

Summary of CSIRO and Geoscience Australia (GA) Advice on Groundwater Management Plans and Response

Advice on monitoring

1. CSIRO and GA recommended that Adani:

- a. Install more bores to monitor the deeper groundwater units in the central zone between the mine and the Doongmabulla springs. Installing these bores at existing points would remove any significant access issues, and would enable comparison to existing data.

Action: The Department required that Adani install additional deeper bores at existing sites (condition 3a/iii/6b) and collect suitable baseline data (condition 3b) at these sites.

Response: Adani have committed (refer section 7 of the GMMP) to install deeper bores at, or within 500m of, three existing monitoring locations in the central zone. These bores will not monitor all of the deeper units. Adani will investigate drilling bores into deepest units where coal occur for monitoring and research purposes. These commitments have also been referenced in the GDEMP (see sections 4.3.2 and 8.8).

- b. Include stream flow gauging upstream and downstream of the mine area in their ongoing monitoring program, with updated height-discharge surveys

Action: The Department required more precise gauging locations and commitments for future height-discharge surveys in the GDEMP (condition 6b).

Response: Adani have committed in the GDEMP to install an additional 3 gauging locations, in addition to the two existing locations, and further surveys to determine height-discharge relationships (see section 6.6.1).

- c. include a more sophisticated statistical analysis of hydrochemistry data to constrain the source aquifer(s) of the Doongmabulla Springs. This includes assessing a wider variety of groundwater and surface water parameters.

Action: The Department required clarity on these methods, which are a requirement of research under the *Great Artesian Basin Springs Research Plan (GABSRP)* at condition 25e and rely on installation of additional nested bores to the west of the site.

Response: Adani will address this issue in revisions to the GABSRP.

Advice on management

2. The limitations of the numerical groundwater model mean that drawdown could be under-predicted, so the adopted thresholds and triggers will be reached sooner than anticipated and are not a suitable foundation for the proposed monitoring and management approaches.

Action: The Department required that Adani adopt a more conservative approach to monitoring and management until the model is reviewed within two years of the first box cut (or first extraction of coal). For example, more conservative measures might include:

- Monitoring additional parameters, e.g. spring flow / flux, in addition to groundwater level and pressure;
- Committing to a particular mine plan or number of tonnes of coal; and/or

- Applying rate-based triggers for more bores to verify model predictions and to other GDEs to ensure they are protected.

Response: Adani has:

- included monitoring of spring flow under the GDEMP (refer section 8.7).
- not committed to a scaled-down mine plan, but has included further details about the proposed mine plan for the first five years of operations in the GMMP (refer section 2.6 and Appendix B).
- committed to investigating any drawdown rates that are faster than predicted as per standard practices at model review and update (see section 5.3.5.2 of the GMMP).

3. The proposed monitoring and management approaches do not sufficiently address the uncertainty regarding potential alternative or additional source aquifers of Doongmabulla Springs. Recommendations to address this uncertainty include: the installation of monitoring bores between the mine and the Doongmabulla springs, streamflow gauging and a more sophisticated statistical analysis of hydrochemistry data as described under item 2 above.

Action: The Department required that Adani address the actions under item 2 and commit to apply triggers and limits for the additional nested bores to the west of the site. These triggers must be based on baseline condition (condition 6f).

Response: Adani has addressed the advice under item 2 and committed to apply triggers and limits to the additional nested bores in the GMMP (see section 7). The revised early warning triggers and impact thresholds will be submitted to the Department for approval as part of review of the GMMP. The Department will ensure that these triggers and limits are set to ensure the protection and long-term viability of the Doongmabulla Springs Complex.

4. CSIRO and GA advice on the design of water level thresholds and triggers included that:

- a. All monitoring locations for which water level thresholds are defined should also have drawdown rate limits derived. Evaluation of drawdown rate limits should form part of routine monitoring data assessment and be included in the Impact Threshold Assessment approach.

Action: The Department required that rate limits are applied for both the Carmichael River and the Doongmabulla Springs in the GDEMP, based on the requirement for early-warning triggers at these GDEs (condition 6f), not all bores.

Response: Early warning triggers have been included in the GDEMP for both the Carmichael River and the Doongmabulla Springs (see Appendix B).

Action: To account for model limitations, and likely underpredictions, the Department required that Adani apply drawdown rate limits until the model is reviewed within two years of the first box cut.

Response: Adani has committed to investigating any drawdown rates that are faster than predicted as per standard practices at model review and update (see section 5.3.5.2 of the GMMP).

- b. A bore in the alluvium, 'C025P1', has been dry during the baseline monitoring period and should not be used as a threshold monitoring point.

Action: The Department required that a trigger not be set at C025P1.

Response: Adani has committed in the GMMP (see section 7) that bore C025P1 will be replaced. In the interim, if bore C025P1 is dry, or has no water level readings longer than 6 months, the trigger will be exceeded (section 5.3.3.1). This trigger is cross-referenced in the GDEMP Appendix B.

5. CSIRO and GA provided advice to improve the investigation procedures. Recommendations included that the GMMP:

- a. Explicitly state that the Commonwealth regulator will be notified whenever a groundwater exceedance occurs

Action: The Department required that Adani commit to notify the Department whenever a groundwater exceedance occurs

Response: Section 4.7.2.2 of the GMMP now states: The administering authority will be notified when an investigation is to be instigated for both groundwater quality and levels.

- b. Commit to a maximum timeframe in which the investigation will be completed (for example three months).

Action: The Department required that Adani specify a timeframe in which a groundwater exceedance investigation will be completed.

Response: Section 4.7.2.2 of the GMMP now states: If the groundwater level thresholds exceedance is because of authorised mining activities, the investigation will be prioritised and, depending on the nature of the impact, completed within three months.

- c. Provide details of the process to remove non-mining influences will occur during investigation of threshold exceedances.

Action: The Department required upfront details of these investigations so when there is an exceedance it can be assigned to the cause.

Response: Adani has provided further details of the trend analysis that will be undertaken in the GMMP (section 4.7.2.2) , which will include assessing at least 12 months of groundwater data for the bore and comparing it to climate data, nearby bores, other local projects and assessing the potential for cumulative impact.

- d. Present mitigation actions in the GMMP itself

Action: The Department required that mitigation actions be summarised within the GMMP to address condition 3d, rather than just references to mitigation in other plans.

Response: The GMMP (section 4.7.2.2) uses examples of mitigation actions in response to an exceedance, including:

- review of the mine plan (including sequencing of mining);
- limiting thickness of extraction of coal seams and reviewing extraction of multiple coal seams for the underground longwall mining; and
- freezing mine development at current levels until the completion of investigations and assessments which conclude that further development will not exceed approved impacts.

6. CSIRO and GA provided advice on the design of water quality thresholds and triggers

Action: The Department notes that water quality triggers and limits are not a requirement of the EPBC conditions of approval. This advice will be provided to DES for their information.

Response: Not applicable for the groundwater management plans under EPBC conditions.

Advice on modelling

7. The review found that the numerical groundwater model used by the GMMP is the most conservative of the model scenarios available. However CSIRO and GA do not consider the model fit-for-purpose for achieving the outcomes sought by the conditions of approval, and have provided recommendations, including:
- a. fixing identified errors in the bore heights used to calibrate the model, explaining how they have changed over time and how these changes affect model prediction and performance
 - b. using locally-appropriate parameters (which dictate how water moves through the model layers) to represent the Carmichael River, Rewan Formation and Clematis Sandstone, and subsidence above longwall mining
 - c. recalibrating the model using the revised information in (a) and (b), using the baseflow in the Carmichael River as a target to ensure it produces realistic values
 - d. global sensitivity analysis and uncertainty analysis to determine the full range of likely impacts and the influence of each parameter and
 - e. validating the model based on data from new bores drilled since approval of the mine.

Action: The Department required that Adani commit in the GMMP and GDMP to these updates as part of the model review required within two years of the first box cut under Queensland's EA.

Response: Adani have committed to address the limitations identified by the CSIRO and GA review in the groundwater model re-run - see section 7 of the GMMP and section 4.3.2 of the GDMP.