

## Advice to decision maker on coal mining project

### IESC 2017-082: Grosvenor Coal Mine G200s Expansion Project (EPBC 2016/7796) – Expansion

---

<b>Requesting agency</b>	The Australian Government Department of the Environment and Energy
<b>Date of request</b>	7 <sup>th</sup> February 2017
<b>Date request accepted</b>	8 <sup>th</sup> February 2017
<b>Advice stage</b>	Assessment

---

#### Context

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the IESC) was requested by the Australian Government Department of the Environment and Energy to provide advice on Anglo Coal (Grosvenor) Pty Ltd's Grosvenor Coal Mine G200s Expansion Project in Queensland.

This advice draws upon aspects of information in the assessment documentation, together with the expert deliberations of the IESC. The project documentation and information accessed by the IESC are listed in the source documentation at the end of this advice.

The Grosvenor G200s Coal Mine Expansion Project (the proposed project) is an extension of the approved Grosvenor Mine, an underground longwall mine located within the Bowen Basin in Central Queensland 150 km southwest of Mackay, near Moranbah. Construction of the approved Grosvenor Mine commenced in 2012 with mining beginning in May 2016. Approval under the EPBC Act was granted in 2011, prior to the water trigger. Surface infrastructure associated with the existing mine includes coal handling and transport (overland conveyor) infrastructure, a mine industrial area, administration buildings and a mine water management system. The coal handling and preparation plant (CHPP) and rejects disposal area are located at Moranbah North Mine.

The proposed project includes eight new longwall panels. Coal extraction is predicted to be approximately 10.5 Mtpa ROM (million tons per annum run of mine) of high quality coking coal from the Goonyella Middle Seam. The proposed project will cover an area of approximately 900 ha, with a predicted life of six years. The proposed project will utilise existing infrastructure at the approved Grosvenor Mine and Moranbah North Mine.

The proposed project is located within the Isaac River catchment, a sub-catchment of the Fitzroy River Basin. The Isaac River flows across the northeast corner of the proposed project site, directly above two proposed longwall panels. Two drainage paths flow southeast across the proposed project site to the Isaac River. The Isaac River catchment, to the downstream boundary of the proposed

project, is approximately 1800 km<sup>2</sup>. Groundwater at the project site is located within the Isaac Connors Groundwater Management Area.

The proposed project is adjacent to several existing coal mines (e.g. Moranbah North Mine, Isaac Plains Mine). In addition, part of Arrow Energy's Moranbah Gas Project is located within the proposed project boundary. Existing mines within the area have been operating for several years and have resulted in altered groundwater levels and pressures within the Permian Coal Measures, Tertiary sediments and Tertiary basalt aquifers. Alterations to the flow regime and geomorphology of the Isaac River have also occurred.

Several EPBC Act-listed fauna species have been observed at the proposed project site. Two threatened ecological communities (EPBC Act-listed) and a number of vegetation communities listed under Queensland legislation also occur within the proposed project site. Remnant riparian vegetation along the Isaac River is part of an ecologically important corridor within an otherwise largely cleared rural landscape.

#### Key potential impacts

The proposed project has the following key potential impacts:

- Structural damage to the Isaac River through the formation of three subsidence troughs, predicted to be approximately 2 m deep and 370 m long within the riverbed.
- Changes to water quality, water-dependent ecosystems and geomorphology within the Isaac River caused by changes to sediment deposition in some reaches as a result of subsidence in the Isaac River.
- Further drawdown and depressurisation of the Tertiary basalt, Tertiary sediments and Permian Coal Measures aquifers.
- Additional cumulative impacts to the groundwater, surface water and ecology of the region.

#### Assessment against information guidelines

The IESC, in line with its Information Guidelines (IESC, 2015), has considered whether the project assessment has used the following:

##### *Relevant data and information*

There are several areas where key conclusions cannot be verified because they are not supported by relevant data or information. These are:

Limited field data (e.g. long-term groundwater levels and groundwater quality) was provided for the alluvial aquifer, especially within the proposed project site. This data is needed to allow assessment of seasonal variability and characterisation of the degree of connectivity between the alluvial aquifer and the Isaac River.

The condition of the Isaac River downstream of the proposed project has not been identified and discussed. An understanding of the sediment supply and the current geomorphological characteristics of the Isaac River downstream is needed to assess potential impacts from the proposed project and to inform the development of mitigation and management options.

The assessment of the occurrence of groundwater-dependent ecosystems (GDEs) relied primarily on the interpolated depth to groundwater at the proposed project site. The observations underpinning the depth to groundwater mapping were not provided.

Current and historic water quality data for the Isaac River was not provided. This data should be provided to assist in establishing the current conditions for surface water quality at the proposed project site. Data characterising water quality within the mine water management system at the existing Grosvenor Mine is needed, along with a site-specific geochemical assessment, to understand the potential risks to surface water and groundwater quality. This information can then be used to inform the development of appropriate mitigation, monitoring and management plans.

The proponent intends to extend several existing Grosvenor Mine management plans to include the proposed project, however, these plans were not provided. Without these documents, which contain the detail of proposed mitigation and management measures, an assessment of the measures' effectiveness cannot be completed.

#### *Application of appropriate methods and interpretation of model outputs*

The subsidence and surface water modelling are generally completed to an appropriate standard. Subsidence modelling used the incremental profile method, and is calibrated using site-specific field observations.

The groundwater modelling methodology is generally consistent with the Australian Groundwater Modelling Guidelines (Barnett *et al.* 2012). Further discussion of model parameterisation and calibration, and a program for ongoing model validation that includes ongoing monitoring and review would improve confidence in long-term model predictions. An independent technical peer review of the groundwater model should be undertaken.

#### **Advice**

The IESC's advice, in response to the requesting agency's specific questions, is provided below.

Question 1: Has the proponent collated the relevant information required to identify and assess impacts to surface and groundwater resources? If not, what additional information would assist in the identification and assessment of impacts to water resources?

#### Response

1. No. While some information on surface water, groundwater, subsidence and ecology has been collated and used to inform the proponent's assessment of impacts to surface water and groundwater resources, there is much information that has not been provided in the assessment documentation. Collation and analysis of the information below is required to identify and assess potential impacts:
  - a. Additional field data (e.g. hydrogeological and ecological) on the occurrence of water-dependent ecosystems within the proposed project area and downstream.
  - b. Quantification of the total predicted cumulative impacts to all aquifers.
  - c. Timeframes over which the recovery of groundwater levels and pressures are expected.
  - d. Data on the current surface water flow regime (i.e. timing, frequency and duration) of the Isaac River and analysis of changes over time.
  - e. Field data on the geomorphological condition of the Isaac River at the proposed project site and downstream, with discussion of how the Isaac River and associated ecosystems may be impacted if supply-limited conditions (i.e. reduced sediment load in the river) arise.

- f. Water quality data for the Isaac River and the mine water management system, including the mine industrial area and ROM dams, the mine worked water dam and the Moranbah North Mine storages.
- g. Updated aquatic ecology surveys, including preliminary stygofauna sampling in accordance with DSITI (2015).
- h. A geochemical assessment is needed to understand the contamination risk to surface water and groundwater, and to inform what analytes should be regularly monitored. Outcomes from this assessment should be used to inform the development of monitoring and management plans. Geochemical data from other operations in the region could be discussed, however, collection of site-specific data should be considered.
- i. A risk assessment should be undertaken to characterise the risk profile of the proposed project and to inform the adoption of monitoring, mitigation and management measures.

### Explanation

#### *Groundwater:*

2. The proponent has stated that there will be no impacts to GDEs within the proposed project site (EAR, p. 5-9). However, this assessment is based on the interpolated depth to groundwater exceeding 15m across the proposed project site, which is considered to be beyond the rooting depth of the local vegetation (EAR, p. 5-9). The map of interpolated depth to groundwater should identify the location of all bores used for the interpolation. The GDE Atlas indicates that groundwater dependent ecosystems may occur at the proposed project site. The data collated by the proponent related to the presence or absence of GDEs should be provided and discussed. This data should also be used to inform further investigations of the alluvial aquifer if riparian vegetation is identified as groundwater dependent (including intermittently or opportunistically).
3. The reliance of GDEs (if found to occur) on the groundwater regime should be established as this would assist in understanding the distribution and persistence (including recruitment) of potential GDEs, and inform the development of suitable mitigation measures.
4. The proponent identifies the percentage increase in cumulative drawdown caused by the proposed project in various aquifers (EAR, Figure 5-9 to 5-11), however, the total predicted cumulative drawdown is not provided. Therefore, the magnitude of cumulative groundwater impacts cannot be determined.
5. The proponent states that groundwater levels are expected to return to pre-mining levels (EAR, p. 5-7), however, the actual timeframe for this is not indicated.

#### *Surface water:*

6. A quantitative assessment of the current flow regime (i.e. timing, frequency and duration) of the Isaac River, including how development in the catchment has resulted in changes to the flow regime over time has not been provided or assessed. The ephemeral nature of the Isaac River may limit this assessment. However, the absence of any information or data in the assessment documentation limits the ability to measure and monitor impacts of the proposed project.
7. The creation of three subsidence troughs within the Isaac River at the proposed project site will result in sediment capture in this reach during infilling. This will reduce the supply of sediment downstream of the proposed project site. Without information on the geomorphological condition of the Isaac River in the downstream reach, the likely impacts of altered sediment supply, such as erosion, bank instability and subsequent impacts to ecosystems, cannot be fully assessed and

managed. Photo monitoring points could be used to monitor these impacts at the site scale. The response to Question 5 provides discussion on understanding and managing the cumulative impacts of subsidence in the Isaac River at the catchment scale.

8. Current water quality conditions within the Isaac River have not been provided and need to be established in order to identify future impacts due to the proposed project. The water quality within the mine water management systems at the existing Grosvenor Mine and Moranbah North Mine requires characterisation to assess the potential risks associated with discharges, to inform analyte selection, and to determine the frequency of sampling required for the monitoring program. Available historical data on water quality in the Isaac River and the mine water management system should be provided.

*Ecology:*

9. As stygofauna are likely to be found in the region (Hansen Bailey 2016), further assessment and monitoring should be undertaken in accordance with the Queensland Guidelines for the Environmental Assessment of Subterranean Aquatic Fauna (DSITI, 2015).
10. Gilgai, considered by Queensland as wetlands (Queensland Government 2013), and which the proponent has identified as providing habitat for the threatened ornamental snake (*Denisonia maculata*) and other EPBC Act-listed species, occur within the proposed project site (EAR, Appendix F, p. 67). No assessment has been undertaken to determine how subsidence and remedial drainage works may affect the water-holding capabilities of gilgai, despite alteration of gilgai hydrology being identified as a key threatening process for the ornamental snake (EAR p. 7-7). Offsetting is proposed in relation to habitat loss for the ornamental snake; however, this has only considered habitat loss from clearing of vegetation and not from subsidence.

Question 2: Is the modelling provided appropriate for a project of this type and at this stage of development? If not, what changes or improvements should be made to the modelling?

Response

11. Surface water and subsidence modelling are generally completed to an appropriate standard. Improvements to the groundwater modelling should be made to increase confidence in predictions, as outlined below.
  - a. Further discussion of aspects of the groundwater model parameterisation and calibration; and improved documentation of the groundwater modelling process to include discussion of assumptions, limitations and the adequacy of the available data.
  - b. Development of a program for model validation and review of the groundwater model, including independent technical peer review.
  - c. Further uncertainty and sensitivity analysis, and a detailed discussion of the implications of the results of these analyses.

Explanation

*Groundwater:*

12. The range of hydraulic conductivity values used, details of where the values are applied within layers, and discussion of the inconsistencies between field observations and applied values are needed to assess the suitability of the selected values. Additionally, the vertical hydraulic conductivity values applied to layers 12 to 14 should be further justified as these values are low and may not adequately represent continuous cracking as proposed by the proponent (EAR,

Appendix A of Appendix E, p. A4). Low vertical hydraulic conductivity values may result in underestimation of the extent of drawdown and depressurisation that could occur in overlying aquifers and connected surface water features.

13. Further discussion and justification of the specific yield and specific storage values applied are required as these appear inconsistent with literature values. These parameters affect groundwater model predictions of the extent and timing of groundwater drawdown and depressurisation.
14. Explanation of the use of general head boundaries for the southern and northern extents of the groundwater model are needed. As no sensitivity analysis of the model results to model boundary conditions (type and location) was undertaken, it is unclear how the applied boundary conditions may be impacting model predictions.
15. Further discussion of the evapotranspiration (ET) rates is needed, including an explanation of the numerical instability identified in the model that affected the selection of ET rates (EAR, Appendix A of Appendix E, p. A12).
16. Calibration hydrographs often do not correlate with observed groundwater levels, with both over- and under-prediction occurring. The proponent states that the calibration is good based on the calibration statistics (EAR, Appendix A of Appendix E, p. A8); however, the calibration statistics are weighted. The unweighted calibration statistics should be provided, and the implications of weighting discussed.
17. There is no program of model validation or review provided. Model predictions should be validated to provide confidence in future predictions. Additionally, an independent technical peer review of the groundwater model should be completed as recommended in the Australian Groundwater Modelling Guidelines (Barnett *et al.*, 2012).
18. Sensitivity analysis varied parameters by  $\pm 50\%$  (EAR, Appendix A of Appendix E, p. A17). Data provided by the proponent highlights that horizontal hydraulic conductivity varies over several orders of magnitude (EAR, Appendix A of Appendix E, Figure A3, p. A11). Sensitivity analysis should adjust parameters by an amount commensurate with the likely range of the parameter (Barnett *et al.* 2012). The analysis of the alluvial take shows potential sensitivity to hydraulic conductivity (EAR, Appendix A of Appendix E, Figure A8, p. A19). Given that the hydraulic conductivity values applied to the alluvium and Tertiary sediments appear to be high, further sensitivity analysis examining the impact on the alluvium as a result of applying lower hydraulic conductivity values should be considered.
19. Undertaking further uncertainty and sensitivity analysis would assist in understanding the potential limitations of model predictions and where to focus any further data gathering. Additionally, it would provide an indication of the confidence in the spatial extent and magnitude of the predicted drawdown.

Question 3: Does the proponent's assessment of groundwater and surface water provide reasonable estimations of the impacts to water resources, their severity and likelihood of occurrence? Are any other impacts likely?

#### Response

20. No. The lack of data provided in the assessment documentation limits the assessment of potential surface water and groundwater impacts. Some potential impacts, in addition to those identified by the proponent, need consideration. These are outlined below.

- a. Potential for water quality changes to occur when sediments become re-saturated due to groundwater levels rising following mining. For example, the potential for mobilisation of oxidation products and the potential for acid waste rock leaching/leakage into aquifers.
- b. Leakage from the Arrow Energy Dams and the mine water stores due to subsidence and the potential for groundwater quality impacts.
- c. Potential for changes in connectivity between the alluvium and underlying aquifers to affect the surface water flow regime, especially ecologically important low flows and the persistence of refugial pools.
- d. The potential for subsidence of the Isaac River to affect downstream reaches due to sediment deposition altering downstream sediment supply as discussed in Paragraph 7 and the response to Question 5.
- e. The potential for subsidence to reduce the water-holding capability of gilgai, and the potential impacts this may have on flora and fauna which utilise the gilgai, as outlined in Paragraph 10.
- f. The potential for non-conventional subsidence and subsequent influences on groundwater flow.

### Explanation

#### *Groundwater:*

21. The groundwater modelling predicts that following the completion of the proposed project, groundwater levels will return to pre-mining levels (EAR, Appendix E, p. 31). As the groundwater levels rise, fractured strata which have been dewatered will be re-saturated, with increased surface area of material interacting with groundwater. These changes could potentially affect groundwater chemistry. A geochemical assessment should be undertaken to assess the potential risks to groundwater quality and to inform the development of management and monitoring plans.
22. Two Arrow Energy Dams are located within the predicted subsidence impact zone. The ROM Dam and the Worked Water Dam for the approved Grosvenor Mine are located approximately 130 m and 230 m respectively from the edge of the proposed longwall panels (EAR, Figure 2-2). No details are provided regarding the quality of the water stored in Arrow Energy Dams. The mine water stores are stated to contain water from the underground workings. Subsidence may affect the integrity of these structures, potentially allowing the water contained within these dams to seep into the groundwater system causing changes to groundwater quality. This could affect the future use of the underlying Tertiary basalt and Tertiary sediments aquifers. The proponent states that the Arrow Energy Dams will be managed under a co-development agreement (EAR, p. 3-4). However, these potential impacts and the proposed mitigation and management measures should be discussed further.

#### *Surface water:*

23. It is predicted that continuous cracking is unlikely to affect the Isaac River or the alluvial aquifer directly (EAR, Appendix B, p. 33). However, surface tension, surface buckling, surface cracking and cracking in underlying aquifers may affect how rapidly water exchanges with the Isaac River and the alluvium. Subsidence may also increase the storage of the alluvium and underlying aquifers. The potential for this to affect the surface water flow regime has not been identified or discussed. Changes to the connection between surface water and groundwater may affect the low-flow regime in the Isaac River with potential impacts on aquatic biota and the ecological integrity of the river (Rolls *et al.* 2012). It may also reduce persistence of dry-season pools that provide drinking water for terrestrial fauna and refuges for aquatic biota.

*Subsidence:*

24. The subsidence assessment did not discuss the potential for non-conventional subsidence. Non-conventional subsidence can be associated with localised geological structures such as dykes and faults that may not have been identified, and where abnormally high stresses occur during mining. Non-conventional subsidence has the potential to change hydrogeological properties of groundwater systems.

Question 4: Are the proposed monitoring, mitigation and management measures adequate to identify, avoid or reduce the likelihood, extent and significance of impacts to water resources? If not, what additional measures are required to monitor, mitigate and manage impacts to water resources?

Response

25. No. The proponent has stated that a number of management plans currently applied at the approved Grosvenor Mine will be extended to the proposed project site. The adequacy of these plans, however, cannot be assessed as only brief summaries of the plans and limited data were provided in the project documentation.
26. Given the range of potential impacts to water resources, additional measures for mitigation, monitoring and management include:
- a. Increasing the spatial coverage of groundwater monitoring bores and including all hydrostratigraphic units which may be impacted.
  - b. Providing further detail of the proposed water quality monitoring programs including the location, frequency of monitoring and the analytes to be measured.
  - c. Developing a monitoring program for the integrity of riparian vegetation.
  - d. Developing a monitoring program for gilgai.
  - e. Developing a program for surveying subsidence impacts to allow model validation and to determine the need for adjustments to longwall geometries.
  - f. Providing details of the excess storage capacity in the mine water storage system and the mine water balances.

Explanation

27. The proposed groundwater monitoring program includes two existing bores, both located within the Tertiary basalt aquifer (EAR, Appendix E, Table 6, p. 34). The proponent states that a data-sharing arrangement with Arrow Energy exists for the provision of groundwater monitoring data (EAR, Appendix E, p. 34). The spatial and hydrostratigraphic coverage of the proposed monitoring network, however, is limited and may not provide sufficient data for validation and review of the groundwater model. For example, the Isaac River alluvial aquifer is not proposed to be monitored within the proposed project site. The closest and only monitoring sites for this aquifer identified by the proponent are approximately 15km downstream of the proposed project site (EAR, Appendix E, Figures 15 & 16). Additional monitoring should be considered, targeting the alluvial and Tertiary basalt aquifers and the shallow groundwater system, in order to understand potential impacts to water-dependent ecosystems.
28. The proponent has committed to continuing both surface water (EAR, p. 4-8) and groundwater quality monitoring programs (EAR, Appendix E, p. 34) and these should be consistent with the National Water Quality Management Strategy. However, further details of the proposed surface water monitoring program, outlining the location, timing and frequency of sampling; and the



analytes to be monitored are required. Additional information is also needed on the proposed site-specific trigger values and associated management actions for both groundwater and surface water quality, and groundwater levels. Derivation of site-specific trigger values based on historical monitoring data should consider not only the potential agricultural uses of the waters, but also ecosystem protection values, particularly if GDEs and stygofauna are identified.

29. The riparian corridors have been identified as the main areas of ecological significance remaining at the proposed project site (EAR, Appendix E, p. 47). Riparian vegetation provides habitat for endangered species and other fauna. While the proponent commits to limiting impacts from vegetation clearance in the riparian corridor (EAR, Appendix E, pp. 78-79), given the importance of this vegetation and the potential for additional impacts related to subsidence, monitoring of ecosystem integrity and any rehabilitation undertaken should be considered.
30. As gilgai impacts have not been identified by the proponent, no program to minimise effects has been discussed. The impacts of subsidence on gilgai should be monitored so that suitable management actions can be developed to limit impacts to flora and fauna that utilise the gilgai, especially EPBC Act-listed species.

Question 5: Do these assessments give adequate consideration to the project's contribution to cumulative impacts associated with other mining activities and coal seam gas production in the area?

Response

31. No. While the proponent provides a cumulative impact assessment highlighting their expected minimal impact to surface water and groundwater locally, the potential cumulative impacts are not adequately considered at the broader regional/catchment scale. This is particularly the case for the Isaac River as more than 50 longwall panels could undermine the river within this region.

Explanation

32. The Cumulative Subsidence Impact Assessment (CSIA) Update (Crerar & Lucas, 2013), which examined the potential cumulative subsidence impacts in the Isaac River catchment, made a number of recommendations regarding the monitoring and management of subsidence in the Isaac River. A key recommendation was for the implementation of a co-ordinated, large scale, adaptive management approach to subsidence (Crerar & Lucas, 2013, p. ii). To achieve this, it is highlighted that all mines need to be involved in a temporally and spatially aligned monitoring, evaluation, review and management program (Crerar & Lucas, 2013, p. ii). Proposed mitigation, monitoring and management measures for the proposed project should be planned and undertaken with consideration of developing such a co-operative approach to subsidence management, particularly given the parent company operates multiple mines in this area.
33. Future assessments of cumulative impacts from subsidence on the Isaac River (e.g. updates to CSIA) should be extended further downstream. Impacts related to sediment starvation resulting from subsidence void infilling may occur at some distance downstream of the actual subsidence voids. Multi-year analysis of sediment movements utilising satellite imagery and aerial photographs at relevant scales could be used to improve the understanding of sediment movement and supply conditions within reaches and throughout the catchment.
34. Cumulative impacts to groundwater systems in the region, particularly to the higher-quality Tertiary basalt aquifer could limit future useability of this water resource. A detailed understanding of the existing and potential ongoing long-term cumulative impacts to the aquifers in this region will require a cooperative monitoring and assessment approach. Such an approach was discussed above for subsidence and should be applied to understanding cumulative impacts to groundwater and ecology.

35. Currently there is a limited number of mine operators within the Isaac River catchment. There has been successful co-operative monitoring and management (e.g. CSIA) between the larger operators previously. Future updates to monitoring and management plans, and groundwater models should consider data-sharing arrangements and focus on cooperative management of cumulative impacts.

<b>Date of advice</b>	24 March 2017
<b>Source documentation available to the IESC in the formulation of this advice</b>	<p>Anglo Coal (Grosvenor) Pty Ltd 2016. <i>Referral of proposed action. The construction and operation of an extension to the existing underground coal mine at Grosvenor Mine, near Moranbah, Queensland.</i></p> <p>Anglo Coal (Grosvenor) Pty Ltd 2016. <i>Grosvenor Mine G200s Project EPBC Act Environmental Assessment Report.</i></p> <p>Anglo Coal (Grosvenor) Pty Ltd 2016. <i>Response to the Department of the Environment and Energy request for further information.</i></p> <p>Geoscience Australia 2016. <i>Advice on EPBC Referral Grosvenor Mine Extension (EPBC 2016/7796).</i></p>
<b>References cited within the IESC's advice</b>	<p>Barnett B, Townley LR, Post V, Evans RE, Hunt RJ, Peeters L, Richardson S, Werner AD, Knapton A and Boronkay A 2012. <i>Australian groundwater modelling guidelines.</i> Waterlines report, National Water Commission, Canberra.</p> <p>Crerar J, and Lucas R 2013. <i>Isaac River Cumulative Subsidence Impacts Assessment Update.</i> Alluvium Consulting for BMA Coal and Anglo American Metallurgical Coal.</p> <p>Hansen Bailey 2016. <i>Isaac Plains East Project: EPBC Act Environmental Assessment Report.</i> [Online]. <a href="http://epbcnotices.environment.gov.au/referralslist/">http://epbcnotices.environment.gov.au/referralslist/</a></p> <p>IESC 2015. <i>Information Guidelines for the Independent Expert Scientific Committee advice on coal seam gas and large coal mining development proposals</i> [Online]. Available: <a href="http://www.iesc.environment.gov.au/system/files/resources/012fa918-ee79-4131-9c8d-02c9b2de65cf/files/iesc-information-guidelines-oct-2015.pdf">http://www.iesc.environment.gov.au/system/files/resources/012fa918-ee79-4131-9c8d-02c9b2de65cf/files/iesc-information-guidelines-oct-2015.pdf</a>.</p> <p>Queensland Government 2013. <i>Conceptual Model Case Study Series. Gilgai Wetlands.</i> Queensland Government. [Online]. <a href="https://wetlandinfo.ehp.qld.gov.au/resources/static/pdf/resources/tools/conceptual-model-case-studies/cs-gilgai-12-04-13.pdf">https://wetlandinfo.ehp.qld.gov.au/resources/static/pdf/resources/tools/conceptual-model-case-studies/cs-gilgai-12-04-13.pdf</a></p> <p>Queensland Government Department of Science, Information Technology and Innovation (DSITI), 2015. <i>Guideline for the Environmental Assessment of Subterranean Aquatic Fauna: Sampling Methods and Survey Considerations.</i> Queensland Government. [Online]. <a href="https://publications.qld.gov.au/dataset/f7e68ccd-8c13-422f-bd46-1b391500423f/resource/ba880910-5117-433a-b90d-2c131874a8e6/download/guideline-subterranean-aquatic-fauna.pdf">https://publications.qld.gov.au/dataset/f7e68ccd-8c13-422f-bd46-1b391500423f/resource/ba880910-5117-433a-b90d-2c131874a8e6/download/guideline-subterranean-aquatic-fauna.pdf</a></p> <p>Rolls RJ, Leigh C and Sheldon F 2012. Mechanistic effects of low-flow hydrology on riverine ecosystems: ecological principles and consequences of alteration. <i>Freshwater Science</i> 31:1163-1186.</p>