

Draft

Drought Plan 2020:

Annex 1n – SEWCUS

WRZ

March 2019



Table of Contents – Annex 1n

1. South East Wales CUS (SEWCUS) - WRZ Reference no. 8121	127
1.1. SEWCUS Water Resources Overview	127
1.2. Drought Triggers.....	129
1.3. Assessment of Drought Risk	130
1.4. Drought Management of the WRZ.....	133
1.5. Supply-side drought management action	135

Table of Figures

Figure 1 - Map of the SEWCUS WRZ.....	127
Figure 2 - Big Five Drought Action Zone with the results of baseline scenario testing.....	130
Figure 3 - Big Five Drought Action Zone with the results of climate change scenario testing.....	132
Figure 4 - SEWCUS DRS Chart for droughts ending September with climate change included	132

Table of Tables

Table 1 - Licensed Sources in SEWCUS WRZ.....	128
Table 2 - Option 8109-1 Reduce Llwynon compensation flow	137
Table 3 - Option 8109-4 Emergency abstraction from the Afon Lwyd at New Inn	139
Table 4 - Option 8112-1 Emergency abstraction from the River Rhondda at Treherbert	141
Table 5 - Option 8116-3 Utilise the Dead Storage in Talybont Reservoir.....	143
Table 6 - Option 8119-1 Reduce Pontsticill compensation flow	145

1. South East Wales CUS (SEWCUS) - WRZ Reference no. 8121

1.1. SEWCUS Water Resources Overview

The South East Wales Conjunctive Use System (SEWCUS) is the largest of all our 24 water resource zones and serves some 1.3 million domestic customers. It covers the large conurbations of Cardiff and Newport as well as the towns and villages of the South Wales valleys as far west as the Rhondda Valley and as far east as Chepstow (see Figure 1).

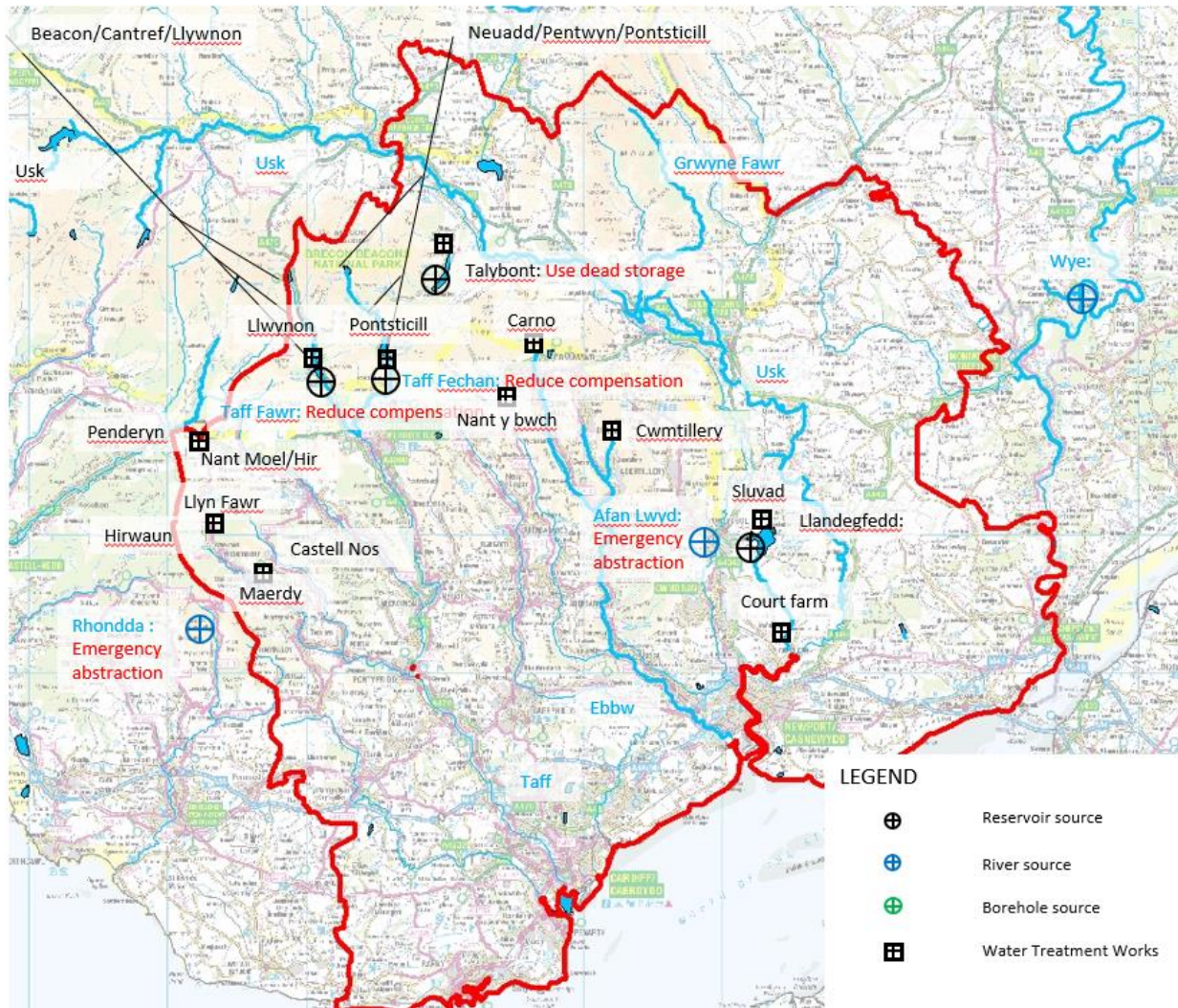


Figure 1 - Map of the SEWCUS WRZ

In total, there are over 30 sources that are used for supply which range from upland reservoirs to large river abstractions from the bigger rivers in the east of the zone. A list of our raw water sources for the zone is presented in Table 1.

Site Name	Licence No.	Source Type	Status
Beacons	21/57/21/0001	Impounding reservoir	Operational
Cantref	21/57/21/0001	Impounding reservoir	Operational
Llwynon	21/57/21/0001	Impounding reservoir	Operational
Pontsticill	21/57/21/0002	Impounding reservoir	Operational
Rhymney Bridge Upper	21/57/11/0001	Impounding reservoir	Operational
Rhymney Bridge Lower	21/57/11/0001	Impounding reservoir	Operational
Shon Sheffrey	20/56/65/0014	Impounding reservoir	Operational
Upper Carno	20/56/64/0003	Impounding reservoir	Operational
Lower Carno	20/56/64/0003	Impounding reservoir	Operational
Blaenycwm	20/56/33/0014	Impounding reservoir	Operational
Cwmtillery	20/56/63/0011	Impounding reservoir	Operational
Usk reservoir	20/56/54/0001	Impounding reservoir	Operational
Nant Henwaun	20/56/54/0003	River intake	Operational
Talybont	20/56/41/0007	Impounding reservoir	Operational
Clydach	20/56/41/0012	River intake	Operational
Prioress Mill	20/56/22/0027	River intake	Operational
Llandegfedd	20/56/13/0017	Pump storage reservoir	Operational
Wye Transfer	19/55/18/0408	River intake	Operational
Nant Moel	21/57/23/0005	Impounding reservoir	Operational
Nant Bodwigiad	21/57/23/0002	River intake	Operational
Nant Bwllfa	21/57/23/0002	River intake	Operational
Penderyn borehole	21/57/23/0060	Groundwater source	Operational
Llyn Fawr	21/57/24/0001	Impounding reservoir	Operational
Garreg Lwyd	21/57/24/0001	River intake	Operational
Nant Ffernol	21/57/24/0007	River intake	Operational
Nant Selsig	21/57/24/0004	River intake	Operational
Lluest Wen	21/57/24/0025	Impounding reservoir	Operational
Castell Nos	21/57/24/0025	Impounding reservoir	Operational
Llantrisant	20/56/21/0034	River intake	Standby
Grwyne Fawr	20/56/34/0018	Impounding reservoir	Mothballed
Wentwood	20/56/72/0018	Impounding reservoir	Mothballed
Pant yr Eos & Ynys Fro	20/56/11/0005 & 20/56/11/0007	Impounding reservoir	Mothballed
Rogerstone Grange	19/55/21/0056	Borehole	Mothballed

Table 1 - Licensed Sources in SEWCUS WRZ

The abstractions from the Rivers Wye and Usk are taken from the lowland stretches of the rivers and are supported by large catchment areas which are able to sustain the flow in the rivers throughout the year. Under low river flow conditions the abstractions from the Wye at Monmouth are maintained by regulation releases from the Elan Valley Reservoirs in the headwaters of the River Wye. Similarly in prolonged dry periods, water can be released into the River Usk from Usk reservoir to allow us to take it out of the river upstream of Usk town at our Prioress Mill pumping station.

The SEWCUS zone is connected by a series of large water mains to allow water from the lowland river sources and their associated treatment works in the east, to be transferred further west and north, to relieve the demand on the upland impounding reservoirs whose storage declines relatively quickly in

dry weather. This preserves the storage in these upland sources and allows them to supply their immediate demand areas throughout an extended drought.

The objective when operating the reservoirs and associated works is to ensure that there is always sufficient water across the zone even during the driest years, but when water is plentiful to make best use of the cheaper upland reservoir sources. This operation is controlled through the use of set rules which govern the amount of water fed to each of the works in relation to the amount of water in the reservoirs.

Of the 30 or so sources that supply SEWCUS, there are five major reservoir systems (the 'Big 5'), which provide the bulk of the water going into supply. These are: Usk Reservoir; Talybont Reservoir; Llandegfedd Reservoir; Taf Fawr Reservoirs (Llwynon, Cantref & Beacons Reservoirs); and Pontsticill Reservoir.

Llandegfedd Reservoir utilises a refill strategy which relies on our ability to abstract the majority of the water we require from the River Usk at Prioress Mill during winter periods when there is a lot of water in the river. This lessens our impact on the environment during summer periods when river levels are lower.

There is an import of water from the Tywi CUS WRZ, which supplies the area north-west of Cardiff around Talbot Green and Llantrisant. There are no exports of water.

1.2. Drought Triggers

The drought status of the zone is assessed by the combined reservoir storage position at any time in relation to the Drought Action Zones (DAZs), defined for the 'Big Five' group of reservoirs. The use of the DAZs are described in more detail in Section 2 of the main report and the 'Big Five' DCL is shown below in Figure 2.

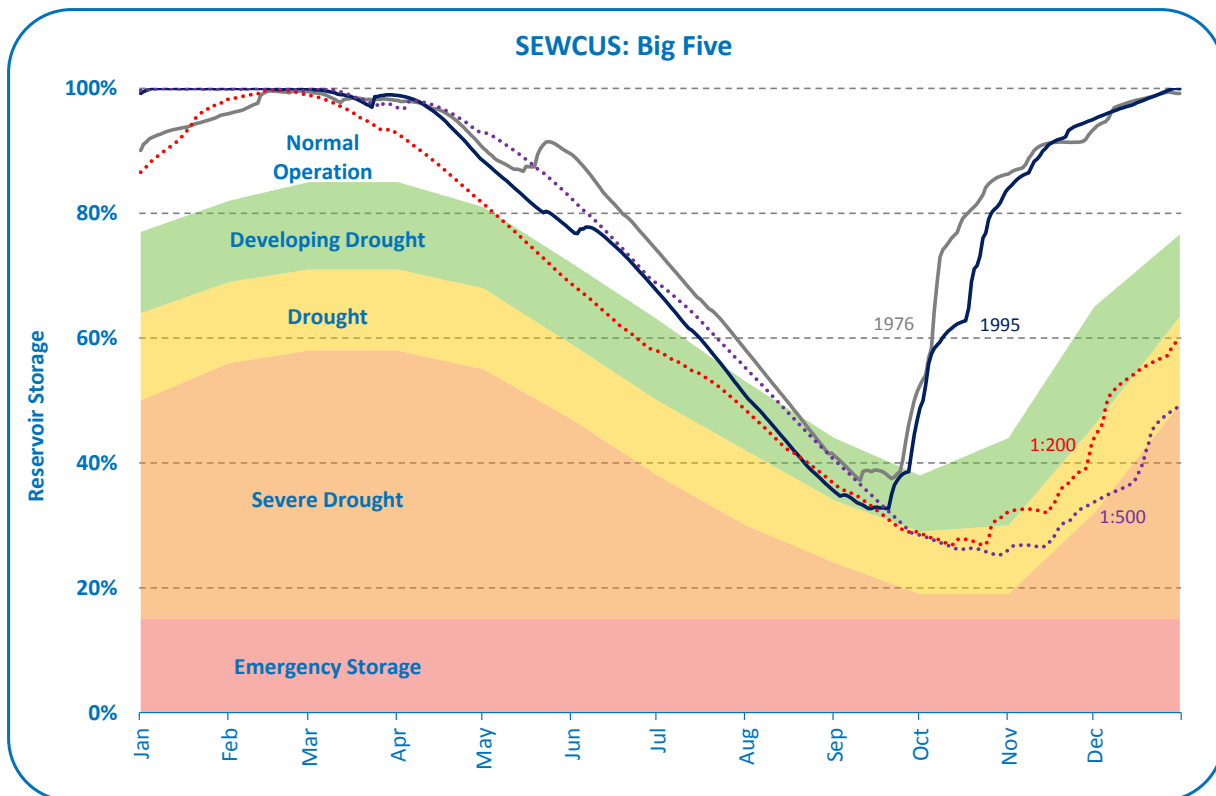


Figure 2 - Big Five Drought Action Zone with the results of baseline scenario testing

1.3. Assessment of Drought Risk

1.3.1. Scenario Testing

Drought risk for the zone is undertaken through assessment of the combined storage position in our 'Big 5' reservoir group against the DAZs we have defined, as shown in Figure 2 above. Despite the large number of sources in the zone, this group of reservoirs and their associated water treatment works provide the bulk of our water supply, including supporting those reservoir sources that are not part of the 'Big 5' group e.g. Shon Sheffrey, Lluest Wen and Llyn Fawr.

The baseline flow record used for our deployable output scenario testing covers the period 1973 – 2015 and so encompasses the known drought events of 1976, 1984, 1989 and 1995. In addition to analysing the performance of the reservoirs using historic time series data, statistical techniques were used to generate more extreme drought events to test our systems against.

A stochastic set of inflows for all the individual reservoir and river intake catchments within SEWCUS were produced using novel flow generation techniques. This work produced a time series of c10,000 years of inflow data. As we are unable to model this long a time series, sub sampling was undertaken to allow the production of 'Drought Libraries' of 500 years' worth of 6, 12, 18, 24 and 48 month drought events, of varying return periods between 1:50 and 1:5000. These were then run through our WRAPSim water supply model for the zone, the results of which are shown in Figure 2.

Figure 2 shows that if we were to experience a repeat of the hydrological conditions of the 1976 and 1995 drought events, then the zone is wholly resilient to these to the extent that we would be unlikely

to implement a hosepipe ban to help preserve resource. This is a significantly improved position for our customers when compared to the disruption that was caused to supplies during the actual 1976 drought. Figure 2 also presents a small sample of results from our drought library scenario testing, which shows that under the more extreme droughts we have simulated (i.e. 1:200 and 1:500 year return period events respectively), there are no breaches of our Emergency Storage provision across the 'Big 5' reservoir group.

Our SEWCUS WRZ is highly conjunctive and we have the ability to balance our water supplies in response to changing weather conditions which is why our resilience to drought is high. However, we know that to produce this level of drought resilience, we have to carefully manage our water resources as not all our reservoirs have the same level of risk to drought.

Although the overall analysis indicates that drought risk is low for the WRZ, given that local issues may occur within such a large and complex zone, we have retained a number of Drought Permit/Drought Order options to provide additional support should these ever be required. Section 1.5 provides further details on this.

1.3.2. Drought Response Surface

As outlined in Chapter 3, application of the Drought Vulnerability Framework (DVF) screening methodology indicated that the SEWCUS WRZ is at high risk of significant drought impact and so advanced techniques (DVF method 1b) have been used to generate the data necessary to produce a Drought Response Surface (DRS) chart. Utilising DVF method 1b, a stochastic set of inflows for all the individual reservoir and river intake catchments within SEWCUS were produced using novel flow generation techniques. This work produced a time series of c10,000 years of inflow data containing As we are unable to model this long a time series, sub sampling was undertaken to allow the production of 'Drought Libraries' of 500 years' worth of 6, 12, 18, 24 and 48 month drought events, of varying return periods between 1:50 and 1:5000. These were then run through our WRAPSim water supply model for the zone in order to provide the outputs necessary to produce the Drought Response Surface charts. Full details of the approach taken in SEWCUS are given in Appendix 1.

As there were no breaches of the Emergency Storage provision within the 'Big 5' reservoir group under the baseline drought scenario then there was no requirement to produce a DRS chart. The stochastic time series was then run with the influence of climate change now included and as Figure 3 shows, there is now more risk of the Emergency Storage provision being breached. Using the data from this scenario we have produced the DRS in Figure 4 which highlights that the type of drought event needed to create this 'failure' is around 50% of the long term average rainfall for a 12 month period. The return period of this type of event is estimated to be around 1:500 years with a forecast shortfall in supplies of up to 1 week. Therefore we would still be confident of having enough water to maintain customer supplies even during such an extreme event.

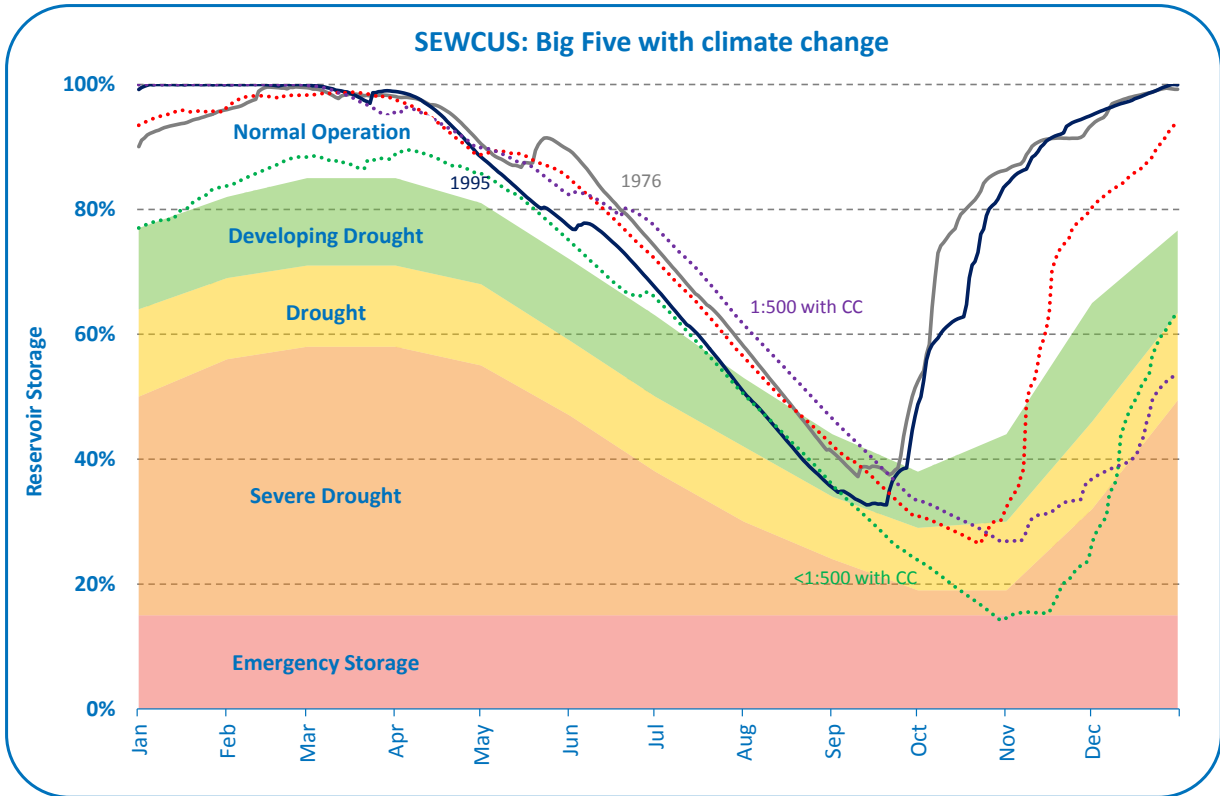


Figure 3 - Big Five Drought Action Zone with the results of climate change scenario testing

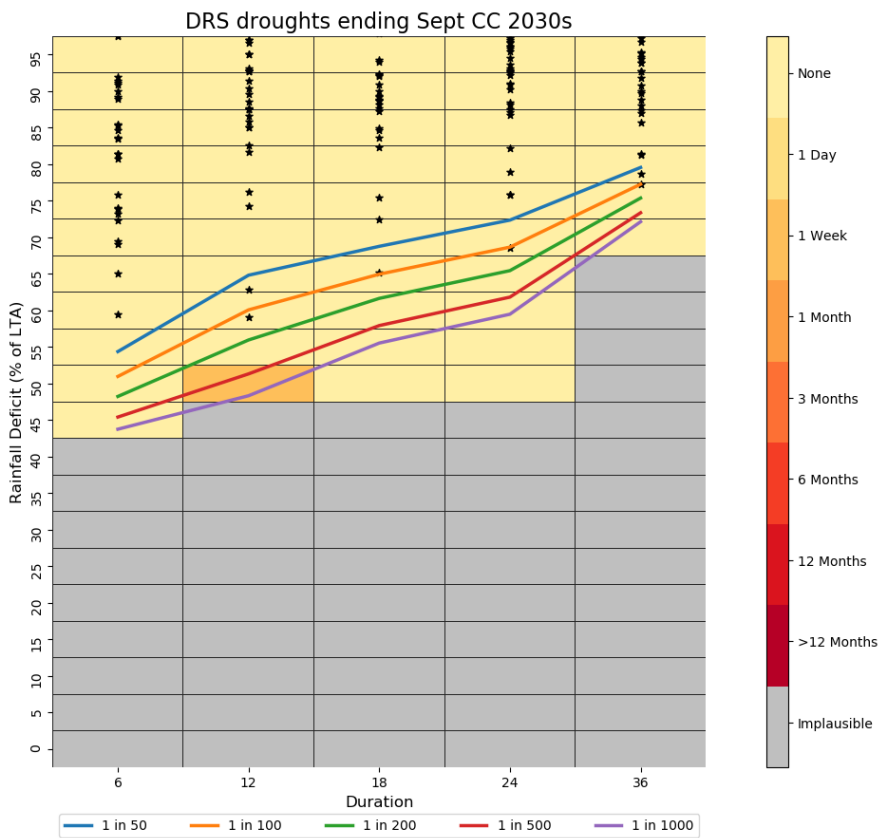


Figure 4 - SEWCUS DRS Chart for droughts ending September with climate change included

1.4.Drought Management of the WRZ

As the identified drought risk in the zone is low then our water resource management philosophy is to ensure we operate our water resources in line with our control curves and take all necessary actions in good time, in order to maintain this high level of drought resilience.

The following sections describe the operation of the zone as we move into a drought period and the actions that we will take to ensure that we minimise the impact on our customers. It outlines the timing of water saving messages that we might put out and how we will manage demand. In the event of extreme drought, options to increase the quantity of water resource available for public water supply may be required – these are also outlined, with supporting summary information on the requirements of those options.

1.4.1. Normal Operation

During normal weather conditions we optimise our sources to minimise the cost of operations. In the SEWCUS zone this means that we make maximum use of our upland reservoirs and water treatment works at Llwynon, Cantref, Beacons, Pontsticill, Llyn Fawr and Talybont that gravitate supplies to our customers. As reservoir storages start to decline we make small, stepped reductions in the supply areas of all of these water treatment works. Cantref and Llwynon output flows can be reduced to the point of shutting down the WTW. As Llwynon WTW reduces the volume of water that it puts into supply, less water is available to be sent to west Cardiff as well as Merthyr Tydfil. Routine valve operations on our distribution network are then carried out to allow water from Sluvad/Courtfarm WTWs to supply these areas instead.

Sluvad/Courtfarm water can be further utilised within the SEWCUS zone through additional valve operations on the network, in conjunction with the operation of our Memorial pumping station, to support the area around Pontypridd. This operation serves two purposes. It allows Pontsticill WTW to reduce its output thus preserving resource in Pontsticill reservoir and it also allows for the preservation of storage in Llynfawr reservoir by allowing Sluvad/Courtfarm water to supply the areas of the Rhondda valleys that it normally feeds.

As stocks in the Heads of the Valleys area decline, stand-by pumping stations can be turned on to allow Talybont WTW water to supply customers in the areas south of the A465 corridor, such as Tredegar and Ebbw Vale. Similar operations can be carried out in the Abertillery valley to support Cwmtillery reservoir.

Some of our reservoirs require active management as their stocks decline in order to better utilise the water within them. This takes the form of releasing water from the upper reservoirs in tiered systems such as the Taff Fawr, Rhymney Bridge and the Carno reservoir complexes. In addition we also have the ability to directly transfer water via pipelines between reservoirs either by gravity, such as Nant Moel into Penderyn, or via pumping arrangements such as Blaenycwm into Shon Sheffrey.

As storage in Penderyn reservoir declines then we have the option to operate our borehole at Penderyn to bolster reservoir stocks.

The continued decline in storage at Llwynon and Pontsticill would be the trigger for us to initiate a scheme to install temporary transfer pumps that allow us to bring water in from the Tywi Gower WRZ. Alongside this capital scheme intervention, the water distribution team need to then make the necessary changes to our networks to allow this water to be used to support the area around Church Village.

Dependent on the storage position in Llandegfedd, which may start to decline more quickly as we increase the output at Sluvad to supply more of SEWCUS, we may commence regulation releases from Usk Reservoir to support our abstraction at Prioress Mill. The low river flows will mean that our permitted levels of abstraction from the River Usk are much less than the demands being placed on Llandegfedd reservoir and so to make up some of this shortfall, we can make releases of water from Usk reservoir that can be abstracted in addition to the water that we are permitted to take.

1.4.2. Developing Drought Action Zone

As reservoir storages move into the developing drought action zone, the operations which may be necessary to preserve resource are less frequently undertaken. This increases the risk of the operations impacting our customers, and so to authorise these activities, the 'Gold' incident command centre will convene.

Making further, controlled changes to our networks we will look to increase the supply of water from the Sluvad/Courtfarm system into areas normally supplied by Pontsticill and Llwynon. This will reduce these treatment works to their minimum operating levels, or shuts them down in Llwynon's case, and accordingly lowers the demand on Pontsticill and Llwynon reservoirs.

By this point our leakage effort and targeting activities will have been stepped up with greater focus placed on those areas within the zone that are under the greatest strain.

We may also consider abstracting from our Manorafon intake in the Twyi Gower WRZ to support Bryngwyn and reduce demand on Usk reservoir. This allows more water to be released into the River Usk for abstraction at Prioress Mill. This in turn bolsters the storage in Llandegfedd Reservoir and enables Sluvad WTW to support the rest of the zone.

1.4.3. Drought Action Zone

Once all changes to our water supply systems have been made, the operation of the zone will be fully optimised to preserve water resource. As reservoir storage approaches the Drought Action Zone we will prepare to bring any of our mothballed sources that are listed in Table 1, back into supply. At the same time we will request permission from NRW and Welsh Government to take more water from the environment. To support these requests, we will commence environmental monitoring in line with our Environmental Assessment Reports (Appendix 16 to 20) and submit our applications for the options identified in Section 1.5.

1.4.4. Severe Drought Action Zone

As reservoir storage enters the Severe Drought Action zone, subject to receiving the necessary permissions from NRW and Welsh Government, we will look to implement our five Drought Order/Permit schemes. As set out in Section 1.5 the options available to us are: 1) reduce the compensation flows at Llwynon reservoir, 2) reduce the compensation flow from Pontsticill reservoir, 3) Emergency abstraction from the Afon Lwyd, 4) Emergency abstraction on the River Rhondda, 5) Utilise the dead storage in Talybont reservoir.

1.5. Supply-side drought management action

The following tables (Table 2, Table 3, Table 4, Table 5, and Table 6) provide the information required by Appendix G of NRW's Water Company Drought Plan Technical Guideline (Dec 2017). The tables summarise the key information from within the associated Environmental Assessment Reports (EARs) including any potential environmental impacts, risks to the scheme implementation and any necessary mitigation that may be required.

Action Implementation Assessment	Name:	Reduce Llwynon compensation flow by 50%
	Trigger(s)	Storage in Big 5 reservoir group crosses into Severe Drought Action Zone.
	Deployable Output or yield of the action	9.1 MI/d yield
	Location	Llwynon reservoir
	Implementation timetable	Preparation time: We assume a decision from NRW within 14 days of submitting the Drought Permit application. The practical implementation of the option could be effected immediately. Time of year effective: The option is most likely to be implemented during September to November. Duration: Drought permits are valid for up to six months, but is most likely to be three months.
	Risks associated with action	The application, as applied for, is not approved. Reduction in compensation releases have potential environmental impacts. These will be assessed through the EAR submitted with the application.
	Other considerations	N/A
Environmental Assessment: alone & in-combination	Risk to the Environment	Reduced flow in the Afon Taf Fawr and River Taff.
	Summary of likely environmental impacts	The hydrological assessment has concluded that there is potential for major impact on river flows and major impacts on the physical environment of the river, including water quality. The environmental assessment has concluded that there are major-minor impacts on aquatic ecology specifically: major impacts on fish, minor impacts on macroinvertebrates, macrophytes and phytobenthos. In-combination effects with the Pontsticill option 8119-1 are anticipated on fish, macroinvertebrates and macrophytes.
	Baseline information used	Hydrological data: <ul style="list-style-type: none"> • Daily Llwynon water level data • Daily abstractions from Llwynon Reservoir • Daily mean compensation flows to the Afon Taf Fawr • NRW river flow gauge on the River Taff at Merthyr Tydfil, the River Taff at Fiddler's Elbow, and the River Taff at Pontypridd Ecological data: <ul style="list-style-type: none"> • NRW and APEM macrophyte sampling data from the Taf Fawr and the River Taff • NRW and APEM macroinvertebrate sampling on the Afon Taf Fawr and the River Taff • NRW and APEM fish survey data on the Afon Taf Fawr and the River Taff • NRW phytobenthos data from the Afon Taf Fawr
	Summary of additional monitoring requirements	<ul style="list-style-type: none"> • Spot flow gaugings • Biochemical water sampling • Fish surveys (including salmon, brown trout, lamprey, bullhead, eel)
	Mitigation & Compensation measures	The mitigation measures that could be considered at the on-set of drought, during implementation of the drought permit and post-drought permit implementation include: <ul style="list-style-type: none"> • Temporary reduction or cessation of the terms of the Drought Order/Permit • Fish distress monitoring with triggers and response plan

		<ul style="list-style-type: none"> • Protection of 'spate flows' • Reduction of fish predation • Physical in-river works • Provision of alternative compensation flows • Provision of alternative water supplies if other water users are at risk of derogation. <p>Potential mitigation measures have also been proposed and further discussion with NRW is required in order to develop suitable mitigation measures.</p>
	Impact on other activities	A reduction in flows on the Taf Fawr and River Taff has potential temporary and uncertain impact to visual amenity and recreation. Because flows would be naturally low at the time of the drought permit, it is uncertain how significant further reduction in flows would be on the visual appeal of the rivers, and recreational activities in the area include angling, riding, cycling, walking and canoeing.
	Any permissions or approvals required and constraints that apply	N/A

Table 2 - Option 8109-1 Reduce Llwynon compensation flow

Action Implementation Assessment	Name:	Emergency abstraction from the Afon Lwyd at New Inn
	Trigger(s)	Storage in Big 5 reservoir group crosses into Severe Drought Action Zone.
	Deployable Output or yield of the action	Up to 12 Ml/d yield
	Location	Afon Lwyd at New Inn
	Implementation timetable	Preparation time: We assume a decision from WG within 28 days of submitting the Drought Order application, and a decision from NRW within 28 days of submitting the associated Flood Risk Activity Permit (FRAP). The practical implementation of the option could potentially be effected within two weeks. Time of year effective: The option is most likely to be implemented during September to November. Duration: Drought orders are valid for up to six months, but is most likely to be three months.
	Risks associated with action	The application, as applied for, is not approved. Emergency abstractions have potential environmental impacts. These will be assessed through the EAR submitted with the application.
Other considerations	Lower yield than expected from the Afon Lwyd.	
Environmental Assessment: alone & in-combination	Risk to the Environment	Reduced flow in the Afon Lwyd.
	Summary of likely environmental impacts	The hydrological assessment has concluded that there is potential for minor impact on flows in headwater streams and a major impact on flows in the Afon Lwyd, which could lead to negligible impacts on the physical environment of the river, including water quality. There is potential for major environmental impacts on fish, moderate impacts on macrophytes, white-clawed crayfish, macroinvertebrates and phytobenthos and minor impacts on the Lower Usk SSSI.
	Baseline information used	Hydrological data: <ul style="list-style-type: none"> • Weekly/daily Llandegfedd water level data • NRW river flow gauge on the Afon Lwyd at Abersychan and Ponthir • NRW and DCWW spot flow gaugings at various locations on the Afon Lwyd Ecological data: <ul style="list-style-type: none"> • NRW and Cascade macrophyte sampling data on the Afon Lwyd • NRW and Cascade macroinvertebrate data on the Afon Lwyd • NRW and DCWW fisheries monitoring data on the Afon Lwyd • White clawed crayfish surveys on the Afon Lwyd
	Summary of additional monitoring requirements	<ul style="list-style-type: none"> • Walkover survey during low flow conditions to map sensitive habitats, communities, species and any monitoring sites that are required in order to improve understanding of the baseline communities • Spot flow gauging surveys • Biochemical water quality sampling • Macrophyte surveys • Macroinvertebrate surveys • Fish surveys (including brown / sea trout, Atlantic salmon, bullhead, European eel and other fish species) • Phytobenthos surveys • White clawed crayfish surveys

	Mitigation & Compensation measures	<p>The mitigation measures that could be considered at the on-set of drought, during implementation of the drought permit and post-drought permit implementation include:</p> <ul style="list-style-type: none"> • Temporary reduction or cessation of the terms of the Drought Order/Permit • Fish distress monitoring with triggers and response plan • Protection of 'spate flows' • Reduction of fish predation • Physical in-river works • Provision of alternative compensation flows • Provision of alternative water supplies if other water users are at risk of derogation. <p>Potential mitigation measures have also been proposed and further discussion with NRW is required in order to develop suitable mitigation measures.</p>
	Impact on other activities	<p>A reduction in flows in the Afon Lwyd has potential uncertain impact on the visual amenity. Any reduction in wetted width and depth may influence the angling resource on the Afon Lwyd flows in the study area.</p>
	Any permissions or approvals required and constraints that apply	<p>Flood Risk Activity Permit (FRAP) would need to be applied for to install sandbags in the Afon Lwyd (main river).</p> <p>Land access permission would be required to install temporary pump and pipeline to water treatment works.</p>

Table 3 - Option 8109-4 Emergency abstraction from the Afon Lwyd at New Inn

Action Implementation Assessment	Name:	Emergency abstraction from the River Rhondda at Treherbert
	Trigger(s)	Storage in Big 5 reservoir group crosses into Severe Drought Action Zone.
	Deployable Output or yield of the action	1 MI/d yield
	Location	River Rhondda at Treherbert
	Implementation timetable	<p>Preparation time: We assume a decision from NRW within 14 days of submitting the Drought Permit application .The practical implementation of the option could potentially be effected within two weeks.</p> <p>Time of year effective: The option is most likely to be implemented during September to November.</p> <p>Duration: Drought permits are valid for up to six months, but is most likely to be three months.</p>
	Risks associated with action	The application, as applied for, is not approved. Delays in the granting of the Flood Risk Activity Permit (FRAP). Emergency abstractions have potential environmental impacts. These will be assessed through the EAR submitted with the application.
Other considerations	Lower yield than expected from the River Rhondda	
Environmental Assessment: alone & in-combination	Risk to the Environment	<p>The hydrological assessment has concluded that there is a minor impact on flows in headwater streams and a major impact on flows in the Afon Rhondda Fawr as a result of implementing the drought permit. Impacts on the Afon Rhondda Fawr from the confluence of the Afon Rhondda Fach to the confluence of the River Taff have been assessed as negligible. These hydrological impacts are assessed as leading to minor impacts on the physical environment of the river, including water quality.</p> <p>The environmental assessment has concluded that during periods when abstractions from a temporary intake at Treherbert on the Afon Rhondda Fawr occur there are major impacts on fish, macrophytes and white-clawed crayfish and moderate impacts on macrophytes, macroinvertebrates and phytobenthos.</p>
	Summary of likely environmental impacts	The EAR has concluded that there is potential for major impacts on fish, macrophytes and white-clawed crayfish and moderate impacts on macrophytes, macroinvertebrates and phytobenthos.
	Baseline information used	<p>Hydrological data:</p> <ul style="list-style-type: none"> • NRW Tynwydd flow gauges, Afon Rhondda Fawr • NRW Trehafod flow gauge, River Rhondda <p>Ecological data:</p> <ul style="list-style-type: none"> • NRW macrophyte sampling data from the AT Pentre site on the Afon Rhondda Fawr. • NRW macroinvertebrate sampling on River Rhondda • Fisheries monitoring data on the Afon Rhondda Fawr and Afon Rhondda
	Summary of additional monitoring requirements	<ul style="list-style-type: none"> • Walkover survey during low flow conditions to map sensitive habitats, communities, species and any monitoring sites that are required in order to improve understanding of the baseline communities. • Spot flow gauging surveys

		<ul style="list-style-type: none"> • Biochemical water quality sampling. • Macrophyte surveys • Macroinvertebrate surveys including white clawed crayfish • Fish surveys (including salmon, brown/sea trout, bullhead, and other fist species)
	Mitigation & Compensation measures	<p>The mitigation measures that could be considered at the on-set of drought, during implementation of the drought permit and post-drought permit implementation include:</p> <ul style="list-style-type: none"> • Temporary reduction or cessation of the terms of the Drought Order/Permit • Fish distress monitoring with triggers and response plan • Protection of 'spate flows' • Reduction of fish predation • Physical in-river works • Provision of alternative compensation flows • Provision of alternative water supplies if other water users are at risk of derogation. <p>Potential mitigation measures have also been proposed and further discussion with NRW is required in order to develop suitable mitigation measures.</p>
	Impact on other activities	<p>A reduction in flows of the Afon Rhondda Fawr may alter the visual amenity of the area during drought permit implementation. There is also potential for significant impact on angling activities as river flows, width, depth and velocities are reduced.</p>
	Any permissions or approvals required and constraints that apply	<p>Flood Risk Activity Permit (FRAP) would need to be applied for to install sandbags in the Afon Rhondda Fawr (main river).</p> <p>Land access permission would be required to install temporary pump and pipeline to water treatment works.</p>

Table 4 - Option 8112-1 Emergency abstraction from the River Rhondda at Treherbert

Action Implementation Assessment	Name:	Utilise the Dead Storage in Talybont Reservoir
	Trigger(s)	Storage in Big 5 reservoir group crosses into Severe Drought Action Zone.
	Deployable Output or yield of the action	30 MI/d yield for up to 30 days
	Location	Talybont Reservoir
	Implementation timetable	Preparation time: We assume a decision from WG within 28 days of submitting the Drought Order application. The practical implementation of the option could potentially be effected within two weeks. Time of year effective: The option is most likely to be implemented during September to November. Duration: Drought orders are valid for up to six months, but is most likely to be three months.
	Risks associated with action	The application, as applied for, is not approved.
	Other considerations	N/A
Environmental Assessment: alone & in-combination	Risk to the Environment	N/A
	Summary of likely environmental impacts	The hydrological 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. The environmental 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.
	Baseline information used	Hydrological data: <ul style="list-style-type: none"> • Weekly/daily Talybont storage volumes • Daily abstraction volumes from Talybont reservoir and Nant Clydach intake • 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 • NRW Llandetty gauging station on the River Usk Ecological data: <ul style="list-style-type: none"> • River Usk SAC and the River Usk (Tributaries) SSSI baseline conditions
	Summary of additional monitoring requirements	The EAR concluded that no feature specific monitoring will be required.
	Mitigation & Compensation measures	The mitigation measures that could be considered at the on-set of drought, during implementation of the drought permit and post-drought permit implementation include: <ul style="list-style-type: none"> • Temporary reduction or cessation of the terms of the Drought Order/Permit • Fish distress monitoring with triggers and response plan

		<ul style="list-style-type: none"> • Protection of 'spate flows' • Reduction of fish predation • Physical in-river works • Provision of alternative compensation flows • Provision of alternative water supplies if other water users are at risk of derogation. <p>Potential mitigation measures have also been proposed and further discussion with NRW is required in order to develop suitable mitigation measures.</p>
	Impact on other activities	There would be negligible impact on landscape, visual amenity, recreation and archaeology.
	Any permissions or approvals required and constraints that apply	N/A

Table 5 - Option 8116-3 Utilise the Dead Storage in Talybont Reservoir

Action Implementation Assessment	Name:	Reduce Pontsticill compensation flow by 50%
	Trigger(s)	Storage in Big 5 reservoir group crosses into Severe Drought Action Zone.
	Deployable Output or yield of the action	9.1 Ml/d yield
	Location	Pontsticill Reservoir
	Implementation timetable	<p>Preparation time: We assume a decision from NRW within 14 days of submitting the Drought Permit application. The practical implementation of the option could be effected immediately.</p> <p>Time of year effective: The option is most likely to be implemented during September to November.</p> <p>Duration: Drought orders are valid for up to six months, but is most likely to be three months.</p>
	Risks associated with action	The application, as applied for, is not approved. Reduction in compensation releases have potential environmental impacts. These will be assessed through the EAR submitted with the application.
	Other considerations	N/A
Environmental Assessment: alone & in-combination	Risk to the Environment	Reduced flow in the Afon Taf Fechan and River Taff.
	Summary of likely environmental impacts	<p>The hydrological assessment has concluded that there is potential for major impact on river flows and moderate impacts on the physical environment of the river, including water quality.</p> <p>This could lead to potential for major impacts on aquatic ecology specifically: major impacts on fish, and minor impacts on macroinvertebrates, macrophytes and phytobenthos.</p> <p>In-combination effects with Llwynon reduced compensation flow option 8109-1 are anticipated on fish, macroinvertebrates and macrophytes.</p>
	Baseline information used	<p>Hydrological data:</p> <ul style="list-style-type: none"> • Daily Pontsticill water level data • Daily abstractions from Pontsticill Reservoir • DCWW river flow gauging on the Afon Taff Fechan • NRW river flow gauge on the River Taff at Merthyr Tydfil, the River Taff at Fiddler's Elbow, and the River Taff at Pontypridd <p>Ecological data:</p> <ul style="list-style-type: none"> • NRW, DCWW and APEM macrophyte sampling data from the Afon Taff Fechan and River Taff. • NRW and APEM macroinvertebrate sampling at the Afon Taff Fechan and River Taff. • NRW and APEM fish surveys, fisheries monitoring and salmonid surveys along the Afon Taff Fechan and River Taff • NRW Phytobenthos data for the Afon Tef Fechan
	Summary of additional monitoring requirements	<ul style="list-style-type: none"> • Spot flow gaugings • Biochemical water sampling • Fish surveys (including salmon, brown trout, lamprey, bullhead, eel)
	Mitigation & Compensation measures	<p>The mitigation measures that could be considered at the on-set of drought, during implementation of the drought permit and post-drought permit implementation include:</p> <ul style="list-style-type: none"> • Temporary reduction or cessation of the terms of the Drought Order/Permit

	<ul style="list-style-type: none"> • Fish distress monitoring with triggers and response plan • Protection of 'spate flows' • Reduction of fish predation • Physical in-river works • Provision of alternative compensation flows • Provision of alternative water supplies if other water users are at risk of derogation. <p>Potential mitigation measures have also been proposed and further discussion with NRW is required in order to develop suitable mitigation measures.</p>
Impact on other activities	Pontsticill Reservoir and the Afon Taf Fechan lie within the Brecon Beacons National Park. Reduced flows in the river will have an impact on the visual amenity of the watercourse, including and waterfalls. Changes in river level may influence water-dependent activities such as angling and canoeing, however water levels will be naturally low in drought, and impacts will be temporary in nature.
Any permissions or approvals required and constraints that apply	N/A

Table 6 - Option 8119-1 Reduce Pontsticill compensation flow