Dŵr Cymru Welsh Water

Environmental Assessment of Talybont Reservoir Drought Order (8116-3)

Final

March 2019

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Produced By

.....
Dr Anne Fairhead
Principal Environmental Scientist

Authorised for Release By

.....
John Sanders
Technical Director

*As part of a share purchase agreement in August 2015, Cascade Consulting (Environment & Planning) Ltd transferred its business to Ricardo plc. All employees transferred to Ricardo Energy & Environment, a trading name of Ricardo-AEA Ltd which is a wholly owned subsidiary of Ricardo plc. The work described in this report spanned the pre-acquisition and post-acquisition period and throughout this time the consultants involved maintained a continuity of service both as employees of Cascade Consulting and then subsequently as employees of Ricardo Energy & Environment.

CONTACT DETAILS:

Ricardo Energy & Environment
Bright Building, First Floor
Manchester Science Park
Pencroft Way
Manchester
M15 6SGZ

Tel: +44 (0)1235 753000

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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 Talybont Reservoir, over and above those arising due to natural effects of drought and those which would occur under "normal" abstraction licence conditions.

Talybont Reservoir is located in Welsh Water's SEWCUS - Talybont (8116) WRZ. The Talybont sub-zone is located to the north of the SEWCUS WRZ which supplies the south-east area of Wales.

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 the Welsh Ministers for a drought order at Talybont, 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 SEWCUS 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 Talybont reservoir.

This drought option may be required in severe drawdown conditions when storage approaches the dead storage zone in Talybont Reservoir, and involves pumped abstraction of 30Ml/d from the dead storage zone for up to 30 days.

The drought order is most likely to occur during the autumn and winter period, and is considered not to extend outside the period September to November. This has been

confirmed by Welsh Water's water resources modelling.

The revised abstraction arrangements would legally be authorised for three months but would be removed sooner if water resources have returned to adequate levels to safeguard future water supplies, as agreed with the Welsh Ministers / Natural Resources Wales (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 sources considered by Welsh Water will be completed at the time of application for the drought order at Talybont Reservoir. This will demonstrate justification for the proposed drought option details applied for.

POTENTIAL IMPACTS OF DROUGHT ORDER IMPLEMENTATION

The scope of the assessment has been defined by a screening and scoping exercise.

Summary of the Hydrological Assessment

The assessment has concluded that there is a **minor** impact on flows in the Nant Caerfanell as a result of implementing the drought order, relating to an extension of the period the river is at compensation flow. There are **negligible** impacts on the physical environment of the river, including water quality.

Summary of the Environmental Features Screening

Environmental assessment is required and included for features where screening has identified a major or moderate impact or minor where a site is designated.

Screening identified the River Usk and River Usk (Tributaries) SSSI as features for which environmental assessment is required.

The assessment has concluded that there are **negligible** impacts on the River Usk and River Usk (Tributaries) SSSI.

The HRA Screening concluded that implementation of a drought order would not

result in likely significant effects on the otter; bullhead; river lamprey; brook lamprey; Atlantic salmon populations within the River Usk SAC.

Cumulative Impacts

No cumulative effects of implementing the drought order with other 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 Talybont Reservoir.

MITIGATION AND MONITORING

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 permit, in order to monitor the adherence (or otherwise) of the river system to that expected from the assessment presented in this EAR.

CONCLUSIONS

In summary, it has been concluded that the environmental effects on river flows, water quality and ecology of implementing a drought order at Talybont Reservoir during September to November inclusive, 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.**

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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 utilise the dead storage in Talybont Reservoir. Water stored at Talybont Reservoir is used to provide public water supplies to Welsh Water's South East Conjunctive Use System (SEWCUS) Water Resource Zone (WRZ) (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 Talybont. 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 September to November 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 Talybont drought order, covers the following waterbodies:

- Caerfanell - source to confluence R Usk (GB109056033000)

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**)
- 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 Drought Plan

Guideline[1] (DPG); specifically Section 5 and Appendices I and J, and Welsh Government / Defra / NRW / Environment Agency guidance on drought permits and drought orders[2].

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 orders / permits where there is certainty that there are no such impacted sensitive features.

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 NRW).

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 NRW to ensure that

[1] 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.
[2] Welsh Government / Defra / Natural Resources Wales / Environment Agency (2015) *Apply for a drought order or emergency drought order*, https://www.gov.uk/government/collections/apply-for-a-drought-permit-drought-order-or-emergency-drought-order Accessed 21 December 2018.

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 Talybont Reservoir, 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)

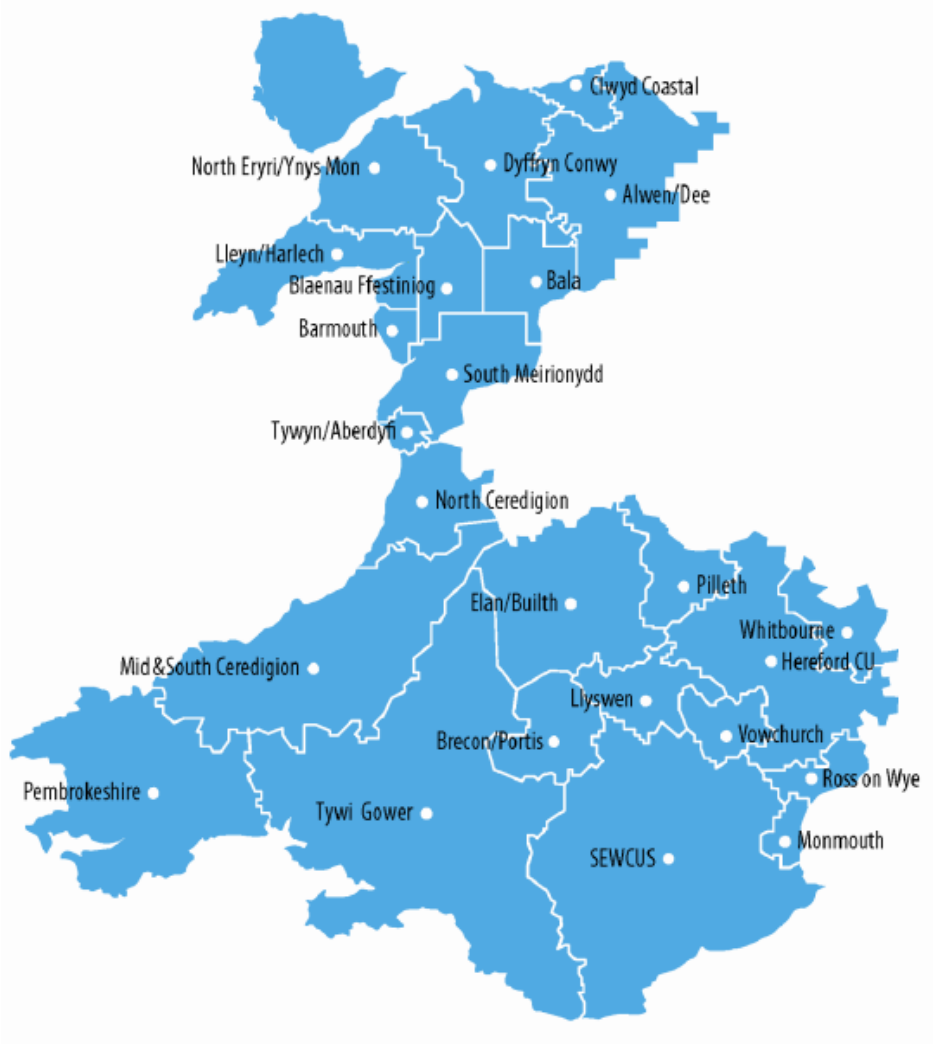
Section 11: Conclusions

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**).

Figure 2.1 Welsh Water Water Resource Zones

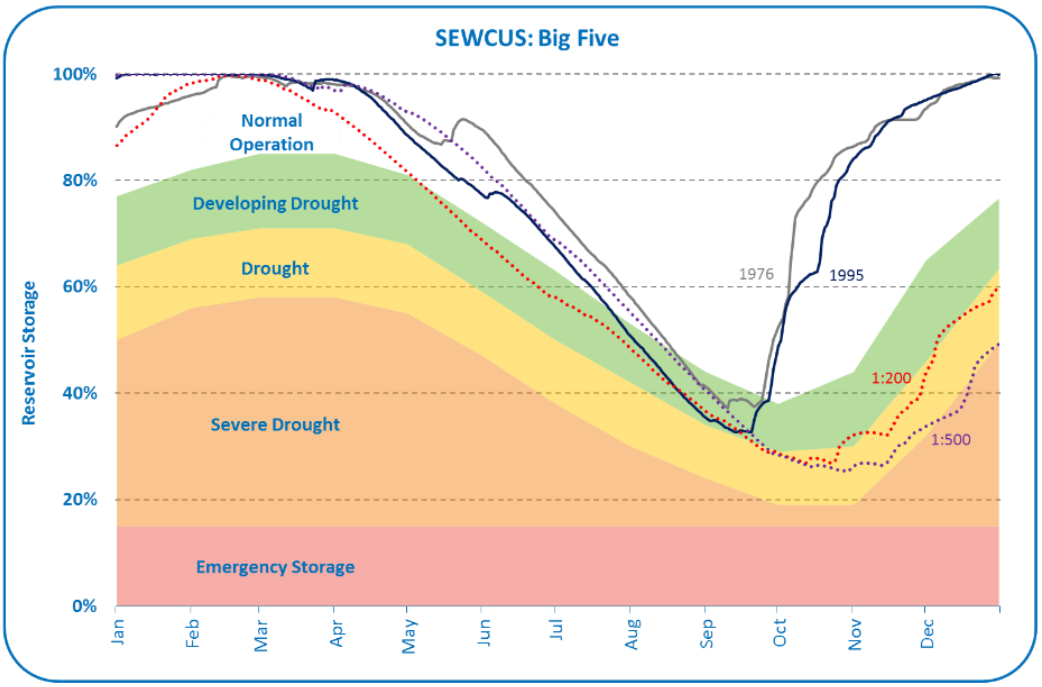


Talybont Reservoir is located in Welsh Water's SEWCUS - Talybont (8116) WRZ. The Talybont sub-zone is located to the north of the SEWCUS WRZ which supplies the south-east area of Wales.

The drought trigger for implementing a Drought Order at Talybont Reservoir is when storage in the Big 5 Reservoir group crosses into the Severe Drought Action Zone. 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 SEWCUS WRZ : The Big Five Drought Action Zones and Historic Droughts



2.2 DESCRIPTION OF EXISTING ARRANGEMENTS AT TALYBONT RESERVOIR

Welsh Water's licence (number: 20/56/41/0007) to abstract water under the Water Resources Act 1991 at Talybont Reservoir includes the following conditions:

- 26,550 million litres (Ml) authorised to be abstracted per annum (specified as 1 April to 31 March)
- Daily abstraction rate not exceeding 72.736Ml/d (million litres per day)
- Provision of a uniform statutory compensation flow discharge at all times (this is measured on the Nant Caerfanell downstream of the Nant Clydach confluence and includes flow from the Nant Clydach) as follows:
  - 25.0Ml/d during the period 1 November to 30 April
  - 18.2Ml/d during the period 1 May to 31 July
  - 13.6Ml/d during the period 1 August to 31 October.

The abstraction licences for the major reservoirs in the River Usk catchment contain a table defining the compensation flow release control line for Talybont Reservoir related to the total quantity of water stored in the "Big Five" reservoirs (Talybont, Usk,

Llandegfedd, Taf Fechan (Neuadd and Ponsticill) and Taf Fawr (Beacons, Cantref and Llwynon Reservoirs). If reservoir percentage storage for the Big Five reservoirs combined is lower than the compensation flow control line for Talybont Reservoir, then the normal compensation flow releases from Talybont Reservoir can be reduced by 50%.

A further licence condition allows for spate releases from Talybont Reservoir into the Nant Caerfanell of no more than 180Ml/d to be made in accordance with the River Usk Operating Manual.

The abstraction for potable supply is made directly from the reservoir and piped by gravity to Talybont water treatment works (WTW) for treatment before going into public supply.

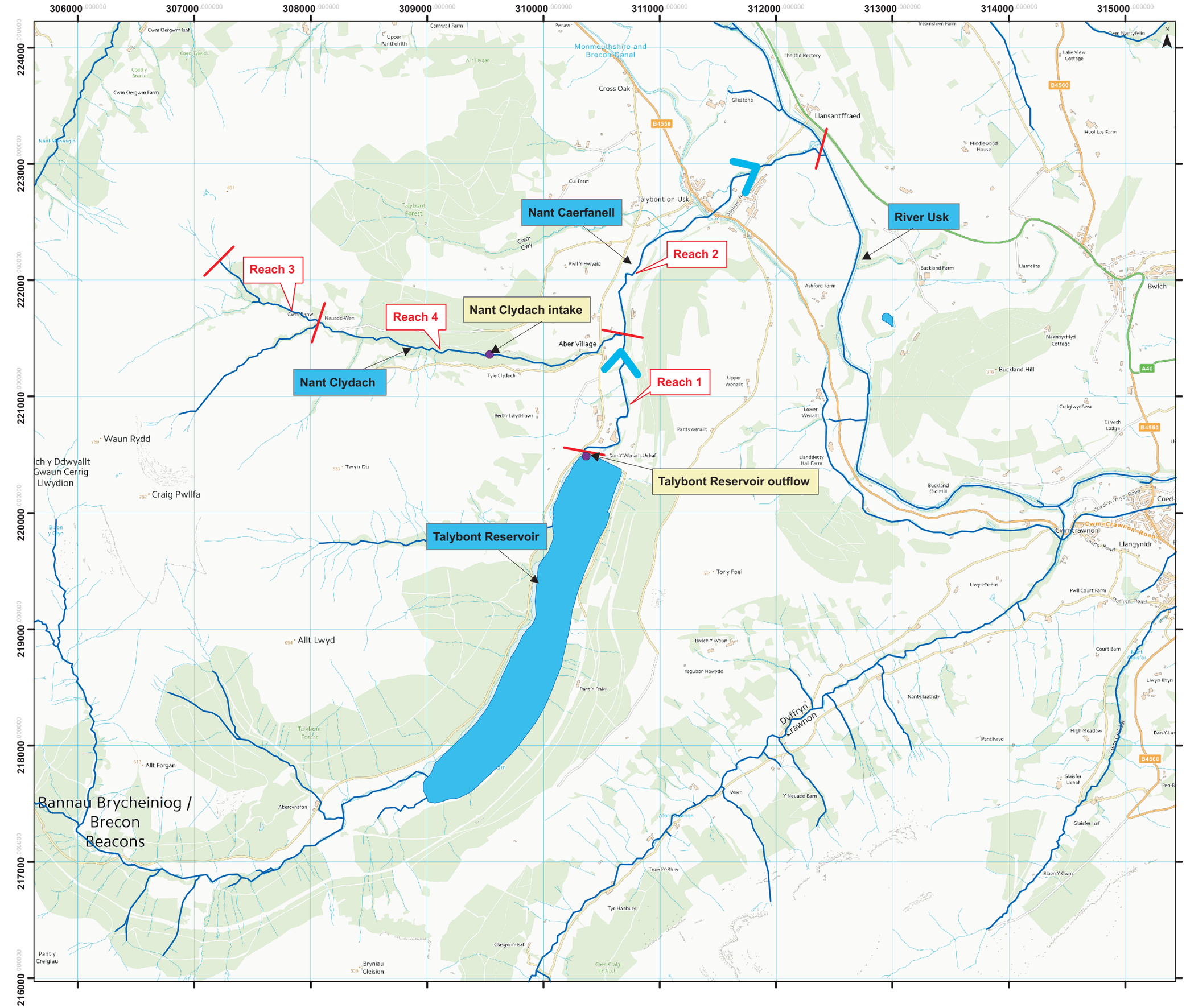
In addition to the main Talybont abstraction licence, there is a separate abstraction licence for a stream capture system which authorises the piping of additional stream flows into Talybont Reservoir from outside the reservoir's natural catchment area on the Nant Clydach.

Welsh Water's licence (number: 20/56/41/0012) to abstract water under the Water Resources Act 1991 at Nant Clydach includes the following conditions:

- 91Ml authorised to be abstracted per day
- No annual maximum abstraction limit
- No abstraction when flow in the Nant Clydach immediately downstream of the stream capture system is less than 1.82Ml/d
- Provision of a residual flow of 1.82Ml/d at such times when abstractions are being made.

The intake structure on the Nant Clydach enables the piping by gravity of stream water to Talybont Reservoir and also manages the residual flow release.

The study area is illustrated on **Figure 2.2**.



Legend

- Waterbody
- Water Courses
- Hydrological Reach
- Flow Direction
- Abstraction

RICARDO

Dŵr Cymru Welsh Water

1:30,000

Note: All locations are approximate

Project Title: Welsh Water Drought Plan Environmental Assessment

Figure Title: Study area: 8116-3 Utilise the Dead Storage in Talybont Reservoir

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 the 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 SEWCUS WRZ in the event of a future severe drought, Welsh Water may need to make an application to NRW for a drought order to vary the conditions of its abstraction licence from Talybont Reservoir.

It is assumed that a reduction of 50% in the statutory compensation flow release to the Nant Caerfanell (as permitted in the abstraction licence relating to the compensation flow control line) is already in place prior to this drought option being implemented.

If granted, the drought order involves pumped abstraction of 30Ml/d from the dead storage zone for up to 30 days. This drought option may be required in severe drawdown conditions when storage approaches the dead storage zone in Talybont Reservoir.

The proposed drought order conditions could be required at any time of the year, although inspection of historic reservoir storage records indicates that storage generally reaches its lowest levels during the early autumn period (September to October). Water resources modelling undertaken by Welsh Water indicates that this drought option is most likely to be implemented during the period September to December inclusive.

Table 2.1 Talybont Reservoir Existing and Proposed Drought Order Abstraction

Abstraction Water Source	NGR	Normal Abstraction	Proposed Drought Order Abstraction	Benefit Ml/d
Talybont Reservoir		Welsh Water's licence (number 20/56/41/0007/V004) to abstract water under the Water Resources Act 1991 at Talybont Reservoir includes the following conditions: • 26,550 million litres (Ml) authorised to be abstracted per annum (specified as 1 April to 31 March) • Daily abstraction rate not exceeding 72.736Ml/d • Provision of a uniform statutory compensation water discharge at all times (this is measured on the Nant Caerfanell downstream of the Nant Clydach confluence and includes flow from the Nant Clydach), at the following flows: • 25Ml/d during the period 1 November to 30 April • 18.2Ml/d during the period 1 May to 31 July • 13.6Ml/d during the period 1 August to 31 October.	If granted, the drought order involves pumped abstraction of 30Ml/d from the dead storage zone for up to 30 days.	30 Ml/d yield for up to 30 days

2.8 DROUGHT ORDER PROGRAMME

Drought orders 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 September to November, 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 the continuation of Welsh Water's existing abstraction and compensation arrangements at Talybont Reservoir, including 50% reductions to the variable rates of compensation flow releases when storage in the "Big 5" reservoir group is below the compensation flow release control line for Talybont Reservoir.

3 APPROACH

3.1 INTRODUCTION

The DPG states that the environmental report must include:

i. the 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 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, 4 and 5.

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.

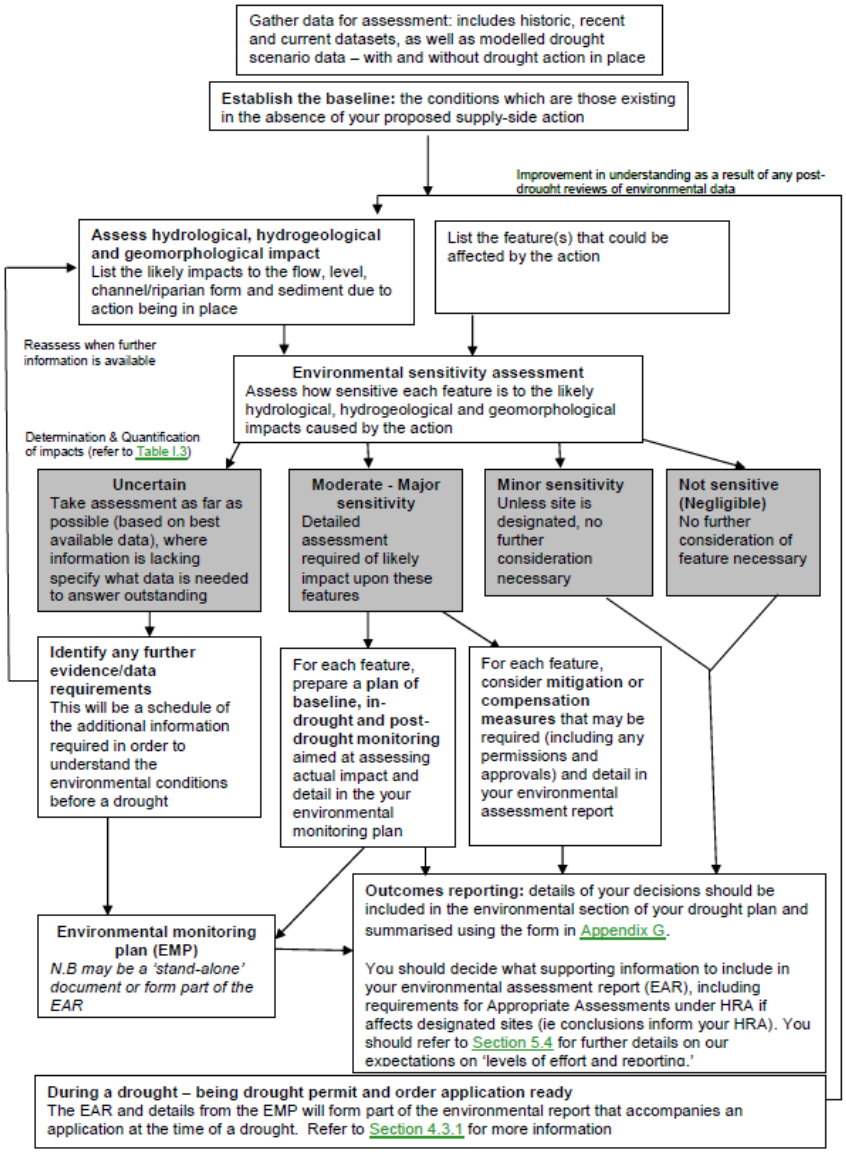
This is discussed further in Section 7.

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 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 order.
- **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 Talybont Reservoir.

Stage 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 Box 1 in 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 Talybont Reservoir 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. Four outcomes are possible 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 on a precautionary basis.

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 (2017) Water Company Drought Plan Technical Guideline (DPG)
- Welsh Ministers (2017) The Drought Plan (Wales) Direction
- Environment (Wales) Act 2016
- 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[3]
- 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

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

- The Convention on Wetlands of International Importance especially as Waterfowl Habitat , December 1975
- Conservation of Habitats and Species Regulations 2017
- 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**.

The impact assessment for sensitive features is feature specific and is dependent on the availability and resolution of available data. Where possible, quantitative assessments have been undertaken. However, for many features, it is acknowledged that the assessments are qualitative and based on professional judgement, and using, where relevant, experience of local knowledge and reference to literature. This introduces uncertainty into the impact assessment. A precautionary approach has been used to assigning impact significance where data are absent or found not to be robust.

The assessment of impacts on designated sites has been undertaken using professional judgement with reference to conservation objectives and condition status of habitats and species, for which a site has been designated. The ecological assessment has been undertaken recognising the IEMA[4,5] and the CIEEM study guidelines[6]. The assessment of impacts on other environmental receptors e.g. recreation and landscape has been carried out largely by qualitative expert judgement.

Assessment of impacts on specific features has then been undertaken. Specific assessment methodologies have been developed for key environmental features. These are set out in **Appendix C** (assessment methodologies for the ecological assessment of Environment (Wales) Act Section 7 species, designated sites and other flora and fauna).

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.

[4] IEMA (2004) Guidelines for Environmental Impact Assessment.
[5] IEMA (2011) Special Report – The State of Environmental Impact Assessment Practice in the UK
[6] CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland.

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 TALYBONT RESERVOIR 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 Talybont Reservoir 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 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 2.2**) is identified as the Talybont Reservoir and both the Nant Caerfanell and the Nant Clydach streams, comprising four distinct hydrological reaches.

- Reach 1 is the Nant Caerfanell, from the Talybont Reservoir outflow to the Nant Clydach confluence.
- Reach 2 is the Nant Caerfanell, from the Nant Clydach confluence to the River Usk confluence.
- Reach 3 is the Nant Clydach, from the headwaters to the Talybont stream capture system.
- Reach 4 is the Nant Clydach, from the Talybont stream capture system to the Nant Caerfanell confluence.

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:

- Change in river flows downstream of Talybont Reservoir.

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.

2. 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 autumn and winter period, considered to not extend outside the period September to November.

4.3 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

Issue	Identified Impact
Talybont Reservoir	
Water levels in Talybont Reservoir *Minor impacts during the period from September to December inclusive*	• Reduction of up to 24% in the minimum water level in Talybont Reservoir, and a 3% increase in the duration for which reservoir storage is below top water level.
Nant Caerfanell (Reach 1)	
Flows in the Nant Caerfanell *Minor impacts during the period from September to December inclusive*	• Up to 3% increase in the duration of reservoir drawdown period before overflows recommence (period of compensation flow only)
Nant Caerfanell (Reach 2)	
Flows in the Nant Caerfanell *Minor impacts during the period from September to December inclusive*	• Up to 3% increase in the duration of reservoir drawdown period before overflows recommence (period of compensation flow only)
Nant Clydach (Reach 3)	
Flows in the Nant Clydach headwaters *No hydrological impacts at any time of year*	• No hydrological impact
Nant Clydach (Reach 4)	
Flows in the Nant Clydach *No hydrological impacts at any time of year*	• No hydrological impact

4.3.1 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.

4.3.2 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 TALYBONT RESERVOIR DROUGHT ORDER ENVIRONMENTAL FEATURES ASSESSMENT

5.1 INTRODUCTION

As set out in **Box 1** above, 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. However, for completeness, and in compliance with the DPG, environmental sensitivity screening has been undertaken within the zone of hydrological influence.

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 permit. Susceptibility to the flow / level impacts resulting from the drought permit (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 Talybont Reservoir 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)
River Usk (Tributaries) SSSI	Minor	Designated due to the presence of a number of important notable species. Additionally, there are water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation.	Minor	Yes
River Usk SAC	Minor	Designated due to the presence of a number of important species at the European scale. Additionally, there are water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation.	Minor	Yes
Talybont Reservoir LNR	Minor	The site is an over-wintering site for wildfowl. Large numbers of tufted duck *(Aythya fuligula)*, pochard (*Aythya ferina*) and goosander *(Mergus merganser)* have been recorded in the area.	Minor	No
Notable Species – Fish Atlantic salmon *Salmo salar* Twaite shad *Alosa fallax* Allis shad *Alosa alosa* River lamprey *Lampetra fluviatilis* Brook lamprey *Lampetra planeri* Sea lamprey *Petromyzon marinus* Bullhead *Cottus gobio* Brown and sea trout *Salmo trutta*	Minor	A number of Habitats Directive and/or notable species are noted in the reach. Changes to velocity, depth, wetted width may restrict the access of migratory fish to spawning tributaries or to dry spawning gravels. Habitat availability will be significantly altered but only over the short term.	Minor	No
Brown trout *Salmo trutta*	Minor	Wild brown trout are known to be present within the Talybont Reservoir. An increase in the refill delay period of 13 days is unlikely to impact brown trout populations in the reservoir.	Minor	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 – Mammals Otter *Lutra lutra* Water vole *Arvicola terrestris* Daubenton's bat *Myotis daubentonii* Lesser horseshoe bat *Rhinolophus hipposideros*	Minor	These species have been recorded in the area. Otter (Habitats Directive designated species) are water-dependent, foraging in, over or adjacent to water for fish and aquatic invertebrates. However these 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. Water vole are associated with bankside tree cover, but are considered not to be detrimentally affected. Daubenton's bat and lesser horseshoe bat are known to be present and hunt flying insects associated with the River Usk however they are not expected to be impacted by implementation of the drought option against a baseline of reduced flows characteristic of drought.	Minor	No
Notable and Notable Species – Birds Grey heron *Ardea cinerea*, Common sandpiper *Actitis hypoleucos*, Grey wagtail *Motacilla cinerea*, Dipper *Cinclus cinclus*, Kingfisher *Alcedo atthis* and Goosander *Mergus merganser*	Minor	These bird species to varying extents rely on water dependent habitats. However, they are not expected to be severely impacted by implementation of the drought option against a baseline of reduced flows characteristic of drought.	Minor	No
SSSI & Notable Species – Crustacea White-clawed crayfish *Austropotamobius pallipes*	Minor	White-clawed crayfish (*Austropotamobius pallipes*) are known to be present in the Usk catchment and have been previously recorded in the Nant Caerfanell. The Environment (Wales) Act Section 7 states that the species is sensitive to habitat modification from the management of water bodies. Therefore, they are considered to be sensitive to hydrological impacts, particularly low flows.	Minor	No
Notable Species – Macrophytes *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	Minor	Reduction in flows and level as a result of the drought order could reduce the overall extent of habitat availability for freshwater macrophytes in the study area.	Minor	No
Benthic macroinvertebrate communities	Minor	Reduction in flows and level as a result of the drought order could reduce the overall extent of habitat availability for freshwater macrophytes in the study area.	Minor	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)
Invasive flora and fauna	Minor	Invasive plant species utilise flow of the watercourse for dispersal but are not reliant on it. Implementation of the drought order is unlikely to increase the risk of dispersal of invasive plant species. Two non-native macroinvertebrate species were recorded in Reach 2: a freshwater shrimp *Crangonyx* sp. and the New Zealand mud snail *Potamopyrgus antipodarum*.	Negligible	No
Landscape and visual amenity	Minor	The reach is located in the Brecon Beacons National Park, and within the Usk catchments. The area is predominantly rural, and sparsely populated, with agriculture as the dominant land use. Any reduction in flow and level may affect the landscape and visual amenity value of the site, although this will only be temporary and will be ameliorated once the drought has passed.	Negligible	No
Recreation	Minor	The River Usk and riparian land is used for a range of recreational activities including canoeing, fishing, walking, cycling, picnicking and bird watching. However, water levels will be naturally low in times of drought and impacts will be temporary in nature.	Negligible	No
Archaeology	Minor	Four ancient monuments – all prehistoric hillforts which are not water dependent.	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	**Caerfanell - source to confluence R Usk' (GB109056033000)**	
Hydrological Impact at Location (Major, Moderate, Minor, Negligible)	Minor	
Heavily Modified Waterbody (Y/N)	Yes	
RBMP Cycle	RBMP2 (2015)[7]	2018 C2 Interim[8]
Overall Biological	Moderate	Moderate
Fish	Moderate	Moderate
Macrophytes	High	High
Phytobenthos	High	High
Macro-invertebrates	Good	Good
Total P/ Phosphate	Good	High
Ammonia	High	High
Dissolved Oxygen	High	High
pH	High	High
Sensitivity (Uncertain, Moderate/ Major, Minor, Not sensitive)	Not Sensitive	
Further Consideration Required (Y/N)	No	

5.3 FEATURES ASSESSMENT

5.3.1 Basis of Features Assessment

This section describes and assesses the potential impacts on the sensitive features during the period of implementation of the drought order.

Based on the sensitive features identified in Section 5.2.1, the degree of impact has been assessed and analysed in Section 5.3. Desk-based assessments have been completed for each of the sensitive receptors, where applicable, in order to determine the magnitude of impact in the relevant reservoir / river reaches for the Talybont Reservoir drought order. Each feature assessment describes the analyses carried out and a statement of the assessed impact. All impacts are considered to be negative / adverse unless otherwise stated in the feature assessment. The approach is described in Section 3.3.

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

5.3.2 Summary of Features Assessment

Table 5.3 presents the overall summary of the significance of potential impacts of the drought order identified from the assessment of designated sites and other ecologically significant receptors and their relevant reaches. Full details of the features assessment are provided in **Appendix D**. A brief summary of the features assessment is also provided below in Sections 5.3.3 – 5.3.6.

Table 5.3 Summary of Impacts of Drought Order Implementation Pre-Mitigation

Month	J	F	M	A	M	J	J	A	S	O	N	D
Reach 1 – (Nant Caerfanell to confluence with Nant Clydach) Reach 2 (Nant Caerfanell from the Nant Clydach confluence to confluence with the River Usk) Reach 3 – (Nant Clydach upstream of Nant Clydach stream capture system) Reach 4 – (Nant Clydach from downstream of Nant Clydach stream capture system to confluence with Nant Caerfanell)												
River Usk (Tributaries) SSSI	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N	N	N	N
River Usk SAC	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N	N	N/A

Key to Environmental Effects:

N/A	Outside implementation period
N	Negligible impacts are considered likely
	Minor adverse impacts are considered likely
	Moderate adverse impacts are considered likely
	Major adverse impacts are considered likely
	Potential minor beneficial impacts are considered likely
	Potential moderate beneficial impacts are considered likely

5.3.3 Designated Sites

Table 5.4 presents a summary of the potential impacts of the drought order identified from the assessment of designated sites. The location of each of the designated sites discussed below is set out in **Figure 2.3**.

Table 5.4 Summary of Impacts on SAC and SSSI Designated Sites and Species

Feature	Impact	Significance of Impact
Reaches 1, 2, 3 and 4– Nant Caerfanell and Nant Clydach		
River Usk SAC Unit 7 River Usk (Tributaries) SSSI	No likely effects on SAC/SSSI features, including Atlantic salmon, bird and bat species, and associated flying insects, over and above those due to natural drought conditions.	**Negligible**

6 TALYBONT RESERVOIR DROUGHT ORDER - MITIGATION

The environmental assessment has not identified any features which are anticipated to be impacted by the drought order implementation. 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 NRW Review of Consents reports;
- Assessment of cumulative impacts of the drought order with other Welsh Water supply-side and drought order 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 2025).
    - Drought supply-side and drought order / permit options from 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

The assessment of hydrological impacts presented in **Appendix B**, and summarised in Section 4, has considered how the proposed drought order may affect the environment in combination with the effects of existing licences and consents. Therefore no relevant licences or consents have been identified as relevant for assessment of cumulative effects.

Other relevant Welsh Water drought permit / orders

No cumulative effects of implementing the Talybont drought order with drought order / permit schemes have been identified. However, this should be reviewed at the time

of any future application for a drought order at Talybont Reservoir.

Welsh Water WRMP schemes

No WRMP schemes identified with cumulative impacts.

NRW Drought Plans

No cumulative impacts of options in NRW Drought Plan with a drought order Talybont are anticipated. 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.

Environmental Monitoring

Recommendations for environmental monitoring before, during and after drought order implementation have been made in the EMP which is presented in Section 10 of this EAR. The EMP has been developed in consultation with NRW.

It is assumed that all monitoring activities will be undertaken with the best interests of the site in mind, and in discussion and agreement with NRW. Where activities which require in-river working are proposed, a method statement for the survey will be prepared and agreed with NRW in advance of the survey.

Assuming rigorous implementation of the method statements, there will be no adverse impacts of the monitoring on hydrology, water quality or ecology, and no adverse impacts of environmental monitoring on the site are anticipated.

8 TALYBONT RESERVOIR 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 impacts associated with the drought order has been assessed as negligible (see Sections 4 and 5).

9 HABITATS REGULATIONS ASSESSMENT: STAGE 1 SCREENING

9.1 INTRODUCTION

Under Regulation 63 of the Habitats Regulations, the competent authority (in the case of a drought order in Wales this would be Welsh Ministers, advised by NRW) is required to undertake an Appropriate Assessment of any plan / project which is likely to have a significant effect on a European site, to determine the implications for the site in view of the site's conservation objectives. The Regulations state that a person applying for any such consent (in this case Welsh Water), must provide such information as the competent authority (Welsh Ministers, advised by NRW) may reasonably require for the purposes of the assessment or to enable them to determine whether an appropriate assessment is required.

9.1.1 HRA Stages

Stage 1 – Screening

The first stage in the Habitats Regulations Assessment (HRA) is screening to determine the potential of the drought order to have a likely significant effect (LSE) on any European site (either alone or in-combination with other plans and projects) and thus if a full 'Appropriate Assessment' of any of the drought order would be required.

An in-combination assessment is carried out to establish the possibility of cumulative or synergistic impacts.

The screening stage identifies if the drought order is likely to have significant effects on European designated site, and requires Appropriate Assessment.

Stage 2 – Appropriate Assessment

Drought orders that are identified during HRA Screening (Stage 1) as being likely to have a significant effect (either alone or in combination) will be taken forward to Appropriate Assessment. The Appropriate Assessment will consider the impacts of the drought order, against the conservation objectives of a European Site, in order to identify whether there are likely to be any adverse effects on site integrity and site features. The assessment will conclude whether or not the drought order, either alone or in combination with other plans and projects, would adversely affect the integrity of the European site in question. This is judged in terms of the implications of the plan for a site's conservation objectives, which relate to its 'qualifying features' (i.e. those Annex I habitats, Annex II species, and Annex I bird populations for which it has been designated). The responsibility for undertaking the Appropriate Assessment lies with the (Welsh Ministers, advised by NRW).

Stage 3 – Alternative Options Stage

Where significant adverse effects are identified at the Appropriate Assessment stage, alternative options would be examined to avoid any potential damaging effects to the integrity of the European site.

Stage 4 – Assessment where adverse impacts remain

Stage 4 comprises an assessment of compensatory measures where, in the light of an assessment of Imperative Reasons of Overriding Public Interest, it is deemed that the project or plan should proceed. Imperative Reasons of Overriding Public Interest will only be progressed if no alternatives are identified as part of Stage 3.

9.2 STAGE 1 SCREENING OF TALYBONT RESERVOIR DROUGHT ORDER

The objective of this section is to bring together all relevant information to enable a HRA to be undertaken of the impacts of the Talybont Reservoir drought order on relevant European designated sites.

These assessments have been completed in accordance with the DPG (see Section 3.3).

This section considers each of the River Usk SAC designated features and discusses the potential for the drought order at Talybont Reservoir to influence their status. For species, impacts on populations, range and supporting habitats and species have been considered.

9.2.1 Potential Impacts on River Usk SAC Qualifying Features

In carrying out the screening process, the assessment has considered the main possible sources of effects on the sites arising from the potential drought order, possible pathways to the designated sites and the effects on possible sensitive receptors in the sites. Only if there is an identifiable pathway between the impacted reaches and the designated sites, or individual receptors, is there likely to be an impact and where this is absent those sites have been screened out. The screening assessment has also considered the River Usk SAC conservation objectives. The development of conservation objectives is required by the 1992 'Habitats' Directive (92/43/EEC). In accordance with the Habitats Directive, the objectives aim to achieve the 'favourable conservation status' of habitats and species features for which SAC is designated (see **Figure 9.1**).

Site-specific conservation objectives provide a description of what is considered to be the favourable conservation status of the feature within the whole plan area. Conservation objectives for the site have been prepared by NRW.

Figure 9.1 Favourable conservation status as defined in Articles 1(e) and 1(i) of the Habitats Directive

"The conservation status of a natural habitat is the sum of the influences acting on it and its typical species that may affect its long-term natural distribution, structure and functions as well as the long term survival of its typical species. The conservation status of a natural habitat will be taken as favourable when:

- *Its natural range and areas it covers within that range are stable or increasing, and*
- *The specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and*
- *The conservation status of its typical species is favourable.*

The conservation status of a species is the sum of the influences acting on the species that may affect the long-term distribution and abundance of its populations. The conservation status will be taken as 'favourable' when:

- *Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and*
- *The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and*
- *There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis."*

In addition to the conservation objectives, the Core Management Plan has been used to determine LSEs against each of the specific attributes and targets for each of the qualifying features. A summary of the overall screening conclusion for each feature is provided below, with **Table 9.1** providing the assessment against each attribute and target.

Allis and Twaite Shad

There are no records of Allis *Alosa alosa* or Twaite *Alosa fallax* Shad within or near to the hydrological zone of impact because of barriers to upstream river migration (e.g. Crickhowell Bridge) further down the main River Usk. As a result, these species are screened out from further consideration in this assessment with no likely significant effects.

Brook, River and Sea Lamprey

The available evidence in the Core Management Plan for the SAC states that in Management Unit 7 (the Unit impacted by the drought order), brook lamprey *Lampetra planeri* and river lamprey *Lampetra fluviatilis* are present, but there is no evidence of sea Lamprey *Petromyzon marinus* being present in the impacted reaches.

The hydrological assessment has identified that there is no reduction to the magnitude of flow rates in Reaches 1-4 as a result of this drought order. However, as a result of the increased pumping from Talybont Reservoir's dead storage zone, there is estimated to be a 3% increase (13 days) in the duration of the period for which storage is below top water level, and for which reservoir outflow is limited to compensation only. This also leads to a delay of 13 days in the first occurrence of reservoir overflows following refill, which increase the flows in Reaches 1 and 2. No impacts on flow magnitude have been identified. Implementation of a drought permit will not result in any changes to minimum wetted widths or depths of the Nant Caerfanell or Nant Clydach No impacts have been identified on Reaches 3 and 4.

In addition, NRW / Environment Agency Review of Consents Stage 3 concluded the existing licensed compensation flow is not limiting to SAC species, including lamprey. As a result, these species are screened out from further consideration in this assessment with no likely significant effects.

Bullhead

Bullhead are likely to be present throughout the hydrological zone of influence. The species is flow sensitive and spawning and egg incubation takes place from March to May. Particularly susceptible juvenile lifestages are therefore likely to be affected by reduced flows (and likely reduced water quality) associated with implementation of a drought order. The major reductions in flow in all reaches are likely to have a significant impact on bullhead.

The hydrological assessment has identified that there is no reduction to the magnitude of flow rates in Reaches 1-4 as a result of this drought order. However, as a result of the increased pumping from Talybont Reservoir's dead storage zone, there is estimated to be a 3% increase (13 days) in the duration of the period for which storage is below top water level, and for which reservoir outflow is limited to compensation only. This also leads to a delay of 13 days in the first occurrence of reservoir overflows following refill, which increase the flows in Reaches 1 and 2. No impacts on flow magnitude have been identified. Implementation of a drought permit will not result in any changes to minimum wetted widths or depths of the Nant Caerfanell or Nant Clydach No impacts have been identified on Reaches 3 and 4.

In addition, NRW / Environment Agency Review of Consents Stage 3 concluded the existing licensed compensation flow is not limiting to SAC species, including bullhead. As a result, these species are screened out from further consideration in this assessment with no likely significant effects.

Atlantic Salmon

The River Usk is an important migratory corridor for Atlantic salmon with two main

upstream migratory runs of adult salmon. The River Usk has a modest spring run (April to June) of often very large Atlantic salmon; however, the majority of upstream migrating Atlantic salmon are likely to enter the river during the summer and autumn (to November) and there is the potential for drought order-related impacts on flow to effect the timing of this migration.

However, the hydrological assessment has identified that there is no reduction to the magnitude of flow rates in Reaches 1-4 as a result of this drought order. However, as a result of the increased pumping from Talybont Reservoir's dead storage zone, there is estimated to be a 3% increase (13 days) in the duration of the period for which storage is below top water level, and for which reservoir outflow is limited to compensation only. This also leads to a delay of 13 days in the first occurrence of reservoir overflows following refill, which increase the flows in Reaches 1 and 2. No impacts on flow magnitude have been identified. Implementation of a drought permit will not result in any changes to minimum wetted widths or depths of the Nant Caerfanell or Nant Clydach No impacts have been identified on Reaches 3 and 4.

In addition, NRW / Environment Agency Review of Consents Stage 3 concluded the existing licensed compensation flow is not limiting to SAC species, including salmon. As a result, these species are screened out from further consideration in this assessment with no likely significant effects.

Otter

The assessment has identified the potential for impacts on otter as a result of a reduction in the flow velocity, wetted width and depth of the river.

However, there are not anticipated to be any changes to habitat or prey availability for otter as a result of drought order implementation and the drought order is not anticipated to result in likely significant effects on otter populations. Consequently, this species is screened out of the assessment with no likely significant effects. .

Water Courses of Plain to Montane Levels with the Ranunculion fluitantis and Callitricho-Batrachion Vegetation

This feature is not identified as one of the primary reasons for designation of the River Usk SAC and the Core Management Plan indicates that it is not present within Management Unit 7 which includes the river reaches impacted by the drought order. Consequently, this feature is screened out of the assessment with no likely significant effects.

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Table 9.1 Summary of Impacts of Talybont Reservoir Drought Order Implementation Against Conservation Objectives for the River Usk SAC

Feature	Attribute (taken directly from NRW Conservation Objectives document)	Site Specific Target range and Measures	Impact of Drought Order	LSE?
River Usk SAC				
Brook Lamprey	Age/size structure of ammocoete population	Samples < 50 ammocoetes ~ 2 size classes Samples > 50 ammocoetes ~ at least 3 size classes	No risk to achievement of conservation objective.	No
	Distribution of ammocoetes within catchment	Present at not less than 2/3 of sites surveyed within natural range No reduction in distribution of ammocoetes	No risk to achievement of conservation objective.	No
	Ammocoete density	Optimal habitat: >10m^{-2} Overall catchment mean: >5m^{-2}	No risk to achievement of conservation objective.	No
River Lamprey	Age/size structure of ammocoete population	Samples < 50 ammocoetes ~ 2 size classes Samples > 50 ammocoetes ~ at least 3 size classes	No risk to achievement of conservation objective.	No
	Distribution of ammocoetes within catchment	Present at not less than 2/3 of sites surveyed within natural range No reduction in distribution of ammocoetes	No risk to achievement of conservation objective.	No
	Ammocoete density	Optimal habitat: >10m^{-2} Overall catchment mean: >5m^{-2}	No risk to achievement of conservation objective.	No
Atlantic Salmon	Adult run size	Conservation Limit complied with at least four years in five As there is no fish counter in the Usk, adult run size is calculated using rod catch data.	No risk to achievement of conservation objective.	No
	Juvenile densities	Expected densities for each sample site using HABSCORE	No risk to achievement of conservation objective.	No
	Water quality – biological	Biological GQA class A	No risk to achievement of conservation objective.	No
	Water quality – chemical	RE1	No risk to achievement of conservation objective.	No
	Hydromorphology – flow	Targets are set in relation to river/reach type(s)	No risk to achievement of conservation objective.	No
Bullhead	Adult densities	No less than 0.2 m^{-2} in sampled reaches	No risk to achievement of conservation objective.	No
	Distribution	Bullheads should be present in all suitable reaches. As a minimum, no decline in distribution from current	No risk to achievement of conservation objective.	No
	Reproduction/ age structure	Young-of-year fish should occur at densities at least equal to adults	No risk to achievement of conservation objective.	No

9.2.2 Summary

In summary, it can be concluded that implementation of a drought order would not result in likely significant effects on the otter; bullhead; river lamprey; brook lamprey; Atlantic salmon populations within the River Usk SAC.

9.2.3 Cumulative and In-combination Impacts

The Habitats Directive requires a consideration in the assessment of '*any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plan or projects*'.

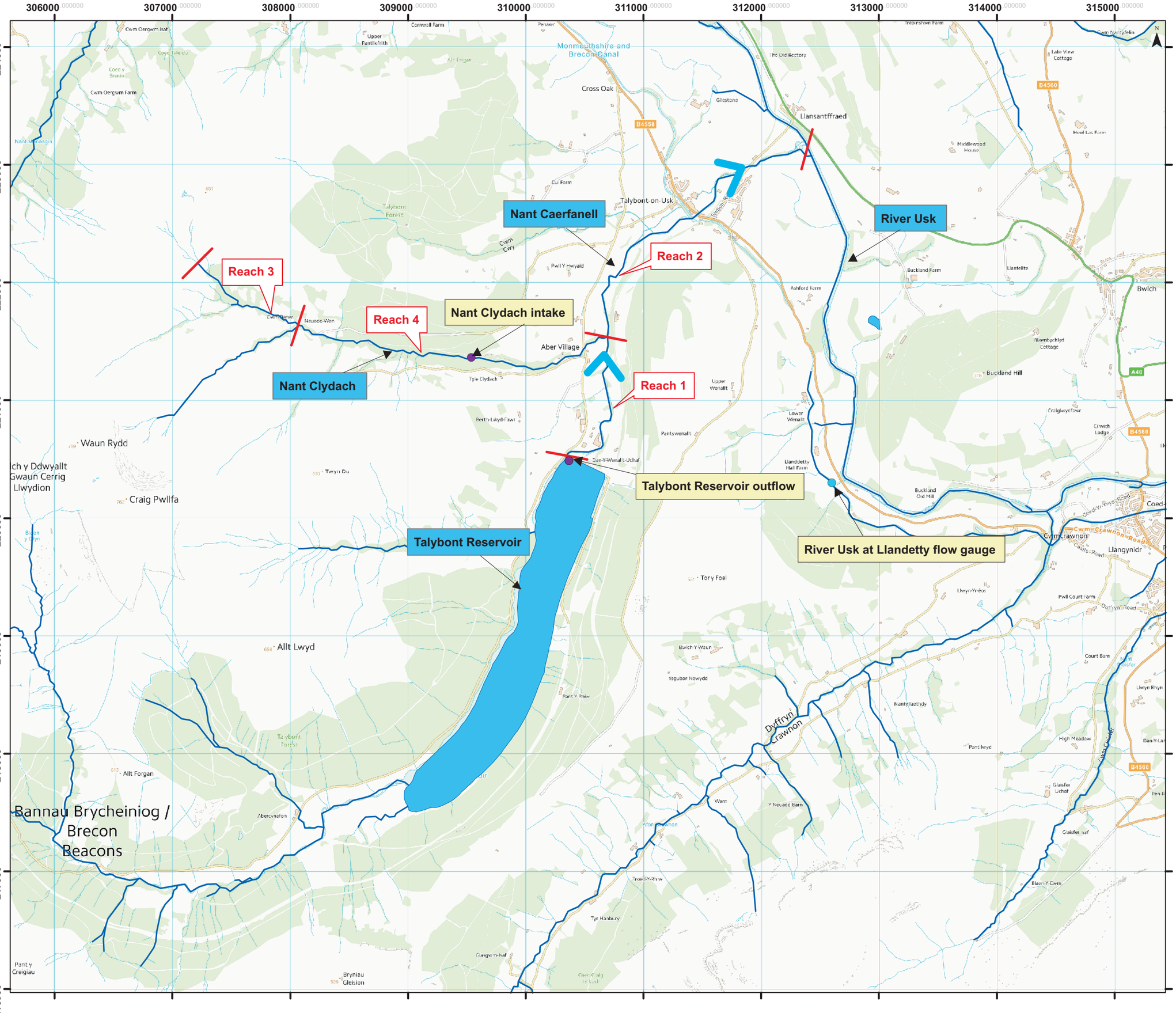
Consideration of potential plans or projects with cumulative effects is presented in Section 7.

10 ENVIRONMENTAL MONITORING PLAN (EMP)

The environmental assessment has not identified any features which are anticipated to be impacted by the drought order implementation. 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 order, 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 Talybont Reservoir storage volumes
- Daily abstraction volumes from Talybont Reservoir
- Daily mean flow in the Nant Caerfanell downstream of Talybont Reservoir and the Nant Clydach confluence
- Daily mean residual flows in the Nant Clydach downstream of the intake: 2003 to date.
- NRW Llandetty gauging station on the River Usk; daily river flow.



Legend

- Abstraction
- Flow gauge
- Hydrological Reach
- Water Courses
- Flow Direction
- Reservoir

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: 8116-3 Utilise the Dead Storage in Talybont Reservoir

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 Talybont drought order. If granted and implemented, the drought order would enable Welsh Water to utilise the dead storage in Talybont Reservoir..

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 as **minor** impacts on the Nant Caerfanell, relating to an extension of the period the river is at compensation flow.

The DPG states that environmental assessment is not required for features where screening has identified a minor (if there are no designated environmental sites) or negligible impact. Screening identified the River Usk and River Usk (Tributaries) SSSI as features for which environmental assessment is required.

The assessment has concluded that there are **negligible** impacts on the River Usk and River Usk (Tributaries) SSSI.

The HRA Screening concluded that implementation of a drought order would not result in likely significant effects on the otter; bullhead; river lamprey; brook lamprey; Atlantic salmon populations within the River Usk SAC.

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 permit, 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 with existing licences, consents and plans are currently anticipated. However, this should be reviewed at the time of any future application for a drought permit at the Talybont Reservoir.

In summary, it has been concluded that the environmental effects on river flows, water quality and ecology of implementing the Talybont drought permit, 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.**

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 - 8116-3 HYDROLOGY AND PHYSICAL ENVIRONMENT ASSESSMENT

B1 INTRODUCTION

This appendix assesses the potential impacts on the physical environment of the Talybont Reservoir and the downstream Nant Caerfanell and River Usk catchments 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 at Talybont Reservoir, including 50% reductions to the variable rates of compensation flow releases when storage in the "Big 5" reservoir group is below the compensation flow release control line for Talybont Reservoir. This drought option involves further abstraction of 30Ml/d from the dead storage zone of Talybont Reservoir for a period of up to 30 days.

B.1.1 Welsh Water's Existing Operations

Welsh Water's licence (number: 20/56/41/0007) to abstract water under the Water Resources Act 1991 at Talybont Reservoir (see **Figure B1.1**) includes the following conditions:

- 26,550 million litres (Ml) authorised to be abstracted per annum (specified as 1 April to 31 March)
- Daily abstraction rate not exceeding 72.736Ml/d (million litres per day)
- Provision of a uniform statutory compensation flow discharge at all times (this is measured on the Nant Caerfanell downstream of the Nant Clydach confluence and includes flow from the Nant Clydach) as follows:
  - 25.0Ml/d during the period 1 November to 30 April
  - 18.2Ml/d during the period 1 May to 31 July
  - 13.6Ml/d during the period 1 August to 31 October.

The abstraction licences for the major reservoirs in the River Usk catchment contain a table defining the compensation flow release control line for Talybont Reservoir related to the total quantity of water stored in the "Big Five" reservoirs (Talybont, Usk, Llandegfedd, Taf Fechan (Neuadd and Ponsticill) and Taf Fawr (Beacons, Cantref and Llwynon Reservoirs). If reservoir percentage storage for the Big Five reservoirs combined is lower than the compensation flow control line for Talybont Reservoir, then the normal compensation flow releases from Talybont Reservoir can be reduced by 50%.

A further licence condition allows for spate releases from Talybont Reservoir into the Nant Caerfanell of no more than 180Ml/d to be made in accordance with the River Usk Operating Manual.

The abstraction for potable supply is made directly from the reservoir and piped by gravity to Talybont water treatment works (WTW) for treatment before going into public supply.

In addition to the main Talybont abstraction licence, there is a separate abstraction licence for a stream capture system which authorises the piping of additional stream flows into Talybont Reservoir from outside the reservoir's natural catchment area on the Nant Clydach (see **Figure B1.1**).

Welsh Water's licence (number: 20/56/41/0012) to abstract water under the Water Resources Act 1991 at Nant Clydach includes the following conditions:

- 91Ml authorised to be abstracted per day
- No annual maximum abstraction limit
- No abstraction when flow in the Nant Clydach immediately downstream of the stream capture system is less than 1.82Ml/d
- Provision of a residual flow of 1.82Ml/d at such times when abstractions are being made.

The intake structure on the Nant Clydach enables the piping by gravity of stream water to Talybont Reservoir and also manages the residual flow release.

Overflows and compensation flow releases from Talybont Reservoir discharge into the Nant Caerfanell, a tributary of the River Usk. The Nant Caerfanell and River Usk are designated as part of the River Usk Special Area of Conservation (SAC).

B.1.2 Welsh Water's Proposed Drought Order Operations

It is assumed that a reduction of 50% in the statutory compensation flow release to the Nant Caerfanell (as permitted in the abstraction licence relating to the compensation flow control line) is already in place prior to this drought option being implemented.

This drought option may be required in severe drawdown conditions when storage approaches the dead storage zone in Talybont Reservoir, and involves pumped abstraction of 30Ml/d from the dead storage zone for up to 30 days.

The proposed drought order conditions could be required at any time of the year, although inspection of historic reservoir storage records indicates that storage generally reaches its lowest levels during the early autumn period (September to October). Water resources modelling undertaken by Welsh Water indicates that this drought option is most likely to be implemented during the period September to December inclusive.

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

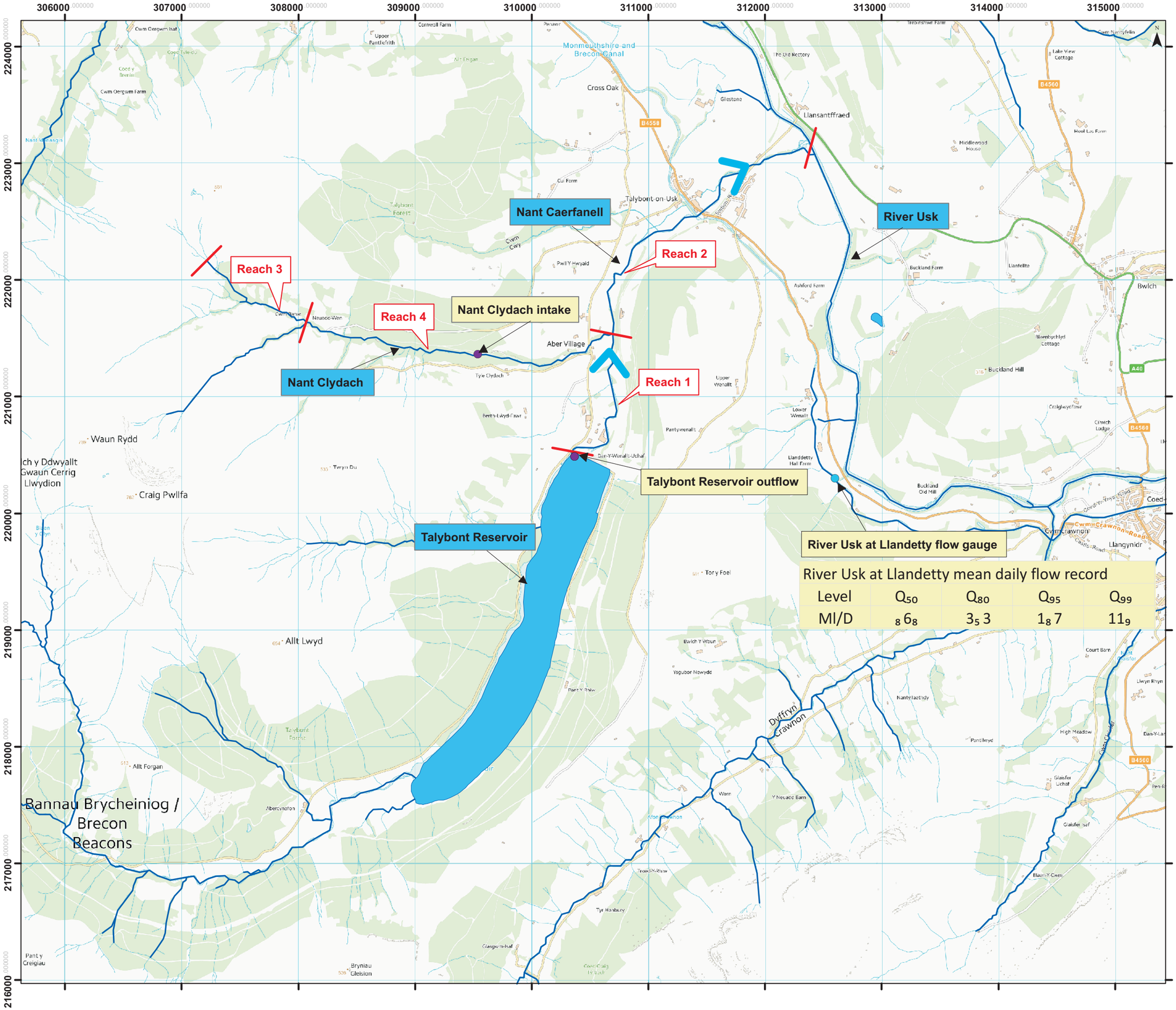
action being in place" as required by the DPG[1] and set out in Figure 2 of the DPG.

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.

This appendix is set out in the following sections:

Section B.2 Hydrological Impact
Section B.3 Physical Environment Assessment
Section B.4 Physical Environment Impact Summary
Section B.5 Cumulative Impacts.

[1] 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.



River Usk at Llandetty mean daily flow record

Level	Q_{50}	Q_{80}	Q_{95}	Q_{99}
Ml/D	$_{8}6_{8}$	$3_{5}3$	$1_{8}7$	11_{9}

Legend

- Abstraction
- Flow gauge
- Hydrological Reach
- Water Courses
- Flow Direction
- Reservoir

RICARDO

Dŵr Cymru Welsh Water

1:30,000

Note: All locations are approximate

Project Title: Welsh Water Drought Plan Environmental Assessment

Figure Title: Hydrological Overview: 8116-3 Utilise the Dead Storage in Talybont Reservoir

Figure Number: Figure B1.1

Date: February 2019

B2 HYDROLOGICAL IMPACT

B.2.1 Reference Conditions

B.2.1.1 Catchment Overview

Talybont impounding reservoir is located in the Brecon Beacons National Park in mid Wales, in the headwaters of the Nant Caerfanell stream which is a tributary of the River Usk. The River Usk is one of the largest rivers in Wales, being over 120km long from its source on the northern slopes of the Black Mountain to its confluence with the Severn Estuary below Newport.

Talybont Reservoir was completed in 1939. The impoundment holds back a maximum usable storage of 10,340Ml, with a surface area of 129ha (at top water level) at an altitude of around 190m. The live or usable storage zone extends to a depth of around 12m below top water level. An additional dead storage of around 1000Ml is believed to be available, to a depth of around 26m below top water level. The 11.2km^2 catchment, draining naturally to the reservoir, experiences high rainfall and is characterised by upland moors and unimproved grassland with large areas of conifer plantations. The stream capture system on the Nant Clydach increases the catchment area draining into the reservoir by 4.1km^2.

The compensation flow release from Talybont Reservoir sustains flow in the Nant Caerfanell. This provides a substantial proportion of the flow in the downstream river during low flow periods. Implementation of this drought order, when considered in isolation from any other drought permits or orders in the River Usk catchment, is likely to have no significant impact on river flows in the main River Usk.

The residual flow required to be maintained downstream of the Nant Clydach stream capture system makes up a substantial proportion of the flow in that stream during low flow periods.

A review of the flows and physical habitat characteristics of the river network downstream of Talybont Reservoir and the Nant Clydach stream capture system has identified the study area for this assessment (see **Figure B1.1**). The study area includes Talybont Reservoir itself, a length of the Nant Caerfanell comprising two distinct hydrological reaches, as well as a length of the Nant Clydach and its headwaters comprising two further distinct hydrological reaches. The four hydrological reaches are listed in **Table B2.10** and identified on **Figure B1.1**.

The potential hydrological impact of the drought order has been reviewed for Talybont Reservoir and for each of the four hydrological reaches, as discussed in Section B.2.2.

B.2.1.2 Baseline Data Availability

Continuous monitoring is undertaken by Welsh Water to monitor its operations at Talybont Reservoir, including:

- Weekly Talybont Reservoir storage volumes: data for 1976, 1984 and from 1989 to 2010
- Daily Talybont Reservoir storage volumes: 2010 to date
- Daily abstraction volumes from Talybont Reservoir: 2005 to date
- Daily abstraction volumes from the Nant Clydach stream intake: 1993 - 2007.

The monitoring of compensation flow releases and the overflow (spill) of excess water from Talybont Reservoir is undertaken by Welsh Water at a flow gauge on the Nant Caerfanell downstream of the Talybont dam and which is also located downstream of the Nant Clydach stream capture system and its confluence with the Nant Caerfanell:

- Daily mean flow in the Nant Caerfanell downstream of Talybont Reservoir and the Nant Clydach confluence: 1979 to 1989; 2001 to date

Residual flows downstream of the Nant Clydach stream capture intake are also monitored:

- Daily mean residual flows in the Nant Clydach downstream of the intake: 2003 to date.

A number of spot river flow gauging values are also available for several locations in the Nant Clydach and Nant Caerfanell as presented in Section B2.2.

Continuous monitoring of river level is undertaken by Natural Resources Wales (NRW) at the Llandetty gauging station on the middle River Usk and the data are also available as river flow, although there is a period of missing flow data in the 1980s:

- NRW Llandetty gauging station on the River Usk; daily river flow from 1965 to 2018 (some periods missing, in particular 1982 – 1985).

In addition to the gauged flow records listed above, a number of relevant flow data series for the River Usk catchment used in the recently developed (2013 onwards) Wye and Usk water resource spreadsheet model (developed by the Wye and Usk Foundation in consultation with NRW, Welsh Water and Canal & River Trust) have been utilised as a comparison. These flow data series have been calculated or derived from existing gauged records, adjusted as appropriate for known abstractions and discharges, and / or by factoring existing flow data series from adjacent or nearby sub-catchments. A summary of the relevant flow records considered in this assessment is included in the following sections.

The reference conditions for the Talybont Reservoir, Nant Clydach and Nant Caerfanell streams and middle River Usk catchment are summarised below.

B.2.1.3 Hydrology

Talybont Reservoir

Actual water storage in Talybont Reservoir ranges from 946Ml (around 9% of live capacity) to 10,340Ml (full) over the period 1976 – 2018. Generally, during most dry summer periods,

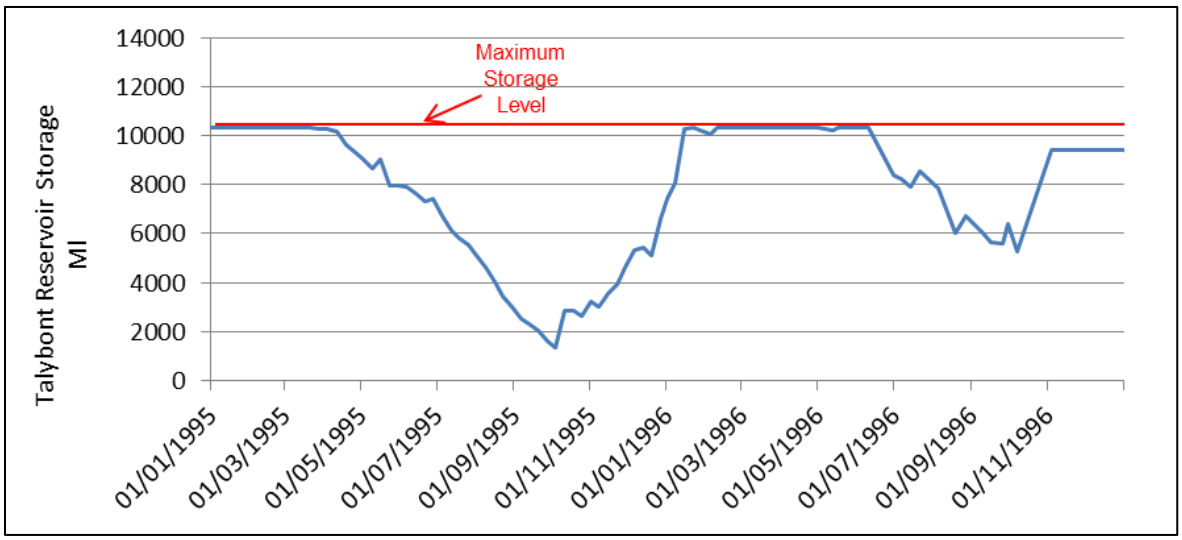
reservoir storage falls to around 45% to 75% of live capacity, but in the more severe drought periods of 1976, 1984, 1989-1990, 1995-1996 and 2003, storage drops significantly lower, to around 10% to 25% of live capacity. In the dry summer of 2018 storage dropped to around 43% of live capacity. The lowest storage of 946Ml occurred in September 1976. **Figure B2.1** illustrates the pattern of reservoir storage over a 2-year drought period from 1995 to 1996.

There is an additional 1000Ml (approximately) of dead storage but this has not been utilised within the period for which reservoir level / storage records are available.

A bathymetry survey of Talybont Reservoir was carried out in 2013 by APEM; information from this survey has been used to relate storage volume, water level and surface area data in the dead storage zone. This was used in the hydrological assessment to estimate the impact on water levels and areas of exposed shoreline, of pumped abstraction from the dead storage zone.

Talybont Reservoir is one of Welsh Water's "Big 5" reservoirs in the Usk catchment, along with Llandegfedd, Usk, Taf Fawr and Taf Fechan reservoirs. The combined storage in the "Big 5" reservoir group is monitored against a group reservoir drought control line to determine when drought measures need to be implemented in Welsh Water's South East Wales Conjunctive Use System (SEWCUS) Water Resources Zone.

Figure B2.1 Talybont Reservoir Storage, 1995 – 1996



Nant Caerfanell downstream of Talybont Reservoir

River flow is measured in the Nant Caerfanell stream downstream of the Talybont Reservoir impoundment at grid reference SO107216; the gauges measures reservoir overflows as well as the statutory compensation release from the reservoir and also the residual flow from the Nant Clydach tributary stream. However, it is noted that between 2001 and 2015, recorded flows were always below 100Ml/d, whereas before 1989 and in 2015 flows were recorded considerably above this level; it is understood that the gauge rating was limited to 100Ml/d during the period 2001 to 2015.

A summary of the available daily flow data from 1979 to 1989 is given in **Table B2.1** below.

Table B2.1 Summary of Recorded Mean Daily Flow in Nant Caerfanell downstream of Talybont Reservoir (1979 – 1989)

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	941.8	664.4	1321.9	406.1	285.1	191.8	118.4	419.0	150.3	267.0	1045.4	1710.7	1710.7
10% (high flow)	278.3	193.9	288.0	152.2	118.1	51.8	32.7	60.9	96.2	105.4	226.8	301.5	169.3
50%	75.0	43.6	43.2	35.5	31.5	31.1	19.4	17.6	17.1	36.0	43.2	86.1	34.8
80%	36.8	34.6	33.5	32.5	25.5	18.7	16.0	12.4	10.5	15.6	34.3	36.7	20.0
90%	31.1	25.3	32.2	29.4	19.9	16.2	13.0	10.0	7.7	10.9	31.8	31.4	15.7
95% (low flow)	27.6	20.3	30.6	27.0	18.0	14.9	4.8	4.0	4.2	6.4	28.2	29.9	11.1
99% (extreme low flow)	25.4	19.3	26.3	21.7	17.7	8.7	4.0	3.7	3.9	4.7	26.3	25.7	4.1
Minimum flow	22.9	18.5	18.9	21.4	17.7	8.1	3.8	3.6	3.7	4.3	12.9	12.1	3.6

The low flow statistics for the summer period (1st April to 30th September inclusive) are: Summer Q_{95} = 8.5Ml/d; Summer Q_{99} = 4.0Ml/d. Minimum flows do fall below the statutory prescribed flows reflecting implementation of a previous drought order during the summer of 1984.

Figure B2.2 shows the typical pattern of flows in the Nant Caerfanell during 1983 and 1984, and the flow duration curve is shown in **Figure B2.3**.

Figure B2.2 Nant Caerfanell Downstream of Talybont Reservoir Flows (1983 – 1984)

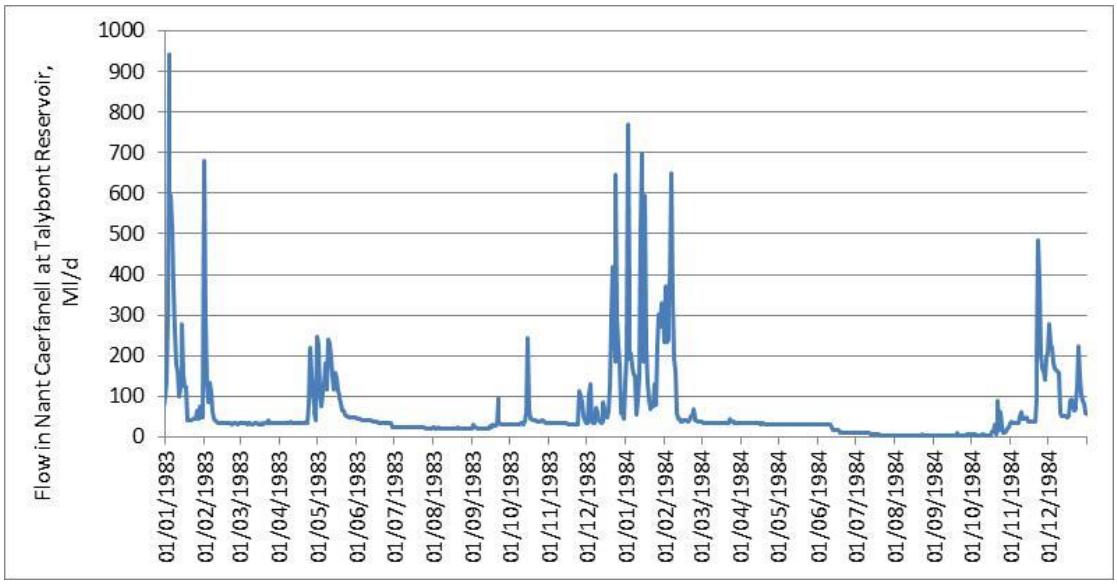
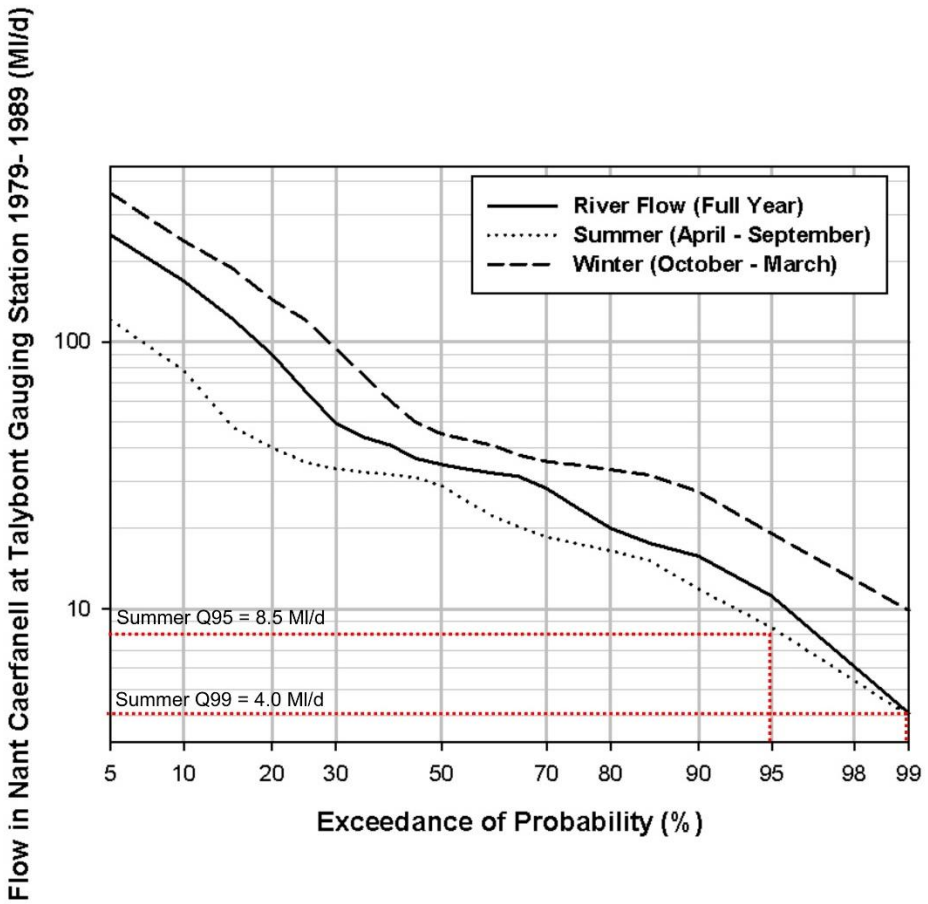


Figure B2.3 Nant Caerfanell at Talybont Reservoir Flow Summary (1979 – 1989)



Given the short record period and the influence of the 1984 drought order on the low flow statistics in this short record period, the gauged flow record is not used in the hydrological

assessment of the drought order. Low flow statistics have instead been calculated based on flow data sets from the Wye and Usk Water Resource Model developed by Wye and Usk Foundation in collaboration with Welsh Water, NRW and CRT.

River Usk at Llandetty

NRW continuously monitors river level on the River Usk at the Llandetty gauging station (grid reference SO127204) at an altitude of 103.6m AOD. A data record is also available as daily flows from 1965 to 1981 and from 1986 to 2018. The full record from 1965 - 2018 is summarised in **Table B2.2;** note however that the flow statistics exclude the period of missing data from 1982 to 1985.

Table B2.2 Summary of Recorded Mean Daily Flow in the River Usk at Llandetty Gauging Station (1965 – 2018 excluding 1982 to 1985)

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	20064	37498	31277	13717	7921	8364	10714	9660	19958	97096	18976	105714	105714
10% (high flow)	6801	5167	3537	2451	1702	1181	1014	1158	1829	3525	5086	6686	3726
50%	2137	1590	1217	841	626	432	312	346	406	941	1681	1932	872
80%	1089	895	720	479	371	275	198	214	200	384	878	941	354
90%	786	724	565	375	312	219	170	161	155	261	678	720	244
95% (low flow)	654	596	433	316	273	187	144	135	129	195	492	587	188
99% (extreme low flow)	370	465	326	249	200	133	109	101	100	99	333	474	120
Minimum flow	304	302	274	213	160	94	93	68	32	84	213	275	32

The low flow statistics for the summer period (1st April to 30th September inclusive) are: Summer Q_{95} = 158Ml/d; Summer Q_{99} = 110Ml/d.

Figure B2.4 shows the flow patterns in the River Usk at Llandetty from 1975 to 1976, a period of prolonged dry weather and a notably very dry summer in 1976. The flow duration curve for the River Usk at Llandetty is shown in **Figure B2.5**.

Figure B2.4 River Usk at Llandetty (1975 - 1976)

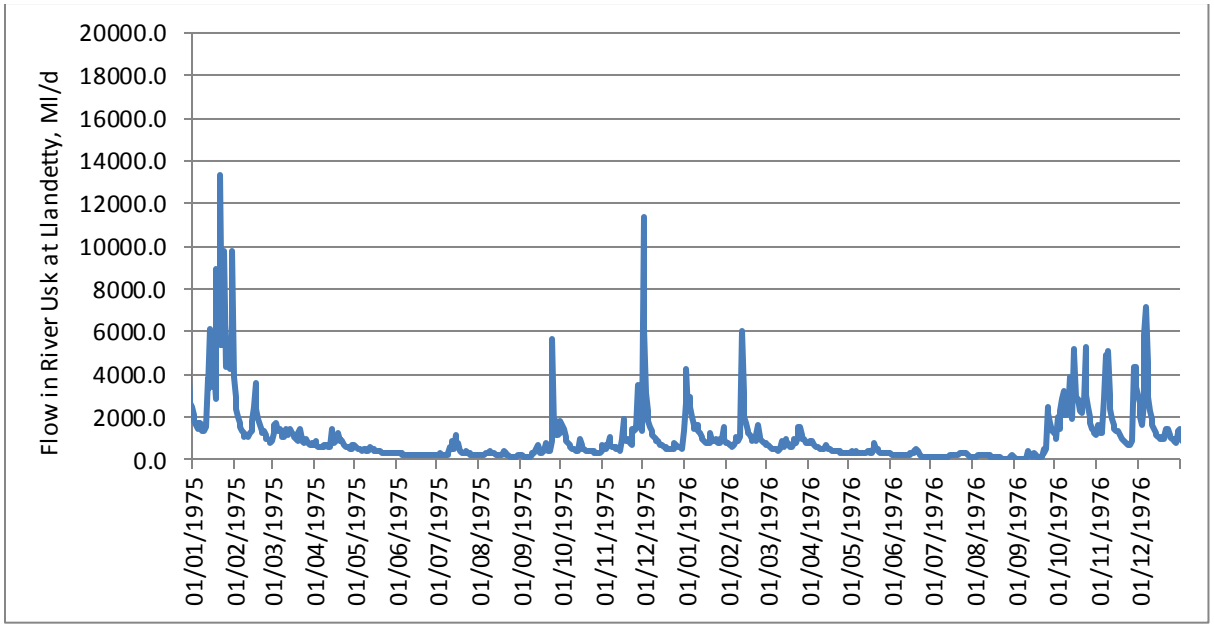
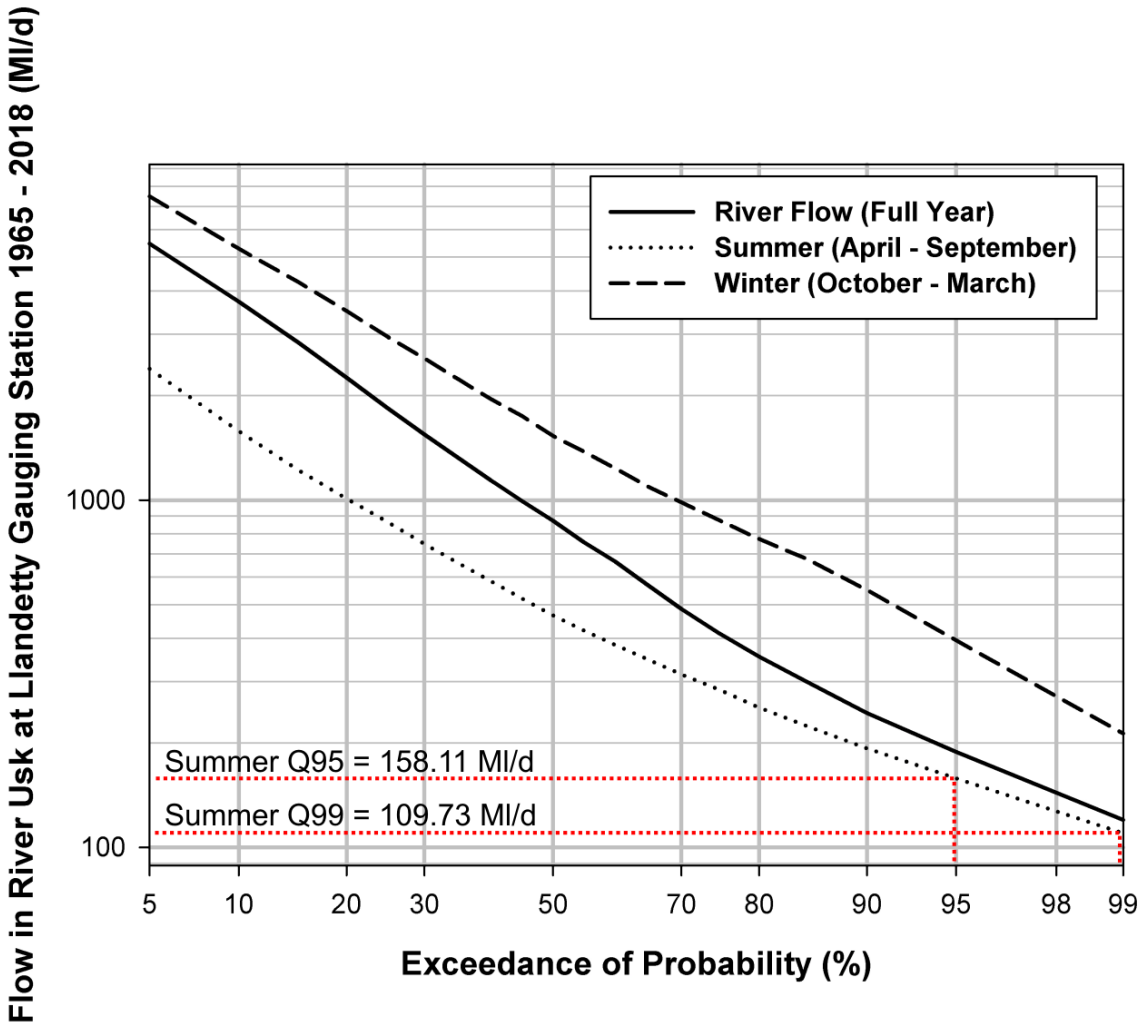


Figure B2.5 River Usk at Llandetty Flow Summary (1965 –2018)



B.2.2 Hydrological Impact

B.2.2.1 Hydrological Zone of Influence

The study area includes Talybont Reservoir and both the Nant Caerfanell and the Nant Clydach streams, comprising four distinct hydrological reaches as shown in **Figure B1.1**.:

- Reach 1 is the Nant Caerfanell, from the Talybont Reservoir outflow to the Nant Clydach confluence
- Reach 2 is the Nant Caerfanell, from the Nant Clydach confluence to the River Usk confluence
- Reach 3 is the Nant Clydach, from the headwaters to the Talybont stream capture system
- Reach 4 is the Nant Clydach, from the Talybont stream capture system to the Nant Caerfanell confluence.

The potential hydrological impacts of the drought order have been considered for Talybont Reservoir itself and for the four separately identified river reaches, as summarised in **Table B2.9** at the end of this section.

It is assumed that the 50% reductions in compensation flow releases to the Nant Caerfanell, applicable under the existing licence when "Big 5" reservoir storage drops below the Talybont reservoir compensation flow control line, would already be in place at the time of implementation of this drought order. These reduced rates vary according to the time of year as follows:

- 1 November – 30 April: compensation flow reduced to 12.5Ml/d
- 1 May – 31 July: compensation flow reduced to 9.1Ml/d
- 1 August – 31 October: compensation flow reduced to 6.8Ml/d

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

B.2.2.2 Hydrological Impact Assessment

<u>Talybont Reservoir</u>

The most severe drawdown period in the available data record occurred in 1976, when recorded storage was 946Ml (approximately 9% of live storage) on 12/9/1976. Reservoir levels recovered rapidly after this date and returned to top water level in less than 2 months. Hence the available data record does not include any droughts of sufficient severity to require pumping from dead storage as a drought measure. 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 five most severe drawdown periods within the Talybont data record from 1976 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 B2.3** and **B2.4** below.

Note that in **Table B2.4** we have quoted net refill rates, allowing for outflows or other losses, and estimated natural inflow rates. Refill rates are highly variable and in practice the length of time to refill Talybont Reservoir will depend on a number of factors, in particular the timing and extent of drawdown and the pattern of winter flows following a drawdown event.

We have assumed a daily abstraction rate of 35Ml/d for the water balance calculations, based on the average recorded daily abstraction from 2007 to 2018 inclusive. The total compensation flow is based on recorded data at the Talybont compensation flow gauge for the 1984 and 2003/04 droughts, but this data is not available for the droughts of 1976, 1989 and 1995. We have therefore taken the average compensation rate recorded during the drawdown period of the 1984 drought (23Ml/d approximately) and used this to estimate the compensation flows during the 1989 and 1995 drawdown and refill periods.

Table B2.3 Summary of Talybont Reservoir Drawdown Analysis 1976 – 2018

Year	Start Date of drawdown period in Talybont Reservoir	Date of lowest drawdown in Talybont Reservoir	Lowest storage volume in Talybont Reservoir (Ml)	Recorded or Estimated total compensation flow during drawdown period (Ml)	Estimated total abstraction during drawdown period (Ml)	Length of Talybont Reservoir drawdown period (days)	Average daily natural inflow Ml/d
1976	Not known	12/09/1976	946				
1984	08/02/1984	19/09/1984	1841	5188	7840	224	20
1989	08/03/1989	18/10/1989	1016	5188	7840	224	17
1995	15/03/1995	04/10/1995	1356	4701	7105	203	14
2003	17/03/2003	27/10/2003	2152	5886	7840	224	25
2018	03/05/2018	16/09/2018	4422	3108	4760	136	14

NB Talybont Reservoir maximum usable storage capacity is 10340Ml.

Table B2.4 Summary of Talybont Reservoir Refill Analysis 1976 – 2015

Year	Date of lowest drawdown in Talybont Reservoir	Lowest storage volume in Talybont Reservoir (Ml)	Date of refill	Length of Talybont Reservoir refill period (days)	Average daily natural inflow (Ml/d)
1976	12/09/1976	946	07/11/1976	56	226
1984	19/09/1984	1841	28/11/1984	70	202
1989	18/10/1989	1016	15/02/1990	120	136
1995	04/10/1995	1356	22/01/1996	110	140
2003	27/10/2003	2152	02/02/2004	98	149
2018	16/09/2018	4422	01/12/2018	76	166

NB Talybont Reservoir maximum usable storage capacity is 10340Ml

The average daily inflow during the drawdown periods analysed, ranged from 14Ml/d to 25Ml/d. The total duration of the periods when water levels were below top water level ranged from about 30 weeks (2018) to 49 weeks (1989/90). During the reservoir refill periods analysed, which mainly occurred during the early autumn to winter period, average daily natural inflow ranged from 136Ml/d to 226Ml/d.

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 involving pumping from dead storage:

- Talybont Reservoir is at full capacity on 1/2/2016.
- Storage drops to the base of the live storage zone on 1/10/2016.
- A further drawdown period of approximately 1 months' duration occurs between 1/10/2016 and 1/11/2016, with average daily natural inflow of 14Ml/d (the lower end of the range analysed).
- Reservoir levels begin to recover from 1/11/2016, with average daily natural inflow of 136Ml/d (again, the lower of the values analysed).
- Under the existing licence, a reduction in the variable compensation release rates to 50% of the normal values is assumed to be in place prior to implementation of this drought option and to remain in force until 1/2/2017, after which date the compensation release rate is assumed to return to the normal rates of between 13.6Ml/d to 25Ml/d depending on the time of year.
- In the baseline drought, no abstraction takes places when reservoir storage is in the dead storage zone below the gravity off-take level (at about 12m below top water level).
- This drought option, pumping from dead storage, is implemented on 1/10/2016, and daily abstraction of 30Ml/d continues after that date.

- Once reservoir levels begin to recover, from 1/11/2016 onwards, abstraction continues at 35Ml/d in both the baseline and the drought order scenario.

For the baseline drought, abstraction ceases once storage drops to the base of the live storage zone on 1/10/2016, but we have assumed that Welsh Water would still be required to provide the reduced variable compensation release of between 6.8Ml/d to 12.5Ml/d, depending on the time of year. This may require pumping depending on the operational arrangements for the release of compensation water, but we have assumed that this would not require a further drought order to be in place.

For the assessed drought order, once water levels reach the base of the live storage zone, abstraction continues at a daily rate of 30Ml/d for a further 30 days by pumping from the dead storage zone (and compensation at the variable reduced rate also continues).

We have assumed that after 30 days of pumping from dead storage, reservoir levels will begin to recover, although based on historical inflow analysis, this is more likely to occur earlier (the latest recharge observed in the historical record is mid-November).

Figure B2.6 illustrates the impact on reservoir drawdown of the drought order options.

Figure B2.6 Talybont Reservoir Storage in Synthesised Drought: Baseline and With Drought Order Impacts

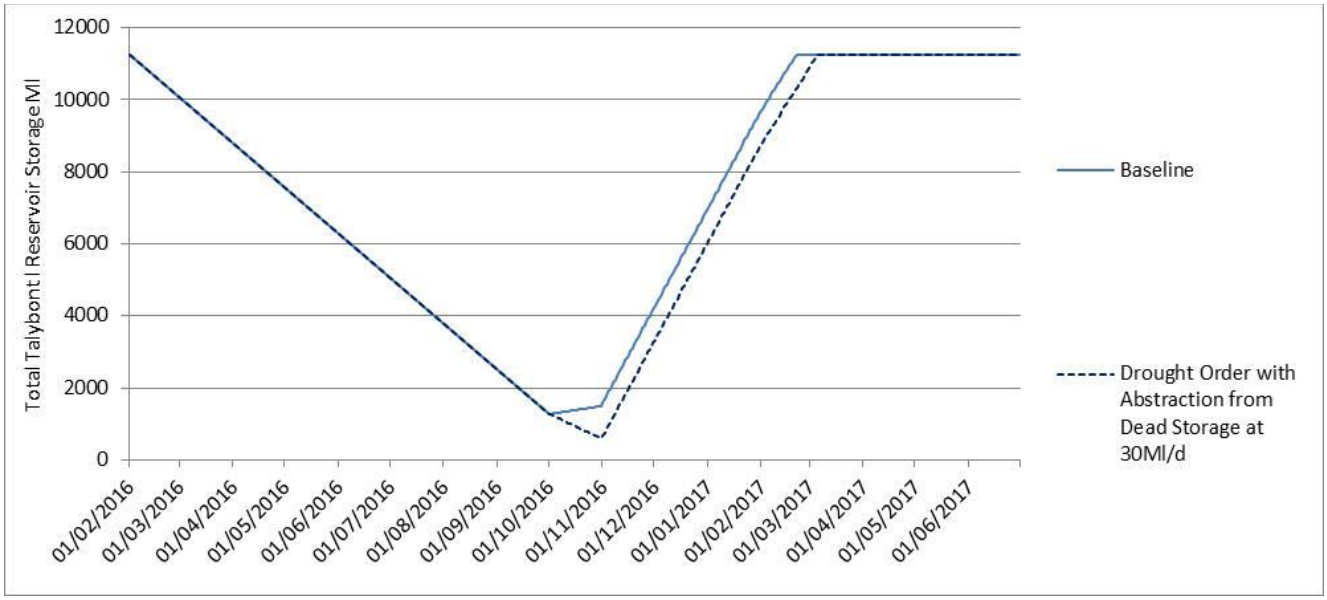


Table B2.5 below summarises the impacts of the modelled drought options on water levels and drawdown durations in Talybont Reservoir.

Table B2.5 Modelled Impacts of Drought Order on Talybont Reservoir Drought Duration and Minimum Water Levels

Modelled Scenario	Duration below full capacity (days)	Minimum Water Level (m below top water level)	Minimum Level (m above base of dead storage zone)	Increase in duration below full capacity (%)	Decrease in minimum level (%)
Baseline: Existing licence (reduced variable compensation rates due to "Big 5" reservoir storage below control line)	386	12	14	-	-
With Drought Option (pumping from dead storage)	399	15.3	10.7	3% (13 days longer)	24%

With a further 30 days of pumping from dead storage, reservoir volume at the end of the 9-month drawdown period has reduced by 684Ml relative to the baseline scenario, a reduction of about 3.3m, or 24%, in the minimum water level (when measured relative to the base of the dead storage zone at about 26m below top water level). The overall duration of the period for which reservoir storage is below full capacity has increased by 13 days relative to the baseline scenario, an increase of about 3%.

With reference to the hydrological assessment matrix for reservoir impacts (**Figure A.6**), we have therefore assessed the hydrological impact of the drought order on Talybont Reservoir as **minor** for up to about 2 weeks during the period from September to December inclusive.

The reduction in the minimum water level due to the increased abstraction from Talybont Reservoir's dead storage zone is equivalent to an increase in the area of exposed shoreline of approximately 0.17km² or 18% (from 0.96km² to 1.13km²). This is based on data from the bathymetry survey of 2013.

Assessment of River Reach Impacts

In order to assess the potential hydrological impacts on each of the four river reaches, estimates of key flow statistics are required. There are only limited spot flow data available between the headwaters of the Nant Clydach stream, the Nant Caerfanell compensation flow gauge and the confluence with the River Usk near Llansantffraed[2]; these have been assessed with a view to estimating flow statistics at ungauged locations in the study area.

Tables B2.6 and **B2.7** provide a summary of the relevant spot flow gauging locations and the flows recorded, respectively.

[2] Located on the River Usk, upstream of the confluence with the Nant Caerfanell.

Table B2.6 Spot Flow Gauging Locations in the Study Area

Spot Gauge Ref.	Location	Grid Reference	Hydrological Reach
Usk40	Nant Clydach upstream of Caerfanell confluence	SO10602140	Lower Reach 4
Usk42	Nant Caerfanell upstream of Usk confluence	SO11902300	Lower Reach 2
Usk123	Nant Clydach at Talybont intake	SO09542136	Downstream end of Reach 3
Usk124	Nant Clydach upstream of Caerfanell confluence	SO10662153	Downstream end of Reach 4

Table B2.7 Summary of Spot Flow Gauging Results in the Study Area

Spot Gauge Ref.	Date	Reach	Spot Flow (Ml/d)	Talybont Reservoir Comp. (Ml/d)	Llandetty (Ml/d)	Llandetty Summer flow percentile	Llandetty Year-round flow percentile
Usk40	28/06/1978	4	2.48	-	213.4	87	93
Usk40	03/07/1979	4	3.23	18.6	261.8	79	88
Usk40	17/09/1979	4	1.75	16.6	211.7	87	93
Usk42	26/06/1975	2	25.48	-	192.8	90	94
Usk42	06/04/1976	2	21.65	-	626.1	37	62
Usk42	06/04/1976	2	33.64	-	626.1	37	62
Usk42	06/04/1976	2	27.33	-	626.1	37	62
Usk42	03/08/1976	2	10.44	-	139.4	97	98
Usk42	17/08/1976	2	14.75	-	87.5	99.7	99.8
Usk42	19/08/1976	2	10.21	-	84.6	99.8	99.9
Usk42	27/08/1976	2	9.87	-	68.1	99.91	99.96
Usk42	20/06/1978	2	2.13	-	201.7	89	94
Usk42	29/06/1978	2	24.34	-	214.4	87	93
Usk42	26/10/1978	2	18.68	-	246.2	-	90
Usk42	12/06/1979	2	25.19	18.8	580.6	40	64
Usk42	03/07/1979	2	21.60	18.6	261.8	79	88
Usk42	09/07/1979	2	21.91	20.1	237.6	83	91
Usk42	23/11/1979	2	35.90	28.0	1537.9	-	30
Usk42	24/07/1980	2	17.59	19.8	437.2	53	73
Usk42	08/10/1980	2	28.05	20.8	2056.3	-	22
Usk42	06/07/1984	2	7.74	9.4	-	-	-
Usk42	24/07/1984	2	4.29	4.2	-	-	-
Usk42	14/08/1986	2	1.59	11.2	555.5	42	66
Usk42	16/05/1988	2	28.50	22.3	504.6	46	69
Usk42	21/10/1988	2	131.20	101.9	1091.2	-	41
Usk42	27/07/1989	2	21.21	-	158.1	95	97
Usk42	24/01/1992	2	28.62	-	839.8	-	51
Usk42	28/05/1992	2	14.39	-	349.1	65	80
Usk42	22/06/1992	2	37.46	-	216.0	86	93
Usk123	28/01/1997	3	1.31	-	317.9	-	83
Usk124	04/02/1992	4	3.40	-	670.5	-	60

Spot Gauge Ref.	Date	Reach	Spot Flow (Ml/d)	Talybont Reservoir Comp. (Ml/d)	Llandetty (Ml/d)	Llandetty Summer flow percentile	Llandetty Year-round flow percentile
Usk124	28/05/1992	4	2.21	-	349.1	65	80
Usk124	17/09/1996	4	2.15	-	134.8	97	98

Comparison of the spot flow gauging results with the daily gauged flows at Llandetty indicates a poor relationship between the Nant Clydach and Nant Caerfanell managed flows and the downstream River Usk flow regime. There is inconsistency in the relationship between the spot flow values and the Llandetty flow percentile statistics, therefore the spot flow values have not been used further in the hydrological assessment.

In order to assess the impacts of the drought option on flows, flow data sets from the Wye and Usk Water Resource Model developed by Wye and Usk Foundation in collaboration with Welsh Water, NRW and CRT were used to calculate key flow statistics for those locations where modelled data sets are available. These flow statistics are presented in **Table B2.8** below.

Table B2.8 Summary of Key Flow Statistics for Wye and Usk Model Flow Data Sets

Area/ location	Details of relevant data set from Wye and Usk Model	Modelled Key Flow Statistics Ml/d			
		Summer		Year Round	
		Q_{99}	Q_{95}	Q_{95}	Q_{50}
Nant Clydach at intake to Talybont Reservoir	Nant Clydach naturalised flows (factored from Senni record)	1.3	1.8	2.1	11.3
Nant Caerfanell upstream of River Usk confluence	Nant Caerfanell flows at River Usk confluence (factored from Senni record)	6.4	9.0	10.9	57.7
Llandetty flow gauge	Llandetty flow gauging station data	101.0	139.6	166.2	923.9

The hydrological impact assessment in the following sections is based on the Usk river flow data sets from the Wye and Usk model (where available) when calculating potential flow impacts of the drought order. Given the flow data uncertainties, the precautionary principle has also been applied when assessing the magnitude of the hydrological impact of the drought order.

Hydrological Reach 1 – Nant Caerfanell from Talybont Reservoir to Nant Clydach confluence

The Nant Caerfanell in Reach 1 flows for 1.4km from the Talybont Reservoir dam to the confluence with the Nant Clydach, which is located immediately upstream of the Nant Caerfanell compensation flow gauging station. The stream falls steeply and is restrained by a steep sided-valley. The compensation flow releases from Talybont Reservoir to the upper Nant Caerfanell support flow in Reach 1 throughout the year. During periods with low effective

rainfall, flow accretion from the intervening catchment area is considered to be minor.

Compliance with the required compensation flow is measured just downstream of the confluence with Nant Clydach, and therefore includes the residual flow downstream of the Nant Clydach stream capture system. The required flow release from Talybont reservoir, when the "Big Five" reservoir group storage is below the compensation flow trigger control line, is therefore the seasonal compensation rate minus the Nant Clydach residual flow:

- 1 November – 30 April: (12.5-1.82)=10.68Ml/d
- 1 May – 31 July: (9.1-1.82)=7.28Ml/d
- 1 August – 31 October: (6.8-1.82)=4.98Ml/d

If natural flows in the Nant Clydach fall below the residual flow requirement, the compensation flow release from Talybont reservoir would need to be slightly higher; consequently, the above reservoir compensation flow release rates represent the minimum flow rates from the reservoir into the top of Reach 1.

There is no reduction to the magnitude of flow rates in Reach 1 as a result of this drought order. However, as a result of the increased pumping from Talybont Reservoir's dead storage zone, there is estimated to be a 3% increase (13 days) in the duration of the period for which storage is below top water level, and for which reservoir outflow is limited to compensation only. This also leads to a delay of 13 days in the first occurrence of reservoir overflows following refill, which increase the flows in this reach.

The hydrological impact of the drought order on Reach 1 has therefore been assessed as **minor** for up to about 2 weeks during the period from September to December (relative to the baseline in which compensation rates are already reduced due to "Big 5" reservoir storage being below the compensation flow control line).

Hydrological Reach 2 – Nant Caerfanell, from Nant Clydach confluence to River Usk confluence

The Nant Caerfanell in Reach 2 flows for 2.8km from the confluence with the Nant Clydach to the confluence with the River Usk. The stream continues to fall steeply and is restrained by a steep sided-valley for the upper 1.8km. The Nant Caerfanell emerges into the wide valley floor of the River Usk and meanders 1km across the drift deposits of the valley floor to the Usk confluence.

The compensation flow releases from Talybont reservoir to the Nant Caerfanell support flow in the stream throughout the year. During periods with low effective rainfall, flow accretion from the intervening catchment, including the Nant Clydach, is minor.

The normal minimum required compensation flow release, measured at the compensation flow gauge at the top of Reach 2, is reduced by 50% when the "Big Five" reservoir group storage

falls below the compensation flow trigger control line. The baseline flow rate at the top of Reach 2 is therefore as follows:

- 1 November – 30 April: 12.5Ml/d
- 1 May – 31 July: 9.1Ml/d
- 1 August – 31 October: 6.8Ml/d

There are no further reductions to the magnitude of flows in Reach 2 anticipated as a result of this drought order. However, an estimated increase of 3% in the duration of the reservoir drawdown (13 days) will lead to a delay in spills occurring and a corresponding increase in the duration of time for which flow at the top of Reach 2 is limited to the above compensation rates only. Therefore the hydrological impact on Reach 2 has been assessed as **minor** for up to about 2 weeks during the period from September to December inclusive (relative to the baseline scenario).

Hydrological Reach 3 – Nant Clydach, from the stream headwaters to the Talybont reservoir stream capture system.

The Nant Clydach is a small tributary of the Nant Caerfanell. Due to its close proximity to Talybont Reservoir, it is possible to divert flows from the Nant Clydach to the reservoir by gravity through a pipeline from the stream capture system intake structure. This effectively increases the natural catchment area of the reservoir. At the lowest point on the upper Nant Clydach from which it is practicable to make transfers, the intake includes a small impoundment to manage stream level and flows.

The drought order does not amend or impact on the flow regime of Reach 3. No impacts are expected due to the implementation of this drought order (pumped abstraction from dead storage).

The hydrological impact of the drought order on Reach 3 has therefore been assessed as **no impact** for all times of the year.

Hydrological Reach 4 – Nant Clydach, from the Talybont reservoir stream capture system to the Nant Caerfanell confluence.

Downstream of the stream capture system intake, the lower Nant Clydach continues through a steep, incised valley for 1.4km to the confluence with the Nant Caerfanell. At low flows, no abstractions are made at the intake and flow downstream in Reach 4 naturally falls below 1.82Ml/d. Available data show that this can occur in both winter and summer periods. There are no tributaries to the Nant Clydach below the stream capture system.

No reduction in flows in Reach 4 is anticipated as a result of this drought order; the hydrological impact of the drought order on Reach 4 has therefore been assessed as **no impact** at any time of year.

No impacts to the River Usk are likely as a result of this drought order; the small 3% increase in the duration of the period for which Talybont Reservoir is not spilling to the downstream catchment is unlikely to have any discernible effects on the flow regime in the River Usk, which has therefore been excluded from this assessment.

B.2.2.3 Hydrological Impact Summary

Four hydrological reaches have been considered; the assessed hydrological impacts for two of the reaches are **minor** for up to about 2 weeks during the period from September to December, whilst there are no hydrological impacts on Reaches 3 and 4. The impacted reaches are shown in **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 Talybont Reservoir itself has been assessed as **minor**, due to the increased duration of reservoir drawdown and the decrease in minimum water levels.

Table B2.9 Hydrological and Monitoring Reaches identified in the Study Area

Hydrological Reach		Reach boundary		Reach length	% Change due to Drought Order		Hydrological Impact
		Upstream	Downstream		Minimum water level	Duration of drawdown period	
Talybont Reservoir		n/a	n/a	n/a	24%	3%	**Minor**
1	Nant Caerfanell Reach 1	Talybont Reservoir	Nant Clydach confluence	1.4km	n/a	n/a	**Minor**
2	Nant Caerfanell Reach 2	Nant Clydach confluence	River Usk confluence	2.8km	n/a	n/a	**Minor**
3	Nant Clydach Reach 3	Headwaters	Talybont Reservoir stream capture system intake	7.7km	n/a	n/a	**No impact**
4	Nant Clydach Reach 4	Talybont Reservoir stream capture system intake	Nant Caerfanell confluence	1.4km	n/a	n/a	**No impact**

B3 PHYSICAL ENVIRONMENT ASSESSMENT

Given that there is no adverse hydrological impact associated with the drought order, effects on the drought order 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 Talybont Reservoir.

B4 PHYSICAL ENVIRONMENT IMPACT SUMMARY

Potential impacts on the physical environment associated with the Talybont Reservoir 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 Talybont Reservoir Drought Order

Talybont Reservoir	
Water levels in Talybont Reservoir *Minor impacts during the period from September to December inclusive*	• Reduction of up to 24% in the minimum water level in Talybont Reservoir, and a 3% increase in the duration for which reservoir storage is below top water level.
Nant Caerfanell (Reach 1)	
Flows in the Nant Caerfanell *Minor impacts during the period from September to December inclusive*	• Up to 3% increase in the duration of reservoir drawdown period before overflows recommence (period of compensation flow only)
Nant Caerfanell (Reach 2)	
Flows in the Nant Caerfanell *Minor impacts during the period from September to December inclusive*	• Up to 3% increase in the duration of reservoir drawdown period before overflows recommence (period of compensation flow only)
Nant Clydach (Reach 3)	
Flows in the Nant Clydach headwaters *No hydrological impacts at any time of year*	• No hydrological impact
Nant Clydach (Reach 4)	
Flows in the Nant Clydach *No hydrological impacts at any time of year*	• No hydrological impact

B5 CUMULATIVE IMPACTS

The focus of this EAR is the Talybont Reservoir 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 permits / 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 permit / 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 Talybont Reservoir Drought Order with other Drought Management Options

Organisation	Potential In-combination Impacts	Further Consideration Required (Yes/No)
Welsh Water - other drought options in the SEWCUS Talybont WRZ / Usk Catchment	8201-1 (Reduce Crai compensation flow by 50%) – No in combination effects are anticipated as the 8116-3 Talybont drought order has no hydrological influence on the River Usk.	No
	8109-4 Afon Lwyd - The Afon Lwyd tributary joins the River Usk below the tidal limit and therefore no in-combination effects with other River Usk catchment options are anticipated.	No
Natural Resources Wales - Drought options	No previous drought order applications have been made in the South East Wales region.	No

APPENDIX C
ENVIRONMENTAL FEATURES ASSESSMENT METHODOLOGY

A.1 ENVIRONMENTAL FEATURES ASSESSMENT METHODOLOGIES

The assessments undertaken in the EARs will use available environmental data. The following methodologies detail the preferred approach to impact assessment for the sensitive receptors identified in the screening process.

However, in certain circumstances the supporting data on hydrological conditions, habitat availability and species occurrence may not be currently available. In these cases, other supporting data will be used, where available, and the assessment will be undertaken using expert judgement. An example may be where flow-induced river habitat for fish would ideally be defined through the total wetted area, depth and flow velocities to describe the habitat preferences of a species and its lifestages. Where these data are currently unavailable, the use of habitat walkover, RHS and / or aerial survey data may be used in combination with judgements on the hydrological change resulting from the drought option (e.g. reduction in river flows) to arrive at a statement on habitat reduction and consequent impact on the fish species. The analysis will detail the increased uncertainty prevalent in the approach and will therefore adopt a precautionary approach to impact prediction (possibly assigning a higher impact where fewer substantiating data are available).

The gaps in data and evidence will be noted and monitoring proposals established.

Assessment sheets are included for the following features:

- Flow pressures
- Water quality pressures.
- WFD Status: Fish
- WFD Status: Aquatic macroinvertebrates
- Environment (Wales) Act Section 7 species, designated sites and other sensitive fauna and flora.

FLOW PRESSURES

Potential Effects

In support of understanding the physical environment and the risk assessment in the zone of influence of each drought option, a review will be undertaken of additional flow pressures from licensed surface water and groundwater abstractions. Relevant pressures have been identified and risk assessed in terms of in-combination flow impacts from implementation of a drought option. Abstractions have the potential to exacerbate low river flows or, in the case of groundwater-dominated catchments where rivers seasonally run dry (ephemeral watercourses), to increase the length of river that is dry and the period of time for which it remains so, potentially beyond the period for which the drought option is in place.

As a result of a drought option, there may be less water available in the zone of influence (rivers and groundwater bodies) for licence holders to abstract, and any abstractions that do occur reduce the amount of surface water available – affecting the wetted perimeter of the habitat, velocities within the wetted area and the ability to dilute any pollutants entering the system. For surface water abstractions, this includes consumptive abstraction and partially consumptive/non-consumptive abstraction – where some or all of the water is returned to the river locally after use, with the potential to reduce flow in the river if the discharge is downstream of the abstraction.

Definition of Risk

Continuously flowing watercourses

In order to define the potential risk to flow from river and groundwater abstractions in a readily understandable manner, a series of criteria have been defined. The assessment is informed by long term gauged flow data. The impact of the drought option will be considered against baseline 'drought' conditions (without drought option implementation). The assessment will use the following criteria, based on the potential severity of the risk to river water quality and flow during an ongoing drought.

- High: A major reduction in low river flows, including the influence of the drought option - typically >25% reduction in summer Q95 (with drought option in place)
- Medium: A moderate risk to low river flows (as above) , including the influence of the drought option - typically 10-25% reduction in summer Q95 (with drought option in place)
- Low: A minor risk to low river flows, including the influence of the drought option - typically <10% reduction in summer Q95 (with drought option in place)
- Negligible: Indicative of no significant change from the "without drought" option baseline situation.

Ephemeral watercourses

In line with the methodology for hydrology, an alternative approach to risk is required for

watercourses that naturally dry for part of the year that are potentially impacted upon by the drought option. Such watercourses are identified from previous investigations and available data. The assessment will use the following criteria, based on the potential severity of the risk to river water quality and flow during an ongoing drought.

- High: If the abstraction resulted in sections drying (with drought option in place) that would not (without drought option in place)
- Medium: If the abstraction resulted in sections drying earlier (by more than a handful of days) and/or returning to flow later (by more than a handful of days) and hence flow reduction occurring in the channel for more than just a handful of days (with drought option in place)
- Low: If the abstraction resulted in sections drying earlier (by just a handful of days) and/or returning to flow later (by just a handful of days) and hence flow reduction occurring in the channel for more than just a handful of days OR if the abstraction were a secondary flow driver (e.g. flow through gravels being primary cause of flow losses rather than the drought permit) (with abstraction in place)
- Negligible: Indicative of no significant change from the "without drought" option baseline situation.

Data Requirements

- Relevant zone of influence (as identified from screening)
- Surface water and groundwater abstraction licences in the zone of influence
- River flow representative of the zone of influence (daily gauged flow and spot flow surveys) – all available records
- Flow predictions and zones of hydrological impact for each drought option.

Assessment Methodology and Uncertainty

1. Identify relevant abstraction licences within the zone of hydrological impact for the drought option: both groundwater abstractions from the aquifer(s) impacted by the drought option (confined and unconfined) and surface water abstractions from the impacted river reaches.

Groundwater abstractions

2. For groundwater abstractions, identify which aquifer they abstract from and key characteristics of the aquifer (confined/unconfined) if available. List relevant details from each abstraction licence including licence number, holder, use, depth abstracted from and maximum daily abstraction rate.
3. Use depths of abstraction to identify which of these abstractions are likely to be affected by reduced groundwater levels in the aquifer with the drought option in place. If depth information is not available, take a precautionary approach and assume all abstractions within the relevant area (or, if known, from the relevant aquifer) are affected.
4. Calculate the maximum volume of groundwater abstractions from each aquifer at low flows (i.e. the sum of abstractions of sufficient depth from the aquifer) with a drought option in place.

5. Use expert judgement to assess the in-combination significance of these groundwater abstractions on river flows in impacted reaches (both continuously flowing and ephemeral watercourses), based on known (measured or modelled) relationships between groundwater levels and river flows in that area and the definition of risk set out above.

Surface water abstractions – continuously flowing watercourses

6. Assign relevant abstraction licences to an impacted river reach, and list relevant details from the licence including licence number, holder, use, type (consumptive or non-consumptive), location (mainstem or tributary) and daily maximum abstraction rate (including any Hands-Off Flow restrictions). Identify which of these abstractions are likely to be affected by reduced water levels in the river with the drought option in place.
7. Calculate the maximum volume of surface water abstractions in each reach at low flows (i.e. the sum of consumptive, unrestricted abstractions on the main stem of the river) as a proportion of summer Q95 river flow with a drought option in place.
8. Assess the in-combination significance of these pressures on river flow with respect to hydrological assessment methodologies described in Section 2.2.2 of the main report.
9. Use expert judgement to assess the significance of these pressures on river flows based on the definition of risk set out above.

Surface water abstractions – ephemeral watercourses

10. Assign relevant abstraction licences to an impacted river reach, and list relevant details from the licence including licence number, holder, use, type (consumptive or non-consumptive), location (mainstem or tributary) and daily abstraction maximum (including any Hands-Off Flow restrictions). Identify which of these abstractions are likely to be affected by reduced water levels in the river with the drought option in place.
11. Use expert judgement to assess the significance of these pressures on river flows based on the definition of risk set out above.

All abstractions

12. For both groundwater and surface water abstractions, incorporate any flow pressure risks identified as significant into the assessment of impacts on significant features and the selection of appropriate mitigation measures for the drought option.

WATER QUALITY PRESSURES

Potential Effects

In support of the physical environment understanding and risk assessment in the zone of influence of each drought option, a review will be undertaken of additional water quality pressures from consented surface water discharges. Discharges put pressure on water quality during a drought as lower than normal river flows mean that there is less water available to dilute discharges such as final effluent from STW. A drought option may exacerbate these low flows and contribute to a reduction in water quality, with potentially detrimental impacts on sensitive features in the impacted reach. Discharges impacting the oxygen balance and ammonia concentration (to support fish and macroinvertebrates, where these are identified as sensitive features) and soluble reactive phosphorus (SRP) concentration (to support macrophytes and algae, where these are identified as sensitive features) in the river have been reviewed.

Intermittent discharges from combined sewer overflows (CSOs) may also contribute to a reduction in water quality during an environmental drought. CSOs relieve strain on the sewers during storm events by temporarily diverting water into nearby watercourses to prevent sewer flooding. As there is usually a time lag between discharges from CSOs and rises in river levels during a storm event, the potential exacerbation of low flows by the drought option may decrease the amount of water immediately available to dilute CSO discharges, leading to a temporary reduction in river water quality if a storm event occurs during implementation of the drought option.

Definition of Risk

Continuously flowing watercourses

In order to define the potential risk to water quality from discharges into the river in a readily understandable manner, a series of criteria have been defined. The assessment will use the following criteria, based on the potential severity of the risk to water quality during an ongoing drought.

- High: A major risk to water quality under low river flow conditions (without the drought option) which affects the suitability of the water quality to support *Good* or *High* status for fisheries and macroinvertebrates, macrophytes and algae (as relevant); and exacerbation of the risk by the flow reduction from the drought option
- Medium: A moderate risk to water quality under low river flow conditions (without the drought option) which affects the suitability of the water quality to support *Good* or *High* status for fisheries and macroinvertebrates, macrophytes and algae (as relevant); or exacerbation of a minor risk by the flow reduction from the drought option
- Low: A minor risk to water quality under low river flow conditions (without the drought option) which affects the suitability of the water quality to support *Good* or *High* status for fisheries and macroinvertebrates, macrophytes and algae (as relevant); or exacerbation to a minor risk by the flow reduction from the drought option
- Negligible: Indicative of no significant risk without the drought option nor exacerbation of risk by the flow reduction from the drought option

Ephemeral watercourses

In line with the methodology for hydrology, an alternative approach to risk is required for

watercourses that naturally dry for part of the year that are potentially impacted upon by the drought option. Such watercourses are identified from previous investigations and available data. The assessment will use the following criteria, based on the potential severity of the risk to river water quality during an ongoing drought.

- High: A major risk to water quality under low river flow conditions (without the drought option) which affects the suitability of the water quality to support *Good* or *High* status for fisheries and macroinvertebrates, macrophytes and algae (as relevant); and exacerbation of the risk if the drought option resulted in sections drying (with drought option in place) that would not (without drought option in place)
- Medium: A moderate risk to water quality under low river flow conditions (without the drought option) which affects the suitability of the water quality to support *Good* or *High* status for fisheries and macroinvertebrates, macrophytes and algae (as relevant); or exacerbation of a minor risk by the flow reduction from the drought option occurring in the channel for more than just a handful of days.
- Low: A minor risk to water quality under low river flow conditions (without the drought option) which affects the suitability of the water quality to support *Good* or *High* status for fisheries and macroinvertebrates, macrophytes and algae (as relevant); or exacerbation to a minor risk by the flow reduction from the drought option occurring in the channel for just a handful of days.
- Negligible: Indicative of no significant risk without the drought option nor exacerbation of risk by the flow reduction from the drought option

Data Requirements

- Relevant zone of influence (as identified from screening)
- Surface water discharge consents in the zone of influence (including numeric water quality and flow conditions)
- Routine NRW / Environment Agency riverine water quality monitoring data for the water quality determinands dissolved oxygen saturation, SRP concentration and total ammonia concentration for relevant monitoring sites in the zone of influence and significant tributaries
- River flow representative of the zone of influence (daily gauged flow and spot flow surveys) – all available records
- Flow predictions and zones of hydrological impact for each drought option
- CSO locations and previous assessments of intermittent discharges from Welsh Water.

Assessment Methodology and Uncertainty

1. Identify sensitive features (fish, macroinvertebrates, macrophytes and algae) which may be impacted by the drought option. Use this information to determine whether assessment of oxygen balance, ammonia concentration and/or SRP concentration is required.
2. Identify all discharge consents within the zone of hydrological impact for the drought option.
3. Assign relevant discharge consents to an impacted reach, and list relevant details from the consent including consent number, holder, use, location (mainstem or tributary) and relevant numeric

consent conditions (Dry Weather Flow, BOD, ammonia (N), total phosphorous)[1].

4. Identify those discharge consents which relate to effluent from Welsh Water's sewage treatment works (STWs).

Continuously flowing watercourses

5. Model the maximum current contribution of each STW to BOD, ammonia (N) and total phosphorous concentrations (as relevant) in the river at low flows (based on the water quality consents, DWF and upstream flows).
6. Model the maximum potential increase in each STW's contribution to river BOD, ammonia (N) and total phosphorous concentrations (as relevant) at low flows as a result of the drought option (based on the water quality consents, DWF, upstream flows and maximum flow reduction from drought option).
7. Assess the potential risk that the STW could pose to river ammonia quality (using the consented discharge condition total ammonia) using modelled data and the appropriate matrix below. This combines an acknowledgement of existing conditions and potential variation as a result of the drought option.

Upland low alkalinity river		% increase in contribution as result of drought option(s)	
		<20%	≥20%
Current contribution to ammonia concentrations at low flows [a]	<0.2mgN/l	Minor	Moderate
	≥0.2mgN/l	Moderate	Major

[a] Standards are WFD high/good threshold for ammonia (N) of 0.2mg/l for upland low alkalinity rivers[2].

Lowland high alkalinity river		% increase in contribution as result of drought option(s)	
		<20%	≥20%
Current contribution to ammonia concentrations at low flows [b]	<0.3mgN/l	Minor	Moderate
	≥0.3mgN/l	Moderate	Major

[b] Standards are WFD high/good threshold for ammonia (N) of 0.3mg/l for lowland high alkalinity rivers[3].

8. Assess the potential risk that the STW could pose to river oxygen balance (using the consented discharge condition BOD) using modelled data and the matrix below. This combines an acknowledgement of existing conditions and potential variation as a result of the drought option.

Upland low alkalinity river		% increase in contribution as result of drought option(s)	
		<20%	≥20%
Current contribution to BOD concentrations at low flows [c]	<1mg/l	Minor	Minor
	1-3mg/	Minor	Moderate
	≥3mg/l	Moderate	Major

[c] Standards are WFD high/good threshold for BOD of 3mg/l and good/moderate threshold of 4mg/l for upland low alkalinity rivers[4].

Lowland high alkalinity river		% increase in contribution as result of drought option(s)	
		<20%	≥20%
Current contribution to BOD concentrations at low flows [d]	<1mg/l	Minor	Minor
	1-4mg/	Minor	Moderate
	≥4mg/l	Moderate	Major

[d] Standards are WFD high/good threshold for BOD of 4mg/l and good/moderate threshold of 5mg/l for lowland high

[1] Note that not all STWs have water quality consents relating to ammonia or total phosphorous (depends on size and location of STW). Consents are set with respect to total phosphorous rather than SRP.

[2] The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. ISBN 978-0-85521-192-9.

[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.

[4] The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. ISBN 978-0-85521-192-9.

alkalinity rivers[5].

9. Assess the potential risk that the STW could pose to river phosphorous quality (using the consented discharge condition total phosphorous) using modelled data and the matrix below. This combines an acknowledgement of existing conditions and potential variation as a result of the drought option. Consents are set with respect to total phosphorous rather than SRP (on which WFD river standards are based), therefore this approach conservatively assumes that all phosphorous from STWs is reactive and has direct implications for ecology in the river.

Upland low alkalinity river		% increase in contribution as result of drought option(s)	
		<20%	≥20%
Current contribution to ammonia concentrations at low flows [e]	<0.2mgN/l	Minor	Moderate
	≥0.2mgN/l	Moderate	Major

[e] Standards are WFD high/good threshold for SRP of 0.02mg/l and good/moderate threshold of 0.04mg/l for upland low alkalinity rivers[6].

Lowland low alkalinity river[7]		% increase in contribution as result of drought option(s)	
		<20%	≥20%
Current contribution to ammonia concentrations at low flows [f]	<0.03mgN/l	Minor	Moderate
	≥0.03mgN/l	Moderate	Major

[f] Standards are WFD high/good threshold for SRP of 0.03mg/l and good/moderate threshold of 0.05mg/l for lowland low alkalinity rivers[8].

Upland/ lowland high alkalinity river		% increase in contribution as result of drought option(s)	
		<20%	≥20%
Current contribution to ammonia concentrations at low flows [g]	<0.05mgP/l	Minor	Moderate
	≥0.05mgP/l	Moderate	Major

[g] Standards are WFD high/good threshold for SRP of 0.05mg/l and good/moderate threshold of 0.12mg/l for upland/ lowland high alkalinity rivers[9].

10. Identify those discharges which relate to effluent from Welsh Water's combined sewer overflows (CSOs).
11. If required, carry out qualitative analysis using previous assessments of intermittent discharges to evaluate whether any CSOs are likely to present a significant water quality pressure as a result of the drought option.
12. Use expert judgement to assess the significance of these pressures on river flows based on the definition of risk set out above.
13. Incorporate any water quality pressure risks identified as significant into the assessment of impacts on significant features and the selection of appropriate mitigation measures for the drought option.

Ephemeral watercourses

14. Calculate the maximum concentrations of BOD, ammonia (N) and SRP (as relevant) in the final effluent of each STW under consented conditions (i.e. concentrations in the river with no natural dilution).

[5] The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. ISBN 978-0-85521-192-9.

[6] The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. ISBN 978-0-85521-192-9.

[7] Note that "Lowland low alkalinity" is a category that only exisits for SRP standards, and not for total ammonia or BOD.

[8] The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. ISBN 978-0-85521-192-9.

[9] The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. ISBN 978-0-85521-192-9.

15. Identify those discharges which relate to effluent from Welsh Water's combined sewer overflows (CSOs).
16. If required, carry out qualitative analysis using previous assessments of intermittent discharges to evaluate whether any CSOs are likely to present a significant water quality pressure as a result of the drought option.
17. Use expert judgement to assess the significance of these pressures on river flows based on the definition of risk set out above.
18. Incorporate any water quality pressure risks identified as significant into the assessment of impacts on significant features and the selection of appropriate mitigation measures for the drought option.

WATER FRAMEWORK DIRECTIVE STATUS: FISH

Potential Effects
For WFD river waterbodies within the zone of influence of the drought option, where screening of the drought option has identified that the fish element of biological status is *High* or *Good*, the potential impact is to be investigated. This investigation is specific to the risk of deterioration below the *Good* status band to the *Moderate* status band, as advised by NRW / Environment Agency.
Definition of Impacts
In order to define the potential WFD status impacts for fish in a readily understandable manner, a series of criteria have been defined. The assessment will use the following criteria, based on the potential severity of the drought option impacts during an ongoing drought. • Major: A major impact is one that results in deterioration in the WFD classification of the waterbody, or specifically the fish biological element of the classification. • Moderate: A moderate impact on fish status occurs when the fish population is predicted to be materially influenced, including effects on density, abundance or community composition, but where no deterioration in WFD classification is predicted. Consideration should be given to the scale of the impact and the potential for recovery of the populations. • Minor: A minor impact occurs when there is a predicted impact on fish abundance, density or community composition that is within the usual variability for the site and which will recover within a short timescale. • Negligible: A negligible impact is one where the predicted impact will not result in a detectable change in the fish population.
Data Requirements
Fish status baseline assessment requires data from standard NRW / Environment Agency monitoring programmes in the potentially impacted zone, and preferably in a control site outside of the zone of influence. Fish data should include species presence, abundance and density. Environmental supporting data should include habitat availability, hydrology (flow, velocity, wetted area (width and depth) as follows: • Relevant study area (as identified in the screening report) • Hydrology at or close to the monitoring sites to link to fish data, including full flow hydrograph, wetted width and depth, velocity profile. Will include daily gauged flow and spot flow surveys, all available records • Meteorology (where flow data insufficient) from available NRW / Environment Agency rain gauges • Habitat data for the monitoring sites, which may include recent RHS or Habscore surveys • Routine NRW / Environment Agency water quality monitoring data (dissolved oxygen, BOD, ammonia, pH, hardness, water temperature, conductivity) representative of the study area.

Assessment Methodology and Uncertainty

The WFD classification for the waterbody will be identified and the reasons for classification established from the NRW / Environment Agency. The data used to support the assessment will be reviewed to ensure that the classification is accurate.

Baseline conditions for sites within the zone of influence of the drought option will be established through existing data. These will include graphing the hydrology, water quality, habitat and fish variation temporally over the monitored period.

The analysis will consider the relationship between fish status and the supporting environmental variables over the period, with an emphasis on changes to fish status and environmental conditions between low, average and high flow years. The purpose of the analysis is to establish whether fish status responds to changes in flow and associated environmental variables inter-annually relating to changes in flow, climate, quality (dissolved oxygen and temperature) and/or habitat quality and availability.

Having established the baseline conditions and variability outside the drought option conditions (care will be taken to avoid using periods in the baseline analysis within which a drought option may have been in operation), a prediction will be made of the changes in the supporting environmental variables (flow, habitat and water quality) resulting from application of the drought option. This will be undertaken for the hydrological data by overlaying the drought option flows over the baseline flow hydrograph, and, where cross sectional data are available, how the wetted width and depth will vary with the drought option. This can be extrapolated to the habitat data to consider whether the key features are compromised by the change in water depth.

Once the flow, habitat and water quality drought option predictions have been established, their implications for existing fish species will be assessed. The flow and habitat environmental envelope of the key fish species is known. The predicted changes in supporting environmental variables (flow, depth, velocity, habitat quality, dissolved oxygen levels and temperature) due to the drought option will be assessed against the fish population data. Where the supporting environmental variables for fish species are modified to take them outside of their preferred envelope it can be assumed that there will be a moderate or major impact on that fish population. Consideration will be given to the potential for density dependent mortality where data show that the fish population has an existing good density, and where the drought option reduces habitat availability significantly The assessment will consider the scale and longevity of any fish status impacts. The WFD classification is calculated on a 3 year rolling basis. A deterioration in classification would require a long term (2+ breeding seasons) and significant effect on fish population structure to allow prediction of a deterioration in status.

Where data are not available the assessment will be undertaken using expert judgement and drawing on broad-scale evidence from other similar catchments if applicable.

The prediction of impacts of hydrological and water quality changes on aquatic ecology remains subject to significant uncertainty. This is exacerbated where few data or

surveillance data are used for impact assessment purposes. Lastly the environmental envelopes within which fish species can successfully exist, and the relationship between populations in stressed river conditions remains subject to debate. The assessment must therefore be undertaken in recognition that the outcome prediction will be subject to large potential variability. The study will therefore adopt a precautionary approach, with potential impact highlighted where doubt exists. Monitoring and mitigation proposals for the drought option can then be specified so that, should an option be enacted, the actual impact can be recorded and adaptive mitigation/management of the option undertaken to safeguard where possible the fish populations.

WATER FRAMEWORK DIRECTIVE STATUS: MACROINVERTEBRATES

Potential Effects

For Water Framework Directive (WFD) river waterbodies within the zone of influence of the drought option, where screening of the drought option has identified that the aquatic macroinvertebrate component of ecological status is *High* or *Good*, the potential impact is to be investigated. This investigation is specific to the risk of deterioration below the *Good* status band to the *Moderate* status band.

Definition of Impacts

In order to define the potential WFD status impacts for aquatic macroinvertebrates in a readily understandable manner, a series of criteria have been defined. The assessment will use the following criteria, based on the potential severity of the drought option impacts during an ongoing drought.

- Major: A major impact is one that results in deterioration in the WFD classification of the waterbody, or specifically the macroinvertebrate biological element of the classification.
- Moderate: A moderate impact on macroinvertebrate status occurs when the macroinvertebrate community is predicted to be materially influenced, including reduction in the LIFE score, or in community density +/or abundance, but where no deterioration in WFD classification is predicted. Consideration should be given to the scale of the impact and the potential for recovery of the community.
- Minor: A minor impact occurs when there is a predicted impact on macroinvertebrate abundance, density or composition that is within the usual variability for the site and which will recover within a short timescale.
- Negligible: A negligible impact is one where the predicted impact will not result in a detectable change in the macroinvertebrate community.

Data Requirements

The baseline for macroinvertebrates will be established from existing data together with a comparison of species flow preference and taxon abundance. The analysis will provide an assessment of the community type and its sensitivity.

Macroinvertebrate status baseline assessment requires data from standard NRW / Environment Agency monitoring programmes in the potentially impacted zone, and preferably in a control site outside of the zone of influence. Macroinvertebrate data should include the LIFE and BMWP scores, together with abundance and density data where available. Environmental supporting data should include habitat availability, hydrology (flow, velocity, wetted area (width and depth) and other environmental variables as follows:

- Relevant study area (as identified by screening)
- Hydrology at or close to the monitoring sites to link to macroinvertebrate data, including full flow hydrograph, wetted width and depth, velocity profile. Will include daily gauged flow and spot flow surveys, all available records
- Meteorology (where flow data insufficient) from available NRW / Environment Agency

rain gauges

- Habitat data for the monitoring sites, which may include recent RHS or Habscore surveys, to calculate HQA / HMS.
- Routine NRW / Environment Agency water quality monitoring data (dissolved oxygen, BOD, ammonia, pH, hardness, water temperature, conductivity) representative of the study area.

Assessment Methodology and Uncertainty

Having established the baseline, the relative changes expected as a result of the drought actions (in relation to normal drought conditions) in river hydrology, geomorphology and water quality will be identified (see WFD fish assessment). An assessment will then been made of the habitat requirements of the key riverine macroinvertebrate communities present, using existing knowledge of their range of preferences. Depending on the resolution of baseline data available, detailed statistical analysis of the datasets may be possible. However, in some cases, where relatively limited spatial and/or temporal datasets are available, the impact assessment of the drought actions will be based on qualified expert judgement of the potential effects of the predicted changes in the environmental variables on the macroinvertebrate communities. The analysis is supplemented by consideration of the implications of environmental change on the key macroinvertebrate metrics, including LIFE scores.

The WFD macroinvertebrate classification for the water body will be identified and the reasons for classification established from the NRW / Environment Agency. The data used to support the assessment will be analysed to ensure that the classification is accurate.

Baseline conditions for sites within the zone of influence of the drought option will be established through existing data. These will include graphing the hydrology, water quality, and macroinvertebrate (ASPT and LIFE scores) variation temporally over the monitored period.

The analysis will consider the relationship between macroinvertebrate status and the supporting environmental variables over the period, with an emphasis on changes to status and environmental conditions between low, average and high flow years. The purpose of the analysis is to establish whether status responds to changes in flow and associated environmental variables inter-annually relating to changes in flow, climate, quality (dissolved oxygen and temperature) and/or habitat quality and availability.

Having established the baseline conditions and variability outside the drought option conditions (care will be taken to avoid using periods in the baseline analysis within which a drought option may have been in operation), a prediction will be made of the changes in the supporting environmental variables (flow, habitat and water quality) resulting from application of the drought option. This will be undertaken for the hydrological data by overlaying the drought option flows over the baseline flow hydrograph, and, where cross sectional data are available, how the wetted width and depth will vary with the drought option. This can be extrapolated to the habitat data to consider whether the key features are compromised by the change in water depth. These data may have been developed for the WFD fish status assessment and duplication of effort will be avoided.

Once the flow, habitat and water quality drought option predictions have been established, their implications for the existing macroinvertebrate community will be assessed. The linkage between flow and habitat environmental envelope for upland macroinvertebrate communities is subject to continuing debate but has been shown to be linked (see for example, Dunbar et al 2009; 2010). The predicted changes in supporting environmental variables (flow, habitat quality) due to the drought option should be assessed against the macroinvertebrate community LIFE scores. Consideration will be given to the relationships between flow, habitat and LIFE scores in the DRIED-UP research papers. The predicted relative change in Q_{95} low flow value for the drought option should be compared to the Q_{95}/reduction in LIFE score; HQA/reduction in LIFE score in Dunbar *et al* 2010 to develop an approximation of the scale of change in macroinvertebrate community that could be expected.

The assessment will consider the scale and longevity of any macroinvertebrate community impacts. The WFD classification is calculated on a 3 year rolling basis. A deterioration in classification would require a long term and significant effect on macroinvertebrate community structure to establish prediction of a deterioration in status.

Where data are not available the assessment will be undertaken using expert judgement and drawing on broad-scale evidence from other similar catchments within the reservoir group.

The prediction of impacts of hydrological and water quality changes on aquatic ecology remains subject to significant uncertainty. This is exacerbated where few data or surveillance data are used for impact assessment purposes. Lastly the environmental envelopes within which the macroinvertebrate community can successfully exist, and the relationship between populations in stressed river conditions remains subject to debate. For macroinvertebrates the evidence base for the prediction of flows and changes to LIFE score remain subject to significant debate. The assessment must therefore be undertaken in recognition that the outcome prediction will be subject to large potential variability. The study should therefore adopt a precautionary approach, with potential impact highlighted where doubt exists. Monitoring and mitigation proposals for the drought option can then be specified so that, should an option be enacted, the actual impact can be recorded and adaptive mitigation/management of the option undertaken to safeguard where possible the macroinvertebrate community.

NOTABLE SPECIES, DESIGNATED SITES AND OTHER SENSITIVE FAUNA AND FLORA

Potential Effects

Where screening of the drought option has identified that a notable species or designated site is present within the zone of influence of the drought option and screening has indicated that it is sensitive to the impacts of the drought option, the potential impact is to be investigated. Notable species are defined as Environment (Wales) Act Section 7 species or species with significant ecological sensitivity in the specified locality including species listed on IUCN red list and those not included in the red list which are nonetheless uncommon. This investigation will consider the habitat preferences of the species and its lifestages (if appropriate) and the impacts of the variation in flow (and consequent physical habitat and ecosystem) on these preferences. Potential effects are associated either 1) directly to a reduction in river flow; or 2) a reduction in water quality; 3) secondary effects of reduced velocity, for example on sediment characteristics.

Definition of Impacts

In order to define the potential impacts for sensitive ecological features in a readily understandable manner, a series of criteria have been defined. The significance of impacts upon the sensitive ecological feature will be identified following the Institute of Ecology and Environmental Managements (CIEEM) Ecological Impact Assessment (EcIA) guidance[10]. The potential significance of the impacts is identified using the following:

- **Value of the Ecological Receptor** – each ecological receptor is attributed a geographic value based upon its legislative and conservation status, as identified in Table 1.

Table 1 Value of Ecological Receptor

Ecological Value	Example
International	Existing or warranting designation as a e.g SPA and/or of significant conservation status for Europe (e.g European Protected Species (EPS)).
National	Existing or warranting designation as a SSSI and/or of significant conservation status for England (i.e. identified as a NERC / Environment Act (Wales) Section 7 species).
Regional	Habitats or species valuable at a regional level and/or of significant conservation status for the region (e.g viable breeding populations of Nationally Scarce species).
County	For example, existing or warranting designation as a County Wildlife Site (CWS) and/or of significant conservation status for the county (e.g viable breeding populations of species of county/metropolitan rarities).
District	For example, habitats or species of significant conservation status for the district (e.g viable breeding populations of species listed as rare in the district or borough).
Parish (local)	Species whose presence is considered to appreciably enrich biodiversity within the context of the parish or local neighbourhood, including as a local recreational/educational resource.
Site (within zone of influence only)	Species which are so low grade or widespread so as to be considered as not contributing to biodiversity value outside the boundaries of the site.

- **Positive or Negative Impact** – all impacts are considered to be negative unless

[10] CIEEM (2018) *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine*. Chartered Institute of Ecology and Environmental Management, Winchester.

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 using the criteria identified in **Table 2**

Table 2 Magnitude of Impact

Impact Magnitude	Description
High	There is a long-term large-scale (i.e. catchment) change in the ecological receptor and/or changes in the overall integrity of the ecological receptor.
Medium	There is a short-term large-scale change or long-term short-scale (i.e. reach) change in the ecological receptor, however no changes in the overall integrity of the ecological receptor.
Low	There is a short-term small-scale change in the ecological receptor, but its overall integrity is not impacted.
Negligible	No perceptible change in the ecological receptor.

- **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 impacts are considered to be reversible unless they are identified to have a likely impact upon the overall integrity of the ecological receptor.
- **Timing and Frequency** – the drought option could be implemented at any point in the year, however the different life stages of the sensitive ecological features will be taken into account. The assessment is based upon the operation of a single drought permit, with subsequent applications for a drought permit required to consider cumulative effects of multiple drought permits.
- **Probability** – all impacts are considered to be probable, unless otherwise stated.

Once the value of the ecological receptor, magnitude of impacts and other parameters listed above have been identified, these are used to inform the assessment of significance of impact on the ecological receptor.

Data Requirements

Sensitive ecological features baseline review requires data from standard NRW / Environment Agency monitoring programmes in the potentially impacted zone, and preferably in a control site outside of the zone of influence. Data should include species presence, abundance and density. It is likely that most fisheries data will be for O and O+ lifestages, with some indication of older echelons. Environmental supporting data should include habitat availability, hydrology and water quality as follows:

- Relevant study area (as identified in the screening report)
- Hydrology at or close to the monitoring sites to link to fish data, including full flow hydrograph, wetted width and depth, velocity profile. Will include daily gauged flow and spot flow surveys, all available records

- Meteorology (where flow data insufficient) from available NRW / Environment Agency rain gauges
- Habitat data for the monitoring sites, which may include recent RHS or Habscore surveys
- Routine NRW / Environment Agency water quality monitoring data (dissolved oxygen, BOD, ammonia, pH, hardness, water temperature, conductivity) representative of the study area
- Habitat preferences for the given sensitive ecological features will be described, against which habitat change can be assessed.

Assessment Methodology and Uncertainty

The NERC / Environment (Wales) Act Section 7 species status for the watercourses will be identified and the reasons for its inclusion in the NERC / Environment (Wales) Act Section 7 established from the relevant bodies (start with NRW / Environment Agency). The data used to support the Environment (Wales) Act Section 7 assessment will be reviewed to ensure that it is accurate.

Baseline conditions for sites within the zone of influence of the drought option will be established through existing data. These should include graphing the hydrology, water quality, habitat and fish variation temporally and, if multiple sites, spatially over the monitored period. The analysis will consider the relationship between sensitive ecological feature lifestages and the supporting environmental variables over the period, with an emphasis on changes to status and environmental conditions between low, average and high flow years. The purpose of the analysis is to establish whether the sensitive ecological features population responds to changes in flow and associated environmental variables inter-annually relating to changes in flow, climate, quality (dissolved oxygen and temperature) and/or habitat quality and availability.

Having established the baseline conditions and variability outside the drought option conditions (care will be taken to avoid using periods in the baseline analysis within which a drought permit may have been in operation), a prediction will be made of the changes in the supporting environmental variables (flow, habitat and water quality) resulting from application of the drought option conditions. Ideally this will be undertaken for the hydrological data by overlaying the drought option flows over the baseline flow hydrograph, and, where cross sectional data are available, how the wetted width and depth will vary with the drought option. This can be extrapolated to the habitat data to consider whether the key features are compromised by the change in water depth. In many cases these data are currently unlikely to exist and proxy measures such as RHS and/or aerial survey data will be used.

Once the flow, habitat and water quality drought option predictions have been established, their implications for the sensitive ecological features will be assessed. The flow and habitat environmental preferences of the sensitive ecological features will be described. The predicted changes in supporting environmental variables (flow, depth, velocity, habitat quality, dissolved oxygen levels and/or temperature) due to the drought option should be assessed against the sensitive ecological features population data.

Where data are not available the assessment will be undertaken using expert judgement and

drawing on broad-scale evidence from other similar catchments.

The prediction of impacts of hydrological and water quality changes on aquatic ecology remains subject to significant uncertainty. This is exacerbated where few data or surveillance data are used for impact assessment purposes. Lastly the environmental preferences within which species can successfully exist, and the relationship between populations in stressed river conditions remains subject to debate. The assessment must therefore be undertaken in recognition that the outcome prediction will be subject to large potential variability. The study will therefore adopt a precautionary approach, with potential impacts highlighted where doubt exists. Monitoring and mitigation proposals for the drought option can then be specified so that, the actual impact can be recorded and adaptive mitigation/management of the option undertaken to safeguard where possible the sensitive ecological features populations.

Habitat Preferences

Habitat Preferences		**Unfavourable Habitat**	**Potential Impacts**
Type/ Age Class	**Description**		
Atlantic salmon *Salmo salar* and Brown/Sea trout *Salmo trutta*			
Spawning	• Clean and unconsolidated gravels typically in the transitional area between pools and riffles where the flow is accelerating and depth is decreasing	-	Deposition of silt
			Reduction in velocity, depth and/or wetted width, possibly resulting in exposure of river bed
			Increased water velocity and depth
Nursery (fry and parr life stage)	• Shallow areas with a low water velocity and pebble substrate, often at the margins of riffles	• Deep and/or high velocity habitats.	Reduction in velocity, depth and/or wetted width, possibly resulting in exposure of river bed
			Increased water velocity and depth
			Increased risk of entrainment into water intake
			Deterioration in water quality
Adults	Deep habitats that provide shelter including one or more of the following: • submerged structures • undercut banks • overhanging vegetation < 50cm above the water surface • water surface turbulence causing a broken surface • Deep pools downstream of obstacles and sufficient water quantity through structures to enable passage across obstacles.	• Open and shallow habitats, but will use these during migration to reach spawning gravels. • Habitats upstream of significant obstructions.	Reduction in velocity, depth and/or wetted width, possibly resulting in exposure of river bed
			Increased water velocity and depth
			Increased risk of entrainment into water intake
			Increased significance of barriers to impede migration as a result of decreased flows
			Deterioration in water quality
Brook lamprey *Lampetra planeri*			
Spawning	• Clean, unconsolidated spawning gravels with suitable sheltering areas, usually located at the tail end of pools where flows are increasing.	- -	Deposition of silt
			Reduction in velocity, depth or wetted width resulting in exposure of river bed
			Increased water velocity and depth
Nursery	• Areas of sandy silt with slow water velocity, often in the margins of watercourses, above the estuary. • Variation in depth between 2 cm and 30 cm (>15cm is optimal) with a relatively high organic content.		Reduction in velocity, depth and/or wetted width, possibly resulting in exposure of river bed
			Increased water velocity and depth
			Increased risk of entrainment into water intake

Habitat Preferences		Unfavourable Habitat	Potential Impacts
Type/ Age Class	**Description**		
			Deterioration in water quality
Adults	• Cover (stones and vegetation) in the vicinity of spawning gravels.		Reduction in velocity, depth and/or wetted width, possibly resulting in exposure of river bed
			Increased water velocity and depth
			Increased risk of entrainment into water intake
			Deterioration in water quality
River lamprey *Lampetra fluviatilis*			
Spawning	• Clean and unconsolidated spawning gravels with suitable sheltering areas, usually located at the tail end of pools where flows are increasing.	-	Deposition of silt
			Reduction in velocity, depth or wetted width resulting in exposure of river bed
			Increased water velocity and depth
Nursery	• Areas of sandy silt with slow water velocity, often in the margins of watercourses, above the estuary. Variation in depth between 2cm and 30cm (>15cm is optimal) with a relatively high organic content.	-	Reduction in velocity, depth or wetted width resulting in exposure of river bed
			Increased water velocity and depth
			Increased risk of entrainment into water intake
			Deterioration in water quality
Adults	• Suitable estuarine conditions, that is free from pollution and with suitable prey species available. • Clear migration routes from the estuary to spawning grounds with suitable river flows and no barriers.	• Areas with significant pollution or limited prey availability. • Habitats upstream of significant obstructions.	Increased significance of barriers to impede migration as a result of decreased flows
			Increased risk of entrainment into water intake
			Deterioration in water quality
Sea lamprey, *Petromyzon marinus*			
Spawning	• Clean and unconsolidated spawning gravels with suitable sheltering areas, usually located at the tail end of pools where flows are increasing.	-	Deposition of silt
			Reduction in velocity, depth or wetted width resulting in exposure of river bed
			Increased water velocity and depth
Nursery	• Areas of sandy silt with slow water velocity, often in the margins of watercourses, above the estuary. Variation in depth between 2cm and 30cm (>15cm is optimal) with a relatively high organic content.	-	Reduction in velocity, depth or wetted width resulting in exposure of river bed
			Increased water velocity and depth
			Increased risk of entrainment into water intake
			Deterioration in water quality
Adults	• Suitable estuarine conditions, that is free from pollution and with suitable prey species available. • Clear migration routes from the estuary to spawning grounds with suitable river flows and no barriers.	• Areas with significant pollution or limited prey availability. • Habitats upstream of significant obstructions.	Increased significance of barriers to impede migration as a result of decreased flows
			Increased risk of entrainment into water intake
			Deterioration in water quality
Bullhead, *Cottus gobio*			
Spawning	• Coarse, hard substrate of gravel and stones.	• Deep, silty watercourses with high flow velocities and little or no cover.	Deposition of silt
			Reduction in velocity, depth and/or wetted width
			Increased water velocity and depth

Habitat Preferences		Unfavourable Habitat	Potential Impacts
Type/ Age Class	**Description**		
Nursery	• Shallow, stony riffles		Reduction in velocity, depth and/or wetted width, possibly resulting in exposure of river bed
			Increased water velocity and depth
			Increased risk of entrainment into water intake
			Deterioration in water quality
Adult	• Sheltered sections created by woody debris, tree roots, leaf litter, macrophyte cover or larger stones.		Reduction in velocity, depth and/or wetted width, possibly resulting in exposure of river bed
			Increased water velocity and depth
			Increased risk of entrainment into water intake
			Deterioration in water quality
European eel, *Anguilla anguilla*			
Juvenile (<30cm)	• Wetland habitats within 30km of tidal limit with high diversity and cover of vegetation, soft substrates and high productivity.	• Low productivity watercourses with dominance of coarse substrates and low macrophyte cover and diversity. • Habitats upstream of significant obstructions.	Reduction in velocity, depth and/or wetted width, possibly resulting in exposure of river bed
			Increased water velocity and depth
			Increased risk of entrainment into water intake
			Deterioration in water quality
Adult (>30cm, female >45cm)	• Deep, slow flowing watercourses and wetland habitats within 80km of tidal limit with high diversity and cover of vegetation, soft substrates and high productivity.		Reduction in velocity, depth and/or wetted width, possibly resulting in exposure of river bed
			Increased significance of barriers to impede migration as a result of decreased flows
			Increased water velocity and depth
			Increased risk of entrainment into water intake
			Deterioration in water quality
Barbel *Barbus barbus*			
Spawning	• Run/glide flow • Less than 50cm deep • Velocities greater than 0.5m/s • Substrate composed of clean and uncompacted gravel	-	Deposition of silt
			Reduction in velocity, depth or wetted width resulting in exposure of river bed
			Increased water velocity and depth
Nursery	• Marginal shallow bays set back from or within margins of main channel • Depths between 1cm and 30cm • No discernible to minimal flow • Substrate composed of >30% gravel and sand with low silt content • Lack of or very little riparian shading		Reduction in velocity, depth and/or wetted width, possibly resulting in exposure of river bed
			Increased water velocity and depth
			Increased risk of entrainment into water intake
			Deterioration in water quality
Adults	• Commonly associated with stretches of clean gravel and macrophyte beds, showing a preference to relatively fast-flowing stretches in the middle reaches of larger rivers. • The species also occupies deep water habitats at the foot of weirs,		Reduction in velocity, depth and/or wetted width, possibly resulting in exposure of river bed
			Impedance to movement upstream
			Increased water velocity and depth
			Increased risk of entrainment into water intake

Habitat Preferences		Unfavourable Habitat	Potential Impacts
Type/ Age Class	**Description**		
	in the lee of large woody debris, rock ledges or other obstructions on the river bed.		Deterioration in water quality
			Increased water velocity and depth
Fine-lined pea mussel, *Pisidium tenuilineatum* and depressed river mussel *Pseudanodonta complanata*			
All life stages	• Fine sediments of lowland rivers and canals,	• High velocity watercourses with coarse substrates.	Reduction in velocity, depth and/or wetted width, possibly resulting in exposure of river bed
White-clawed crayfish *Austropotamobius pallipes*			
All life stages	• Slow-flowing sections of stony rivers • Boulder riffles in chalk or clay streams • Submerged tree roots • Debris dams • Crevices in old or damaged submerged brickwork, stonework, cracked concrete or rotten wooden structures • Un-mortared stone revetting which protects banks from erosion • Stands of submerged and emergent aquatic plants • Old gravel workings and chalk pits • Good water quality	• Uniform clay channels • Areas of deep or soft silt • Dense filamentous algae • Narrow fast-flowing channels • Areas of sand and gravel, or bedrock, which are lacking in cobble or boulder (though they may feed in or commute through these areas) • Pebble or cobble shingle regularly exposed by changing river levels • Areas of armoured bed where the substrate is compacted by the river flow • Acidic streams or ochreous drainage • Poor water quality or salinity	Reduction in velocity, depth and/or wetted width, possibly resulting in exposure of river bed
			Increased water velocity and depth
			Increased risk of entrainment into water intake
			Transfer of non-native species or disease
			Deterioration in water quality

APPENDIX D
ENVIRONMENTAL FEATURES ASSESSMENT

D1 INTRODUCTION

This appendix presents information regarding the environmental features associated with the Talybont Reservoir drought order. Baseline data and the impact assessments are presented for the environmental features that form part of the scope of the assessment (established by the screening exercise described in Section 3.2.2 of the EAR and results of which are summarised in Section 5.2). The features assessment presented in full below is summarised in Section 5.3 of the EAR.

Points of interest referred to throughout the text are indicated in **Figure D1.1**.

The approach to the assessment addresses the following: i) potential effects on each sensitive receptor; ii) definitions for impacts (adverse / beneficial), i.e. the significance criteria (quantitative and / or qualitative measures used to grade the severity of impacts of the drought order for the impact criteria major, moderate, minor, negligible; following the requirements of the DPG); iii) the data requirements; iv) assessment methodology (including the treatment of uncertainty where the complete data requirements are not available).

The assessment of environmental features is informed by the assessment of the physical environment (which includes hydrology and hydrodynamics; geomorphology; and water quality), this is summarised in Section 4 presented in full in **Appendix B**.

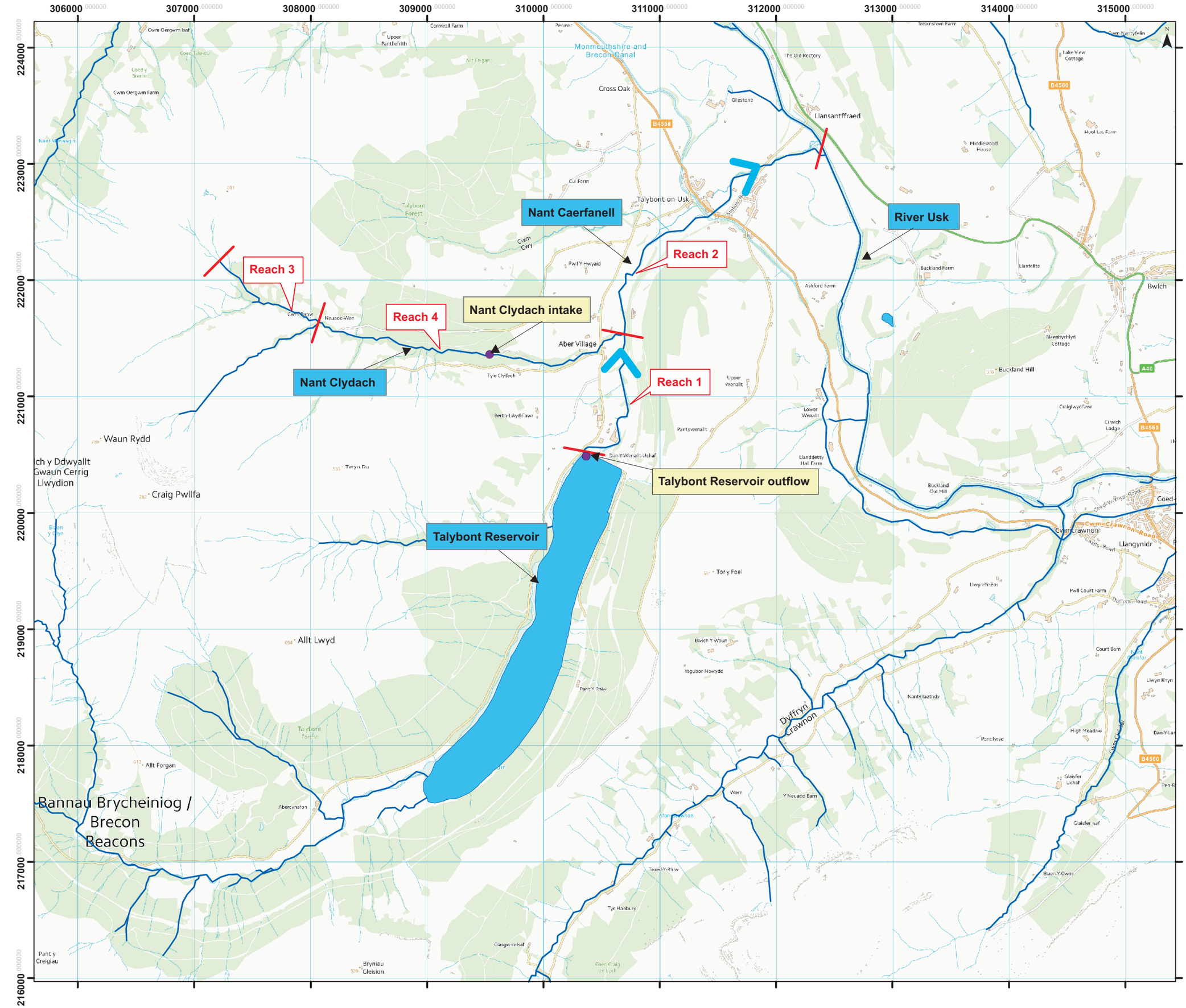
The ecological assessment has been undertaken recognising the Institute of Environmental Management & Assessment (IEMA)[1][2] and the Chartered Institute of Ecology and Environmental Management (CIEEM) study guidelines[3]. The assessment of impacts on other environmental receptors e.g. recreation and landscape has been carried out largely by qualitative expert judgement. Specific assessment methodologies for key environmental features are set out in **Appendix C**.

Desk-based assessments have been completed for each of the sensitive receptors, where applicable, in order to determine the magnitude of impact in the relevant lake / river reaches for the Talybont Reservoir drought order. Each feature assessment describes the analyses carried out and a statement of the assessed impact. All impacts are considered to be negative / adverse unless otherwise stated in the feature assessment.

This appendix is set out in the following sections:

Section D.2 Designated Sites

[1] IEMA (2004) Guidelines for Environmental Impact Assessment.
[2] IEMA (2011) Special Report – The State of Environmental Impact Assessment Practice in the UK
[3] CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland.



Legend

- Waterbody
- Water Courses
- Hydrological Reach
- Flow Direction
- Abstraction

RICARDO

Dŵr Cymru Welsh Water

1:30,000

Note: All locations are approximate

Project Title: Welsh Water Drought Plan Environmental Assessment

Figure Title: Study area: 8116-3 Utilise the Dead Storage in Talybont Reservoir

Figure Number: Figure 2.3

Date: February 2019

D2 DESIGNATED SITES

D.2.1 River Usk (Tributaries) SSSI, River Usk (Upper Usk) SSSI and River Usk SAC

D.2.1.1 Baseline

The Nant Caerfanell is designated as part of the River Usk (Tributaries) SSSI as well as being designated as part of the River Usk SAC. The River Usk and the majority of the upper Usk tributaries support aquatic plant communities typical of moderately nutrient rich waters, including some where water crowfoot *Ranunculus* spp. are prominent. Extensive areas of semi-natural riparian habitats can still be found next to the tributaries. These include semi-natural woodland, dry and marshy grassland, stands of tall fen and marsh vegetation and gravel banks.

The impacted Reaches 1 and 2 fall within Management Unit 7 of the River Usk SAC and the River Usk (Tributaries) SSSI. As the hydrological impacts of implementation of this drought order do not extend into the main stem of the River Usk (see **Appendix B**), the River Usk (Upper Usk) SSSI is not expected to be impacted and is therefore not assessed further.

The presence and importance of the designated features within the SAC Management Unit 7 are shown in **Table D2.1**. Annex II species for which the site is designated that are present with Unit 7 are: otter *Lutra lutra*; bullhead *Cottus gobio*; river lamprey *Lampetra fluviatilis*; brook lamprey *Lampretra planeri*; Atlantic salmon *Salmo salar*. The Annex II species allis shad *Alosa alosa*, twaite Shad *Alosa fallax*, sea Lamprey *Petromyzon marinus*, and the Annex I habitat Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation are absent from Unit 7[4]. White-clawed crayfish *Austropotamobius pallipes* have also been recorded in the Caerfanell and are therefore expected to be located in the impacted reaches of the Caerfanell.

Further species for which the SSSI is designated include breeding birds associated with riparian habitats including grey heron *Ardea cinerea*, common sandpiper *Actitis hypoleucos*, grey wagtail *Motacilla cinerea*, dipper *Cinclus cinclus*, kingfisher *Alcedo atthis* and goosander *Mergus merganser*. Additionally, the river and bankside trees support large populations of flying insects, an important food source for bat species located along the Usk valley including Daubenton's bat *Myotis daubentonii* and lesser horseshoe bat *Rhinolophus hipposideros*.

[4] Countryside Council for Wales (2008) Core Management Plan Including Conservation Objectives For River Usk Special Area Of Conservation.

Table D2.1 SAC features within Management Unit 7 – Nant Caerfanell

SAC features	
Atlantic salmon	KS
European otter	KS
River Lamprey	Sym
Brook Lamprey	Sym
Bullhead	Sym
Sea lamprey	x
Twaite Shad	x
Allis shad	x
Rivers with floating vegetation often dominated by water-crowfoot	x

Key for Table D2.1	
KS	Key species in the management unit
Sym	Features of importance the unit but are not the main focus of management or monitoring. These features will benefit from management for the key feature(s) identified in the unit. These may be classed as 'Sym' features because: • they are present in the unit but are of less conservation importance than the key feature; and/or • they are present in the unit but in small areas/numbers, with the bulk of the feature in other units of the site; and/or • their requirements are broader than and compatible with the management needs of the key feature(s).
X	Features not present in Management unit

Assessment

The hydrological assessment has identified that there is no reduction to the magnitude of flow rates in Reaches 1-4 as a result of this drought order. However, as a result of the increased pumping from Talybont Reservoir's dead storage zone, there is estimated to be a 3% increase (13 days) in the duration of the period for which storage is below top water level, and for which reservoir outflow is limited to compensation only. This also leads to a delay of 13 days in the first occurrence of reservoir overflows following refill, which increase the flows in Reaches 1 and 2. No impacts have been identified on Reaches 3 and 4. Implementation of a drought permit will not result in any changes to minimum wetted widths or depths of the Nant Caerfanell or Nant Clydach.

Atlantic salmon, river lamprey, brook lamprey, and bullhead (Annex II species for which the SAC has been designated) are present within the impacted reaches. The drought permit implementation period (September to December) coincides with the spawning migration of Atlantic salmon and river lamprey, and the spawning period for Atlantic salmon. Atlantic salmon predominantly enter the Usk system in summer through to autumn (depending on rainfall and spates), with fish unlikely to reach the tributaries until alter in the year. However, due to the short duration of the delay in compensation release combined with no impact on flow magnitude or habitat availability, the upstream migratory life stages of the salmon and river lamprey are unlikely to be adversely impacted. Bullhead and brook lamprey typically

spawn in spring, with localised spawning migrations made during the autumn months. Similar to salmon and river lamprey, drought permit impacts are unlikely to adversely impact bullhead and brook lamprey populations. Impacts on fish populations are therefore assessed as **negligible**.

European otter are also designated but this mobile species is able to adapt to changes in river levels and may potentially benefit from easier predation of fish species; consequently effects on otter are not considered further.

White-clawed crayfish are known to be present in the Caerfanell and, taking a precautionary approach, are also assumed to be potentially present in the Nant Clydach. The overall impacts for this species are assessed as **negligible**.

Breeding bird and bat species (and associated flying insects) designated as part of the SSSI are not likely to be impacted by implementation of the drought order against a baseline of reduced flows characteristic of natural drought conditions.

Summary

The potential impacts of the Talybont Reservoir drought order on the features of Unit 7 of the SAC and relevant parts of the SSSI are summarised in **Table D2.1**. The impacts, and their magnitude, have been based on the hydrological impacts (see Section 4.2 of the main report and Appendix B), their influence on the physical environment (including geomorphology, water quality and likely habitat availability) (see Section 4.3 of the main report) and the sensitivities of the features of the designated sites. The impacts presented in **Table D2.1** represent the worst case impacts of implementing a drought order, over and above the impacts potentially caused by a natural drought.

Table D2.1 Summary of Impacts on SAC and SSSI Designated Sites and Species

Feature	Impact	Significance of Impact
Reaches 1, 2, 3 and 4– Nant Caerfanell and Nant Clydach		
River Usk SAC Unit 7 Usk Tributaries SSSI	• No likely effects on SAC/SSSI features, including Atlantic salmon, lamprey species, bullhead, bird and bat species, and associated flying insects, over and above those due to natural drought conditions.	**Negligible**