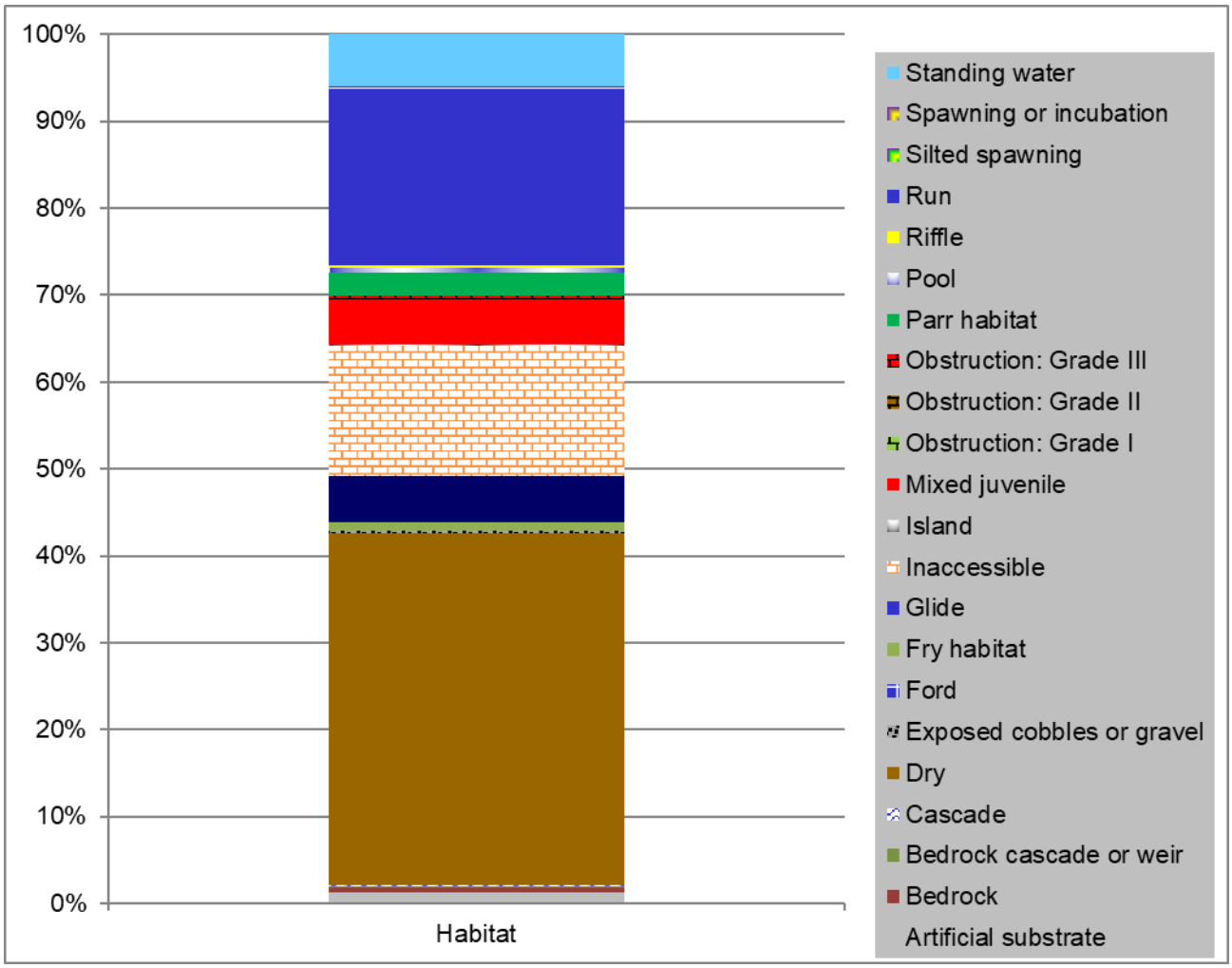


Figure 3.3 Percentage coverage of habitat types during the habitat walkover

3.3.5 Flow gauging

Flow gauging was completed at seven sites on 29/10/2020. Where possible the gauging locations were closely aligned to the other survey sites (macroinvertebrate, water quality); however, to gauge at sites which align with the requirements of BS EN ISO 748:2007, as much as practically possible, this was not always feasible. For example, as the unnamed tributary flowing from Reservoir No. 3 was dry it was not possible to gauge directly that watercourse, therefore as a proxy for that watercourse the Nant Gain was gauged upstream and downstream of the unnamed tributary confluence. It was also not possible to gauge at Site 5 on the Nant Gain, just upstream of the confluence with the Afon Alyn, as the Nant Gain was dry at that location. Therefore, as a proxy for the Nant Gain the Afon Alyn was gauged both upstream and downstream of the Nant Gain confluence.

The flow gauging results are shown in Table 3.5.

On the day of the flow gaugings, 29/10/2020, the Rhydymwyn flow gauging station (NRFA 67009 - Alyn at Rhydymwyn[2]) recorded a mean daily flow of 3.47 Ml/d equivalent to the 49% Exceedance (Q49) at that gauging station. For comparison with the flow gauging results, LowFlows 2[3] outputs were derived for the Nant Gain and the Afon Alyn, as shown in Table 3.5, for Q49 and Q95 flows, although uncertainty in LowFlows2 outputs should be acknowledged due to contributions to/ from groundwater (limestone). The resulting accretion profile is shown in Figure 3.4.

Table 3.5 Flow gauging results

Site	Distance from Site 1 (m)	Flow (Ml/d)	Low Flows (Ml/d) - Qn49	Low Flows (Ml/d) - Qn95
Site 1	0	12.40	3.97	1.04
d/s WTW	113	5.93	3.97	1.04
u/s unnamed tributary	328	8.83	3.97	1.04
d/s unnamed tributary	357	13.58	5.27	1.30
Site 4	865	8.22	5.88	1.56
Afon Alyn u/s Nant Gain	1758	21.22	6.31	1.56
Afon Alyn d/s Nant Gain	1800	16.08	48.73	13.99

The lack of a consistent accretion along the Nant Gain is considered in part due to lack of suitable robust flow gauging sites along the Nant Gain (and hence high uncertainty in the flow

[2] https://nrfa.ceh.ac.uk/data/station/info/67009

[3] https://www.hydrosolutions.co.uk/software/lowflows2/

gaugings) and likely losses (and potentially gains to) from the river to the underlying limestone system, specifically for the lower reaches of the Nant Gain. This is further evidenced by the gaugings taken on the Afon Alyn upstream and downstream of the Nant Gain confluence (sites 'Afon Alyn u/s Nant Gain' and 'Afon Alyn d/s Nant Gain') where the site upstream of the confluence recorded a higher discharge value than the flow downstream of the confluence. Note, the site 'Afon Alyn u/s Nant Gain' is not shown on the accretion profile in Figure 3.4.

The Nant Gain/ Afon Alyn confluence area is noted by an NRW hydrology report (Bissell[4], 2011) to be a known area of flow losses/ gains from the Nant Gain and Afon Alyn and so this may account for some of the flow fluctuations at that site, although as evidenced from the site photographs in Appendix 5 neither of the flow gauging sites on the Afon Alyn showed characteristics ideal for the measurement of flows.

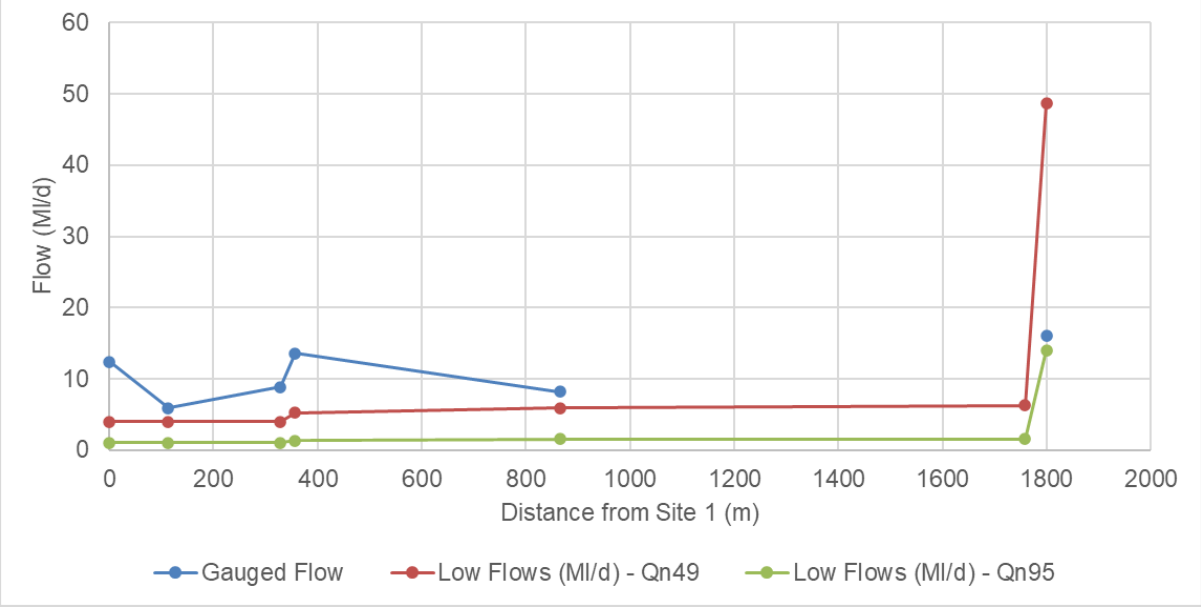


Figure 3.4 Flow gauging accretion profile

[4] Bissell, R. (2011). Assessment of Compensation Flow and Drawdown at Cilcain Reservoirs. Cyfoeth Naturiol Cymru/Natural Resources Wales.

3.3.6 Literature search and desk study

To support the study and to allow interpretation of the hydro-ecology of the Nant Gain in the context of natural variation, a brief web search for third party information was completed in addition to a data request to NRW pertaining to the Nant Gain.

A number of sources of information were collated which are referenced in **Error! Reference source not found.**. The derived information can be grouped into a number of categories, as below.

3.3.6.1 Ecology

Document ref. 3, 8 and 12 discuss the diversity, value and status of the trout resource within the Welsh Water Authority area. Nant Gain is not mentioned and the only mention of Afon Alyn in Ref. 3 refers to declining brown trout populations. Ref. 12 attempts to pinpoint and identify any problems there may be in the brown trout habitat which are controlling the natural breeding, survival and holding capacity of the water and to recommend such measures that could be taken by the Mold Fly Fishing club to mitigate or remedy any of these problems.

Document ref. 13 reports a systematic survey to assess the distribution and status of the Eurasian otter (*Lutra lutra*) in Wales between July 2009 and March 2010. The only mention of Afon Alyn is in general context i.e. 'brown trout fishing is enjoyed on the Afon Alyn'.

Document ref. 14 references the Alyn Valley Woods being a large stand of semi-natural broadleaved woodland arising along the steep gorge of the Afon Alyn.

3.3.6.2 Geology & Geomorphology

Document ref. 1 discusses a methodology named CAFES (Combined Automated Flood, Elevation and Stream power), to quantify downstream change in river flood power, based on integrating Flood Estimation Handbook systems in a GIS framework with the 5 m grid. The paper presents initial results from five rivers in western Britain: the Dart, Otter, Taff, Trannon and Alyn. There is no relevant material to the potential impacts from proposed compensation flow repeal losses/ gains to/ from the Afon Alyn.

Document ref. 4, 5 and 11 attempts to trace the evolution of the unusual courses adopted by the Alyn and Wheeler rivers. Ref. 4 notes that lead-mining operations have caused very considerable lowering of the water table in the underlying Limestone and that much of the Afon Alyn is supplying water to the Limestone rather than draining water from it.

Document ref. 16 explores the hydrological effects of one of the largest drainage levels in Europe, the Milwr Tunnel in northern Wales (mean flow rate of 1.270 m^3/s). The Milwr Tunnel is a mine drainage adit running some 10 miles from the hamlet of Cadole near Loggerheads, Denbighshire to Bagillt on the Dee Estuary in North Wales. It was originally built in 1897 to drain the lead mines beneath Halkyn Mountain, which are vulnerable to flooding in their lower levels. This enabled the exploitation of new lodes and was variously used for the extraction of lead, zinc and limestone during its working history. It is part of a network of mines, lodes and natural cave systems – the Halkyn United Mines – that extends for up to 100 km, the longest in the United Kingdom. It forms part of the mine drainage system that is responsible for draining Ogof Hesp Alyn and leaving much of the Afon Alyn between Loggerheads and Rhydymwyn dry during summer months.

3.3.6.3 Hydrology

Document ref. 6 scopes, develops, calibrates and validates a fluvial flood forecasting model for the Afon Alyn and its tributaries. The report covers, in general, the characteristics of the Afon Alyn, in addition to specific flood model issues. It should be noted that the upstream extent of the model was 3.6 km downstream of the Rhydywymn flow gauging station.

Document ref. 7 demonstrated a method to objectively prioritise Impacted and Probably Impacted water bodies (from mine waters) into ranked lists, using water quality, ecological, groundwater and higher impact metrics. This information was then used to inform future management of pollution from abandoned non-coal mine sites. The Afon Alyn upstream of Rhydywymn is ranked no. 2 in the assessed list of watercourses (high potential impact) of being impacted by abandoned non-coal mine impacts.

Document ref. 2 appraises the options to mitigate against low levels in the Cilcain reservoirs, experienced before 2011. The report analysed reservoir level and stage-storage data, received from DCWW, for reservoirs no. 3 and 4 from 2000 to 2010. No data was available for reservoir no. 1 and 2. The analysis showed that reservoir no. 3 experienced drawdown events of 2.0 m or more in every year prior to 2010. The data, prior to 1996, was advised to be treated with caution as it did not show any drawdowns, in contradiction to anecdotal evidence. However, drawdowns in three years (2005, 2008, 2009) were attributed to engineering works; therefore, confirmed drawdowns were only attributed to compensation releases in two dry years (2010, 2011).

The report attempted to construct a hydraulic model of the reservoirs so that a compensation flow level could be determined that would no cause excessive drawdown of the reservoirs. Unfortunately, due to the lack of robust available data, it was not possible to construct and calibrate a reliable model.

Five potential solutions were tabled (with no preferred option chosen) to limit the extent and duration of reservoir drawdowns. These were:

a. Reduce the compensation flow to a more sustainable rate (7.8 l/s);

b. Remove the compensation flow requirement;

c. Maintain the current compensation flow but amend the reservoir control rules to prevent excessive drawdown, thereby allowing cessation of the compensation flows at certain times;

d. Only release compensation water when DCWW abstract from the reservoirs. As the reservoirs are not currently used, it was noted this option was effectively the same as option 2.

e. Stop releasing compensation flows when the flow at Rhydymwyn FGS is zero. This acknowledges that the Afon Alyn frequently runs dry.

In 2012 NRW notified DCWW that the compensation flow could be reduced to 0.69 Ml/d (7.8 l/s) on a trial basis, to be reviewed every three months or until such a time that complaints were received from downstream stakeholders.

3.4 Stages 4 Assessment summary and conclusion

3.4.1 Summary

A Weight of Evidence approach has been used to combine the different strands of information into an assessment of the likely impact of ceasing the compensation flow. This follows a Source – Pathways – Receptor model to identify any likely pathways of impact and to establish whether these are corroborated by biological evidence. Two pathways were considered; the likelihood of impacts due to changes in physical habitat (including barriers) and of any changes in water quality (dilution).

Were compensation flows to cease, flows would be similar to those under current circumstances for the majority of the time, because (as under current operation) outflows would match inflows (with due allowance for evaporation). However, removal of the compensation flow may not entirely prevent water levels falling below the level at which the reservoirs may spill, because of evaporative losses and wind-generated wave overtopping. Under these circumstances spills from the reservoir would cease and outflows would be reduced to any reservoir leakage. Any such episodes would generally be short-lived, however, and would be synchronised with periods of naturally low inflow that are a natural feature of headwaters. Overall, therefore, the effect on the flow regime is likely to be modest and would constitute a move towards a more natural flow regime, but with short-lived periods of very low flows. Any such periods would be reached gradually.

A convincing pattern of accretion has not been established, but effects during temporary cessations in spills are likely to constitute a substantial reduction in flow immediately downstream of the reservoirs, but some wetted habitat is likely to be maintained. The effect of flow changes would decrease with distance downstream, and it is unlikely that flows in the lower reaches would be affected because in dry periods the lower reaches dry under current circumstances. For the same reason flows on the Afon Alyn would not be affected.

Water quality data suggests that the water quality is generally good for most determinands. The data do, however, indicate that orthophosphate and dissolved zinc are currently not complying with WFD objective of meeting good ecological status and this applies to all five sampling sites. Short-lived flow reductions may cause temporary increases in pollutant concentrations, assuming that pollutant inputs occur downstream of the reservoirs. However, any such increases are likely to be short-lived. Corresponding temporary decreases in pollutant concentrations may also be expected during any periods during which flows are increased due to the removal of the compensation flows (generally during short periods in which the compensation flows currently cause temporary drawdown and deferral of spills).

The walkover survey demonstrated a lack of habitat heterogeneity in the wetted and accessible parts of the surveyed reach and a lack of habitat likely to host flow-dependent fish species along the Nant Gain. Given this, transects were not considered necessary to ascertain that impacts on fish would be unlikely.

Macroinvertebrate data suggest that macroinvertebrate communities in the watercourse are consistent with Good status, in line with the downstream water body Alyn – upstream Dolfechlas Brook. Although potentially affected by drying in the lower reaches, this would not be affected by changes to the compensation flow. Elsewhere, whilst the sampling period is short, the data demonstrate a degree of resilience to low flows experienced during the dry springs of 2019 and 2020. If the compensation flow is repealed, flows in the upper reaches of

the Nant Gain may fall below recently experienced flows for short periods, but macroinvertebrate communities have demonstrated resilience to short periods of very low flows, particularly as such periods are likely to occur only during summer periods, to which macroinvertebrates are adapted (with many species reaching their aerial stage).

Overall, therefore, it is not considered that repealing the compensation flow provision will significantly detrimentally impact habitats and species downstream of the Cilcain resevoirs. Any impacts are likely to be infrequent and restricted to the upper and, possibly, middle reaches of the Nant Gain. Effects on the Afon Alyn can be discounted. The Nant Gain is not currently classified under the WFD and therefore, effects on WFD status at the waterbody scale are considered unlikely.

3.4.2 Conclusion

This assessment concludes that there is a very low risk of deterioration in the ecological status of the Alyn – upstream Dolfechlas Brook water body by repealing the compensation flow provision from the Cilcain reservoirs and returning the flow regime of the Nant Gain to a more natural state. Given the evidence assessed, this is considered Quite Certain.

3.4.3 Mitigations

To mitigate any possible short-term impacts of removing the compensation flows the following measures are recommended:

<u>Best time of year</u>

It is possible that any potential negative effects of the switch-off of the compensation flows on riverine organisms can be mitigated by ceasing the compensation flows during late autumn/ winter. The switch off should not be done during summer low flows, when the effect of water level change may be greatest and is most likely to result in the crossing of critical thresholds for organisms. If the scheme is implemented in late autumn/ winter, under higher flows, then the effect will be less noticeable to organisms and it gives a longer period over winter and spring for the river to adjust to the new flow regime in synchrony with natural cycles of flow change.

<u>Adaptive monitoring</u>

Both macroinvertebrate and water quality data used in this assessment are temporally limited; however, the data provides a robust baseline. Following the cessation of the compensation flows it is recommended that macroinvertebrate and water quality data is collected in spring and autumn 2021 and in again in 2022 (if compensation flows are stopped in winter 2020/ 2021) to provide a comparison with the pre-project baseline.

It is not recommended to complete further flow gaugings.

4. Assessment of the proposed scheme against other designations

4.1 Alyn Valley Woods/ Coedwigoedd Dyffryn Alyn SAC

The Conservation of Habitats and Species Regulations 2017, referred to as the 'Habitats Regulations', transpose the requirements of the European Birds and Habitats Directive5 into UK legislation. The Birds Directive aims to protect rare and vulnerable birds and the habitats that they depend upon and this is achieved in part through the classification of Special Protection Areas (SPAs).

The UK is also a contracting party to the Ramsar Convention6, which seeks to protect wetlands of international importance, especially those wetlands utilised as waterfowl habitat. It is UK Government policy (in England this is identified within the National Planning Policy Framework) that all competent authorities should treat Ramsar sites similarly as if they are fully designated European sites.

Collectively, all formally proposed and fully classified or designated SPAs and SACs, and all formally proposed or listed Ramsar sites form a pan-European Union network of protected areas known as Natura 2000. These are also referred to as European sites7, and this term has been adopted throughout this report.

Regulation 63 of the Habitats Regulations requires a competent authority to undertake an 'appropriate assessment' of any plan or project (alone or in-combination with other plans and projects) which is likely to have a significant effect on the features of a European Site, unless the project is directly connected with the management of the site.

It is incumbent on any public body (referred to as a competent authority within the Habitats Regulations) to carry out a HRA where they are proposing to carry out a project, implement a plan or authorise another party to carry out a plan or project. Competent authorities are required to record the process undertaken, ensuring that there will be no adverse effects on the integrity of a European site as a result of a plan or project.

[5] Council Directive on the conservation of natural habitats and of wild fauna and flora of 21st May 1992 (92/43/EEC) and Council Directive on the conservation of wild birds of 2nd April 1979 (70/409/EEC) consolidated by the Birds Directive 2009 (2009/147/EC).

[6] Convention on wetlands of international importance especially as waterfowl habitat, Ramsar, Iran, 2/2/71 as amended by the Paris protocol of 3/12/92 and the Regina amendments adopted at the extraordinary conference of contracting parties at Regina, Saskatchewan, Canada 28/5 – 3/6/87, most commonly referred to as the 'Ramsar Convention'.

[7] Tyldesley, D. and Chapman, C., (2013) The Habitats Regulations Assessment Handbook, September 2013 2013 edition UK: DTA Publications Limited

The European Commission has developed guidance in relation to Articles 6(3) and 6(4) of the Habitats Directive8, and this recommends a four-stage approach to addressing the requirements of these Articles.

summarises the four HRA stages.

Table 4.1 Stages in the Habitats Regulations Assessment process

Stage	Description
Stage 1: Screening	Assessment of whether a plan or project, either alone or in combination with other plans or projects, is likely to have a significant effect on a Natura 2000 site.
Stage 2: Appropriate Assessment	Consider the impacts of the plan on the integrity of a European site, alone or in combination with other plans or projects and with reference to the site's conservation objectives. Consider measures to mitigate the identified impacts. Prepare an Appropriate Assessment Report for consultation with key stakeholders including NRW.
Stage 3: Assessment of alternative solutions	Re-assessing alternatives if effective mitigation proves impossible and develop/ select a different alternative that does not harm site integrity. If no such alternatives exist the process continues to Stage 4.
Stage 4: Assessment where no alternative solutions exist and where adverse impacts remain	At this stage, plans which, after mitigation still have an adverse effect on the site(s) integrity should be dropped. Assessing whether a plan can be passed justified by 'imperative reasons of overriding public interest' (IROPI) or permitted on the grounds of human health, public safety or primary beneficial consequences for the environment.

Stage 1 Screening

This stage identifies the likely effects of the Project on any European site, either alone or in combination with other plans or projects. Specifically, this stage considers whether these effects are likely to be significant with regard to the integrity of the European site. The Project will require 'appropriate assessment 'if it is considered that any aspect of it will have a significant effect on any European site.

Stage 2 Appropriate Assessment

If it is considered that a plan or project is likely to have a significant effect on the integrity of a European site, the requirements of Stage 2 are triggered. This stage considers the impacts of the Project on the integrity of a European site, alone or in combination with other plans or projects. The assessment should consider the implications for the European site in view of the

[8] European Commission (2001). Assessment of plans and projects significantly effecting Natura 2000 site. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC. Published November 2001.

site's conservation objectives. If adverse impacts are identified, this assessment should also consider measures to mitigate the identified impacts.

If necessary, modifications to those proposals or policies are identified to avoid any adverse effects on site integrity. If mitigation is not possible and adverse effects on a Europeans site's integrity remain, the process must proceed to Stage 3.

European and Ramsar Site(s) Identified and Assessment

The Alyn Valley Woods/ Coedwigoedd Dyffryn Alyn SAC predominantly occupies the steep Carboniferous Limestone escarpment alongside the Afon Alyn, together with adjoining areas. The site supports a large stand of semi-natural broadleaved woodland.

The site has been selected for the presence of one interest feature that qualify under Annex I of the Habitats Directive (92/43/EEC). The primary reason for designation is the presence of the Annex I habitat "Tilio-Acerion forests of slopes, screes and ravines".

Further two Annex I habitats are present as qualifying features, but not a primary reason for site selection are "Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites)" and "Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)".

We have carried out a preliminary screening assessment as regards the potential for LSE on the Alyn Valley Woods/ Coedwigoedd Dyffryn Alyn SAC. Current conservation management issues and actions include removing non-native and exotic species from the woodland and excluding/ reducing grazing from some areas.

Although the Nant Gain (and consequently Afon Alyn) bisect the site, the site is not directly supported by flows from the Nant Gain. Given the likely losses (and potentially gains to) from the watercourse to the underlying limestone system and that the proposed cessation of compensation flows will not reduce the quantity of water flowing to the Nant Gain, only return the watercourse to a more naturalised state, it is not considered likely that there will be a significant effect on the site.

Therefore, there is no plausible impact pathway (hydrological or other realistic mechanism) for the Project to result in a LSE on the Alyn Valley Woods/ Coedwigoedd Dyffryn Alyn SAC, and as such, no formal screening is required.

4.2 Alyn Valley Woods and Alyn Gorge Caves SSSI

The site predominantly occupies the steep Carboniferous Limestone escarpment alongside the Afon Alyn between Loggerheads and Rhydymwyn but also includes the subsidiary wooded valleys of the Aber Eilun and Nant Gain to its west. The site is of special interest for its geomorphology, the Alyn Gorge Caves and its semi-natural broadleaved woodlands including their size and specific types of woodland vegetation, its calcareous and mesotrophic grasslands, its scarce plant assemblage, its population of wayfaring tree *Viburnum lantana* and its population of the grizzled skipper butterfly.

Alyn Gorge Caves site comprises three cave systems: Ogof Hesp Alyn, Ogof Hen Ffynhonau and Ogof Nadolig. Ogof Hesp Alyn and Ogof Hen Ffynhonau lie behind resurgences in the

Alyn Gorge, and both represent relatively recent phases in the development of the gorge. Many of the cave passages were drained as a result of local mining activities, and now provide excellent examples of both shallow and deep phreatic drainage systems within the limestone.

Collectively, the cave systems contain an impressive range of solutional and erosional features along with extensive sediment sequences characteristic of a range of water-flow regimes and climatic conditions. They provide an important three-dimensional example of underground landform development.

As noted above, part of the site is classified as the Alyn Valley Woods/ Coedwigoedd Dyffryn Alun SAC.

Given the overlap in location and type of designated features of Alyn Valley Woods/ Coedwigoedd Dyffryn Alun SAC and Alyn Valley Woods and Alyn Gorge Caves SSSI it is considered appropriate to extend the assumptions of the HRA Screening assessment to the SSSI features which overlap with those of the SAC i.e. geomorphology, broadleaved woodlands, vegetation and grasslands, and therefore conclude that the Project will not result in an adverse impact to these features of the Alyn Valley Woods and Alyn Gorge Caves SSSI.

Regarding the Alyn Gorge Caves features, clearly flow losses are experienced from the Nant Gain (and to a greater extent from the Afon Alyn), which no doubt some of which (in the absence of quantifiable evidence) end up traversing through the cave system. However, as the proposed repeal of the compensation release provision will not result in a loss of water in the Nant Gain, except perhaps marginally in the driest of summers, it is considered that the proposed repeal is also not likely to significantly impact the Alyn Gorge Caves features.

Appendix 1 References

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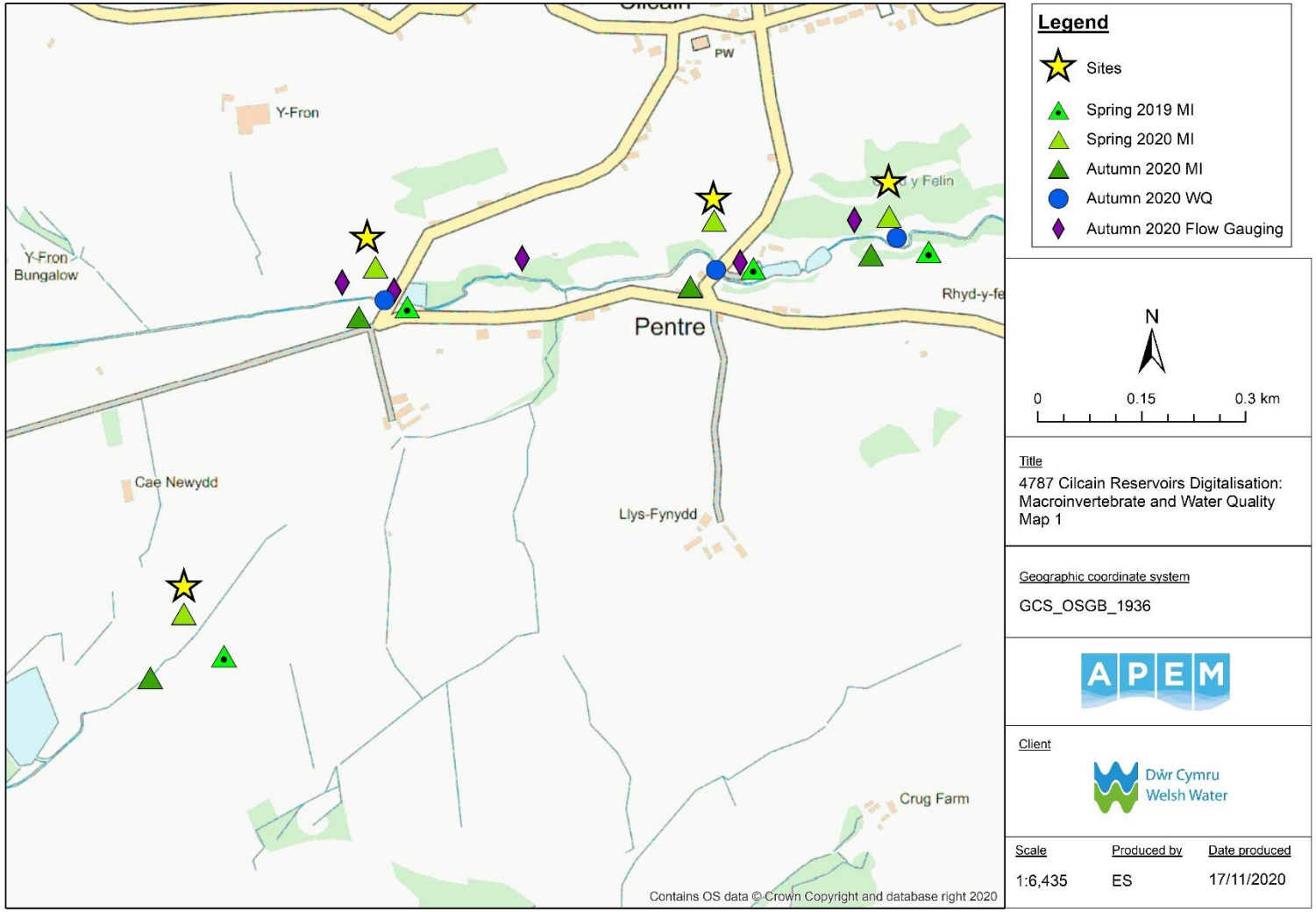
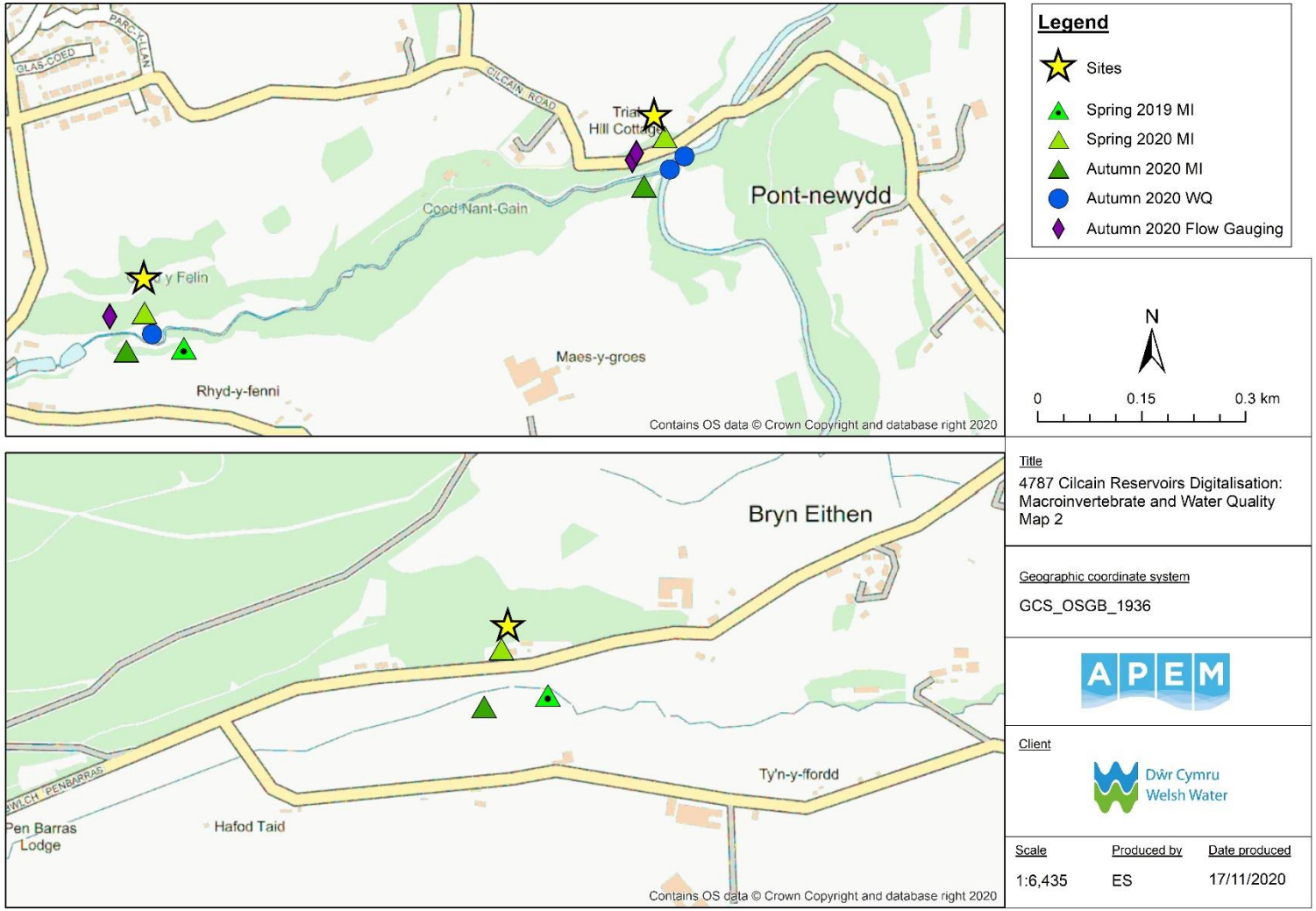
Appendix 2 Sampling location maps

Note, the sampling location labels on the maps have been adjusted marginally to enable all sampling types to be visible, when at the same location.


Legend
Sites
Spring 2019 MI
Spring 2020 MI
Autumn 2020 MI
Autumn 2020 WQ
Autumn 2020 Flow Gauging
N
0
0.15
0.3 km
Title
4787 Cilcain Reservoirs Digitalisation: Macroinvertebrate and Water Quality Map 1
Geographic coordinate system
GCS_OSGB_1936
Client
Dŵr Cymru Welsh Water
Scale
Produced by
Date produced
1:6,435
ES
17/11/2020
Y-Fron
PW
Y-Fron Bungalow
Pentre
Rhyd-y-fe
Cae Newydd
Llys-Fynydd
Crug Farm
Contains OS data © Crown Copyright and database right 2020


GLAS-COED
PARC-Y-LLAN
CILCAIN ROAD
Hill Cottage
Pont-newydd
Coed-Nant-Gain
Maes-y-groes
Rhyd-y-fenni
Contains OS data © Crown Copyright and database right 2020
Bryn Eithen
Ty'n-y-ffordd
Hafod Taid
Pen Barras
Lodge
Contains OS data © Crown Copyright and database right 2020
Legend
Sites
Spring 2019 MI
Spring 2020 MI
Autumn 2020 MI
Autumn 2020 WQ
Autumn 2020 Flow Gauging
N
0
0.15
0.3 km
Title
4787 Cilcain Reservoirs Digitalisation: Macroinvertebrate and Water Quality Map 2
Geographic coordinate system
GCS_OSGB_1936
Client
Dŵr Cymru Welsh Water
Scale
Produced by
Date produced
1:6,435
ES
17/11/2020

Appendix 3 WFD Water Quality standards

Determinands	Status	Site 1	Site 3	Site 4	Site 5	Site 5B	Comments
Biochemical Oxygen Demand, mg/l	High	3	3	3	3	3	Sites 1 to 5 are water body type 2 and site 5B is water body type 4.
	Good	4	4	4	4	4	
	Moderate	6	6	6	6	6	
	Poor	7.5	7.5	7.5	7.5	7.5	
Ammoniacal Nitrogen, as N mg/l	High	0.2	0.2	0.2	0.2	0.2	Sites 1 to 5 are water body type 2 and site 5B is water body type 4.
	Good	0.3	0.3	0.3	0.3	0.3	
	Moderate	0.75	0.75	0.75	0.75	0.75	
	Poor	1.1	1.1	1.1	1.1	1.1	
pH	Pass/Fail	>=6 and <=9	>=6 and <=9	>=6 and <=9	>=6 and <=9	>=6 and <=9	
Suspended Solids, mg/l	Pass/Fail	25	25	25	25	25	The standard is taken from the Freshwater Fish Directive (repealed).
Ortho Phosphate, as PO4 mg/l	High	13	13	13	13	20	Site specific standards were determined using the UKTAG river phosphorus calculator.
	Good	28	28	28	28	42	
	Moderate	87	87	87	87	118	
	Poor	752	752	752	752	856	
Nitrate, as NO3 mg/l	Pass/Fail	50	50	50	50	50	The standard is taken from the Nitrates Directive.
Copper, dissolved µg/l	Pass/Fail	10.69	11.20	11.27	13.93	12.06	Site specific standards were determined using the UKTAG metal bioavailability assessment tool (M-BAT).
Lead, dissolved µg/l	Pass/Fail	3.12	3.36	3.24	3.96	3.48	
Zinc, dissolved µg/l	Pass/Fail	17.06	16.88	16.07	18.36	19.56	

Appendix 4 Habitat walkover maps

Due to the large file sizes the habitat walkover maps are appended separately.

Appendix 5 Flow gauging sites photographs

	
Site 1 Viewing upstream	Site 1 Viewing downstream
	
D/S WTW site	D/S WTW site

u/s unnamed tributary

d/s unnamed tributary

Site 4 Viewing downstream

Afon Alyn u/s Nant Gain, viewing upstream

Afon Alyn d/s Nant Gain, viewing upstream

Afon Alyn d/s Nant Gain, viewing downstream