Dŵr Cymru
Welsh Water

Revised Draft Drought Plan 2020: Annex 1k – Herefordshire and Monmouthshire Group of Zones

November 2019

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1. Herefordshire and Monmouthshire Group

As described in chapter 2 of the Drought Plan, we have produced combined Drought Action Zones (DAZs) across a number of our south east Wales WRZs. The Herefordshire and Monmouthshire group includes Hereford, Monmouth, Ross-on-Wye, Pilleth, Vowchurch and Whitbourne WRZs. Our experiences during the 2018 drought have shown that are we able to mobilise and maintain a tankering operation to meet local needs and so we are confident that we will be able to manage these six zones in the same way during future droughts.

Based on this knowledge, we have updated our trigger lines to reflect the risk of the combined demand levels exceeding our overall treatment capacity. We would only then consider the implementation of customer restrictions (e.g. widespread pressure management or water rationing) if combined demand levels exceed the group's total treatment capability.

1.1. Drought Triggers

The drought status of the combined zone is assessed by the total water demand at any time in relation to the maximum water treatment works capacity as shown in Figure 1. The use of the DAZs are described in more detail in section 2 of the Drought Plan.

For the development of this Drought Plan we moved away from using supply side triggers as we know that the availability of water resource is not going to be an issue in the Herefordshire and Monmouthshire WRZs and so there will be no need for us to go to the environment to seek additional water. The problems we have experienced historically are related to meeting short term peaks in demand which we are confident can be managed through tankering if needed, as was evidenced through our experiences in 2018. Demand management actions such as Temporary Use Bans can be introduced within two weeks and so the triggers allow us plenty of time to prepare for these as we move from 'Developing Drought' to 'Drought'. Should we require a Drought Order to implement a Non Essential Use Ban then we have assumed a further four weeks to have this in place ahead of levels of demand reaching 'Severe Drought'. The 'Severe Drought' Action Zone level is set around 45% higher than our average annual demand level which from our scenario testing shows that we would need approximately 3 months of continuous hot, dry weather required before demand levels would increase by that much.

Figure 1 shows these new DAZs generated for this group of WRZs. For comparison, the demands experienced in summer 2018, the drought of 1976 and a "normal" year of 2006 have been plotted. During June to July 2018 we managed supply during an increase in demand levels of around 30% above typical levels. Our analysis shows that we have a robust position in that demand would need to increase by over 60% before we would have concerns around our capability to meet customer demands.

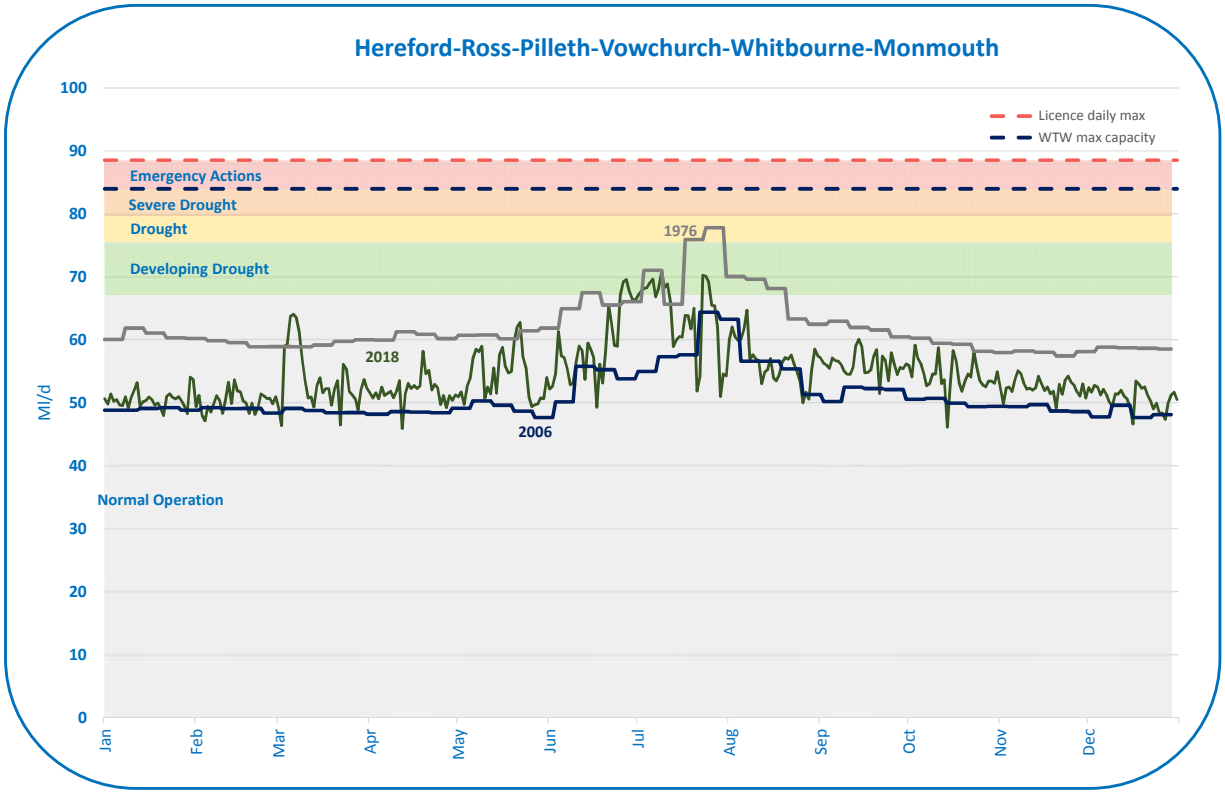

Figure 1 - Herefordshire and Monmouthshire group Drought Action Zone

1.2.Assessment of Drought Risk

We have used our models to demonstrate that we will always have sufficient water resource during the most severe droughts. Our WRMP19 supply capability assessments confirmed that our Herefordshire and Monmouthshire drought group (comprising of Hereford, Monmouth, Ross-on-Wye, Pilleth, Vowchurch and Whitbourne WRZs) is limited by the capability of our assets to produce and distribute water to our customers, not by the volume of raw water we have available.

Our drought concern is, therefore, related to our ability to meet peak customer demands during a prolonged hot, dry spell rather than running of out raw water. Table 1 shows our predominant raw water sources within this group of WRZs, compared to the river catchment they are abstracting from. As can be seen in the table, the water available in the catchment under drought conditions (Q95 flows) is significantly higher than the source maximum output and it is not plausible that more extreme droughts could reduce river flows to less than our abstraction licence limits. This confirms why we are confident that a lack of water resource during a severe event will not be the restriction on our ability to meet customer demand.

WRZ	Source	Source Type	Source maximum output* (Ml/d)	Q 95 (Ml/d)
Hereford	River Wye at Broomy Hill	River abstraction	52	355
Monmouth	River Wye at Monmouth (Mayhill intake)	River abstraction	5.3	580

Ross-on-Wye	Lydbrook (operated by Severn Trent Water)	River abstraction	9	544
Whitbourne	Whitbourne WTW	River abstraction	8.5	170
*WTW maximum output as limited by WTW capacity and daily licence				

Table 1 - Relative abstraction vs catchment comparison

2. Hereford Water Resources Overview

Hereford WRZ includes Hereford city and the surrounding area and rural villages as far north as Leintwardine (see Figure 2). The normal operational water resources within the zone consist of one river and two groundwater abstractions. A list of our raw water sources for the zone is presented in Table 2.

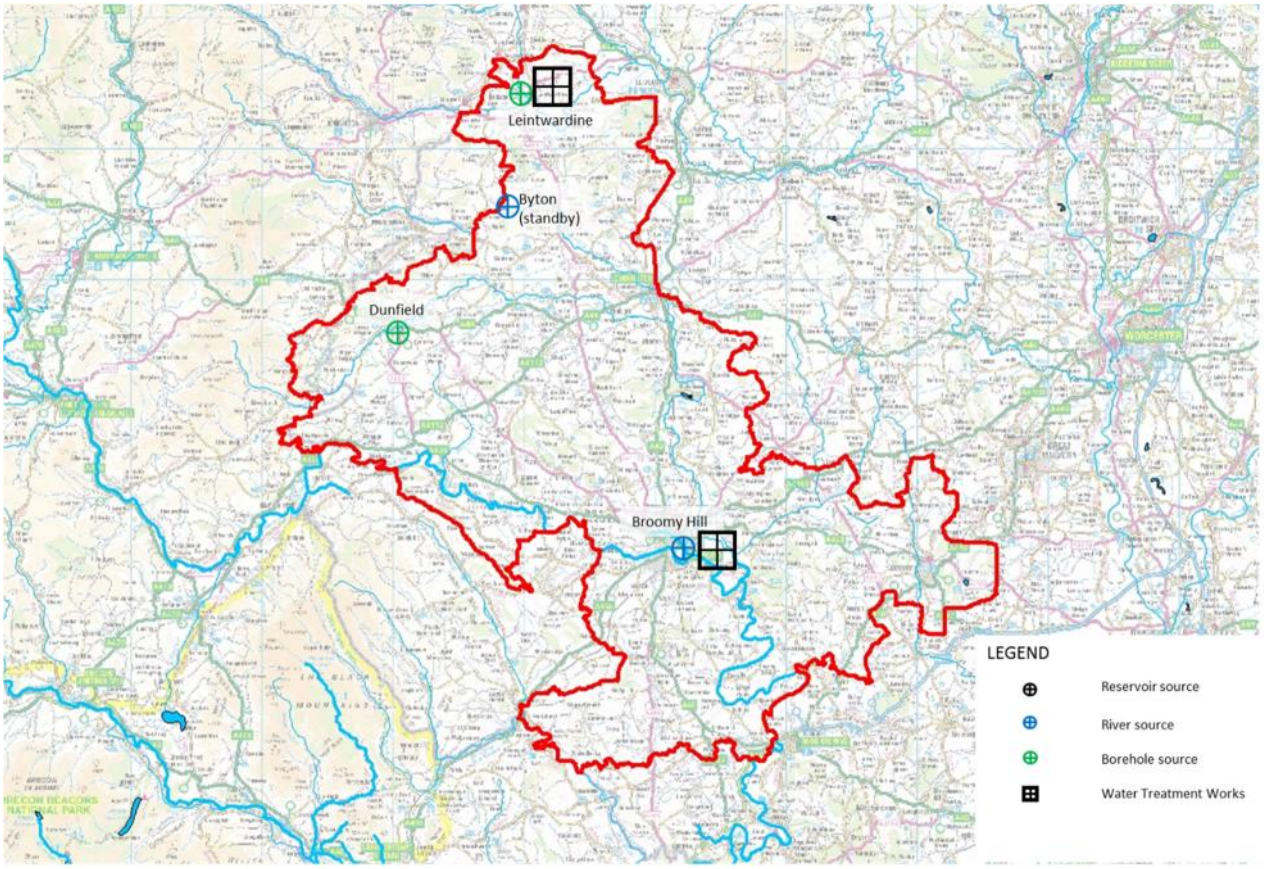

Figure 2 - Map of the Hereford WRZ

The River Wye abstraction at Broomy Hill in Hereford meets the vast majority of the WRZ demand. A small volume of water is also abstracted from the boreholes at Dunfield and Leintwardine to serve these local areas.

Site Name	Licence No.	Source Type	Status
River Wye at Broomy Hill	19/55/15/0246	River abstraction	Operational
Dunfield	19/55/09/0330	Borehole	Operational
Leintwardine	18/54/09/0367	Borehole	Operational

Table 2 - Licensed sources in the Hereford WRZ

There are small exports of water from the Hereford WRZ into the adjacent Whitbourne and Vowchurch WRZ's.

2.1. Drought Management of the WRZ

2.1.1. Normal Operation

During normal weather conditions we abstract a small volume from the Dunfield and Leintwardine boreholes and the remainder of the water required by the zone is provided from the River Wye at Broomy Hill.

2.1.2. Developing Drought/ Drought/ Severe Drought Action Zone

Given the abstraction at Broomy Hill on the River Wye is not dependent upon the Elan reservoirs regulation releases and that the Broomy Hill intake pumps can operate under extreme low river level, the zone is considered resilient. Table 1 shows that the maximum possible abstraction is only 14% of Q95 low flows in the River Wye.

2.1.3. Emergency Action Zone

We have set our trigger level for the Emergency Action Zone as the point at which demand for water is greater than our supply capability. At this point we would be in an exceptional drought and may need extreme measures in order to maintain supplies to our customers.

To enact these extreme measures we would need to apply to Welsh Government for an Emergency Drought Order that would allow us total discretion on the uses of water that may be prohibited or limited including the implementation of rationing measures such as the use of standpipe filling points, rota cuts in water supply or widespread pressure management. These are last resort actions, which at any other time we would deem unacceptable, and would only be used when all other reasonable drought measures have been implemented.

2.1.4. Supply-side drought management action

Given the resilience of the zone, it is not considered necessary to develop supply-side options. There are therefore no associated Environmental Assessment Reports (EARs) and so we have not completed Appendix G for this WRZ.

3. Monmouth Water Resources Overview

Monmouth WRZ is a small zone in southeast Wales, covering the town of Monmouth and the area to the south of it. The water resources within the zone consist of one river abstraction on the River Wye and one groundwater abstraction. A map of these raw water sources is shown in Figure 3, and a list of the sources is presented in Table 3.

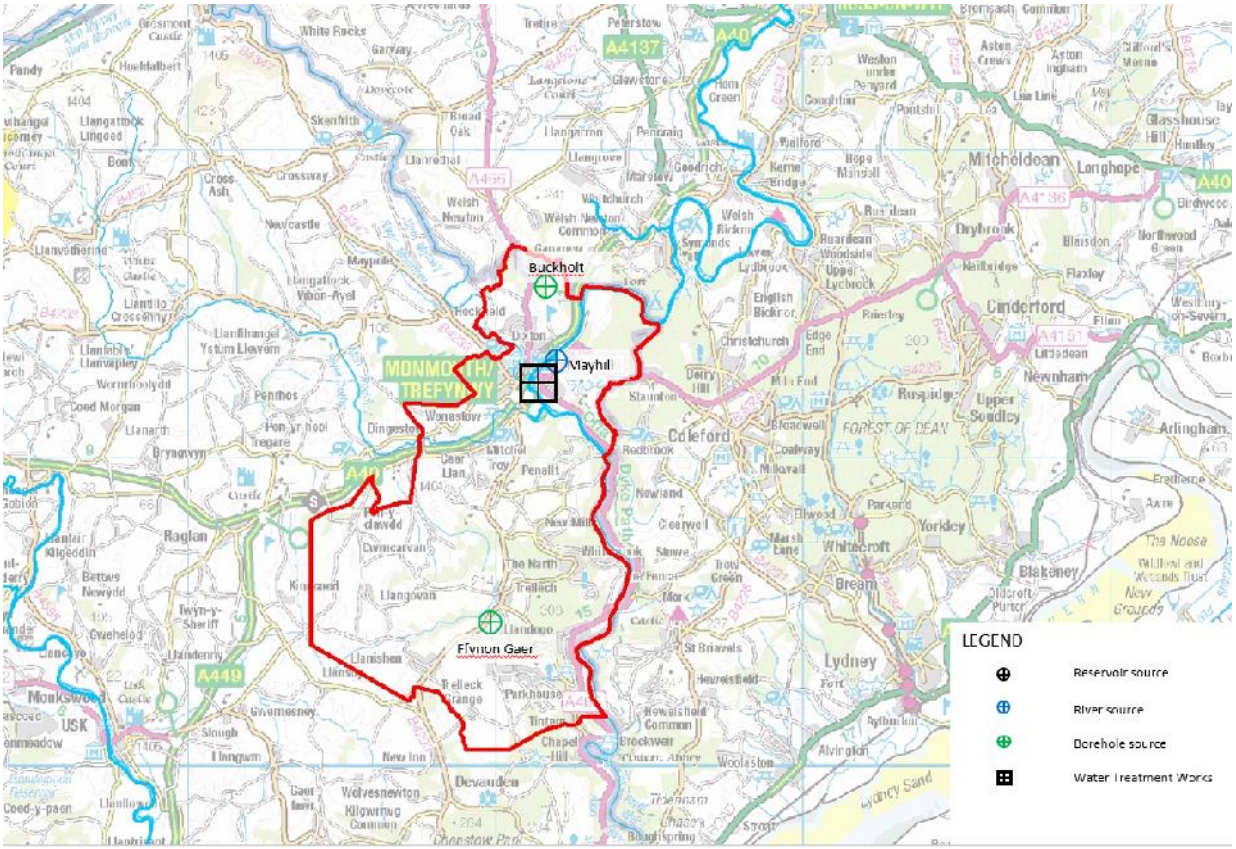

Figure 3 - Map of the Monmouth WRZ

The majority of supply in the WRZ is from the Mayhill intake on the River Wye at Monmouth. A small volume of water is abstracted from Ffynon Gaer springs in the south of the WRZ.

Under normal operation, there are no imports or export of water in the zone.

Site Name	Licence No.	Source Type	Status
River Wye at Monmouth (Mayhill)	19/55/18/0201	Regulated river intake	Operational
Ffynnon Gaer	19/55/21/0066	Spring	Operational
Buckholt	19/55/18/0203	Borehole	Mothballed

Table 3 - Licensed sources in the Monmouth WRZ

3.1. Drought Management of the WRZ

3.1.1. Normal Operation

During normal weather conditions we abstract a small volume from the springs at Ffynon Gaer with the majority of the water required by the zone provided from our Mayhill intake on the River Wye.

3.1.2. Developing Drought/ Drought/ Severe Drought Action Zone

The abstraction at Mayhill is dependent upon flows in the River Wye, however given the size of the abstraction licence relative to the size of the River Wye flows, even under drought flow conditions, it is extremely unlikely that the WRZ will be constrained by lack of resource availability during a drought. The zone is therefore considered highly drought resilient.

However, should more treated water be required we would investigate the potential to lift operational restrictions in our water treatment works to increase the water output up to the maximum abstraction volume of the licence. Should the smaller spring source at Ffynon Gaer or the WTW at Mayhill be under stress during a drought event, tankering support would be made available from the Hereford WRZ. In the event of demand reaching the Severe Drought action zone we will prepare to bring Buckholt back into supply, though this will require significant planning to ensure no impact to customers.

3.1.3. Emergency Action Zone

We have set our trigger level for the Emergency Action Zone as the point at which demand for water is greater than our supply capability. At this point we would be in an exceptional drought and may need extreme measures in order to maintain supplies to our customers.

To enact these extreme measures we would need to apply to Welsh Government for an Emergency Drought Order that would allow us total discretion on the uses of water that may be prohibited or limited including the implementation of rationing measures such as the use of standpipe filling points, rota cuts in water supply or widespread pressure management. These are last resort actions, which at any other time we would deem unacceptable, and would only be used when all other reasonable drought measures have been implemented.

3.1.4. Supply-side drought management action

Given the resilience of the zone, it is not considered necessary to develop supply-side options. However, as there is one mothballed source that may be operated during a drought, we will undertake the necessary environmental assessment post publication of our Final Drought Plan 2020.

4. Ross-on-Wye Water Resources Overview

Ross-on-Wye WRZ is a small zone around the town of Ross-on-Wye in Herefordshire (see Figure 4). Supply is from a bulk import from Severn Trent Water, who abstract the water from the River Wye at Lydbrook. This is listed in Table 4.

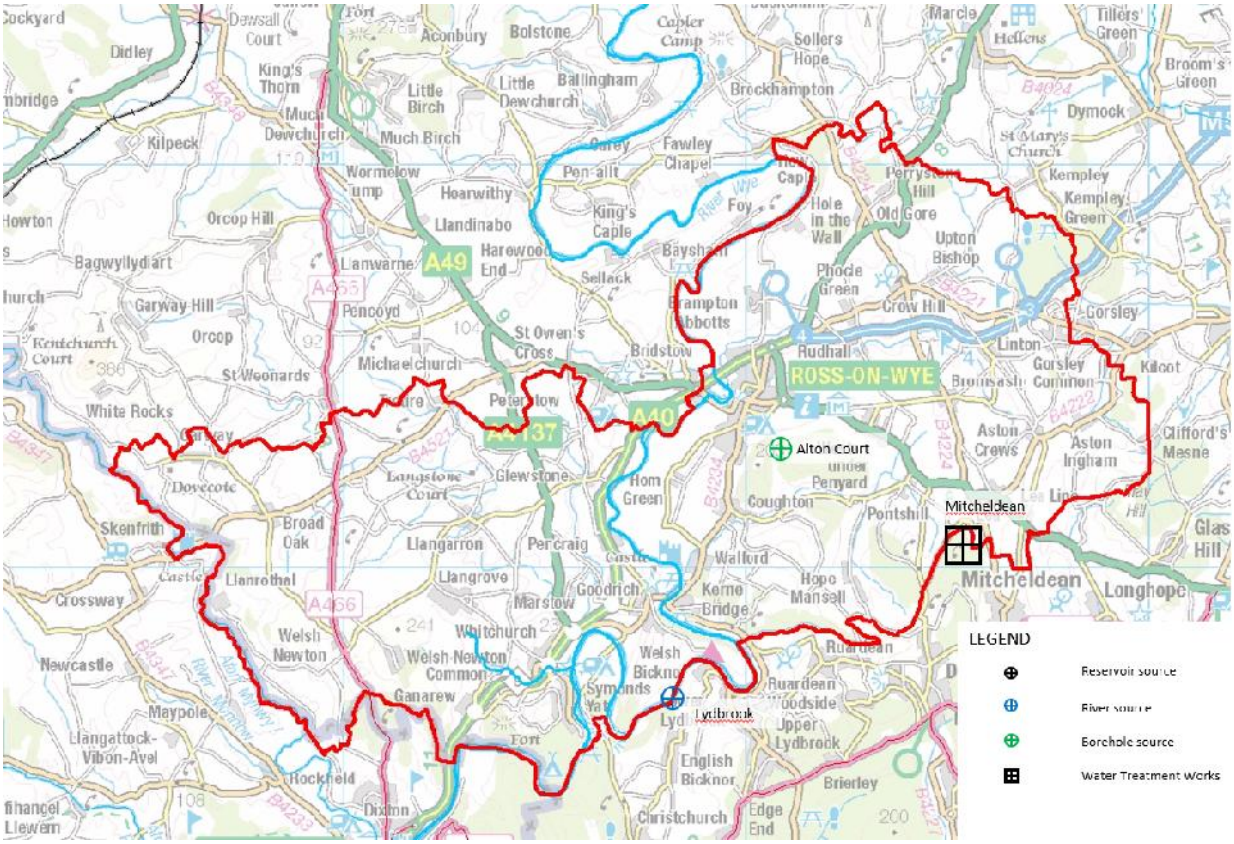

Figure 4 - Map of the Ross-on-Wye WRZ

Under normal operation, the zone is supplied by the bulk import of potable water from Severn Trent Water, which is abstracted from the River Wye at Lydbrook.

The import from Severn Trent Water meets the majority of the WRZ demand during normal operations, however we are also able to import a small amount of water from the neighbouring Hereford zone via tanker.

Site Name	Licence No.	Source Type	Status
Lydbrook (operated by Severn Trent Water)	N/A	Regulated river and abstraction constrained by licence conditions related to regulation conditions.	Operational

Table 4 - Licensed sources in the Ross-on-Wye WRZ

4.1. Drought Management of the WRZ

4.1.1. Normal Operation

During normal weather conditions we import a small volume from Hereford and the remainder of the water required by the zone is provided from the River Wye at Lydbrook, operated by Severn Trent Water.

4.1.2. Developing Drought/ Drought/ Severe Drought Action Zone

Severn Trent Water's abstraction at Lydbrook is dependent upon flows in the River Wye at Redbrook and storage in the Elan valley reservoirs. However, given the size of the abstraction licence relative to the size of the River Wye flows, even under drought flow conditions, it is extremely unlikely that the WRZ will be constrained by a lack of resource availability during a drought. Severn Trent Water have tested their supplies against a range of extreme droughts and confirmed that under all scenarios, they were still able to maintain the export to Ross-on-Wye. We will continue to review our tankering plans to ensure we could bring additional supplies into the zone if needed.

4.1.3. Emergency Action Zone

We have set our trigger level for the Emergency Action Zone as the point at which demand for water is greater than our supply capability. At this point we would be in an exceptional drought and may need extreme measures in order to maintain supplies to our customers.

To enact these extreme measures we would need to apply to Welsh Government for an Emergency Drought Order that would allow us total discretion on the uses of water that may be prohibited or limited including the implementation of rationing measures such as the use of standpipe filling points, rota cuts in water supply or widespread pressure management. These are last resort actions, which at any other time we would deem unacceptable, and would only be used when all other reasonable drought measures have been implemented.

4.1.4. Supply-side drought management action

Given the resilience of the zone, it is not considered necessary to develop supply-side options.

5. Pilleth Water Resources Overview

Pilleth WRZ is a small, rural zone centred on the town of Presteigne near the England/Wales border (see Figure 5). The zone is a single-source zone reliant on boreholes adjacent to the river Lugg, as presented in Table 5.

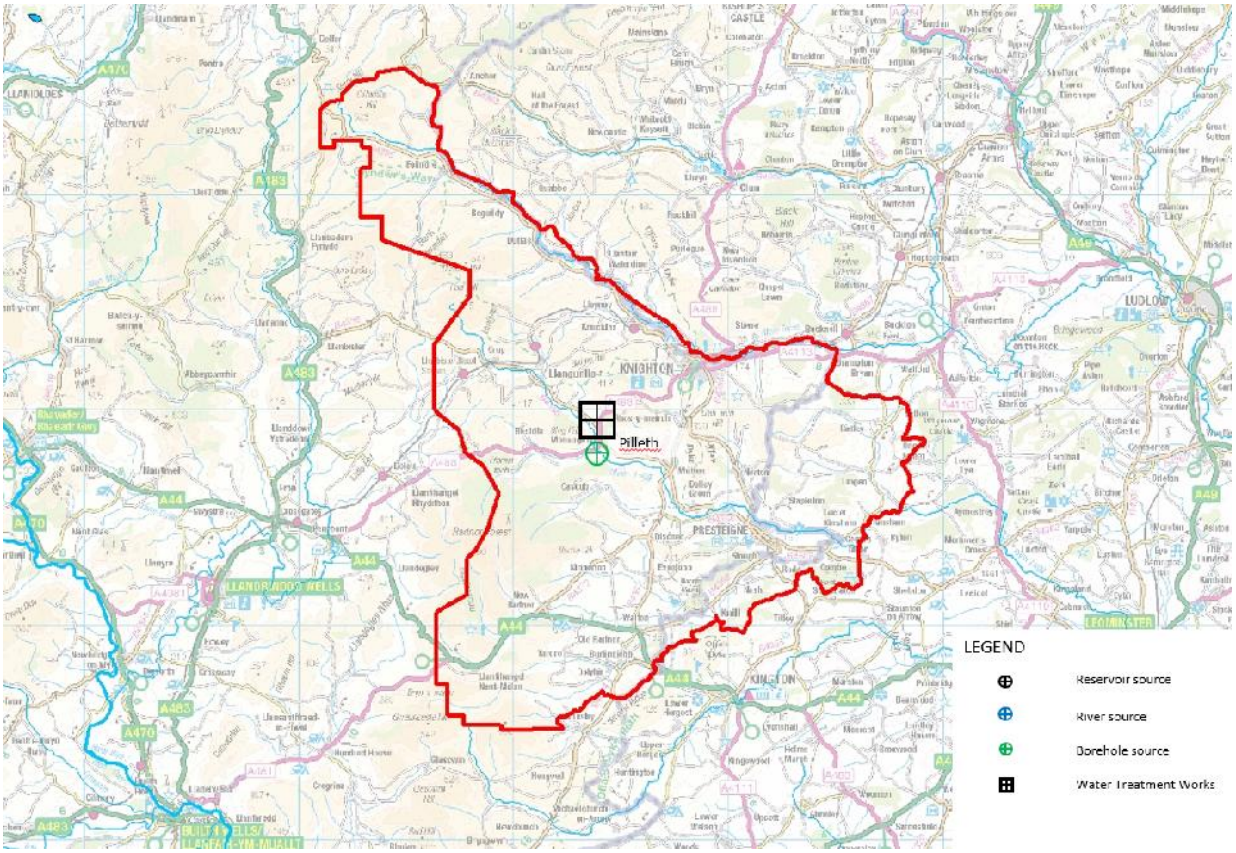

Figure 5 - Map of the Pilleth WRZ

The Pilleth borehole abstraction meets all of the WRZ demand during normal operations. Industrial usage in Presteigne is a large component of the water demand.

There are no exports or imports of water for the Pilleth zone.

Site Name	Licence No.	Source Type	Status
Pilleth	19/55/08/0179	Borehole	Operational

Table 5 - Licensed source in the Pilleth WRZ

5.1. Drought Management of the WRZ

5.1.1. Normal Operation

During normal weather conditions all of the water required by the zone is provided from the boreholes at Pilleth.

5.1.2. Developing Drought/ Drought/ Severe Drought Action Zone

Pump testing undertaken during 2004/ 2005 demonstrated that the gravel aquifer can sustain an output of 5 Ml/d. Therefore, we do not consider that the WRZ is resource constrained and the zone is considered resilient. However, should more water be required we would investigate the potential to lift operational restrictions in our water treatment systems to increase the water output up to the maximum abstraction volume of the licence. Finally the import of supplementary water from adjacent zones by tankering would be organised as necessary.

5.1.3. Emergency Action Zone

We have set our trigger level for the Emergency Action Zone as the point at which demand for water is greater than our supply capability. At this point we would be in an exceptional drought and may need extreme measures in order to maintain supplies to our customers.

To enact these extreme measures we would need to apply to Welsh Government for an Emergency Drought Order that would allow us total discretion on the uses of water that may be prohibited or limited including the implementation of rationing measures such as the use of standpipe filling points, rota cuts in water supply or widespread pressure management. These are last resort actions, which at any other time we would deem unacceptable, and would only be used when all other reasonable drought measures have been implemented.

5.1.4. Supply-side drought management action

Given the resilience of the zone, it is not considered necessary to develop supply-side options. There are therefore no associated Environmental Assessment Reports (EARs) and so we have not completed Appendix G for this WRZ.

6. Vowchurch Water Resources Overview

Vowchurch WRZ is a small zone covering a rural area to the southwest of Hereford (see Figure 6). The zone reliant on one groundwater source, as presented in Table 6.

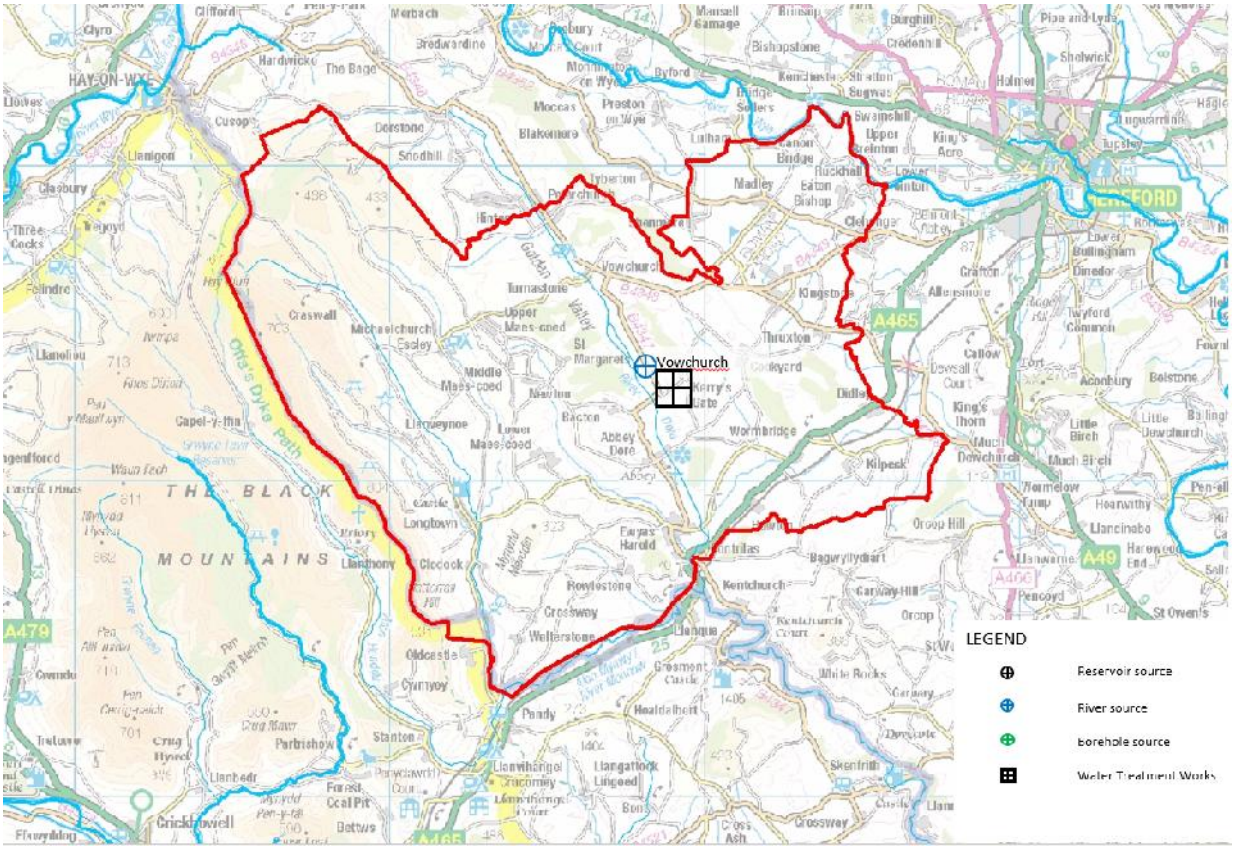

Figure 6 - Map of Vowchurch WRZ

The groundwater abstraction meets the majority of the WRZ demand during normal operations. The WRZ is supplied by four boreholes that abstract from the gravel aquifer adjacent to the River Dore at Vowchurch, south-west Herefordshire. A small volume of water is imported from Hereford WRZ.

There are no exports of water during normal operations.

Site Name	Licence No.	Source Type	Status
Vowchurch	19/55/17/0451	Boreholes	Operational

Table 6 - Licensed sources in the Vowchurch WRZ

6.1. Assessment of Drought Risk

Our water supply in the Vowchurch WRZ comes from four shallow boreholes in the gravels adjacent to the River Dore. Initial drought resilience assessment work undertaken for our WRMP19 indicated that

we may need to implement extreme supply side measures (widespread pressure management or water rationing) due to a shortage of raw water to meet our customers' demand for drought events more severe than 1:60 return period.

To examine this risk is greater detail, for this Plan we used advanced statistical techniques to generate more extreme drought events to test our systems against. The generation of a stochastic set of river flows for the River Dore followed the DVF method 1a, whereby long length time series of inflows are produced using novel weather and flow generation techniques. In order to provide the outputs necessary to produce the Drought Response Surface charts, an amended version of the DVF 1a methodology was taken whereby for each month, the equivalent 10^{th}, 25^{th}, 75^{th} and maximum flows based on the stochastic monthly average record were produced. The next stage then is for each stochastically generated month, it was calculated whether the 10^{th}, 25^{th}, mean, 75^{th} or maximum flows fell below our known level of customer demand. Full details of the approach taken in Vowchurch are given in Appendix 1.

The key conclusion that can be drawn from the DRS (Figure 7 and Figure 8) is that significant risks (flow< abstraction for more than 1 week) will only tend to occur during significant periods of low rainfall (< 35% long term average) which are not likely to occur more frequently than 1 in 100 years, but these risks can develop quickly, for durations of 6 months or less. The risk is similar for the period ending August and September – i.e. such events will tend to happen during dry periods that extend into the late summer.

To understand longer term risk in the zone, the analysis was re-run with the effects of climate change included. The DRS outputs with 2030s climate change factors applied are shown in Figure 9 and Figure 10 and indicate that the risk from summer droughts increases significantly, with 1:50 year events generating potential low flow periods of more than a week, and events lasting more than a month occurring at a 1 in 200 year frequency.

Although there is a drought risk in the zone which currently means we are not meeting our target level of service of 1:200, the shortfalls in supply should we experience a severe drought are likely to be relatively small and so we therefore feel that in the short term we could manage the drought risk through the use of tankering additional supplies from neighbouring WRZs. However given the forecast worsening situation as the effects of climate change take hold, then delivery of our WRMP19 scheme that allows us to meet customer demand in the area from a more robust water source is key. As the concern during these severe drought events is insufficient water resource then there are no Drought Permit/Drought Order schemes within the Vowchurch WRZ that we could apply which would resolve this.

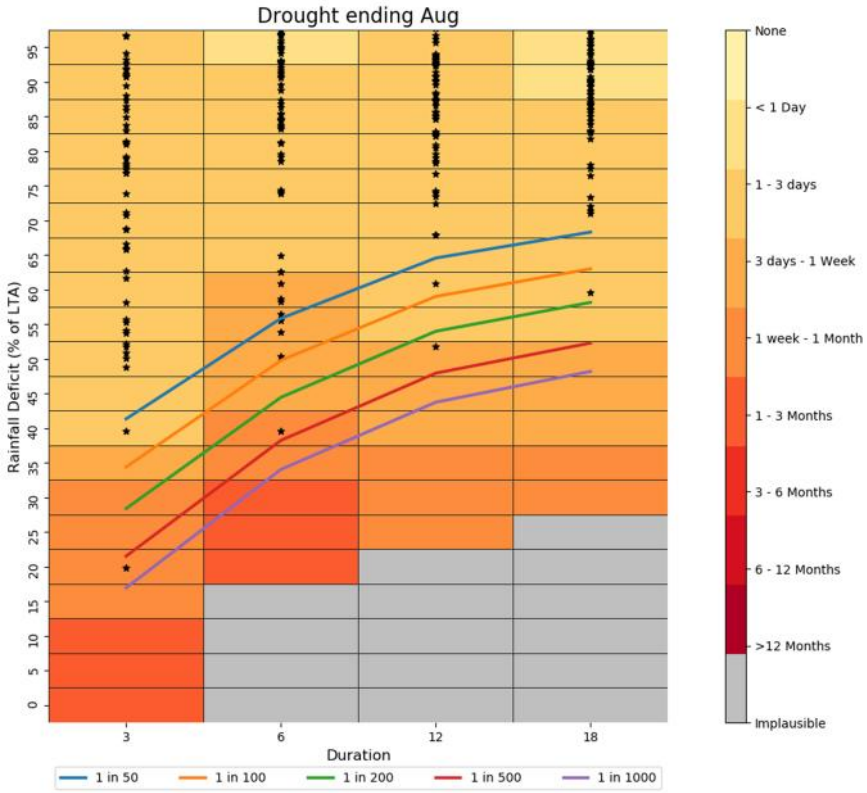

Figure 7 - DRS for Vowchurch - droughts ending in August

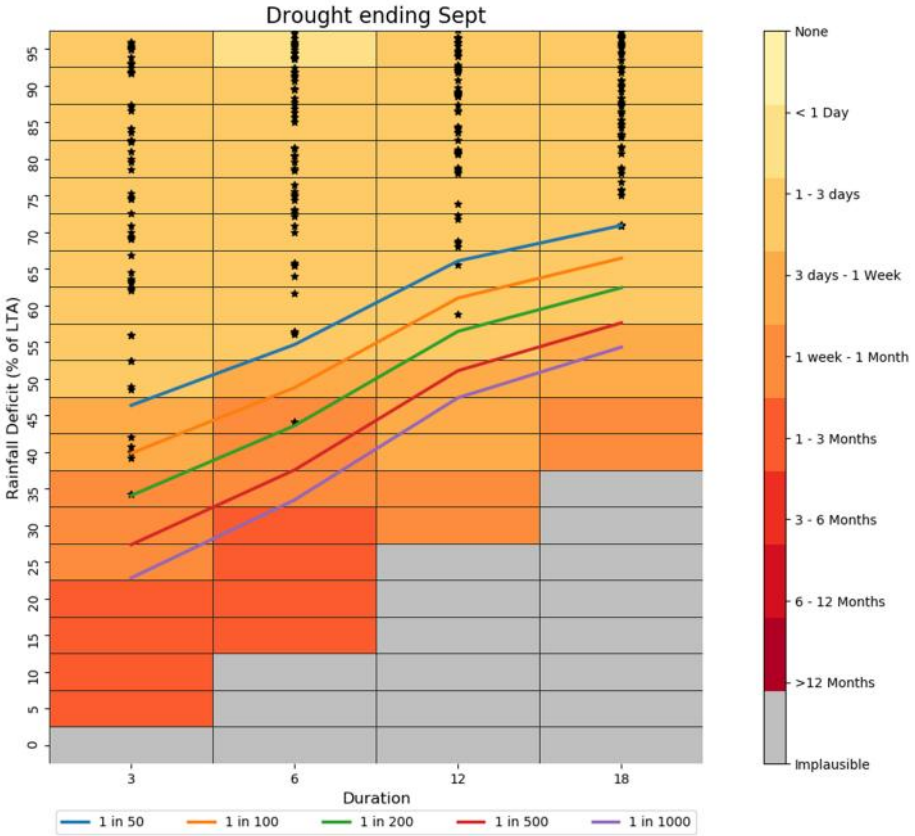

Figure 8 - DRS for Vowchurch - droughts ending in September

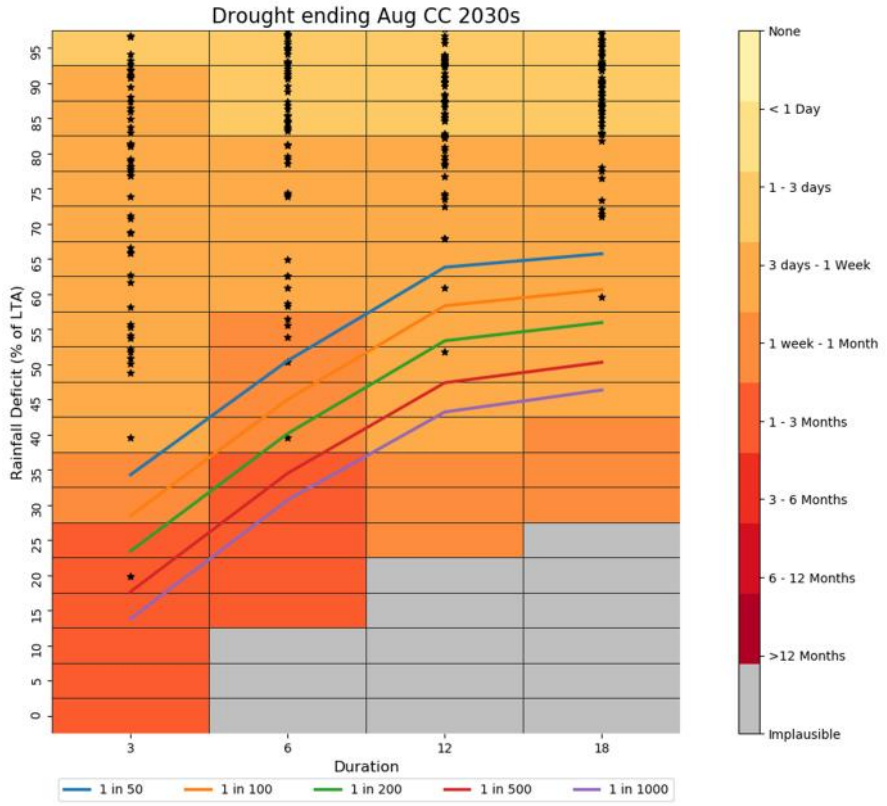

Figure 9 - DRS for Vowchurch - droughts ending in August with the effects of climate change

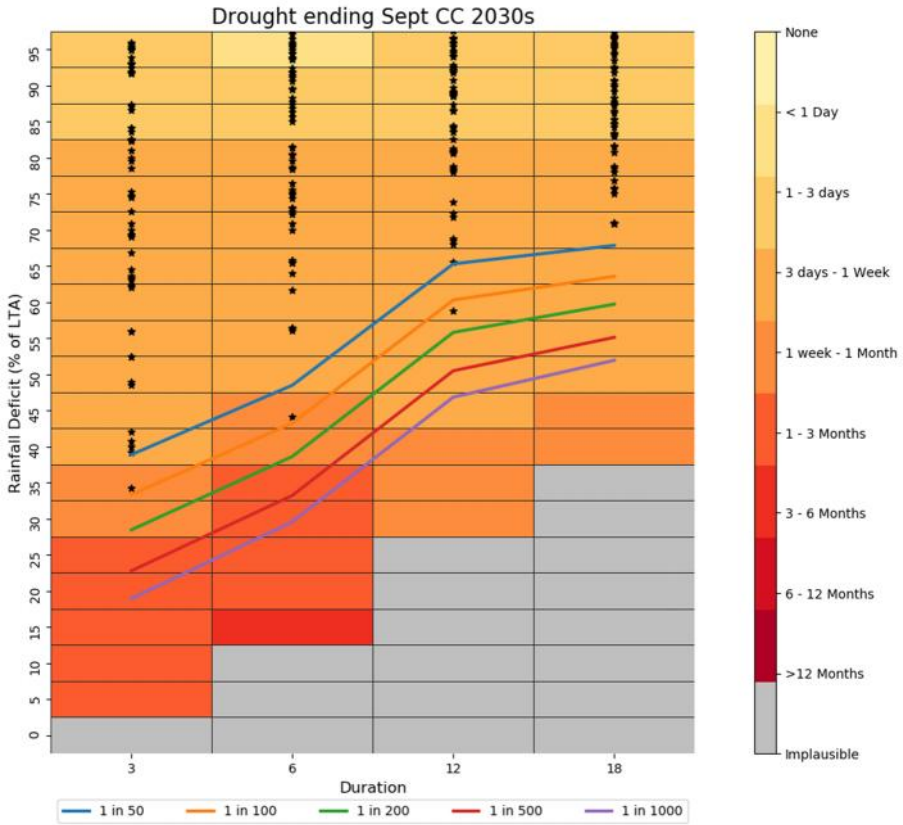

Figure 10 - DRS for Vowchurch - droughts ending in September with the effects of climate change

6.2. Drought Management of the WRZ

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. 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.

6.2.1. Normal Operation

During normal weather conditions the majority of the water required by the zone is provided from the boreholes in the gravel aquifer at Vowchurch and a small volume is imported from the Hereford WRZ.

6.2.2. Developing Drought/ Drought/ Severe Drought Action Zone

Initial indications from our resilience assessment show that the zone is likely to be susceptible to less than a 1:100 drought event. The gravel aquifer is linked with the adjacent River Dore and relatively low flows have been experienced in the river during dry weather. In case of a severe drought event, the boreholes and the associated River Dore may, therefore, not meet demand. We plan to invest to improve this level of zonal resilience through installation of permanent connection with the Hereford WRZ to allow supplies from Broomy Hill to be fed into the Vowchurch zone.

In the mean-time, the import of supplementary water from adjacent zones by tankering would be organised as necessary. A small volume of water can also be imported from the Llyswen WRZ.

6.2.3. Emergency Action Zone

We have set our trigger level for the Emergency Action Zone as the point at which demand for water is greater than our supply capability. At this point we would be in an exceptional drought and may need extreme measures in order to maintain supplies to our customers.

To enact these extreme measures we would need to apply to Welsh Government for an Emergency Drought Order that would allow us total discretion on the uses of water that may be prohibited or limited including the implementation of rationing measures such as the use of standpipe filling points, rota cuts in water supply or widespread pressure management. These are last resort actions, which at any other time we would deem unacceptable, and would only be used when all other reasonable drought measures have been implemented.

6.2.4. Supply-side drought management action

Given the location of the zone and our ability to tanker to meet customer demand, it is not considered necessary to develop supply-side options. There are therefore no associated Environmental Assessment Reports (EARs) and so we have not completed Appendix G for this WRZ.

7. Whitbourne Water Resources Overview

Whitbourne WRZ is located in east Herefordshire adjacent to the Worcestershire border and supplies the rural towns and villages in the area surrounding Bromyard (see Figure 11).

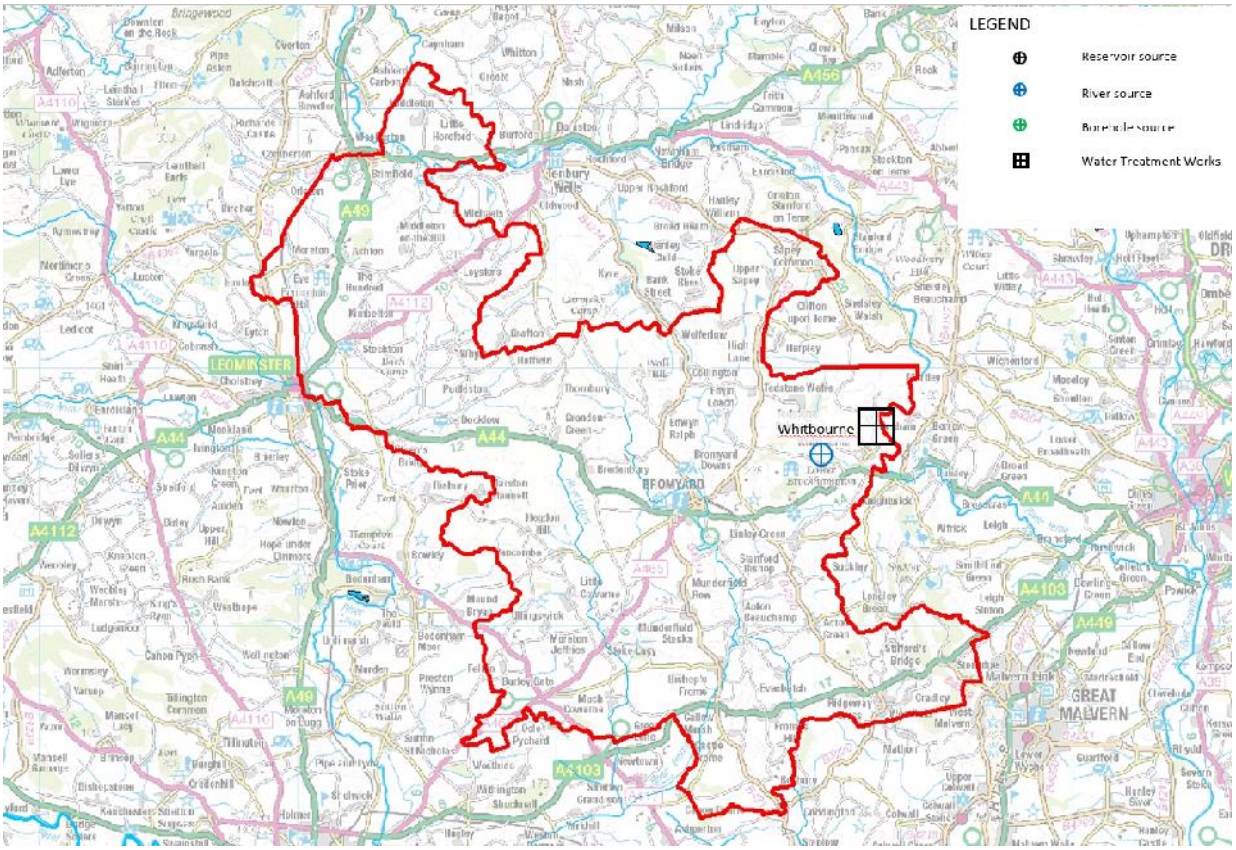

Figure 11 - Map of the Whitbourne WRZ

The zone is a single-source zone reliant on one river abstraction point from the River Teme, as presented in Table 7.

Site Name	Licence No.	Source Type	Status
Whitbourne	18/54/09/0008	River abstraction	Operational

Table 7 - Licensed sources in the Whitbourne WRZ

7.1. Drought Management of the WRZ

7.1.1. Normal Operation

During normal weather conditions all of the water required by the Whitbourne zone is provided from the River Teme.

7.1.2. Developing Drought/ Drought/ Severe Drought Action Zone

Given the large flows in the River Teme in relation to our much smaller abstraction licence, the zone is considered resilient. However should more water be required we would investigate the potential to lift operational restrictions in our water treatment systems to increase the water output up to the

maximum abstraction volume of the licence. In addition the import of supplementary water from adjacent zones by tankering would be organised as necessary. A small import from the Hereford zone is available for use when required.

7.1.3. Emergency Action Zone

We have set our trigger level for the Emergency Action Zone as the point at which demand for water is greater than our supply capability. At this point we would be in an exceptional drought and may need extreme measures in order to maintain supplies to our customers.

To enact these extreme measures we would need to apply to Welsh Government for an Emergency Drought Order that would allow us total discretion on the uses of water that may be prohibited or limited including the implementation of rationing measures such as the use of standpipe filling points, rota cuts in water supply or widespread pressure management. These are last resort actions, which at any other time we would deem unacceptable, and would only be used when all other reasonable drought measures have been implemented.

7.1.4. Supply-side drought management action

Given the resilience of the zone, it is not considered necessary to develop supply-side options. There are therefore no associated Environmental Assessment Reports (EARs) and so we have not completed Appendix G for this WRZ.