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Water supply modelling in a water-stressed remote community

R. Holden and C. Seccull

Power and Water Corporation, Darwin, Australia
Email: rachael.holden@powerwater.com.au

Abstract: Yuelamu (population approx. 260) is located 280 km northwest of Alice Springs. The community is located in the arid region and has a long history of water supply challenges. In 2016, Yuelamu Dam was taken offline due to health risks following a persistent blue-green algal bloom. Since 2016, groundwater has been the only drinking water source for the community, with two production bores drawing from a small, poor quality aquifer.

Preliminary advice from a hydrogeological study received in March 2022 identified that at existing extraction rates, the local aquifer was at critically low levels and at risk of imminent failure through dewatering. An immediate response was initiated to reduce the risk of failure including groundwater modelling and demand management. In parallel, medium to longer term water source augmentation solutions were evaluated and shortlisted, including the reconnection of Yuelamu Dam and/or a new groundwater source. Yuelamu Dam is known to fail during extended dry periods so any solution that involved this storage would also have to involve groundwater as a contingency source.

A catchment model combined with a water supply schematic model was developed using eWater Source as part of the assessment into the feasibility of re-connecting Yuelamu Dam. The objective of this modelling was to understand the reliability of the surface water storage in terms of both frequency and duration of failure. This reliability assessment would then be used in conjunction with groundwater modelling of the two existing production bores to determine whether they could be used as a contingency source, or if additional groundwater sources would be required to meet the community's demands.

There were challenges with developing and calibrating the Yuelamu Dam catchment model as both input and calibration data was limited. Three different rainfall runoff models were trialled during the calibration process; GR4J, Sacramento and Australian Water Balance Model (AWBM). The Calibration Wizard in eWater Source was used to automatically calibrate each of the different model options. GR4J was selected as it provides a reasonable correlation to available calibration data while also being relatively simple given the limitations in the input and calibration data.

An interesting climate trend was evident with the modelling results showing significantly different storage inflow pre and post 1970. An analysis of the climate data used in the model showed that the rainfall data was the biggest driver for this difference. When assessing storage reliability during the full 130 year simulation, there was a storage failure rate of 60% and an average failure duration of 2 years. This failure rate reduced to only 26% and an average duration of 1 year when running the simulation from 1970 onwards. Results also showed that the use of the existing bores to provide a constant supply contribution of 50 kl/day could significantly improve the reliability of the surface water storage with the estimated failure rate reducing to 44% (based on 130 year dataset).

Though there was significant uncertainty in the surface water modelling, the analysis confirmed that the return to service of Yuelamu Dam is a viable option with supplementary supply from the groundwater. A concept design for a new surface water treatment plant is being developed and a bore drilling program is in progress which will inform the preferred longer-term strategy.

Modelling will continue to play a critical role in adaptive planning for the Yuelamu community.

Keywords: *Water supply model, remote community, eWater Source*