Lake Onslow

Analysis of lake level in response to historic calculated inflows

Lake Onslow does not have any direct measurement of inflows.

To calculate inflows there are two options. Daily inflow can be calculated based on the change of lake level and the lake discharge each day. The alternative is to assume the inflow characteristics are similar to a nearby catchment and adjust the recoded flow from that catchment based on relative catchment area.

The low accuracy of the Lake inflow-outflow approach, particularly while spilling, means that there is relatively low confidence in the derived inflow via this method. Therefore, the inflow data hydrograph has been based off the flow recorded in the Taieri River at Canadian Flat. This data has been supplied by MBIE and has been calculated for the Lake Onslow Battery Project.

The lake level response to historical inflows has been based on the following assumptions:

- The maximum take is 6m^3/s
- The maximum daily drawdown is 28.57mm (200mm/7days)
- The Lake storage at depth is based on lake storage charts held in PEL archives, Formula (Volume = 0.000035*L^3+1.09612*L^2+11455.116638*L+46000000)
- Inflow is the derived Taieri River adjusted hydrograph.
- The outflow is determined to be the lesser of either the drawdown limit or the drawdown as a result of maximum outflow
- The lake is assumed not to drop lower than 5.2m below crest.
- The inflow hydrograph for Lake Onslow calculated from the Taieri River at Canadian Flat historical record is valid

The derived lake level response has been determined based on the following process:

1. Lake level at given time 'T_n' is known (assume to be 0m below crest in 2007 or from previous time step)
2. Lake volume 'V_n' (m^3) at T_n is calculated based on storage formula at level in step 1
3. Inflow volume (m^3) is the average daily inflow (m^3/s) for the day multiplied by 86400 (24hx60minx60sec)
4. Determine Max outflow case
    a. Outflow is initially assumed to be 6m^3/s
    b. Outflow volume(m^3) is calculated (6 * 86400s)

c. New volume at t_{n+1} is calculated ($V_{n+1} = V_n$ + Inflow (step 3) – outflow (step 4b))
d. New Level at T_{n+1} is determined from V_{n+1} (step 4c) (this is done with a lookup table which is derived from the storage formula, minimum level -5.2m)
e. Check Drawdown (step 1 – step 4d)
f. Test if drawdown (step e) greater than allowable (>28.57mm?)

5. Determine Max drawdown case
    a. Calculate New level (Level (T_n) – 28.57mm)
    b. New Volume Calculated for level 5a (calculated from Storage formula)
    c. Change in volume calculated for Max drawdown case (step 2 – step 5b)
    d. Outflow Volume derived for Max drawdown case (Change in volume - inflow volume)
    e. Average outflow calculated based on Outflow in step 5d (to check).
6. Set New lake Level – Maximum of Max Flow case or Max Drawdown case

7. Repeat step 1

The lake level response for the 400mm/wk scenario is the same as above except maximum daily drawdown is 57.14mm (400mm/7days).