Dŵr Cymru Welsh Water

Environmental Assessment of Llyn Cwellyn Drought Order (8001-2)

Final

March 2019

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NON-TECHNICAL SUMMARY

INTRODUCTION AND PURPOSE OF THIS REPORT

Welsh Water's Drought Plan provides a comprehensive statement of the actions Welsh Water will consider implementing during drought conditions to safeguard essential water supplies to customers and minimise environmental impact. It encompasses a number of drought management options that will only be implemented if and when required and includes drought permit / order options.

A drought permit or order is a management action that, if granted, can allow more flexibility to manage water resources and the effects of drought on public water supply and the environment.

The objective of this report is to provide an independent and robust assessment of the potential environmental effects of implementing a drought order at Llyn Cwellyn, over and above those arising due to natural effects of drought and those which would occur under "normal" abstraction licence conditions.

Llyn Cwellyn Reservoir is located in Welsh Water's North Eryri / Ynys Môn Water Resource Zone (WRZ) which includes the mainland adjacent to the Menai Straits (North Eryri) and Ynys Môn (Anglesey). Llyn Cwellyn is a natural glacial moraine lake with managed water levels and controlled outflows in the upper catchment of the Afon Gwyrfai located in Snowdonia National Park. The Afon Gwyrfai is designated as a Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI) therefore consideration has been given to the potential impacts of drought order implementation on the designated site features and species.

The assessment also considers how the proposed drought order may affect the environment in combination with the effects of other existing abstraction licences, environmental permits and other drought management plans.

This report is a 'shelf-copy' report which would be updated to support an application to Natural Resources Wales (NRW) for a drought order at Llyn Cwellyn, which may be required by Welsh Water in the future.

PROPOSED DROUGHT ORDER DETAILS

In order to protect public water supplies within Welsh Water's North Eryri / Ynys Môn (8001) WRZ in the event of a future severe drought, Welsh Water would make an application to Welsh Ministers for a drought order to vary the conditions of abstraction from Afon Gwyrfai at Llyn Cwellyn.

The drought order involves a proposed relaxation of the low lake level abstraction rate

at Llyn Cwellyn. When lake levels have fallen below 0.8m below spillway and the daily abstraction rate has reduced to 10Ml/d in the current licence conditions, the drought order proposes to operate the abstraction at a daily rate of 12Ml/d. The lake level at which abstraction ceases would be maintained as per the current licence conditions of 2.6m below spillway during the period 16 September to 15 November and 2.0m below spillway at all other times. Compensation releases would be maintained as per the current licence conditions of 11.4Ml/d when lake level is between 0.8m and 2.6m below spillway. Freshet releases would not be impacted by the drought order.

The drought order will provide a modest increase in water resource during a drought, with the potential to relieve other sources, and is considered not to extend outside the period May to October. This has been confirmed by Welsh Water's water resources modelling.

The revised abstraction arrangements would be authorised for 6 months but would be removed sooner if water resources have returned to adequate levels to safeguard future water supplies, as agreed with NRW.

NEED FOR THE DROUGHT ORDER

Application for a drought order is a precautionary approach. Due to the time needed to determine a drought order application, Welsh Water will potentially apply for a drought order more frequently than it will be used.

The justification for the drought order sought will be set out in a "Needs Statement". This will be produced by Welsh Water at the time of a potential future application, and will form part of the full drought order application.

ALTERNATIVE SOURCES CONSIDERED

Details of alternative options considered by Welsh Water to maintain essential water supplies to its customers will be completed at the time of application for the drought order. This will provide further justification for the need for the drought order.

POTENTIAL IMPACTS OF DROUGHT ORDER IMPLEMENTATION

The scope of this drought order environmental assessment has been defined by a screening and scoping exercise in accordance with national drought planning guidance.

Summary of the Hydrological Assessment for the Afon Gwyrfai

The assessment has concluded that there is a **negligible** impact on river flows as a result of implementing the drought order. Consequently, there are **negligible** impacts on the physical environment of the river, including water quality.

Summary of the Environmental Features Screening for the Afon Gwyrfai

In accordance with national drought planning guidance, environmental assessment is neither required nor included for features where screening has identified a minor or negligible impact. Screening has not identified any environmental features for which environmental assessment is required. No environmental impacts have, therefore, been identified for any of the features identified in the screening exercise.

Cumulative Impacts

No cumulative effects of implementing the Llyn Cwellyn abstraction drought order with other drought order / permit schemes have been identified.

No further cumulative effects of implementing the drought order with other existing licences, consents and plans are anticipated. However, this should be reviewed at the time of any future application for a drought order at Llyn Cwellyn.

MITIGATION AND MONITORING

The environmental assessment has identified negligible environmental impacts arising from implementation of the proposed drought order at Llyn Cwellyn. This has included consideration and assessment of impacts on sites designated for their environmental importance. No are currently proposed as a consequence.

CONCLUSIONS

In summary, it has been concluded that the environmental effects on river flows, water quality and ecology of implementing a drought order at Llyn Cwellyn, over and above those conditions that already exist under "normal", i.e. licensed, baseline conditions, with the onset of a natural drought, would be **negligible.** This includes consideration of the effects on the Afon Gwyrfai SAC and SSSI in accordance with the requirements of the Habitats Directive and the Crow Act.

Contents

1 INTRODUCTION

1.1 PURPOSE OF THE ENVIRONMENTAL ASSESSMENT

The objective of this Environmental Assessment Report (EAR) is to provide an independent and robust assessment of the potential environmental effects of the implementation of a drought order by Dŵr Cymru Welsh Water (Welsh Water) to temporarily modify the abstraction licence conditions for Llyn Cwellyn to allow a temporary increase in abstraction from 10Ml/d to 12Ml/d when lake levels have fallen below 0.8m below spillway but remain above the no abstraction zone at Llyn Cwellyn Reservoir. Water abstracted at Llyn Cwellyn is used to provide public water supplies to Welsh Water's North Eryri / Ynys Môn (8001) Water Resource Zone (WRZ)[1] (see Section 2.1).

This EAR is a 'shelf-copy' report which would be updated in the event that Welsh Water needs to make an application during any future drought to Natural Resources Wales (NRW) for a drought order at Llyn Cwellyn. A drought order is a management action that, if granted, can help ensure essential water supplies are maintained to homes and businesses. The circumstances under which a drought order may be required is set out in the Welsh Water Drought Plan.

The assessment presented in this EAR considers the effects of implementation of the drought order over the months of May to October inclusive, the period for which Welsh Water has determined it might require a drought order for this water source.. The purpose of the assessment is to determine the environmental impacts of the drought order over and above any effects arising from natural drought conditions.

The study area and focus of this environmental assessment of the Llyn Cwellyn drought order covers the following waterbodies:

- Llyn Cwellyn Reservoir (GB31034002)
- Afon Gwyrfai (GB110065054190) – downstream of Cwellyn outflow to the tidal limit

This EAR includes discussion of the following:

- an assessment of the likely changes in river flow / water level regime due to implementing the proposed drought order (**for a summary, see Section 4 of this report**)
- identification of the environmental features that are sensitive to these changes and an assessment of the likely impacts on these features (**see Section 5 of this report**)

[1] UKWIR/Environment Agency define a WRZ as: 'The largest possible zone in which all resources, including external transfers, can be shared, and hence, the zone in which all customers will experience the same risk of supply failure from a resource shortfall.'

- identification of mitigation measures that may be required to prevent or reduce impacts on sensitive features (**see Section 6 of this report**)
- recommendations for baseline, in-drought and post-drought order monitoring requirements (**see Section 10 of this report**).

The environmental assessment has been conducted in accordance with Government regulations and using the Welsh Government / Natural Resources Wales (NRW) Drought Plan Guideline[2] (DPG); specifically Section 5 and Appendices I and J, and Welsh Government / Defra / NRW / Environment Agency guidance on drought permits and drought orders[3].

Consideration has been given to the potential impacts of drought order implementation on statutory designated sites, including those designated under international law (Habitats Directive, Birds Directive and the Ramsar Convention) and national legislation (notably Sites of Special Scientific Interest (SSSIs)).

In accordance with the DPG, the assessment also considers how the proposed drought order may affect the environment in combination with the effects of existing abstraction licences, environmental permits and other relevant activities and plans. This is discussed further in Sections 3 and 7.

1.2 SUPPORTING STUDIES

The DPG identifies in Section 5.4 that EARs are required as supporting documents to any drought permit or drought order application. The circumstances for which an environmental assessment is required are set out in **Box 1** below.

Box 1: Drought Plan Guidance - requirement for environmental assessment

The DPG requires that all features that could be affected by implementation of a drought order / permit are listed in the EAR and that an assessment is made of how sensitive each feature is to the likely changes in hydrology, hydrogeology and geomorphology, due to implementing the drought order / permit.

The DPG requires a detailed environmental assessment for applications where sensitive features are likely to be subject to a major or moderate impact, or a minor impact where this applies to environmentally designated features. Further environmental assessment is **not** required for those drought permits / orders where there is certainty that there are no such impacted sensitive features.

[2] Natural Resources Wales (2017) *Water Company Drought Plan Technical Guideline*. Available at https://cdn.naturalresources.wales/media/684414/final-wc-drought-plan-guidance-2017.pdf?mode=pad&rnd=131656713580000000, Accessed 04 February 2019.
[3] Welsh Government / Defra / Natural Resources Wales / Environment Agency (2015) https://www.gov.uk/government/collections/apply-for-a-drought-permit-drought-order-or-emergency-drought-orderhttps://www.gov.uk/guidance/apply-for-a-drought-order-or-emergency-drought-order#after-youve-received-your-drought-order, Accessed 21 December 20181

This environmental assessment is based on data available at the time of writing and includes the environmental features and data types determined by Box 1 in Appendix I of the DPG (except where these are considered not to be relevant to this drought order). Data were requested from key consultees (including Natural Resources Wales).

Where appropriate, this report also identifies areas where there are deficiencies in data availability and makes recommendations for future data / information gathering and monitoring. Welsh Water will continue to engage closely with Natural Resources Wales to ensure that adequate and sufficient data / information are collated and kept up-to-date in subsequent years to inform future environmental assessments.

1.3 CONSULTATION

Consultation is identified as an essential exercise in the preparation of the EAR. In preparing this 'shelf-copy' EAR for a drought order at Llyn Cwellyn, consultation with regulators and wider stakeholders has been undertaken to gain feedback on potential adverse effects, gather data and discuss any required monitoring and / or mitigation measures.

Further consultation will be also be undertaken at the time of any future applications for the drought order.

1.4 STRUCTURE AND CONTENT OF THE REPORT

This EAR comprises the following sections:

Section 1: Introduction

Section 2: Background to the Drought order

Section 3: Approach

Section 4: Hydrology and the Physical Environment

Section 5: Environmental Features Assessment

Section 6: Mitigation

Section 7: Cumulative Impacts

Section 8: Summary of Residual Impacts

Section 9: Impacts on Statutory Designated Sites

Section 10: Environmental Monitoring Plan (EMP)

Section 11: Conclusions

2 BACKGROUND TO THE DROUGHT ORDER

2.1 WELSH WATER'S SUPPLY SYSTEM

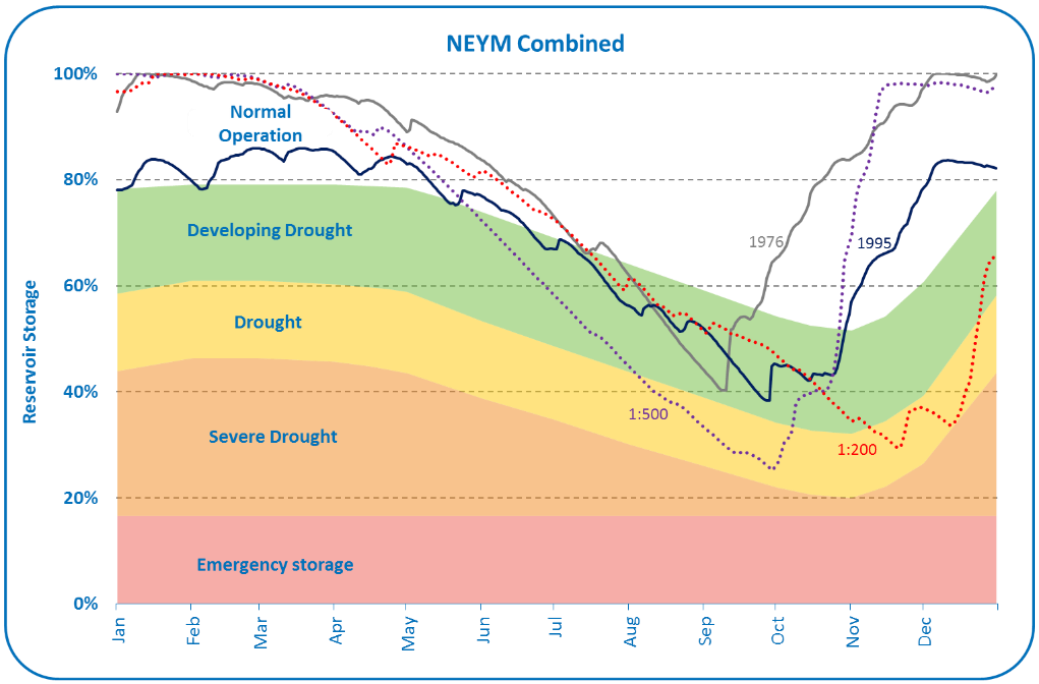
Welsh Water supplies water to more than 3 million people. The Welsh Water supply area covers the majority of Wales and a small part of England. It is split into 24 WRZ's (see **Figure 2.1**).

The North Eryri Ynys Môn (8001) Water Resource Zone (WRZ) includes the mainland adjacent to the Menai Straits (North Eryri) and Ynys Môn (Anglesey). Water is supplied from five impounding reservoirs; on the mainland Ffynnon Llugwy, Llyn Cwellyn and Llyn Marchlyn Bach and on Ynys Mon, Llyn Alaw and Llyn Cefni. The resources are operated conjunctively with the ability to feed water from the mainland to parts of the island from the gravity resources of Llyn Cwellyn, Ffynnon Llugwy and Llyn Marchlyn Bach when storage allows. As storage declines, the area of Ynys Môn supported from the mainland is reduced and the area supported by Llyn Alaw and Llyn Cefni increases.

Figure 2.1 Welsh Water Water Resource Zones

Llyn Cwellyn Reservoir is located on the mainland, North Eryri region. The trigger levels for applying for a drought order at Llyn Cwellyn are based on combined reservoir storage falling below a defined level; this is shown in **Figure 2.2** (dark orange shading labelled as 'severe drought'). Storage in Llyn Cwellyn would also need to be low. Welsh Water's assessment in its draft Drought Plan 2020 indicates that drought conditions severe enough to require an application for this drought option are unlikely to occur more frequently than at a return period of around once every 200 to 500 years. Fuller details of the work undertaken to assess this risk are provided in Annex 1 to the draft Drought Plan 2020.

Figure 2.2 North Eryri Ynys Môn Drought Action Zones and Historic Droughts



2.2 DESCRIPTION OF EXISTING ARRANGEMENTS AT LLYN CWELLYN

Welsh Water's licence (number 23/65/15/24) to abstract water under the Water Resources Act at Llyn Cwellyn (see **Figure B1.1**) includes the following conditions:

- 6,570 million litres (Ml) authorised to be abstracted per annum
- At a daily abstraction rate dependent on lake level (all levels have been re-cast relative to the spillway level of 141.15m) under the following scenarios:
  - 20.4Ml/d[4] when lake level is 0.5m below spillway or higher
  - 15.9Ml/d when lake level is 0.5m to 0.8m below spillway
  - 10.0Ml/d when lake level is 0.8m to 2.0m below spillway

4 1 Ml/d is 1 million litres per day.

  - 10.0Ml/d when lake level is between 2.0m to 2.6m below spillway during the period 16 September to 15 November only

- At an abstraction rate not exceeding 300 litres per second
- Provision of uniform statutory compensation releases from Llyn Cwellyn, dependent on lake level and season under the following scenarios:
  - 18.2Ml/d from 1 April to 31 December when lake level is 0.2m below spillway or higher
  - 13.6Ml/d from 1 January to 31 March when lake level is 0.2m below spillway or higher
  - 18.2Ml/d from 7 September to 31 December when lake level is between 0.2m and 0.8m below spillway
  - 13.6Ml/d from 1 January to 6 September when lake level is between 0.2m and 0.8m below spillway
  - 11.4Ml/d when lake level is between 0.8m and 2.6m below spillway.

Should the level of Llyn Cwellyn drop to specified levels, NRW can request Welsh Water to operate the adjustable-level temporary spillway. Temporary spillway operation is dependent on lake level and season and includes:

- Setting the temporary spillway at 0.8m below spillway when lake level is lower than 0.8m below spillway during the period 21 August and 15 November
- Setting the temporary spillway at 1.0m below spillway when lake level is lower than 1.0m below spillway during the period 16 November to 31 December.

Once requested by NRW, the temporary spillway must remain in operation until 1) advised by NRW, 2) until 31 December or 3) if the lake level rises to above the (normal) spillway level. The temporary spillway enables some "natural" outflow from the lake whilst the level is below the normal spillway.

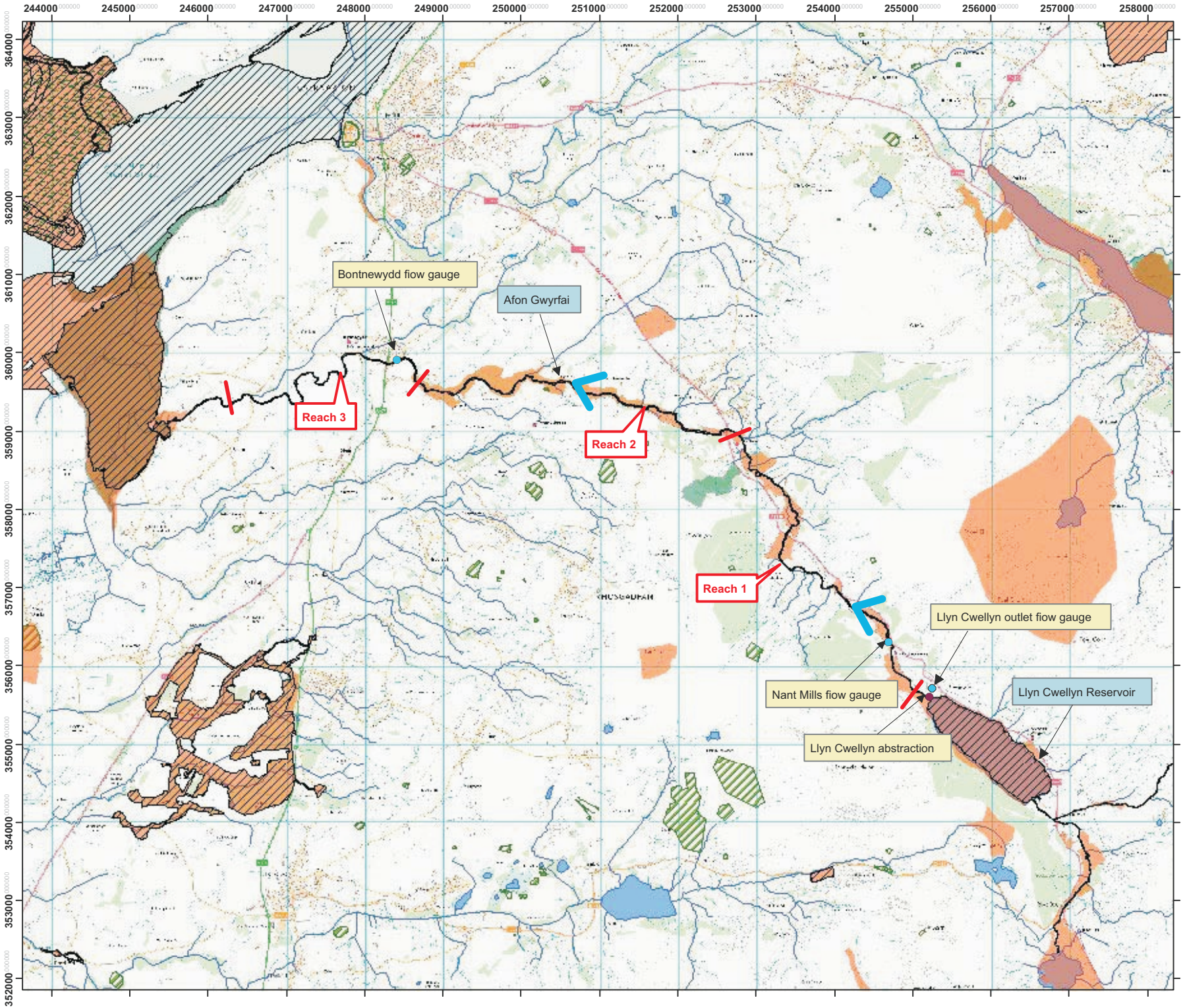
The licence also permits the release of freshets in the period 1 August to 31 December. The volume of the freshet bank is dependent on daily lake level in the period 1 April to 20 August. If NRW requests operation of the temporary spillway, the volume of the freshet bank will be deemed to be zero for the remainder of that calendar year.

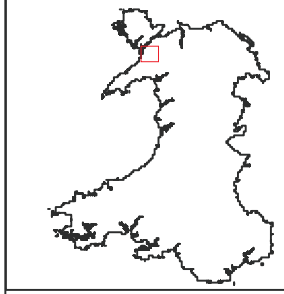
The abstraction for potable supply is made directly from the lake and piped to Cwellyn Water Treatment Works (WTW) for treatment. Distribution is by mains to the mainland area of the North Eryri / Ynys Mon water resource zone.

These licence conditions have been in force since 1994 to coincide with infrastructure amendments at Llyn Cwellyn which enabled direct abstraction from the lake instead of from the Nant Mills river intake on the Afon Gwyrfai, some 1km downstream of the

lake outflow. These infrastructure amendments included installation of the adjustable-level temporary spillway so that natural inflows could be released at the end of a drought prior to the reservoir storage reaching spillway level, and the extension of the raw water main from Nant Mills up to Llyn Cwellyn. A revised licence has been issued following the Habitats Directive Review of Consents process which still has the same licence conditions but also specifies the need for an approved fish pass.

The study area is illustrated on **Figure 2.3**.





Legend

- Flow Gauge
- Abstractions
- Water Courses
- Reservoir
- Special Area of Conservation
- National Nature Reserve
- Site of Special Scientific Interest
- Local Nature Reserve
- Scheduled Ancient Monuments
- Direction of Flow

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1:45,000

Note: All locations are approximate

Project Title: Welsh Water Drought Plan Environmental Assessment

Figure Title: Study Area: 8001-2 Llyn Cwellyn

Figure Number: Figure 2.3

Date: February 2019

2.3 WELSH WATER'S DROUGHT PLANNING PROCESS

Water companies in England and Wales are required to prepare and maintain Statutory Drought Plans under Sections 39B and 39C of the Water Industry Act 1991, as amended by the Water Act 2003, which set out the management and operational steps a water company will take before, during and after a drought. The Water Industry Act 1991 defines a drought plan as '*a plan for how the water undertaker will continue, during a period of drought, to discharge its duties to supply adequate quantities of wholesome water,* with *as little recourse as reasonably possible to drought orders or drought permits*'.

The Drought Direction (Wales) 2017 states that revised Drought Plans should be submitted according to the following schedule:

> *4(b) for a revised drought plan –*
>
> *if section 39B(6)(a) of the Act applies, within 6 months after the date on which the material change of circumstances occurs; and*
>
> *if section 39B(6)(c) of the Act(c) applies, no later than 4 years after the date on which its drought plan, or its last revised drought plan, is published.*

2.4 STATEMENT OF THE NEED FOR DROUGHT ORDER

This section will be completed at the time of application for a drought order.

2.5 DROUGHT ORDER – REGULATORY ARRANGEMENTS

In periods of unusually low rainfall, when water resources become scarce, the Water Resources Act 1991, as amended by the Environment Act 1995 and the Water Act 2003, allows for three mechanisms for temporarily augmenting water supplies from rivers, lakes, reservoirs and groundwaters: drought permits; ordinary drought orders; emergency drought orders.

Drought permits are granted by NRW, and allow a water company powers to abstract from specified water sources, or to modify or suspend the conditions set out in existing abstraction licences. Drought orders are granted by Welsh Ministers and give powers either to a water company or to NRW to abstract from specified water sources, or to modify or suspend the conditions set out in existing abstraction licences, but also to allow the discharge of water to specified places, modify or suspend conditions relating to a discharge or prohibit or limit particular non-essential uses of water as set out in the Drought Plan (Wales) Direction 2017. Emergency drought orders grant the same powers as a drought order, but in addition, confer powers to prohibit or limit water uses as specified by the water company and allow the set up and supply of water by means of standpipes and / or water tanks or rota cuts.

Drought permits and orders may be granted for a period of up to six months and they can be extended for up to a further six months.

As part of the drought order/permit application process, water companies are required to prepare an Environmental Report setting out anticipated effects of the proposal, including the effect on other abstractors and sufficient information to inform assessments, where applicable, in relation to the Habitats Directive, Countryside and Rights of Way Act (CRoW), and the Water Framework Directive (WFD).

Further information on the requirements for the environmental assessment and reporting according to legislation and national guidance are provided in Section 3.

2.6 REVIEW OF ALTERNATIVE OPTIONS

This section will be completed at the time of application for a drought order, setting out the alternative options to the drought order that Welsh Water has considered in addressing the risks to essential public water supplies due to drought.

2.7 PROPOSED DROUGHT ORDER DETAILS

In order to protect essential public water supplies within Welsh Water's North Eryri / Ynys Môn (8001) WRZ in the event of a future severe drought, Welsh Water may need to make an application to Natural Resources Wales for a drought order to vary the conditions of its abstraction licence from Llyn Cwellyn. If granted, the drought order will permit a temporary relaxation of the low lake level abstraction rate at Llyn Cwellyn. When lake levels have fallen below 0.8m below spillway and the daily abstraction rate has reduced to 10Ml/d in the current licence conditions, the drought order proposes to operate the abstraction at a daily rate of 12Ml/d. The lake level at which abstraction ceases would be maintained as per the current licence conditions of 2.6m below spillway during the period 16 September to 15 November and 2.0m below spillway at all other times. Compensation releases would be maintained as per the current licence conditions of 11.4Ml/d when lake level is between 0.8m and 2.6m below spillway. Freshet releases would not be impacted by the drought order.

It is unlikely that water level will reach 1.8m below spillway, from available data the lowest recorded value is 897Ml/d which equates to 0.93m below the normal spillway level. In the event that levels reduce below 1.8m an additional pump to aid eel passage will be installed.

Details of the existing and proposed drought order abstraction at Llyn Cwellyn are presented in **Table 2.1**.

The drought order is most likely to occur during the summer and autumn period, considered to not extend outside the period May to October. This has been confirmed by Welsh Water's water resources modelling.

Table 2.1 Llyn Cwellyn Existing and Proposed Drought Order Abstraction

Abstraction Water Source	NGR	Normal Abstraction	Proposed Drought Order Abstraction	Benefit Ml/d
Llyn Cwellyn	SH 55993 54890	Welsh Water's licence (23/65/15/24) to abstract water under the Water Resources Act at Llyn Cwellyn includes the following conditions: • 6,570 million litres (Ml) authorised to be abstracted per annum. • At a daily abstraction rate dependant on lake level (all levels have been re-cast relative to the spillway level of 141.15m): • 20.4Ml/d when lake level is 0.5m below spillway or higher; • 15.9Ml/d when lake level is 0.5m to 0.8m below spillway; • 10.0Ml/d when lake level is 0.8m to 2.0m below spillway; • 10.0Ml/d when lake level is between 2.0m to 2.6m below spillway during the period 16 September to 15 November only • At an abstraction rate not exceeding 300 litres per second • Provision of uniform statutory compensation releases from Llyn Cwellyn, dependent on lake level and season. Should the level of Llyn Cwellyn drop to specified levels, NRW can request Welsh Water to operate the adjustable-level temporary spillway. Temporary spillway operation is dependent on lake level and season.	Relaxation of the low lake level abstraction rate at Llyn Cwellyn. When lake levels have fallen below 0.8m below spillway and the daily abstraction rate has reduced to 10Ml/d in the current licence conditions, the drought option proposes to operate the abstraction at a daily rate of 12Ml/d. The lake level at which abstraction ceases would be maintained as per the current licence conditions of 2.6m below spillway during the period 16 September to 15 November and 2.0m below spillway at all other times. Compensation releases would be maintained as per the current licence conditions of 11.4Ml/d when lake level is between 0.8m and 2.6m below spillway. Freshet releases would not be impacted by the drought option.	2.00 Ml/d

[Note: it will probably be necessary to remove the NGR for any public domain version]

2.8 DROUGHT ORDER PROGRAMME

Drought order may remain in force for a period of up to six months, and they can be extended for up to a further six months. However, the period of implementation for this drought order is restricted to May to October, as confirmed by water resources modelling carried out by Welsh Water.

Prevailing weather conditions and rainfall in the intervening period may delay the requirement for applications, or even result in no requirement to apply. An order may be granted but not actually implemented if weather conditions improve or, equally, the order may only be partially implemented.

2.9 DROUGHT ORDER BASELINE

It is important for the assessment to establish the environmental "baseline" conditions that would exist in drought conditions but in the absence of the drought order being implemented. For the purposes of this assessment, the "without drought order" baseline includes a continuation of abstraction at Llyn Cwellyn when lake levels have fallen below 0.8m below spillway at a daily rate not exceeding 10Ml/d.

3 APPROACH

3.1 INTRODUCTION

The DPG states that the environmental report must include:

i. likely changes in flow, level, channel/riparian form and sediment, due to implementing the action;
ii. the features that are sensitive to these changes;
iii. potential impacts on sensitive features;
iv. a plan of baseline, in-drought and post-drought monitoring; and
v. mitigation or compensation measures that may be required

Items i and ii above were subject to an initial screening process as part of the scoping exercise. Section 3.2 below describes the approach taken. This has provided the relevant study area for the drought order assessment and a list of features scoped into the environmental assessment which are the subject of this EAR.

Section 3.3 describes how the environmental assessment has been undertaken, including discussion of the general approach, guidance used, provision of data, assessment methodologies and consideration of mitigation and monitoring. Limitations to the environmental assessment are described in Section 3.4.

To set the context of the studies, it should be noted that EAR considers the environmental impacts of implementing a drought order during the worst environmental conditions (natural drought) that the order could be implemented in.

In accordance with the DPG and the Habitats Regulations, the assessment considers how the proposed drought order may affect the environment in combination with the effects of other existing abstraction licences, environment permits and other plans. This includes assessment of the potential cumulative effects of the following:

- Welsh Water's existing abstraction licences that operate within the hydrological zone of influence of the drought option, as well as other abstraction and discharge consents
- Assessment of cumulative impacts of the drought order with other Welsh Water supply side and drought permit / order options within the hydrological zone of influence (including both intra- and inter- zone options)
- Other plans and projects of relevance, including
    - Welsh Water's WRMP schemes which are scheduled to be implemented and become operational within the time period of the revised Drought Plan (i.e. before 2025)

- Drought options from other neighbouring water company Drought Plans, Natural Resource Wales Drought Plans
- National Policy Statements for Wastewater and Renewable Energy Infrastructure.

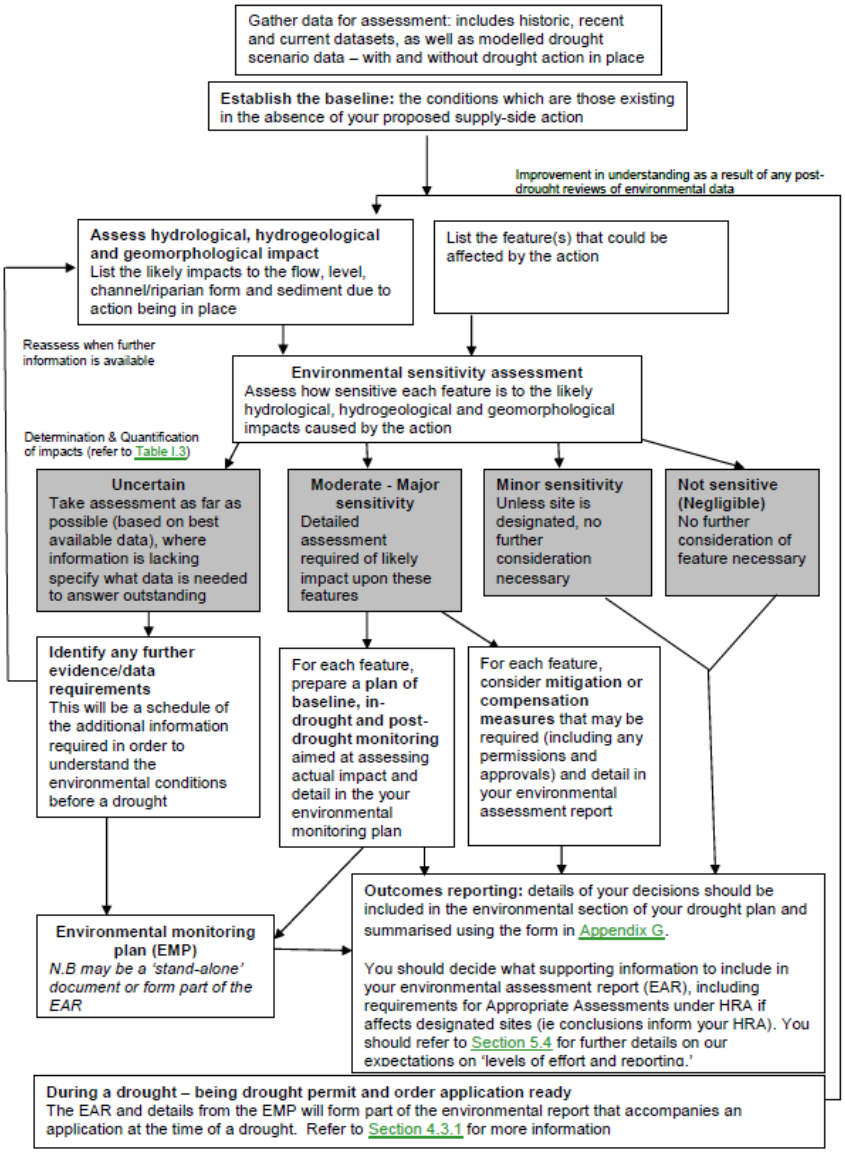
This is discussed further in Section 7.

3.2 APPROACH TO SCREENING AND SCOPING

3.2.1 Screening

Screening was undertaken using the DPG; specifically Section 5 and Appendix I. Figure 2 of the DPG (replicated in **Figure 3.1** below) identifies the environmental impact activities required.

Figure 3.1 Environmental Impact Activities Identified in the Drought Plan Guideline



The screening fulfils the requirement to "Assess how sensitive each feature is to the likely hydrological, hydrogeological and geomorphological impacts caused by the action". Stage 1 (hydrological impact) fulfils the requirement to "List the likely impacts to the flow, level, channel/riparian form and sediment due to action being in place". Stage 2 (environmental sensitivity) fulfils the requirement to "list the feature(s) that could be affected by the action" and to "Assess how sensitive each feature is to the likely hydrological, hydrogeological and geomorphological impacts caused by the action".

It is important to acknowledge the basis of the assessment; i.e. impacts of drought order implementation should be considered in the context of what would occur without drought order implementation (see Sections 2.2, 2.7 and 2.9).

The approach to undertaking Stages 1 and 2 is described below.

Stage 1 – Hydrological and Hydrogeological Impact

Consideration is required (by the DPG) of the likely changes impacts on the hydrology, hydrogeology and geomorphology of every river reach, wetland or lake area influenced by the proposed drought management action, specifically:

- identify the drought conditions which trigger the proposed action;
- identify any changes that the action is likely to bring about, specifying their length, severity and location in relation to existing natural and artificial features;
- describe the likely conditions in the absence of the proposed action;
- describe how the likely conditions would differ with the action in place compared to the same (or analogous) watercourse under natural conditions; and
- identify the extent of the area affected by the planned actions.

The hydrogeological and hydrological information is used together with information on the other environmental features in the study area from Stage 2 - Environmental Sensitivity (see below) to identify the environmental risk of implementing the drought order.

Although the DPG informs the hydrometric data to be used as part of environmental features for consideration within the environmental assessment (see Box 1 Appendix I of the DPG), it does not provide a methodology for identifying the hydrological impact. A bespoke assessment has therefore been undertaken.

The full hydrological assessment approach is set out in **Appendix A**.

The output from these studies provides an understanding of the scale of change in the hydrological characteristics as a result of implementing the drought order. Where

changes have been identified, the potential significance of adverse or beneficial impacts has been assessed.

Quantitative and qualitative measures have been used to grade the impacts on surface waters. The assessment has identified the potential severity of impact based on the following criteria:

- **Positive or Negative Impact** – all impacts are considered to be negative unless otherwise stated in the feature assessment.
- **Extent** – the extent of the impact is covered as part of the magnitude consideration.
- **Magnitude** – the magnitude of the impact is identified as**:**
  - *High*: There is a long-term large-scale (i.e. catchment) change in the physical environment.
  - *Medium*: There is a short-term large-scale change or long-term short-scale (i.e. reach) change in the physical environment, however, no changes in the overall integrity of the physical environment.
  - *Low*: There is a short-term small-scale change in the physical environment, but its overall integrity is not impacted.
  - *Negligible*: No perceptible change in the physical environment.
- **Duration** – the duration of impact is considered to be for 6 months, which is the duration for which a drought option is implemented, unless otherwise stated.
- **Reversibility** – all hydrological impacts are considered to be reversible**.**
- **Timing and Frequency** – the drought option could be implemented at any point in the year, unless otherwise stated. The assessment is based upon the operation of a single drought order, with subsequent applications for a drought order required to consider cumulative effects of multiple drought orders.
- **Probability** – all impacts are considered to be probable, unless otherwise stated.

The hydrological impact assessment is described fully in **Appendix B**.

Section 4 provides a summary of the hydrology and physical environment assessment as a result of implementing a drought order at Llyn Cwellyn.

tage 2 - Environmental Sensitivity

With the extent and level of flow impact mapped, using GIS and other data sources, potentially sensitive receptors (sites / features) located within the extents of impact have been identified. Potentially sensitive features investigated in the screening have been drawn from Appendix I of the DPG. These include:

- designated biodiversity sites (Local Nature Reserve (LNR), National Nature Reserve (NNR), Marine Protected Areas, National Parks, Areas of Outstanding Natural Beauty (AONB), SSSI, Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar) and Environment (Wales) Act Section 7 species / habitats which are located on or within 500m of the impacted reaches;
- protected species;
- ecological communities (fish, bryophytes & lichen, macro-invertebrates, macrophytes, algae) and, where identified, Water Framework Directive (WFD) status of designated waterbodies which contain the impacted reaches;
- invasive non-native species;
- sensitive ecological features as advised by NRW;
- wider features which should be taken into account in determining the potential impacts of drought option implementation – specifically socio-economic & health, amenity & aesthetics, , recreation, navigation, architectural & archaeological heritage.

Each of the identified sensitive receptors within the extent of impact have been listed, alongside a brief summary of their potential susceptibility to flow impacts. For designated sites, this has included an indication as to whether the sites have water dependent qualifying interests.

The environmental sensitivity of each site has been identified according to the ecological and nature conservation interests of the area and, in particular, the proximity of and / or connectivity with the designated protected area. Each site has been assessed according to whether the extent of hydrological influence includes or is considered to affect a designated or protected site. Designated or protected sites outside the extent of hydrological influence are considered not to be influenced by the drought order.

The outcome of Stage 1 and Stage 2 of the screening exercise are presented in Sections 4 and 5 respectively.

3.2.2 Scope

The screening exercise establishes the study area for the Llyn Cwellyn drought order together with identification of relevant, sensitive environmental features within those study areas (based on the risk of them being impacted by the drought order during the period of its operation).

As set out in **Figure 3.1**, the environmental sensitivity screening identifies the outcome for each listed feature. DPG Figure 5 categorises four outcomes from the screening: uncertain; moderate-major sensitivity; minor sensitivity; not sensitive

(negligible); and identifies appropriate next steps. Sections 4.2 and 5.2 present the findings which show that a number of features were identified as either: 1) uncertain; 2) moderate-major sensitivity; or 3) minor sensitivity in a designated site and in accordance with the DPG are features for which further assessment work will be required. These features alone form the scope of monitoring, environmental assessment, and consideration of mitigation actions.

The DPG states that environmental assessment, mitigation and / or monitoring is not required for features where screening has identified a minor (unless a site is designated) or negligible impact. However, the requirement for assessment, monitoring and / or mitigation has been reviewed on a case-by-case basis. In some cases, mitigation and / or monitoring has been recommended where minor impacts are identified, where considered appropriate.

3.3 APPROACH TO ASSESSING IMPACTS, MITIGATION AND MONITORING

3.3.1 General Approach

The assessment approach is in accordance with legislation, national regulations and guidance, including:

- NRW Water Company Drought Plan Technical Guideline (DPG)
- Welsh Ministers (2017) The Drought Plan (Wales) Direction
- Institute of Environmental Management and Assessment (2004) Guidelines for Environmental Assessment
- Chartered Institute of Ecology and Environmental Management (CIEEM) (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland[5]
- UKWIR (2007, updated 2012) Strategic Environmental Assessment – Guidance for Water Resources Management Plans and Drought Plans. Prepared by Cascade Consulting
- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)
- Council Directive 2009/147/EC of 30 November 2009 on the conservation of wild birds
- The Convention on Wetlands of International Importance especially as Waterfowl Habitat , December 1975
- Conservation of Habitats and Species Regulations 2017

[5] CIEEM, Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial. Freshwater and Coastal. September 2018.

- The Countryside and Rights of Way Act 2000.

All aspects of the drought order of potential environmental significance are considered in the environmental assessment.

The DPG states that a water company should clearly show what evidence and data have been used in decision making, that uncertainties should be identified, and which additional data requirements are provided for through the environmental monitoring plan.

In accordance with the DPG the approach to the assessment addresses the following: i) potential effects on each sensitive receptor; ii) definitions for impacts (adverse / beneficial); iii) the data requirements; iv) assessment methodology (including the treatment of uncertainty where the complete data requirements are not available).

This EAR presents the environmental baseline, i.e. habitats and environmental pressures (including flow and water quality) in the study identified zone of hydrological influence without the drought order in place, utilising a description of the catchment, geomorphology, anthropogenic features and water quality. Key changes to the physical environment as a result of implementing the drought order have been identified and described and, where appropriate, this information is used to frame and support the assessments of features which have been scoped in further to the screening and scoping exercise (see Section 3.2).

3.3.2 Assessment Methodologies

The aim of the Environmental Assessment is to provide:

- A clear summary of the outcome of each assessment (per feature) from which NRW can readily identify the significance of the impact when determining the drought order application.
- Identification of those predicted impacts which are to be taken forward to consider additional monitoring and mitigation actions.

The assessment considers the environmental impacts of implementing the drought order against baseline operating conditions of Welsh Water's abstraction licence in advance of drought order implementation. Environmental sensitivity has been assessed considering the context of the timing of drought order implementation. **It is important to acknowledge the basis of the assessment; i.e. impacts of drought order implementation are assessed against what would occur without drought order implementation**.

Other abstractors, including other water company abstractions, are features that have been reviewed within the assessment. This has been undertaken to determine whether other abstractors could potentially be affected by changes to surface water flows and

levels as a result of implementation of the drought order.

3.3.3 Mitigation and Monitoring

Section 5.3 of the DPG identifies the specific requirements for mitigation of serious impacts on the environment as a result of implementing a drought management measure. The assessments undertaken in this EAR confirm the features requiring consideration of mitigation and appropriate monitoring triggering mitigation. Appropriate mitigation actions identified are both available and practicable.

The DPG also identifies the specific requirements for monitoring. The assessments undertaken in this EAR inform the features requiring consideration for monitoring prior to, during, or after implementation of the drought order.

The mitigation and monitoring proposals (see Sections 6 and 10) will act as a safeguard that responds and is responsive to both predicted and unpredicted drought impacts. Future data collection and monitoring can then be focused to identify the aquatic ecosystem interaction to better quantify the potential impacts where gaps in the evidence base are identified and ensure the appropriate targeting of monitoring and mitigation response. The EMP will need to be finalised in agreement with NRW.

3.4 LIMITATIONS OF THE ASSESSMENT AND UNCERTAINTIES

The DPG states that a water company should clearly show what evidence and data have been used in decision making, that uncertainties should be identified, and which additional data requirements are provided for through the environmental monitoring plan.

The assessment presented in this document draws on available information from surveys and investigations undertaken by Welsh Water, NRW, as well as other bodies, over a number of years. Reference has also been made to wider studies from published and grey literature, i.e. academic literature that is not formally published, where appropriate.

Specific details are provided on the quality of the data collected and used in the assessment. Where uncertainties remain with respect to the quantification and prediction of impacts, the limitations and any assumptions made are included in the relevant technical sections (Sections 4 and 5).

Overall, it is considered that the conclusions are based on information that is robust and valid at the time of writing. However, it should be noted that this EAR would be updated to support any future actual application, including a review of data.

4 LLYN CWELLYN DROUGHT ORDER - HYDROLOGY AND THE PHYSICAL ENVIRONMENT

4.1 INTRODUCTION

Consideration of hydrology and the water physical environment sets the context for the potential range of environmental effects of the drought order. **Appendix B** sets out an assessment of the potential impacts on the physical environment of Llyn Cwellyn during the period of implementation of the drought order. The "without drought order" baseline is set out in Section 2.9.

The water physical environment assessment includes consideration of hydrology and hydrodynamics, geomorphology and water quality. The assessment has three key objectives:

1. It is used to "list the likely changes in flow, level, channel/riparian form and sediment due to implementing the action" as required by the DPG and set out in Figure 2 of the DPG

2. It is used to support the screening and assessment of sensitive features (including ecological features and designated sites) as required by the DPG and set out in Section 5 of this report

3. Where sensitive features are the physical environment itself, it provides supporting technical information for their screening and assessment.

Each of these are summarised below.

4.2 SUMMARY OF STAGE 1 SCREENING

This fulfils the DPG requirements of Stage 1 of the screening of potential drought order impacts, identifying the likely changes in flow/ level regime due to implementing the drought order. The specific requirements of the DPG are summarised as:

- identify any changes that the drought order is likely to bring about, specifying their length, severity and location in relation to existing natural and artificial features (e.g. flow, water level, channel dynamics and sediment changes);

- describe the likely conditions in the absence of the drought order;

- describe how the likely conditions would differ with the drought order in place compared to the same (or analogous) watercourse under natural conditions; and

- identify the extent of the area affected by your planned actions.

These requirements are addressed in the following sections.

1. The perceived extent of potential impact:

The study area (see **Figure 2.3**) is identified as Llyn Cwellyn reservoir and the Afon Gwyrfai from the Llyn Cwellyn outflow to the tidal limit.

2. The nature and duration of the potential impact:

A description of the likely conditions with the drought order in place, in comparison to the baseline conditions (absence of the proposed action) is provided in Appendix B. Given the conditions of the proposed drought order, the key areas for the assessment of the physical environment have been identified as:

- changes in water levels of Llyn Cwellyn reservoir
- changes in flow of the Afon Gwyrfai

The **Appendix B** assessment has been summarised in **Table 4.1** in terms of the magnitude and duration of each of these potential physical environment impacts.

3. The length of the potential impact:

The **Appendix B** assessment has been summarised in **Table 4.1** in terms of the timing of each of the potential physical environment impacts. The drought order is most likely to occur during the summer and autumn period, considered to not extend outside the period May to October. Summary of Potential Effects on the Physical Environment

The potential changes to the physical environment (water quality and geomorphology) due to implementation of the drought order are summarised in **Table 4.1.** These impacts are presented in detail in **Appendix B**.

Table 4.1 Summary of Potential Hydrodynamic and Water Quality Impacts of the Drought Order

Afon Gwyrfai (Reach 1)	
Flows in the Afon Gwyrfai *Negligible for up to 7 days at the end of drawdown during the autumn/winter period*	• Negligible increase of low flow period (estimated at 3.3% increase in duration, depending on reservoir abstraction rate)
Afon Gwyrfai (Reach 2)	
Flows in the Afon Gwyrfai *Negligible for up to 7 days at the end of drawdown during the autumn/winter period*	• Negligible increase of low flow period (estimated at 3.3% increase in duration, depending on reservoir abstraction rate)
Afon Gwyrfai (Reach 3)	
Flows in the Afon Gwyrfai *Negligible for up to 7 days at the end of drawdown during the autumn/winter period*	• Negligible increase of low flow period (estimated at 3.3% increase in duration, depending on reservoir abstraction rate)

4.2.1 Support to the Screening and Assessment of Sensitive Features

The assessment included in **Appendix B** has provided information to support the screening and assessment of sensitive features in Section 5. This includes information on short and long term (acute and chronic), direct and indirect, cumulative, and permanent and temporary effects. The assessment is also specific on the difference between the drought order impacts and the baseline condition without a drought order in place.

4.2.2 Supporting Technical Information for Assessment of any Physical Environment Sensitive Features

As described in Section 5, several sensitive features relate to the physical environment, rather than ecology or human interaction (e.g. landscape, recreation). The assessment included in **Appendix B** has provided supporting technical information for their screening and assessment in Section 5.

5 LLYN CWELLYN DROUGHT ORDER ENVIRONMENTAL FEATURES ASSESSMENT

5.1 INTRODUCTION

In compliance with the DPG, environmental sensitivity screening has been undertaken within the zone of hydrological influence. As set out in **Box 1** above, further environmental assessment is neither required nor included for features where screening has identified a minor (where there are no environmentally designated sites) or negligible impact.

Points of interest referred to throughout the text in Section 5 are indicated on **Figure 2.3**.

5.2 SUMMARY OF STAGE 2 SCREENING AND SCOPING

5.2.1 Designated Sites and Other Sensitive Fauna and Flora

In accordance with the DPG, **Table 5.1** identifies designated biodiversity sites (including LNR, NNR, SSSI, SAC, SPA), Environment (Wales) Act Section 7 species / habitats and other sensitive receptors that could be affected by the drought order. Susceptibility to the flow / level impacts resulting from the drought order (see Section 4) is identified according to whether interest features of the site or the species are water dependent. Sensitivity is then determined according to professional judgment based on susceptibility and the level of hydrological impact at the location.

Table 5.1 Designated Sites and Other Sensitive Receptors within the Zone of Influence of the Llyn Cwellyn Drought Order

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, Moderate/ Major, Minor, Negligible)	Further Consideration Required (Yes/No)
Afon Gwyrfai (Reaches 1-3)				
Afon Gwyrfai a Llyn Cwellyn SAC / SSSI	Negligible	The site is designated running and standing water, aquatic plant assemblage and numerous notable species: Floating water plantain (*Luronium natans*) Otter (*Lutra lutra*) Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea Atlantic salmon (*Salmo salar*) Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation In addition, the SSSI designation includes Arctic charr (*Salvelinus alpinus)*. Llyn Cwelyn is one of three remaining natural localities in Wales for the Arctic charr (*Salvelinus alpinus)*. The Cwellyn population is genetically different from those that occur in Llynnau Padarn and Llyn Bodlyn.	Negligible	No
Dudley Quarry LNR	Negligible	A mixed woodland resting on the lower sheltered slopes of Moel Smytho.	Negligible	No
Notable Species – Macrophytes Floating water-plantain *Littorelletea uniflorae* and/or *Isoeto Nanojuncetea*	Negligible	The reach is important for floating water-plantain notable species, which are found in oligotrophic to mesotrophic waters.	Negligible	No
Notable species – Invertebrates White-clawed crayfish *Austropotamobius pallipes*	Negligible	The changes to river flow following initial onset of environmental drought is not anticipated to significantly alter habitat availability and quality for white-clawed crayfish.	Negligible	No
Benthic macroinverebrate communities	Negligible	The negligible hydrological impact is not anticipated to reduce the availability of habitats or lead to exposure of benthic macroinvertebrate habitats	Negligible	No

Site/Feature and designation	Hydrological Impact at Location (Major, Moderate, Minor)	Susceptibility to flow and level impacts	Sensitivity (Uncertain, Moderate/ Major, Minor, Negligible)	Further Consideration Required (Yes/No)
Notable Species – Fish Arctic charr *Salvelinus alpinus* Atlantic salmon *Salmo salar* River lamprey *Lampetra fluviatilis* Brook lamprey *Lampetra planeri* Sea lamprey *Petromyzon marinus* Bullhead *Cottus gobio* Brown trout *Salmo trutta*	Negligible	A number of notable species occur in the reach. Changes to velocity, depth, wetted width may restrict the access of migratory fish to spawning tributaries or to dry spawning gravels. Reductions in flow and level are short term and are not anticipated to significantly alter habitat and availability for the resident fish community.	Negligible	No
Notable Species – Mammals Otter *Lutra lutra* Water voles *Arvicola terrestris*	Negligible	Otter have well established populations in the Afon Gwyrfai a Llyn Cwellyn SAC and SSSI. Otter are water-dependent, foraging in, over or adjacent to water for fish and aquatic invertebrates. However this species are not expected to be significantly impacted by the drought order implementation, as habitat availability and quality for otter is not anticipated to be significantly altered.	Negligible	No
Invasive flora and fauna	Negligible	The negligible hydrological impact is not anticipated to change the status of invasive flora and fauna	Negligible	No
Landscape and visual amenity	Negligible	Llyn Cwellyn and the upper reaches of the Afon Gwyrfai lie within Snowdonia National Park, which is appealing for tourists, especially walkers. Implications of the drought plan may lower lake level at a faster rate, and increase shoreline exposure. River flows, width, depths and velocities would be reduced. The degree of shoreline exposure and reduction in river flows directly affects landscape and visual amenity value. This will only be temporary and will be ameliorated once the drought has passed.	Negligible	No
Recreation	Negligible	The area east of Llyn Cwellyn has been highlighted as a key amenity area. Recreation activities including angling, canoeing, windsurfing and walking. There is potential for the lake level to lower at a faster rate and to lower levels than without the drought order present. This may increase shoreline exposure, and impact recreational access. Lake drawdown and shoreline exposure in times of drought will be temporary in nature.	Negligible	No
Archaeology	Negligible	3 scheduled ancient monuments. 2 prehistoric enclosed hut circles, 1 prehistoric hut circle settlement.	Negligible	No

5.2.2 WFD Waterbody Status

Table 5.2 identifies the WFD status classification of the WFD waterbodies that may be impacted by implementation of the drought order. Waterbodies classified as overall high / good status / potential, and / or high / good ecological status for fish or macroinvertebrates are likely to be more sensitive to flow impacts. **Table 5.2** summarises the risk to WFD status and indicates where further assessment has been carried out as reported in Section 5.3 below.

Table 5.2 WFD Status Classifications

Waterbody Name	**Llyn Cwellyn (GB31034002)**		**Gwyrfai – downstream of Cwellyn (GB110065054190)**	
Hydrological Impact at Location (Major, Moderate, Minor, Negligible)	Negligible		Negligible	
Heavily Modified Waterbody (Y/N)	Yes		Yes	
RBMP Cycle	RBMP2 (2015)[6]	2018 Cycle 2 Interim Classification[7]	RBMP2 (2015)	2018 Cycle 2 Interim Classification
Overall Biological	Moderate	Moderate	Good	Moderate
Fish			Good	Good
Macrophytes	Good	Good		
Phytobenthos	Good	Good		Good
Macro-invertebrates			High	Good
Total P/ Phosphate	Good	Good	Good	High
Ammonia	High	High	High	High
Dissolved Oxygen	High	Good	High	High
pH			High	Moderate
Sensitivity (Uncertain, Moderate/ Major, Minor, Not sensitive)	Not sensitive		Not sensitive	
Further Consideration Required (Y/N)	No		No	

5.3 FEATURES ASSESSMENT

The hydrological impact of the drought permit has been assessed as negligible. Screening has not identified any environment features for which environmental assessment is required. No environmental impacts have, therefore, been identified for any of the features identified in screening (see Section 5.2).

[6] NRW (2017) https://drive.google.com/file/d/0B2hsDbbdxz1tZHItRU9lNkg1YWs/view
[7] NRW (2018) https://drive.google.com/file/d/14w17jL05sNuToVELqMCK_yc6DdHU7STb/view

6 LLYN CWELLYN DROUGHT ORDER – MITIGATION

The hydrological impact of the drought order has been assessed as negligible. Screening has not identified any environment features for which environmental assessment is required and, therefore, no mitigation is required during drought order implementation.

7 CUMULATIVE IMPACTS

In accordance with the DPG and the Habitats Regulations, consideration has been given to how the proposed drought order may affect the environment in combination with the effects of existing abstraction licences, environmental permits and other plans. This includes assessment of the potential cumulative effects of the following:

- Welsh Water's existing abstraction licences that operate within the hydrological zone of influence of the drought option, as well as other abstraction licences and discharge permits, as identified in NRWs Review of Consents reports
- Assessment of cumulative impacts of the drought order with other Welsh Water supply-side and drought order / permit options within the hydrological zone of influence (including both intra- and inter- zone options)
- Other plans and projects of relevance, including
    - Any Welsh Water WRMP schemes which are scheduled to be implemented and become operational within the time period of the Drought Plan (i.e. before 2020)
    - Drought supply-side and drought order / permit options from other neighbouring water company Drought Plans and NRW Drought Plans
    - National Policy Statements for Wastewater and Renewable Energy Infrastructure
- Environmental monitoring before, during and after drought order implementation (see Section 10).

If a drought order application is progressed in the future, the potential for cumulative effects will be reviewed and revised to reflect any changes which are relevant to the timing of the drought order specified in the application.

Welsh Water's existing abstraction licences and other abstraction licences and discharge permits

No cumulative effects of implementing the Llyn Cwellyn abstraction drought order with other drought order / permit schemes have been identified.

Other relevant Welsh Water drought permit / orders

No drought permit / order schemes identified with cumulative impacts.

Welsh Water WRMP schemes

No WRMP schemes identified with cumulative impacts.

Drought options from other neighbouring water company Drought Plans and NRW Drought Plans

No cumulative impacts of options in Natural Resources Wales Drought Plans or neighbouring water company drought plans with a drought order at Llyn Cwellyn are anticipated (see Section B5 in **Appendix B**). However, this should be reviewed at time of future application for a drought order.

National Policy Statements for Wastewater and Renewable Energy Infrastructure

No cumulative schemes have been identified for assessment.

8 LLYN CWELLYN DROUGHT ORDER - SUMMARY OF RESIDUAL IMPACTS

The residual impact on environmental features is dependent on the effects observed during environmental monitoring, and the mitigation measures that are taken forward and their timely and effective application once the trigger for their need has been identified.

At this stage, no mitigation measures have been identified as required as the hydrological influence of the drought order has been assessed as negligible (see Section 4).

9 HABITATS REGULATIONS ASSESSMENT: STAGE 1 SCREENING

The DPG (see Section 3.3) requires that an environmental assessment report provides all relevant information to enable Habitats Regulations Assessment Stage 2 Appropriate Assessment of the Llyn Cwellyn drought order on European designated sites to be undertaken.

The Afon Gwyrfai forms part of the Afon Gwyrfai a Llyn Cwellyn SAC, which is designated for:

- Floating water plantain (*Luronium natans)*
- Otter (*Lutra lutra)*
- Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*
- Atlantic salmon (*Salmo salar)*
- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

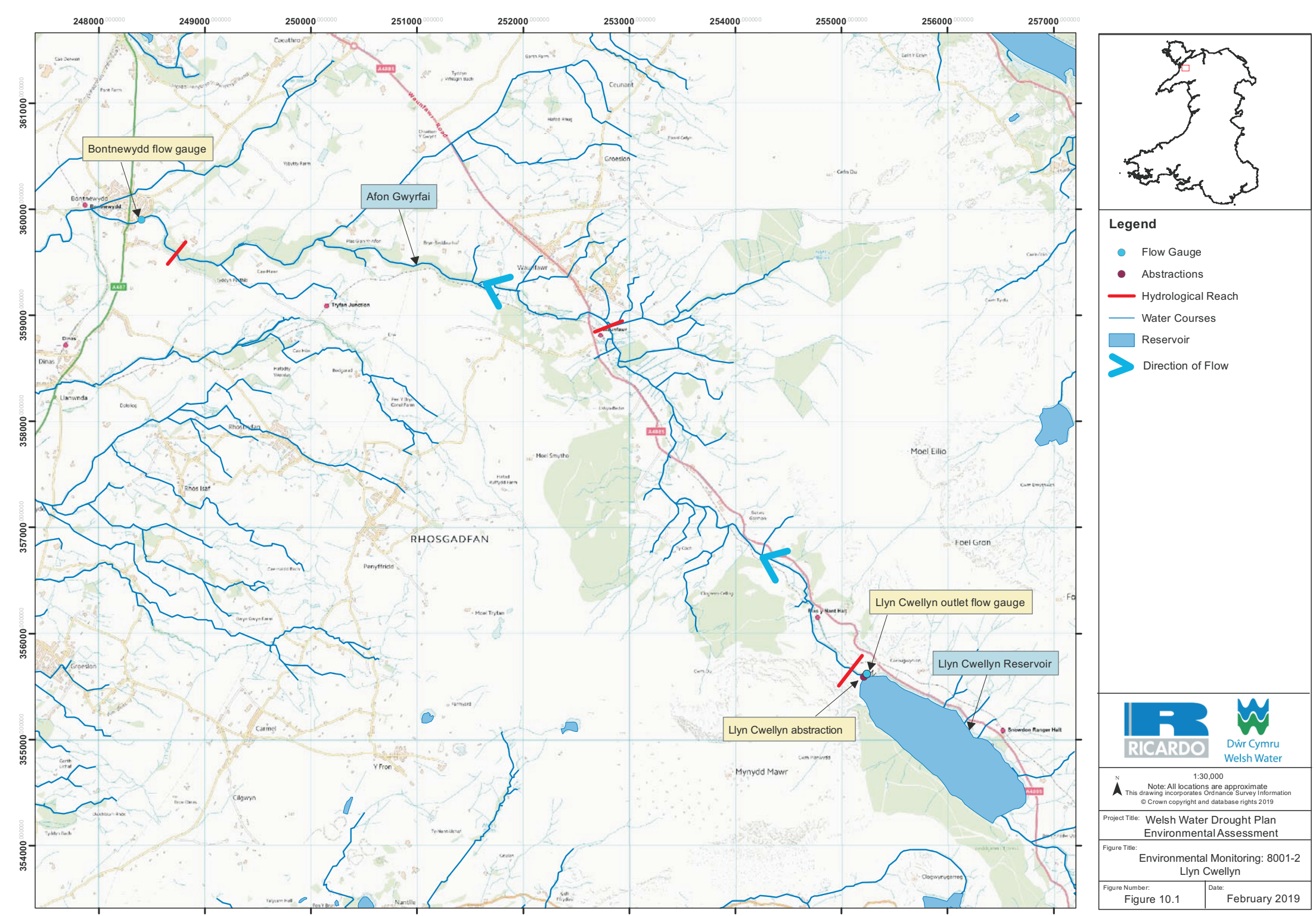
The hydrological impacts of the drought order at Llyn Cwellyn have been assessed as negligible on Llyn Cwellyn and the Afon Gwyrfai (see Section 4) and as such no likely significant effects on the features for which the SAC is designated are anticipated.

10 ENVIRONMENTAL MONITORING PLAN (EMP)

The hydrological impact of the Llyn Cwellyn drought order has been assessed as negligible. Screening has not identified any environment features for which environmental assessment is required and, therefore, no feature specific monitoring will be required.

However, it is recommended that current hydrological monitoring should continue to be carried out during the development of drought conditions and implementation of the drought permit, in order to monitor the adherence (or otherwise) of the river system to that expected from the baseline assessment in Section 4. Such monitoring is mapped on **Figure 10.1,** and should include:

- daily river flow at NRWs permanent Bontnewydd flow gauge on the Afon Gwyrfai
- daily river flow at Welsh Water's permanent flow gauge downstream of Llyn Cwellyn
- daily Welsh Water abstractions from Llyn Cwellyn
- daily Llyn Cwellyn water level.



Legend

- Flow Gauge
- Abstractions
- Hydrological Reach
- Water Courses
- Reservoir
- Direction of Flow

RICARDO

Dŵr Cymru Welsh Water

1:30,000

Note: All locations are approximate

Project Title: Welsh Water Drought Plan Environmental Assessment

Figure Title: Environmental Monitoring: 8001-2 Llyn Cwellyn

Figure Number: Figure 10.1

Date: February 2019

11 CONCLUSIONS

This EAR provides an assessment of the potential environmental impacts relating to the implementation of the Llyn Cwellyn drought order. If granted and implemented, the drought order would enable Welsh Water to abstract 12Ml/d from Llyn Cwellyn at lake levels lower than 0.8m below spillway. Such usage is not authorised by the existing abstraction licence and a drought order would be required; this would be applied for under this drought option.

The scope of the assessment has been defined by an impact screening and scoping exercise. In accordance with the DPG, the screening exercise involved two stages: a hydrological impact assessment (Stage 1) and the identification of the environmental features that could be affected by the drought order (Stage 2).

The hydrological impact assessment identified a **negligible** impact on flows in the Afon Gwyrfai and a **negligible** impact on Llyn Cwellyn Reservoir.

The DPG states that further environmental assessment is not required for features where screening has identified a minor (if there are no designated environmental sites) or negligible impact. Screening has not identified any environment features for which further environmental assessment is required. No environmental impacts greater than negligible have, therefore, been identified for any of the features identified in the screening exercise. In light of this and in accordance with the DPG no mitigation or feature specific monitoring is identified. However, hydrological monitoring has been recommended during the development of drought conditions and implementation of the drought order, in order to monitor the adherence (or otherwise) of the river system to that expected from the assessment presented in this EAR.

No cumulative effects of implementing the drought order with existing licences, consents and plans are currently anticipated. However, this should be reviewed at the time of any future application for a drought order at Llyn Cwellyn.

APPENDIX A
HYDROLOGY AND HYDROGEOLOGY METHODOLOGY

A.1 HYDROLOGICAL AND HYDROGEOLOGY IMPACT METHODOLOGY (STAGE 1 SCREENING)

Consideration is required (by the DPG[1]) of the likely changes in flow / level regime due to implementing the drought management action, specifically:

- the perceived extent of potential impact
- the nature and duration of the potential impact
- the timing of the potential impact.

The hydrogeological and hydrological information is used together with information on the other environmental features in the study area from Stage 2 - Environmental Sensitivity (see Section 3.2.1 in main report) to identify the environmental risk of the drought order / permit.

Although the DPG informs the hydrometric data to be used as part of environmental features for consideration within the environmental assessment (see Box 1 Appendix H of the DPG), it does not provide a methodology for identifying the hydrological impact.

Cascade has developed a flexible approach[2] to identifying the spatial extent of the study area from hydrological information and characterising the hydrological impact within the study area, in terms of the scale, nature, duration and timing of impacts, although this is only appropriate to apply to reaches that do not dry naturally. A hydrological methodology for watercourses that naturally dry for part of the year is also presented that characterises the hydrological impact within the study area, in terms of the scale, nature, duration and timing of impacts. These are presented below.

Perennially flowing watercourse hydrological methodology

This methodology is applied to watercourses that flow throughout the year and that are potentially impacted on by the drought order / permit.

Core to this approach is the use of relevant long term flow statistics to inform the scale of hydrological impact and thereby delimit the zone of influence in the downstream river system. To determine these, potential reductions in flow resulting from implementation of the drought order / permit are compared with flows without the drought order / permit in place (i.e. the additional abstraction advocated by the drought order / permit over and above the existing abstraction). This helps to determine the scale of potential impact at any particular site/ feature using the matrix in **Figure A.1** or **Figure A.2** depending on the altitude of the waterbody and whether it is classified as lowland or upland[3]. Where possible, the hydrological assessments presented in previous EMPs and EARs of the drought options have been used to

1 Welsh Government / Defra / NRW / Environment Agency (2011). Water Company Drought Plan Guideline. June 2011.
2 Hydrological impact approach used in previous drought plan environmental assessments for water companies including Thames Water, Yorkshire Water and United Utilities
3 The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. ISBN 978-0-85521-192-9.
The Directions set out the principles of classification of surface water and groundwater bodies, including the use of 80m above Ordnance Datum as the altitude that differentiates water quality requirements for upland and lowland biology. Where there are ambiguities, or thresholds are crossed, upland is assumed to apply to ensure a precautionary assessment.

help identify the spatial extent of the study area from hydrological information and characterising the hydrological impact within the study area.

Figure A.1 Hydrological Assessment Matrix (Upland)

		Summer Q99		
	% reduction in flow	<10%	10-25%	>25%
Summer Q95	<10%	Negligible	Minor	Moderate
	10-25%	Minor	Moderate	Major
	>25%	Moderate	Major	Major

Figure A.2 Hydrological Assessment Matrix (Lowland)

		Summer Q99		
	% reduction in flow	<10%	10-25%	>25%
Summer Q95	<20%	Negligible	Minor	Moderate
	20-50%	Minor	Moderate	Major
	>50%	Moderate	Major	Major

Figure A.1 illustrates that at the time of implementation of a drought order / permit, upland river systems of relevance to each of these proposed options will exhibit high sensitivity to changes in low flow (represented by Q_{95}, summer[4]) and very high sensitivity to changes in extreme low flow (represented by Q_{99}, summer). As illustrated by **Figure A.2**, lowland rivers of relevance to each of these proposed options are considered to be less sensitive to reductions in summer low flows (summer Q_{95}), but similarly sensitive to reductions in extreme summer low flows (summer Q_{99}).

Figures A.1 and **A.2** are appropriate for the assessment of hydrological impacts on low flow regimes in watercourses during the spring, summer and autumn. However, in some cases there is a need to assess the impacts of drought order schemes on watercourses during the winter. For example, a reduction in compensation release may remain in force during the winter high flow period, to increase the probability of reservoir refill prior to the following year's spring/summer drawdown period. During the winter season, watercourses have relatively lower sensitivity to changes in low flow, and moderate sensitivity to changes in moderate flow. This can be reflected by the use of the matrices in **Figures A.3** and **A.4** for the assessment of drought order / permit schemes which are only likely to impact on a watercourse during the winter. The categorisation of impacts as negligible, minor, moderate or major is based on the percentage reduction in year round low flow (Q95) and year round median flow (Q50).

Figure A.3 Hydrological Assessment Matrix (Upland / Winter)

		Year round Q95		
	% reduction in flow	<10%	10-25%	>25%
Year round Q50	<10%	Negligible	Minor	Moderate
	10-25%	Minor	Moderate	Major
	>25%	Moderate	Major	Major

[4] Flow statistics indicate the proportion of days a flow is equalled or exceeded. Therefore Q95 indicates flow equalled or exceeded on 95% of days in the measured record (equivalent to an average of 347 days per year)

Figure A.4 Hydrological Assessment Matrix (Lowland / Winter)

		Year round Q95		
	% reduction in flow	<10%	10-25%	>25%
Year round Q50	<20%	Negligible	Minor	Moderate
	20-50%	Minor	Moderate	Major
	>50%	Moderate	Major	Major

The matrices are used to identify 1) the overall study area – which extends downstream of the abstraction until the hydrological impact has reduced to negligible; 2) reaches with similar scales of impact within the overall study area; and 3) the scale of hydrological impact within each reach. Typically reaches have been delimited by the addition of flow from a significant tributary or discharge; although the similarity of geomorphological characteristics of the reach may also be important in reach specification. The matrices can be applied to a variety of upland or lowland catchments respectively including those dominated by groundwater, and can be applied until the tidal limit.

In addition to the information provided by summary flow statistics in the matrix, information on the timing, duration and relevant seasons of the drought order / permit impacts have been informed by licence details and river gauging data have also been used to characterise the likely nature of the drought order / permit impacts.

If the drought order / permit does not impact on the magnitude of low flows in a watercourse, but does cause changes in the duration of low flow periods (which can be quantified), then the matrix in **Figure A.5** may be appropriate. The assessment is based on the percentage increase in the number of days for which flow is at or below the low flow (Q95) value. Typically this would be the case when the low flow regime in a watercourse downstream of a reservoir is protected by a statutory compensation release from the reservoir, but the reservoir may be drawn down below top water level for longer periods due to increased direct abstraction under the drought order / permit conditions.

If low flows in a watercourse are adversely affected in both magnitude and duration, then the impacts on magnitude are always used to determine the significance of hydrological impacts, using the appropriate matrix from **Figures A.1** to **A.4** inclusive. **Figure A.5** is only used when the impacts on low flows are on duration only.

Figure A.5 Hydrological Assessment Matrix (Low Flow Duration)

Percentage increase in low flow duration	Significance
<5%	Negligible
5-10%	Minor
10-25%	Moderate
>25%	Major

Intermittently flowing watercourse hydrological methodology

This methodology is applied to watercourses, potentially impacted on by the drought order / permit, that flow for most of the time but seasonally or occasionally ceasing to flow in response to decreased water availability e.g. due to increased evapotranspiration or bed seepage. . Such watercourses are identified from previous investigations and available data. Examples of watercourses where this methodology would be applied include winter bournes or watercourses that dry along their route due to losses to underlying aquifers. The impact classification of this methodology is as follows:

- Major - If the drought order / permit resulted in sections drying that did not dry up anyway
- Moderate - If the drought order / permit resulted in sections drying earlier (by more than a week) and / or recovering later (by more than a week) and hence flow reduction occurring in the channel for more than a week
- Minor - If the drought order / permit resulted in sections drying earlier (up to a week) and/or recovering later (by up to a week) and hence flow reduction occurring in the channel for up to a week OR if the drought order / permit were a secondary flow driver (e.g. flow through gravels being primary cause of flow losses rather than the drought order / permit)
- Negligible - No significant impact

In addition to the derived classifications, information on the timing, duration and relevant seasons of the drought order / permit impacts have been informed by licence details, available data and findings of previous investigations. These have been used to characterise the likely nature of the drought order / permit impacts.

Reservoir hydrological methodology

More recently Cascade has developed a similar approach to categorise the significance of hydrological impacts of drought order / permit operations on reservoirs. The assessment requires an estimate of the relative change in duration of reservoir drawdown (i.e. the period for which water in the reservoir is below top water level), and the percentage decrease in the minimum reservoir level reached during the drawdown period. These two parameters are then compared against the reservoir impacts hydrological assessment matrix in **Figure A.6**.

This approach would be a suitable method to assess the impacts of a drought order / permit which involves significant changes to the reservoir water level regime (that would not normally be experienced during a drought without any additional measures implemented). For example, a drought order / permit may involve increasing daily or annual licensed abstraction limits to allow an increased rate of direct abstraction from the reservoir. This may enable some or all of a reservoir's emergency storage volume to be utilised, but is likely to lead to both lower water levels and increased periods of time below top water level.

Figure A.6 Hydrological Assessment Matrix (Reservoir Impacts)

	% Increase in duration of reservoir drawdown			
% Decrease in minimum reservoir level	<5%	5-10%	10-25%	>25%
<5%	Negligible	Negligible	Minor	Moderate
5-10%	Negligible	Minor	Moderate	Major
10-25%	Minor	Moderate	Major	Major
>25%	Moderate	Major	Major	Major

Additional Considerations

For groundwater schemes, hydrogeological data, where available, has been reviewed to inform the study area and duration of any impacts (noting impacts on groundwater may extend beyond the six month period of drought order / permit implementation - see below). An increase in groundwater abstractions would lead to an increased cone of depression in groundwater levels for groundwater abstraction. This impact can affect other non-surface water receptors such as other wells, springs or groundwater dependent ecosystems. It could also mean that surface water impacts would extend upstream of the abstraction point or, in significant instances, to other watercourses some distance from the abstraction.

For groundwater abstractions, the impact of a drought order / permit could extend beyond the six month period (time limited) of abstraction depending on the local hydrogeology of the area. During drought situations, where there is limited recharge to the aquifer system, the abstraction can be mainly at the expense of groundwater stored in the aquifer. This can, in the long run, delay groundwater level recovery and have a knock on effect on baseflow contributions to watercourses. Flows could, therefore, be reduced for longer than the six month period during which the drought order / permit could be implemented and, as such, has been considered as part of the assessment described in this report.

APPENDIX B
HYDROLOGY AND PHYSICAL ENVIRONMENT ASSESSMENT

B1 INTRODUCTION

This appendix assesses the potential impacts on the physical environment of the Llyn Cwellyn Reservoir and the downstream Afon Gwyrfai river catchment during the period of implementation of the drought order.

For the purposes of this assessment, the "without drought order" baseline includes the continuation of Welsh Water's existing abstraction and compensation arrangements, related to lake level in Llyn Cwellyn as outlined below. The assessed drought order assumes an increased rate of abstraction from 10Ml/d to 12Ml/d when lake level is lower than 0.8m below the spillway, but with no abstraction when the level is lower than 2m below the spillway as specified in the existing licence conditions. All other licence conditions including the varying compensation release rate remain unchanged.

B.1.1 Welsh Water's Existing Operations

Welsh Water's licence (number 23/65/15/24) to abstract water under the Water Resources Act at Llyn Cwellyn (see **Figure B1.1**) includes the following conditions:

- 6,570 million litres (Ml) authorised to be abstracted per annum
- Aa daily abstraction rate dependent on lake level (all levels have been re-cast relative to the spillway level of 141.15m) under the following scenarios
  - 20.4Ml/d[1] when lake level is 0.5m below spillway or higher
  - 15.9Ml/d when lake level is 0.5m to 0.8m below spillway
  - 10.0Ml/d when lake level is 0.8m to 2.0m below spillway
  - 10.0Ml/d when lake level is between 2.0m to 2.6m below spillway during the period 16 September to 15 November only
- At an abstraction rate not exceeding 300 litres per second
- Provision of uniform statutory compensation releases from Llyn Cwellyn, dependent on lake level and season under the following scenarios
  - 18.2Ml/d from 1 April to 31 December when lake level is 0.2m below spillway or higher
  - 13.6Ml/d from 1 January to 31 March when lake level is 0.2m below spillway or higher
  - 18.2Ml/d from 7 September to 31 December when lake level is between 0.2m and 0.8m below spillway

[1] 1Ml/d is 1 million litres per day.

- 13.6Ml/d from 1 January to 6 September when lake level is between 0.2m and 0.8m below spillway
- 11.4Ml/d when lake level is between 0.8m and 2.6m below spillway

Should the level of Llyn Cwellyn drop to specified levels, Natural Resources Wales (NRW) can request Welsh Water to operate the adjustable-level temporary spillway. Temporary spillway operation is dependent on lake level and season and includes:

- Setting the temporary spillway at 0.8m below spillway when lake level is lower than 0.8m below spillway during the period 21 August and 15 November
- Setting the temporary spillway at 1.0m below spillway when lake level is lower than 1.0m below spillway during the period 16 November to 31 December.

Once requested by NRW, the temporary spillway must remain in operation until 1) advised by NRW, 2) until 31 December or 3) if the lake level rises to above the (normal) spillway level. The temporary spillway enables some "natural" outflow from the lake whilst the level is below the normal spillway.

The licence also allows for the release of freshets in the period 1 August to 31 December at the request of NRW. The volume of the freshet bank is dependent on daily lake level in the period 1 April to 20 August. If NRW requests operation of the temporary spillway, the volume of the freshet bank will be deemed to be zero for the remainder of that calendar year.

The abstraction for potable supply is made directly from the lake and piped to Cwellyn Water Treatment Works (WTW) for treatment. Distribution is by mains to the mainland area of the North Eryri / Ynys Mon water resource zone.

These licence conditions have been in force since 1994 to coincide with infrastructure amendments at Llyn Cwellyn which enabled direct abstraction from the lake instead of from the Nant Mills river intake on the Afon Gwyrfai, some 1km downstream of the lake outflow. These infrastructure amendments included installation of the adjustable-level temporary spillway so that natural inflows could be released at the end of a drought prior to the reservoir storage reaching spillway level, and the extension of the raw water main from Nant Mills up to Llyn Cwellyn. A revised licence has been issued following the Habitats Directive Review of Consents process which still has the same licence conditions but also specifies the need for an approved fish pass.

B.1.2 Welsh Water's Proposed Drought Order Operations

The drought order involves a proposed relaxation of the low lake level abstraction rate at Llyn Cwellyn. When lake levels have fallen below 0.8m below spillway and the daily abstraction rate has reduced to 10Ml/d in the current licence conditions, the drought order proposes to operate the abstraction at a daily rate of 12Ml/d. The lake level at which abstraction ceases would be maintained as per the current licence conditions of 2.6m below spillway during the period 16 September to 15 November and 2.0m below spillway at all other times.

Compensation releases would be maintained as per the current licence conditions of 11.4Ml/d when lake level is between 0.8m and 2.6m below spillway. Freshet releases would not be impacted by the drought order (it is assumed that in drought conditions as outlined, the temporary spillway would be in operation and therefore the volume of the freshet bank would be deemed to be zero for the remainder of the calendar year).

The drought order will provide a modest increase in water resources during a drought, with the potential to relieve other sources. The timing of the increase in abstraction rate is most likely to occur during period from May to October inclusive. This is based on modelling of Llyn Cwellyn's performance under normal operating conditions in dry summers, together with Welsh Water's experience of operating the source.

It is unlikely that water level will reach 1.8m below spillway, from available data the lowest recorded value is 867Ml/d which equates to 0.93m below the normal spillway level. In the event that levels reduce below 1.8m an additional pump to aid eel passage will be installed.

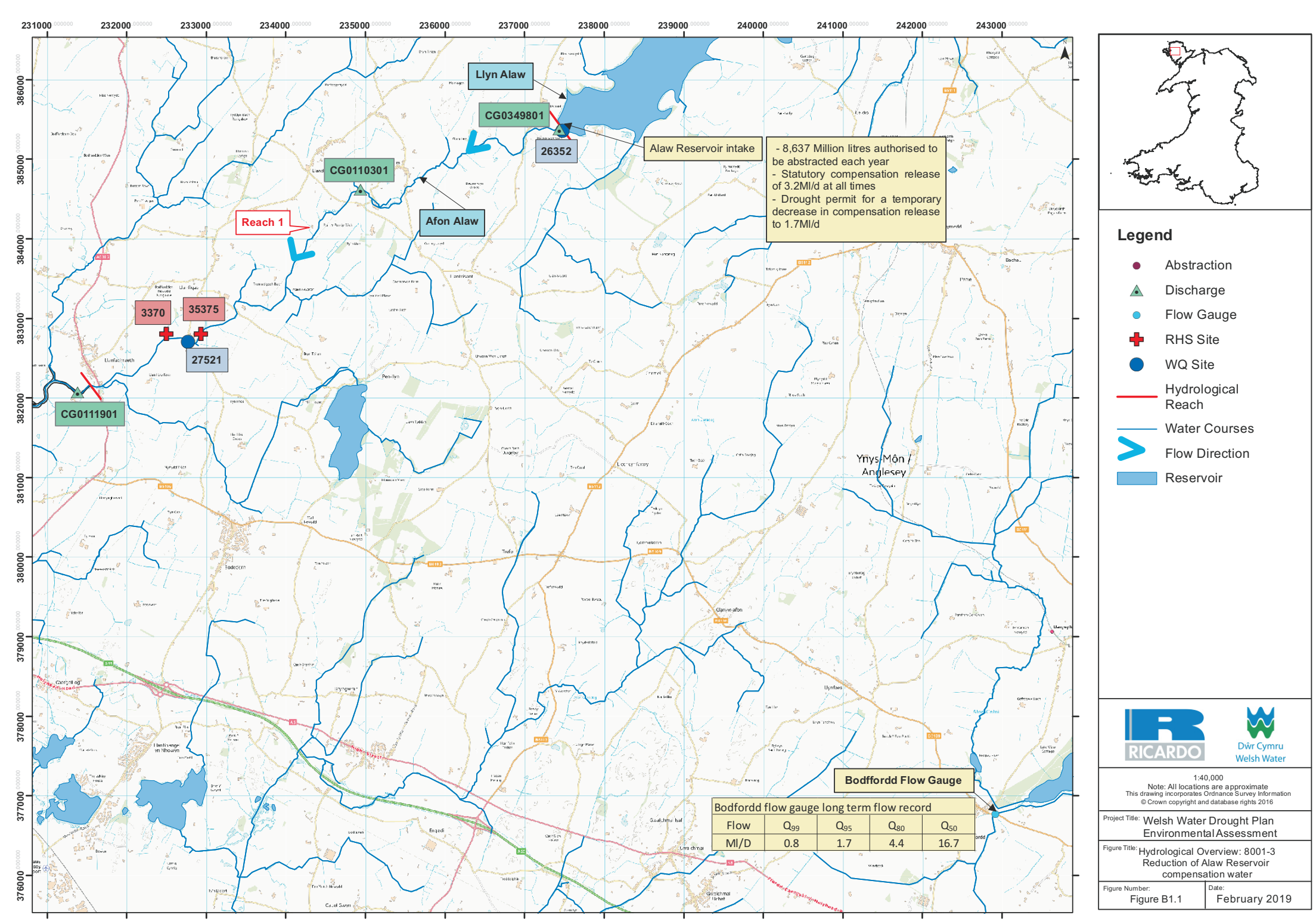
The study area is shown on **Figure B1.1**.

The physical environment includes consideration of hydrology and hydrodynamics; geomorphology; and water quality. The assessment has three key objectives:

1. To "list the likely impacts to the flow, level, channel/riparian form and sediment due to action being in place" as required by the DPG[2] and set out in Figure 2 of the DPG.
2. To support the screening and assessment of sensitive features (including ecological features and designated sites) as required by the DPG and set out in Section 5 of this report.
3. Provide supporting technical information for their screening and assessment where sensitive features are the physical environment itself.

This appendix is set out in the following sections:

[2] Natural Resources Wales (2017) *Water Company Drought Plan Technical Guideline.* Available at https://cdn.naturalresources.wales/media/684414/final-wc-drought-plan-guidance-2017.pdf?mode=pad&rnd=131656713580000000, Accessed 04 February 2019.



Legend

- Abstraction
- Discharge
- Flow Gauge
- RHS Site
- WQ Site
- Hydrological Reach
- Water Courses
- Flow Direction
- Reservoir

RICARDO

Dŵr Cymru Welsh Water

1:40,000

Note: All locations are approximate

Project Title: Welsh Water Drought Plan Environmental Assessment

Figure Title: Hydrological Overview: 8001-3 Reduction of Alaw Reservoir compensation water

Figure Number: Figure B1.1

Date: February 2019

B2 HYDROLOGICAL IMPACT

B.2.1 Reference Conditions

B.2.1.1 Catchment Overview

Llyn Cwellyn is a natural glacial moraine lake with managed water levels and controlled outflows in the upper catchment of the Afon Gwyrfai (see **Figure B1.1**). This small river catchment (52.4km^2 total drainage area from upstream of Llyn Cwellyn to the tidal limit) is located in the county of Gwynedd. The catchment rises on the western slopes of the Snowdon massif in the Snowdonia National Park and flows to the Menai Straits west of Caernarfon.

Llyn Cwellyn is an oligotrophic glacial lake, relatively large and deep, stratifying in the summer with a thermocline developing at depths of 10 to 15m. Located approximately 13km south-east of Caernarfon, at an altitude of 183m, Llyn Cwellyn covers an area of 86ha and is very deep at over 37m. The catchment area of the lake is steep ground used for rough grazing. The A4085 runs adjacent to the north shore with commercial forestry (Beddgelert Forest) on the south shore. The upstream (eastern) shore is at a lower gradient and potentially most sensitive to lake level fluctuation.

A review of the flows and physical habitat characteristics of the river network downstream of Llyn Cwellyn has identified the study area for this environmental assessment. The study area includes Llyn Cwellyn and the Afon Gwyrfai and is illustrated on **Figure B1.1**.

B.2.1.2 Baseline Data Availability

Continuous monitoring is undertaken by Welsh Water to monitor its operations at Llyn Cwellyn and data sets include:

- daily water levels at Llyn Cwellyn, from 1989 to date
- daily abstractions at Llyn Cwellyn, 1987 to date.

The monitoring of compensation releases and the spill of excess water from Llyn Cwellyn is undertaken by Welsh Water immediately downstream of Llyn Cwellyn , and previously at a flow gauge at Nant Mills on the Afon Gwyrfai downstream of the impoundment and includes:

- daily mean river flows at Nant Mills from August 2000 to August 2012 (although there are concerns over the data quality at this gauge, due to weed growth and gravel accumulation)
- daily mean river flows at Llyn Cwellyn Outlet from August 2012 to date.

Continuous monitoring of river level is undertaken by NRW at the Bontnewydd flow gauge on the lower Afon Gwyrfai. The measurement weir experienced a structural failure in 2005; the weir was rebuilt in late 2009 and river levels continued to be recorded thereafter.

Available flow data includes:

- NRW Bontnewydd river flow gauge on the Afon Gwyrfai daily river flow from 1970 to 2005, and from 2010 to date following the reconstruction of the weir.

B.2.1.3 Hydrology

Llyn Cwellyn Reservoir

Water levels in Llyn Cwellyn range from 0.9m below weir crest to 1.2m above weir crest over the period 1989 – 2018. A summary of monthly water levels over this period is given in **Table B2.1** below. It is understood that a more significant drawdown event occurred in 1984, and a drought order application was made in this year, but the available data does not cover this period. **Figure B2.1** illustrates a typical pattern of reservoir storage over two six-year periods from 1990 onwards and 2005 onwards; note in particular the rapid refill after each of the significant drawdown events shown. **Figure B2.2** shows the pattern of reservoir storage during the most recent drawdown event which occurred in the summer of 2018 (the lowest recorded storage volume in 2018 was 923Ml or 0.87m below the normal spillway level, on 27th July 2018).

Table B2.1 Summary of Recorded Mean Daily Water Level in Llyn Cwellyn (1989 – 2018)

Percentage of time water level equalled or exceeded	Mean daily level, m above weir crest, per month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All year
Maximum level	1.2	1.2	0.6	0.5	0.5	0.7	0.6	0.7	0.6	0.7	0.9	0.9	1.2
10% (high level)	0.4	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.3
50%	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.1
80%	0.1	0.0	0.0	0.0	0.0	-0.2	-0.1	0.0	0.0	0.0	0.1	0.0	0.0
90%	0.0	0.0	0.0	-0.1	-0.1	-0.3	-0.2	-0.2	-0.1	0.0	0.1	0.0	-0.1
95% (low level)	0.0	0.0	0.0	-0.1	-0.2	-0.5	-0.3	-0.3	-0.2	-0.2	0.0	0.0	-0.2
99% (extreme low level)	-0.1	0.0	-0.1	-0.3	-0.4	-0.6	-0.8	-0.7	-0.5	-0.9	-0.9	-0.1	-0.5
Minimum level	-0.2	-0.2	-0.1	-0.3	-0.5	-0.8	-0.9	-0.7	-0.8	-0.9	-0.9	-0.2	-0.9

Figure B2.1 Llyn Cwellyn Reservoir Storage, 1990 – 1995 and 2005-2010

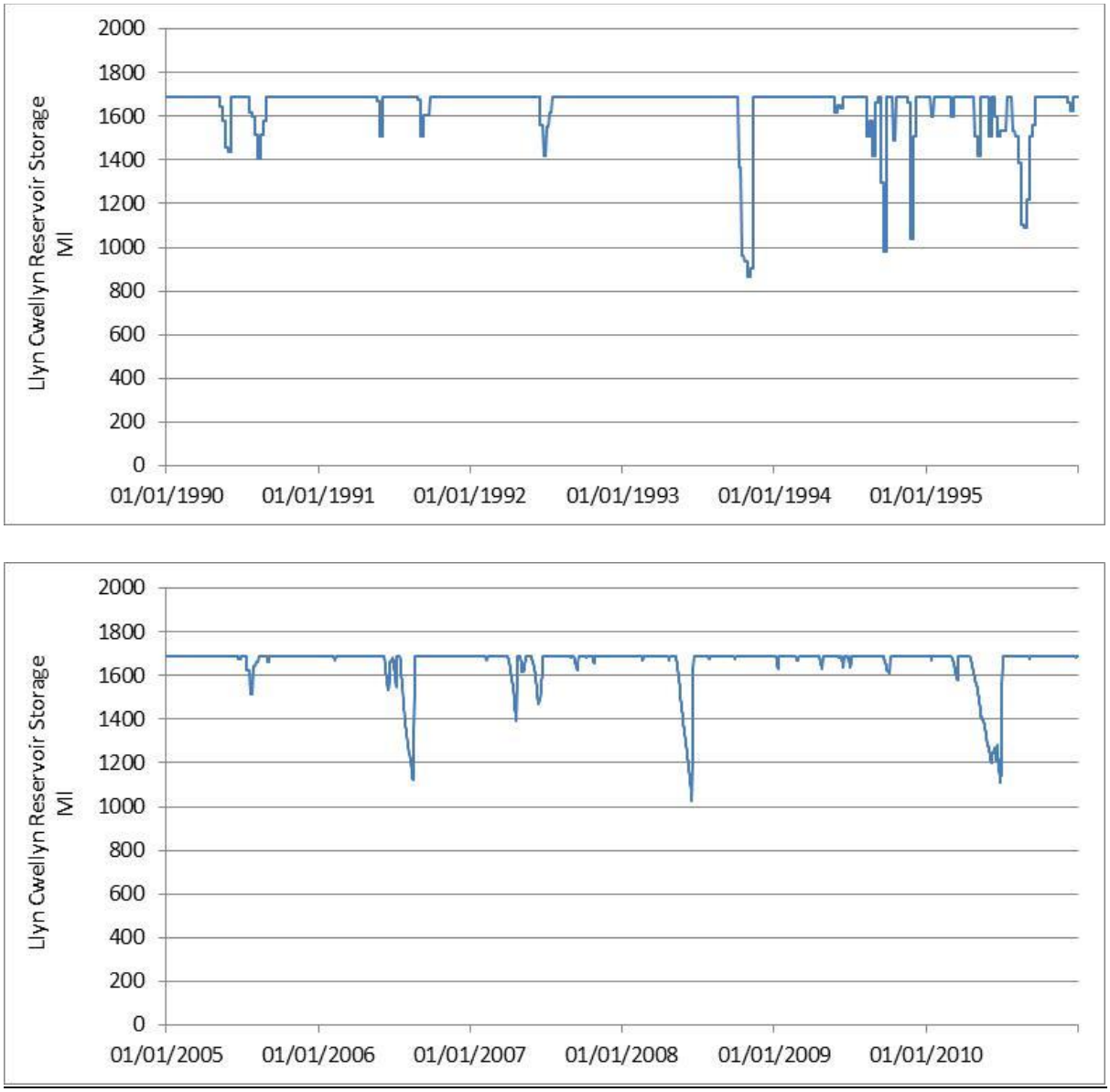
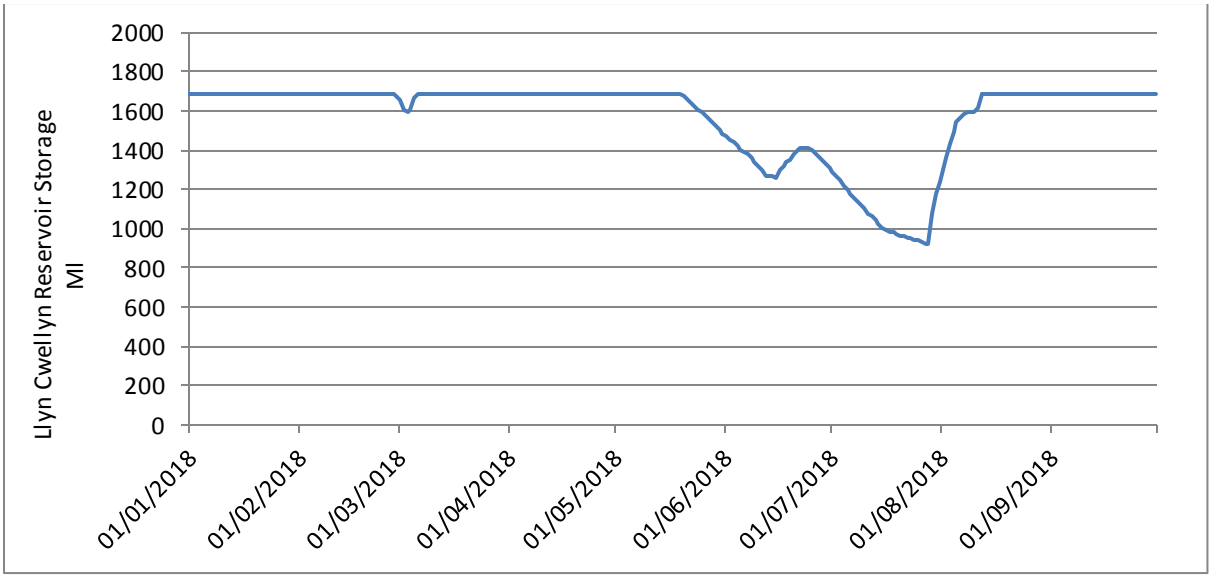


Figure B2.2 Llyn Cwellyn Reservoir Storage, 2018



Afon Gwyrfai at Nant Mills

Since 2012 flow has been measured in the Afon Gwyrfai immediately downstream of the Llyn Cwellyn impoundment; previously the flow measurement was at Nant Mills, approximately 1km downstream of the reservoir impoundment. A summary of the available daily flow data from 2000 to 2012 for Nant Mills is given in **Table B2.2** below. There are concerns over the data quality at this gauge, due to weed growth and gravel issues, however prior to 2012 there was no other flow measurement immediately downstream of the reservoir.

Table B2.2 Summary of Recorded Mean Daily Flow in Afon Gwyrfai at Nant Mills (2000– 2012)

Percentage of time river flow equalled or exceeded	Mean daily flow Ml/d, per month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All year
Maximum flow	1072.3	1126.8	647.5	673.5	650.3	813.5	865.6	897.6	798.8	916.9	1136.8	1122.5	1136.8
10% (high flow)	410.5	322.5	235.9	243.1	227.0	135.5	263.3	294.4	312.2	387.4	412.5	410.4	335.8
50%	158.2	80.8	69.8	70.9	51.0	22.9	68.5	71.4	84.0	120.8	183.6	138.0	85.2
80%	64.1	40.9	35.0	24.2	21.9	16.6	18.4	20.1	31.0	49.9	80.3	49.8	29.5
90%	38.1	29.2	26.8	20.0	19.5	14.5	16.9	16.0	22.5	29.0	58.9	36.4	19.3
95% (low flow)	30.3	22.3	21.9	18.4	17.2	13.7	15.3	14.7	17.8	18.4	48.6	30.6	16.6
99% (extreme low flow)	21.1	18.1	19.3	14.6	14.6	11.2	12.5	6.0	13.2	10.4	38.1	21.3	13.2
Minimum flow	19.5	14.8	16.5	13.2	14.3	11.1	11.3	0.4	0.3	9.2	35.9	13.7	0.3

The low flow statistics for the summer period (1 April to 30 September inclusive) are: Summer Q_{95} = 15.1Ml/d; Summer Q_{99} = 12.6Ml/d.

Figure B2.3 shows the typical pattern of flows at Nant Mills from 2005 to 2006, and the flow duration curve is shown in **Figure B2.4**.

Figure B2.3 Afon Gwyrfai at Nant Mills Flows (2005 – 2006)

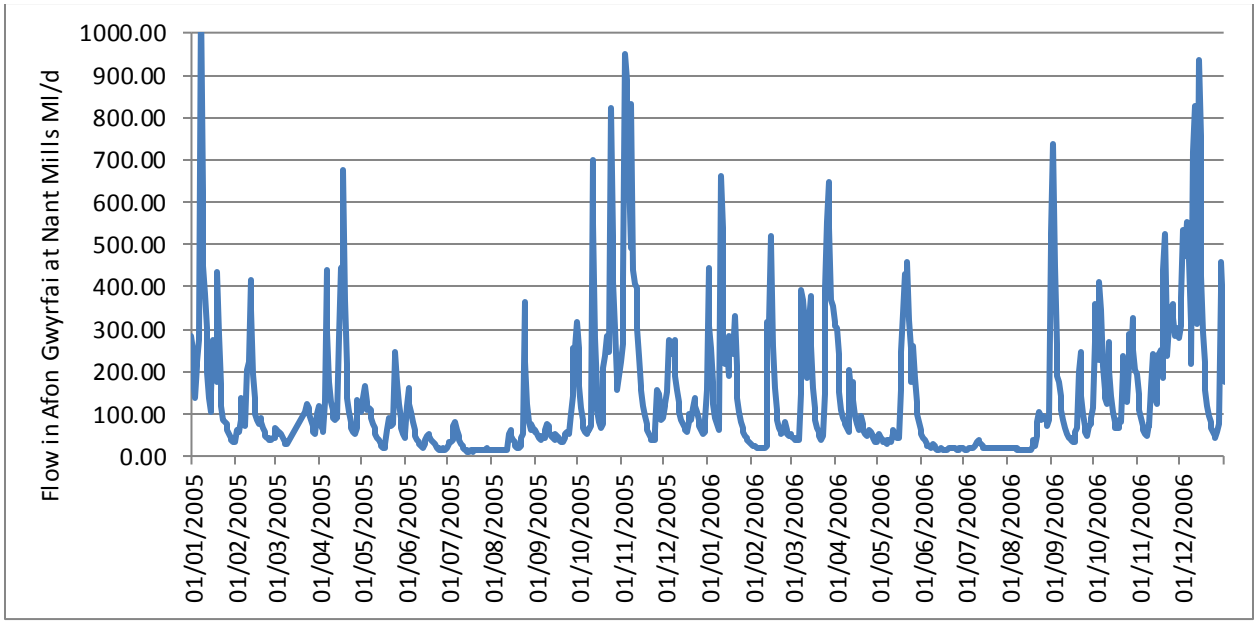
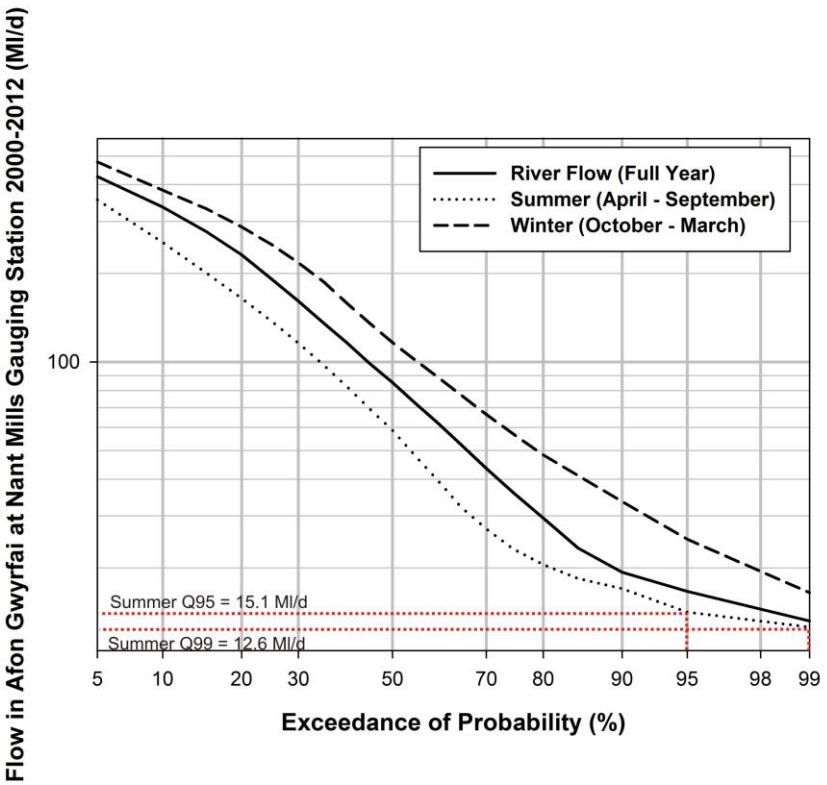


Figure B2.4 Afon Gwyrfai at Nant Mills Flow Summary (2000 – 2012)



Afon Gwyrfai at Llyn Cwellyn Reservoir Outlet

From 2012 onwards, flow has been measured at the outlet from Llyn Cwellyn. A summary of the available daily flow data from 2012 to 2018 for Llyn Cwellyn Reservoir outlet is given in **Table B2.3** below.

Table B2.3 Summary of Recorded Mean Daily Flow in Afon Gwyrfai at Llyn Cwellyn Reservoir Outlet (2012– 2018)

Percentage of time river flow equalled or exceeded	Mean daily flow Ml/d, per month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All year
Maximum flow	453.0	588.9	518.8	500.7	389.5	448.6	293.6	353.5	652.7	965.1	971.5	703.2	971.5
10% (high flow)	286.6	228.3	201.7	158.1	149.5	135.7	141.6	187.8	233.0	223.6	275.7	312.3	225.1
50%	166.3	122.7	75.4	48.4	48.8	30.0	44.0	61.6	57.6	90.5	135.5	150.6	72.1
80%	69.5	47.5	38.5	25.8	28.9	17.5	17.1	29.4	28.7	37.3	55.8	74.0	30.1
90%	50.8	31.2	26.8	23.2	22.7	14.4	13.8	22.5	23.3	25.5	38.7	32.4	22.7
95% (low flow)	44.4	26.5	19.0	21.3	22.0	13.9	12.5	18.6	21.8	22.4	30.5	29.0	19.2
99% (extreme low flow)	25.8	19.9	16.4	17.8	19.5	13.5	11.6	14.1	21.0	19.2	22.2	23.7	13.8
Minimum flow	25.3	18.3	16.0	17.2	14.8	9.5	11.6	13.9	20.4	16.7	19.7	21.7	9.5

The low flow statistics for the summer period (1 April to 30 September inclusive) are: Summer Q_{95} = 14.8Ml/d; Summer Q_{99} = 13.4Ml/d. These low flow values are strongly influenced by the statutory compensation flow regime at Llyn Cwellyn.

Figure B2.5 shows the pattern of flows at Llyn Cwellyn Reservoir outlet during the most recent drawdown event of summer 2018. The flow duration curve is shown in **Figure B2.6.**

Figure B2.5 Afon Gwyrfai at Llyn Cwellyn Reservoir Outlet (2018)

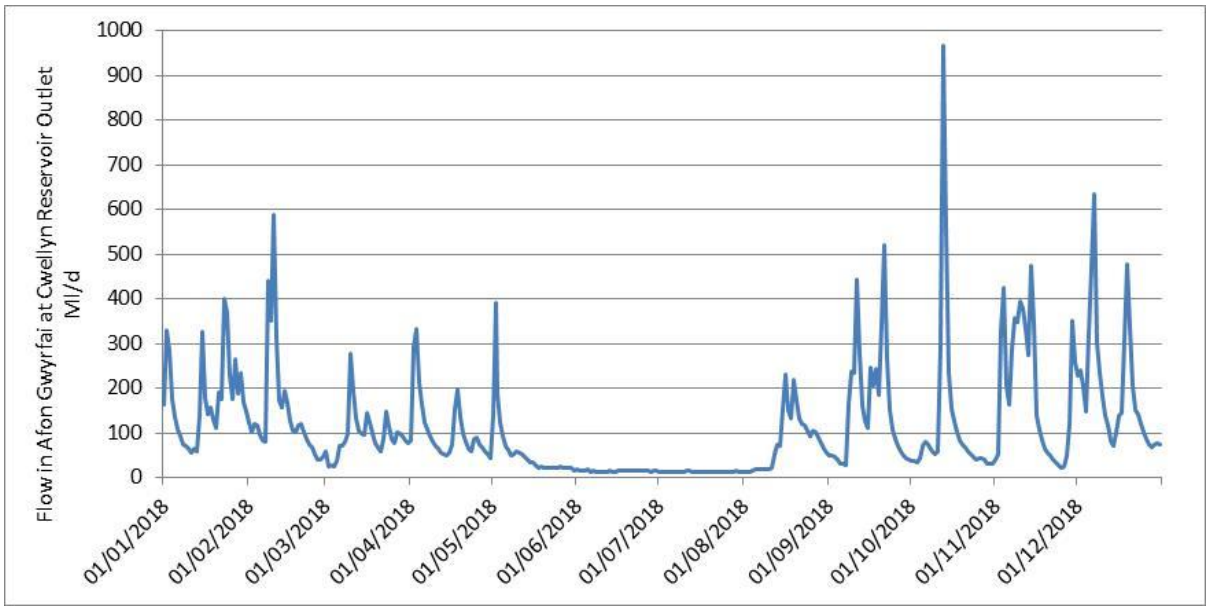
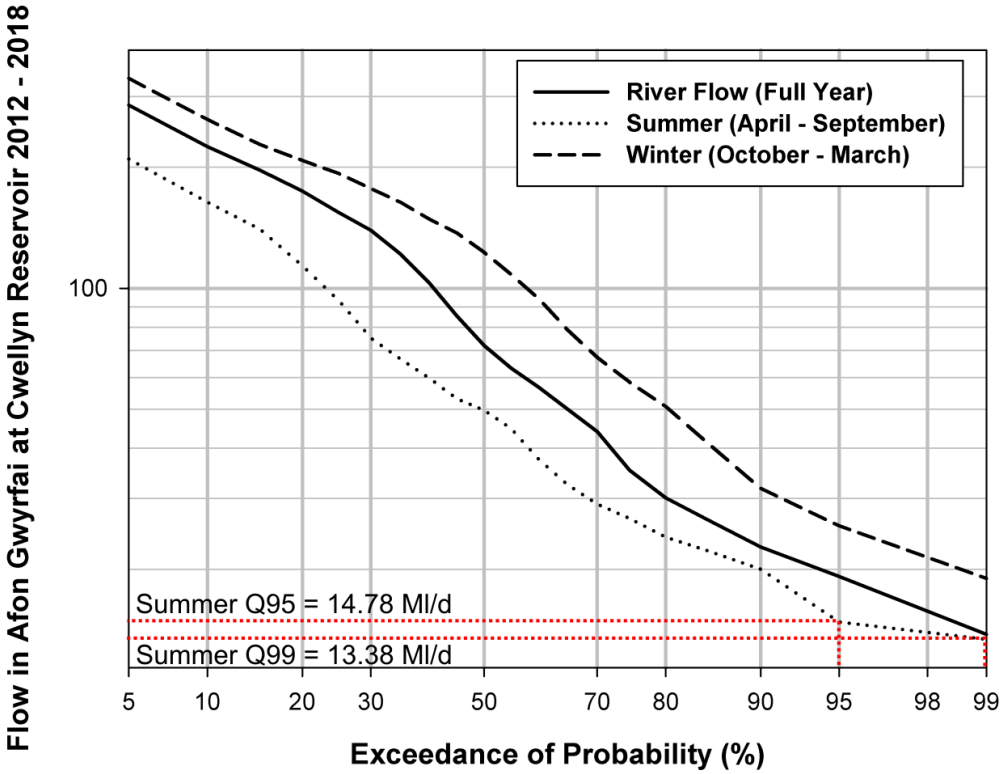


Figure B2.6 Afon Gwyrfai at Cwellyn Reservoir 2012-2018



Afon Gwyrfai at Bontnewydd

NRW continuously monitor river level on the Afon Gwyrfai at the Bontnewydd flow gauging station at an altitude of 31m AOD. The available flow record extends from 1970 to 2005, and is summarised in **Table B2.4**. River level and flow data for the period since 2009 is also now available, following the reconstruction of the weir.

Table B2.4 Summary of Recorded Mean Daily Flow in the Afon Gwyrfai at Bontnewydd gauging station (1971 – 2005 and 2010 - 2018)

Percentage of time river flow equalled or exceeded	Mean daily flow Ml/d, per month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All year
Maximum flow	1991.5	2160.0	2481.4	1114.6	1047.2	1494.7	1337.5	1045.4	1287.4	2343.2	2548.8	3006.7	3006.7
10% (high flow)	597.6	547.3	432.4	322.6	241.3	210.5	229.7	297.7	396.6	540.9	618.1	651.1	457.8
50%	231.6	164.8	138.5	108.6	65.2	53.5	54.1	84.8	113.6	171.1	243.0	237.2	127.6
80%	113.3	84.0	71.6	50.7	33.2	28.5	27.1	32.1	48.3	78.1	120.5	102.5	50.7
90%	72.5	62.2	54.1	36.2	27.3	23.4	22.3	22.7	32.5	53.3	83.6	68.7	33.0
95% (low flow)	53.1	53.6	45.5	31.1	23.4	20.1	19.5	17.0	26.1	39.1	60.2	55.1	25.8
99% (extreme low flow)	30.9	41.3	36.6	25.7	19.8	14.0	14.0	10.2	13.6	10.4	38.5	39.1	16.0
Minimum flow	0.0	31.4	29.9	18.1	17.9	11.1	12.4	6.0	6.7	5.3	31.4	33.0	5.3

The low flow statistics for the summer period (1 April to 30 September inclusive) are: Summer Q_{95} = 21.3Ml/d; Summer Q_{99} = 14.0Ml/d.

Figure B2.7 shows the typical flow patterns in the Afon Gwyrfai from 1982 to 1984, a period which includes the notable drought period of summer 1984. The flow duration curve for this location is shown in **Figure B2.8**.

Figure B2.7 Afon Gwyrfai at Bontnewydd (1982 - 1984)

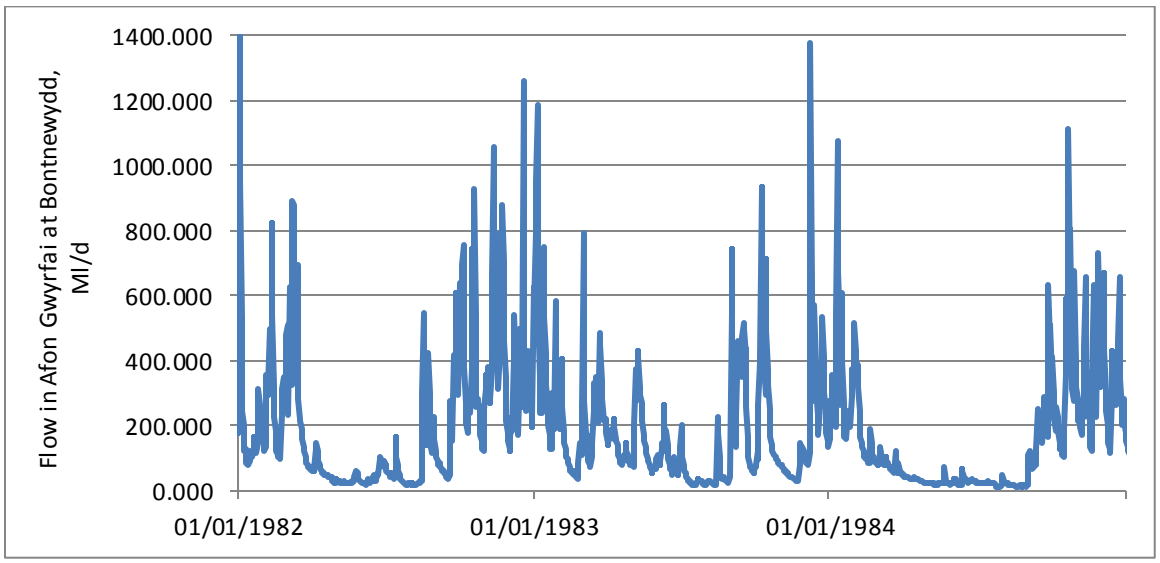
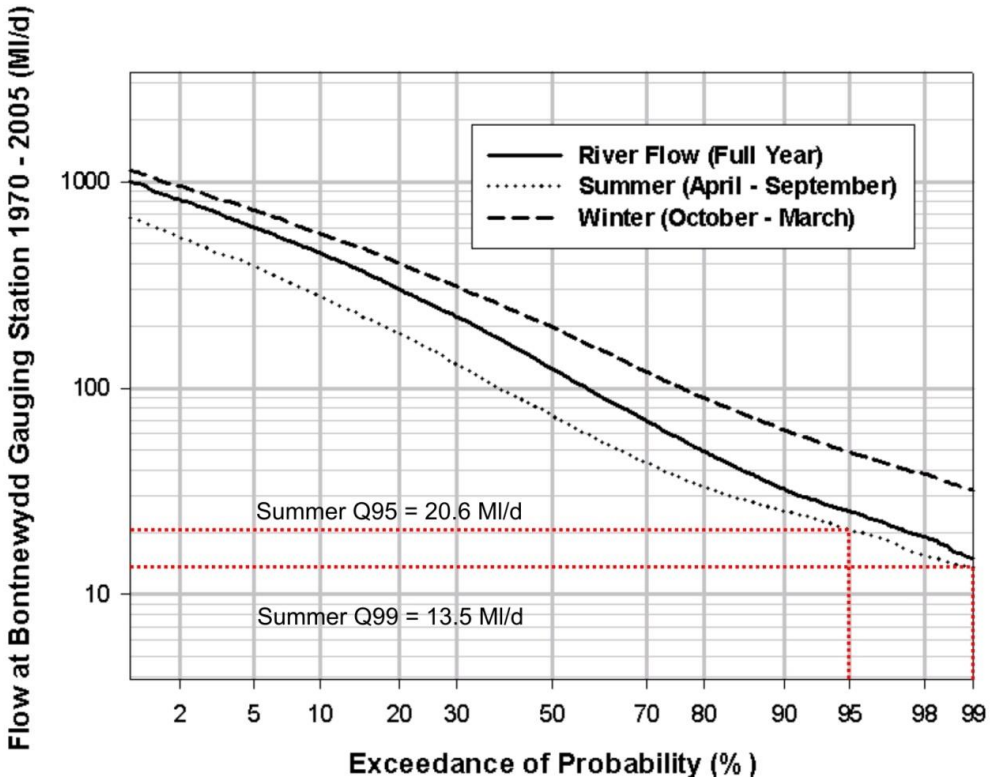


Figure B2.8 Afon Gwyrfai at Bontnewydd Flow Summary (1970 – 2005)



B.2.2 Hydrological Impact

B.2.2.1 Hydrological Zone of Influence

The study area includes all of the Afon Gwyrfai from the Llyn Cwellyn Reservoir outflow down to the tidal limit, comprising three distinct hydrological reaches as shown in **Figure B1.1**:

- Reach 1 is the Afon Gwyrfai from Llyn Cwellyn outflow to the confluence with Nant-y-Betws.
- Reach 2 is the Afon Gwyrfai, from the confluence with Nant-y-Betws to the Bontnewydd gauging station.
- Reach 3 is the Afon Gwyrfai, from Bontnewydd gauging station to the tidal limit.

The potential hydrological impacts of the drought order option have been assessed for Llyn Cwellyn itself and for the three separately identified river reaches, as summarised in **Table B2.5** at the end of this section.

The details of the assessment for each reach are presented below.

B.2.2.2 Hydrological Impact Assessment

Llyn Cwellyn Reservoir

The lowest storage volume in Llyn Cwellyn within the available data record is 867Ml (0.93m below normal spillway level) on 28/10/1993 (related to a deliberate drawdown for operational/maintenance reasons), however refill occurred within two weeks on this occasion, which is due to the large wet catchment where reservoir levels fluctuate rapidly. The next lowest recorded storage was 923Ml (0.87m below normal spillway level) on 27/7/2018 but again reservoir storage returned to full capacity very quickly, in just over 2 weeks. Hence the available data record does not include any droughts of sufficient severity to warrant the implementation of a drought order. We have therefore based our assessment on a synthesised drought; we have set out below the assumptions and method used to define the relevant drought parameters.

In order to determine typical drawdown rates, we have analysed the available data for the seven most severe drawdown periods within the Llyn Cwellyn data record from 1989 to 2018. By a simple water balance calculation for each of these periods, it is possible to estimate the average natural rate of catchment inflow (allowing for any evaporation losses) during each drawdown event, along with the durations of drawdown and refill, and net refill rate. The drawdown and refill analysis is summarised in **Tables B2.5** and **B2.6** below.

Note that the daily refill rates quoted in **Table B2.6** are net refill rates, including any outflows or other losses. Refill rates are highly variable and in practice the length of time to refill Llyn Cwellyn will depend on a number of factors, including the timing of any requests from NRW to lower the temporary spillway to allow overflows from Llyn Cwellyn before storage has returned to full capacity.

Table B2.5 Summary of Llyn Cwellyn Drawdown Analysis 1989 – 2018

Year	Start Date of drawdown period in Llyn Cwellyn	Date of lowest drawdown in Llyn Cwellyn	Lowest storage volume in Llyn Cwellyn (Ml)	Total Nant Mills flow during drawdown period (Ml)	Total abstraction during drawdown period (Ml)	Natural inflow during drawdown period (Ml)	Length of Llyn Cwellyn drawdown period (days)	Average daily natural inflow Ml/d
1993	07/10/1993*	28/10/1993	867	N/A	N/A	N/A	21	N/A
1994	15/09/1994	22/09/1994	980	N/A	N/A	N/A	7	N/A
1995	27/07/1995	24/08/1995	1093	411.64	562.72	380.36	28	13.6
2006	16/07/2006	17/08/2006	1119	564.46	559.34	555.80	32	17.4
2008	09/05/2008	17/06/2008	1023	770.12	626.74	732.85	39	18.8
2010	17/04/2010	07/06/2010	1200	905.22	666.17	1084.39	51	21.3
2018	19/05/2018	27/07/2018	923	1081.70	702.41	1020.11	69	14.8

NB Llyn Cwellyn maximum usable storage capacity is 1687 Ml.

* Deliberate drawdown by Welsh Water for operational/maintenance purposes

Table B2.6 Summary of Llyn Cwellyn Refill Analysis 1989 – 2018

Year	Date of lowest drawdown in Llyn Cwellyn	Lowest storage volume in Llyn Cwellyn (Ml)	Date of refill	Length of Llyn Cwellyn refill period (days)	Net refill rate in Llyn Cwellyn (Ml/d)
1993	28/10/1993	867	11/11/1993	14	58.57
1994	22/09/1994	980	29/09/1994	7	101.00
1995	24/08/1995	1093	21/09/1995	28	21.21
2006	17/08/2006	1119	21/08/2006	4	142.00
2008	17/06/2008	1023	21/06/2008	4	166.00
2010	07/06/2010	1200	04/07/2010	27	18.04
2018	27/07/2018	923	12/08/2018	16	47.75

NB Llyn Cwellyn maximum usable storage capacity is 1687 Ml.

The average daily inflow during the drawdown periods analysed, ranged from 13.6Ml/d to 21.3Ml/d. Note that it was not possible to calculate the average daily natural inflow for the drawdown periods in 1993 and 1994, as the Nant Mills outflow data was not available for those years and the 1993 event was the result of a deliberate operational drawdown. The total duration of the periods when water levels were below the normal spillway level ranged from about 14 days (1994) to 85 days (2018).

Using the above information as a guide, we have used the following assumptions to create a synthesised drawdown period of sufficient severity to warrant the implementation of a drought order:

- Water levels drop to 0.87m below normal spillway level on 31 July (storage of 923Ml)
- Storage continues to draw down for a further 30 days, with an average daily natural inflow of 13.6Ml/d (the lower end of the range analysed).

For the baseline drought, abstraction continues at a rate of 10Ml/d during the further 30 days of drawdown below 0.87m below spillway level. For the assessed drought order, although water levels are lower than 0.8m below spillway level, abstraction is reduced only to 12Ml/d. In both cases, the compensation release is continued at the rate of 11.4Ml/d. An alternative drought order scenario has also been modelled in which abstractions are permitted to continue at a rate of 14Ml/d when water levels are lower than 0.8m below spillway level.

Figure B2.9 illustrates the impact on reservoir drawdown (storage volume) of the two alternative drought order options. **Figure B2.10** shows the equivalent reservoir levels of each of the alternative scenarios.

Figure B2.9 Llyn Cwellyn Reservoir Storage in Synthesised Drought: Baseline and With Drought Order Impacts

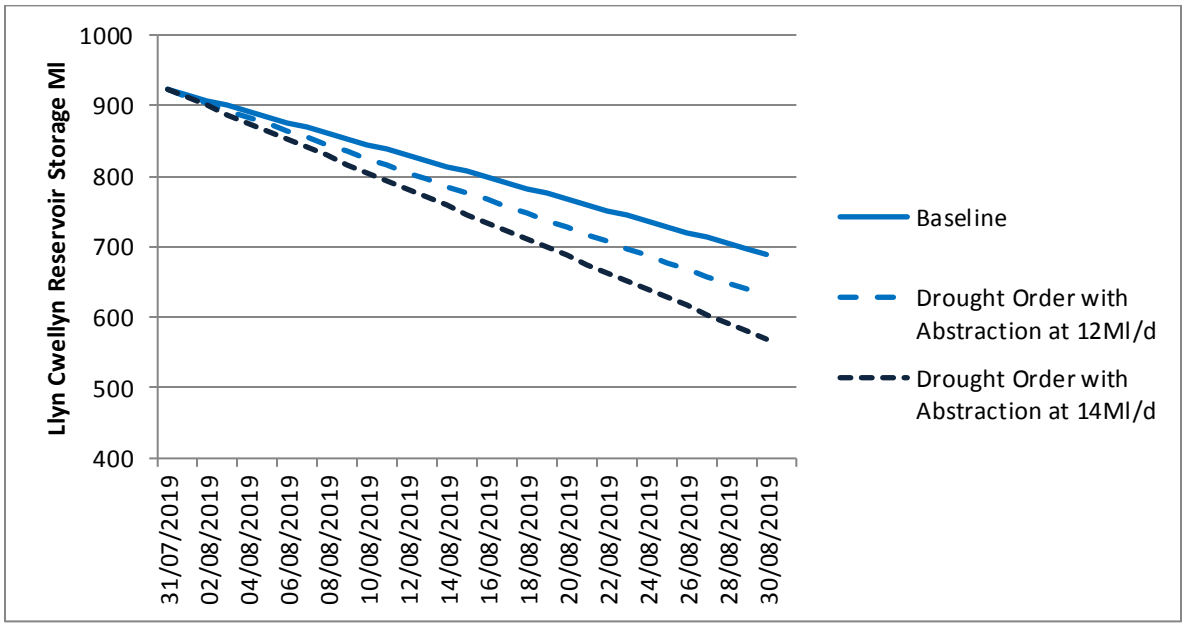
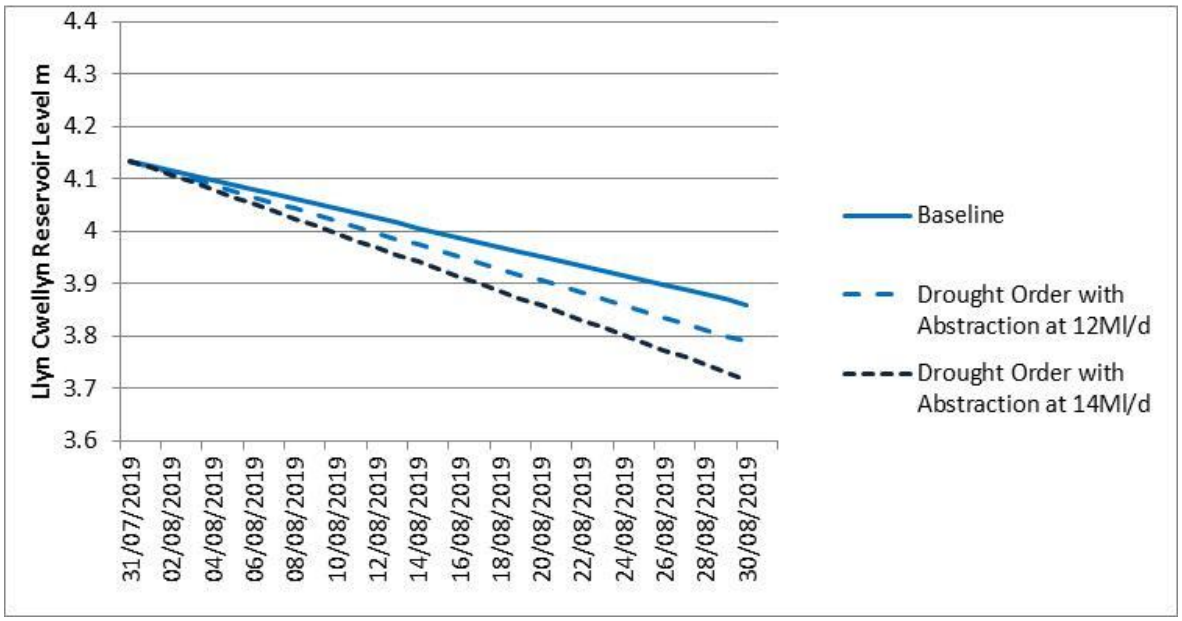


Figure B2.10 Llyn Cwellyn Reservoir Level in Synthesised Drought: Baseline and With Drought Order Impacts



With abstraction at 12Ml/d, water levels at the end of the 30-day drawdown period have reduced by 7.4cm relative to the baseline case, a reduction of about 1.9% in the minimum water level when measured relative to the datum at 5m below the normal spillway.

The decrease in storage relative to the baseline is 62Ml and this will lead to a marginal increase in the length of time required to refill the reservoir following the drawdown period, with a corresponding reduction in the number of days of hydraulic connectivity between lake and

river. However, even with the lower of the net refill rates from our analysis, 18Ml/d (see **Table B2.6**), the additional time required under the drought order is only of the order of around 4 days. Assuming that the total duration of the period for which storage is below top water level is at least 4 months, for a drought of this severity (at least 1 month longer than the drawdown period of 85 days experienced in 2018), this only represents an increase of around 3.3% in the duration of this period (4/122 days = 3.3%).

Taking into consideration the small percentage reductions in both minimum water levels and durations of drawdown periods which the drought order options have on the theoretical baseline drought, we have assessed the hydrological impact of both options on Llyn Cwellyn Reservoir as **negligible**.

Assessment of River Reach Impacts

In order to assess the potential hydrological impacts on each of the three river reaches, estimates of key flow statistics are required. Measurements are available at the top of Reach 1 (Afon Gwyrfai downstream of Llyn Cwellyn) and the end of Reach 2/top of Reach 3 (Afon Gwyrfai at Bontnewydd gauging station). A summary of the key flow statistics from gauging records at relevant locations within the study area is given in **Table B2.7**; note that the time periods of the data records for the three measured locations do not correspond. All three gauged records are strongly influenced by the compensation flow regime from Llyn Cwellyn, particularly at low flows.

Table B2.7 Summary of Key Summer Flow Statistics: Afon Gwyrfai Catchment

Location	Grid Reference	Summer Q_{99}	Summer Q_{95}	Summer Q_{90}	Summer Q_{80}	Summer Q_{50}	Summer Q_{10}
Llyn Cwellyn Reservoir Impoundment (Top of Reach 1)	SH552556	**13.4**	**14.8**	**20.0**	**29.7**	**49.7**	**163.9**
Afon Gwyrfai at Nant Mills (upper reach 1)	SH547563	**12.6**	**15.1**	**17.0**	**29.5**	**58.5**	**254.9**
Afon Gwyrfai at Bontnewydd Gauging Station	SH483598	**14.0**	**21.3**	**26.0**	**33.8**	**76.3**	**287.9**

Reach 1 – Afon Gwyrfai from Llyn Cwellyn outflow to the confluence with Nant-y-Betws

The drought order does not involve any change to the magnitude of the low flows immediately downstream of the reservoir, as the statutory compensation release arrangements are unchanged. During the drought period when reservoir levels are lower than 0.8m below normal spillway level, compensation releases will continue at the daily rate of 11.4Ml/d. However, the duration of the period of time for which reservoir outflow continues at this rate is likely to be increased by the drought order. As outlined in the reservoir assessment above, for the theoretical drought analysed the duration of the low flow period with outflows at 11.4Ml/d is estimated to be around 4 days or 3.3% longer.

The hydrological impact of the drought order on Reach 1 has therefore been assessed as

negligible during the period of implementation of May to October.

Reach 2 – Afon Gwyrfai, from the confluence with Nant-y-Betws to the Bontnewydd gauging station

Similarly to Reach 1, the drought order does not lead to any reduction in the magnitude of low flows in Reach 2, but there is estimated to be a marginal increase in the duration of the period for which compensation flow from the reservoir upstream is limited to the lower value of 11.4Ml/d. The effect is reduced in Reach 2 compared to Reach 1, as there is theoretically some flow accretion along the length of Reach 1, however at low flows the magnitude of flow accretion appears to be marginal. The compensation rate is estimated to be around 98% of the summer Q_{99} extreme low flow value and 64% of the Q_{95} low flow in the Afon Gwyrfai at the top of Reach 2.

The high proportion of downstream flow contribution from the compensation release indicates that it is in fact protecting the river catchment from the impacts of the very lowest flows of the natural flow regime without the reservoir in operation.

As outlined previously, for the theoretical drought analysed, the duration of the low flow period with reservoir outflows at 11.4Ml/d is estimated to be around 4 days or 3.3% longer than the baseline case.

The hydrological impact of the drought order on Reach 2 has therefore been assessed as **negligible** during the period of implementation of May to October.

Reach 3 – Afon Gwyrfai, from Bontnewydd gauging station to the tidal limit.

Again there will not be any reduction in the magnitude of low flows in Reach 3 due to the drought order, but there is likely to be a marginal increase in the length of time for which upstream reservoir outflow is limited to the lower rate of 11.4Ml/d. This could be mitigated to some extent by further flow accretion along the length of Reaches 1 and 2, however inspection of the summer flow statistics for Reach 3 indicates that the magnitude of flow accretion is small at times of low or extreme low summer flow. At the summer Q_{95} low flow value, the compensation release is estimated to be around 53% of the flow in the Afon Gwyrfai at Bontnewydd Gauging Station (or around 81% of the Q_{99} extreme low flow).

As outlined previously, for the theoretical drought analysed, the duration of the low flow period with reservoir outflows at 11.4Ml/d is estimated to be around 4 days or 3.3% longer than the baseline case.

The hydrological impact of the drought order on Reach 3 has therefore been assessed as **negligible** during the period of implementation of May to October.

B.2.2.3 Hydrological Impact Summary

Three river reaches have been considered for which the assessed hydrological impacts are **negligible**. The impacted reaches are shown in **Table B2.8** and **Table B2.9** and establish

the full in-channel zone of influence of the drought order for environmental sensitivity screening (see **Figure B1.1**).

The hydrological impact on Llyn Cwellyn itself has been assessed as **negligible**.

Table B2.8 Hydrological and Monitoring Reaches Identified in the Study Area – Summer Impact (May to September)

Hydrological Reach		Reach boundary		Reach length	% flow reduction		Hydrological Impact
		Upstream	Downstream		Summer Q_{95}	Summer Q_{99}	
Llyn Cwellyn reservoir		n/a	n/a	n/a	n/a	n/a	**Negligible**
1	Afon Gwyrfai reach 1	Llyn Cwellyn outflow	Nant-y-Betws confluence	5.2km	0%	0%	**Negligible**
2	Afon Gwyrfai reach 2	Nant-y-Betws confluence	u/s Bontnewydd	5.0km	0%	0%	**Negligible**
3	Afon Gwyrfai reach 3	u/s Bontnewydd	Tidal limit	4.4km	0%	0%	**Negligible**

Table B2.9 Hydrological and Monitoring Reaches Identified in the Study Area – Winter Impact (October)

Hydrological Reach		Reach boundary		Reach length	% flow reduction		Hydrological Impact
		Upstream	Downstream		Year round Q_{50}	Year round Q_{95}	
Llyn Cwellyn reservoir		n/a	n/a	n/a	n/a	n/a	**Negligible**
1	Afon Gwyrfai reach 1	Llyn Cwellyn outflow	Nant-y-Betws confluence	5.2km	0%	0%	**Negligible**
2	Afon Gwyrfai reach 2	Nant-y-Betws confluence	u/s Bontnewydd	5.0km	0%	0%	**Negligible**
3	Afon Gwyrfai reach 3	u/s Bontnewydd	Tidal limit	4.4km	0%	0%	**Negligible**

B3 PHYSICAL ENVIRONMENT ASSESSMENT

Given that there is no adverse hydrological impact associated with the drought order, effects on geomorphology and water quality are equally assessed as **negligible**. Similarly, there would be no flow pressures or water quality pressures that would pose an increased risk to any water-dependent environmental features within the vicinity of Llyn Cwellyn and Afon Gwyrfai.

B4 PHYSICAL ENVIRONMENT IMPACT SUMMARY

Potential impacts on the physical environment associated with the Llyn Cwellyn Drought Order are summarised in **Table B4.1.**

Table B4.1 Summary of Potential Changes to the Physical Environment of the Impacted Reaches from Implementation of Llyn Cwellyn Drought Order

Afon Gwyrfai (Reach 1)	
Flows in the Afon Gwyrfai *Negligible for up to 7 days at the end of drawdown during the autumn/winter period*	• Negligible increase of low flow period (estimated at 3.3% increase in duration, depending on reservoir abstraction rate)
Afon Gwyrfai (Reach 2)	
Flows in the Afon Gwyrfai *Negligible for up to 7 days at the end of drawdown during the autumn/winter period*	• Negligible increase of low flow period (estimated at 3.3% increase in duration, depending on reservoir abstraction rate)
Afon Gwyrfai (Reach 3)	
Flows in the Afon Gwyrfai *Negligible for up to 7 days at the end of drawdown during the autumn/winter period*	• Negligible increase of low flow period (estimated at 3.3% increase in duration, depending on reservoir abstraction rate)

B5 CUMULATIVE IMPACTS

The focus of this EAR is the 8001-2 Llyn Cwellyn drought order. The assessment, as described in previous sections, has considered how the proposed drought order may affect the environment in combination with the effects of existing licences and consents. In accordance with the DPG the assessment also considers the potential cumulative effects of Welsh Water implementing other drought orders within a similar timeframe. The potential for options to act in combination is set out in **Table B5.1**.

Consideration has also been given to the potential for cumulative impacts of drought options implemented by neighbouring water companies (see **Table B5.1**). The assessment of the potential for cumulative impacts of Welsh Water's supply side and drought order / order options with drought options listed in neighbouring water companies' drought plans has also been undertaken as part of the Strategic Environmental Assessment (SEA) of Welsh Water's Draft Statutory Drought Plan. The SEA was informed by the most recent information available on the neighbouring water companies' drought plans.

Table B5.1 Cumulative Impacts of the Llyn Cwellyn Drought Order with other Drought Options

Organisation	Potential In-combination Impacts	Further Consideration Required (Yes/No)
Welsh Water - other drought options in the North Eryri Ynys Mon WRZ / Afon Gwyrfai catchment	8001-3 (Reduction of Alaw Compensation water) – The impacts of this option do not occur within the same catchment and therefore no in-combination effects are anticipated.	No
	8001-4 (Reduction of Ffynnon Llugwy Compensation water) – The impacts of this option do not occur within the same catchment and therefore no in-combination effects are anticipated.	No
	8001-5 (Reduction of Cefni Compensation water) – The impacts of this option do not occur within the same catchment and therefore no in-combination effects are anticipated.	No
Natural Resources Wales - Drought options in the Afon Gwyrfai catchment	No in-combination effects are anticipated at this time but this will be reviewed at the time of any drought order application.	No