

APPENDIX 'C' TESTING OUR TRIGGERS

This Appendix includes information that was in the main part of the 2019 Drought Plan. It has been moved to an Appendix following the suggestions of the EA Guidance December 2020. The Appendix provides a description of how Portsmouth Water would typically respond to historic droughts and a range of other plausible droughts if they were repeated under the current supply system capability and demand patterns. Scenarios used for testing have not changed for this Drought Plan and they are consistent with our WRMP19. Small additions have been made in terms of the timings of interventions and better quality of the figures presented, to make it clearer to the reader.

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1 DROUGHT SCENARIO TESTING

Scenario testing has been used to test the groundwater triggers and demonstrate their validity and how they would be used in a drought situation. The Environment Agency Guideline suggests that a Drought Plan should be able to cope with a range of plausible droughts as set out in the Water Resources Management Plan (WRMP). These should include:

- Short duration one season droughts (6-12 months)
- Medium duration multi-season droughts (1-2 years)
- Long term droughts (2-3 years)

Portsmouth Water's Draft Drought Plan 2019 is based on the same scenarios as the WRMP19 with a range from a 'Dry Year' to a 'Severe Drought'. The Scenarios are summarised as follows:

- Dry Year 1 in 20 (5% risk)
- Scenario 'A' Historic Drought 1 in 40 (2.5% risk)
- Scenario 'B' Extended Drought 1 in 80 (1.25% risk)
- Scenario 'C' Serious Drought 1 in 125 (0.8% risk)
- Scenario 'D' Severe Drought 1 in 200 (0.5% risk)

In terms of Long-Term Average (LTA) Rainfall each drought is different but the scenarios can be related to an overall shortage of rainfall:

- Scenario 'A' 70% LTA Rainfall
- Scenario 'B' 60 % LTA Rainfall
- Scenario 'C' 50% LTA Rainfall
- Scenario 'D' Less than 50% LTA

These droughts cover the plausible range that Government has suggested with the Reference Level of Service for a Severe Drought at 1 in 200. Extreme Droughts (1 in 500) are not covered by the Drought Plan but by a separate Emergency Plan which also covers other resilience issues such as flooding or major source works pollution

Groundwater triggers

Portsmouth Water does not have any surface water storage reservoirs and therefore does not have any conventional control curves for drought contingency use. Historically we have used groundwater levels to monitor the water supply situation and to compare trends with critical years. With no surface water storage, the necessity for Drought Management Actions is principally to ensure that during the peak demand period of May to August sufficient supplies will be available to balance demand. Groundwater levels remain the key drought indicator since these levels affect springs, well and borehole yields. They also provide the base flow in the River Itchen which supports the Company's Source A abstraction.

The following figures show groundwater control curves with triggers for:

- Implementing the Drought Plan (Level 1)
- Introducing Temporary Bans (Level 2)
- Introducing Drought Orders and Permits (Level 3)
- Removing restrictions at the end of the drought (Upper Trigger).

We also include the Level 4 trigger for information only, as this is covered in our Emergency Plan.

To test the robustness of the groundwater control curves developed, historical data has been tested against the curves to establish if the appropriate actions would have been triggered. The following sections set out potential timetables for drought management actions for each of the scenarios. The exact timings will depend on the actual weather conditions and the decisions of the Drought Management Team. There is a danger if the triggers and zones are too prescriptive that this will hamper the efficient management of a future drought. Supply availability has been determined using the source yields calculated in our WRMP19. It should be noted that these source yields are derived from simulated weather data and do not represent actual outturn data.

Application of Drought Management Actions

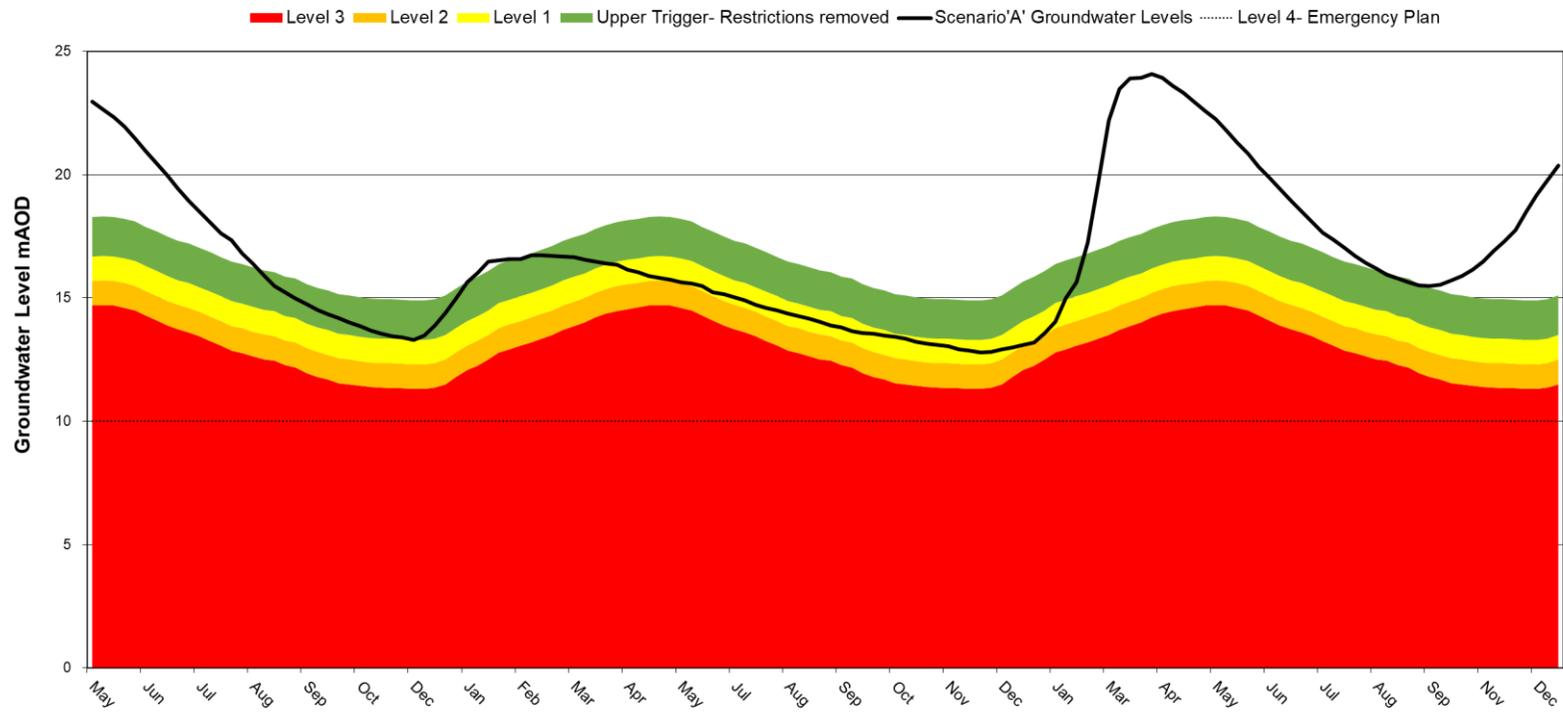
The sequence of Drought Actions will be determined by our Drought Management Team, but will be largely dictated by the severity of the drought situation together with the particular drought scenario being followed. It must be recognised that the critical period for us to maintain supplies because of the lack of raw water storage, will be the peak demand months of May to August. These will be the prime periods for actions and they may only be required for relatively short durations.

On a monthly basis, we will assess the impacts of the theoretical scenarios in the following seasons and apply them to current groundwater levels in order to determine the need for possible actions. In the event that the Trigger Profile is breached, or likely to be breached during the following season, our Drought Management Team will be convened in order to determine the necessary actions to be taken. The actions will also be very dependent upon the lead-in time needed for development of the options which can vary due to numerous constraints.

1.1 Scenario 'A' Indicative Drought Management Actions

Figure 1 represents Scenario 'A' or the 'Historic Drought' which simulations give a return period of 1 in 40 (2.5% risk of failure). This is based on the lowest ground water levels recorded at Well X. The initial drought plan trigger 'Level1' is used to determine the start of the drought planning process. In some years no further actions will be required and calls for restraint and additional leakage control will be sufficient to meet the supply/demand balance. In this example 'Temporary Bans' are triggered at the end of April in the second year.

Groundwater Levels Under Scenario 'A' Drought



	Year 1				Year 2								Year 3																			
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Drought Stage	Normal				Normal/ Developing				Normal				Developing/ Drought				Developing				Normal											
Monitoring Status	Monitoring situation				Projections based on forecast demands				Potential recovery				Monitoring decreasing levels and notification of possible implementation of TUBs				Monitor demand closely coming into the peak week of August				Consideration of drought permit implementation if groundwater levels continue declining.				Groundwater level recovered. Review actions and lessons learned							
Demand side actions	None				Appeals for restraint and enhanced leakage control				Prepare for possible TUBs				Implement TUBs				Remove TUBs															
Supply side actions	None																Review application ready documents for drought permit				None											

Figure 1: Scenario 'A' Drought

Groundwater levels enter the green zone, which represents calls for restraint, and just touches the orange zone which represents temporary bans. None of the other triggers are crossed until the end of the drought in the third year. The Drought Management Team would be working with the Environment Agency and neighbouring Water Companies. Appeals for restraint and enhanced leakage control are assumed to result in a 2.5% reduction in demand and bring demand back towards the supply available.

The range of measures employed would be based upon the extent of the projected deficit in supplies as compared to forecast demands, together with the level of effectiveness of each stage of measures. These would be determined by the Drought Management Team as the drought develops. Notification of the possible need for a 'Temporary Ban' would be made by the end of March with the aim of introducing restrictions by mid-May. Restrictions imposed in early summer would be expected to reduce demand by 5% allowing for the concessions that have now been made.

After the end of May, demand will rise with warmer weather and the impacts of additional personal washing. For example, when the peak week occurs in August deployable output will be falling again. Under Scenario 'A' some headroom is maintained in the summer between supply and demand (See appendix 'H').

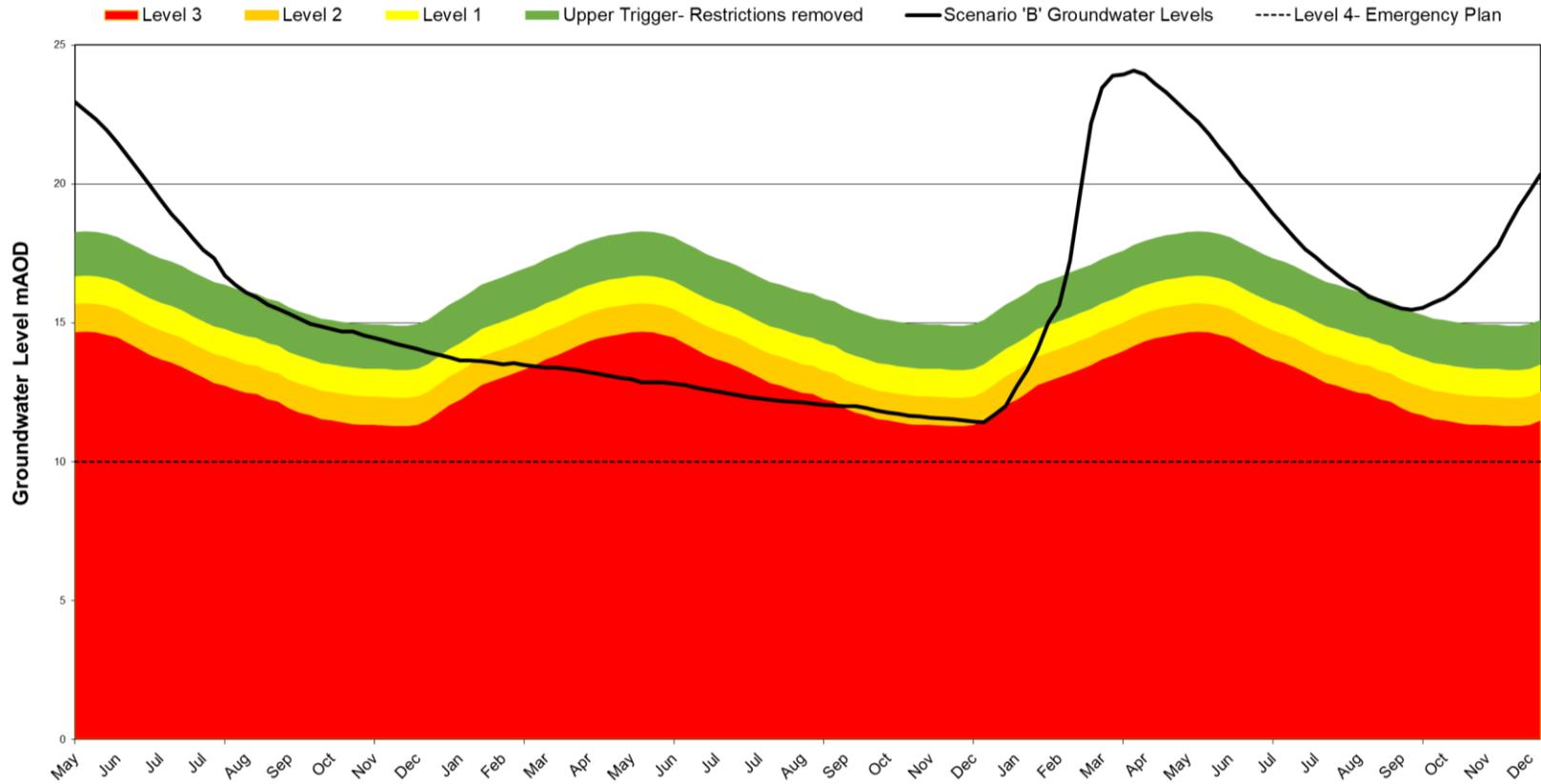
Headroom is required to allow for the inaccuracies of the demand forecasts and uncertainties about the source yields. Loss of works due to pollution or mechanical failure is already allowed for in the Water Available for Use (WAFU) figure. Under Scenario 'A' the trigger for 'Drought Orders' is not crossed and additional demand restrictions are not required. It would be prudent to consider a 'Drought Permit' in September (Year 2) and think about implementation if groundwater levels continue to fall. If the drought permit is not required then there is no increase in the amount of water available.

When the peak week has passed, demand is expected to fall away rapidly. The final drought trigger is then used to determine when to remove the 'Temporary Ban'. Under Scenario 'A' this would be around January as winter rainfall caused groundwater levels to rise rapidly. Even under Scenario 'A' we would continue to monitor rainfall and groundwater levels after the drought had ended.

1.2 Scenario 'B' Indicative Drought Management Actions

Under Scenario 'B' there is no recharge in the first winter and groundwater levels continue to fall over the whole of the second year. This scenario represents an 'Extended Drought' which the simulations give a 1 in 80 year return period (1.25% risk of failure).

Groundwater Levels Under Scenario 'B' Drought



	Year 1												Year 2												Year 3											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
Drought Stage	Normal						Developing	Drought			Severe						Drought			Normal																
Monitoring Status	Monthly Monitoring						Daily Monitoring and projections based on forecast demands						Continue Daily monitoring/ Drought Management Team develop actions to balance S-D in the summer.												Groundwater level recovered. Review actions and lessons learned											
Demand side actions	None						Appeals for restraint and enhanced leakage			TUBs			NEUBs						Remove TUBs and NEUBs																	
Supply side actions	None						Prepare for drought permit application			None						None																				

Figure 2: Scenario 'B' Drought

The first trigger is crossed at the end of December and there are calls for restraint and extra leakage control activities. The second trigger is crossed in January and 'Temporary Bans' are introduced in time to influence the spring and summer garden watering season. If there has been a sufficient shortage of rainfall then 'Non Essential Use Bans' will be introduced to restrain non household demand in the summer. This is the third trigger and takes groundwater levels into the red zone.

In this example the 'Temporary Ban' restrictions stay in place for more than six months and the 'Non Essential Use Bans' are not removed until the drought has ended in February of the third year.

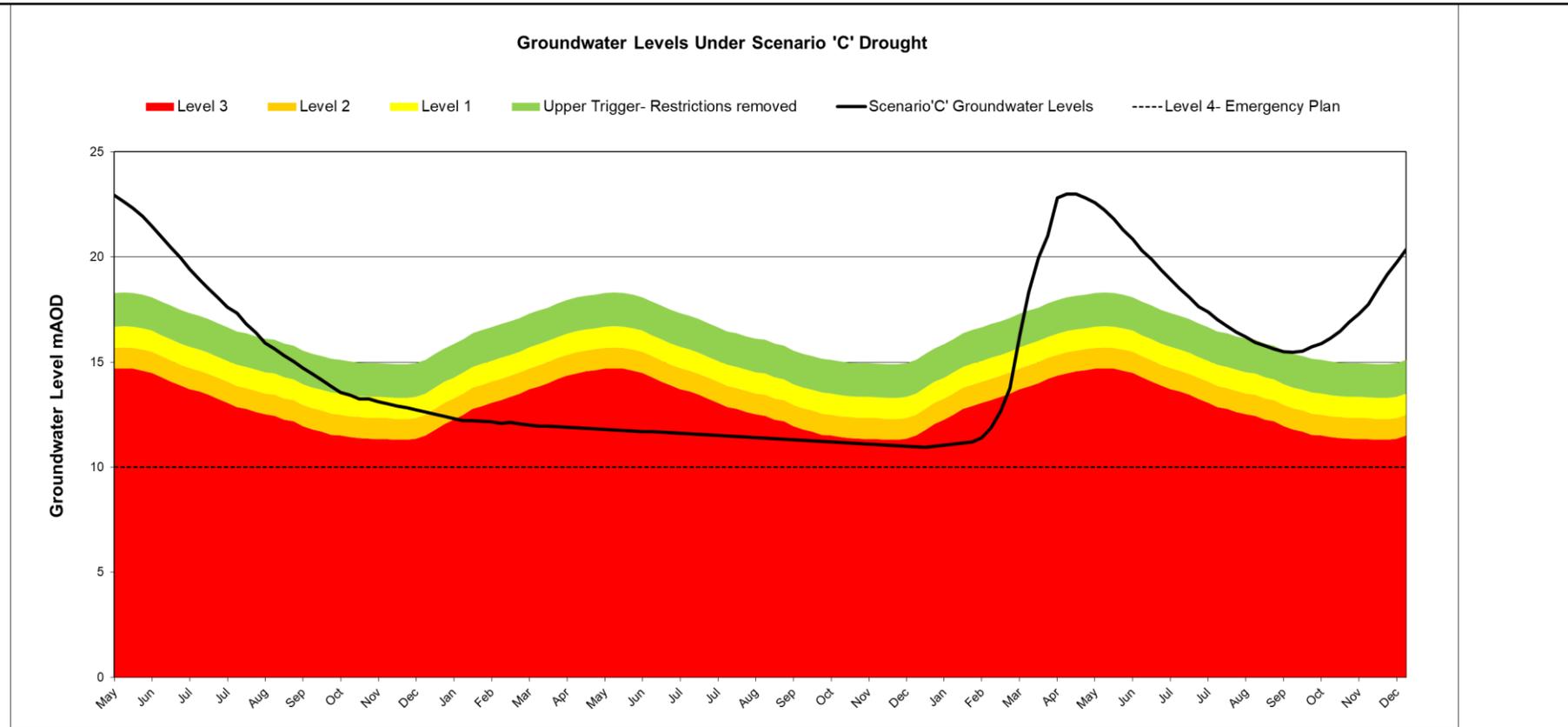
As described previously, Scenario 'B' assumes a dry winter following average conditions in the preceding summer. Scenario 'B' anticipates insufficient rainfall to provide any recharge during the winter and this is followed by a dry summer and autumn through to December. It is anticipated that the first trigger level will be crossed in December and that groundwater levels remain below the trigger until the following spring. Scenario 'B' would have a shorter time sequence of drought management actions compared to Scenario 'A'. There would be less time to prepare temporary bans and drought permits but the lack of winter recharge makes the need for restrictions more obvious.

Notification of the need for a Temporary Ban would be made by the end of December with the aim of introducing restrictions by the end of January. Restrictions are expected to reduce demand by 5% (See appendix 'H'). With falling groundwater levels in the spring, an application would be made for a Drought Order with further restrictions on demand and the possibility of relaxed licence conditions at North Arundel. Although included in this plan, and the Environment Agency's South East Drought Plan, it is unlikely that the Drought Order would be available before August under any scenario.

The lowest groundwater levels would be reached in December with recovery starting in January or February. The 'Temporary Ban' would remain in force in case the drought continued into a third year. The 'Upper Trigger' would be used to help decide when to remove the remaining restrictions. This decision would be taken by the Drought Management Team but would also be influenced by the national situation and the actions of neighbouring companies.

1.3 [Scenario 'C' Indicative Drought Management Actions](#)

The figure below shows data for a Scenario 'C' a 'Serious Drought' with lower rainfall in the first Autumn and no recharge over the whole of the next year. The graph indicates that a 'Temporary Ban' would have been introduced in December.



	Year 1												Year 2												Year 3											
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
Drought Stage	Normal				Developing Drought				Drought				Severe Drought												Normal											
Monitoring Status	Monthly Monitoring				Daily Monitoring and projections based on forecast demands				Drought Management Team develop actions to balance S-D in the summer.								Monitor effects of drought permit				Groundwater level recovered. Review actions and lessons learned															
Demand side actions	None				Appeals for restraint and enhanced leakage control				TUBs				Prepare for NEUBs				NEUBs				Further leakage and pressure management				Removal of demand restrictions											
Supply side actions	None								Prepare for drought permit application				Apply for Drought Permit				Drought Permit				Consider extending Drought Permit				None											

Figure 3: Scenario 'C' Drought

The 'Non-Essential Use Ban' would be instigated in January and would need to be in place for the peak demand period in August. The drought would have ended at the beginning of the third year with winter recharge. The green zone shows removal of the 'Temporary Ban' and 'Non-Essential Use Ban' when recharge was confirmed.

Assuming that the first trigger 'level 1' is breached in the autumn of the first year this would enable the Drought Management Team to put in place the actions needed to balance supplies with demand in the following summer.

Due to the serious nature of this Drought Scenario, no concession would be offered for micro irrigation. Impacts on the environment mean that as little water should be used on gardens as possible, even at night.

With lower yields available from sources in a 'Serious Drought' it might be necessary to apply for the Drought Permit in year two. This would produce an additional 8.5 Ml/d of supply for a short time during the summer. The application process would start in May with implementation expected in August when groundwater levels were already low.

As with the previous Scenarios it would be for the Drought Management Team to make the appropriate decisions as the drought develops.

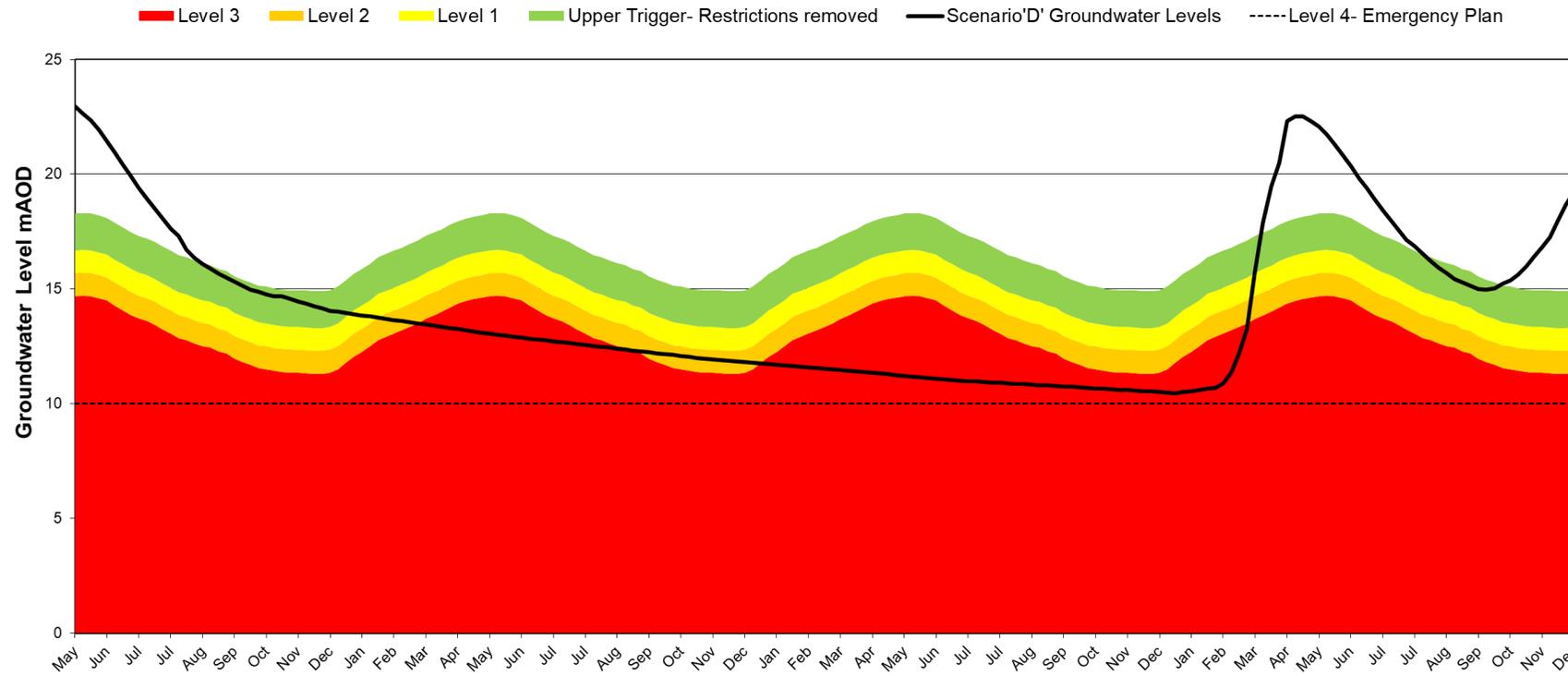
The source yields at lowest groundwater levels have been simulated and are subject to uncertainty. As demand fell in the Autumn of year two the output of North Arundel could be reduced. It would be prudent not to remove the demand restrictions until groundwater levels rise above the 'Upper Trigger'.

1.4 [Scenario 'D' Indicative Drought Management Actions](#)

Scenario 'D' is based on Scenario 'C' but with the groundwater recession extended into a third year with very low rainfall. Under Scenario 'D' the first year is a bit wetter than Scenario 'C' but instead of recovering at the end of year two groundwater levels, and therefore deployable output, continue to fall in year three. This is defined as a 'Severe Drought' and recovery only occurs in year four with winter rainfall.

In addition to 'Temporary Bans', which would need to be repeated, and a 'Non Essential Use Ban' imposed, this drought would require the 'Drought Permit' to reinforce supplies.

Groundwater Levels Under Scenario 'D' Drought



	Year 1				Year 2				Year 3				Year 4																			
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Drought Stage	Normal				Developing	Drought			Severe Drought												Normal											
Monitoring Status	Monthly Monitoring				Daily Monitoring and projections based on forecast demands				Drought Management Team develop actions to balance S-D in the summer.				Monitor effects of drought actions. Drought Management Team publicising prospects of a third dry year. Prepare for prospect of enacting the emergency plan.				Consider extreme drought actions. Liaise with regulators and water companies.				Groundwater level recovered. Review actions and lessons learned											
Demand side actions	None				Appeals for restraint and enhanced leakage control		TUBs		NEUBs and further leakage and pressure management				Extension of TUBs and removal of certain concessions. Prepare for extreme drought actions.				Removal of demand restrictions															
Supply side actions	None				Prepare for drought permit application				Apply for Drought Permit		Drought Permit		Potential drought permit extension. Prepare for extreme drought actions.				None															

Figure 4: Scenario 'D' Drought

Ground water levels would drop to 10.5 m ADO and deployable output would be significantly constrained. Portsmouth Water would already have been working closely with the Environment Agency and other stakeholders, during the first two years of the drought. By the spring of the third year, the Drought Management Team would be publicising the prospects of a third dry summer. This would involve the extension of the existing 'Temporary Bans' and the removal of some concessions.

By the end of May, the danger of rising demand would require the introduction of the 'Non-Essential Use Ban'. This would impact on commercial customers such as window cleaners, gardeners and vehicle washers. Portsmouth Water assumes that the response to a 'Non-essential Use Ban' would be a further 3% reduction in demand.

With lower groundwater levels than ever recorded before, and lower yields, it might be necessary to apply for a Drought Permit for North Arundel. This would produce an additional 8.5 Ml/d of supply for the whole of year three. In this example, groundwater levels return to normal in the spring of year four following winter rainfall.

As groundwater levels approach the Emergency Plan level (Level 4), we will start to explore the need and prepare for extreme drought actions. We will also implement actions from 'More Before 4', with the aim to delay the implementation of the Emergency Plan (Level 4). It is essential to liaise with regulators and regional water companies to discuss these options and possible collaborative regional solutions. We will also consider the need to extend the drought permit and prepare the application.

As with previous scenarios it would be for the Drought Management Team to make the appropriate decisions as the drought develops.

This scenario is assumed to have a return period of around 1 in 200 years. With no historical data to base this drought on the source yields are highly uncertain. The table only represents an indication of what the Company might do under the influence of a 'Severe Drought'.

It would not be prudent to remove demand restrictions until groundwater levels rose above the 'Upper Trigger' at the beginning of year four.