BEFORE THE COMMISSIONER ON BEHALF OF THE OTAGO REGIONAL COUNCIL

Consent No. RM18.004

Between the Applicant: Pioneer Energy Limited and the Consent Authority: Otago Regional Council

Speaking Notes from Luiz Lobo Coutinho, 4 July 2022

Introduction

1. I have prepared a review of the Lake Onslow hydrological numerical model ("the Model") as presented by the applicant in the excel spreadsheet "*Onslow level with inflows (Taieri synthetic) (ID 40368).xlsx*" (the "Spreadsheet") for the Hearing of RM18.004.

2. I have reviewed the document "Inference Questions for Lake Onslow lake levels model" sent on 26 May 2022 to Otago Regional Council by the Applicant.

3. I have reviewed Mr Jacks and Mr Couper's evidence on aspects that relate to the Model.

Lake levels model review

4. The Model, as provided in the Spreadsheet, uses a mass balance approach where the calculated lake level variation depends only on one inflow stream (the catchment runoff mean daily - MBIE data) and one outflow stream (the water take determined by drawdown limit or maximum outflow). No other data, such as precipitation, evaporation, and groundwater flows, is used.

5. As the Model does not use any meteorological or hydrogeological data, only taking into consideration the inflow from the catchment based on Taieri River flows, the reliability of the Model is heavily dependent on the accuracy of the single inflow data used, and how well it represents overall inflows (runoff from the catchment, direct precipitation, groundwater) and outflows (evaporation, groundwater leakage) to the Lake.

6. The Applicant, on the document "Inference Questions for Lake Onslow lake levels model", proposed a validation of the inflows using the period of 01/06/2013 to 01/08/2013, to which the daily lake outflow is estimated in 2.5 m³/s. Using the suggested period for validation of the model results in a correction factor of 0.688 for the inflow data. Even then, the graph shows that actual inflows to the Lake appears to be more delayed (smoother rise in level) than the Model calculates. This can be seen in Figure 2 of my review memo.

7. The Model checks for the weekly drawdown limits on a daily basis (i.e. 200 mm per week is used as 28.57 mm per day), it is possible that after a period of no drawdown (high inflow), the Model would underestimate the potential drawdown by limiting the weekly drawdown condition to a daily average. For instance, after 6 days of no drawdown due to high inflow, on the 7th day there would be potential for 70 mm of drawdown (maximum outflow volume and no inflow), but the Model would limit the daily drawdown to 28.57 mm for the 200 mm scenario and 57.14 mm for the 400 mm scenario. Due to this methodology, the Model would underestimate how quickly lake levels could fall, resulting in overestimation of lake levels.

Improving the Model reliability

8. The Model should limit drawdown on a rolling 7 days total against the consent limit instead of a daily average of that value. In this way drawdown would be better calculated, particularly after strong inflow periods. This change would allow the Model to better calculate how quickly the Lake levels can drop, particularly in short periods.

9. Meteorological data (precipitation and evaporation) could be added to the model. This data can be obtained from NIWA for the Lake location using interpolation of nearby stations. Adding this data could reduce the dependency on the inflow data and improve Model calibration. This is particularly significant if the Lake has a large surface area and low depth.

10. Once these changes are made, further calibration of the model, using periods of known outflow, could be used to derive correction factors for the inflow data. It could be possible that multiple correction factors can be applied for different periods or seasons, depending on the differences between the lake catchment and the catchment from where the data is sourced. These changes and further calibration would improve the Model reliability.

Comments on other submitted evidences

11. I agree with Mr Couper's comments (paragraph 11 of his evidence) on the reliability of the Model. The Model, as presented by the Applicant, should be considered to overestimate lake levels. Although the proposed calibration factors for the inflow data improves the reliability, the Model should still be considered with a degree of uncertainty.

12. I agree with Mr Jack paragraph 32, in that the Model demonstrates that the actual utilisation of Lake Onslow as historically been significantly less than that permitted under resource consents. I am however, not in a position to comment if the differences between modelled scenarios is "significant".

13. Despite what Mr Jack proposes in his evidence (paragraph 30) regarding the impact of including meteorological data in the Model, I believe it would be an easy change that would improve the Model reliability. Although the lake surface might be a small area of the overall catchment, it receives direct precipitation and is a direct source of evaporation, while the catchment will have losses to infiltration and uptake from vegetation. Therefore, direct precipitation and evaporation to/from the lake are likely to have a higher impact to lake levels than the relationship of the lake area to the catchment area might indicate.