

# LAND COURT OF QUEENSLAND

CITATION: *Adani Mining Pty Ltd v Land Services of Coast and Country Inc & Ors* [2015] QLC 48

PARTIES: Adani Mining Pty Ltd  
(applicant)  
v  
Land Services of Coast and Country Inc  
(first respondent)  
and  
Conservation Action Trust  
(second respondent)  
and  
Chief Executive,  
Department of Environment and Heritage Protection  
(Statutory Party)

FILE NO: MRA428-14 & EPA429-14 (MLA 70441)  
MRA430-14 & EPA431-14 (MLA 70505)  
MRA432-14 & EPA433-14 (MLA 70506)

DIVISION: General Division

MATTERS: Applications for mining leases; objections to mining lease applications; objections to application for environmental authority

DELIVERED ON: 15 December 2015

DELIVERED AT: Brisbane

HEARD ON: 31 March; 7-10 April; 13-17 April; 20-24 April; 27-30 April; 1 May; 14 May 2015  
Written submissions: 14, 28 May; 25 June 2015

HEARD AT: Brisbane

PRESIDENT: CAC MacDonald

ORDERS: **1. Pursuant to s 269(1) of the *Mineral Resources Act 1989*, I recommend to the Honourable the Minister administering the *Mineral Resources Act 1989* that, subject to the inclusion of additional conditions in the environmental authority as set out in Order 2 below, mining leases 70441, 70505 and 70506 be granted over the application area.**

2. Pursuant to s 190(1)(a)(ii) of the *Environmental Protection Act 1994*, I recommend to the administering authority that the environmental authority be issued in the terms of the draft environmental authority issued on 28 August 2014, subject to the insertion of the following conditions into the BTF Species Management Plan referred to in Condition I6 of the environmental authority:

(a)

- i. monitoring of water bodies should be conducted over at least a six hour period commencing from dawn in order to accurately capture utilization of the watering points;
- ii. detailed botanical assessment should be focussed on all BTF siting locations to record habitat values within those locations;
- iii. more effort should be placed into actively locating BTF and collecting information on their movements across the project and offset areas;
- iv. call playback should be used when BTF are encountered to assist in gaining a more complete identification of birds present in the local area;
- v. specific surveys targeting breeding be undertaken to provide details on locations and habitat values in breeding areas;
- vi. persons undertaking the survey/monitoring should be experienced ecologists with sound understanding of the BTF and its habitats;
- vii. any future revision of the current survey and monitoring programs should be developed in consultation with researchers from the BTF recovery team and independently peer reviewed.

(b) The research management plan include provision for funding a research project to determine the correlation between water source, woody habitat and *Poaceae* food resources across the MLA areas and the proposed offset areas, to determine the interrelationships between these factors.

(c) The research management plan include a provision that the Ten Mile Bore and its surrounds be investigated to determine whether that area maintains an important function in sustaining the BTF population.

3. **Orders 1 and 2 above will not be made final until 17 December 2015 at 4:00 pm or until such further Order of the Court, so as to allow the parties to make any submissions to the Court as to why the conditions set out in Order 2 should not be included in the environmental authority.**
  
4. **I direct the Registrar of the Land Court to provide a copy of these reasons to the Honourable the Minister administering the *Mineral Resources Act 1989* and to the administering authority under the *Environmental Protection Act 1994* and to direct those persons' attention to my observations in [583] – [586].**

**CATCHWORDS:**

Mining – application for mining lease – objections – functions and powers of the Land Court – statutory criteria in considering grant – *Mineral Resources Act 1989* (MRA) ss 268, 269

Mining – application for environmental authority – objections – functions and powers of the Land Court – *Environmental Protection Act 1994* (EPA) ss 190, 191

Mining - *Mineral Resources Act 1989* and *Environmental Protection Act 1994* – different and competing objects – Land Court must endeavour to construe provisions of both Acts to give effect to presumptions that the statutes are intended to work together – *Xstrata* decision followed

Mining - *Environmental Protection Act 1994* – object of EPA is to protect Queensland's environment while allowing for development that is ecologically sustainable

Mining – *Environmental Protection Act 1994* – relevance of Standard Criteria (Schedule 2) and relevance of environmental harm s 14

Mining – determination of significant project by Coordinator-General – no inconsistent environmental conditions permissible – *Xstrata* decision followed

Mining – application for mining lease – precautionary principle explained and applied

Mining – application for mining lease – objections considered under headings – groundwater, groundwater dependent ecosystems, impact on biodiversity (endangered bird species and vulnerable plant species), climate change, financial capacity and economic viability

Groundwater – complexity and uncertainty with expert

evidence – uncertainty about source of aquifer supplying springs – hydrochemistry – fault lines – regional geology – groundwater modelling – precautionary principle applied – draft EA and Federal conditions sufficient

Ecology – springs – complexity and uncertainty with expert evidence – precautionary principle applied

Ecology – Waxy Cabbage Palm – precautionary principle - draft EA conditions sufficient

Ecology – Black-throated Finch - biodiversity offsets - precautionary principle not applicable – serious irreversible damage – impose further conditions to draft EA – not inconsistent with Coordinator-General’s conditions s 190(2)(b) EPA

Climate change – whether any “adverse environmental impacts” – whether public interest will be prejudiced – relevance of global Scope 3 emissions – *Hancock and Coast and Country* decisions followed

Economics – future price of carbon – energy markets – projections as to future use of coal – economic modelling

Financial capacity – economic impact and profitability to be considered under MRA ss 269(4)(c) and (f)

*Environmental Protection Act 1994*

*Environmental Protection (Greentape Reduction) and Other Legislation Amendment Act 2012*

*Environment Protection and Biodiversity Conservation Act 1999 (Cth)*

*Mineral Resources Act 1989*

*National Environment Protection Council (Qld) Act 1994*

*State Development and Public Works Organisation Act 1971*

*Armstrong v Brown* [2004] 2 Qd R 345

*Bentley v BGP Properties Pty Ltd* (2006) 145 LGERA 234

*Coast and Country Association of Queensland Inc v Smith* [2015] QSC 260

*Hancock Coal Pty Ltd v Kelly (No. 4)* [2014] QLC 12

*McKinnon v Secretary, Department of Treasury* (2006) 228 CLR 423

*O’Sullivan v Farrer* (1989) 168 CLR 210

*Sinclair v Maryborough Mining Warden* (1975) 132 CLR 473

*Telstra Corporation v Hornsby Shire Council* (2006) 67 NSWLR 256

*Water Conservation & Irrigation Commission (NSW) v Browning* (1947) 74 CLR 492

*Wildlife Preservation Society of Queensland,*

*Proserpine/Whitsunday Branch Inc v The Minister for Environment and Heritage* (2007) 232 ALR 510  
*Xstrata Coal Queensland Pty Ltd & Ors v Friends of the Earth – Brisbane Co-Op Limited* (2012) 33 QLCR 79

COUNSEL: Mr P Ambrose QC for the applicant  
 Mr S Holt QC with Dr C McGrath for the first respondent  
 Ms KM Clayton for the statutory party

SOLICITORS: McCullough Robertson for the applicant  
 Environmental Defenders Office of Queensland for the first respondent  
 Ms K Harbert, Senior Lawyer, Department of Environment and Heritage Protection, for the statutory party

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## **ORDERS**

### **Background**

- [1] Adani Mining Pty Ltd (the applicant) has applied for three mining leases, ML 70441, ML 70505 and ML 70506, under the provisions of the *Mineral Resources Act 1989* (MRA), and an associated environmental authority (EA) under the *Environmental Protection Act 1994* (EPA). The applications relate to the proposed Carmichael coal mine located in the north Galilee Basin approximately 160 kms north-west of Clermont in Central Queensland.
- [2] It is proposed that the Carmichael mine will be an open cut and underground coal mine which will extract approximately 60 million tonnes of coal per annum (mtpa) and will have an operating life of approximately 60 years. The mining lease development will include
- Six open-cut pits with a combined capacity of 40 mtpa and five independent underground longwall mines with a combined capacity of 20 mtpa of product coal, mining two seams over 45 km north to south;
  - A coal handling and processing plant designed to process 74.5 mtpa of raw coal and out-of-pit waste rock structures for the storage of the critical volumes of the project's 13.1 billion bank cubic metres of over and interburden prior to storage of waste rock in mine voids when available;
  - Coal stockpiles, tailings storage cells, water management structures, a 2.5 km portion of the rail loop and coal-loading facilities adjacent to the rail; and



- Development of off-lease quarries and mine support infrastructure, including a workers accommodation village, industrial precinct and an airport.

- [3] ML 70441 was applied for on 8 November 2010 and ML 70505 and ML 70506 were both applied for on 9 July 2013. Each of the mining lease applications (MLAs) seeks a mining lease with a term of 30 years. The applicant has indicated that it will apply for a renewal of the mining leases at the appropriate time during the operation of the mine.
- [4] On 26 November 2010, the mine and rail aspects of the Carmichael mine were gazetted as a coordinated project under the *State Development and Public Works Organisation Act 1971* (SDPWOA) for which an environmental impact statement (EIS) was required. The project was subject to the environment impact assessment process under the SDPWOA.
- [5] On 6 January 2011, the Commonwealth Government determined that the Carmichael mine and rail project constituted a controlled action pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBCA).
- [6] On 25 May 2011, the terms of reference for the EIS were finalized by the Coordinator-General. In November 2012, Adani Mining submitted the EIS for the coordinated project and public notification occurred from 15 November 2012 until 11 February 2013. On 26 March 2013, the Coordinator-General requested additional information from the applicant to address matters raised about the EIS. This information was incorporated into a supplementary environmental impact statement (SEIS) which was made available for public and agency comment from 25 November 2013 to 20 December 2013. Adani subsequently prepared additional information for the EIS (AEIS) which was supplied to the Coordinator-General.
- [7] On 9 July 2013 the applicant submitted an application for a site-specific environmental authority for the mine.
- [8] On 7 May 2014 the Coordinator-General's report evaluating the EIS was released. The Coordinator-General recommended approvals for the Carmichael mine project subject to the conditions and recommendations set out in the report.
- [9] On 24 July 2014 the Federal Minister for the Environment granted approval for the Carmichael Coal Mine and Rail Infrastructure Project pursuant to the EPBCA, subject to conditions. That approval was subsequently withdrawn and a new approval, with conditions, was granted on 14 October 2015<sup>1</sup>.
- [10] On 28 August 2014, the delegate for the administering authority under the EPA issued a draft environmental authority to Adani Mining for the mine. The draft EA included a number of conditions including the relevant conditions required by the Coordinator-General. The

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<sup>1</sup> AA072, Exhibit 140. With the consent of the parties, a copy of the new approval was provided to the Land Court on 28 October 2015 and was made an exhibit in the proceedings. References to the EPBCA approval in these reasons are to Exhibit 140.

Statutory Party says that the conditions proposed in the draft EA were reasonable, necessary and desirable to deal with the impact of the mining activities.

- [11] Following notification of the mining lease applications and application for associated draft environmental authority, objections were lodged with the relevant departments to the MLAs and the draft EA. Those objections were referred to the Land Court on 1 October 2014.
- [12] The first respondent, Land Services of Coast and Country Inc, objected to the grant of the MLs and also to the application for the EA. Pursuant to a Land Court Practice Direction<sup>2</sup>, the first respondent elected to be a Level 3 Objector, that is, to participate fully in the proceedings.
- [13] The second respondent, Conservation Action Trust, an organization based in Mumbai, India, objected to the application for the EA. The second respondent elected to be a Level 1 Objector, that is, to rely only upon its notice of objection and not to attend the hearing. Accordingly the second respondent did not file any material, call any evidence, cross-examine any witnesses or make any final submissions.
- [14] The Chief Executive, Department of Environment and Heritage Protection, is a statutory party to the application for the EA, pursuant to s 186(a) of the EPA.
- [15] In general terms, the first respondent objected to the applications on a number of grounds:
- (a) the impacts of the mine on groundwater and groundwater dependent ecosystems, particularly the Doongmabulla Springs Complex (DSC);
  - (b) the impacts of the mine on biodiversity, particularly an endangered bird species, the black-throated finch (BTF) (*poephila cincta*) and a vulnerable plant species, (the waxy cabbage palm (WCP) *livistona lanuginosa*);
  - (c) the contribution that the burning of the coal from the mine will make to climate change, thereby contributing to environmental harm to the Great Barrier Reef World Heritage Area;
  - (d) the mine is not economically viable; and
  - (e) approval of the mine is contrary to the public interest.
- [16] The second respondent's objection relates to the impacts on the local environment and communities of existing and in-development power stations in India that are owned by the group of companies of which the applicant is a part.
- [17] Under the MRA, the Land Court must hear the applications for grant of mining leases and the objections thereto and all other matters that are to be heard, considered or delivered by the Court and to determine the relative merits of the application, objections and other matters<sup>3</sup>. The Court is also required to make a recommendation to the Minister that the application be

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<sup>2</sup> Practice Direction No. 7 of 2013.

<sup>3</sup> Section 268(1) and (2) *Mineral Resources Act 1989*.

granted or rejected in whole or in part and may make a recommendation that the mining lease be granted subject to such conditions that the Land Court considers appropriate<sup>4</sup>. The Court must take certain matters into account under s 269(4) of the MRA when making a recommendation that the mining lease be granted in whole or in part. Those provisions are considered in detail below.

[18] Under s 185(1) of the EPA the Land Court must make an objections decision in relation to the referral of the application for a draft environmental authority. Section 190 of the EPA sets out the nature of an objections decision.

[19] It is not part of the Court's function, under either statute, to consider the associated rail project.

## **Legal framework**

### ***Mineral Resources Act 1989***

[20] The major relevant provisions of the MRA are set out in this section. Their application in relation to the specific issues raised by the parties will be considered where relevant throughout the decision.

[21] The objects of the MRA are set out in Section 2 which provides that:

#### **"2 Objectives of Act**

The principal objectives of this Act are to –

- (a) encourage and facilitate prospecting and exploring for and mining of minerals;
- (b) enhance knowledge of the mineral resources of the State;
- (c) minimise land use conflict with respect to prospecting, exploring and mining;
- (d) encourage environmental responsibility in prospecting, exploring and mining;
- (e) ensure an appropriate financial return to the State from mining;
- (f) provide an administrative framework to expedite and regulate prospecting and exploring for and mining of minerals;
- (g) encourage responsible land care management in prospecting, exploring and mining."

[22] Section 268(1) and (2) provide:

#### **"268 Hearing of application for grant of mining lease**

- (1) On the date fixed for the hearing of the application for the grant of the mining lease and objections thereto, the Land Court shall hear the application and objections thereto and all other matters that pursuant to this part are to be heard, considered or determined by the Land Court in respect of that application at the one hearing of the Land Court.

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<sup>4</sup> Section 269(1)(d), (2) and (3) *Mineral Resources Act 1989*.

- (2) At a hearing pursuant to subsection (1) the Land Court shall take such evidence, shall hear such persons and inform itself in such manner as it considers appropriate in order to determine the relative merits of the application, objections and other matters and shall not be bound by any rule or practice as to evidence. "

[23] Section 269 relevantly provides:

**"269 Land Court's recommendation on hearing**

- (1) Upon the hearing by the Land Court under this part of all matters in respect of an application for the grant of a mining lease, the Land Court shall forward to the Minister -
- (a) any objections lodged in relation thereto; and
  - (b) the evidence adduced at the hearing; and
  - (c) any exhibits; and
  - (d) the Land Court's recommendation.
- (2) For subsection (1)(d), the Land Court's recommendation must consist of -
- (a) a recommendation to the Minister that the application should be granted or rejected in whole or in part; and
  - ...
- (3) A recommendation may include a recommendation that the mining lease be granted subject to such conditions as the Land Court considers appropriate, including a condition that mining shall not be carried on above a specified depth below specified surface area of the land.
- (4) The Land Court, when making a recommendation to the Minister that an application for a mining lease be granted in whole or in part, shall take into account and consider whether -
- (a) the provisions of this Act have been complied with; and
  - (b) the area of land applied for is mineralised or the other purposes for which the lease is sought are appropriate; and
  - (c) if the land applied for is mineralised, there will be an acceptable level of development and utilisation of the mineral resources within the area applied for; and
  - (d) the land and the surface area of the land in respect of which the mining lease is sought is of an appropriate size and shape in relation to -
    - (i) the matters mentioned in paragraphs (b) and (c); and
    - (ii) the type and location of the activities proposed to be carried out under the lease and their likely impact on the surface of the land; and
  - (e) the term sought is appropriate; and
  - (f) the applicant has the necessary financial and technical capabilities to carry on mining operations under the proposed mining lease; and
  - (g) the past performance of the applicant has been satisfactory; and

- (h) any disadvantage may result to the rights of
    - (i) holders of existing exploration permits or mineral development licences; or
    - (ii) existing applicants for exploration permits or mineral development licences; and
  - (i) the operations to be carried on under the authority of the proposed mining lease will conform with sound land use management; and
  - (j) there will be any adverse environmental impact caused by those operations and, if so, the extent thereof; and
  - (k) the public right and interest will be prejudiced; and
  - (l) any good reason has been shown for a refusal to grant the mining lease; and
  - (m) taking into consideration the current and prospective uses of that land, the proposed mining operation is an appropriate land use.
- (5) Where the Land Court recommends to the Minister that an application for the grant of a mining lease be rejected in whole or in part the Land Court shall furnish the Minister with the Land Court's reasons for that recommendation.
- ..."

***Environmental Protection Act 1994***

[24] The object of the EPA is set out in Section 3 which provides that:

**"3 Object**

The object of this Act is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (*ecologically sustainable development*)."

[25] In *Telstra Corporation Ltd v Hornsby Shire Council*<sup>5</sup>, Preston CJ said that ecologically sustainable development, in its most basic formulation, is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"<sup>6</sup>. More particularly, his Honour said, ecologically sustainable development includes a cluster of elements or principles. Three of these principles are the precautionary principle, principles of equity and the conservation of biological diversity and ecological integrity<sup>7</sup>.

[26] Section 5 provides:

**"5 Obligations of persons to achieve object of Act**

If, under this Act, a function or power is conferred on a person, the person must perform the function or exercise the power in the way that best achieves the object of this Act."

[27] The word "environment" is defined in s 8 as follows:

**"8 Environment**

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<sup>5</sup> (2006) 67 NSWLR 256.

<sup>6</sup> At [108].

<sup>7</sup> At [113], [116] and [118].

*Environment* includes –

- (a) ecosystems and their constituent parts, including people and communities; and
- (b) all natural and physical resources; and
- (c) the qualities and characteristics of locations, places and areas, however large or small, that contribute to their biological diversity and integrity, intrinsic or attributed scientific value or interest, amenity, harmony and sense of community; and
- (d) the social, economic, aesthetic and cultural conditions that affect, or are affected by, things mentioned in paragraphs (a) to (c).”

[28] “Environmental value” is defined in s 9 as follows:

**“9 Environmental value**

*Environmental value* is –

- (a) a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or
- (b) another quality of the environment identified and declared to be an environmental value under an environmental protection policy or regulation.”

[29] The first respondent submitted that the following are all components of the “environment” and “environmental value” as defined in ss 8 and 9:

- (a) the biological integrity of an aquatic ecosystem that is effectively unmodified or highly valued (in relation to groundwater supply to the Doongmabulla Springs Complex, which are high ecological value waters, particularly the Moses Springs);
- (b) biodiversity (such as represented by the black-throated finch and waxy cabbage palm);
- (c) the social, economic, aesthetic and cultural conditions that affect, or are affected by the environment, such as jobs, royalties and taxes;
- (d) the concentration of carbon dioxide (CO<sub>2</sub>) in the atmosphere and its associated greenhouse effect;
- (e) the climate.

[30] The application for the environmental authority was referred to the Land Court under s 185(1) of the EPA for an “objections decision”.

[31] Section 190 of the EPA provides:

**"190 Nature of objections decision**

(1) The objections decision for the application must be a recommendation to the administering authority that -

- (a) if a draft environmental authority was given for the application -

- (i) the application be approved on the basis of the draft environmental authority for the application; or
- (ii) the application be approved, but on stated conditions that are different to the conditions in the draft environmental authority; or
- (iii) the application be refused; or

...

- (2) However, if a relevant mining lease is, or is included in, a coordinated project, any stated conditions under subsection (1)(a)(ii) or (b)(i) –
  - (a) must include the Coordinator-General’s conditions; and
  - (b) can not be inconsistent with a Coordinator-General’s condition."

[32] Section 191 of the EPA specifies the matters that the Land Court must consider for an objections decision. The section provides:

**“191 Matters to be considered for objections decision**

In making the objections decision for the application, the Land Court must consider the following –

- (a) the application;
- (b) any response given for an information request;
- (c) any standard conditions for the relevant activity or authority;
- (d) any draft environmental authority for the application;
- (e) any objection notice for the application;
- (f) any relevant regulatory requirement;
- (g) the standard criteria;
- (h) the status of any application under the Mineral Resources Act for each relevant mining tenure.”

[33] “Standard criteria” is defined in Schedule 4 to the EPA to mean:

“*standard criteria* means -

- (a) the following principles of environmental policy as set out in the Intergovernmental Agreement on the Environment –
  - (i) the precautionary principle;
  - (ii) intergenerational equity;
  - (iii) conservation of biological diversity and ecological integrity; and
- (b) any Commonwealth or State government plans, standards, agreements or requirements about environmental protection or ecologically sustainable development; and
- (d) any relevant environmental impact study, assessment or report; and

- (e) the character, resilience and values of the receiving environment; and
- (f) all submissions made by the applicant and submitters; and
- (g) the best practice environmental management for activities under any relevant instrument, or proposed instrument, as follows—
  - (i) an environmental authority;
  - (ii) a transitional environmental program;
  - (iii) an environmental protection order;
  - (iv) a disposal permit;
  - (v) a development approval; and
- (h) the financial implications of the requirements under an instrument, or proposed instrument, mentioned in paragraph (g) as they would relate to the type of activity or industry carried out, or proposed to be carried out, under the instrument; and
- (i) the public interest; and
- (j) any relevant site management plan; and
- (k) any relevant integrated environmental management system or proposed integrated environmental management system; and
- (l) any other matter prescribed under a regulation.”

[34] It can be seen that paragraph (a) of the definition of “standard criteria” refers to the principles of environmental policy set out in the Intergovernmental Agreement on the Environment (IGAE). The IGAE is defined in Schedule 4 to mean the agreement made on 1 May 1992 between the Commonwealth, the States and Territories and the Australian Local Government Association<sup>8</sup>.

[35] The IGAE provides as follows in relation to the precautionary principle, inter-generational equity and conservation of biological diversity and ecological integrity:

**“3.5.1 Precautionary principle**

Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In the application of the precautionary principle, public and private decisions should be guided by:

- (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and
- (ii) an assessment of the risk-weighted consequences of various options.

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<sup>8</sup> A note to the definition provides that a copy of the agreement is in the *National Environment Protection Council (Qld) Act 1994*, Schedule.



### 3.5.2 Intergenerational equity

The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

### 3.5.3 Conservation of biological diversity and ecological integrity

Conservation of biological diversity and ecological integrity should be a fundamental consideration.”

#### *Precautionary principle*

[36] The first respondent submitted that the precautionary principle was engaged in this case in relation to the DSC, the black-throated finch and the waxy cabbage palm. The application of the precautionary principle was discussed in detail in *Telstra Corporation Ltd v Hornsby Shire Council*<sup>9</sup>, where Preston CJ said<sup>10</sup>:

“The application of the precautionary principle and the concomitant need to take precautionary measures is triggered by the satisfaction of two conditions precedent or thresholds: a threat of serious or irreversible environmental damage and scientific uncertainty as to the environmental damage. These conditions or thresholds are cumulative. Once both of these conditions or thresholds are satisfied, a precautionary measure may be taken to avert the anticipated threat of environmental damage, but it should be proportionate.”

[37] His Honour went on to say that

- determining the existence of a threat of serious irreversible environmental damage does not involve, at the stage of assessing the first condition precedent, any evaluation of the scientific uncertainty of the threat. If there is not a threat of serious or irreversible environmental damage, there is no basis upon which the precautionary principle can operate<sup>11</sup>.
- The second condition precedent required to trigger the application of the principle is that there be a “lack of full scientific certainty”. The uncertainty is as to the nature and scope of the threat of environmental damage<sup>12</sup>. Full scientific certainty is not required<sup>13</sup>. If there is no, or not considerable scientific uncertainty, the second condition precedent is not satisfied and even though there is a threat of serious or irreversible environmental damage (that is, the first condition precedent is satisfied) the precautionary principle will not apply. The threat of serious irreversible environmental damage can be classified as relatively certain because it is possible to establish a causal link between an action or event and environmental damage, to calculate the probability of their occurrence, and to insure against them. Measures will still need to be taken but these will be preventative measures to control or regulate the relatively certain threat of serious or irreversible environmental damage, rather than precautionary measures which are appropriate in relation to uncertain threats<sup>14</sup>.
- If each of the two conditions precedent is satisfied the precautionary principle will be activated. At this point the evidentiary burden of proof shifts. A decision-maker must assume that the threat of serious or irreversible environmental damage is no longer uncertain but is a reality. The burden of showing that the threat does not exist or is negligible reverts to the proponent of the development. The rationale for requiring this shift of the burden of proof

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<sup>9</sup> (2006) 67 NSWLR 256.

<sup>10</sup> At [128]. (citation omitted)

<sup>11</sup> At [137], [138].

<sup>12</sup> At [140].

<sup>13</sup> At [143], [145].

<sup>14</sup> At [149].

is to ensure preventative anticipation; to act before scientific certainty of cause and effect is established. The preference is to prevent environmental damage rather than to remediate it<sup>15</sup>.

- The function of the precautionary principle is, therefore to require the decision-maker to assume that there is or there will be a serious or irreversible threat of environmental damage and to take this into account, notwithstanding that there is a degree of scientific uncertainty about whether the threat exists<sup>16</sup>.
- There is nothing in the formulation of the precautionary principle which requires the decision-maker to give the assumed factor (the serious or irreversible environmental damage) overriding weight compared to the other factors required to be considered, such as social and economic factors, when deciding how to proceed. The effect of the shift in the evidentiary burden of proof simply means that, in making the final decision, the decision-maker must assume that there will be serious or irreversible environmental damage. That factor must be taken into account in the calculus which decision-makers are instructed to apply under environmental legislation<sup>17</sup>.
- The precautionary principle should not be used to try to avoid all risks. Rationality also dictates that the precautionary principle and any preventative measure cannot be based on a purely hypothetical approach to the risk, founded on mere conjecture which has not been scientifically verified<sup>18</sup>.
- The type and level of precautionary measures that will be appropriate will depend on the combined effect of the degree of seriousness and the irreversibility of the threat and the degree of uncertainty. This involves assessment of risk, namely the probability of the event occurring and the seriousness of the consequences should it occur. The more significant and more uncertain the threat, the greater the degree of caution required<sup>19</sup>.
- Prudence also suggests that some margin for error should be retained until all the consequences of the decision to proceed with the development are known<sup>20</sup>. One means of retaining a margin for error is to implement a step-wise or adaptive management approach, whereby uncertainties are acknowledged and the area affected by the development plan, program or project is expanded as the extent of uncertainty is reduced<sup>21</sup>. An adaptive management approach might involve the following core elements:
  - monitoring impacts of management or decisions based on agreed indicators;
  - promoting research, to reduce key uncertainties;
  - ensuring periodic evaluation of the outcomes of implementation, drawing lessons, and review or adjustment, as necessary, of the measures or decisions adopted;
  - establishing an efficient and effective compliance system<sup>22</sup>.
- The precautionary principle embraces the concept of proportionality, that is that measures should not go beyond what is appropriate and necessary in order to achieve the objectives in question. A reasonable balance must be struck between the stringency of the precautionary measures, which may have associated costs, such as financial, livelihood and opportunity costs and the seriousness and irreversibility of the potential threat<sup>23</sup>.

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<sup>15</sup> At [150], [151].

<sup>16</sup> At [152].

<sup>17</sup> At [154].

<sup>18</sup> At [157], [159].

<sup>19</sup> At [161].

<sup>20</sup> At [162].

<sup>21</sup> At [163].

<sup>22</sup> At [164].

<sup>23</sup> At [166], [167].

- The precautionary principle, where triggered, does not necessarily prohibit carrying out the development plan, program or project until full scientific certainty is attained<sup>24</sup>. The solution is to assess the risk-weighted consequences of various options and select the option that affords the appropriate degree of precaution for the set of risks associated with the option<sup>25</sup>.
- The precautionary principle is but one of the sets of principles of ecologically sustainable development. It should not be viewed in isolation, but rather as part of the package. This means that the precautionary measures that should be selected must not only be appropriate having regard to the precautionary principle itself, but also in the context of the other principles of ecologically sustainable development, including inter-generational and intra-generational equity and the conservation of biological diversity and ecological integrity<sup>26</sup>.

### *Intergenerational equity*

[38] In relation to the principles of equity, Preston CJ said that there is a need for inter-generational equity and intra-generational equity. He explained that inter-generational equity means that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for future generations. This is the definition contained in s.3.5.2 in the Schedule to the IGAE. Preston CJ said that intra-generational equity involves considerations of equity within the present generation, such as uses of natural resources by one nation-state (or sectors or classes within a nation-state) needing to take account of the needs of other nation-states (or sectors or classes within a nation-state)<sup>27</sup>.

### *Conservation of biological diversity and ecological integrity*

[39] In *Bentley v BGP Properties Pty Ltd*<sup>28</sup> Preston CJ said:

“Maintaining ecological integrity involves maintaining ecosystem health. Ecosystems become unhealthy if their community structure (species richness, species composition or food web architecture) or ecosystem functioning (productivity, nutrient dynamics, decomposition) has been fundamentally upset by human pressures ...

The conservation of threatened species is an essential action in the conservation of species diversity, and hence of biological diversity and ecological integrity.”

### *The character, resilience and values of the receiving environment*

[40] The character, resilience and values of the receiving environment are matters identified in para (e) of the definition of standard criteria which the Court is required to take into account under s 191(g) of the EPA.

[41] The first respondent submitted that the agreed ecological value of the DSC and low resilience to changes in groundwater supply are clearly matters requiring careful consideration. Similarly the potential loss of the core habitat of the most important population of the

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<sup>24</sup> At [179].

<sup>25</sup> At [181].

<sup>26</sup> At [182].

<sup>27</sup> At [117].

<sup>28</sup> (2006) 145 LGERA 234 at [61], [63].

threatened black-throated finch and the very low resilience of the species to further impact are matters requiring careful consideration.

*The public interest*

[42] Paragraph (i) of the definition of the standard criteria in the EPA identifies the public interest as another matter which the Court must consider under s 191(g) of the EPA.

[43] The public interest involves a discretionary balancing exercise of the widest import confined only so far as the subject matter and the scope and purpose of the statute may enable<sup>29</sup>.

[44] The first respondent submitted that while the public interest is a relevant consideration under both the EPA and MRA, they are two very different Acts with very different objects. This means, said the first respondent, that there are different frameworks for considering the public interest under the two Acts. The MRA provides a system aimed at promoting the development of the mining resources of the State, while the EPA is focussed on the protection of the environment. These elements overlap to some extent but they are quite different, said the first respondent, and it would be wrong to assume that the public interest aspect of the mining lease application under the MRA and the consideration of public interest in the application for the environmental authority under the EPA are the same.

[45] This submission will be considered below when discussing the application of the public interest test under the EPA.

***The relevance of environmental harm for the objections decision***

[46] Section 14 of the EPA defines “environmental harm” to mean:

**“14 Environmental harm**

(1) ***Environmental harm*** is any adverse effect, or potential adverse effect (whether temporary or permanent and of whatever magnitude, duration or frequency) on an environmental value, and includes environmental nuisance.

(2) ***Environmental harm*** may be caused by an activity –

(a) whether the harm is a direct or indirect result of the activity; or

(b) whether the harm results from the activity alone or from the combined effects of the activity and other activities or factors.”

[47] The first respondent submitted that:

- An act that adversely affects the biological integrity of the Moses Springs, loss of biodiversity, the concentration of CO<sub>2</sub> in the atmosphere, or the climate, constitutes environmental harm.
- While s 191 of the EPA and the standard criteria do not refer to environmental harm specifically, it is clear from the structure and objects of the EPA that the risk and

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<sup>29</sup> See *O’Sullivan v Farrer* (1989) 168 CLR 210 at 216; *Water Conservation & Irrigation Commission (NSW) v Browning* (1947) 74 CLR 492 at 504-5 (Dixon J); *McKinnon v Secretary, Department of Treasury* (2006) 228 CLR 423 at [55].

extent of likely environmental harm is central to assessing any application for an environmental authority and, therefore, any objections decision.

- The EPA directly links the concept of environmental harm to an environmental authority granted under it in the following way:
  - Sections 437 and 438 of the EPA provide criminal offences for unlawfully causing serious or material environmental harm (which are defined in ss 16 and 17 of the EPA).
  - In the context of sections 437 and 438, causation of environmental harm must be construed by reference to section 14.
  - Section 493A provides that serious or material environmental harm is lawful, if amongst other things, it is authorized under an environmental authority.
- Therefore, the environmental harm that the mining activity will cause (which, absent the environmental authority, is unlawful) must be considered in granting an environmental authority for it. Were this not the case, the decision to grant the authority would authorize something that was not considered in making the decision.
- Therefore having regard to the subject matter, scope and purpose of the EPA and the central function of the grant of an environmental authority, it is apparent that the enumerated factors in s 191 do not constitute an exhaustive list. It follows that the environmental harm that any activity may cause is a “relevant consideration” that the Court is bound to consider in respect of the grant of an environmental authority to authorize that activity (or, rather, the environmental harm that flows therefrom). A failure to have regard to relevant matters may lead a decision-maker to wrongly deny the existence of its jurisdiction or mistakenly impose limits on its functions or powers. Considering something irrelevant might disclose a constructive failure to exercise jurisdiction.

[48] Although s 191, which sets out the matters to be considered for an objections decision, does not expressly refer to “environmental harm”, as defined in s 14, as a matter to be taken into account by the Court in making an objections decision, I accept that in considering the matters set out in s 191 the Court will inevitably consider activities that may constitute “environmental harm” as defined. This does not, however, mean that the Court’s jurisdiction to examine factors such as any climate change caused by burning the coal from the mine is thereby expanded. This issue is considered further in the discussion of climate change below. At this point it is sufficient to say that the Court will only consider those aspects of environmental harm that are within its jurisdiction.

### ***The Court’s response***

[49] The applicant and the first respondent do not agree as to the appropriate response of the Court to circumstances where any of the principles of ecologically sustainable development are infringed.

[50] Section 5 of the EPA provides that

**“5 Obligations of persons to achieve object of Act**

If, under this Act, a function or power is conferred on a person, the person must perform the function or exercise the power in the way that best achieves the object of this Act.”

[51] The first respondent submitted that a relevant question to ask is whether the purpose of the EPA means that a recommendation by the Court to approve an unsustainable activity is invalid having regard to the language, scope and object of the Act. Legislation must be construed on the prima facie basis that its provisions are intended to give effect to harmonious goals, and where conflict is found, the Land Court may be required to determine a hierarchy of provisions, citing *Project Blue Sky v Australian Broadcasting Authority*<sup>30</sup>.

[52] The first respondent submitted that s 5 states a clear legislative intent that, in exercising its functions under the Act of hearing the objections and making its recommendation to the Minister, the Land Court must “perform the function or exercise the power in the way that best achieves the object of this Act” of ecologically sustainable development. In contrast ss 190 and 191 provide a list of matters that the Court is required to consider but leave it to the Court to determine the appropriate balance and weight to be given to each consideration. The EPA creates a hierarchy in which the obligation in s 5, linked directly to the object of the Act stated in s 3, provides an overriding duty when exercising any function under the Act including the functions of the Court. This construction is confirmed by the Environmental Protection Bill 1994 Explanatory Notes because the reasons for the Bill state – “protection of the environment is ensured by requiring economic development to be ecologically sustainable”. (emphasis added by first respondent).

[53] If the Court concludes that a proposed mining activity is unsustainable, the first respondent submitted, the Court is obliged to recommend that the activity is refused. The effects of the mine on the exceptional ecological values of the DSC and the black-throated finch, and the contribution of the mine to climate change raise first order questions of unsustainability, the first respondent submitted.

[54] The applicant submitted in relation to the precautionary principle, that if the precautionary principle is enlivened in relation to any specific risk identified and relevant to the objections, the Court may have regard to the conditions of the draft EA and to some degree the EPBCA approval. The parties and the Court must assume that the applicant will act lawfully and abide by these conditions if the EA is issued. The applicant submitted that the evidence establishes that the draft EA applies a cautious adaptive management approach.

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<sup>30</sup> (1998) 194 CLR 355 at [70], (McHugh, Gummow, Kirby and Hayne JJ).

- [55] In the event that the Court is not satisfied that the conditions of the draft EA address the established risk of damage and uncertainty, the applicant submitted that the proper approach is not to refuse the application. This would apply the inappropriate no risk response.
- [56] In my opinion, the Court is required to carry out its obligations under the EPA by considering the provisions of that Act in the context of the Act as a whole, as recognized in *Project Blue Sky*, and on the basis that its provisions are intended to give effect to harmonious goals. To that end it may be necessary to determine a hierarchy of provisions.
- [57] In addition, however, because this Court is dealing with applications under the MRA and the EPA, the Court must also consider the objects of the MRA and, as recognized in *Xstrata Coal Queensland Pty Ltd v Friends of the Earth – Brisbane Co-op Limited*, the Court must endeavour to give effect to the presumption that two laws made by the one legislature are intended to work together<sup>31</sup>.
- [58] In light of those general principles, and the terms of s 5 of the EPA, I accept that the Court must exercise its powers in the way that best achieves the object of that Act. That is, the Court must recognize that the object of that Act is to protect Queensland’s environment while allowing for development that is ecologically sustainable. The relevant development here is the operation of the mine and associated activities, which will be enabled if the mining leases are granted. The first question for the Court to determine is whether the mine can be developed in an ecologically sustainable way. It is unnecessary for me to determine, at this point, the consequences, if I were to conclude that the development would be unsustainable.

### **Water Objections**

- [59] The following grounds of the first respondent’s objection to the MLA are relevant to the issue of water:
- (1) If the mine proceeds, there will be severe and permanent adverse environmental impacts caused by the operations carried out under the authority of the proposed mining leases.
  - (3) Good reason has been shown for a refusal to grant the mining leases due to the risk of environmental impacts and the lack of scientific certainty regarding those impacts.
  - (8) In the alternative to grounds 1 - 7 above, if the applications are not refused, conditions should be imposed to address the matters raised in grounds 1 – 7.
- [60] In the “Facts and Circumstances” attached to the objections, the first respondent said:

#### **Groundwater**

11. If the mine proceeds, it will cause severe adverse environmental impact to groundwater and dependent users, species and ecosystems.

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<sup>31</sup> (2012) 33 QLCR 79 at [32]; see also *Ferdinands v Commissioner for Public Employment* (2006) 225 CLR 130 at [49] (Gummow and Hayne JJ).

12. If the mine proceeds, it will impact groundwater dependent springs and systems that are important for human use, agriculture and biodiversity, including but not limited to:
  - (a) the Doongmabulla Springs Complex – including Moses, Little Moses and Joshua;
  - (b) the Mellaluka Springs Complex – including Mellaluka Spring, Lignum Spring and Stories Spring.
13. The full extent of the adverse environmental impacts to groundwater and dependent species and ecosystems cannot be particularized by the objector due to the inadequate information provided by the Applicant in the applications, EIS and SEIS.
14. It has not been adequately demonstrated that the mine will not have an unacceptable adverse impact on groundwater and dependent species and ecosystems. In particular:
  - (a) it has not been adequately demonstrated that the mine will not have an unacceptable adverse impact on the environment by changes to the quality and quantity of groundwater considering section 269(4)(j) of the MRA;
  - (b) the absence of adequate scientific information about a potential impact with severe and long term impacts is good reason to refuse the mining lease applications considering section 269(4)(l) of the MRA; and
  - (c) the adverse environmental impacts and potentially severe adverse environmental impacts caused by these proposed mining operations on groundwater make it an inappropriate use of the land when current land use does not pose a similar threat considering section 269(4)(m) of the MRA.

### **Surface water**

15. If the mine proceeds it will cause severe adverse environmental impacts to surface water and dependent users, species and ecosystems on and associated with the area of the mine and downstream.
16. The full extent of the adverse environmental impacts to surface water and dependent users, species and ecosystems cannot be particularized by the objector due to the inadequate information provided by the Applicant in the application, EIS and SEIS.
17. It has not been adequately demonstrated that the mine will not have unacceptable adverse impacts and potentially severe and long term adverse impacts on the quantity and quality of surface water and dependent ecosystems and species that have not been adequately assessed. In particular:
  - (a) the mine will have an unacceptable adverse impact on the environment by adverse impacts on surface water quality, quantity and ecology, (including dependent species) considering section 269(4)(j) of the MRA;
  - (b) the absence of adequate scientific information about potentially severe and long term impacts is good reason to refuse the mining lease applications, including section 269(4)(l) of the MRA; and
  - (c) the adverse environmental impacts and potentially severe adverse environmental impacts caused by these proposed mining operations on surface



water by the creation of a permanent final void, alienating the land from current and future productive use, make it an inappropriate use of the land when current land use does not pose a similar threat considering section 269(4)(m) of the MRA.

[61] The first respondent also objected to the EA application on the basis of the considerations stated in ss 3, 5, 171 and 191 of the EPA. In particular, the first respondent said, approval of the mine would be contrary to the object of the EPA stated in s 3; contrary to the requirement in s 5 for the decision-makers to perform a function or exercise its power under the Act in the way that best achieves the object of the Act; contrary to the precautionary principle, intergenerational equity and the conservation of biological diversity and ecological integrity; would cause environmental harm to the character, resilience and value of the receiving environment; contrary to the public interest; and would cause material and serious environmental harm.

[62] The facts and circumstances relied on by the first respondent in its notice of objection to the EA application are similar to those set out in relation to the facts and circumstances set out in the MRA objection.

[63] In the first respondent's further amended preliminary identification of issues<sup>32</sup>, these objections were particularized as follows:

5. The Doongmabulla Springs Complex (DSC) comprises a group of several large permanent springs that supply base flow to the Upper Carmichael River which flows permanently in this area. The Doongmabulla Springs lie only ~ 8km west of the proposed mine.
6. Dewatering for the proposed mine is modelled in the SEIS to have only a minor impact on the Doongmabulla Springs (DS), because they issue from a sandstone unit that is separated from the coal-bearing Colinlea Sandstone by a regional aquitard, the clay-rich Rewan Formation.
7. There is considerable uncertainty about the likely impact of the proposed mine on the hydrogeology relevant to the DSC.
  - (a) It is likely that the DS are supplied from the Colinlea Sandstone rather than the lower sandstone overlying the Rewan Formation. Evidence for this includes:
    - (i) the hydraulic head in the sandstone at the DS site, as shown by Bore HD02, is several metres below ground level, whereas the hydraulic head for the aquifer supplying the springs is at least 3 metres above ground level. (Note there are no measurements of the existing hydraulic head at the DS, rather, the average head pressures are assumed based on the maximum height of the water level in the dam fed by the springs);
    - (ii) the DS are most likely fed by flow along a fracture/fault, as is the case for the Mellaluka Springs, which receive groundwater from the Colinlea Sandstone;

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<sup>32</sup> OL010, Exhibit 2.

- (iii) the Rewan Formation generally has a very low permeability, but measurements on this unit around the proposed Alpha Coal Mine to the south show that it contains zones of high permeability that are likely to be fractures;
  - (iv) groundwater with a similar salinity to the DS occurs in the Colinlea Sandstone to the east of the DS;
  - (v) there is a marked trough in the potentiometric surface of the Permian Units to the east of the DS which suggest the influence of a fault;
  - (vi) the potentiometric surface of the Permian Units is sufficiently elevated within part of the proposed mine area to drive groundwater flow to the DS.
- (b) The applicant's predictive numerical modelling does not account for a major fault/fracture system feeding the springs, which would require model cells to be defined with the appropriate locations, dimensions and hydrogeological properties for groundwater flow along this fracture system.
  - (c) If the DS are fed by groundwater flow from the Colinlea Sandstone, then the impact of the mine dewatering on spring flow will be similar to that at Mellaluka Springs, i.e. the springs will be likely to permanently dry out.
8. In turn, this will remove baseflow from the Carmichael River which will no longer flow permanently in this area.
  9. There can be no confidence in the analysis of river hydrology and river-groundwater interaction analysis in the SEIS.
  10. The Mellaluka Springs Complex to the south east comprises three separate springs that lie along a straight line. The Mellaluka Springs Complex is supplied by groundwater flow from the Colinlea Sandstone.
  11. Dewatering for the proposed mine will severely impact these springs, which are likely to disappear.
  12. The DSC has exceptional ecological value:
    - (a) The exceptional ecological value of the DSC is primarily based on the unusually high level of endemism among the species for which it provides habitat.
    - (b) This high level of endemism in the DSC is understood to be largely a consequence of in situ evolution driven by factors among the following:
      - (i) the age of the springs – DSC is likely to be at least 1 million years old;
      - (ii) the isolation of the DS; and
      - (iii) the particular/peculiar water chemistry.
  13. It is accepted that the proposed mine may lead to the permanent drying of the Mellaluka Springs Complex such that that Springs' ecological values will be permanently lost.
  14. The likely impacts of the proposed mine on the ecological values on the DSC are not clear.

- (a) If the drawdown impact on the DS is greater than predicted by the applicant's numerical modelling, then the impact on the Springs' hydraulic head and flow rates will be greater than anticipated.
- (b) The applicant does not properly assess the potential or likely extent of the ecological impacts on the DS;
  - (i) the applicant's hydrogeological modelling indicates that the mine dewatering will have some impact on the DS.
  - (ii) any drawdown from the source aquifer will have an impact on the DS, such as a reduction in the flow rate into the springs and some reconfiguration of the habitat, ie reduction in the volume of any pools and the area inundated by the DS.
  - (iii) if the drawdown impacts reduce the flow rate but maintain artesian discharge, the extent of the impacts on the ecology of the DS is very difficult to predict.
- (c) Subject to the outcomes of the meetings of experts in hydrogeology, there appears to be significant uncertainty or disagreement about:
  - (i) which of the underlying aquifers is the likely source of water to the DS;
  - (ii) whether the applicant's predictive numerical modelling:
    - A. adequately reflects the geological features that create the DS;
    - B. accurately predicts the likely extent of groundwater drawdown impacts on the DS.
- (d) If the DS dry, either permanently or temporarily, any endemic species will not survive and become extinct.

### **Doongmabulla Springs Complex – the source aquifer**

- [64] There are two areas of springs that will be impacted by the mining operations at the Carmichael mine – the Doongmabulla Springs and the Mellaluka Springs.
- [65] The Doongmabulla Springs Complex consists of
- a. Joshua Spring;
  - b. The Moses Spring group; and
  - c. Little Moses Spring
- [66] The evidence was that while the Mellaluka Springs do not support vegetation of exceptional ecological value, the DSC has exceptional ecological values. A major issue in this case is the impact that the mine may have on the DSC.
- [67] The conceptualisation of the geology in the region of the proposed Carmichael lease relied on by the applicant is set out in the EIS for the project. Dr Webb disagreed with that interpretation and has re-conceptualised the regional geology, relying on additional materials. The first respondent submitted that the regional geology is relevant only to the extent that Mr Bradley relied on the Vine et al regional geology in his alternative conceptualisation of the

source aquifer of the DS, the first respondent submitted. The issue is discussed further below, in that context.

[68] The applicant says that the geological strata in the general region of the Carmichael mine occur in the following descending depth order (where they exist):

- i. Moolayember Formation;
- ii. Clematis Sandstone;
- iii. Dunda beds;
- iv. Rewan Formation;
- v. Bandanna Formation;
- vi. Colinlea Sandstone; and
- vii. Jochmus Formation (known as the “Joe Joes”).

[69] Coal at the Carmichael mine will be extracted from the strata below the Rewan Formation, being the Bandanna Formation and the Colinlea Sandstone. The coal bearing seams below the Rewan formation will be dewatered.

[70] It is the case for the applicant that the source aquifer for the DSC must be above the Rewan Formation and, therefore, the dewatering caused by the mine will have little impact on the DSC. The applicant acknowledged however that if the source is below the Rewan, the impacts will be significant and the Doongmabulla Springs will not merely suffer drawdown but will be lost.

[71] The first respondent says that the DS are sourced at least in part from an aquifer below the Rewan Formation, namely the Colinlea Sandstone, and, therefore, as the applicant had conceded, the springs will be lost.

[72] The applicant retained Mr John Bradley in relation to groundwater and geology. Mr Bradley is the principal hydrologist at JBT Consulting Pty Ltd and is a geologist and hydrogeologist with over 23 years experience in groundwater assessment and management. The applicant also engaged Dr Noel Merrick of Heritage Computing Pty Ltd. Dr Merrick is a hydrogeologist with over 40 years experience in groundwater modelling, assessment and management.

[73] Dr John Webb was engaged by the first respondent. Dr Webb has over 30 years experience in geology and 20 years experience in hydrogeology, both in practice and in tertiary level teaching. The first respondent also engaged Dr Adrian Werner who is a professor in hydrogeology at Flinders University and a chief investigator of the National Centre for Groundwater Research and Training. Dr Werner has expertise in hydrogeology and groundwater modelling.

- [74] The experts produced two joint reports, the first dated 9 January 2015<sup>33</sup> and the second dated 27 March 2015<sup>34</sup>. In addition, two individual reports by Mr Bradley were tendered<sup>35</sup> as was one individual report by each of Dr Merrick<sup>36</sup>, Dr Webb<sup>37</sup> and Dr Werner<sup>38</sup>.
- [75] As noted above, the applicant says that the water source for the DS is the Clematis Sandstone, which lies above the Rewan Formation. This is because, the applicant said, the incredibly low permeability of 90% of the Rewan Formation, coupled with the fact that zones of somewhat higher permeability are isolated from each other such that there is no continuous zone of high permeability throughout the strata, means that, at most, only a negligible amount of groundwater could possibly move through the Rewan Formation from strata below.
- [76] Furthermore, the applicant submitted, even if there is a high permeability pathway through the Rewan Formation that allows groundwater to move from below the Rewan Formation to above the Rewan Formation, such movement would only occur if the groundwater head above the Rewan Formation is lower than the head below (due to accepted hydrogeological principles that groundwater will move from a high head to a low head). There is no evidence that the head differential between the Clematis Sandstone and the Colinlea Sandstone would lead to groundwater flowing from the Colinlea to the Clematis, said the applicant.
- [77] The first respondent says that the DS are sourced at least in part from an aquifer below the Rewan Formation, namely the Colinlea Sandstone.
- [78] Dr Webb’s evidence was that while the Rewan Formation is generally a low permeability unit and acts as an aquitard, it is “leaky” – that is, it has areas of high vertical conductivity and is capable of transmitting significant volumes of groundwater in places. He relied on a combination of a number of lines of evidence to support his conclusion that the spring water is derived at least in part from the underlying Permian aquifers<sup>39</sup>:
- a. There is a marked trough in the potentiometric surface of the Permian Units to the east of the springs (EIS hydrogeology 4-8 to 4-12), and in fact the groundwater flow directions in the Colinlea Sandstone to the north, south and west of the springs converge on the springs. This is most easily explained if the springs represent a discharge point for the aquifer.
  - b. The potentiometric surface of the Permian Units is sufficiently elevated to drive groundwater flow to the springs, particularly north of the springs within the mine lease (EIS hydrogeology).
  - c. There is evidence for a fault through the middle of the Carmichael lease, as interpreted by Xenith Consulting (2009); this fault could breach the Rewan Formation and allow upwards groundwater flow from the Colinlea Sandstone.
  - d. Although faults and fractures in the Rewan Formation might be expected to be self-sealing due to the clay-rich nature of this formation, there is clear evidence that the Colinlea

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<sup>33</sup> JR004, Exhibit 14.

<sup>34</sup> JR010, Exhibit 15.

<sup>35</sup> AA008, Exhibit 16 and AA020, Exhibit 17.

<sup>36</sup> AA010, Exhibit 19.

<sup>37</sup> OL012, Exhibit 18.

<sup>38</sup> OL011, Exhibit 20.

<sup>39</sup> OL012, Exhibit 18 at [54].

- Formation to the west of the Carmichael lease is recharged through the Rewan Formation which therefore must allow groundwater flow through it in places.
- e. Groundwater with a similar salinity to the springs occurs in the D seam in two bores to the east of the springs (50-60 mg/L Cl).
  - f. The Sr isotope composition of most springs matches that of Mellaluka Bore, consistent with the origin of the spring water from the same aquifer i.e. the Colinlea Sandstone or immediately underlying Joe Joes Formation.
  - g. To obtain artesian pressures within the Dunda Beds sufficient to drive the groundwater flow at Joshua Spring, there must be a confining layer within the Dunda Beds. There is no clear evidence of this and bores in the Dunda Beds near the springs ( e.g. HD02) are not artesian. The previous geological map for the springs area assigns these outcrops to the Clematis Sandstone as previously discussed; there is little evidence of major confining layers within the Clematis Sandstone wherever it outcrops.

***Permeability/hydraulic conductivity of Rewan Formation***

- [79] The evidence is that the Rewan Formation is extremely thick in the area of the DS. Core sample results from the closest available bore, Shoemaker 1 bore, which is approximately 500 m from Joshua Spring, record the Rewan Formation as being 279.2 m thick, commencing at 246.8 m below ground level and extending to 526 m below ground level.
- [80] Mr Bradley’s evidence was that the median hydraulic conductivity values of the Rewan Formation are:
- a.  $2.78 \times 10^{-9}$  m/second in areas expected to have lower hydraulic conductivity (being areas predominantly comprised of fine grained sediments such as siltstones and claystone); and
  - b.  $1.16 \times 10^{-6}$  m/second in areas expected to have higher hydraulic conductivity (being areas predominantly comprised of coarse grained sediments such as sandstone and sandy clay).
- The median value of the hydraulic conductivity is markedly lower than a recognized international standard for sufficiently low permeability to act as a liner preventing seepage<sup>40</sup>.
- [81] Mr Bradley said that the sandy, higher hydraulic conductivity regions of the Rewan Formation are isolated and discrete and comprise no more than 10% of the total Rewan Formation thickness. There is a continuous low permeability zone of the Rewan Formation approximately 134 m thick before the first region of higher hydraulic conductivity commences at 384 m below ground level. The hydraulic conductivity of that continuous zone has a median value of  $2.78 \times 10^{-9}$  m/second. Further there are two additional continuous zones of low permeability in the Rewan Formation of 48 and 38 m. These additional zones further impede the vertical flow of any groundwater through the Rewan Formation.
- [82] Dr Webb’s evidence was that the piezometric data for the Colinlea Sandstone shows that there is a groundwater divide to the west of the Carmichael lease in the vicinity of Lake Galilee. (This issue is discussed further below). Accordingly, Dr Webb said, recharge to the Colinlea Sandstone must be occurring along this groundwater divide. However, on either

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<sup>40</sup> The Environment Protection Society in South Australia requires that a waste water lagoon be constructed with a .3 metre compacted clay liner with permeability of less than  $1 \times 10^{-9}$  metres/second.

conceptual model of the hydrogeology, the Rewan Formation overlies the Colinlea/Bandanna aquifer along the groundwater divide so that, Dr Webb said, recharge to the Colinlea Sandstone is occurring through the Rewan Formation which must be a leaky aquitard. Dr Webb accepted that the Rewan is dominantly clay-rich and the majority of hydraulic conductivity measurements from the Formation are low, and that Mr Bradley had said that any fractures or faults through the Rewan might be expected to self-heal. Nevertheless the presence of the groundwater divide to the west of the lease area indicated unequivocally, Dr Webb said, that recharge is occurring through the Rewan Formation. Further, the data from the Kevin's Corner EIS showed that parts of the Rewan are quite transmissive.

[83] The applicant said that Dr Webb had ignored the relevant evidence in relation to the permeability values. Dr Webb's only reference in his written report to permeability data, the applicant said, was a statement that "parts of the Rewan Formation are quite transmissive, as shown by scattered high vertical hydraulic conductivity values of 0.3 – 1.2 m/day", referring to the Kevin's Corner EIS, 12 Groundwater, Table 12-30. The applicant submitted that that statement by Dr Webb selectively ignored much more geographically relevant data sourced locally from the Carmichael mine site and immediate surrounds. Further, the publicly available EIS for the Kevin's Corner project showed that the context in which Table 12-30 was included was a summary of the contents of the table as follows<sup>41</sup>:

"These results indicate heterogeneity within the Rewan Group, which contains layers of very low permeability. These zones provide the confining pressures for artesian and sub-artesian conditions recorded in the GAB and reduce the potential for vertical induced flow. The results match the conceptualisation of the Rewan Group acting as a regional aquitard, which prevents inter-aquifer and inter-basin flow.

The impacts of mine dewatering on the Rewan Group and ultimately to the Clematis Sandstone are, as predicted in the groundwater model (section 12.11.3), therefore recognised as negligible."

### ***Faulting in the Rewan Formation***

[84] The first respondent said that the DS are most likely fed by flow along a fracture/fault as is the case of the Mellaluka Springs which receive groundwater from the Colinlea Sandstone. The first respondent submitted that complete disruption of the Rewan was not necessary for faulting or fracturing to create a preferred flow pathway. Dr Webb's evidence was that there may be a smaller amount of movement or fault so that one side moves up a small amount compared to the other side so that aquifers do not match, but the fault can open and leave a space that can provide a pathway for groundwater movement.

[85] The applicant submitted that there was no evidence of any fault through the Rewan Formation in the location of the DSC and none should be implied. Mr Bradley and Dr

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<sup>41</sup> AA041, Exhibit 75 at 128.

Merrick were of the opinion that there was no evidence of any fault through the Rewan Formation which could transmit significant groundwater flow. They noted that:

- a. there was no evidence to establish the presence of faults with a continuous hydraulic connection;
- b. the probability of such continuous faults through the Rewan Formation was extremely low; and
- c. the Rewan Formation would “self heal” any faults, such that they would not affect the low permeability of the Rewan Formation.

[86] The applicant’s conceptual model of the groundwater system does not attempt to model any faults. The groundwater experts disagreed on the need to invoke faults as a major feature in the conceptual model of the groundwater system. Mr Bradley and Dr Merrick considered that the principle of parsimony<sup>42</sup> should be applied as there is no definitive evidence of faults affecting the groundwater system. Dr Werner’s view was that the analysis of faults and other preferential pathways such as abandoned wells was inadequate to predict with reasonable certainty the competence of the aquitards as barriers to flow. Dr Webb believed that because faulting may be feeding the DS, faulting should be a major feature of the conceptual model.

[87] Mr Bradley’s evidence was that if the presence of faults with a continuous hydraulic connection has not been established (e.g. by drilling, geophysics, geochemistry etc) then the inclusion of faults should not form part of the conceptualization, and modelling of water level impacts due to faulting should not be attempted. He considered that the water source for the Doongmabulla Spring Complex is above the Rewan Formation and therefore it was not necessary to invoke faulting as the explanation for the water source.

[88] Mr Bradley also said that discussions with site geological personnel indicated that the Rewan Formation is generally a difficult formation to drill because open bore holes tend to close within one or two drilling shifts due to the presence of swelling clays that can completely close the bore hole. This demonstrated the properties of clay within the Rewan Formation that would tend to heal any faults rather than allow the presence of hydraulically continuous faults through the entire thickness of the Formation. Accordingly the presence of fault traces within the Rewan Formation would not necessarily indicate the presence of hydraulically continuous zones that would allow the vertical transfer of water. Mr Bradley’s opinion was that due to the thickness of the low-permeability sediments and the field observations that swelling clays tend to heal bore holes, the probability that hydraulically continuous faults occur through the Rewan Formation is extremely low.

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<sup>42</sup> That is, that the number of entities should not be increased without good reason.



- [89] In any event, Mr Bradley said, the Commonwealth EPBCA approval conditions specify a requirement to undertake a study that specifically focuses on the issue of connectivity of the Rewan Formation. This will allow this hypothesis to be tested and remedial actions to be developed as appropriate.
- [90] There is evidence that a number of springs in the Great Artesian Basin occur because of faulting. Dr Fensham (called by the first respondent) said that about 35% of the discharge springs would be associated with fault structures. He said that the seismic record shows that there is a displacement of the rocks and that the aquitard is just too thick to conceivably be penetrated by the groundwater without a fault, a pathway.
- [91] Dr Webb pointed to evidence of a fault in the middle of the Carmichael lease as interpreted by Xenith Consulting (2009)<sup>43</sup>. Dr Webb said that this fault could breach the Rewan Formation and allow upwards groundwater flow from the Colinlea Sandstone.
- [92] It is evident from that report that, although a fault had been identified, the authors recommended that further work should be carried out to increase the understanding of the interpreted fault structure in the middle of the deposit<sup>44</sup>.
- [93] The applicant relied on two more recent reports to demonstrate that there is only minimal faulting in the region of the Carmichael lease. The first is a report entitled “Adani Mining Pty Ltd JORC Coal Resource Estimate – Carmichael Coal Project” produced by Xenith Consulting Pty Ltd in April 2013 (Xenith 2013) report<sup>45</sup>. That report says that four faults are interpreted to exist with vertical throws of between 20 m to 40 m and that more drilling focussed around the faulted zones will be needed to better pinpoint the location, throw and angle of the fault plane. The applicant submitted that these throw amounts should be compared to the estimated thickness of the Rewan Formation of approximately 279 m in the location of the DS. The second report, authored by ROM Resources<sup>46</sup>, refers to minor faulting in the D1 fault seam in the area of the lease and the geological modelling assumption of the presence of four faults with vertical throws of between 20 to 40 m but does not state that further work is required to understand faulting in the region.
- [94] The first respondent referred to the Independent Expert Scientific Committee (IESC) advice<sup>47</sup> which includes the following observations:

“Regional Faults: The conceptual model would benefit from an assessment of regional faults. The proponent’s groundwater model does not take into consideration the influence of faulting within the Rewan Formation. The Committee notes that faults

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<sup>43</sup> Xenith (2009) is a report entitled “Link Energy Ltd Galilee Project – MDLa372 Insitu Coal Resource Estimate” produced by Xenith Consulting Pty Ltd, November 2009, AA030 Exhibit 53.

<sup>44</sup> At 13, 31.

<sup>45</sup> AA031, Exhibit 54.

<sup>46</sup> Carmichael Coal Deposit, Queensland Minescape Model Report and 2014 Resource Statement (to the 2012 JORC Code) April 2014, Exhibit LL1 to AA005, Exhibit 4.

<sup>47</sup> IESC Advice to Decision-maker on Coal Mining Project, OL032, Exhibit 59 at 3.

have been identified on the eastern boundary of the Galilee Basin within the Rewan Formation in other project proposals, but their potential role on groundwater flow processes has not been considered in this project.”

- [95] The applicant said that in its response to that advice, GHD<sup>48</sup> had noted that following overall assessment of the publicly available regional geology reports and maps together with JORC resource modelling by recognized independent geologists, it was concluded that there was a general absence of any significant faults in the area<sup>49</sup>.
- [96] Annexed to the GHD Response to the IESC Advice, is a document entitled “Short Technical Series for Adani Mining Pty Ltd: a Short Review of Regional Structure in the Region of the Carmichael Coal Deposit Central Queensland” written by Mr M Biggs of ROM Resources in February 2014<sup>50</sup>. Mr Biggs reviewed the available literature including multiple reports as to the results of drilling, seismic surveys and geological investigations. He concluded that it was unlikely that there were any significant faults in the region and he expressly rejected the idea that there could be a fault disrupting the entirety of the 280 m thick Rewan Formation which would thereby connect the coal bearing sequences to the aquifers above the Rewan Formation.
- [97] The applicant submitted that these reports collectively demonstrated that the understanding of faulting in the region of the Carmichael mine had increased significantly since the Xenith 2009 Report. The reports conclude that there is limited faulting in the region comprising four faults in the coal bearing seams each of no more than 20 m to 40 m in displacement. Accordingly, the applicant submitted, Dr Webb’s contention that the Xenith 2009 Report could be used to support the hypothesis that there may be faulting that facilitates greater groundwater flow through the Rewan Formation, should not be accepted.

#### *Seismic data*

- [98] Dr Webb reviewed a report that had been prepared for the applicant - 2011 Adani 2-D Seismic Survey – Interpretation and Data Processing Report, prepared by Velseis<sup>51</sup>. The data related to the proposed mining lease area. The main purpose of the survey was to locate faults and other fissures associated with the roof of the AB1, AB3 and D1 seams that might influence future mine planning and design. The seismic section labelled “Line 2011 – 10” in the Velseis report shows a fault spanning from a depth of about 230 m to about 520 m that extends through the AB1 and AB3 seams and the strata above these. Mr Bradley accepted

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<sup>48</sup> GHD Pty Ltd are the authors of the EIS, SEIS and additional SEIS which were prepared for and on behalf of the applicant.

<sup>49</sup> GHD Response to the IESC Advice February 2014, MR204 at 2.2.2.

<sup>50</sup> MR204 at Attachment 5.

<sup>51</sup> OL040, Exhibit 67.

that the probable fault shown in this cross section extended through 200 m of the Rewan Formation.

[99] The first respondent submitted that although the applicant had seismic data that showed faulting through most of the thickness of the Rewan Formation on the mining lease area, it had never conducted seismic testing in the area of the DS even though that would provide important data. Further, Mr Bradley had failed to properly consider or bring the Court's attention to the relevant seismic data, the first respondent submitted. Accordingly, the first respondent submitted, there is an absence of evidence about possible faulting rather than evidence of an absence of faulting.

#### *Drilling data*

[100] The first respondent said that:

- Figures 10 and 11 in the Adani Mining Pty Ltd Carmichael Coal Project Initial Development Plan (IDP) shows faults present on the MLA<sup>52</sup>.
- Analysis of bore logs of drilling carried out at the Shoemaker 1 bore, the Carmichael 1 bore and the Montani 1 bore may support faulting because:
  - The coal seams were located 120 metres higher than predicted before drilling (that is at a depth of 529 metres compared to 650 metres predicted);
  - Although the Shoemaker 1 bore and Carmichael 1 bore logs draw the coal seams in direct connection with each other based on the [dip] which might suggest that there is no evidence of a fault, Mr Bradley conceded later that the cross section in question was of no assistance in ruling out the possibility of faults;
  - Mr Bradley said in evidence that the high permeability zones within the Rewan Formation provide no evidence that the zones continue from the base to the surface. When it was put to Mr Bradley that drilling data through a fault would only be likely to pick up a relatively short area of high conductivity, Mr Bradley again acknowledged that drill testing is not necessarily going to pick up a fault.

[101] The first respondent submitted that the resource drilling data collected on the MLA area provided clear evidence of faulting through the Rewan Formation. The limited onsite drilling data did not and could not provide conclusive evidence of the presence or absence of faulting at the Doongmabulla Springs. The applicant, said the first respondent, had chosen not to properly investigate in the area of springs and then used that failure and the consequential lack of data to conclude that there was no evidence of faulting.

#### *Self Sealing*

[102] As noted above, Mr Bradley's evidence was that site geological personnel had said that open bore holes tend to close within one or two drilling shifts due to the pressure of swelling clays.

[103] The applicant submitted that it is scientifically impossible and inconsistent with all available data, that a fault facilitates greater groundwater flow through the relevant strata in the Rewan

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<sup>52</sup> MR024 at 30.

Formation which may help the groundwater to the DSC. This is because of the application of “shale gouge ratio” theory.

[104] Dr Merrick said that this theory, which had been developed in the petroleum industry, is that only 15 – 20% of the Rewan Formation would need to comprise fine grain low permeable materials in order for any fault through the Rewan to self-seal. 90% of the Rewan Formation comprises low permeable fine grain materials, and therefore there is no possibility of a fault in the Rewan Formation not sealing.

[105] The shale gouge ratio is calculated by dividing the aggregate thickness of the fine, low permeable material in the geological stratum by the throw caused by a fault. If the shale gouge ratio is greater than 15 or 20%, self-sealing of the fault is guaranteed. Here, Dr Merrick said, the aggregate thickness of fine grain materials in the Rewan Formation is 250.2 m. It is apparent that a fault would need to cause a throw in the Rewan Formation of over 1,200 m in order for it not to self-seal. As the Rewan Formation is only approximately 280 m thick, it would be impossible for a fault to cause a throw through the Rewan Formation that would not self-seal. This is consistent with Mr Bradley’s evidence that site personnel had indicated that the Rewan Formation is self-healing.

[106] Dr Merrick also considered that Dr Webb’s reliance on a recent publication by Cherry & others<sup>53</sup> that faulting can occur through aquitards was not relevant because the work by Cherry was a ten year old literature review which made no reference to the petroleum literature. For that reason Dr Merrick regarded the review as deficient. He said that it was a good review for shallow work but not for deeper investigations in hard rock formations.

[107] Dr Werner’s evidence was that there was a great deal of uncertainty in the literature he had looked at as to the impact on vertical conductivity of faults. He had not been convinced that faults through clay materials will not have vertical flow.

### ***Hydrochemistry***

[108] Dr Webb relied on two aspects of the hydrochemical analysis of the DS as part of the evidence to suggest that the spring water is derived partially at least from the underlying Permian aquifers:

- Groundwater with a similar salinity to the springs occurs in the D seam in two bores to the east of the springs (50 – 60 mg/L Cl);
- The Strontium (Sr) isotope composition of most springs matches that of Mellaluka bore, consistent with the spring water originating from the same aquifer, that is, the Colinlea Sandstone or immediately underlying the Joe Joe Formation.

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<sup>53</sup> Cherry et al, Role of Aquitards in the Protection of Aquifers from Contamination : a “State of the Science” Report (2004) OL048, Exhibit 83 at 49.

- [109] In the second joint expert report<sup>54</sup>, Dr Webb and Mr Bradley agreed that the hydrochemistry data was more consistent with the Clematis Sandstone and the Colinlea Sandstone than any other strata. In oral evidence, Dr Webb agreed that the Strontium isotope data was neutral in seeking to answer the question of the source aquifer for the Doongmabulla Springs and he also agreed that the salinity analysis was not convincing on its own. In the second joint expert report, Dr Webb said that the similarity in chloride chemistry between the Colinlea Sandstone and the DSC, made the Colinlea Sandstone a viable source aquifer for the DSC. However, Mr Bradley considered that the hydrochemistry data was too inconclusive to support this view.
- [110] Dr Webb suggested that collection of additional hydrochemical data would assist in identifying the source aquifer for the DS. Mr Bradley did not agree, on the basis that additional water quality data was unlikely to provide definitive proof of the source aquifer for the DSC. This was because the data that is available to date is sufficient to be able to conclude that the water quality of individual groundwater units in the vicinity of the Carmichael project site is similar to the likely range of water quality within the DSC.

### ***Groundwater flow***

- [111] Figure 1 in the water experts' first joint report<sup>55</sup> shows the groundwater heads and flow directions in the Colinlea Sandstone. Figure 1 shows west-to-east and south-to-north groundwater flow towards the area of the DS. The experts agreed that the flow directions as shown are a reasonable estimate of groundwater flow at depth. They also agreed that the head contours for the Colinlea Sandstone suggest a groundwater divide which is offset to the west from the DS and is offset also from the groundwater divide presented in the conceptual model, which was the basis for the original numerical model.
- [112] Figure 2 in the joint report<sup>56</sup> shows simulated groundwater heads (m AHD) for the Clematis Sandstone. The experts agreed that the contours in Figure 2 suggest flow directions reasonably consistent with those in Figure 1, with the exception of areas in the north and north-west of the model domain. Figure 2 was extracted from the latest numerical model report (GHD November 2014). The experts agreed that there remained significant uncertainty regarding flow at and beyond the western boundary of the model due to a lack of field measurements.
- [113] Dr Webb said that recharge to the Colinlea Sandstone must be occurring along the groundwater divide and the hydraulic gradients to the east and west cause groundwater flows in these respective directions within this Formation. He said that as the Rewan Formation

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<sup>54</sup> JR010 Exhibit 15 at [1].

<sup>55</sup> JR004, Exhibit 14 at 6.

<sup>56</sup> At 7.

overlies the Bandanna/Colinlea aquifer along the groundwater divide (irrespective of the conceptual model of the geology adopted), recharge to the Colinlea Sandstone is occurring through the Rewan Formation which must be a leaky aquitard. The presence of the groundwater divide to the west of the Carmichael lease, Dr Webb said, indicated unequivocally that recharge is occurring through the Rewan Formation in this area.

[114] Dr Webb also said that the similar groundwater flow pattern in Figure 1 and Figure 2 will occur when both aquifers are subject to similar recharge and discharge. He said that both aquifers appear to converge on the DS which indicates they are both feeding the springs.

[115] Mr Bradley and Dr Merrick were of the opinion that the observed groundwater flow in the underlying Bandanna/Colinlea aquifer could be provided by a lateral source. Mr Bradley said that recharge through the Rewan Formation to the west of the Carmichael project was not required to explain the observed groundwater pressures in the underlying Colinlea Sandstone and the subsequent groundwater flow direction in that aquifer from west to east (that is in a direction that is up-dip of the geological strata). Mr Bradley said that, conceptually, recharge water that moves into shallow level strata in the vicinity of Lake Galilee (for example, the Clematis Sandstone and the Dunda Beds), increased the pressure in those strata and thereby exerted pressure on the strata below (for example, the Rewan Formation and the Colinlea Sandstone), thus increasing the observed pressures in those deep strata. This pressure transfer occurs without the need for the transmission of groundwater. A simple two-dimensional groundwater model developed by Mr Bradley predicted outcomes consistent with that explanation of recharge leading to a high head in the Colinlea Sandstone.

[116] Subsequently the water experts produced a second joint report<sup>57</sup>. They agreed that groundwater movement must occur through the Rewan Formation to some extent with the rate of movement dictated by the hydraulic conductivity (predominantly the vertical hydraulic conductivity) of the Rewan Formation and the total heads that act on the system.

[117] Mr Bradley and Dr Merrick were of the opinion that the pressure of overlying water (leading to a transfer of pressure to underlying units) was the dominant mechanism leading to areas of higher hydraulic head in the Colinlea Sandstone to the west of the mine area. They considered that the volume of water transferred through the Rewan would be minor due to the low permeability and overall thickness of the unit.

[118] Dr Webb and Dr Werner believed however that groundwater mounding in the Colinlea Sandstone must be accompanied by significant inflow (either from natural sources if any exist, or from leakage through the Rewan) that is high enough to support the Colinlea Sandstone flow rates and directions. If pressures in the overlying aquifers dominate the heads

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<sup>57</sup> JR010, Exhibit 15.

in the Colinlea Sandstone, then the overlying aquifers most likely also dominated the inflows to the Colinlea Sandstone through the Rewan Formation. Dr Webb and Dr Werner considered that it was not possible for lateral inflows to dominate the Colinlea Sandstone flows if overlying aquifers dominate the Colinlea Sandstone hydraulic head distributions (that is by vertical transfer of heads through the Rewan).

- [119] Dr Webb and Dr Werner were also of the opinion that pressure transfer cannot occur through the Rewan Formation without there being sufficient leakage through the Rewan to accommodate groundwater flow in the underlying Bandanna/Colinlea aquifer that is not provided by lateral sources. Dr Webb said that the rate of groundwater movement through the Rewan must be significant in order to generate the observed groundwater flow in the Colinlea Sandstone. He and Dr Werner were of the opinion that flow in the Bandanna/Colinlea aquifer is likely due to both lateral sources (for example, recharge occurring to the south) and leakage through the Rewan Formation.
- [120] Dr Webb noted that the northwards and eastwards hydraulic gradient in the Bandanna/Colinlea aquifer is approximately the same, so that if the permeability of the aquifer is approximately the same everywhere, the groundwater flow per unit cross-sectional area in the aquifer is approximately the same northwards and eastwards. Thus, he said, the groundwater flow per unit cross-sectional area in the aquifer due to recharge through the Rewan along the groundwater divide is equivalent to that derived from recharge to the south.
- [121] Dr Webb was of the opinion that the higher permeability pathway that feeds the Joshua Spring is most likely a fault that allows transfer of water from the underlying Colinlea Sandstone aquifer, through the Rewan Formation to the surface.
- [122] Mr Bradley said that the source aquifer for the DSC is located above the Rewan Formation and that the higher permeability pathway that feeds Joshua Spring may be a localised weakness in the strata, but was not necessarily a fault or fracture.
- [123] The applicant submitted that the extremely low likelihood of groundwater transmissive faulting in the Rewan Formation and the extremely low permeability of the Rewan had already been established. Those conclusions significantly weakened any argument advanced by Dr Webb that recharge indicates permeability or faulting in the Rewan Formation. Further, Mr Bradley had demonstrated that recharge through the Rewan was not required in the vicinity of Lake Galilee to explain the observed high head in the Colinlea Sandstone found at that location.
- [124] The applicant also submitted that the parsimony principle required that Mr Bradley's straightforward explanation be accepted in preference to Dr Webb's explanation for the high

head of the Colinlea Sandstone, which required unlikely faulting and permeability in the Rewan Formation and movement of groundwater through over 600 m of strata.

[125] Finally, the applicant said, even if it were established that there was recharge into the Colinlea Sandstone in the vicinity of Lake Galilee through a fault or high permeability in the Rewan Formation, this said nothing about whether similar faulting or permeability exists at the DS approximately 25 km away.

[126] Dr Webb's evidence, said the applicant, is that if the Rewan Formation can be a leaky aquitard beneath the groundwater divide, it could easily be a leaky aquitard underneath the DS. This amounted, said the applicant, to nothing more than mere supposition by Dr Webb. Dr Webb said that he did not know why the groundwater did not move horizontally at the source of the groundwater divide, but it did not. Dr Webb's evidence failed to address the full pathway for the groundwater to travel to and from the Colinlea Sandstone which meant that his evidence offered no support for his overarching notion that the Colinlea is sourcing the DS.

[127] The applicant also submitted that none of the other groundwater experts agreed with Dr Webb's theory that the recharge at the groundwater divide was equivalent to that which is derived from recharge in the southern area, below the region of Figure 1. Although Dr Webb had proposed that the Rewan was leaky in places, he chose to conceptualize the Bandanna/Colinlea strata as uniformly permeable, both propositions being unsupported by any evidence.

#### *Unexplained discharge*

[128] Dr Webb's evidence was that there is a marked trough in the potentiometric surface in the Permian Units to the east of the springs<sup>58</sup> and the groundwater flow in the Colinlea Sandstone to the north, south and west of the springs converge on the springs. He considered this to be most easily explained if the springs represent a discharge point for the aquifer. Dr Webb accepted that the contour lines are necessarily interpretive but he said his interpretation was based on Figures 4.8 – 4.12 of the EIS Hydrogeology Report.

[129] Mr Bradley disagreed with Dr Webb on this issue. He considered that the flow pattern contours in Figure 2 show that flow in the Clematis Sandstone converges on the DS, but flow in the Colinlea does not.

[130] The first respondent submitted that with the exception of the DS there is no satisfactory explanation as to where the Colinlea is discharging. The EIS documentation says that groundwater extraction at Labona Homestead accounts for the necessary discharge.

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<sup>58</sup> MR122, EIS, Volume 4, Appendix R – Mine Technical Report – Hydrogeology Report, 46-50, Figures 4.8-4.12.



However, there was no evidence of water use for irrigation at Labona on the scale necessary to account for the amount of water discharging from the Colinlea.

[131] The applicant submitted that there is evidence showing that there are a number of possible and likely locations for the discharge of Colinlea groundwater to the surface – near the Labona homestead where a number of windmill driven extraction wells are used for stock watering purposes; at a number of artesian bases south of the Carmichael mine site and at a topographically low area where the Colinlea Sandstone is close to outcrop; and possibly at 12 registered bores identified in Table 21 in Appendix K to the SEIS<sup>59</sup>.

### ***Groundwater heads***

[132] There is no dispute that the DS are artesian. The experts' competing views as to the source aquifer of the DS require that either the Clematis Sandstone or the Colinlea Sandstone, or both, have sufficient potentiometric head at the DS to drive spring flow.

[133] It is common ground that the source aquifer must have sufficient potentiometric head to drive the spring flow at the DS. There is little or no reliable data as to the elevation at the different springs or the potentiometric head at any of the springs. However, the experts agree that the head at Joshua Spring is approximately 3 m above the surface.

[134] Dr Fensham produced data from the Queensland Herbarium as to the elevations in the area. This data is acknowledged to have a margin of error of +/-5m as the readings were GPS derived.

[135] Mr Bradley's opinion is that a source aquifer above the Rewan Formation is the most likely explanation for the DSC, for example, with recharge and artesian head derived from a mountain range north of the springs (Darkies Range) in outcrop areas of the Warang Sandstone. Based on his observations of the elevation and surface water flows of the springs and a number of geographical features and bores in the vicinity of the springs, Mr Bradley proposed a mechanism for the existence of the DSC as follows:

1. Groundwater recharge occurs in the topographically elevated region of Darkies Range with downward flow occurring through the Warang Sandstone to the underlying Clematis Sandstone.
2. Groundwater flow also occurs from the recharge area and laterally through the basal Moolayember Formation, which is interpreted to be relatively sandy at this location (based on the drilling and geophysical logs for Shoemaker 1 bore as well as inspection at the Moolayember outcrop adjacent to Moses Spring);
3. Groundwater flow direction is topographically controlled with groundwater flow lines occurring from the recharge area of Darkies Range towards surface drainage features that drain to the south-east (e.g. Carmichael Creek);
4. The potentiometric surface of the Clematis Sandstone/Moolayember Formation comes above the ground surface just below the 250 metres AHD contour line, that is in the area of the confluence of a number of creeks and where a spot height of 245 metres AHD is recorded;

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<sup>59</sup> MR167 at 105, 106.

5. Upward discharge of groundwater occurs to the DSC in areas where groundwater pressure is able to exploit weaknesses in the rock strata, creating vents that allow groundwater discharge to the ground surface.

[136] Mr Bradley said that although the artesian water level at the springs is unknown, the head can be inferred from a review of the Joshua Spring which has been dammed by construction of a turkey's nest dam around the spring vent. Based on the height of water in the dam, he considered that the spring feeding the dam is artesian by approximately 3 m. Joshua Spring, Moses Spring and Little Moses Spring all occur within surface drainage areas close to the confluence of Carmichael Creek, Cattle Creek and Dyllingo Creek. Therefore the spring complex is preferentially developed at a topographically low point in the landscape where the potentiometric surface of the source aquifer is marginally above ground level (in the order of 3 m above ground level as outlined) and conditions exist within the confining cover strata to allow water to discharge to the ground surface.

*Bore C14012SP*

[137] Mr Bradley said that a recently drilled groundwater monitoring bore (C14012SP) within the Clematis Sandstone is located to the east of Joshua Spring. The bore records show the approximate water elevation in the Clematis Sandstone at that site at approximately 249.5 m AHD. The applicant submitted that as Joshua Spring is to the west of C14012SP and it is agreed that the Clematis groundwater is flowing from west to east in this region, the head of the Clematis at Joshua Spring must be at least 249.5 m AHD.

[138] As the head of the Clematis at Joshua Spring is at least 249.5 m AHD and the elevation is no more than 248 m AHD, C14012SP supports a conclusion that the Clematis is artesian at Joshua Spring, the applicant submitted.

[139] Similarly, the applicant submitted, as the Moses Springs are located to the west of C14012SP, the head of the Clematis at Moses must be at least 249.5 m AHD. Dr Fensham's evidence was that the surface elevation of each of the Moses Springs is no higher than 245 m AHD. If that is correct, the Clematis must be artesian at each of the Moses Springs. If the data is adjusted by +/-5m to allow for the margin of error, seven of the eight Moses Springs must be artesian. The eighth, Moses 3B, which has a recorded elevation of 245 m AHD must be artesian if the recorded elevation is within 4.5 m of the actual elevation, the applicant submitted. Further, the applicant said, the head at Moses 3B must be greater than 249 m AHD, because the Moses complex is approximately 5.5 km west of C14012SP and, therefore, must have higher heads than those at C14012SP as Clematis groundwater flows from west to east. As the highest possible elevation of Moses 3B is 250 m AHD, the applicant submitted that the Clematis is artesian at Moses 3B.

[140] The applicant also submitted that it is likely that the Clematis is artesian at the Little Moses Spring which is situated to the east of C14012SP. That location would indicate that the head of Little Moses is slightly lower than the head at C14012SP. Even if Dr Fensham's recorded elevation of Little Moses at 242m were adjusted by +5m to 247 m AHD, the Clematis head could reduce by up to 2.5 m AHD as the groundwater moves east from the bore to Little Moses and the Clematis would still be artesian at Little Moses.

#### *Shoemaker 1 Bore*

[141] Shoemaker 1 bore taps into the Colinlea Sandstone and provides the only available head data for the Colinlea Sandstone in the area of the DS. Mr Bradley said, relying on the head data from the Shoemaker 1 bore well completion report, that the Colinlea Sandstone is not artesian at the location of the DSC. The groundwater head level in the Colinlea was estimated at [245]m AHD at Shoemaker 1 bore in Figure 1. The bore is located close to Joshua Spring and, said the applicant, is elevated from Joshua Spring given that Joshua Spring is located in a floodplain and Shoemaker 1 bore is located out of that floodplain. The elevation of Shoemaker 1 bore is 248 m AHD and therefore Joshua Spring must have an elevation of no more than 248 m AHD.

[142] Dr Webb said that there is sufficient potentiometric head in the Colinlea Sandstone to drive groundwater flow to the springs. The first respondent submitted that ground level at Joshua Spring is approximately the same as at the Shoemaker 1 bore, 248m AHD. As the groundwater head at Joshua Spring in the Colinlea was estimated at [245] m AHD, the Colinlea could not be the source of Joshua Spring. Further, the groundwater head level in the Clematis was modelled at 242m AHD and therefore it could not be the source of the Joshua Spring.

[143] However, the first respondent submitted that the head measurement taken at the Shoemaker 1 bore log was recognized as unreliable and should be taken only as a guide because:

- (a) the bore was not drilled for the purpose of groundwater investigation, is now sealed and the only available data from the bore are the drill stem tests done at the time the bore was drilled;
- (b) the DNRM advice on groundwater flow direction was that the drill stem tests could be taken as a guide only<sup>60</sup>;
- (c) Mr Bradley accepted, in the light of this uncertainty, that the head in the Colinlea may be above the ground at Shoemaker 1 bore.
- (d) Similarly, Dr Merrick accepted that, although he had relied on the [245] m AHD estimated head for the Shoemaker 1 bore log in interpreting the contours in Figure 1, this

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<sup>60</sup> SP001.12, Appendix 3 at 489.

measurement was subject to a margin of error of 5 m or more, which would bring the head above the ground level of 248 m AHD.

[144] Accepting some margin of error in the estimates/modelling, the first respondent said, it is more likely that the Colinlea is the source because the head is estimated to be higher in the Colinlea than the Clematis. Alternatively, the figures are consistent with Dr Webb's hypothesis that both aquifers are sources for the DS.

*Bore HD02*

[145] HD02 is a monitoring bore which taps into the Clematis unit. If the Clematis is the source aquifer for the DS, HD02 should be artesian. The bore lies to the east of the Moses Springs and to the west of Little Moses. Results of tests at HD02 indicate that the groundwater there is not artesian. The ground elevation at HD02 is 240 m AHD and it has a sub-artesian head at approximately 2 metres below the ground surface.

[146] Nevertheless, the applicant submitted, the groundwater level at HD02 is consistent with the submission that the Clematis is the source aquifer of the DS, because:

- (a) HD02 is not deep enough to have tapped artesian pressure. As the bore is drilled to 32 m below ground level, Mr Bradley said that there is a possibility that HD02 has not accessed the artesian portion of the Clematis. He said that aquifers may be artesian in some areas but not others.
- (b) HD02 is located between Dyllingo and Cattle Creeks. Accordingly the Clematis would have a reduced head at the location of the bore resulting from the loss of groundwater into these creeks.
- (c) Mr Bradley's evidence was that potentiometric head has been lost as the groundwater flows from west to east. This does not affect the applicant's submissions that the Clematis is artesian at Little Moses as there is no correlation between the two.
- (d) There is no confining layer for the Clematis at the location of HD02 and, therefore, the Clematis could not be expected to be artesian at that point.
- (e) HD02 was not constructed to identify the potentiometric head of the Clematis but to identify the water level at that location. That the bore was not sunk to encounter artesian conditions may explain why it is not artesian.

[147] The first respondent submitted that HD02 provides strong evidence that the Clematis Sandstone is not artesian in the vicinity of the DS and that it could not be the only source aquifer.

***Regional geology***

[148] The geological mapping relied on by the applicant was based on mapping carried out in 1969 and 1972 by Vine et al. In addition a 1997 map by Habermehl and Lau was relied on, that map being entirely based on the earlier mapping by Vine et al. Mr Bradley agreed with the

regional geology as mapped previously and said that his hydrogeological conceptualization of the DS is consistent with that.

- [149] Dr Webb said that the current geological model of the geology within and surrounding the Carmichael Project shows the Permian and Triassic Strata dipping at 2-4° to the west, the DS flowing from outcrops from Clematis Sandstone and extensive outcrops of Moolayember Formation. Remapping using airborne radiometric and Landsat images, seismic and drilling data shows, he said, that the Triassic Strata do not dip uniformly to the west, but have been folded into two broad, low angled folds, and unconformably overlie the Permian Strata. The DS flow from outcrops of Dunda Beds, and the Clematis Sandstone is restricted to the northern part of the area. There are extensive outcrops of Rewan Formation but no outcrops of Moolayember Formation.
- [150] Dr Webb said therefore that the current hydrogeological modelling is based on an incorrect geological model and, most likely, a misunderstanding of the aquifer feeding the DS. In addition, the springs are fed by a fracture flow which is not explicitly modelled, in the present hydrogeological modelling. As a result, the conclusions of the current modelling, that there will be little impact of the proposed Carmichael mine on the DS, are unlikely to be correct and there is the real possibility that the dewatering from the mine could cause the springs to dry up (as acknowledged for the Mellaluka Springs).
- [151] Dr Webb said that when he is involved in any study of geology of a particular area, he gathers all the available data which includes the existing geology maps, the topography, the radiometrics, the aeromagnetics and satellite imagery. He puts that together and uses it to check the geology to confirm that what has been said in the past is correct.
- [152] The data collected by Dr Webb included radiometric imaging that showed, based on Dr Webb's earlier work in the region, that there was outcropping of the Rewan Formation in an area where the overlying unit has been eroded. This was identifiable, said Dr Webb, by the pink radiometric signature which he said showed high potassium Rewan outcrop.
- [153] Mr Bradley said that the radiometric imaging suggestive of Rewan Formation outcropping was a consequence of floodplain deposits. However Dr Webb's evidence was that there is no upstream geology that shows the same radiometric signature so that the high potassium readings could not be caused by flood deposition and were better explained by erosion of surface strata in the surface drainage channels to reveal the underlying Rewan Formation. Nevertheless Mr Bradley reiterated his view that the radiometrics were showing floodplain deposits which showed clay that had come from somewhere within the catchment, that is the image was simply showing drainage. Further, the information from the bore holes showed

the Rewan Formation at 500 m plus depth and he therefore could not see the pink areas as being Rewan Formation.

- [154] Dr Webb's response to the suggestion that the pink radiometric signature might simply indicate the presence of Mica was that to obtain the uniform pink colour, more than traces of Mica would be necessary and, further, he had matched the radiometric signature with the topography which showed that there was erosion of a surface layer and exposure of a layer underneath. Similarly in relation to the suggestion that Glauconite was the cause of the signature, Dr Webb said that Glauconite is predominantly found in shallow marine environments and as the Moolayember Formation was a freshwater deposit he would be very surprised to see Glauconite in it.
- [155] Dr Webb also identified an outcrop of Clematis Sandstone to the north-east and at a higher elevation than the DSC. Counsel for the first respondent submitted that if Dr Webb's identification of the Clematis Sandstone and the Rewan Formation at this point were accepted, then it followed that the historic mapping of the Moolayember Formation around the DSC relied on by the applicant must be incorrect.

*Shoemaker 1 Bore log data*

- [156] Shoemaker 1 bore is the closest available bore to the DS about 500 m from Joshua Spring. The bore was drilled in January 2010.
- [157] The well completion report<sup>61</sup> shows the geological strata at the location of the bore as follows:
- (a) Moolayember Formation (from 3.2 m below ground level to 80.8 m below ground level);
  - (b) Clematis Sandstone (from 80.8 m below ground level to 199.7 m below ground level);
  - (c) Dunda Beds (from 199.7 m to 250 m below ground level; identified as an inter-bedded sequence at the top of the Rewan Formation);
  - (d) Rewan Formation (from 250 m to 529.2 m below ground level);
  - (e) Betts Creek Formation (from 529.2 m to 652.5 m below ground level);
  - (f) Colinlea Sandstone (from 652.5 m below ground level to 670.6 m below ground level);  
and
  - (g) Jochmus Formation (from 670.6 m to 698.15 m below ground level).
- [158] The first respondent submitted that there were a number of features in the Shoemaker 1 bore log which pointed to different stratigraphy from those presented in the Bore log –
- (a) the Shoemaker 1 bore log shows no coal in the Colinlea Sandstone although the applicant says that the target coal in the D Seam is in the Colinlea Sandstone;

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<sup>61</sup> AA034, Exhibit 57.

- (b) the thickness of the seams identified in the bore log is very different from the descriptions of the strata relied on by the applicant:
  - i. what is described as Dunda Beds in Shoemaker 1 bore is only 50 m thick compared with approximately 150 to 200 m in Mr Bradley's evidence;
  - ii. what is described as Clematis Sandstone in the bore log is only 119 m thick, compared with approximately 200 m near Doongmabulla in Mr Bradley's evidence.
- (c) Mr Bradley says the Rewan Formation is a marker unit with a characteristic thickness, yet he also accepted that sometimes the Dunda Beds are arbitrarily included in the Rewan Formation.

[159] Dr Webb's view is that the labelling of units in the bore log is based on the assumption that the Moolayember Formation is the surface unit whereas the lithology and gamma log are consistent with his conceptualization of the geology. There are no samples and it was recognized by Mr Bradley that there were limitations on the identification of the units in the top 200 m.

[160] The first respondent also submitted that there is evidence of a number of features in the bore log to support Dr Webb's interpretation of the stratigraphy:

- (a) the interpretation in the top 200 m of the bore log, which has been identified as including the Moolayember Formation and the Clematis Sandstone, is based entirely on the gammalog, as no chips were collected at this point;
- (b) the reading on the gamma log is a measure of clay content in the rock;
- (c) the gamma log for the top 80 m of the bore log shows very low clay content compared to the following 120 m. This does not support the identification in the bore log of the top layer as Moolayember because Dr Webb's evidence was that the gamma log for the first 80 m of the bore indicated that this is clean quartz sandstone, which would typically be a good aquifer. However the Moolayember Formation is recognized to be an aquitard in the applicant's evidence;
- (d) the gamma log from the underlying 80 m to 200 m shows more clay content within the sandy sequences which does not support the identification in the bore log of the portion from 80 m to 200 m as Clematis Sandstone:
  - i. Clematis Sandstone is recognized elsewhere in the applicant's evidence as an aquifer (sandstone) rather than interbedded sandstone and clay (that is, siltstone, mudstone).
  - ii. Clematis Sandstone is described in the Galilee Sheet Explanatory Notes as "quartzose sandstone, fine to coarse with conglomerate beds; minor interbedded siltstone and mudstone".
  - iii. Mr Bradley accepted that the section picked as Clematis Sandstone (80 m to 120 m) shows more clay sequences than the section picked above as Moolayember Formation.

- [161] The first respondent submitted that on a proper interpretation of the evidence, the Shoemaker 1 bore log can be seen to have been completed to fit within the 45 year old mapping by Vine et al and should not have been relied on unquestioningly. The first respondent said that the bore log is entirely consistent with Dr Webb's re-interpretation and supports his mapping.
- [162] The applicant submitted that the area identified in the log as Clematis Sandstone is consistent with Mr Bradley's evidence that the log shows a succession of stacked sandstone and a stacked succession of sandy sequences and clay sequences. That is consistent with Mr Bradley's evidence that the Clematis Sandstone is predominantly sandstone and is inconsistent with an identification of Rewan Formation at that depth because Mr Bradley identified the Rewan Formation as a low permeability unit which, the applicant submitted, indicated the presence of clays.
- [163] There is a shale/clay rich unit evidenced on the Shoemaker 1 bore drill log sitting above the coal seam. Mr Bradley and the geologist who produced the well completion report identified that unit as the Rewan Formation. Mr Bradley also identified the Rewan Formation as a marker unit because it is so easy to identify given its particular nature when compared with all the other formations. The applicant submitted that Dr Webb should have identified the coal seams which are clearly and undisputedly at the depth identified on the well completion report. From there he should have seen this thick clayey sequence and confirmed the view taken by all the other experts that it is the Rewan Formation.
- [164] In any event, the applicant submitted, the aquitard as identified by Dr Webb (whether conceptualized as the Rewan Formation or the Bandanna Formation) is what will prevent groundwater from moving from the dewatered coal seams below to the DS above.
- [165] The applicant submitted further that Dr Webb had not referred to the Shoemaker 1 bore well completion report in his report and, it appears, only obtained a copy of the report when it was attached to Mr Bradley's report. The applicant submitted that it appeared therefore that Dr Webb had not relied on the Shoemaker 1 bore results in remapping his geology but sought to explain them as consistent with his theory.
- [166] Finally, Dr Webb said that he had also relied on the Carmichael 1 and Lake Galilee 1 well completion reports for the purposes of his reinterpretation of the geology of the area. The applicant submitted that the results of the well completion reports for Lake Galilee 1 and Carmichael 1 strongly reject Dr Webb's position, that in the area of the DS, there is a thin surface layer of Dunda Beds at surface overlying approximately 140 m of the Rewan Formation.
- [167] The well completion report for Lake Galilee 1 (which is located approximately 25 km from the DS) shows the following strata:



- (a) Surface clay (48 m thick)
- (b) Moolayember Formation (282 m thick)
- (c) Clematis Sandstone (204 m thick)
- (d) Rewan Formation (322 m thick) and
- (e) Unnamed upper Permian Unit (197 m).

[168] Carmichael 1 is located 30 km from the DS and the report from that bore shows the following geological strata:

- (a) Surface clay (49 m thick)
- (b) Moolayember Formation (221 m thick)
- (c) Clematis Sandstone (180 m thick)
- (d) Rewan Formation (339 m thick) and
- (e) Bandanna Formation/Colinlea Sandstone (157 m thick).

***Conclusions about the source aquifer of the DS***

[169] As is evident from the material set out above, lengthy and complex evidence and submissions were presented in relation to the issue of the source aquifer of the DS.

[170] The applicant adduced a great deal of evidence to show that the DS are sourced in the Clematis Sandstone and that it is extremely unlikely that there is faulting in the Rewan Formation sufficient to enable water from the Colinlea to be feeding the DS. I have accepted the evidence that the Rewan Formation is extremely thick in the area of the DS, that the hydraulic conductivity values of the Rewan are low and that the areas of higher conductivity are isolated and discrete.

[171] I have also accepted the applicant's evidence that bore holes in the Rewan Formation tend to close relatively quickly due to the swelling clays. Further, the evidence about the shale gouge ratio theory points strongly to the conclusion that it is highly unlikely that a fault facilitates significant groundwater flow through the Rewan. Similarly, the evidence in the April 2013 JORC Report and the ROM Report all show there being limited faulting in the mining lease area.

[172] It appears nevertheless that there has been no direct investigation by the applicant of the DSC area to gather further information about the likelihood of faulting in the area. In particular there has been no seismic testing and limited drilling. Further no faults were modelled in the applicant's conceptual model. The lack of modelling was noted by the IESC who say that the model would benefit from an assessment of regional faults. The applicant responded to that advice with additional information as to the general lack of faulting in the area.

[173] Given the exceptional ecological significance of the DSC (which is detailed further below) I consider that the lack of direct investigation or modelling is concerning.

- [174] There is evidence in the Velseis report of seismic data showing faulting of some 300 m in depth in the Rewan Formation in the mining lease area. In addition, Dr Webb's evidence was that the presence of the groundwater divide to the west of the lease area indicated unequivocally that recharge is occurring through the Rewan Formation. Figure 1 of the first groundwater joint report shows the groundwater heads and flow directions in the Colinlea Sandstone. Dr Webb said that the recharge to the Colinlea must mean that the Rewan is a leaky aquitard. Dr Werner's evidence supported this opinion. However, Mr Bradley was of the opinion that the groundwater flow in the Colinlea resulted from an increase in pressure of overlying water in the shallow level strata. And Mr Bradley and Dr Merrick said that the groundwater flow in the Bandanna/Colinlea aquifer could be provided by a lateral source.
- [175] There is evidence supporting both parties' position as to the likelihood of faulting in the Rewan Formation. On balance, I have come to the conclusion that the applicant's evidence and explanation is to be preferred because it seems to me to be unlikely that there could be a continuous preferential pathway through the Rewan Formation from the Colinlea Sandstone, given the thickness of the Rewan, its low permeability and the lack of evidence about any significant faulting. Nevertheless the first respondent's evidence and the lack of investigation and modelling of faulting has raised some doubt in my mind as to that conclusion. That doubt or uncertainty may warrant the application of the precautionary principle which is a topic I discuss below, under the heading "Conclusions about water objections".
- [176] There is also some uncertainty as to the discharge point(s) of the Colinlea. The applicant provided some possible explanations but there was no persuasive evidence.
- [177] I have accepted the applicant's submission that the evidence shows that the measurements at Bore C14012SP and the Shoemaker 1 bore point to the Clematis as the source aquifer of the DS. The logic of the applicant's analysis in this regard appears to me to be unanswerable. Further, I did not find the first respondent's evidence that the Shoemaker 1 bore shows that the Colinlea is either the sole source or one of the sources of the DS to be convincing. The first respondent relied on the unreliability of the head measurement at the Shoemaker 1 bore and the margin of error in the estimates and modelling to reach that conclusion. However that contradicts the evidence that ground level at Shoemaker 1 bore is 248 m AHD whereas the estimated head level in the Colinlea is [245] m AHD.
- [178] Contrary to the measurements at Bore C14012SP and the Shoemaker 1 bore, the evidence concerning the groundwater heads measured at HD02 does not point to the Clematis being the source aquifer of the Little Moses Spring at least. Mr Bradley attempted to say, nevertheless, that the Colinlea could still be the source aquifer. I did not find any of Mr

Bradley's explanations for that convincing. Accordingly, I consider that there is some uncertainty as to the source aquifer of the Little Moses Spring at least.

[179] I consider that the evidence about the hydrochemical analysis of the DS is inconclusive as to the source of the springs. The effect of the evidence is that either the Clematis or the Colinlea may be the source. However that does not mean that either is the source of the springs and there was nothing further in the evidence to lead me to conclude whether either of the two aquifers (or both) may be the source.

[180] Finally, I have concluded that I do not accept Dr Webb's reconceptualization of the regional geology. Specifically, I was not persuaded by Dr Webb's evidence that the pink radiometric imaging showed the Rewan outcropping in the area of the DS, because I found Mr Bradley's explanation to be equally possible. Similarly the evidence as to the interpretation of the Shoemaker 1 bore log data was also equivocal. There were equally convincing explanations from both parties as to how that data should be interpreted. While Dr Webb has used modern techniques to carry out his remapping, the evidence was that Dr Webb's work has not been peer reviewed nor published in any recognized scientific journal, and, therefore, it does not appear to have been accepted by any other expert.

[181] The applicant's mapping is based on work carried out in 1969 and 1972 by Vine et al, and a 1997 map by Habermehl and Lau. There has been a great deal of geological work in relation to the Carmichael mine and other large mining projects in the Galilee Basin. It appears that no-one other than Dr Webb has considered it necessary to reconceptualise the geology. The applicant's mapping has also been accepted by the regulatory authorities who have reviewed the applications.

### **Groundwater modelling**

[182] As reported in the SEIS, the applicant's groundwater model predicted maximum drawdown of groundwater of 0.19 m at Joshua Spring and between 0.05 m and 0.12 m at the various Moses Springs<sup>62</sup>.

[183] The first respondent submitted that the GHD numerical modelling under-estimated the drawdown at the DS because of the input choices made by the modellers about conductivity, recharge, discharge and storage values. Further, the first respondent said, two features had not been included in the model – the springs were not modelled and faulting or fracturing was not modelled. In addition, the calibration of the modelling was defective as was the uncertainty analysis applied in the modelling process.

[184] The first respondent said that because of the breadth and depth of the problems in the applicant's numerical modelling, Dr Werner had concluded that it could not be safely relied

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<sup>62</sup> AA010, Exhibit 19, Table 23.

on to predict the impacts of dewatering. Accordingly, the first respondent said, if the Court concludes that it cannot rely on the GHD model to predict impacts then it is left with a risk of complete loss of the Doongmabulla Springs which have exceptional ecological value, with no sound basis to assess what the level or probability of the impact will be. The mine cannot proceed on such a footing, at least not consistently with the precautionary principle, the first respondent submitted.

[185] Dr Merrick's evidence was that the model is sound and fit for purpose.

#### *Conductivity*

[186] Conductivity is a measure of the flow of water through a geological unit, with aquifers exhibiting a higher conductivity and aquitards exhibiting a lower conductivity. Each geological unit has characteristic horizontal conductivity and vertical conductivity. The model assumes that vertical conductivity is one-tenth of horizontal conductivity.

[187] Mr Bradley's evidence was that a vertical conductivity value of 0.01 m/day (i.e.  $1 \times 10^{-2}$  m/day) is typical of an aquitard and is an extremely low level of conductivity. A vertical conductivity value of 1.1 to 1.2 m/day is typical of an aquifer and is a comparatively high level of vertical conductivity.

[188] Lower vertical conductivity values, particularly for the Rewan Formation, will result in the model predicting less impacts on the DS, because the Rewan protects the overlying aquifers from the effect of mining. Dr Merrick's evidence was that lower conductivity values for the target aquifers, in particular the Colinlea Sandstone, would also result in the impacts at the DS being "muted", because this limited the propagation of dewatering defects.

[189] The modelling process adopted necessarily arrives at a single value for the conductivity of a unit, largely through the process of calibration. However Dr Merrick said that there are reasonable ranges of conductivity values for a given unit that can cross over orders of magnitude.

[190] The IESC raised the following concerns<sup>63</sup>:

"The current groundwater model assumes the Rewan Formation will respond uniformly as an aquitard. However, the Committee questions this assumption based on variability in the hydraulic conductivity field data. Further data collection and assessment of the Rewan Formation is necessary...

The proponent's field data needs to be further integrated into the groundwater model to establish an appropriate set of values and ranges for model layers, in particular hydraulic conductivity parameters for the Rewan Formation. Sensitivity analysis of the groundwater model confirms that the integrity of the Rewan Formation plays a critical role in controlling impacts to the GAB and the Doongmabulla Springs Complex. ...

Rewan Formation: On-site measurements of hydraulic conductivity values for the Rewan Formation ranged across several orders of magnitude, consistent with the

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<sup>63</sup> OL032, Exhibit 59 at 2-3.

variable lithology presented from drilling logs. These variations in local geology, including the potential for faulting, deep weathering or lateral gradation into the Warang Sandstone, may increase the permeability of the Rewan Formation. The implications of this contrasting behaviour for regional groundwater processes needs to be further explored.”

- [191] There is no on-site vertical conductivity data at Carmichael. Consequently the vertical conductivity values for the Rewan have been adopted on the basis of horizontal conductivity values and regional data. The first respondent submitted that this was inadequate given the importance of determining whether the Rewan will protect the overlying units and the DS from the effects of dewatering.
- [192] Further, the first respondent submitted, the horizontal conductivity value adopted in the modelling for the Colinlea Sandstone,  $7.38 \times 10^{-5}$  m/day, is below the minimum estimated site value as shown in SEIS Figure 32. There is also inconsistent reporting as to the sensitivity of the DS to the Rewan Formation conductivity, the first respondent said. The SEIS Report states that predicted impacts at DS are relatively insensitive whereas the SEIS Addendum report stated that predicted drawdown impacts are relatively sensitive to the modelled hydraulic conductivity of the Clematis Sandstone and Rewan group.
- [193] Moreover, the Response to Federal Approval Conditions, Table 8 (Adopted hydraulic conductivity values<sup>64</sup>) shows that the Colinlea Sandstone (which is combined with the coal in the D seam) in model layer 11 has been assigned a horizontal conductivity of  $1.00 \times 10^{-4}$  m/day (and therefore a vertical conductivity of  $1.00 \times 10^{-5}$  m/day). The first respondent submitted that it was not clear why the conductivity values of the Colinlea Sandstone in the EPBCA Response Report are an order of magnitude lower than the values shown in the SEIS Report.
- [194] The applicant submitted, and I accept, that Figure 32 in the SEIS does not show a conductivity value of  $1.00 \times 10^{-4}$  m/day for the Colinlea. Rather that figure was the value used in the applicant’s revised model carried out in response to the EPBCA approval conditions in October 2014.
- [195] Dr Merrick’s modelling of the Colinlea Sandstone for the Galilee Coal Project Assessment is  $1.3 \times 10^{-1}$  m/day<sup>65</sup>, that is, it is 1300 times more conductive than the SEIS Report. Similarly, the other Permian Units are given lower conductivity values in the SEIS Report. The first respondent submitted that these unexplained decisions by GHD have had the effect of reducing the predicted impact on the DS. Further, given that stopping the springs flowing requires a drawdown in the order of centimetres, these decisions are of central relevance.

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<sup>64</sup> Adopted conductivity values, Response to Federal Approval Conditions – Groundwater Flow Model – November 2014, AA036, Exhibit 68 at 44.

<sup>65</sup> Exhibit 80 at [26].

- [196] Accordingly, the first respondent submitted, conductivity is underestimated and unreliable. The first respondent also submitted that based only on the choice of very low conductivity values for the Rewan Formation, Dr Werner considered that a drawdown in the Clematis Sandstone of up to 1 m was plausible. And for the reasons discussed below, a drawdown at that level would cause most of the Doongmabulla Springs to run dry.
- [197] Dr Werner has drawn attention to some conductivity values that, he says, may lead to an underestimation in the modelling of the drawdown at the DS. I do not accept that the values adopted are too low. The values have been accepted in the SEIS and the values in the revised model have been accepted by the Commonwealth. Further the model was reviewed by an independent reviewer and accepted as fit for purpose as outlined below. The weight of the evidence therefore favours the values adopted by the applicant.

#### *Recharge*

- [198] The groundwater model adopts recharge rates of 0.1 to 1.1 mm per year.
- [199] The first respondent submitted that the recharge values adopted in the model are too low. Adopting lower recharge values leads to lower conductivity values which leads to prediction of lesser impacts, Dr Werner said. He also said that low recharge values may lead to underestimation of model inflows to the final void and that errors in recharge will translate to errors in the simulation of groundwater discharge to and impact on the Carmichael River.
- [200] Dr Merrick had originally said that the recharge values were at the low end of values and that in other models he had done elsewhere in the Galilee Basin he had used values ranging from 0.1 to 30 mm/year. Subsequently however he had become aware of tender documents issued by Geoscience Australia, whom he regarded as the experts in the field, which specified that an applicable recharge rate for the area of the proposed mine was 0.1 mm/year.
- [201] I have accepted that the recharge rates adopted in the model are reasonable, given that they are consistent with those adopted by Geoscience Australia. Further, it is noted that the rates were not criticized by Mr Middlemis, the independent reviewer. Mr Middlemis' review is discussed further below.

#### *Discharge*

- [202] The first respondent submitted that GHD's estimate of discharge was about half the actual discharge from the DS and that Dr Merrick had accepted that this would impact the choice of conductivity and recharge values in order to keep the model calibrated. Dr Merrick had based his original assessment of the model on an assumed discharge of 1.35 ML/day, based on GHD's 2012 assessment but he accepted the discharge estimates provided by Mr Wilson of 2.68ML/day. Further GHD had modelled 152 m<sup>3</sup>/day of extraction from bores which Dr Merrick conceded was not much and was subject to a huge error band. It also appears that

GHD had assumed that only 30% of the entitlement was being used whereas Dr Merrick would assume the full entitlement was being used unless he knew otherwise. In addition Dr Merrick was not sure but had the impression that the amount of extraction was attributable to licensed bores only and did not include registered bores which should have been taken into account.

[203] The first respondent submitted that the failure to properly consider discharge from bores added further uncertainty to the calibrated conductivity and recharge values.

#### *Storage*

[204] Storage properties are significant, said the first respondent, because they play an important role in the timing of impacts in that higher storage values lead to lower aquifer responses to mine induced drawdowns. They are particularly important in the timing of recovery of water levels after mining.

[205] Dr Werner's opinion was that the storage values applied in the model were not adequately justified and were lower than the values suggested by Todd and Mays (2005). Dr Merrick was critical of Dr Werner's reliance on storage values in Todd and Mays. He made clear that he placed no credence on text books as, he said, they are the refuge of academics.

#### *Failure to model certain features*

[206] No attempt was made by GHD to model the springs. Dr Werner said that the springs could have been modelled and if that had been done then the model could have generated information on spring flow. The approach taken by GHD was a blunt tool in comparison to modelling the springs, he said.

[207] The applicant's evidence was that springs are difficult to model and that the approach taken in the model was to use estimates of water drawdown to model spring impacts.

[208] That appears to be a reasonable approach and therefore, I do not consider the model to be defective for this reason.

[209] Faulting and fracturing have also not been modelled. Dr Merrick said, and the applicant submitted, that faulting or fracturing had not been modelled because it would be wrong to model a fault without any evidence of one. The first respondent submitted, however, that there was significant evidence of faulting from the data collected on the ML area.

[210] The evidence was that the applicant considered that the potential for faulting and the concerns of the IESC had been addressed by way of sensitivity analysis because in the SEIS Addendum, hydraulic conductivity values for the Rewan Formation of  $1 \times 10^{-2}$  m/day horizontally and  $1 \times 10^{-3}$  m/day vertically were assumed for the Rewan Formation, increasing post mining to  $1 \times 10^{-2}$  m/day horizontally and vertically in the area immediately overlying the underground mine workings. Dr Merrick said that that groundwater modelling assumed that

the Rewan will respond uniformly as a fractured sandstone aquifer, which was akin to assuming that the Rewan was heavily faulted and fractured throughout the area such that it ceased to function as an aquitard.

- [211] Hydraulic conductivity in the Rewan Formation of  $1 \times 10^{-3}$  m/day is highly unlikely, according to GHD. That value was chosen as it was the conductivity assigned by Audibert in 1976 who would have used very basic computing power<sup>66</sup>. GHD noted that such a vertical conductivity value is likely to match or exceed the hydraulic conductivity value that would be observed in a highly faulted Rewan Formation.
- [212] I have accepted the evidence that the use of a hydraulic conductivity value of  $1 \times 10^{-3}$  m/day is likely to exceed or match the hydraulic conductivity value that would be observed in a highly faulted Rewan Formation and therefore the model should not be criticized for failing to model faults.
- [213] Dr Werner took the view that a sensitivity value of  $1 \times 10^{-3}$  m/day was plausible. I am prepared to assume that this is the case, for the purpose of discussing this issue. The effect of such an assumption is, said GHD, that maximum impacts could be up to about a 1 m drawdown at the DS.
- [214] The applicant submitted that such a drawdown would not lead to a complete loss of the DS. While that may be correct, there is evidence, which is discussed further below, that a drawdown of a few centimetres would cause all the seep springs to cease flowing. The implications of a modelled drawdown of 1 m are discussed under the heading 'Impacts of mine on spring flow', below.

#### *Analysis of model uncertainty*

- [215] Uncertainty analysis is about understanding how good or otherwise a model is at predicting outcomes. The Australian Groundwater Guidelines published by the National Water Commission (June 2012) distinguished between sensitivity analysis and uncertainty analysis<sup>67</sup>:

“... uncertainty analysis builds upon, but is distinct from, sensitivity analysis. Whereas sensitivity simply evaluates how model outputs change in response to model input, uncertainty analysis is a more encompassing assessment of quality of model predictions. In uncertainty analysis, sensitivities of predictions to model parameters are combined with a statistical description of model error and parameter uncertainty. Thus, the uncertainty associated with a prediction depends on both the sensitivity of the prediction to changes in the model input, and on the uncertainty of the inputs, parameters, observations and conceptual model itself.”

- [216] The first respondent said that the sensitivity analysis taken by GHD was a simple perturbation of individual model parameters, one at a time. GHD had not done anything that permitted a

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<sup>66</sup> MR170.2, (SEIS Volume 4, Appendix K6, Mine Hydrogeology Report Addendum) at 36, 37.

<sup>67</sup> AA042, Exhibit 78 at 95.



statistical description of model error and what had been done with respect to parameter uncertainty was at the most basic and rudimentary level. Dr Werner said that the analysis and understanding of the uncertainty in model predictions was weak and that sensitivity analysis was not an adequate assessment of uncertainty in the model.

[217] Further, this approach to sensitivity analysis was applied in relation to conductivity such that although there are a number of model layers with similar or lower conductivity values than the Rewan Formation, an increase in the conductivity of any one of these at a time can have limited effect on the impact predictions. Perturbation increasing the conductivity of two parameters at the same time would increase the observed impact. The first respondent submitted that by assigning very low permeability values to the unit between the coal seam and the DS and then perturbing only one parameter at a time, GHD had taken an approach that could not be expected to usefully demonstrate the sensitivity of the model outputs and predicted impacts on the DS.

[218] The first respondent identified other failings in the analysis of model uncertainty. Figure 12 in the SEIS addendum<sup>68</sup> shows that some of the results are off the function line. Dr Merrick agreed that this was the case and said that in his view this indicated that the modellers had not used the exact base model when they perturbed it. He thought there must have been some variation in the base model without the modellers realising it.

[219] Further, Figure 14 in the same report<sup>69</sup>, which shows the sensitivity analysis on the final void, indicates that a number of simulations did not converge which, Dr Merrick said, showed a water balance error, a mathematical error. In his view if the errors were significant then those runs should be thrown away.

[220] Type I – Type IV analysis involves plotting the outputs of a sensitivity analysis within four quadrants which assign Type I to Type IV sensitivity. The first respondent was critical of the Type I-IV analysis carried out in the model on the basis that the model will readily calibrate a Type IV parameter to a range of different values, but the value ultimately used in the predictive model will have a major effect on the accuracy of the impact prediction. Dr Werner was concerned that the placement of the lines in the quadrant that effectively determine the sensitivity type had been applied in such a way as to avoid demonstrating any Type IV sensitivity.

[221] Dr Merrick said that what GHD had done could be described as statistical prediction parameter certainty but it could not and had not been used to attempt to assign a probability, a quantitative estimated prediction of uncertainty. While the 2012 Water Commission Guidelines identified quantitative estimates of prediction uncertainty as a method that could

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<sup>68</sup> MR170.2 SEIS Volume 4, Appendix K6, Mine Hydrogeology Report Addendum at 32.

<sup>69</sup> At 34.

be used for carrying out uncertainty analysis, in Dr Merrick's view that was too computationally demanding to get to a point of describing probabilities that have any meaning.

[222] While the IESC said that such an analysis should be carried out in relation to mining applications, Dr Merrick said that full uncertainty analysis just never happens. The IESC's expectations are aspirational. They are beyond what he had done and what should be done in developments of this sort. Dr Merrick said that a judgment could be made about risk without having a probability distribution.

[223] The first respondent submitted that ultimately the evidence demonstrated that neither the Court nor any other decision-maker could properly understand the likelihood of the modelled predictions being correct, because the analysis simply had not been done. The fact that it is not industry practice to carry out such analysis, does not, the first respondent submitted, provide a proper basis to excuse inadequate impact assessment. Nor should it be allowed to effect the quality of decision-making on a project with such significant potential groundwater impacts.

#### *Calibration*

[224] In the context of the groundwater model, calibration refers to the process by which the inputs into the model are adjusted to produce the best match between results projected by the model and actual observed data.

[225] The model has been subjected to steady state calibration but not transient calibration. A steady state calibration assumes that the inputs remain constant over time (eg rainfall). A transient calibration adjusts the values of the inputs in different time periods (eg different rainfall each month).

[226] The first respondent criticized a number of aspects of the calibration of the applicant's numerical model. The first respondent said that the absence of transient calibration meant that there was no corroboration of storage parameters in the model and no independent assessment of rainfall recharge. According to the 2012 Water Commission guidelines, it appears that the model is a Class 1 (low confidence) model. To be Class 2 (medium confidence) the model should have undergone transient calibration to at least some extent. For the purpose of evaluation and management of potentially high risk, the model should be heading towards class 3, the first respondent said.

[227] There was an issue between the modelling experts as to the availability of data to form the basis of transient calibration, Dr Merrick saying that there was limited data available at the time the earlier modelling was done but transient calibration could have been done in respect of one bore. Only limited data was available, he said, because mining has not commenced, so

that there has been insufficient time to collect data to enable transient calibration to be performed. Dr Werner said that a few bores with transient records would usually provide useful insights to a transient calibration attempt.

[228] The Coordinator-General has required, as a condition of the EA, that the applicant undertake transient calibration within two years of commencement of box cut. A further groundwater model incorporating the results of transient calibration is subject to approval by the administering authority. On that basis Dr Merrick was unconcerned about the lack of transient calibration at this stage. Dr Werner considered that to do that modelling two years after mining starts, raised a very large red flag.

#### *Automated calibration*

[229] The model uses the parameter estimation software (PEST). GHD said that the use of PEST was automated and therefore objective<sup>70</sup>. Dr Werner said that it would be wrong to rely completely on an automatic process without oversight and intuition and involvement of the modeller.

[230] The evidence as to the adequacy of the uncertainty modelling and calibration was complex and there were persuasive reasons given by the experts for each of the parties in support of their position. In the end, I have come to the conclusion that the uncertainty analysis and calibration adopted in the model should be accepted as adequate because that was the conclusion reached by the independent reviewer, Mr Middlemis. Mr Middlemis' conclusions are set out below.

#### *Peer review*

[231] Conditions 22 and 23 of the Commonwealth EPBCA approval required the applicant to undertake an independent peer review of the adequacy of the groundwater flow model to characterize groundwater impacts, with consideration of the parameters used in the groundwater flow model, the required additional modelling information and the model reruns outlined in Condition 23.

[232] That review was carried out by Mr Hugh Middlemis of Hydrogeologic Pty Ltd. Mr Middlemis' report was in evidence<sup>71</sup> but Mr Middlemis was not called to give evidence.

[233] Mr Middlemis concluded that<sup>72</sup>:

“The review process did not identify any material weaknesses in the model design, boundary conditions, parameter values or calibration performance. The exploration of model uncertainty in conceptual and parameter value terms is commendable and the results indicate low sensitivity/uncertainty. It is my professional opinion ... the revised model design and performance is consistent with guidelines and suitable as is for impact

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<sup>70</sup> MR167, SEIS, Volume 4, Appendix K1, Mine Hydrogeology Report.

<sup>71</sup> AA010, Exhibit 19, Exhibit NPM2 to affidavit of Dr Merrick.

<sup>72</sup> At p 1 of Mr Middlemis' report.

assessment purposes, with future model refinements dependent on monitoring to obtain data for validation.”

[234] The first respondent submitted that the Middlemis review should be given very little weight because Mr Middlemis was not involved in the conclave process and his opinions were not scrutinized under cross-examination. Further Mr Middlemis appeared to have overlooked or failed to recognize all the issues brought to the Court’s attention by Dr Merrick and Dr Werner.

[235] I do not accept that submission. Although Dr Werner was critical of Mr Middlemis’ review, I do not consider that Mr Middlemis’ review was effectively challenged at the hearing and I have no reason to doubt his conclusions. I have formed the view therefore that that review, which is the work of an independent peer reviewer, provides persuasive evidence that the model is fit for purpose.

### **Impacts of mine on spring flow**

[236] As noted above, the SEIS model predicted maximum drawdowns of groundwater of 0.19 m at Joshua Spring and from less than 0.05 m to 0.12 m at the Moses Springs<sup>73</sup>.

[237] Dr Merrick assessed the potential reduction in spring flow as follows:

- spring flow rate would reduce in the same proportion as drawdown to the driving head;
- for substantial drawdown, flow would cease abruptly when a geomorphic threshold is reached;
- flow reductions are most unlikely to exceed 10% at the Doongmabulla Springs; and
- flow reductions are more likely to be in the 3% to 5% range at the Doongmabulla Springs.

[238] While Dr Werner did not disagree with the equation that Dr Merrick had used to calculate the reduction in spring flow, the evidence on this issue was obscured by the fact that the experts did not agree on the inputs to be used to calculate the impact of the drawdown. Their conclusions therefore were very different from one another. Dr Merrick differed from Dr Werner as to what the relevant driving head difference is for any given spring. Dr Merrick considered that the relevant measure was the head difference between the water table and the artesian head which drives the spring flow. Dr Werner considered the relevant measure to be the difference between the artesian head driving flow at each spring and the geomorphic threshold of that spring. It was common ground that the geomorphic threshold can be seen as the point at which water stops flowing over the rim of a bathtub or the top of a container. Nevertheless it appears that Dr Merrick and Dr Werner were in agreement about the practical

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<sup>73</sup> AA010, Exhibit 19, Table 23.

outcome of the spring flow assessment. They agreed that spring flow will stop when the artesian head of a spring drops to the level of a geomorphic threshold.

[239] Dr Merrick's evidence was that the baseflow as occurring near the springs had been modelled. Given that baseflow represents groundwater discharge the modelling of baseflow is a surrogate for modelling impacts on spring flow, he said.

[240] Dr Werner said that the use of the watertable head (2-3 m below ground surface) was incorrect. He considered that the head difference (source aquifer head minus spring water level head) is probably much smaller than that suggested by Dr Merrick, because the heads at the springs are higher than 2-3 m below ground surface. Hence the springs are much more susceptible to drawdown impacts i.e. the driving head difference is much smaller than the figure used by Dr Merrick and therefore the relative reduction in flow is much larger.

[241] The first respondent submitted therefore that the two necessary pieces of information required to determine what amount of drawdown will cause each of the springs to stop flowing are: (a) the level of the geomorphic threshold for each spring; and (b) the artesian head at each spring. The first respondent also submitted that given the range of spring types that comprise the Doongmabulla Springs there are different geomorphic thresholds:

- (a) at Joshua Spring, the geomorphic threshold is the discharge pipe;
- (b) for a mound spring, the geomorphic threshold is the top of the mound;
- (c) for seeps coming out at ground level, the geomorphic threshold is ground level.

[242] The first respondent said that the potentiometric heads at the individual springs were not known, except to the extent that they are at least at ground surface because if they were not, there would be no spring. The artesian head at each spring will be different and Dr Fensham's evidence was that measuring the heads at different springs is difficult. However Dr Merrick believed that the head at the seep springs at the DS is only a matter of centimetres from the ground. Accordingly, he agreed that if the drawdown were of the order of 5 cm, he would expect that the seeps would dry up.

[243] The percentages in Dr Merrick's spring flow assessment, the first respondent submitted, are not percentages of the drawdown necessary to cause the springs to stop flowing. Instead they are percentages of the reduction necessary to stop water moving upwards from the Clematis Sandstone to the overlying unit. All of the springs will have stopped flowing well before that point is reached, the first respondent submitted.

[244] The applicant submitted that, before the drawdown drops the potentiometric head below the geomorphic threshold, spring flow will reduce at the same rate as the diffuse upflow from the Clematis to the Moolayember.

[245] I have not accepted Dr Werner's evidence that the relevant measure to be used in the equation to calculate the reduction in spring flow is the difference between the artesian head driving flow at each spring and the geomorphic threshold of that spring. It appears to me to be logical that the spring flow would be proportionate to the upflow until the drawdown caused by head difference causes the artesian head to match a geomorphic threshold. Accordingly, I have accepted Dr Merrick's calculations as to the potential reduction in spring flow caused by drawdown.

### **Proposed environmental conditions relevant to the Doongmabulla Springs**

[246] The applicant says, in general terms, that the draft EA conditions adequately protect against harm to the DS as a result of mining activities. Similarly the conditions attached to the EPBCA approval provide that the risk of environmental harm to the springs will be comprehensively managed.

[247] The first respondent submitted that neither set of conditions adequately dealt with the environmental harm likely to be caused by the mine.

### ***Draft Environmental Authority conditions***

#### ***Groundwater***

[248] Condition E3 of the draft EA provides:

#### **Baseline Monitoring Program**

A baseline groundwater monitoring program must be developed and certified by an appropriately qualified person and implemented by the holder of this environmental authority no later than *<insert 4 months from the issuance of the EA>*. The program must be made available to the administering authority on request. The baseline groundwater monitoring program must result in the holder of this environmental authority finalising a groundwater dataset that must be provided to the administering authority at least 30 days prior to commencing any mining activities associated with box cut excavation. The groundwater dataset must:

- a) contain representative groundwater quality samples from the geological units identified as potentially affected by mining activities including Quarternary alluvium, Tertiary sediments, Bandanna Formation, Colinlea Sandstone, Clematis Sandstone, Rewan Formation, Dunda Beds, and Early Permian sediments.
- b) include at least 12 sampling events that are no more than 2 months apart over a 2 year period, so as to determine background groundwater quality;
- c) include background groundwater quality in hydraulically isolated background bore(s); and
- d) allow for the identification of natural groundwater level trends and groundwater contaminant trigger levels.

[249] Condition E4 provides:

#### **Groundwater Management and Monitoring Program**

A Groundwater Management and Monitoring Program must be developed and certified by an appropriately qualified person which addresses all phases of the mining operation approved under this environmental authority. The groundwater management and monitoring program must be provided to the administering authority for approval with the baseline monitoring program in condition E3. The groundwater management and

monitoring program must be developed to ensure that the plan meets the following objectives:

- a) Validation of groundwater numerical model (including review of boundary and recharge conditions) to refine and confirm accuracy of groundwater impacts predicted;
- b) Groundwater level monitoring in all identified geological units present across and adjacent to the mine site to confirm existing groundwater flow patterns and monitor drawdown impacts;
- c) Identification of groundwater drawdown level thresholds for monitoring the impacts to Groundwater Dependant Ecosystems (including spring complexes and Carmichael River alluvium);
- d) Monitoring of aquifers in the area to the south of the mining lease that may affect the Mellaluka springs;
- e) Identify and refine potential impacts on groundwater levels in the Great Artesian Basin Clematis Sandstone and Dunda Beds geological units;
- f) Estimation of groundwater inflow to mine workings and surface water ingress to groundwater from flooding events using the groundwater model;
- g) Monitoring in any identified source aquifers for alternative water supplies, relevant to any approval issued under the Water Act 2000 for the project;
- h) Monitoring of geological units throughout all phases of project life including for the period post-closure in accordance with Appendix 1;
- i) Identifying monitoring bores that will be replaced due to mining activities; and
- j) To ensure all potential groundwater impacts from mine dewatering and mine water and waste storage facilities (artificial recharge) are identified, mitigated and monitored.

[250] The applicant submitted that condition E4 ensures that the applicant's Groundwater Management and Monitoring Program (GMMP) will ensure that dewatering of the springs, no matter what their source aquifer and whether or not such dewatering is contributed to by faulting or similar features through the Rewan Formation, will be monitored and appropriately mitigated.

[251] The first respondent submitted that a number of aspects of Condition E4 undermined any confidence there may be in the condition's capacity to address substantive issues with the groundwater impact assessment or the impacts themselves:

- (a) The GMMP must be provided to the administering authority for approval at least 30 days prior to commencement of any activities associated with box cut excavation. However, the first respondent said, the condition gives no indication of:
  - (i) when any of the listed objectives proposed to be achieved under the GMMP are supposed to be achieved;
  - (ii) when any of the presently undefined actions to achieve these objectives will be undertaken.
- (b) The lack of clarity around the plan contemplated by the GMMP is concerning.
- (c) A number of objectives to be achieved under the GMMP are fundamental to understanding the extent of the mine's impacts particularly on the DS, and should have been dealt with in the impact assessment process. In particular:

- (i) the requirement for monitoring to understand groundwater flow patterns;
  - (ii) the requirement to identify groundwater drawdown level thresholds for monitoring the impacts to the DS; and
  - (iii) the requirement to identify and refine potential impacts on groundwater levels in the GAB.
- (d) The requirement to “ensure all potential groundwater impacts ... are identified, mitigated and monitored” is aspirational and nonspecific:
- (i) such impacts should have already been identified such that they could be considered in the impact assessment and by this Court;
  - (ii) there is a baseless assumption that any presently unidentified impacts can be mitigated. The evidence is that any substantial drawdown impacts on the DS cannot be mitigated.
- (e) The mere existence of condition E4 does not ensure an outcome as suggested by the applicant. It requires that the GMMP be developed to ensure that some undefined plan achieves certain outcomes. It is questionable whether those objectives are in fact achievable.
- (f) More generally such an ill-defined plan should not be considered the appropriate instrument to identify all potential groundwater impacts. Groundwater impacts must be identified before a proper assessment can be made and an approval granted.

[252] Condition E6 in the draft EA provides:

**Groundwater Model Review**

The numerical groundwater model in the reports titled “Carmichael Coal Mine and Rail Project SEIS: Report for Mine Hydrogeology Report (13 November 2013)” and “Carmichael Coal Mine and Rail Project SEIS: Mine Hydrogeology Report Addendum (24 October 2013)” must be reviewed to incorporate groundwater monitoring data and measured mine dewatering volumes from the Groundwater Management and Monitoring Program in condition E4 and E5. The review must be conducted within two years of commencement of any mining activities associated with box cut excavation and at least every 5 years thereafter, or at other intervals specified by the administering authority in writing, if the observed groundwater levels and groundwater flow rates to surface water are not consistent with those predicted by the groundwater model.

The review must provide a revised numerical groundwater model which is based on a transient calibration and includes additional model layers for aquifers below the D seam of the Colinlea Sandstone. The revised model must include:

- a) Review of the hydrogeological conceptualisation used in the previous model;
- b) An update of the predicted impacts;
- c) Revised water balance model;
- d) Review of assumptions used in the previous model
- e) Predictions of changes in groundwater levels for a range of scenarios;
- f) Information about any changes made since the previous model review, including data changes;
- g) A report outlining the justification for the refined model and the outputs of the refined model;
- h) An evaluation of the accuracy of the predicted changes in groundwater levels, groundwater flow rates to surface water and recommended actions to improve the accuracy of the model predictions.



[253] Condition E7 is as follows:

A report outlining the findings and any recommendations from the review under condition E6 must be completed by an appropriately qualified person and submitted to the administering authority for approval no later than 3 months after the commencement of the model review.

[254] The first respondent submitted that a review of the primary predictive model for the assessment of groundwater impacts two years after box cut excavation has commenced cannot sensibly be considered a substitute for adequate impact assessment in the first instance. Dr Werner's evidence was that to conduct a review two years after mining starts, raised a very large red flag before him. The first respondent submitted that the model review may ultimately be a process of demonstrating how much the impacts will be after it is too late to address them.

[255] The applicant submitted that draft conditions E6 and E7 ensure that if the actual impacts on the springs vary from predicted impacts, then the administering authority must approve the recommendations to deal with that variance. This will ensure that the administering authority will be able to control the responses taken if that scenario occurs. The applicant submitted that this adaptive management approach satisfies any application of the precautionary principle with respect to protection of the DS.

[256] Table E3 in the draft EA proposes groundwater monitoring locations at sites to be identified. The table will set out groundwater level thresholds at each of the sites. Draft condition E13 requires the applicant to monitor groundwater level fluctuations such that, the applicant said, if it becomes apparent, as a result of mining, that the groundwater levels are being drawn down to a greater extent than is predicted in the groundwater model, the applicant must notify the administering authority and propose actions to reduce environmental harm under condition E14.

[257] Schedule I to the draft EA deals with offsets and biodiversity. Condition I8 requires the proponent to develop and implement a Groundwater Dependent Ecosystems Management Plan (GDEMP) to detail the management of threats to defined environmental values and to report results and corrective actions for each GDE over the full period of mining activities and for a period of five years post mining rehabilitation. The GDEMP must be approved by the administering authority (Condition I9). The GDEs identified in Condition I10 include the Doongmabulla Springs.

### ***EPBCA Approval Conditions***

[258] As noted above the applicant also relies on conditions that have been imposed under the approval issued under the EPBCA to deal with impacts of the mine.

*Condition 23 – groundwater model rerun*

- [259] Condition 23 of the EPBCA approval requires the approval holder to rerun the groundwater flow model on certain specified parameters and to address additional information requirements.
- [260] By consent, the applicant tendered a letter from the Commonwealth Department of the Environment dated 17 April 2015 which letter said that the Department had reviewed the model rerun and found it to have met the requirements of condition 23<sup>74</sup>.
- [261] The first respondent submitted that significant concerns remain about the issues identified in condition 23 which raised the question of how the Commonwealth Department of the Environment could have approved the model given the current state of knowledge. Counsel for the first respondent said that the letter demonstrates the problems about post-approval process. In particular, there is unequivocal evidence that no attempt was made to model the DS yet the Commonwealth Department of the Environment appears to have been satisfied that the applicant has documented these non-existent model outflow mechanisms.
- [262] The first respondent submitted that it was of major concern that a further Government review and approval had been given without any apparent consideration of the fundamental problems identified by the groundwater expert witnesses in this case.

*Conditions 27 and 28 – Rewan Formation connectivity research plan*

- [263] Condition 27 of the EPBCA approval requires the applicant to submit for approval of the Minister, a Rewan Formation connectivity research plan at least 3 months prior to commencing excavation of the first box cut. That plan must, amongst other matters, address methods to determine the type, extent and location of fracturing, faulting and preferential pathways (including any fracturing induced by long wall mining subsidence and also including any fracturing impacting on the DSC), and an examination of the hydraulic properties of the Rewan Formation, to better characterize the Formation and the contribution of fracturing, faulting and preferential pathways to connectivity. The plan must be peer reviewed. The plan must be approved by the Minister in writing before the applicant commences excavation of the first box cut.
- [264] The applicant submitted that this condition adequately guards against any risk that could arise from there being any preferential pathways or conduits through the Rewan Formation that would allow dewatering of the coal bearing sequences to affect the DS.
- [265] The first respondent submitted that the conditions require only that the Minister approve the Rewan research plan before the box cut commences, they do not give any indication that these investigations will be complete within any particular timeframe. Further the conditions

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<sup>74</sup> AA070, Exhibit 139.

allow for mining to commence after the plan is approved, which implies that the investigations required to be conducted under the plan will not be complete until some time after mining commences and impacts on the DS may already have been realized. The first respondent submitted that this approach was inappropriate and ineffective in this case where there is a real likelihood of environmental harm before the necessary investigations can be made.

### **Conclusions about groundwater objections**

[266] I concluded above, after considering the evidence as to the source aquifer of the DS, that I was concerned at the lack of direct investigation by the applicant of the area of the DS to determine the likelihood of faulting in the area. While I considered that on balance, it is unlikely that there was a continuous preferential pathway from the Colinlea Sandstone through the Rewan Formation, there was evidence to the contrary which raised some uncertainty as to the existence of faulting. There was also uncertainty as to the source aquifer of at least the Little Moses Spring and Dr Webb's evidence about the groundwater flow directions in the Colinlea Sandstone also raised further uncertainty as to the source aquifer of the DS.

[267] As the DSC has exceptional ecological value I consider that the precautionary principle should be applied as discussed above in *Telstra Corporation v Hornsby Shire Council*<sup>75</sup>. It is clear that, if the source aquifer for the DS is below the Rewan Formation in the Colinlea Sandstone, the DS will be lost as a consequence of dewatering caused by the mining operation. There is thus a threat of serious environmental damage. However there is scientific uncertainty as to environmental damage because it is by no means certain that the Colinlea Sandstone is the source of the DS.

[268] Application of the precautionary principle means that a decision maker must assume that the threat of serious environmental damage is a reality and therefore preventative measures should be taken to prevent environmental damage. This does not necessarily mean that the applications for mining leases and an environmental authority should be refused. Rather, this is a case where it is considered that the adoption of an adaptive management approach is warranted. Preston CJ said, in *Telstra*, such an approach might involve the following core elements<sup>76</sup>:

- monitoring impacts of management or decisions based on agreed indicators;
- promoting research to reduce any uncertainties;

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<sup>75</sup> (2006) NSWLR 256.

<sup>76</sup> At [164].

- ensuring periodic evaluation of the outcomes of implementation, drawing lessons and review or adjustments of the measures or decisions adopted;
- establishing an efficient and effective compliance system.

[269] As indicated above, the mining operation will be subject to a number of conditions as set out in the draft EA and the EPBCA approval. Relevantly, condition E4 in the draft EA requires that the applicant's GMMP must:

- monitor groundwater levels in all identified geographical units present across and adjacent to the mine site to confirm existing groundwater flow patterns and monitor drawdown impacts.
- identify groundwater drawdown level thresholds for GDEs including spring complexes and the Carmichael River alluvium; and
- ensure all potential groundwater impacts from mine dewatering are identified, mitigated or monitored.

[270] The first respondent was critical of these conditions on the basis that no timeframe was included as to when the objectives to be achieved under the GMMP were to be advised; the level of clarity around the GMMP; and because the requirements were aspirational and non specific.

[271] I do not accept the first respondent's criticisms of these conditions. The GMMP must be provided to the administering authority for approval. The conditions about the GMMP will ensure that dewatering of the Springs will be appropriately monitored and mitigated. I consider that the conditions represent aspects of the adaptive management approach referred to in *Telstra*. Further, condition E4 is reinforced and supported by conditions E6 and E7 which also provide that the groundwater model must be reviewed to incorporate groundwater monitoring data and measured mine dewatering values. The model must also be revised to incorporate features specified in condition E6.

[272] Similarly, Condition 23 of the EPBCA approval requires that the groundwater flow model be rerun as specified. That has occurred and the rerun has been accepted by the Commonwealth Department of the Environment.

[273] I also consider that Conditions 27 and 28 of the EPBCA approval directly address my concerns as to the possibility that the Colinlea may be the source aquifer of the DS. Those conditions require the applicant to submit for approval of the Minister a Rewan Formation connectivity research plan. The plan must address methods to determine the type and location of fracturing, faulting and preferential pathways, including any fracturing impacting on the DSC.

[274] Again I consider that that condition is an example of the application of an adaptive management plan and it is appropriate in the circumstances.

[275] There remains the possibility that despite all the regulatory conditions, there will be permanent and irreversible damage to the DS caused by the mining operation. I will consider the implications of that possibility when discussing my recommendations at the end of this decision.

### **Springs Ecology - the Doongmabulla Springs and the Mellaluka Springs**

[276] Mr Bruce Wilson, a senior ecologist with Eco Logical Australia Pty Ltd, was called by the applicant to give evidence in relation to the ecology of the springs. Mr Wilson is an ecologist with over 25 years experience in the management and delivery of major vegetation survey, mapping, monitoring, research and assessment projects across Queensland and the Northern Territory.

[277] Dr Roderick Fensham was called by the first respondent. Dr Fensham is a principal botanist at the Queensland Herbarium, Department of Science Information and Technology Innovation. Dr Fensham has extensive research and publication experience, extending over a period of 25 years, particularly in relation to springs and springs ecology.

#### ***Mellaluka Springs***

[278] The experts agreed that the Mellaluka Springs do not support vegetation of exceptional ecological value. They agreed that if the proposed mine leads to the permanent drying of the Mellaluka Springs, the springs' ecological values will be lost. Mr Wilson said, however, that the loss of some ecological values of the Mellaluka Springs could be mitigated in some circumstances, for example by the provision of permanent water for target fauna species.

#### ***Doongmabulla Springs***

[279] Mr Wilson and Dr Fensham prepared a joint report in which they agreed that the DSC has exceptional ecological values<sup>77</sup>. The springs complex supports numerous spring wetlands with a large area (10.3 ha) of permanent or near permanent wetlands.

[280] Mr Wilson and Dr Fensham also agreed that there are a large number of plant species endemic to the Great Artesian Basin (GAB) spring wetland. Of the 6 such species they identified at the Doongmabulla Springs, Mr Wilson said that two are listed by the Commonwealth and the State as threatened species and three more are listed at State level. One is not listed yet because, he thought, it has not been described properly.

[281] Mr Wilson and Dr Fensham also agreed that the DS support a community of native species dependent on natural discharge of groundwater from the GAB Spring Wetlands which is listed as an endangered threatened ecological community under the EPBCA. The springs are

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<sup>77</sup> JR005, Exhibit 21.

therefore considered a Matter of National Environmental Significance (MNES) and have been dealt with as such in the current EIS and subsequent approvals. Mr Wilson said that the DS represent 13% of the threatened ecological community in Queensland.

- [282] The experts noted that the debate between the groundwater experts as to the source aquifer for the DS has implications for the listing of the DS as a GAB spring wetland under the EPBC. Aquifers below the Rewan Formation are classified as Galilee rather than Great Artesian Basin aquifers and therefore may not meet the definition of threatened ecological community in the listing advice or recovery plan.
- [283] Nevertheless, Mr Wilson said, even if the DS were no longer a MNES (because it is sourced in the Galilee Basin rather than the GAB), the ecological community would be a matter of State environmental significance which means it would still have to be offset. However, the offset provisions would not be as onerous as they would not be restricted to GAB springs. Even so, there were very limited opportunities to offset the DS.
- [284] The first respondent submitted that the exceptional ecological values of the springs were independent of the listing as a GAB threatened ecological community.
- [285] Mr Wilson and Dr Fensham agreed that if the DS dry either permanently or temporarily, the endemic species would not survive and would become extinct from the site. They also agreed that reductions in the flow rate of the springs would reduce the extent of the wetlands associated with the DS. The extent of impact on the ecology of endemic species was very difficult to predict. However, the endemic plant species can survive on spring wetlands much smaller than the largest spring wetlands at Doongmabulla, as demonstrated by their existence on small spring wetlands at Doongmabulla and elsewhere.
- [286] Mr Wilson accepted that the Moses group is in good condition and pretty well free from exotic species and said that Moses is the important group as far as conservation values go. Little Moses is different, not having the assemblage of endemic species, and Joshua is heavily impacted with exotic species. However both Joshua and Little Moses have wetland values.
- [287] Mr Wilson and Dr Fensham agreed that assessing the impact on ecological values of the DSC requires an assessment of the predicted change in flow rates caused by the mining operation. Such a report was subsequently provided by Dr Merrick<sup>78</sup>.
- [288] Mr Wilson said that, relying on the assessment of the potential reduction in spring flow at DS by Dr Merrick, flow reductions are most unlikely to exceed 10% and are more likely to be in the 3-5% range of the DS. On that basis Mr Wilson considered that, as measured by the extent of the associated wetlands, there was unlikely to be a reduction in the ecological values at the DS greater than about 0.7 ha (7.2% of the total area). The reduction was more likely to

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<sup>78</sup> AA010, Exhibit 19.

be between about 0.2 ha (2.1% of total area) and 0.4 ha (3.6% of total area). Mr Wilson said that this was not a substantial reduction in area and no endemic species would be lost from the site.

[289] If the impacts are as predicted by Dr Merrick, the likely loss of wetland would not be substantial, Mr Wilson said, and could be readily offset by the implementation of appropriate management at appropriate GAB springs including:

- establishment of appropriate fencing including the option to regulate stock use rather than exclude stock;
- control of feral animals;
- eradication of exotic plants from springs and ensuring no further deliberate introductions of exotic species occur;
- monitoring of populations of endemic species and understanding their ecology and biology.

[290] Dr Fensham said, in relation to Dr Merrick's assessment of a reduction in flow in the springs in the range of 3-5%, that

- a 3% decline in spring flows would result in an overall decline in wetland area from about 7.85 to 7.68 ha;
- a 5% reduction would result in an overall decline to about 7.57 ha; and
- the number of springs may be reduced with the disappearance of some small vents.

[291] However, Dr Fensham said, the most important values of the springs in terms of biological conservation, namely the persistence of viable populations would almost certainly be maintained under this scenario.

[292] If the springs dry up completely, the spring wetlands will be lost and all spring-dependent species, including the rare plant species endemic to the wetlands will be eradicated.

[293] As set out in more detail below the draft EA requires the applicant to provide an offset for impacts on state significant biodiversity values. The EPBCA approval also requires the applicant to submit a Biodiversity Offset Strategy (BOS) for approval.

[294] Mr Wilson and Dr Fensham agreed that the most effective contribution for offsetting the loss of values at the DS may include investment in recovery actions to address conservation problems at springs in other locations.

[295] Dr Fensham was of the opinion that it was not feasible to offset the complete loss of the DSC effectively because:

- a. enhancing existing values of other springs is not an effective offset for the loss of the exceptional values of the entire complex at the DS; and
- b. the circumstances necessary to reconstruct the hydrological, chemical and biological values at additional artificial springs are unavailable.

- [296] Mr Wilson said that enhancing existing values of other springs is unlikely to provide an effective offset for the loss of exceptional values of the entire complex at DS, because it would be hard to find the area of suitable existing springs required. There are six species at DS that are not found in any great numbers elsewhere so that in practical terms an equivalent area could not be found. Reconstructing artificial springs that are totally equivalent to all the values of the DS is not possible, he said. However enhancing existing values at another spring site may be able to provide equivalent values that could be used to offset specified impacts at the DS. If there were a real potential for severe drawdown, it would be necessary to look at the option of creating artificial wetlands. For example, the artificial habitat provided by flowing bores may be suitable for endemic springs species, because the *myriophyllum* artesian does survive in those conditions. This has never been tried and it is not a proven solution.
- [297] Although Mr Wilson considered that offsetting the loss of the entire DS would be difficult, he considered that specified individual values at the DS such as the loss of a particular endemic species could be offset by enhancing values at another spring with the same values, such as the same endemic species. However it might still be difficult, he said, to find enough different areas with equivalent values to offset the entire DS. Of the 56 endemic species identified at the DS, he thought that in the case of *myriophyllum* and *criocaulon*, 50% could be offset immediately because bore drains could be used. About 30% of the other species could be offset as they are confined to Threatened Ecological Communities elsewhere.
- [298] Mr Wilson also considered that the loss of large areas of springs could be offset by the rehabilitation of springs that are extinct or where flows have been depleted by returning GAB water to areas adjacent to springs. However he was unsure if this strategy could rehabilitate enough areas of GAB springs with equivalent values to offset large areas of the DSC. Mr Wilson said that this action was partly addressed by the EPBCA approval (Condition 11(b)) which requires the implementation of a GAB offset measure of returning at least 730 ML of water per year to the GAB which is to achieve measurable outcomes including the protection and rehabilitation of GAB springs.
- [299] Dr Fensham considered that the historical record was instructive in responding to Mr Wilson's opinion that specified impacts could be offset. Dr Fensham said that a comparison of the current and historical status of GAB springs suggests that when such springs decline in flow in response to reduced aquifer pressure they are far more likely to suffer major than minor impacts. However, he said, there are also areas in the GAB where there have been substantial declines in aquifer pressure and there is no evidence of substantial declines in spring flows.



### ***Draft EA conditions***

- [300] The draft EA contains various conditions relevant to the potential impact of the mine on the springs ecology. That framework includes the conditions referred to above – the development of a base line groundwater monitoring program (E3), ongoing groundwater management, monitoring and assessment (E4) and the specification of trigger points (E9). The trigger points include measures of water drawdown that will initiate investigation, mitigation and offsetting procedures (E11 – E 14).
- [301] Condition I1 requires that the applicant must provide an offset for impacts on applicable state significant biodiversity values in accordance with the mine project BOS. In addition, a Groundwater Dependent Ecosystems Management Plan (GDEMP) must be developed (I8) which will include the DS (I10). The GDEMP must include an assessment of base line monitoring levels (E9) and trigger levels (E13) and a description of any correction actions required including mitigation and offsets (I11). Condition I4 requires the BOS for the project to be updated if the investigations under E13-E14 indicate that additional offsets are required to address significant impacts to the DS that have not been previously identified in the BOS for the project.
- [302] Mr Wilson considered that the adaptive monitoring framework required to be implemented under the draft EA (including E3, E4, E10-E14 and I8 - I11) provides an appropriate and effective way to manage the uncertainty associated with impacts on the Doongmabulla Springs.

### ***EPBCA approval***

#### *Conditions 5, 6(f), 9, 11(o) and 12*

- [303] Condition 5 of the EPBCA approval requires the applicant to submit to the Minister for approval a plan for the management of direct and indirect impacts of mining operations on matters of national environmental significance (MNESMP), at least 3 months prior to commencement of mining operations.
- [304] The MNESMP is required, under condition 6(f), to include a table of specific criteria for assessing the success of management measures against goals, and triggers for implementing corrective measures if criteria are not met within specified timeframes. This table must include but not be limited to measures relating to subsidence and groundwater impacts, including early warning triggers for impacts on groundwater at the DS and the Carmichael River.
- [305] Condition 9 provides that, to compensate for authorized unavoidable impacts on MNES, the applicant must submit a BOS to the Minister for approval at least 3 months prior to commencement of mining operations.

- [306] Condition 11 requires that the BOS must be consistent with a number of other plans. Condition 11(o) says that the BOS must include details of how groundwater and water resource impacts on the MNES will be addressed in the BOS including identification of additional potential offsets for the Carmichael River and DSC to be developed in consultation with the department and relevant Queensland Government agencies.
- [307] Condition 12 provides that mining operations must not commence until the BOS is approved by the Minister and that the approved BOS must be implemented. The approval also requires the applicant to submit an offset management plan for the offset area within three months of the approval of a revised BOS.
- [308] Mr Wilson said that the current BOS (s 6.1.3) addresses these issues through measures that include the development of offset area management plans. These plans have not yet been developed in detail but will include listing management objectives and outcomes, a detailed monitoring plan with criteria for assessing the success of management measures in meeting stated objectives, and corrective actions required if objectives are not met.
- [309] The first respondent submitted that these conditions and the BOS as currently drafted were premised on the impact assessment work done by GHD which had concluded that there is no potential for significant impacts to the DS. The first respondent said that the applicant's own evidence establishes that at least some of the DS will dry up and there is a real likelihood that the DS could dry up completely in which case the impacts cannot be offset.
- [310] Mr Wilson did not agree that the proposed offsets will be ineffective to deal with the permanent damage caused by the proposed mine. He had to assume that provision of the offsets will be specified, monitored and approved and, more importantly, that the offsets will produce the results that are intended. This might require ongoing management but he considered that if appropriate offsets were implemented they would be effective.

*Conditions 25 and 26 – GAB Springs Research Plan*

- [311] Conditions 25 and 26 of the EPBCA approval require the applicant, at least 3 months prior to commencing excavation of the first box cut, to submit for the approval of the Minister a GAB Springs Research Plan that investigates and evaluates methods to prevent, mitigate and remediate ecological impacts on the EPBC listed community of native species dependent on natural discharge of groundwater from the Great Artesian Basin including the DSC. The plan must be peer reviewed and must include, among other things, methods including the conceptualization of the hydrogeology of the springs and geological and geochemical surveys to inform the source aquifers for the DSC; development and evaluation of methods to prevent, remediate and mitigate ecological impacts; and an explanation of how research

outcomes will directly inform the monitoring, management, prevention, mitigation and remediation impacts on the DSC.

[312] Mr Wilson said that the knowledge gained from the research will be an important input into the ongoing management of the springs and the applicant submitted that these conditions provide even further comfort that any risk of environmental harm to the springs will be comprehensively managed.

[313] The applicant also submitted that if the Court concludes that, on balance, it is likely that the source aquifer is from the GAB, then the Court's finding ought to be that there is no real threat or serious harm. Further, the application of the precautionary principle has the effect that, given that the applicant has demonstrated that the biological values associated with the DSC will be preserved, this uncertainty was not a reason not to recommend approval of the mine. This was because Mr Wilson's evidence was that the impacts are required to be, and will be, monitored, mitigated and, where necessary and possible, offset under the relevant approval conditions particularly those contained in the draft EA.

[314] The first respondent said that Dr Fensham's evidence was that there has been limited success in previous attempts to mitigate loss of spring flow or address loss of springs and he also said that provision of money for research would not necessarily provide a solution as it may be very difficult to provide effective offsets for the spring's organisms. The first respondent reiterated that Condition 26 only requires that the plan be approved by the Minister before mining commences.

[315] The first respondent submitted that the applicant has, in effect, closed its eyes to the risk of the complete destruction of the springs and, as a result, has no mitigation or offset plan. The issue requires the application of the precautionary principle, the first respondent said.

### ***Conclusions about springs ecology***

[316] Although the Mellaluka Springs may be permanently dried by the mine, it is agreed that they do not support vegetation of exceptional ecological value and no submissions were made that the potential loss of those Springs was an issue to be addressed by the Court.

[317] By contrast, it is agreed that the DS have exceptional ecological values. The extent of the threat to that ecological community depends on the extent to which the spring flow of the DS will be affected by the mining operations. It was acknowledged by both expert witnesses that if the DS dry up then the ecological community will be lost.

[318] As discussed at length above, I concluded that, on balance, the DS are not fed by the Colinlea Sandstone. If that is correct, then Mr Wilson (who relied on Dr Merrick's calculations of loss of spring flow) said that the reduction in wetland would be no greater than about .7 ha, which

was not substantial and no endemic species would be lost. Dr Fensham said that the persistence of viable populations would almost certainly be maintained.

[319] However, because I concluded that the precautionary principle should be applied as a result of some uncertainty about some of the issues surrounding the identification of the source aquifer of the DS, I consider that the same conclusion should be reached in relation to the ecological issues, that is the precautionary principle should be applied.

[320] Again there are extensive conditions in the draft EA and the EPBCA approval relevant to managing any threat to the ecological community. In addition to the water management provisions discussed previously, the draft EA requires that a BOS and GDEMP be developed in relation to the springs ecology.

[321] Similarly the EPBCA approval requires that a BOS be developed. In addition, that approval also requires that a peer reviewed GAB Springs Research Plan be developed and approved by the Minister before excavation of the first box cut.

[322] While I accept the evidence that if the Springs run dry the ecological community will be lost and that that loss cannot be effectively offset, I consider that the conditions in both the draft EA and EPBCA approval are elements in an adaptive management framework which I consider to be appropriate for mitigating the risk of threat to the ecological value of the springs.

### **Waxy Cabbage Palm (*Livistona lanuginosa*)**

[323] The first respondent objected to the grant of the mining leases and the draft EA on the basis of issues relating to the Waxy Cabbage Palm (WCP). These objections were particularized in the first respondent's further amended preliminary identification of issues<sup>79</sup> as follows:

“36. The Waxy Cabbage Palm (WCP) is very rare and only found in the Burdekin River catchment from the Carmichael River to the environs of Charters Towers.

37. On the basis of the existing knowledge the Carmichael River population is the largest single known population of the species.

38. Of the observed population on the Carmichael River and other populations within its known range within the Burdekin catchments, the Carmichael River population contains the greatest diversity of size classes from seedlings to reproducing adults.

#### ***Adequacy of information***

39. The EIS does not contain sufficient information about the extent and abundance of the WCP in the Carmichael River and its tributaries outside of the proposed mining lease area.

40. The Carmichael River population of WCP may well act as the main population from which other known populations have originated by natural or anthropogenic means.

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<sup>79</sup> OL010.

### ***Impact on population***

41. The WCP appears to be most abundant where there are reliable flows of water and/or more regularly adequate levels of soil moisture for the palms' maintenance and survival in the Carmichael River.
42. If the base flows of the Carmichael River are derived from the underground water flow from the Doongmabulla Springs Complex, and the Doongmabulla Springs Complex is significantly adversely impacted by the proposed mining activity, the abundance of WCP in the Carmichael River is likely to be significantly reduced.
43. If the hydrological conditions in the Carmichael River are significantly adversely impacted by the proposed mining activity, this is likely to significantly reduce the abundance of WCP in the Carmichael River.”

[324] Mr Bruce Wilson was called by the applicant to give expert evidence in relation to this issue. Dr Michael Olsen, a botanist and director of Landscape Assessment, Management and Rehabilitation Pty Ltd, was called by the first respondent.

[325] Mr Wilson and Dr Olsen prepared a joint expert report setting out areas of agreement and disagreement concerning the Waxy Cabbage Palm<sup>80</sup>.

[326] Mr Wilson and Dr Olsen agreed that the WCP is very rare and only found in the Burdekin River Catchment from the Carmichael River to the environs of Charters Towers. They also agreed that the Carmichael River population is the most globally significant population of this species. The species is vulnerable and the Carmichael River population is considered necessary for the species long term survival and recovery, necessary to maintain generic diversity near the limits of species range and habitat critical to the survival of the species. The experts also agreed that a recent survey had expanded the existing knowledge of the distribution of the WCP outside the area of the proposed mining lease. The populations are most dense in the western parts, to the Carmichael River, within the proposed ML area with diminishing (but persistent) populations to the west. The populations east of the proposed MLA diminish dramatically with few individuals found east of the proposed ML area. Mr Wilson and Dr Olsen agreed that the WCP appears to be most abundant where there are reliable flows of water and/or more regularly adequate levels of soil moisture for the palms' maintenance and survival.

[327] The experts disagreed as to whether the Carmichael River population of the WCP contains the greatest diversity of size classes from seedlings to reproducing adults. Dr Olsen considered that the Carmichael River population structure was associated with the hydrology of that system and that that appeared to contrast with the drier sites in the northern parts of its distribution. Dr Olsen had inspected the majority of the sites in the north discussed by Pettit

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<sup>80</sup> JR001, Exhibit 24.

and Dowe (2003)<sup>81</sup> and did not find the maintenance of seedling and juvenile individuals as reported by them. He considered that this may be related to the lesser availability of soil and other sources of moisture in the more northern populations on seemingly more ephemeral watercourses.

[328] Mr Wilson said there was no adequate explanation as to why any changes in the population structure in the northern areas had recently occurred. He subsequently surveyed that area and concluded that since 2003 there had been an increase in the proportion of seedlings on some sites and a decrease at other sites. The proportion of adult and more advanced palms was stable at most sites.

[329] There was also disagreement between Mr Wilson and Dr Olsen as to whether the Carmichael River population of WCP was the main population from which other known populations have originated. However nothing appears to turn on this issue. They did agree that regardless of their origins, the Carmichael River population remained the most significant at the present time.

[330] Mr Wilson and Dr Olsen also disagreed on the significance, to the abundance of WCP in the Carmichael River, of the maintenance of base flows. They acknowledged their need for verification of any predicted changes to base flow and the relative contribution to base flow from the DSC.

[331] Mr Wilson defined base flow as “the component of streamflow supplied by groundwater discharge”. On that basis and on the assumption that the WCP does not have a tap root and does have a relatively shallow root system, he concluded that the WCP is unlikely to be solely reliant on base flow in the Carmichael River for its survival. If it were, any of the palms located more than a few metres from the surface of the water in the river would not have access to water flowing in the river, that is to river base flow. He had observed many of the palms located more than a few metres from the river in a survey of the area in November 2014. He had also observed that the most dense population of the WCP was associated with seasonal streams on Cabbage Tree Creek where there was no base flow in the dry season.

[332] Dr Olsen considered that if the hydrological conditions in the river were significantly adversely impacted by the proposed mining activity, there was likely to be a significant reduction in the abundance of the WCP in the Carmichael River.

[333] Mr Wilson said that if the groundwater conditions of the Carmichael River were significantly adversely impacted by the proposed mine, there was a likelihood that parts of the population would be significantly impacted. However, he said, there were uncertainties in the relationship between the WCP and groundwater and therefore the degree of impact of the

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<sup>81</sup> AA035, Exhibit 25, Attachment 1 to Mr Wilson’s third affidavit (WCP Northern Population Report).

mine on the species. He considered, from information in the SEIS, that the WCP is associated with areas where groundwater is relatively close to the surface. However the range of habitats in which the WCP is found, including the drier areas within the Burdekin Catchment to the north, indicated to Mr Wilson the species may not always be reliant on access to groundwater. Therefore he considered that the palms were likely to have some resistance to impacts on groundwater caused by the proposed mining activity.

[334] Mr Wilson and Dr Olsen agreed that the issue of distribution and causality of the WCP has yet to be determined, that information is needed on the detailed relationship between hydrology and the distribution of the palm, and species specific studies are required to ascertain the relationship discussed by Mr Wilson.

[335] Dr Olsen expressed some uncertainty as to the appropriate use of the terminology of “groundwater”, “base flow” and “water table”. In the end it appears that his opinion was that the survival of the WCP was related to the water table in and around the water courses where spring outflow appeared to maintain soil moisture between rainfall events. That would explain the concentrations of the WCP in the Carmichael River and its tributaries below the springs in that system, he said. The question would then become whether a drop in the Carmichael River base flow results in a measurable drop in the water table.

[336] Mr Wilson’s evidence was that 100% loss of spring flow from the DCS would have a maximum impact of 10% loss of base flow at the Carmichael River. Neither Dr Werner nor Dr Webb expressed an opinion as to how much the river base flow would be affected by 100% loss of flow from the DSC. In Mr Wilson’s opinion only a small proportion of the 100% reaches the Carmichael River and therefore becomes base flow because much of the flow gets taken up by evapotranspiration within the wetland on its way from the springs to the river.

[337] There are two surface water monitoring stations measuring flow in the Carmichael River – one close to the upstream boundary of the lease and one approximately midway between the upstream and downstream boundary. The upstream gauge only operated for approximately 7 months between July 2011 and February 2012. Such information as is available from the upstream gauge indicates that the river is gaining water from the surrounding area in addition to base flow coming from upstream but in dry times, the river loses water to the surrounding area. If that is correct then it appears that the base flow in the river is likely to affect the water table. However there is no information as to how much the water table might drop if the spring flow from the DSC were cut off completely.

### *The proposed offset and management strategy*

- [338] Mr Wilson said that a total of 543 WCP (including 35 adults) in the eastern half of the ML area and Cabbage Tree Creek and a small number of palms occurring in an area of about 50 ha, may be impacted by the changes in water table and base flow reductions predicted in the SEIS<sup>82</sup>. The applicant accepted that this is a significant disruption to the extant WCP population although pointed out that the disruption will be minimal in the areas where the WCP is most dense. The applicant submitted however that the impact can and will be avoided, mitigated or offset.
- [339] Mr Wilson considered that the offset and associated management requirements set out in the draft EA were an effective way to deal with the uncertainties in the potential impacts of the mine. He said that an adaptive management and monitoring framework has been incorporated into the draft EA including the development of baseline groundwater datasets (E3) and ongoing management, monitoring and assessment (E4). The trigger points include measures such as levels of groundwater drawdown that require the initiation of review, mitigation and offsetting procedures (E11 – E14).
- [340] As discussed above, conditions I8 to I11 of the draft EA also require the applicant to develop a GDEMP to detail the management of threats to defined environmental values and to report results and corrective actions over the full period of mining activities and for 5 years post mining rehabilitation.
- [341] The applicant has developed a biodiversity offset strategy (BOS) pursuant to conditions I1 – I5 of the draft EA<sup>83</sup> which strategy Mr Wilson understood to be subject to approval at the time he wrote his report. The area proposed as offset for the WCP is to the west of the mining lease, which Mr Wilson considered was less likely to be impacted by water table drawdown than areas to the east. He said that there are ample areas of WCP located in the upstream area that will not be subject to excessive water table drawdown and are therefore available to meet the minimum offset areas required in the BOS. The BOS proposes that the existing population of the WCP in areas upstream of the mine will be protected by specific management measures including management of damage by feral pigs, management of weeds and management of fire.
- [342] The applicant is also required to secure an area of 90 ha as a minimum offset area for impacts on the WCP, under the EPBCA approval<sup>84</sup>.
- [343] Dr Olsen's opinion is that the proposed offsets will not replace the environmental values lost if there is a significant impact on the Carmichael River population. This is because the

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<sup>82</sup> AA011, Exhibit 22, Figures 10 and 11.

<sup>83</sup> SP001.17, Exhibit 6.

<sup>84</sup> AA072, Exhibit 140, Condition 8.



populations of the WCP in the offset areas are not as large nor do they have the same population structure, nor the same innate capacity for population growth.

[344] Dr Olsen also considered that, from an ecological basis, management per se did not provide an offset for any potential losses from the existing population. Further, there is no meaningful evidence that any current population of WCP is negatively affected by any of the factors to which the improved management will be addressed. Mr Wilson and Dr Olsen agreed that inappropriate fire and grazing regimes may be a threat to the WCP but little empirical evidence existed to say what the optimal regime for the palms should be to maintain population structural and reproductive viability.

[345] The first respondent submitted that the fundamental problem for the applicant in relying on offsets in this case is the absence of information about the environmental values of the impacted environment, the level and risk of environmental harm, and the capacity of offsets to meet the predicted harm.

[346] The first respondent also submitted that the proposed offset areas are themselves associated with the Carmichael River so that any major changes to the hydrogeology of the river caused by the mine are likely to affect those areas. Dr Olsen's opinion was that the lack of knowledge about the unique relationship between the WCP and the hydrogeological regime in the river population made it impossible to proceed with offsets without breaching the precautionary principle.

### ***Conclusions about the Waxy Cabbage Palm***

[347] It is clear that the WCP is a vulnerable species and that the Carmichael River population is the most significant in the world. Beyond that, little appears to be certain. There is uncertainty as to the optimum conditions that are necessary for the continued likely survival of the Carmichael River population. It is also uncertain what impact the mining operations will have on the DS and consequentially on the water table and base flow in the Carmichael River. And if the water table and base flow in the river is affected, it is uncertain what impact that might have on the WCP.

[348] However it is accepted that there will be changes in the water table and base flow reductions as set out in the SEIS caused by the mine and for that reason the draft EA includes offsets and associated management requirements as set out above.

[349] While there is a lack of detailed information about the optimum conditions necessary for the survival of the WCP, I have accepted Mr Wilson's evidence that the WCP is found in a range of habitats and that the population in the drier areas to the north appears to be surviving as well as that in the Carmichael River. I have also accepted Mr Wilson's opinion, for the

reasons given by him, that while the WCP is dependent on groundwater, it is capable of surviving in drier conditions such as in the area to the north.

- [350] I concluded above that the conditions in the draft EA and the EPBCA approval were adequate to manage any adverse impacts on the DS. That should also lessen the potential threat to additional loss of base flow in the Carmichael River.
- [351] In the circumstances I consider that the offset and management conditions in the draft EA are sufficient to avoid, mitigate or offset the potential damage to the WCP. An offset area will be provided and protective management techniques applied to the WCP in that area. Further, the GDEMP requires the applicant to report annually on corrective management of threats, the results and the effectiveness of those strategies.
- [352] There was disagreement between Mr Wilson and Dr Olsen as to the extent of impact of pigs, weed infestation and fire on the existing population of the WCP. It is difficult to accept that management of those factors would not assist the population to survive. While it is not clear why the proposed offset area is not as well populated, currently, with the WCP, it appears that the proposals for management of the WCP and the offset area are reasonable in the circumstances.
- [353] My overall conclusion is that the objections relating to the WCP do not provide grounds for not recommending the grant applications for mining leases and the approval of the application for an EA.

### **Black-throated Finch**

- [354] The Black-throated Finch (BTF) is listed as an endangered species under both the EPBCA and the *Nature Conservation Act 1992 (Qld)*.
- [355] The first respondent objected to the grant of the mining leases and the draft EA on the basis of the impact of the proposed mine on the population of BTF<sup>85</sup>. The first respondent said that on the available evidence the area of the proposed mining leases supports habitat for a significant number of BTF which may contribute to a core component of one of only three nationally (thus internationally) significant subpopulations of the endangered BTF. The base line information provided in the EIS and subsequent supplementary reporting was not sufficient to understand adequately the existing values of the site commensurate with the potential significance of the site's BTF population. In the absence of adequate assessment and an understanding of the existing values of the site, the information provided in the EIS could not be relied upon to confidently assess the significance of the mine's potential impacts to the BTF, the suitability of proposed mitigation measures or the appropriateness of any offsets. Reduction of habitat for a significant number of BTF caused by the mining

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<sup>85</sup> OL010, Exhibit 2, paragraphs 15 – 35.

operations was likely to have a significant impact on the regional population which is of international significance. The EIS documents do not provide sufficient details of the proposed offset locations or the characteristics of those locations to assess their current or potential suitability as viable BTF habitat.

[356] Four experts were called to give evidence regarding the BTF. Mr Adrian Caneris was called by the applicant and Mr Lindsay Agnew by the first respondent in relation to BTF fauna issues. Mr Wilson was called by the applicant and Dr Olsen called by the first respondent in relation to issues relating to botany, in particular certain grasses. Two joint reports were prepared by the four experts<sup>86</sup> and each expert also produced an individual report<sup>87</sup>.

### ***Approval Conditions***

[357] The draft EA<sup>88</sup> replicates conditions I1 to I7 of the Coordinator-General's report. In part, these conditions require the applicant to:

- I1 Provide an offset for impacts on applicable significant biodiversity values. The offset must be provided prior to impacting on State significant biodiversity values or within 36 months of the later of the issue of the EA or the relevant stage of the BOS.
- I2 The BOS must be reviewed and reported on by 5 years after the EA issue and then every 5 years.
- I6 Prepare a BTF Species Management Plan within ten business days of receiving the administering authority's approval in writing. The plan must include:
  - (i) a baseline research program on the specific nesting and feeding requirements of the species that will be undertaken prior to and during project stage 1;
  - (ii) a baseline research program to establish whether the BTF at the project site are sedentary, locally migratory or regionally migratory;
  - (iii) a description of how the results of baseline research are to be used to determine any changes of classification of and/or impact on BTF habitat;
  - (iv) details of proposed impacts to BTF habitat from each project stage; and
  - (v) mitigation measures to be undertaken to avoid, mitigate and manage impacts from each stage of the project, including rehabilitation of habitat.
- I7 The management plan must be reviewed and reported on annually by an appropriately qualified person. The report must assess the plan against the conditions and include recommended actions to ensure actual and potential environmental impacts are effectively managed for the coming year and identify any amendments made to the plan following the review.

[358] Condition 8 of the EPBCA approval requires that, for impacts on the BTF, the applicant must legally secure a minimum offset area of approximately 31,000 ha for the mining operations,

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<sup>86</sup> JR002, Exhibit 27 (first joint report); JR009, Exhibit 28 (second joint report).

<sup>87</sup> AA017, Exhibit 29 (A Caneris); AA015, Exhibit 30 (B Wilson); OL024, Exhibit 31 (L Agnew); OL025, Exhibit 32 (M Olsen).

<sup>88</sup> SP001.17, Exhibit 6.

within two years of commencement of specified components of the project<sup>89</sup>. The Queensland Coordinator-General's decision does not require any additional offsets.

### ***Impacts of project***

[359] Mr Caneris and Mr Agnew agreed that the proposed mining lease area supports habitat for a significant number of BTF which represents a significant population of the endangered BTF. While accurate estimates of the number of BTF were unavailable at the time of writing their first joint report, their opinion was that the population of BTF on the proposed mining lease area and near surrounds may be one of the largest known subpopulations of the southern species of BTF. They said that the Ten Mile Bore and surrounds<sup>90</sup> may maintain an important function in sustaining the BTF population although the extent of this needed further investigation.

[360] Mr Caneris and Mr Agnew also agreed that there has been a significant reduction in the known range of the BTF, and that the Townsville subpopulation of the BTF was thought to be the largest surviving subpopulation with no more than 600 mature individuals. Although the regional subpopulation in the area of the mining lease was previously thought to have been no more than 400 mature birds, this was a notable underestimate given the significant number of BTF recorded on the MLA area and Moray Downs property<sup>91</sup>.

[361] It is estimated that approximately 9,771 ha of BTF habitat will be impacted by the mine. The evidence of Mr Caneris and Mr Agnew was that there will be a complete loss of any potential BTF habitat within the open cut pit area and in areas taken up by related infrastructure such as soil storage areas, dams, roads and accommodation. Any BTF habitat in the area above the underground mine may also be disturbed by subsidence, the extent of which is unknown. As well as a direct loss of habitat, the mining and associated activities will cause further fragmentation of habitat and disturbance to existing feeding and breeding patterns, they said.

[362] Mr Caneris and Mr Agnew agreed that, in response to habitat clearing and disturbance, the BTF are likely to disperse to surrounding areas where they will experience one of the following potential outcomes:

- a. not find suitable habitat and die;
- b. find suitable habitat already occupied by BTF which cannot support an increased carrying capacity, resulting in further dispersal or death;
- c. find suitable habitat that is already occupied by BTF and displace the original BTF;
- d. find suitable habitat not currently occupied by other BTF or occupied by a resident population habitat which could support a further increase in local population.

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<sup>89</sup> Offsets for different species may overlap where they show the same habitat requirements.

<sup>90</sup> The Ten Mile Bore is located close to the northern boundary of MLA 70441.

<sup>91</sup> The mining lease areas are located on Moray Downs.

[363] The first respondent submitted, relying on Mr Agnew's evidence, that the first three scenarios represented higher probability outcomes for BTF displaced by the project. Mr Caneris said that that statement was correct if there were no nearby offsets proposed. With the habitat improvements proposed to the adjoining offset areas, he said it was not unreasonable to consider:

- a likelihood of increased available habitat;
- greater carrying capacity within some areas currently occupied by BTF; and
- currently unused areas becoming suitable to contribute to increased utilization, if not, ultimately, occupation.

[364] Mr Agnew said that, while Mr Caneris' propositions were valid, in practical terms any improvement in carrying capacity may only result in a relatively minor positive outcome in mitigating the impacts of habitat loss on such a large scale.

[365] Mr Caneris and Mr Agnew agreed that reduction of habitat for a significant number of BTF was likely to have a corresponding impact on the internationally significant regional population. Again Mr Caneris pointed out that that statement appeared to assume that there was no commensurate offset. It was his view that the offset and mitigation actions could provide an overall net benefit.

[366] Mr Caneris noted that immediately prior to the commencement of the joint expert reporting process there was consideration of a change in the mine design by reducing the footprint size in the northern portion of the lease and increasing the area of underground mining, to replace open cut mining in that area. Mr Caneris said that this change would alter the potential direct and indirect impacts on BTF habitats and, given that the northern portion is recognized as the area holding the higher value habitats, this change would reduce the potential impacts on the BTF habitats and habitat connectivity in the local landscape. However he considered that the proposed offsets for the BTF as a result of stages 1 and 2 should remain to provide an increase in potential net benefit.

[367] Mr Agnew was unable to comment on the implications of Mr Caneris' remarks as Mr Agnew had no details and such a change had not been notified formally.

### ***Site Studies***

[368] Mr Caneris and Mr Agnew agreed, in their first joint report, that more detailed and targeted studies are required to fully understand the existing values of the site and specific values, particularly in regard to BTF population size, foraging and breeding habitats. They noted that three 20 minute bird surveys had been carried out at 96 x 2 ha survey locations. While these surveys had the capacity to provide a useful overview of the birds using a particular habitat area, they were not a suitable method for investigating BTF site usage, they said. Further, the

survey sites selected were biased towards the existing track systems which resulted in a notable absence of survey coverage across extensive areas of potential BTF habitat throughout the MLA area. Mr Caneris and Mr Agnew said there appeared to be little attention given to implementing water body surveys during the optimum period following dawn and their view was that such water counts should be conducted for a period of at least six hours. The methodology used did not comply with the accepted importance of early morning surveys and the methodology is not referred to in the national guidelines for any nationally threatened bird species.

[369] At the request of Mr Agnew and Mr Caneris, further evidence of sightings of BTF at and around the mine site or camp was provided. Ten additional sightings were recorded during the period from July 2012 to April 2014, seven of which were listed as confirmed. Two of those sightings are regarded as highly significant as they were observations of two large flocks, one >150 BTF and another of 75 BTF. It is probable that the flock of >150 BTF may have been previously recorded.

[370] Mr Agnew and Mr Caneris prepared a table summarizing the applicant's BTF records (as incorporated into the EIS or SEIS) and the additional sightings<sup>92</sup>:

**Table 1: Comparison of the key data parameters of existing and additional BTF records**

<b>Key BTF Record Parameters</b>	<b>Applicant's BTF Records (within reporting)</b>	<b>Additional BTF Records (not within reporting)</b>
Number of BTF record observations	125	40
Cumulative Total of BTF recorded	1025	1019
Number of flocks >30 BTF recorded	9	7
Number of flocks >50 BTF recorded	0	5
Number of flocks >100 BTF recorded	0	At least 3

[371] It can be seen that approximately 100% more birds have been recorded as sighted in the additional records, as compared with the information in the reporting documentation.

[372] Mr Agnew and Mr Caneris also asked that information be provided, in regard to the BTF surveys and monitoring events, as to the personnel and their experience in relation to BTF

<sup>92</sup> JR009, Exhibit 28 at 7.

and target surveys for BTF. That information was provided and Mr Agnew and Mr Caneris concluded that the team leaders overseeing the field work and reporting were of suitable experience.

[373] Mr Agnew said that a group known as the BTF recovery team (BTFRT) had provided a submission to the Coordinator-General (8 February 2013) which was highly critical of all aspects of the survey program concluding that as a result of the deficiencies, the abundance of BTF had been grossly understated and the description of BTF habitat was incorrect. If the survey design deficiencies were to be perpetuated throughout the proposed ongoing monitoring program, such a program could not be relied upon to adequately detect impacts to the BTF.

[374] In relation to breeding habitat, Mr Agnew said that there was a lack of any apparent effort to detect nest sites and a resultant lack of any appreciation for breeding habitat values. He considered this to be a major failure of the site value assessment.

[375] Mr Caneris agreed that there needed to be a better, more refined assessment of breeding habitat values and an accurate estimate of breeding presence within the disturbance areas. However, he said that the lack of such information did not preclude a successful offsetting of lost value. What was important was that there be a measure of breeding success in order to demonstrate that similar levels of breeding are being maintained. He considered that it was likely that information collected in a more refined and targeted monitoring program would provide suitable benchmarks by which the offsets can be assessed.

[376] While Mr Caneris agreed that there was a need for a field assessment to provide the information required to fully understand the habitat preferences of the species, he said that it was only through undertaking detailed monitoring, as required by the approval conditions, that this information will be reliably obtained. With relatively simple improvements to the existing monitoring protocols, the current level of field assessment could be far better targeted to provide the required information on the BTF and its habitats. Mr Agnew did not agree that any relatively simple improvements would be sufficient. He considered that the monitoring program should be completely redesigned by a biologist with suitable experience in BTF ecology, that the survey design be peer reviewed and only be implemented by field investigators with suitable experience in BTF surveys. Further he considered that a better understanding was required before the approval conditions could be imposed.

[377] Mr Caneris and Mr Agnew agreed that there is insufficient data and knowledge to accurately and specifically quantify the cumulative impacts of the project. They also agreed that a relatively significant level of work had been undertaken to date although Mr Agnew pointed out that he and Mr Caneris had agreed previously that there were fundamental deficiencies in

the design and implementation of that work. Mr Caneris' opinion was that a more refined monitoring program, and continuing BTF surveys would over time provide data on temporal and spatial variation of habitat use within the disturbance and offset areas which will contribute significant data for incorporation into the BTF species management plan and, ultimately, the refinement of mitigation and species recovery actions on and off site.

### ***Provision of offsets***

- [378] As set out above, the draft EA requires the applicant to provide offsets for impacts on applicable significant biodiversity values and the EPBCA approval requires that an offset area of 31,000 ha be set aside for the BTF. The first respondent said that in the absence of an adequate assessment and understanding of the existing values of the site for the BTF, the information provided in the EIS documents cannot be relied upon to confidently assess the significance of the potential impacts to the BTF, the suitability of the proposed mitigation measures or the appropriateness of any offsets.
- [379] However Mr Caneris' view was that the work to date although generally broad in nature, provided a reasonably sufficient context to demonstrate that the required offset values can be met. Further, the Coordinator-General's conditions require that a more detailed and specific assessment of the habitat values be undertaken and that the assessments be reviewed.
- [380] Mr Agnew's understanding was that project approvals had been granted on the basis that the accepted deficiencies in the BTF survey, habitat assessments, and the assessment of impact significance and utility of proposed offsets can all be improved post-approval, by implementing relevant approval conditions. He said that there appeared to be no impact thresholds nominated by the relevant approval conditions, thus the only likely primary response to new knowledge is to provide additional offsets. Such offsets may not be commensurate with the significance of the impact on the BTF southern subspecies.
- [381] Mr Agnew also said that in assessing the suitability of the current proposed offsets, it appeared that the BOS was based on the results of implementing the Queensland Government Ecological Equivalence Methodology (EEM) for the mine site and for the proposed offset areas. The application of the standard EEM did not provide scope for the level of assessment required to assess and compare the habitat values for a particular threatened species such as BTF. Further, there appeared to be inequities in the application of the EEM across the mine site and offset sites which had the potential to undermine the potential conclusions. A subset of regional ecosystems was used to provide focus for the assessment of BTF habitat values. In his view the assessment of such values in that way would result in an underestimate of the extent and values of habitat used by the BTF. The reliance of the assessment reports on the



data derived from a deficient BTF survey program notably constrained the capacity of the assessments of BTF habitat values on the mine site.

- [382] Mr Wilson took the view that the EEM assessments followed the standard method specified by DERM<sup>93</sup>. Additional attributes were collected to indicate BTF habitat including the presence/absence of all types of grass species that were listed as a food source in the BTF recovery plan and the distance from permanent water. Mr Wilson said that the sampling intensity used in the assessments met or exceeded the DERM specifications and he considered it to be adequate for assessment of potential offsets. His understanding was that any new knowledge can be incorporated into the assessment through the BOS strategy process.
- [383] Mr Wilson also said that regional ecosystem mapping is the most readily available and appropriate tool to allow rapid mapping over the large areas required for the Carmichael mine project. The grass species richness and/or condition of grass coverage are variable but there is generally a relationship between these attributes and the mapped extent of regional ecosystems.
- [384] Dr Olsen agreed with Mr Wilson with respect to broad scale mapping but, given the global significance of the BTF population in the study area, he considered that a less broad-brush approach was required, regardless of regional based policies or methodologies.
- [385] Mr Wilson agreed that there was no explanation given for the inequalities of sampling effort in the assessment documents. However the sampling intensity did conform to the DERM guidelines and in his view the unequal sampling effort did not distort the final EE score for each unit. He considered the current level of sampling adequate to indicate potential habitat values although he agreed that more intensive sampling would provide more detailed assessment of habitat values. Further work was required, he said, to define specific areas of actual habitat and the improvement in BTF habitat that would result from additional management actions at the offset sites.
- [386] Mr Caneris agreed that information provided in the EIS documents could not be relied on to confidently assess the significance of the potential impacts to the BTF, the suitability of proposed mitigation or the appropriateness of any offsets. It was his view however that the reporting to date only sought to establish that there is a potential to meet the offset requirements. He said that a more accurate measure of specific BTF habitat values within the disturbance and proposed offset area is required and he noted that that is a condition of existing approvals.

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<sup>93</sup> Department of Environment and Resource Management.

### ***Grass species***

- [387] Dr Olsen and Mr Agnew said that not enough is known about the BTF floral habitat to confidently identify or create offset sites. Mr Caneris disagreed. He said that the BOS prepared for the applicant has followed contemporary methodology and the assessment of values was undertaken in accordance with the EEM guidelines published by DERM.
- [388] Mr Caneris and Mr Agnew agreed that BTF are dependent on the seed of native grasses although little is known about dietary preferences or comparative values to BTF of the variety of grass species within the region. Mr Caneris and Mr Agnew also agreed that grass species richness and/or condition of grass cover are variable and regional ecosystem mapping cannot be confidently relied to identify the extent or value of suitable habitat for BTF.
- [389] Dr Olsen understood that certain grasses (*Poaceae*) are a critical component of the feeding habitat for BTF. He said that the existing information does not provide data that enables an adequate assessment of spatial patterning of *Poaceae* across either the proposed mine site or the proposed offset areas. Further, the current process will not provide the required level of confidence in adequately accounting for the increasing level of knowledge that the process may import into management actions and the impacts from the proposed mine. Given the current lack of understanding of the patterning of *Poaceae* and the relationship to BTF across the study area, he said, the precautionary principle must be invoked because of the global significance of the BTF population across the study area.
- [390] Mr Wilson agreed that a more intensive survey of *Poaceae* would provide more detailed information on their occurrence and abundance. However as Mr Agnew and Mr Caneris agreed that little is known about dietary preferences or the comparative values to BTF of the variety of grass species within the region, he considered that a more intense survey of the *Poaceae* species may not provide a lot more additional guidance about BTF habitat at this time.
- [391] Mr Caneris said that there is a need for and it is a requirement of approval conditions to more accurately measure the extant values of both disturbance and offset areas habitat values. However his relatively short site visit had led him to conclude that the overall estimate of values was substantially correct for the purpose for which it is required. Further, with ongoing refined assessment of the disturbance site and offset areas, more detail will be provided of BTF habitat loss and gain.
- [392] The primary management actions proposed for offset areas will be the removal and/or reduction of cattle, provision of additional water sources and the implementation of a weed control program targeting *Cenchrus Ciliaris*. This is to ensure that seeding grass species diversity is optimized.

- [393] Mr Agnew said that offset sites that do not provide appropriate native understorey grasses are of no use in mitigating the risk of population decline. Mr Caneris disagreed. He said that such areas may have little direct value, but they can contribute through provision of habitat linkages, watering points and even, potentially, breeding habitats. In any event he said he did not believe that there are any large notable areas that do not provide native understorey grasses in the proposed offset areas.
- [394] The experts requested details of any further botanical or site specific assessment of extant habitat values. In response, two spreadsheets were provided by the applicant containing data on the presence/absence of key grass species for the mine site and for the proposed offset areas<sup>94</sup>. Eight key grass species were used to form the EE assessment for those areas.
- [395] Mr Agnew said that there is evidence that BTF feed on 23 different grass species and there is evidence that a further 12 grass species may form part of their diet. Of the grass species recorded as confirmed or suspected of forming part of the diet of BTF, approximately 16 species have been recorded on the mine site at survey sites where BTF have been recorded. The 8 key grass species used to inform the EE assessments represent at best only 50% of the suite of grass species which should have been included in a potential list of key grass species. In his opinion the application of the EE assessment was not commensurate with the type of habitat assessment which is warranted given the significance of BTF population and the potential requirements to determine suitable offset habitat.
- [396] Dr Olsen said that within the study area there are globally significant populations of BTF feeding on the *Poaceae* but there is no spatial or autecological data to explain why this is so. Without such an understanding, he said, it would be cavalier to remove the known habitat from the sites and threaten the viability and integrity of the known concentrations of BTF within the proposed Carmichael mine footprint. Reliance on an assay of only 8 species of the many dozens of known food species for BTF and a sample size of only 25 ha of the proposed mine site for this globally significant population did not appear to provide any meaningful data on why this area sustains the greatest known concentrations of BTF on the planet. Accordingly, he reiterated, the precautionary principle must be invoked given the global significance of the BTF population across the study area.
- [397] Mr Caneris said that the more refined assessments which are a condition of approval require an assessment of the offset suitability and overall measures commensurate with the impact. The conditions in the draft EA include a precautionary approach, he said. The ongoing detailed assessments must demonstrate appropriate commensurate offsetting for the project to

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<sup>94</sup> JR009, Exhibit 28, Attachment 2.

progress. The conditions require demonstration of and independent reviews of appropriate mitigation being achieved.

[398] Mr Wilson said that the target grass species information was not collected to provide detailed habitat information but to provide qualitative verification of habitat types. More detailed assessments as per the draft EA conditions are required, he said, to fully assess the habitat but he considered that the approach using broad vegetation groups was appropriate at this stage of the assessment process.

[399] Mr Agnew said that he had no confidence that a potentially significant impact on a naturally significant BTF population could be averted or suitably mitigated were the proposed mine to proceed on the basis of the current approval and the suite of conditions. His fundamental concerns with the proposed offsets are:

- a. there are no impact thresholds nominated by the relevant approval conditions to assess the performance of the impact mitigation strategies; and
- b. there is insufficient evidence to assert that the proposed offsets are suitable.

#### ***Other matters***

[400] Dr Olsen also said that it was his understanding that similar detailed studies conforming to the prescribed survey methodologies have been conducted elsewhere in the Galilee Basin and across the Desert Uplands Bioregion and no analogous concentrations of BTF have been found in those studies. It is his understanding that there is a correlation between the presence of BTF and the following three factors:

- water supply year round (artificial/natural);
- woody habitat for perching and nesting;
- selected *Poaceae* that are known food sources for BTF.

Dr Olsen said that while it is known that concentrations of BTF are at sites with these factors, it is not known why the concentrations have not been recorded as seemingly similar sites with analogous habitat factors.

#### ***2015 BTF recovery team report***

[401] The BTFRT prepared another report which was attached to the second joint experts report. The team consisted of scientists and those involved in research in a variety of aspects of BTF biology who maintain a database of BTF records which contains nearly 3,000 records and spans the period 1800 to the present.

[402] The BTFRT has concluded, as a result of the sizes of flocks recorded on the mine site, that the team no longer assumes the Townsville population to be the largest BTF population. The largest numbers are now thought to be in Central Queensland in the Eastern Desert Uplands

Bioregion. That population is likely to be the most significant largest population of BTF remaining.

[403] Mr Caneris suggested that if further work were conducted in the wider landscape with similar habitat values, similar numbers of BTF could also be recorded. Mr Agnew rejected that, referring to a number of surveys where no or no significant numbers of BTF were recorded.

#### ***Experts' recommendations***

[404] Mr Caneris and Mr Agnew recommended that the monitoring program should be revised and targeted more specifically on the BTF and their habitats. These changes should include as a minimum:

- i. monitoring of water bodies should be conducted over at least a six hour period commencing from dawn in order to accurately capture utilization of the watering points;
- ii. detailed botanical assessment should be focussed on all BTF siting locations to record habitat values within those locations;
- iii. more effort should be placed into actively locating BTF and collecting information on their movements across the project and offset areas;
- iv. call playback should be used when BTF are encountered to assist in gaining a more complete identification of birds present in the local area;
- v. specific surveys targeting breeding be undertaken to provide details on locations and habitat values in breeding areas;
- vi. persons undertaking the surveys/monitoring should be experienced ecologists with sound understanding of the BTF and its habitats;
- vii. any future revision of the current survey and monitoring programs should be developed in consultation with researchers from the BTF recovery team and independently peer reviewed.

[405] Dr Olsen also recommended that a research project be funded to determine the correlation between water source, woody habitat and *Poaceae* food resources across both the proposed Carmichael mine and the potential offset areas, to determine the interrelationships between those factors. He considered that it was only when the outcomes of that research project were known that the existing data gaps could be filled and provide some degree of confidence that there is an adequate understanding of the autecology of BTF across the study area. Further, it would only be then that the utility of the potential offset areas could be appropriately assessed to provide the habitat required for the globally significant population of BTF.

#### ***Conclusions about black-throated finch***

[406] The BTF is an endangered species and the evidence has established that the population in the MLA area and surrounds is the most significant in Australia and globally.

[407] I am satisfied from the evidence that there will be serious or irreversible environmental damage to the continued survival of any BTF in the mining lease area from the proposed mine because there will be a complete loss of any BTF habitat within the open cut pit area and related infrastructure areas. As I am satisfied that there will be serious irreversible damage, this is not a case for the application of the precautionary principle as discussed by

Preston CJ in *Telstra Corporation Ltd v Hornsby Shire Council*<sup>95</sup>. That being the case, it is necessary that preventative measures be taken to control or regulate the certain threat of environmental damage, if the mine proceeds.

[408] The measures proposed in the draft EA include provision of an offset area and preparation of a BTF management plan which must incorporate a base line research program, a description of how the results of the research are to be used to determine any changes of classification of and/or impact on BTF habitat; details of proposed impacts to BTF habitat from each project stage and mitigation measures to be undertaken. The EPBCA approval also requires that the applicant set aside a minimum offset area of approximately 31,000 ha, for impacts on the BTF.

[409] While there is certainty as to the impact of the proposed mine on the habitat and therefore the survival of the BTF in the area, there is a great deal of uncertainty as to whether the proposed measures to deal with the impact on the BTF will be adequate for that purpose.

[410] That uncertainty arises primarily from a lack of scientific knowledge as to the environmental conditions necessary to ensure that any proposed alternative sites include areas of habitat suitable to the continued survival of significant numbers of BTF. Such surveys as have been undertaken appear to have been directed primarily at ascertaining the number of birds using a particular area. The methodologies adopted were criticized by the expert witnesses, so that the results are unreliable even taking into account their limited goal. Further, little or no information has been gathered as to breeding habitat values or dietary preferences of the BTF. While it appears that *Poaceae* are critical to BTF feeding habitat, little else is known about the necessary patterning of that grass for the survival of the BTF. The paucity of information about these issues inevitably makes the assessment of the suitability of proposed offset areas uncertain.

[411] I am not satisfied therefore that the conditions in the draft EA and the offset areas required under the EPBCA approval are sufficient to deal with the adverse impact of the proposed mining operations on the BTF. While the implementation of I6 and I7 of the draft EA, which require a management plan to be prepared, will provide further information about the habitat of the BTF, it is not clear to me how any mitigation measures can be seen to be effective, given the lack of fundamental knowledge outlined above.

[412] At the very least, I consider that additional conditions should be inserted into the draft EA as recommended by various experts. Section 190(2)(b) of the EPA provides that any condition recommended by the Land Court for inclusion in the EA cannot be inconsistent with a Coordinator-General's condition. As the relevant conditions in the draft EA are those

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<sup>95</sup> [2006] 67 NSWLR 256 at [128], [140], [149].

imposed by the Coordinator-General<sup>96</sup>, the proposed additional conditions must not be inconsistent with the Coordinator-General's conditions. This issue was discussed at some length in *Xstrata Coal Queensland Pty Ltd v Friends of the Earth – Brisbane Co-Op Ltd*<sup>97</sup> where it was held that the Court has power under the EPA to recommend conditions for the draft EA dealing with the same subject matter as conditions imposed by the Coordinator-General, provided that the Court's recommended conditions do not contradict or lack harmony with the Coordinator-General's conditions<sup>98</sup>. I do not consider that the conditions proposed below are inconsistent with the Coordinator-General's conditions in that sense.

[413] I therefore propose recommending, as set out below, that the following conditions be added to the draft EA. It is relevant to note at this point that the first respondent took the position throughout the hearing and in final submissions that the Court should recommend that the applications for the mining leases and environmental authority should be refused. Accordingly, the first respondent made no submissions as to the possible inclusion of additional conditions in the mining leases and the EA.

[414] Specifically I propose recommending that the management plan referred to in condition I6 of the draft EA include the following changes, as recommended by Mr Caneris and Mr Agnew:

- i. monitoring of water bodies should be conducted over at least a six hour period commencing from dawn in order to accurately capture utilization of the watering points;
- ii. detailed botanical assessment should be focussed on all BTF siting locations to record habitat values within those locations;
- iii. more effort should be placed into actively locating BTF and collecting information on their movements across the project and offset areas;
- iv. call playback should be used when BTF are encountered to assist in gaining a more complete identification of birds present in the local area;
- v. specific surveys targeting breeding be undertaken to provide details on locations and habitat values in breeding areas;
- vi. persons undertaking the surveys/monitoring should be experienced ecologists with sound understanding of the BTF and its habitats;
- vii. any future revision of the current survey and monitoring programs should be developed in consultation with researchers from the BTF recovery team and independently peer reviewed.

[415] Further, I propose recommending that a requirement be inserted into the research management plan referred to in draft EA condition I6, to the following effect:

The research management plan include provision for funding a research project to determine the correlation between water source, woody habitat and *Poaceae* food resources across the MLA areas and the proposed offset areas, to determine the interrelationships between these factors.

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<sup>96</sup> SP001.12, Exhibit 6, at 350, 351.

<sup>97</sup> (2012) 33 QLCR 79 at [24] – [51].

<sup>98</sup> At [47].

[416] I have also given consideration to the evidence that the Ten Mile Bore and its surrounds may maintain an important function in sustaining the BTF population, although the extent of this needs further investigation. I propose to recommend therefore:

The research management plan include a provision that the Ten Mile Bore and its surrounds be investigated to determine whether that area maintains an important function in sustaining the BTF population.

[417] There remains uncertainty as to whether, assuming that the proposed offset areas are found to be suitable for the BTF, the birds will relocate successfully to those areas. Because of that uncertainty it would be desirable that that risk not be incurred or at least minimized. Accordingly, because of the importance of preserving the habitat of an endangered species, I have given consideration to recommending that an area around the Ten Mile Bore be excised from the proposed ML area, with the intent that the habitat in that area be preserved. However I do not consider that the evidence as to the importance of the Ten Mile Bore area was sufficient to warrant such a recommendation.

[418] Mr Caneris gave evidence that consideration had been given to changing the mine design by increasing the area of underground mining to replace open cut mining in the northern part of the lease area. Mr Lezar, the head of open cut mining operations of the applicant, gave similar evidence.

[419] That suggestion may provide a method of reducing the impact of the mine on the BTF habitat in the vicinity of the Ten Mile Bore. However there is no evidence as to whether such a proposal is viable and therefore I make no recommendation in that regard. Nevertheless, I will draw the proposal to the attention of the administering authority.

### **Climate change**

[420] The first respondent's objections relevant to climate change were:

1. If the mine proceeds, there will be severe and permanent adverse environmental impacts caused by the operations carried out under the authority of the proposed mining leases.
2. If the mine proceeds, the public right and interest will be prejudiced.
3. Good reason has been shown for a refusal to grant the mining leases due to the risk of severe environmental impacts and the lack of scientific certainty regarding those impacts.

[421] Paragraphs 25 to 27 of the Facts and Circumstances attached to the objection forms provide:

#### Climate change

25. If the mine proceeds, it will cause severe adverse environmental impacts due to direct and indirect emissions of greenhouse gases contributing to climate change and ocean acidification from the mining, transport and use of the coal from the mine.
26. The full extent of the adverse environmental impacts due to direct and indirect emissions of greenhouse gases contributing to climate change and ocean acidification from the mining,



transport and use of the coal from the mine cannot be particularised by the objector due to the inadequate information provided by the applicant in the applications, EIS and SEIS.

27. It has not been adequately demonstrated that the mine will not increase the likelihood, severity and longevity of the environmental harms that will result from climate change and ocean acidification, considering the combined effect of section 269(4)(j) and (l) of the MRA.

[422] These objections were particularized in the first respondent's further amended preliminary identification of issues, the detail of which is not set out here.

[423] Dr Christopher Taylor was called by the applicant in relation to climate change issues. Dr Malte Meinshausen was called by the first respondent in relation to climate change emissions and Dr Ove Hoegh-Guldberg in relation to ocean acidification and impacts to the Great Barrier Reef. The first respondent also relied on a witness statement prepared by Mr AW Fontes, a dive operator in the Whitsunday region of the Great Barrier Reef.

[424] Dr Taylor and Dr Meinshausen participated in a joint expert meeting and their joint report was tendered<sup>99</sup>. In addition, expert reports by Dr Taylor<sup>100</sup>, Dr Meinshausen<sup>101</sup> and Dr Hoegh-Guldberg<sup>102</sup> were in evidence.

[425] In the joint report, Dr Taylor and Dr Meinshausen agreed that human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases (GHG) are the highest in history. Recent climate changes have had widespread impacts on human and natural systems. Warming of the climate system is unequivocal, the atmosphere and ocean have warmed, the amounts of snow and ice have diminished and the sea level has risen. Anthropogenic GHG emissions have increased since the pre-industrial era, driven largely by economic and population growth and are now higher than ever. This has led to atmospheric concentrations of carbon dioxide (CO<sub>2</sub>), methane and nitrous oxide that are unprecedented in at least the last 800,000 years. Their effects are extremely likely to have been the dominant cause of the observed warming since the mid-20<sup>th</sup> century.

[426] Emissions of CO<sub>2</sub> from fossil fuel combustion and industrial processes contributed about 78% of the total GHG emissions increase from 1970 to 2010, with a similar percentage contribution for the increase during the period 2000 to 2010. Continued emission of GHG will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems.

[427] The United Nations Framework Convention on Climate Change (UNFCCC) seeks to avoid dangerous interference with the climate system. To that end, Australia and other parties to

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<sup>99</sup> JR006, Exhibit 33.

<sup>100</sup> AA007, Exhibit 34.

<sup>101</sup> OL013, Exhibit 35

<sup>102</sup> OL014, Exhibit 12.

the convention envisaged, in 2009, a 2% goal to limit the increase in global temperatures. Australia has pledged to reduce its GHG emissions by 5% below 2000 levels by 2020. These targets are based on net national emissions and do not include emissions associated with the fuel exported to be used by other nations.

[428] Approaching 2<sup>0</sup>C warming there will be significant impacts in Queensland such as a decline in environmental values including the Great Barrier Reef; increased flooding; erosion and damage in coastal areas due to increased numbers of severe tropical cyclones and sea level rise; significant increase in heat related deaths and diseases; reduced water availability; increased frequency of droughts affecting agricultural production; and coastal erosion due to sea level rise projected to be about 40 cm higher than today by the late 21<sup>st</sup> century. In Australia there will be more frequent heat waves and more frequent and/or more intense droughts. Globally, climate change will amplify existing risks and create new risks for natural and human systems.

[429] Because emissions of CO<sub>2</sub> effectively accumulate in the atmosphere, it is the cumulative not annual CO<sub>2</sub> emissions that matter for long-term climate change. In assessing the extent to which the proposed mine would cause additional cumulative emissions, the mine cannot be viewed in isolation but should be seen in terms of the change in global net emissions. There will be a net change to global emissions to the extent that emissions associated with the mine are not offset by a reduction in emissions elsewhere, or to the extent that they would otherwise occur even if the mine were not approved. All emissions from the burning of product coal from this mine will have a climate impact in the physical cause/effect sense. Whether those climate impacts are additional to what would have occurred in the absence of the mine's approval depends on the extent the mine increases global coal consumption. The calculated cumulative emissions associated with the project, therefore, should be seen as a worst case net change in global emissions.

[430] A global carbon budget of no more than about 1,000 gigatonnes of CO<sub>2</sub> is still available after 2011 in order to stay under the 2<sup>0</sup>C degree climate limit with a likely chance (66% likelihood or higher). Assuming at least 2010 emission levels of 37 gigatonnes CO<sub>2</sub> of total CO<sub>2</sub> emissions for the years 2012-2015, the remaining carbon budget for after 2015 is 850 gigatonnes CO<sub>2</sub>.

[431] Dr Taylor calculated the emissions from the mine by categorizing the emissions as Scope 1, 2 and 3. His evidence was that :

- a. Scope 1 emissions are direct emissions from the mine (eg: fuel burned at the mine);
- b. Scope 2 emissions are indirect emissions associated with the mine (eg: emissions associated with the electricity used on the mine site); and

- c. Scope 3 emissions are supply chain emissions, being emissions associated with the mine but not specifically emitted by the mine (eg: the emissions associated with the transport and burning by third parties of coal produced by the mine).

[432] Scope 1 and Scope 2 emissions are defined under the *National Greenhouse and Energy Reporting Regulations 2008* (Cth) (NGER Regulations) as follows:

- a. Scope 1 emission of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of an activity or series of activities (including ancillary activities) that constitute the facility; and
- b. Scope 2 emission of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but that do not form part of the facility.

There is no definition of Scope 3 emissions in the Regulations.

[433] Dr Taylor’s calculations were set out in Table 1 of the joint report as follows:

Table 1 – Scope 1, 2 and 3 emissions associated with the Mine

Scope	Annual average emissions (tCO <sub>2</sub> -e)	Life of mine emissions (tCO <sub>2</sub> -e)
Scope 1	628,723	37,723,358
Scope 2	808,898	48,533,904
Scope 3	77,395,516	4,643,730,979
<b>Scope 1+2</b>	<b>1,437,621</b>	<b>86,257,262</b>
<b>Scope 1+2+3</b>	<b>78,833,137</b>	<b>4,729,988,241</b>

[434] Dr Taylor and Dr Meinshausen agreed that the combined Scope 1, 2 and 3 emissions would equal approximately 0.53% - 0.56% of the carbon budget that remains after 2015 to have a likely chance of not exceeding 2<sup>0</sup>C warming. It appears that the Scope 1 and 2 emissions associated with the mine will account for 0.01% of the world’s and 0.25% of Australia’s remaining carbon budget having regard to the 2<sup>0</sup>C target.

[435] Dr Taylor and Dr Meinshausen also said that current international pledges to reduce emissions are insufficient to achieve the stated goal of limiting warming to 2<sup>0</sup>C. It may be that national and international policies are adjusted to endeavour to reach that stated goal. Any emissions associated with the mine could therefore be regulated under such policies. Approval of the mine could either be consistent or inconsistent with the goal of limiting warming to 2<sup>0</sup>C depending on a range of external factors such as coal supply chain

economics, whether there is a potential premature end of the project before its end of life time, and to what degree carbon sequestration and storage is used when burning the coal.

- [436] The cumulative emissions related to the mine (4.49 or 4.64 gigatonnes CO<sub>2</sub>-e) are amongst the highest in the world for any individual project and the highest in the Southern Hemisphere. Annual coal production will be approximately 0.8% of global production in 2013. Associated emissions from burning the coal will be equivalent to approximately 0.2% of current global GHG emissions. The annual emissions associated with the mine could be equivalent to approximately 14% of Australia's base year GHG emissions in the year 2000 (567 Mt). Taking into account carbon embedded in Australia's current coal and gas exports (940 Mt), this percentage would be lower, that is approximately 5% of base year emissions. While burning the coal would not fall within Australia's national greenhouse accounts, the magnitude of the annual emissions associated with burning the coal would be equivalent to approximately 3 times Australia's annual emissions reduction target of 5% below 2000 levels by 2020.
- [437] Dr Hoegh-Guldberg's evidence was that the emission of greenhouse gases represents the single greatest threat to the Great Barrier Reef, which is already damaged and degraded with low resilience to further emissions of CO<sub>2</sub> from burning fossil fuels. Such emissions cause the twin problems of warming and ocean acidification. He said that current levels of atmospheric CO<sub>2</sub> and current warming approaching 1°C above pre-industrial levels are dangerous for the Great Barrier Reef. Allowing global temperature to increase 2°C above pre-industrial levels will lead to inevitable large scale changes to coral reefs. Allowing global temperatures to increase by 3°C would mean that any semblance of reefs in the Great Barrier Reef Marine Park would vanish.

***First Respondent's submissions***

[438] The first respondent submitted that:

- it is the cumulative emissions of the mine over its 30 year life that should be considered rather than the annual emissions. This is because it takes millennia for the carbon from coal burning to be removed from the atmosphere.
- The emissions from the mine will have a global impact in the physical cause and effect sense. That climate impact will damage Queensland's environment generally and the Great Barrier Reef specifically.
- Environmental harm likely to be caused by the GHG produced by the mining, transport and use of the coal is clearly harm which is a "direct or indirect" result of the mining activities as comprehended by s 14 of the EPA. It follows, therefore, that the fact that a decision to approve an EA for the mine would authorize that "environmental harm" requires the Court to consider the contribution that the mine would make to climate change through the mining, transport and use of the coal from the mine.

- If those submissions are accepted, it is irrelevant whether someone else will supply an equivalent amount of coal if this mine is not approved. What matters for the purposes of the MRA and EPA is the positive contribution to the harm caused by the relevant activity on a physical cause and effect basis.

[439] In the alternative, the first respondent challenged the previously accepted proposition that, because the thermal coal market is “demand-driven”, if this mine does not go ahead then an equivalent amount of coal will be supplied from elsewhere and consumption (and therefore emissions) will remain the same. The evidence from Mr Buckley and Dr Denniss (expert witnesses called by the first respondent) was that this proposition is at odds with conventional economics. The expected impact of an increase in supply of a commodity is a price reduction resulting in a movement of the demand curve leading to increased consumption. This evidence is examined in more detail below.

***Mineral Resources Act 1989***

[440] Section 269(4)(i), (j) and (k) provide that:

**"269 Land Court’s recommendation on hearing**

...

(4) The Land Court, when making a recommendation to the Minister that an application for a mining lease be granted in whole or in part, shall take into account and consider whether -

...

(i) the operations to be carried on under the authority of the proposed mining lease will conform with sound land use management; and

(j) there will be any adverse environmental impact caused by those operations and, if so, the extent thereof; and

(k) the public right and interest will be prejudiced."

*Section 269(4)(j): Whether there will be any adverse environmental impact caused by those operations and the extent thereof*

[441] In *Xstrata Coal Queensland Pty Ltd & Ors v Friends of the Earth – Brisbane Co-Op Ltd*<sup>103</sup>, it was held that the effect of s 269(4)(j), when read in conjunction with s 269(4)(i), was that the Court is required to consider the extent of the adverse environmental impact caused by the activities of winning and extracting the coal, that is Scope 1 and 2 emissions generated by the project<sup>104</sup>, but that emissions from the transportation and use of the coal, that is Scope 3 emissions, fall outside the scope of the “operations” referred to in s 269(4)(j). It followed that the Court’s role in relation to subparagraph (j) was limited to considering the adverse environmental impact caused by the activities associated with winning and extracting the

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<sup>103</sup> (2012) 33 QLCR 79.

<sup>104</sup> At [565].

coal, but not to the consideration of the GHG emissions from the burning of coal by end-users<sup>105</sup>. It is unnecessary to repeat here the reasoning supporting that conclusion<sup>106</sup>.

[442] In *Hancock Coal Pty Ltd v Kelly (No. 4)*<sup>107</sup>, Member Smith agreed with the conclusions in *Xstrata* about climate change.

[443] The first respondent in this matter sought to challenge the decision in *Xstrata* by submitting that the Court had erred by excluding the impacts of the transport and burning of coal from the mine from its consideration of the matters that fell within the words “any adverse environmental impact caused by these operations” under s 269(4)(j) of the MRA.

[444] The first respondent referred in particular to the decision of the Full Court of the Federal Court in *Minister for Environment and Heritage v Queensland Conservation Council Inc*<sup>108</sup> (the Nathan Dam case) and submitted that although that case had been discussed and distinguished in *Xstrata*, the reasoning in *Xstrata* was erroneous. This was because the key term in both statutes is “impact” which can include both direct and indirect effects of the action or operation. The first respondent said that the Court in *Xstrata* had not considered New South Wales and Victorian cases that had relied on the Nathan Dam case. Further, the Court in *Xstrata* had erred in its reliance on the decision of the Federal Court in *Wildlife Preservation Society of Queensland, Proserpine/Whitsunday Branch Inc v The Minister for Environment and Heritage*<sup>109</sup> as the reasoning relied on in that case was *obiter dicta* and erroneous. The first respondent also submitted that indirect, offsite impacts of the mine must be considered because s 269(4)(j) of the MRA refers to “any adverse environmental effect”. The legislature had thereby acknowledged, said the first respondent, that impacts of the mining operation may be many and varied, direct and indirect. The adverse environmental impact of the mining operations required to be considered by s 269(4)(j) includes the contribution of those greenhouse gases to climate change as a result of the downstream activities of transporting and using the coal won by the mining activities.

[445] In *Coast and Country Association of Queensland Inc v Smith*<sup>110</sup> (*CCAQ v Smith*) this issue was considered by the Supreme Court of Queensland in an application for a statutory order for review of the Land Court’s decision in *Hancock*. The Supreme Court held that the Land

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<sup>105</sup> At [530].

<sup>106</sup> See [520] – [570].

<sup>107</sup> [2014] QLC 12 at [216].

<sup>108</sup> (2004) 139 FCR 24 at [53]-[57].

<sup>109</sup> (2007) 232 ALR 510.

<sup>110</sup> [2015] QSC 260. The Supreme Court decision was handed down on 4 September 2015, after the completion of the hearing of this matter. The parties had been granted leave to file submissions about the Supreme Court decision (by Order dated 14 May 2015) but no submissions were received.

Court's approach to the interpretation of s 269(4)(i) and (j) was correct<sup>111</sup> and that it justified the relevant conclusions in *Hancock*.

[446] I do not accept the first respondent's submissions in this matter that the decision in *Xstrata* was incorrect in excluding the impact of scope 3 emissions from the matters to be considered in s 269(4)(j) of the MRA, that is whether there will be any adverse environmental impact caused by the operations. As discussed in *Xstrata*, there were differences between the wording of the relevant legislative provisions considered in the Nathan Dam case and s 269(4)(j). The first respondent's submissions do not address the complete wording in s 269(4)(j), namely that the Court is required to consider any adverse environmental impact *caused by those operations* (that is the operations to be carried on under the authority of the proposed mining lease (s 269(4)(i))). Moreover, the reasoning and conclusions on this issue have been followed by the Land Court in *Hancock* and approved by the Supreme Court in *CCAQ v Smith*.

*Section 269(4)(k): whether the public right and interest will be prejudiced*

[447] The Land Court held in *Hancock* that the climate change objection lodged in that case raised public interest considerations under s 269(4)(k) of the MRA<sup>112</sup> and that conclusion appears to have been approved by the Supreme Court in *CCAQ v Smith*<sup>113</sup>.

[448] Mr Stanford's<sup>114</sup> evidence in this case was that the supply of coal is governed by global demand which will not change as a result of the commissioning of the Carmichael mine. He said that, other things being equal, if the coal was not supplied by the Carmichael mine it would come from elsewhere. Global reserves of coal are very substantial. The first respondent criticized Mr Stanford's reasoning, submitting that the effect of approving the mine would be to increase supply. I do not accept that that is a necessary consequence. The effect of the mine may equally be to fulfil increasing demand or to remove other suppliers from the market. I have accepted Mr Stanford's evidence in this regard.

[449] It follows therefore that there will be no increase of greenhouse gas emissions if the Carmichael mine is approved. This is because alternative supply will be sourced elsewhere to meet global demand if the mine is not approved. In that sense then, the Scope 3 emissions into will not have an adverse impact on the public interest.

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<sup>111</sup> At [39].

<sup>112</sup> *Hancock Coal Pty Ltd v Kelly (No. 4)* [2014] QLC 12 at [218].

<sup>113</sup> [2015] QSC 260 at [39].

<sup>114</sup> Mr Stanford is an expert witness called by the applicant. He is an economist who specializes in energy markets.

### *Environmental Protection Act 1994*

[450] In *Hancock Coal Pty Ltd v Kelly (No. 4)*, the Land Court found that the evidence in that case had established there would be no difference in the quantum of global scope 3 emissions if the Alpha Mine did not proceed because the coal will simply be sourced from elsewhere<sup>115</sup>.

[451] In this matter, the first respondent submitted that such evidence and the conclusions drawn in that case were irrelevant and should not have been considered by the Land Court or given any weight because:

- the Court's approach removed from consideration the environmental harm caused by the mining activities that would be approved and made lawful by the grant of the environmental authority a matter that the Court was bound to consider by the combined effects of ss 14, 190, 191 and 493A of the EPA;
- the Court had misdirected itself in that the objections decision required the Court to assess the likely environmental harm of the mine, the subject of the application and not the likely impacts that might be caused by other activities;
- the notion that a certain person's unlawful activity (causing environmental harm) should be ignored because some other actor in the market may cause similar harm is, at best unconventional. No other unlawful actor could argue that the impact of her actions should be ignored because another actor might or will have stepped in to cause the same harm;
- there is an issue of general importance that arises – whether liability for a positive contribution to harm can be avoided on the basis of a party establishing that if a party did not act, someone else would cause equivalent harm in circumstances where the harm is not negligible and the party is one of many contributors to the harm.

The first respondent submitted that under the EPA liability for a positive contribution to harm could not be avoided in that way. To do so would defeat the object of the Act of protecting the environment while allowing for ecologically sustainable development. The Court must consider the contribution that the mining, transport and burning of the coal from the mine will make to climate change irrespective of the actions of other mines.

[452] In *CCAQ v Smith*, the Supreme Court held that the Land Court's factual finding in *Hancock Coal v Kelly* that, whether or not the proposed mine proceeds, there will be no effect on global demand for coal and therefore no effect on the amount of GHG emitted globally, was one that was available on the evidence and within the learned Member's jurisdiction to make<sup>116</sup>. The appellant in *CCAQ v Smith* had submitted (as the first respondent has done here) that the Land Court Member misdirected himself "in that the objections decision required the Court to assess the likely environmental harm of the mine the subject of the application and not the likely impacts that might be caused by other notional activities". In response to that submission, the Supreme Court held that the Land Court's conclusion was

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<sup>115</sup> [2014] QLC 12 at [229], [230].

<sup>116</sup> [2015] QSC 260 at [41].



one that was logically available and within the Court's fact finding powers on the basis that, if global emissions are not increased, then there is no impact that constitutes or causes environmental harm<sup>117</sup>. The Supreme Court held that these were essentially matters for the Land Court and they did not reveal legal error in the approach to its factual finding<sup>118</sup>.

[453] The conclusion in *CCAQ v Smith* also in my opinion disposes of the remaining submissions by the first respondent set out above. If in fact global emissions are not increased, then there is no impact that constitutes or causes environmental harm. It begs the question to assert, as the first respondent has done that the activity is unlawful without first determining whether there has been environmental harm caused by an increase in global emissions.

[454] The first respondent submitted that the contribution that the mine will make to climate change through direct emissions of GHG during the mining process and indirectly from the transport and use of the coal from the mine are relevant when considering other mandatory matters in both the EPA and the MRA – in particular, matters such as intergenerational equity; the character, resilience and values of the receiving environment; environmental values; environmental harm and the public interest under the EPA as well as the requirement in s 269(4)(1) of the MRA to consider whether any good reason has been shown to refuse a mining lease or required consideration.

[455] The Supreme Court held in *CCAQ v Smith* that in making an objections decision under the EPA the Court should include a consideration of Scope 3 emissions when considering the public interest<sup>119</sup>. It is accepted that Scope 3 emissions should also be taken into account in considering matters such as intergenerational equity and the character, resilience and values of the receiving environment.

[456] However, as discussed above in relation to the public interest test under the MRA, the evidence is that there will be no increase in Scope 3 emissions if the mine is not approved because other coal will be obtained from elsewhere. On that basis, therefore, I do not consider that matters such as the public interest, intergenerational equity and the character, resilience and values of the receiving environment will be adversely affected by the approval of the mine, at least in the context of the impact of Scope 3 emissions.

[457] The evidence was that the scope 1 and 2 emissions associated with the mine will account for 0.01% of the world's or 0.25% of Australia's remaining carbon budget having regard to the 2°C target. No evidence was adduced by the first respondent as to the impacts of the scope 1 and 2 emissions. The applicant submitted that it would be a negligible contribution. On the face of it, in the absence of specific evidence, I would not characterise such emissions as

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<sup>117</sup> At [45].

<sup>118</sup> At [46].

<sup>119</sup> At [39].

negligible but obviously, such emissions are significantly less than the scope 3 emissions. The impact of the scope 1 and 2 emissions will be taken into account when discussing my final conclusions.

### **Financial capability**

[458] Section 269(4)(f) of the MRA provides that:

“(4) The Land Court, when making a recommendation to the Minister that an application for a mining lease be granted in whole or in part, shall take into account and consider whether -

...

(f) the applicant has the necessary financial and technical capabilities to carry on mining operations under the proposed mining lease; ...”

[459] The first respondent objected to the grant of the MLs and the EA on the ground that the Adani Group does not have the financial resources in place – or likely to be put in place – to successfully commence and continue the project over the life of the proposed mine. In particular:

- The Australian mining company (Adani Mining Pty Ltd) has net debts of over AUD \$1 billion as at 31 March 2014, negative shareholder funds of \$44.9 million and had been loss making for the last 2 years.
- Production of coal from the proposed mine and transport to the export market requires the construction of the mine, rail and port facilities at an estimated cost of AUD \$17 billion. Approximately AUD \$14 billion remains to be funded.
- The Adani Group has consolidated net debts estimated at US \$12.7 billion and Adani Power Ltd has massive financial leverage. Consequently the project is highly unlikely to proceed without substantial new external investments of both debt and equity.
- Possible Government subsidies remain unclear.
- The Indian Government has recently articulated a plan to undertake a major overhaul of the Indian electricity industry and diversify the industry away from coal-fired power generation.
- No binding commitment has been made by the State Bank of India to consider financing US \$200 million of debt for the Carmichael project.
- Nine major international banks which could provide finance to the project have publicly declined to invest in the project.
- Considering the structural decline in the seaborne thermal coal market and the likely financial unviability of the project, there remains a significant risk that sufficient external investors will not be found.
- The lack of financial viability of the project is illustrated by the fact that Adani’s expectations for financial close on the project have been delayed by three to four years since first involvement in 2011.

- [460] Mr John Stanford was nominated by the applicant as an expert in the field of financial analysis and energy demands. Mr Timothy Buckley was nominated by the first respondent in those fields. Mr Stanford and Mr Buckley prepared a Joint Report (Coal Market Joint Report)<sup>120</sup>.
- [461] Mr Stanford, who is an economist with 20 years experience in economics and public policy in relation to energy markets, also prepared an individual report<sup>121</sup>. Mr Buckley, who is a financial analyst who has worked for over 30 years for private equity firms, prepared three individual statements of evidence – first report<sup>122</sup>, supplementary report<sup>123</sup> and second supplementary report<sup>124</sup>.
- [462] Mr Llewellyn Lezar<sup>125</sup> and Mr Rajesh Gupta<sup>126</sup> also gave lay witness evidence by affidavit and orally. Mr Lezar is the head of mining operations for the applicant and Mr Gupta is the group financial controller for the applicant.

### *The evidence*

- [463] Mr Gupta's evidence was that the applicant is a wholly owned subsidiary of Adani Enterprises Limited, an Indian company which had a revenue of AUD\$10 billion for the year ended 30 March 2014. Mr Gupta said that the applicant has the financial capabilities to develop and operate the Carmichael mine once key approvals have been obtained. He provided evidence of the financial position, financial capability and investment history of the Adani group of companies. Adani Enterprises Limited is Adani Mining's ultimate holding company. A restructure of Adani Enterprises was in train which would remove the revenue from Adani Power Limited and Adani Ports and Special Economics Zone Limited from Adani Enterprises. Consequently, about 40% of the revenue would be removed and the net profit of Adani Enterprises would be reduced to approximately \$180 million.
- [464] Mr Buckley's opinion was that the effect of the restructuring was that revenues will shrink materially and the profitability of Adani Enterprises would drop by more than 80% on current projections. The ability to borrow would drop commensurately.
- [465] Mr Buckley said that the accounts for the year ending 31 March 2014 demonstrated that the applicant (Adani Mining Pty Ltd) had net debts of over AUD \$1 billion, negative shareholder funds of \$44.9 million and had been loss making for the two years to 31 March 2014. He also considered that the applicant was unable to finance the project without substantial

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<sup>120</sup> JR007, Exhibit 36.

<sup>121</sup> AA009, Exhibit 37.

<sup>122</sup> OL015, Exhibit 38.

<sup>123</sup> OL021, Exhibit 39.

<sup>124</sup> OL025, Exhibit 40.

<sup>125</sup> AA001; AA005, Exhibit 4.

<sup>126</sup> AA003, Exhibit 5; AA012, Exhibit 9.

investments from banks because of its level of debt. He believed that it was unlikely that banks would fund the project given his estimates of financial unviability and further risks of structural decline. A greater concern for Mr Buckley was that an Australian bank would take the risk of funding and lose money, with consequential losses flowing to Australians generally.

- [466] The applicant submitted that Adani Mining was expected to be loss making during the development phase of the mine site as it had no source of revenue. It was also submitted that the fact that Adani Mining had incurred over AUD \$850 million of expenditure without any corresponding revenue pointed to the fact that the applicant was well funded. The Adani group had undertaken, in the accounts for the year ended 31 March 2014, to enable the applicant to pay its debts as and when they fell due for at least a period of 12 months from the date of those accounts.
- [467] Further, the applicant said, the fact that Adani Mining had incurred significant expenditure without any corresponding revenue pointed to a satisfactory level of funding. Evidence had been also given that funding was available from a loan facility for AUD \$680 million, \$460 million of which had been paid back with the benefit of funding from companies within the Adani group.
- [468] Mr Buckley criticized the high levels of debt and losses of Adani Abbot Point Terminal Pty Ltd. The applicant submitted that the accounts on which Mr Buckley relied for that proposition disclosed positive shareholders' equity of over \$398 million and a comprehensive income of over \$4.6 million. In any event, the financial position and performance of that entity was not relevant to the applications before the Court.
- [469] The applicant also submitted that Mr Buckley's evidence that the Adani group had not demonstrated that it had the financial capacity to fund the additional AUD \$10 billion to \$14 billion investment required for the Carmichael project was largely irrelevant. This was because potential investors will be likely to make decisions based on the merits of the project – its estimated future cash flows and the level of risk associated with those cash flows.
- [470] Mr Buckley said that Adani was reliant on Queensland Government subsidies to try to make the project commercially viable. However, the evidence is that the applicant's financial feasibility analysis has not assumed any form of Government subsidy in relation to the proposed mine. I therefore consider that the question of government subsidies is not relevant to the issues before the Court.
- [471] There was evidence that Adani Enterprises Ltd that has entered into a Memorandum of Understanding (MOU) with the State Bank of India whereby the bank has agreed in principal to consider providing funding of up to US \$1 billion for the development of the Carmichael

mine project. Mr Buckley said that the proposed US \$1 billion included an amount of US \$800 million extended to the Adani group in relation to the terminal at Abbot Point. Mr Buckley also referred to an article that appeared on the Business Standard website to the effect that the Chairman of the Board of the State Bank of India had said the net exposure would be about \$200 million. I am not prepared to place great reliance on that form of evidence.

[472] While there is evidence that there is a US \$800 million facility in place between the State Bank of India and Adani Ports, there is no evidence that that \$800 million is part of the \$1 billion referred to in the Memorandum of Understanding. Overall, I do not consider that Mr Buckley's evidence is sufficient to challenge the evidence as to the MOU in relation to the proposed funding for the Carmichael mine project.

[473] Mr Buckley also gave evidence that nine major international banks had publicly declined to invest in developments in the Galilee Basin and the Abbot Port Terminal. I do not consider that this evidence is persuasive on the issue of the financial capability of the applicant that I am required to consider under s 269(4)(f). Even if I were to find, which I do not, that that evidence indicated that those banks would not provide funding, that evidence says nothing about the ability of the applicant to obtain finance from other sources. Accordingly, I do not accept that that evidence points to a lack of financial capability on the part of the applicant.

[474] It is the case that financial close has not yet been achieved in relation to the Carmichael mine project in the sense that the project is not yet at the point that the proponent has the contractual rights to call upon necessary funds for its project. The applicant submitted that it is simply too early in the development of the mine for formal finance deals to be expected to have been agreed and financial close reached. In particular the MLs and EA for the project have not yet been granted. It does not follow that any adverse inference should be drawn from the fact that financial close had not yet been achieved.

[475] Mr Buckley criticized Dr Fahrer's<sup>127</sup> economic assessment of 30 January 2015 Attachment B<sup>128</sup> which, Mr Buckley said, provided a summary of a financial model of the proposed Carmichael coal project. The financial model was supplied by Adani Mining and, Mr Buckley said, it was affected by a number of omissions and errors such that it was unreliable. Mr Buckley then created a financial model using a number of assumptions which he considered to be more reasonable, conservative and prudent in order to better evaluate the question of commercial viability.

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<sup>127</sup> Dr Fahrer is an expert witness called by the applicant.

<sup>128</sup> AA006, Exhibit 43.

[476] As discussed further below, the applicant says that Mr Buckley has misunderstood the material presented by Dr Fahrer in Attachment B. Dr Fahrer was not providing a financial model of the project but an economic model. This issue will be considered further below.

[477] Mr Buckley's model incorporates the following key assumptions:

1. He used the long term futures price for thermal seaborne coal. He said that the financial markets provide a price of coal out to 2021 that reflects the current consensus on the outlook on demand and supply and what that means for prices. He then assumed real US dollar prices over the life of the mine, largely consistent with Dr Fahrer's model assumption although from a more realistic, lower starting point.
2. Mr Buckley included a 30% discount for the significantly lower than benchmark coal price Mr Buckley considered it likely that Carmichael coal would receive. This is because of the low quality of coal to be extracted from the mine. The Newcastle Export Benchmark Index has a net energy content of 6,000 kcal Net as Received (NAR) and a 12% to 14% ash content. The coal from the Carmichael mine has an energy content of ~ 5,200 kcal Gross as Received (4,950 kcal NAR) which is 17% lower than the benchmark. The 26% average ash content as disclosed in the SEIS is double the ash content in the Benchmark Index, Mr Buckley said.
3. The Australian dollar has continued to depreciate against the US dollar and Mr Buckley had updated the rate to reflect this. He said that the current spot rate was volatile around the US dollar 0.78/AUD level. He had held that constant over the life of the mine.
4. He had adjusted the run of mine (ROM) coal production to reflect closer to the Australian benchmark 80% yield on open cut mining to calculate product coal available for sale.
5. Mr Buckley assumed that there will be real fuel, labour and maintenance costs of running a 388 km rail line and normal port loading charges. He said those two significant costs had been omitted from Dr Fahrer's model.

[478] With those adjustments, Mr Buckley recalculated the cash cost of production in real Australian dollars and the estimated revenue per tonne of product coal in real US dollars and then converted that back into Australian dollars at the US dollar rate of 0.78.

[479] Mr Buckley said that the resulting cash cost of production average is AUD \$65.88/tonne over the life of the mine, which converts to US \$51.39/tonne. The revenue per tonne is US \$39.02 resulting in a gross cash loss of US \$12.37/tonne average over the mine life, before considering the interest costs on debt or any repayment of capital.

[480] Mr Buckley estimated that, excluding purchase costs, capital construction costs and carbon costs, the mine was estimated to lose money at the gross operating level every year with losses totalling US \$11,836 million (AUD \$15,174 million) in real terms. This equated to a real cash operating loss of US \$394 million (AUD \$505 million) per year on average.

[481] In Mr Buckley's view the Carmichael coal project was both financially unviable and unbankable. He said that Adani Enterprises would continue to struggle to find independent financial groups willing and able to fund the project. If the project were developed, he would classify it as extremely likely to be a stranded asset, that being a project that will not deliver

an economic return on new capital employed and which is likely to see a less than economic life as a result of global market and policy changes.

[482] The first respondent submitted that financial viability is also relevant to the objections decision under the EPA because if the mine were developed but became a stranded asset, then there will only be environmental harm with little, if any, economic benefit. Such an outcome would not represent economically sustainable development.

[483] Mr Lezar's evidence was that the coal produced by the mine will have average energy content lower, and ash content higher, than the coal that the Newcastle 6,000 kcal NAR benchmark measures. Adani Mining therefore reasonably expected to receive a lower price for the mine's coal than the Newcastle benchmark and, he said, the financial model for the mine had been prepared based on that expectation. The model reflected forecasts as to the future prices that will be achieved for coal of the quality to be produced by the mine. The evidence as to the discount applied by the applicant was given in closed court and it is unnecessary to disclose that figure in this decision.

[484] Further, Mr Lezar pointed out, the Adani group had commenced coal trading in 1999 and had built a substantial business and revenue from coal trading in India from that date. He said that the group has a demonstrated success record in this market and is one of the largest importers of coal in India. He was satisfied that, with that background, appropriate and relevant acumen and expertise was being applied at the Adani group level when forecasting future coal prices and demand levels.

[485] As to the costs of production, Mr Lezar said that the estimated costs for the mine are lower than average when compared with other thermal coal mines around the world with both open cut and underground operations. He considered the estimated costs to be reasonable and said that the lower average relative costs would be achieved as a result of the following factors:

- (a) the scale of the operation;
- (b) the size of the equipment to be used;
- (c) the use of standard gauge rail;
- (d) strip ratio; and
- (e) the high proportion of bypass coal that will be utilized in the mine, thereby removing the need for costs associated with significant coal washing<sup>129</sup>.

[486] Mr Lezar said Adani Mining is continually increasing its understanding of the quality of the coal seams to be mined and the marginal benefit/cost ratio that will be applied to washing coal that will be produced by the mine. As a result, Adani Mining had determined, after the completion of the SEIS, that the coal seams can be targeted in a manner that will mean that a

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<sup>129</sup> Mr Lezar explained that bypass coal is coal that is not washed through the mine's coal handling and preparation plant.

higher proportion of coal will be bypass coal and therefore unwashed. This increases the estimated yield overall.

[487] Further, in relation to costs, Mr Buckley had stated that he had benchmarked the likely mining costs against a sample of larger scale open cut mines in Queensland and New South Wales. The applicant submitted that there was no basis for the Court to accept that those mines were equivalent in any way to the Carmichael Mine. In particular, Mr Buckley had not chosen mines involving underground operations whereas the Carmichael mine will be a combination of open cut and underground mining. Costs are also inextricably linked to strip ratios. Mr Lezar's evidence was that the strip ratios for Mr Buckley's benchmark mines was 7.3, whereas Adani Mining's unchallenged evidence is that its strip ratios are 4.4.

[488] The applicant also submitted that Mr Buckley's rail costs estimates were in doubt because Mr Buckley had acknowledged that a number of comments and statements made in his report relate to the GVK/Aurizon rail proposal associated with the Alpha Coal and Kevin's Corner projects. It was not apparent that Mr Buckley had conducted a detailed analysis of the rail proposal associated with the Carmichael mine, a completely different proposal.

### **Energy markets**

[489] Mr Stanford and Mr Buckley also provided evidence about the state of the future market for coal, this being relevant both to the question of the financial capability of the applicant and the economic impact assessment of the project which is considered below.

[490] In their joint report<sup>130</sup>, Mr Buckley said that in his opinion the demand for thermal coal would peak globally in 2016 and thereafter there would be structural decline in demand. There would be continuing domestic coal demand declines in Western Europe, America, Australia and Japan coupled with peaking demand out of China by 2016. Mr Buckley said that this view was accepted either as a forecast or an increasingly likely probability by major global financial institutions such as Bernstein Research, Citigroup, Deutsche Bank, Morgan Stanley, Morning Star and Goldman Sachs. Indeed, Mr Buckley said, Goldman Sachs now have their global house forecasts showing that China coal consumption actually peaked in 2013. Mr Buckley noted that due to government policy changes in 2014 designed to reduce China's coal dependence, the Chinese Government announced it would cut China's coal export tariff from 10% to 3% in order to reinvigorate coal exports in the face of diminishing domestic demand. For the last year and a half, Bernstein has forecast China would return to a net coal export position by 2016.

[491] Mr Stanford had not undertaken his own projections or forecasts but relied on the recent work of the International Energy Agency (IEA) and the Australian Government's research agency,

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<sup>130</sup> JR007, Exhibit 36.



the Bureau of Resources and Energy Economics (BREE). Mr Stanford cited the recent IEA world energy outlook report which suggested that coal demand will grow by 15% to 2040, but with most of the growth coming in the next 10 years. In the same report, the IEA forecast that in 2040, just under three quarters of the world's energy demand would still be met by fossil fuels. Mr Stanford noted that the IEA report projects that China's coal consumption will peak by 2030 and that imports of coal by India will increase to 2040. In 2014 BREE noted that coal fired power is a major component of India's existing electricity generation capacity and this role is expected to expand with more than a 100 gigawatts of new coal fired capacity under construction.

[492] Mr Buckley said the IEA represented the views of a particular body which was authoritative in the depths of its analysis but it had a propensity to over-estimate fossil fuel demand and under-estimate the relevance of energy efficiency and renewable energy.

[493] Mr Stanford's response was that the IEA, which is part of the OECD based in Paris, is generally regarded as the most authoritative and independent international energy institution. While banks and other for profit agencies may make short term forecasts from time to time, the IEA reports regularly on an annual basis and provides detailed, long-term forecasts, in this case for 25 years. Mr Stanford had not previously seen instances of the IEA being accused of a pro-fossil fuel bias.

[494] Mr Buckley cited a statement by the Energy Minister of India that due to the economic need to rein in India's current account deficit, India should be able to stop imports of thermal coal in the next two or three years. Mr Buckley saw the Indian Government as pursuing an electricity sector reform program to replicate the scale of transition undertaken by China in the last five years. Mr Buckley said the IEA has not yet incorporated this Indian electricity sector transformation into their forecast.

[495] In Mr Buckley's view, a key driver of India's electricity transformation is predicated on the need for energy security through energy sector diversification and greater domestic self-sufficiency, rather than relying on increasing fossil fuel imports. India has rapidly cut fossil fuel import subsidies, is planning to double domestic coal production, lift wind installations three to fourfold over the next five years, and lift solar installations tenfold by 2019. A further US \$50 billion is planned for electricity grid efficiency gains by 2019. All of these will reduce India's dependency on thermal coal imports.

[496] Mr Buckley also said that seaborne thermal coal trade was a high marginal cost source of supply relative to domestic mine coal and hence seaborne traded coal would lose market share over time. He saw the global seaborne thermal coal market as entering structural decline yet Australia is forecast to gain market share in this declining market segment.

[497] Mr Stanford considered the Indian Energy Minister's statement to be more aspirational than a firm statement of policy. He said it would be impossible for India to develop its domestic coal industry to the extent that it would be able to meet rapidly growing demand for coal within two or three years. A recently announced strategic partnership between India and Australia was focussed on energy security, which imports of energy from Australia could provide. Mr Stanford was optimistic about Australia's ability to gain export market share especially under a lower exchange rate.

[498] Mr Stanford and Mr Buckley agreed that the future commercial viability of carbon capture and storage technologies (CCS) was a key unknown. If CCS eventually plays an important role, then that would provide significant support for the ongoing viability of the global coal industry. In the absence of CCS reaching commercial viability, the IEA forecasts that global climate policy actions will need to be significantly stepped up in order to limit global use of coal.

### **Economic Impact**

[499] The first respondent also objected to the grant of the MLs and the EA on the basis of issues surrounding the economic impact assessment included in the EIS. The objections are set out at paragraphs [109] to [122] of the first respondent's Further Amended Preliminary Identification of Issues<sup>131</sup> and are outlined here:

- The economic assessment methodology relied upon in the Environmental Impact Statement (EIS) was deficient for the reasons set out at [103] of the document.
- The Input/Output (I/O) model on which the economic assessment was based had significant shortcomings [104] – [107].
- The computable general equilibrium (CGE) model adopted by Dr Fahrer did not outline the weaknesses and limitations of CGE modelling and did not make explicit many of the assumptions used in the model [109] – [118].
- The cost benefit analysis (CBA) assumed that the mine is financially viable. However there were several issues that were not addressed or not addressed in detail that are important for financial and economic analysis [119] – [122].

[500] Section 260(1) of the MRA provides that an entity may lodge with the Chief Executive an objection in writing to the application for grant of mining lease. The section does not limit the grounds on which an objection may be lodged. Section 268(1) requires that the Land Court determine the relative merits of the application, objections and other matters. Section 269(4) requires the Court, when making a recommendation to the Minister about an application for a ML, to take into account and consider various matters.

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<sup>131</sup> OL010, Exhibit 2.

[501] None of the subparagraphs in s 269(4) expressly refer to an economic assessment of the project. However, s 269(4)(c) requires the Court to consider whether, if the land applied for is mineralised, there will be an acceptable level of development and utilisation of the mineral resources within the area applied for and s 269(4)(f) requires the Court to consider whether the applicant has the necessary financial capabilities to carry on the proposed mining operations.

[502] Section 269(4)(c) was considered by the Court of Appeal in *Armstrong v Brown*<sup>132</sup>. McMurdo J (with whom McPherson and Jerrard JJA agreed) referred to the decision of the High Court in *Sinclair v Maryborough Mining Warden*<sup>133</sup> and said<sup>134</sup>:

“What *Sinclair* shows is that the Tribunal should not recommend the grant of a mining lease unless the circumstances warrant that recommendation, having regard to the purposes for which the Crown should give a right to mine its minerals. There would be no proper purpose in recommending the grant of a mining lease which was not going to be used for or in relation to any mining. It is relevant for the Tribunal to enquire whether the mining for which the lease is sought is likely to be profitable, because mining is unlikely to occur if it is unlikely to be profitable. The relevance in this way of the likely profitability of mining is effectively recognised by para (c) of s 269(4), which requires the consideration of whether there will be an acceptable level of development and utilisation of the mineral resources. If there is unlikely to be a profit from the mining of the resources, it is unlikely that there would be an acceptable level of development and utilisation of those resources. ... Accordingly, I agree with the views of Kingham DP in *Salmon v Armstrong* [2001] QLRT 72, where she said that whilst there is no specific reference in s 269(4) to the “economic viability” of a project, “it is relevant to interpreting the information about mineralisation” and to at least the matters set out in s 269(4)(c).”

[503] It follows therefore that evidence of the economic impacts of the mine will be relevant to a consideration of s 269(4)(c) (and, I consider, s 269(4)(f)) at least to the extent that that analysis may throw light on the likely profitability of the mine and the financial capability of the applicant to carry out the mining operations under the lease.

[504] Of the remaining matters set out in s 269(4), it is arguable that the following subparagraphs may also be relevant to this objection:

- (i) whether the operations to be carried on under the authority of the proposed mining lease will conform with sound land use management;
- (j) whether there will be any adverse environmental impact caused by those operations and, if so, the extent thereof;
- (k) whether the public right and interest will be prejudiced;
- (l) whether any good reason has been shown for a refusal to grant the mining lease;
- (m) taking into consideration the current and prospective uses of that land, the proposed mining operation is an appropriate land use.

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<sup>132</sup> [2004] 2 Qd R 345.

<sup>133</sup> (1975) 132 CLR 473.

<sup>134</sup> *Armstrong v Brown* [2004] 2 Qd R 345 at [14], [15].

[505] Dr Jerome Fahrer was called by the applicant in relation to the economic impact objections. Mr Roderick Campbell was nominated by the first respondent as the relevant expert in this field. Dr Fahrer and Mr Campbell produced a joint expert report (First Economics JR)<sup>135</sup>.

[506] These were no areas of disagreement between Dr Fahrer and Mr Campbell in the first joint report although Dr Fahrer added some observations on which Mr Campbell did not comment. Dr Fahrer and Mr Campbell agreed that :

- The economic assessment methodology relied on in the EIS was deficient because:
  - it did not compare the costs and benefits of the project. It therefore could not assist in weighing and balancing the relevant matters to be considered by an approval authority when exercising its statutory power to determine a project application. There was no cost benefit analysis (CBA).
  - it did not provide any insight into the financial viability, economic efficiency or wider social implications of the project. A CBA should provide insight into the economic efficiency of the project, some understanding of financial viability and take into account social and environmental impacts where possible.
  - it did not estimate royalties or any other fiscal benefits to the State nor include consideration of subsidies and other fiscal costs that the project may impose on the State nor any non-market impacts such as social or environmental matters. A CBA should include non-market impacts.
- The I/O model upon which the economic assessment was based estimated the impact of the project on economic output (gross state product and gross regional product) and level of employment.
- The I/O modelling had significant recognized shortcomings because:
  - it did not take account of the fact that there are limited productive resources in the economy, effectively assuming unlimited resources such as skilled labour, land, water etc.
  - it ignored the opportunity costs associated with using resources for one project rather than another.
  - it assumed fixed prices, meaning that, regardless of the project's impact on input markets, no prices changed or substitution between goods and services occurred.

Dr Fahrer noted that a CGE model would overcome those shortcomings.

- As a result of the above shortcomings, the I/O modelling was likely to have significantly over-estimated the economic benefit of the project. Dr Fahrer said, however, that it was unclear to what extent output and income impacts were over-estimated. A CGE model would provide a more accurate estimate of output and income impacts.

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<sup>135</sup> JR003, Exhibit 41.

- Other deficiencies include:
  - the economic assessment does not consider the impact of royalty deductions including any royalty ramp up period agreed with the Queensland Government, pursuant to the Galilee Basin strategy. The experts said that this was not a criticism of the assessment because the assessment was written before the Galilee Basin strategy was launched. The purpose of the economic assessment was to assess the project as it stood, not to evaluate the Government policy of the day or speculate about how policy may change in the future.
  - the economic assessment did not consider the implications for the Queensland community of subsidies to the project under any infrastructure enabling agreement. The experts made the same comment about this issue as the previous.
- Dr Fahrer said that the benefit of an I/O model is that it provides an understanding of the order of magnitude of a project.

[507] The first respondent submitted that the EIS economic analysis was deficient, had significant shortcomings and was likely to overstate the employment benefits. The I/O analysis had been relied on at each stage of assessment including by the Coordinator-General who concluded that the project would deliver substantial economic benefits. Further, the EIS economic analysis relied on economic output as a measure of benefits without acknowledging that a large proportion of those benefits will flow offshore to the applicant’s overseas shareholders.

[508] The I/O analysis estimated the number of Queensland jobs generated by the mine alone to be over 10,000 full time equivalent (fte) jobs per annum at peak operation from 2024. As a result of his CGE model, which assumed a partially constrained labour market as compared with a wholly unconstrained labour market, Dr Fahrer estimated that the Carmichael Coal and Rail Project will increase average annual employment by 1,206 fte jobs in Queensland and 1,464 fte jobs in Australia. The first respondent submitted that the Court could not safely rely on the very small jobs benefits as a matter of significant weight to counterbalance the environmental impacts of the project.

[509] As a result of the first economics JR, Dr Fahrer prepared an expert report entitled “Carmichael Coal Mine and Rail Projects – Economic Assessment”<sup>136</sup> which contained both a CBA and a CGE analysis.

[510] The first respondent then nominated Dr Richard Denniss as an additional expert witness on the basis that Mr Campbell did not have sufficient expertise to deal with CBA or CGE modelling. Drs Fahrer and Denniss produced a joint expert report (Second Economics JR)<sup>137</sup>.

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<sup>136</sup> AA006, AA006.1, AA006.2, Exhibit 43.

<sup>137</sup> JR008, Exhibit 42.

Dr Fahrer subsequently produced a supplementary statement of evidence<sup>138</sup>. Dr Denniss also provided a statement of evidence for CGE modelling and CBA<sup>139</sup>.

- [511] The CBA measures the costs and benefits – economic efficiency – of a project relative to not doing the project. Dr Fahrer said that if the present value of a project’s benefits exceeds the present value of its costs, then the project is worth doing, in the sense that it is allocatively efficient. A CBA provides a means of determining whether a project should go ahead, from a social point of view, he said. A CBA says nothing about whether, or to what extent, a project will be privately profitable when the proponent is a private business. Nor does a CBA say anything about whether a private proponent should invest in a project e.g. the financing costs of a project are typically important in a private business case analysis but play no part in a CBA.
- [512] Dr Fahrer said that it is not conceptually correct to count in a project’s CBA the benefits and costs that arise in other markets, even if they are caused indirectly by the project. The cost of any environmental damage of GHG emissions from using the thermal coal produced by the mine should be counted in a CBA of the electricity production but not in a CBA of the Carmichael project. It is correct, however, to include in the Carmichael project CBA the environmental cost of GHGs emitted during the mining and transport of the coal.
- [513] Dr Fahrer’s CBA is for the project regardless of where geographically the cost or benefit occurs. He concluded that:
- (a) net benefits, in real present value terms, range between \$13 billion and \$17.6 billion if estimates of consumer surplus are excluded from the analysis, or \$35.1 billion to \$45.3 billion otherwise; and
  - (b) the benefits of the project outweigh its costs under a range of scenarios.
- [514] The CGE model measures the economic impact of a project, relative to not doing the project, in particular, economic output and real income. The model takes account of interactions between industries and the effects of price changes and resource constraints in an economy. As such, Dr Fahrer said, CGE models provide the most theoretically sound and empirically comprehensive method of evaluating the economic impacts of major projects, shocks to an economy (such as a financial crisis) or policy reforms. However, Dr Fahrer said, CGE modelling is limited in that it does not take into account non-market effects of economic activity, including externalities such as pollution, congestion etc. By definition, externalities are not taken into account when only the forces of demand and supply determine the prices of goods and services.

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<sup>138</sup> AA016, Exhibit 44.

<sup>139</sup> OL022, Exhibit 45.

[515] Dr Fahrer's CGE model presented results for real output, real income, employment and other economic variables of interest for the MIW region (Mackay, Isaacs and Whitsunday local government areas), Queensland and Australia over the period 2014-2015 to 2046-2047. The modelling showed that the first phase of the project will add:

- (a) \$61,577 million (in undiscounted terms) to Australian real economic output; and
- (b) \$42,282 million to Australian real income.

[516] The net benefits in present value terms are between \$18.6 billion and \$22.8 billion. Most of the increase in real output will occur in the MIW region, while most of the increase in real income will occur in the rest of Queensland. The principal reason that the increase in income is less than the increase in output is that the applicant is foreign owned and the profits (after tax and royalties) from the project will not accrue to Australian residents.

***Analysis of reliability of applicant's model input data – in both models***

[517] The first respondent submitted that the two new economic models produced by Dr Fahrer, the CGE model and the CBA model, were deficient because unreliable input data or assumptions had been used. In particular, the first respondent submitted, the estimated royalties were unproven and unreliable, coal prices were unjustified and unrealistically high, corporate tax did not account for deductions or tax havens and the project costs were underestimated.

***Estimated royalties are unproven and unreliable***

[518] The first respondent said that:

- the documents submitted with the mining lease application estimated benefits to the State Government from royalty payments in excess of \$20 billion<sup>140</sup>;
- the evidence of Mr Lezar was that the royalties payable to the State over a period of 30 years (Phase 1 of the project) would be approximately \$14.19 billion;
- the evidence of both Mr Lezar and Mr Gupta was unclear as to whether this figure was in real or nominal terms, whether it was discounted to present day value and whether it was in Australian or US dollars;
- Attachment B to Dr Fahrer's report estimated the royalties at \$7.845 billion (real Australian dollars)<sup>141</sup>. The royalties were not discounted to present day value. Applying the discount rate of 2.8% and 4.3% from Dr Fahrer's report, the present day value of the royalties would be approximately \$4.8 billion and \$3.8 billion respectively;
- the applicant tendered guidelines from the Commonwealth<sup>142</sup> and New South Wales<sup>143</sup>. The New South Wales guidelines suggest discounts of 7% and 10%. If

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<sup>140</sup> MR010 at 62.

<sup>141</sup> AA006, Exhibit 43, Attachment B.

<sup>142</sup> AA057, Exhibit 113.

<sup>143</sup> AA058, Exhibit 114.

those figures were used, the net present value of the royalties would be \$2.56 billion and \$1.74 billion respectively;

- As the royalties were calculated on the basis of coal prices and were highly dependent on those prices, the royalties calculation would be too high if the estimated coal price was too high. No witness had confidently attested to the accuracy of the royalty figures provided to the Court. For those reasons little reliance could be placed on the royalty figures provided by the applicant.

[519] It appears that the discrepancy between the various figures may be explained as follows. The \$20 billion estimate may be for the whole of mine proposal rather than the first phase, which the application before the Court is concerned with. Mr Gupta's evidence was that he thought Mr Lezar's figure of \$14.19 billion was in US dollars because Adani's models are in US dollars, and partly in real and partly nominal dollars. Dr Fahrer's figure of \$7.485 billion was real Australian dollars. Mr Ambrose suggested that it would be unnecessary for Dr Fahrer to convert the figures into real terms if the royalties per tonne supplied by the applicant were already expressed in real terms. That is so, but the evidence was not clear whether the US figures were in real or nominal dollars or both.

[520] It is clear that Dr Fahrer's figure of real AUD \$7.485 billion is the applicant's most recent estimate of the royalties likely to flow from the project. I will return to the question of the input figures used by Dr Fahrer, below.

*Coal prices are unjustified and unrealistically high*

[521] The first respondent submitted that the coal price inputs into columns 3 and 4 of Attachment B to Dr Fahrer's first report were unreliable because those prices were discounted from a benchmark price that was at least 30% above the current benchmark and, moreover, no witness was called in support of those prices.

[522] It appears that the applicant's prices were derived from a Wood Mackenzie analysis and that Dr Fahrer had received the prices from the applicant.

[523] Mr Buckley estimated in his second report that the coal price the applicant would receive throughout the project was about AUD \$50/tonne. Dr Fahrer was critical of Mr Buckley's estimates saying that Mr Buckley's price from 2021 onwards was 40% below the current Newcastle benchmark price for high quality coal.

[524] The first respondent submitted that Dr Fahrer was not an expert in coal markets or coal prices. Accordingly, the first respondent submitted, the applicant's coal price estimates should be rejected and Mr Buckley's estimates preferred, considering Dr Fahrer's professed lack of expertise in the area, his uncritical acceptance of the applicant's coal prices and the lack of any other witness to support the applicant's figures.



[525] Mr Buckley's more realistic coal prices had the consequence, it was submitted, that the royalty estimates should be reduced, the gross income for the project was overstated, any marginal profits and therefore corporate tax payable were overstated and the CBA net result would be negative rather than positive which would diminish any prospects of financial viability.

*Corporate tax does not account for deductions or tax havens*

[526] Attachment B to Dr Fahrer's report includes in column 15 an estimate of corporate tax to be paid in Australia by the applicant in respect of the profits from the project. Dr Fahrer's evidence was that he had received that information from the applicant in nominal US dollars per tonne which he converted to real Australian dollars. He made no inquiries as to how the figures were derived.

[527] Mr Buckley calculated that the data provided by Dr Fahrer suggested an average corporate tax rate of 32% which made no allowance for deductible depreciation on borrowing costs and did not take into account Adani group's current tax minimization strategies including the financing structure of the Australian entities and the creation of a number of legal entities in offshore tax havens.

[528] Mr Gupta was not sure if borrowing costs were included in the costs provided to Dr Fahrer although he assumed they were not. Similarly Mr Gupta could not verify whether the costs provided to Mr Buckley included depreciation although he said that if the capital expenditure had already been considered, depreciation should not have been included in the operating expenditure.

[529] The figures in column 15 total \$9.967 billion in real Australian dollars. Dr Fahrer agreed that that figure would need to be discounted to present day values and did not disagree that at his discount rates of 2.8% and 4.3%, the present value of corporate taxes would be \$5.989 billion and \$4.468 billion respectively. Dr Fahrer also did not disagree with the figure of \$3.037 billion if a discount rate of 7% were applied. He agreed that only about 20% of those Federal taxes would be spent in Queensland. The first respondent submitted that, depending upon the discount rate, this equated to \$1.19 billion and \$607 million over the project life of 30 years.

[530] The first respondent submitted that no reliance should be placed on the applicant's corporate tax figures because no witness was offered in direct support of the calculations, the calculations did not appear to take into account potentially significant deductions for borrowing costs, depreciation or tax optimisation measures, and the numbers rapidly deflated in cross-examination. The first respondent also noted that Mr Buckley had calculated that the applicant would not pay any tax for the simple reason that he did not expect the project to make any profit.

*Costs optimistically underestimated*

[531] Dr Fahrer and Mr Buckley provided estimates of project costs to the Court. The first respondent was critical of Dr Fahrer's acceptance of the costs provided by the applicant because it had become evident that the figures in two of the columns were in error. Those errors were corrected by Dr Fahrer.

[532] The essential difference between the parties was as to the cost advantage attributable to the scale of the operation. It appears that the applicant assumed a 48% cost advantage whereas the first respondent applied a 30% advantage, as compared with comparable Australian mines. The first respondent submitted that the more reliable estimates of costs were those prepared by Mr Buckley.

*Analysis of assumptions in applicant's CGE model*

[533] The first respondent said that the relationships assumed for the applicant's CGE model were highly unrealistic.

*Conventional economics would see increased supply, increasing consumption and reducing price*

[534] The first respondent submitted that in conventional economics, the price and quantity of a product are determined by the interaction of supply and demand. The evidence of Dr Denniss and Mr Buckley was that coal markets operate like any other commodity market, such that if a producer decides to enter the market then, all other things being equal, the supply curve would shift to the right such that quantity increases and price decreases. There may be consequential or secondary effects, the first respondent said, such as the reduction in prices pushing out higher cost producers, thereby reducing supply and increasing price again. But Dr Denniss had said that those should be modelled separately so as to understand the relative effect of each step.

[535] Mr Stanford's response was that all other things are not equal and, in particular, demand does not hold still but can be assumed to continue to increase. The first respondent said that that was not to the point. It was submitted that as long as the increased supply from the project did not in itself shift the demand curve, which no one had suggested, the increase in supply from the mine would have the impacts on consumption and price that Dr Dennis and Mr Buckley described.

*Applicant's model conflates several assumptions*

[536] Dr Denniss said that the foundation of economic analysis is that, to try to describe what is observed, economists create models where they change one thing and see how it affects other things. However, the first respondent said, Dr Fahrer had modelled three changes simultaneously – a mine producing 40 Mt of coal per annum, an identical increase in world demand for coal, and a shift in world preferences to the Carmichael coal over other coal in

precisely the quantity that the mine produces. The result was, said Dr Dennis, the Court was not able to distinguish the benefits that come from increased demand and the benefits that come from building a new coal mine.

*Applicant's model assumes perfect substitution of quantity*

- [537] The first respondent submitted that the applicant's model assumed that world demand for coal would increase by 40 Mt and that if the mine proceeds it would perfectly substitute an identical supply of 40 Mt. In other words, the model has an inbuilt assumption that there will be no more coal consumed in the world as a result of the Carmichael mine. The first respondent submitted that this was a modelling choice and that there was no evidence to establish the assumption as a factual reality. There was no explanation as to how or why other producers would perfectly restrict supply without a price signal.
- [538] The first respondent said that Dr Fahrer had assumed that the applicant would meet new demand that no one else was meeting, but, said the first respondent, no logical reason for that assumption had been offered. The result was that the model predicted a reduction in world supply of coal despite the increasing supply from the largest coal mine in Australia. This was palpably strange and the modelling choice was not connected to reality, said the first respondent, because it requires the suspension of conventional economic theory which says that introducing 40 million tonnes of coal to the thermal coal market would ordinarily increase supply, depress prices and increase the quantity of coal consumed, leading to higher greenhouse gas emissions.
- [539] Dr Fahrer said that he had assumed that the project is a response to existing demand for coal. Accordingly, the supply from the project is counter-balanced by a reduction in supply from other mines elsewhere. Dr Fahrer said that this is a standard assumption in modelling the impacts of an industrial mining project on the mining industry as a whole, and he said, that assumption is more commercially realistic. Moreover, said Dr Fahrer, if the volume of coal in the market increased as a result of the project, the result would be that the benefits of the project would be increased because negative impacts on other operators in Australia and Queensland would be removed. Under Dr Fahrer's assumption, output from the mine comes at the expense of other mines around the world, including in Australia. Under Dr Dennis' assumption, Dr Fahrer said, the negative effect on Australian coal mining would be absent.
- [540] Dr Fahrer agreed that the effect of the assumption of perfect substitution is that there will be no effect on coal prices and also said that even if prices were affected, the effect would be trivially small. This was because the supply from the Carmichael mine was small compared with the total of the world's production of coal.

[541] The first respondent submitted that Dr Fahrer had ignored that the relevant destination market for the Carmichael coal is the seaborne market which is a much smaller subset of all the coal produced in the world. Mr Buckley's opinion was that the coal from the proposed mine would be a significant component of that market and consequently be likely to have a price effect of up to 5%. Dr Fahrer had not modelled any price effect and, the first respondent submitted, his CGE model should have been sensitivity tested for the price effect which was at least plausible. Dr Denniss had demonstrated, said the first respondent, using another CGE model prepared by the Centre of Policy Studies, that the projected benefits of the model could be dramatically altered and become negative if even just a 1% price effect were modelled. Further there was evidence that at least 50% of Australian coal mines were currently operating at a loss and, said the first respondent, the industry cannot cope with a self-inflicted further price decrease. The economic damage would be extensive and has not been revealed or quantified by the applicant.

*Applicant's CGE model assumes objectively low discount rates*

[542] Dr Denniss gave evidence that to value future income in present day values, the future income should be discounted for the risk that it might not be realized and the returns that could be earned if the income were available to be invested today. Dr Denniss said that there is no objectively accurate discount rate – it is a choice for the decision maker – but a modeller should prove a range of discounts so that the decision maker may choose the most appropriate in the circumstances.

[543] As noted above, Dr Fahrer used discounts of 2.8% and 4.3% rather than the conventional 4% to 10%. This, Dr Denniss believed, required further justification.

*Applicant's CBA model is highly susceptible to assumptions*

[544] The first respondent submitted that Dr Fahrer had assumed that the scope of the CBA was global and had included global benefits such as profits accruing offshore to the applicant and benefits accruing to the owners of coal fired power stations in India and elsewhere. That choice meant that significant economic benefits were included in the CBA calculus even though they only accrued outside Queensland. If both of those benefits were excluded, then the CBA would be negative.

[545] The first respondent also submitted that having made the choice to adopt a global CBA, Dr Fahrer should have been consistent and attempted to include global costs. In particular the costs of the carbon emissions from the power stations should have been included. There is no consensus among economists as to how far downstream one goes when considering the scope of a global CBA.

- [546] Dr Fahrer had selected a carbon cost of \$126 per tonne of carbon emissions. The first respondent said that if that assumed cost were applied to total emissions from burning the coal from the project, the externality costs to the world would be around \$560 billion, which vastly exceeded the benefits of the project estimated by Dr Fahrer in the CBA. If only 10% of the scope 3 emissions were included then the cost to the world of emitting that carbon would be AUD \$1.008 billion per year. Over the 30 year life of the project would be more than AUD \$30.24 billion.
- [547] Dr Fahrer agreed that one of the key tasks of a CBA is to include unpriced externalities such as pollution and in particular greenhouse gas impacts. He had made no attempt to cost any of the environmental impacts from the project in his CBA as there was no agreement as to the extent of the impacts and no reliable method of assigning values. Instead, he applied the alternative approach of asking how big the external costs would have to be to undo the benefits of the CBA. Dr Dennis argued that some attempt should have been made to ascribe a value to the anticipated impacts and that uncertainty in those values could have been made clear through error bars. The effect of Dr Fahrer not attempting to value external impacts, Dr Dennis argued, was that Dr Fahrer had implicitly placed a value of zero on those impacts.
- [548] Dr Fahrer's CBA identified that the estimated benefits depend largely on forecasts for thermal coal prices and volumes. The amended figures in his analysis of the sensitivity of the estimated benefits to price gave an implied average break-even coal price of AUD \$60.34 to \$60.46 (at an exchange rate of 0.70). However, the first respondent submitted, futures prices out to 2021 are already below US \$60 for the high quality Newcastle benchmark coal. At an exchange rate of 0.70, together with a 30% discount to reflect the low quality coal as proposed by Mr Buckley, then the price for the Carmichael coal is already below AUD \$60 and therefore below the price at which the estimated benefits become negative.

## **Conclusions about financial capability and economic impact assessment**

### ***Financial capability***

- [549] It is clear from the wording of s 269(4)(f) that the focus of that part of the enquiry relating to the financial capability of the applicant is "to carry on mining operations under the proposed mining lease". On the face of it, therefore, this Court is not concerned with the financial standing of other aspects of the applicant's enterprise, namely the rail and port construction. In *Armstrong v Brown*<sup>144</sup> however, the Court of Appeal held that the effect of s 269(4)(c) was that it was relevant for the Court to enquire whether the mining operation is likely to be profitable.

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<sup>144</sup> [2004] 2 Qd R 345.

- [550] The first respondent raised issues as to the level of debt incurred by the applicant, the capacity of the applicant to obtain appropriate funding to carry out the mining operation, and the likely profitability of the mine.
- [551] The applicant has adduced evidence that the applicant has expended over AUD \$850 million as at the date of the hearing and that the Adani Group had undertaken to pay the applicant's debts as they fell due until at least 31 March 2015. I accept therefore that the applicant has been well funded to date.
- [552] Further there is evidence which I have accepted that funding was available from an existing loan facility of AUD \$680 million, \$460 million of which had been paid back by the Adani Group and that Adani Enterprises Ltd has entered into a MOU with the State Bank of India for consideration of funding the mining project up to \$1 billion.
- [553] I have also accepted that the fact that the applicant has high levels of debt and has been loss making for the last two years is not necessarily surprising given that the mine is not yet in production. It is not a matter that of itself points to a lack of financial capacity on the part of the applicant.
- [554] It is significant that Dr Fahrer was engaged in economic modelling whereas Mr Buckley was modelling the financial viability of the project. The purposes of the two exercises are quite different and the inputs are not necessarily transferable between the two.
- [555] Dr Fahrer's evidence was that Mr Buckley had erred by using data from the CBA in his financial analysis. In particular Mr Buckley included an item for carbon costs that should not be included in a financial analysis because carbon costs are an externality that the applicant will not be paying. However carbon costs are a social cost and therefore should be included in a CBA.
- [556] Dr Fahrer also said that coal royalties and interest costs should be included in a financial analysis, as Mr Buckley had done. However, if Mr Buckley were intending to carry out a CBA, royalties should not be included because they come out of project revenues. Similarly interest should not be counted separately in a CBA because interest represents the opportunity costs of capital which is already accounted for in the discount rate.
- [557] I have accepted these criticisms and, therefore, I do not consider that Mr Buckley's model accurately reflects the financial viability of the project.
- [558] Leaving aside for the moment the evidence relating to the energy market and Dr Fahrer's Attachment B, I consider that such evidence as was put before me establishes that the applicant has the necessary financial capacity to carry on mining operations.

### ***Energy markets***

- [559] There were considerable differences between the applicant's and the first respondent's evidence as to the prices at which the coal might be sold over the life of the mine. This of course depends on the state of the relevant market at any given time. One thing that is to be noted at the outset is that the experts were clear that nobody could say with any certainty what the price of coal might be in 10 years time. Further evidence about the future coal price is discussed below in the context of the discussion of the economic impact of the mine.
- [560] The future of the thermal coal market was also the subject of other conflicting evidence. Mr Buckley's opinion was that that the market would be in structural decline from 2016. Mr Stanford said that it would peak in 2040. In the end it appears that the differences were caused by the different market forecasts on which each relied. Mr Stanford relied on the forecasts of the IEA and BREE, both specialist energy agencies. Mr Buckley relied on the forecasts by major financial institutions. The differences in the forecasts may well relate to the differing functions and purposes of these bodies. I am not persuaded that the applicant would be in error to rely on the IEA and BREE forecasts. I can only conclude that there is uncertainty as to the future of the market for thermal coal in the next 30 to 35 years but the uncertainty is not such as to enable me to say that this project is unviable.
- [561] I also consider that it is unlikely that the applicant and its parent company would undertake the large investment made to date, and required in the future, unless they were confident of a successful outcome. It is also relevant to note in this regard that Adani Enterprises has been trading in coal since 1999 and has substantial experience in that field.

### ***Economic modelling***

- [562] Again there was significant conflicting evidence given by the relevant experts as to the adequacy of the economic modelling carried out in respect of the project.
- [563] There is no doubt that the I/O modelling relied on in the EIS was deficient for the reasons set out above. Consequently, the applicant carried out CBA and CGE modelling to address the deficiencies. The first respondent challenged the reliability of the input data and the assumptions in those models.
- [564] The first respondent submitted that the coal price inputs into Dr Fahrer's model were unjustified and unrealistically high. The prices obtained will be affected by the market price for Newcastle benchmark coal and the discount applied to allow for the lower quality of the Carmichael coal as compared with the Newcastle benchmark.
- [565] I am prepared to accept the discount rates adopted by the applicant as the applicant has detailed knowledge of the quality and processing of the coal, as discussed below. However, as noted above, it is not possible to be certain about the prices at which coal will be sold in

the future. Nevertheless, there was evidence, which I have accepted, that the projected prices adopted by the applicant are probably higher than current trends in the market would warrant, at least in the early years of the projections. That does not mean that I have accepted that Mr Buckley's inputs are correct. I have instead taken the view that there is a great deal of uncertainty surrounding the prices. The prices obtained will also be affected by fluctuations in the exchange rate of the Australian and/or US dollars.

[566] If the selling prices adopted by the applicant are high, then the estimated royalties and the corporate tax payable will be overstated.

[567] The corporate structure of the Adani Group is complex and in my opinion it is not relevant to this Court's enquiry to examine that structure or to pass judgment on any tax minimisation strategies adopted by the Group. It is apparent that the applicant must pay tax on income earned or deemed to be earned in Australia. Mr Buckley's position is that no profit would be made but I have not accepted his financial model.

[568] Although the first respondent's evidence was that the corporate tax figures do not appear to take into account potentially significant deductions for borrowing costs and depreciation, I do not consider that it is within the scope of this Court's enquiry to examine in detail the proposed structure for the project. The applicant has provided prima facie evidence of the corporate tax payable, for the purposes of a CBA analysis, not a financial analysis. I have accepted that evidence as I do not consider it has been effectively challenged. Further, I do not accept Mr Buckley's evidence that no profit will be made as he reached that conclusion on the basis of a number of assumptions that I have rejected.

[569] The applicant and first respondent are also in disagreement as to whether the applicant's modelling reflected the current costs of production. Mr Lezar gave evidence that in his opinion the estimated costs were reasonable given the scale of the operation, the quality of the coal seams to be mined and the high proportion of bypass coal that will be produced from the mine. I have accepted Mr Lezar's evidence. Mr Lezar demonstrated a detailed knowledge of the features of the subject proposal, which Mr Buckley did not have. Further, Mr Buckley drew comparisons with other projects, both mining and rail projects, which were not on all fours with the subject and which therefore did not provide an accurate comparison.

[570] I turn now to consider the first respondent's objections to the assumptions underlying the applicant's CGE model. One difference between the two parties was whether it was valid to assume, as has been done in Dr Fahrer's model, that there will be no more coal consumed in the world as a result of the Carmichael mine. The first respondent said that conventional economics would assume that increasing supply would lead to increasing consumption and a reduction in price.



[571] The crux of the difference between the two parties appears to turn on the fact that each is applying a different form of analysis. The applicant has assumed that both supply and demand are increasing whereas the first respondent has assumed that supply will not be increasing. Both appear to be legitimate assumptions depending on the type of modelling undertaken.

[572] However, even if it were accepted that the first respondent's position is correct, I do not consider that any consequent increase in the supply of coal and reduction in price provides reasons for refusing approval of the mine.

[573] The first respondent submitted and adduced evidence that the discount rates adopted by Dr Fahrler to value further future income in present day values, were lower than those recommended in the NSW guidelines. That does appear to be the case. The consequence is that Dr Fahrler's estimates of income may be somewhat overstated.

[574] I also accept that Dr Fahrler's CBA analysis does not include the externality costs attributable to total emissions from burning the coal produced by the mine. Dr Fahrler's evidence was that it would not be conceptually correct to count those externality costs in a CBA for the mine project because the cost of any environmental damage caused by GHG emissions from burning the coal should be included in a CBA of the electricity production. I have accepted that evidence and therefore do not consider that Dr Fahrler's CBA model is defective in not including the externality costs.

[575] Overall, my conclusions about the financial and economic evidence are that the applicant has overstated certain elements of the benefit of the mine both in the EIS and in the evidence before this Court. In particular:

- the I/O analysis in the EIS estimated the number of Queensland jobs generated by the mine alone to be over 10,000 fte jobs per annum from 2024. Dr Fahrler's evidence, which I have accepted, was that the Carmichael Coal and Rail Project will increase average annual employment by 1,206 fte jobs in Queensland and 1,464 fte jobs in Australia;
- the applicant's input figures contained in Dr Fahrler's CGE and CBA modelling probably overstate the selling price of the coal and therefore the royalties generated by the project and the corporate tax payable;
- the discount rates adopted by Dr Fahrler, to value future income in present day values, are lower than those recommended in some guidelines;

While the employment benefits have been corrected in Dr Fahrler's analysis, the other figures remained. The result is that the benefits of the project are likely to be less than modelled by Dr Fahrler. This is not a matter which leads me to conclude that I should not make a recommendation that the applications not be granted. Rather, I shall draw this information to the attention of the Minister.

## Second respondent's objection

- [576] As noted above, the second respondent, Conservation Action Trust, objected to the application for the EA under the provisions of the EPA. Pursuant to Land Court Practice Direction No 7 of 2013, the second respondent elected to be a Level 1 Objector. The Practice Direction provides for Level 1 Objectors to rely upon their notice of objection only and would not attend the hearing. Accordingly, the second respondent did not file any material, call any evidence, cross-examine any witnesses or make any final submissions. The information set out in the following paragraphs is taken from the second respondent's Submission Form<sup>145</sup>.
- [577] The Conservation Action Trust is an organization located in Mumbai, India. The organization works with communities in Mundra, Tiroda and Bhadreshwar in India, all of which are in the proximity of coal-fired power plants that are currently operational or in development and that are owned by the Adani Group of companies.
- [578] The basis of the objection was that the Carmichael mine and rail project was likely to directly harm the health of local communities in proximity to coal-fired power plants owned by the Adani Group. The second respondent said that the communities are generally poor, rural communities living in poor and inadequate living conditions. Some of the communities are already suffering from health and environmental harm from coal-fired power plants. For example, some community members report that coal ash and dust falls on to their homes, and even their bodies when they sleep on their terraces at night. The second respondent submitted that the project is likely to directly affect the communities. This is because the Adani Group intends coal from the project to be transported to India where it will be burned in the Adani Group's power plants. The Carmichael coal will be key in meeting the Adani Group's aim to expand its capacity to 20,000 MW of power generation by 2020.
- [579] The second respondent also said that burning coal from the project will cause pollution that harms human health in that emissions such as sulphur dioxide, particulate matter, mercury and nitrogen oxides are likely to damage health. Similarly, the coal-fired power plants create significant amounts of waste water that contain toxic pollutants which may be discharged directly from power plants. In addition, the transportation of coal from port to power plant causes pollution that harms human health and the use of water in coal-fired power plants affects the livelihood of fishing communities.
- [580] The second respondent submitted that the harm to the communities is outweighed by any purported benefits to those communities. Further, the administering authority must consider the international impacts of the project in view of Australia's international environmental

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<sup>145</sup> SP001.15

responsibilities. It was submitted that the administering authority should not grant the EA to Adani Mining for the project.

***Conclusions about the second respondent's objection to the application for the EA***

[581] Earlier in these reasons I decided that Scope 3 GHG emissions would not be increased as a result of the approval of this mine, and therefore there would not be an adverse impact from burning the coal from the mine. This was because the evidence was that if the coal is not sourced from the Carmichael mine it will be sourced elsewhere.

[582] I consider that the same reasoning should be applied in response to the second respondent's objection. Therefore I will not take that objection into account in my recommendation to the administering authority under the EPA. In any event, it is noted that, because the second respondent elected to be a Level 1 Objector and did not adduce any evidence in this matter, there is no proof of the factual matters which form the basis of the second respondent's objection.

***Observations to the Honourable the Minister administering the Mineral Resources Act 1989 and the administering authority under the Environmental Protection Act 1994***

[583] As discussed above, I have accepted that the survival of the globally significant population of the endangered BTF will be threatened by the proposed mine. There was evidence that the area around the Ten Mile Bore (which is located near the dividing boundary between MLA 70441 and MLA 70506) may be important in sustaining the BTF population. There is also evidence that the applicant has given consideration to changing the mine design by increasing the area of underground mining to replace open cut mining in the northern part of the lease area. There is also evidence that this may reduce the impact of the mine on the BTF habitat in that area.

[584] I draw this evidence to the attention of the Honourable Minister and the administering authority with the suggestion that this proposal be explored further with the applicant, with a view to improving the chances of survival of the BTF.

[585] I also draw to the attention of the Honourable the Minister administering the *Mineral Resources Act 1989* that the evidence was that the estimate in the EIS of the number of Queensland jobs to be generated by the mine alone was 10,000 full time equivalent jobs per annum from 2024. The applicant's evidence given by Dr Fahrer at the hearing was that the Carmichael Coal and Rail Project will increase average annual employment by 1,206 full time jobs in Queensland and 1,464 jobs in Australia.

[586] Further the applicant's input figures contained in the CGE and CBA modelling probably overstate the selling price of the coal and therefore the royalties generated by the project and the corporate tax payable. In addition, the discount rates adopted by Dr Fahrer, to value

future income in present day values, are lower than those recommended in some guidelines. The consequence is that the benefits of the project are likely to be less than modelled by Dr Fahrer.

**Section 269(4) of the *Mineral Resources Act 1989***

[587] Section 269(4) of the MRA requires the Court, when making a recommendation to the Minister that an application for a mining lease be granted in whole or in part shall take into account and consider a number of matters specified in subparagraphs (a) to (m). Each of these matters is now considered.

*Section 269(4)(a) – whether the provisions of the Act have been complied with*

[588] An affidavit by Mr H Manzi, affirmed 21 November 2014, was filed by the applicant<sup>146</sup>. Mr Manzi deposed that on 16 April 2014, the mining registrar issued certificates of application for the three MLAs, the subject of this hearing. This means that, under s 252(1) of the MRA, the chief executive was satisfied that the applicant was eligible to apply for the mining lease and that the applicant had complied with the requirements of the Act with respect to the application. Mr Manzi also deposed that between 17 April 2014 and 17 June 2014, the applicant notified the three MLAs by posting a copy of the certificates of public notice as required by the Act, giving a copy of the applications to each owner of relevant land necessary for access and the relevant local governments, and publishing notice of the application in the Central Queensland News and Courier Mail on 21 May 2014. The applicant also provided declarations of compliance with its obligations to the Department of Natural Resources and Mines and to the Department of Environment and Heritage Protection. Mr Manzi said that to the best of his knowledge and belief, Adani Mining had complied with the provisions of the MRA in relation to the MLAs.

[589] It appears from this evidence that the applicant has complied with the requirements of the Act and there is no evidence to the contrary. I am therefore satisfied that the provisions of the Act have been complied with.

*Section 269(4)(b) – whether the area of land applied for is mineralised or the other purposes for which the lease is sought are appropriate*

[590] In an affidavit affirmed on 21 November 2014<sup>147</sup>, Mr L Lezar, the head of open cut operations of the applicant, said that as at 31 March 2014, the estimated coal resource within the mine project was 11.04 BT (billion tonnes) of which 4.00 BT is classified as measured resource, 3.22 BT is classified as indicated resource and 3.82 BT is classified as inferred resource within the meaning of those terms as contained in the JORC Code.

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<sup>146</sup> AA004, Exhibit 3.

<sup>147</sup> AA005, Exhibit 4.

[591] There was no evidence to indicate that the area of land is not so mineralised. Accordingly I am satisfied that the area of land applied for is mineralised.

*Section 269(4)(c) – whether there will be an acceptable level of development and utilisation of the mineral resources within the area applied for*

[592] Aspects of this provision were considered in the discussion above about the likely profitability of the mine. I concluded in that regard that I had accepted the applicant's evidence.

[593] In addition, Mr Lezar said in his affidavit affirmed on 21 November 2014, that the land will be used by the applicant for the extraction of coal (and other associated purposes) by open cut and underground mining and to accommodate infrastructure to support the mine. In Mr Lezar's opinion there will be an acceptable level of development and utilisation of the resources on the subject land.

[594] Mr Lezar also said that the applicant had completed a detailed mine and supporting infrastructure plan for the development of the project and, in consultation with other companies, had developed a detailed macro level life of mine plan and associated designs and had identified infrastructure equipment and plant requirements for the life of the mine. The mine plan was developed on the basis of the physical characteristics of the coal deposit, the coal resources to target and mine, the use of low risk, proven and reliable mining methods, considerations of which sections should be mined using open cut methods or underground methods, considerations of mine waste characteristics and mine waste management requirements, supporting infrastructure needs, and optimising locations for infrastructure.

[595] Mr Lezar also said that the applicant is undertaking an ongoing program of geological and geotechnical investigations to further define the coal resources and refine the mine plan. He indicated that it may be necessary to change the mine plan (which is not unusual, he said) from time to time. One possible change identified was the extension of underground mining in the north area of the mine and consequent reduction in open cut mining in that area. Mr Lezar said that the applicant has engaged a consultant to assess the change in impact if any. He said that if the applicant intends to proceed with any optimisations or amendments to the mine plan or mine footprint, it will seek any necessary approvals.

[596] I am satisfied from the evidence summarized above that there will be an acceptable level of development and utilisation of the resources within the area applied for.

*Section 269(4)(d) – whether the mining lease sought is of an appropriate size and shape*

[597] Mr Lezar provided details of the size and shape of each of the MLA areas in his affidavit affirmed 21 November 2014. He said that the applicant had determined the shape of the land applied for under the MLAs on the basis of the location of the coal resource, using

information obtained from geological and geotechnical assessments undertaken in accordance with the JORC Code. The applicant had subsequently removed some areas of land from the original application. Mr Lezar said that the size and shape of the mine now sought by the applicant was the minimum required to successfully and economically extract the resource, having regard to the mining methodologies proposed for the mine, access to power and water, ease of access and manoeuvrability within the site, local topography and the proposed layout of related infrastructure.

[598] There was no evidence to indicate that the area sought was not of an appropriate size and shape. I have therefore accepted Mr Lezar's evidence and am satisfied that the area sought is of an appropriate size and shape.

*Section 269(4)(e) – whether the term sought is appropriate*

[599] The applicant has sought a 30 year term for the mining leases. Mr Lezar's evidence was that the mine is proposed to operate for 60 years on the basis that 56 years mining will be necessary to extract the resource. Thereafter, final decommissioning and rehabilitation were anticipated. He said that the applicant had sought 30 year terms for the mining leases to ensure the relevance of conditions, and in his opinion, the terms of the mining lease sought by the applicant was appropriate.

[600] There has been no objection to the grant of the mining leases on the basis of the term applied for and no evidence has been adduced to suggest that the term was inappropriate. Accordingly, I am satisfied from Mr Lezar's evidence that the terms sought for the mining leases are appropriate.

*Section 269(4)(f) – whether the applicant has the necessary financial and technical capabilities to carry on mining operations under the proposed mining lease*

[601] The first respondent objected to the MLAs on the ground that the applicant did not have the necessary financial and technical capabilities to carry out the mining activities.

[602] That objection and the evidence in relation to it have been considered in some detail above. I concluded above that I was satisfied that the applicant did have the necessary financial capabilities to carry out the proposed mine. No evidence was led that the applicant did not have the technical capabilities to carry out the proposed mining activity. Accordingly, I am satisfied that the applicant has the necessary financial and technical capabilities to carry on mining operations under the proposed mining leases.

*Section 269(4)(g) – whether the past performance of the applicant has been satisfactory*

[603] Mr Lezar said in his affidavit that the applicant had managed the exploration permits underlying the application for these mining leases by undertaking exploration activities and other works on the land. These included geological and geotechnical drilling to prove up the

quality and quantity of the coal resource, geotechnical assessments for the purposes of determining mine infrastructure requirements, 2D seismic surveys over the underground mining area to clearly define the structural geology, hydrology studies to develop models of the sub-surface hydrology, ecological assessments and surveys in relation to fauna and flora on the land, rehabilitation activities and the construction and operation of an exploration camp.

[604] Mr Lezar said in his oral evidence that since he affirmed his affidavit, he had found out that two investigations had been conducted by the Department of Agriculture and Fisheries in relation to the quarry material from the Red Hill Quarry which is within the area of the applicant's existing exploration permits. One of those investigations was concluded after Adani paid royalties and agreed to pay investigation costs. The other is ongoing.

[605] The applicant submitted that the investigations in question were not carried out in relation to the MRA or EPA. They did not relate to any allegations of environmental harm and they did not allege any wilful or intentional breach by Adani Mining.

[606] There was no submission from the first respondent in relation to s 269(4)(g).

[607] In my opinion it is doubtful whether the investigations relating to the extraction of quarry material are relevant to s 269(4)(g) as it is arguable that the subsection is referring to the performance of the applicant under the MRA and or the EPA. In any event, although the applicant has been investigated by the Department of Agriculture and Fisheries, there is no evidence that the applicant has been prosecuted, let alone convicted of any offence under the relevant legislation. In those circumstances I have come to the conclusion that the past performance of the applicant is satisfactory for the purposes of s 269(4)(g).

*Section 269(4)(h) – whether any disadvantage may result to the rights of holders of existing exploration permits or mineral development licences or applicants for such permits or licences*

[608] Mr Lezar's evidence was that two exploration permits for coal (EPCs) exist in respect of the land the subject of the MLAs, EPC1690 and EPC1080. The applicant is the holder of EPC1690. The holder of EPC1080 is Waratah Coal Pty Ltd. On 23 December 2011, Waratah Coal consented to the applicant applying for and being granted mining leases over the eastern portions of EPC1080. The applicant has lodged the subject MLAs, ML 70441, ML 70505 and ML 70506. Mr Lezar said that no person or entity holds an existing mineral development licence for the land and, except for Waratah Coal, no person or entity has applied for an exploration permit or mineral development licence for the land.

[609] There is no evidence of any disadvantage to holders of existing permits/licences or applicants for exploration permits or licences. Accordingly I am satisfied there will be no disadvantage to such persons if the mining leases are granted.

*Section 269(4)(i) – whether the operations to be carried on under the authority of the proposed mining lease will conform with sound land use management*

[610] Mr Lezar pointed out that the management and operation of the mine will be subject to the conditions imposed by the Coordinator-General and any environmental authority issued by the statutory party. Mr Lezar also said that the applicant has developed a number of management plans to ensure that the land is managed in an appropriate way, including a mine waste management strategy plan, environmental management plans for the mine and offsite land and closure and rehabilitation strategies for the mine and offsite land. The applicant has made commitments in respect of the mine to ensure that the activities on the mine constitute sound land use management.

[611] Although the first respondent objected to the grant of the mining leases on this basis, no evidence was directed specifically to this ground of objection. It may be inferred of course that the first respondent does not consider that use of the land for mining activities will conform with sound land use management. The first respondent's objections to the grant of the MLs and the application for the EA have been considered in detail above and there is no need to repeat any of that discussion.

[612] If the MLs are granted as recommended, then I consider that the operations to be carried out under the authority of the MLs will conform with sound land use management.

*Section 269(4)(j) – whether there will be any adverse environmental impact caused by those operations and, if so, the extent thereof*

[613] Again, the potential adverse environmental impacts have been the subject of detailed objections and evidence which I have discussed above.

[614] I concluded above that there is some risk of loss of water flow to the DS and, consequentially, that damage may occur to the springs ecology and the Waxy Cabbage Palm. However I consider that the conditions imposed under the EPA will be adequate to manage the impact of the mine on those aspects of the environments.

[615] I also concluded that there will be significant loss of BTF habitat with a consequential threat to the continued survival of the species in the area of the mine. This is particularly of concern because it is now recognized that the population of the endangered BTF in the mine area is the largest known surviving population globally.

[616] As set out above, I am proposing that additional conditions be inserted into the EA in an endeavour to manage the threat to the BTF more appropriately. If those conditions are included in the EA then I consider that the impact on the BTF will be lessened.

[617] As concluded above, the impact of the Scope 1 and 2 emissions should be taken into consideration when considering the environmental impact of the mine. These emissions will



account for 0.01% of the world's and 0.25% of Australia's remaining carbon budget having regard to the 2°C target. Those additional emissions will also have an adverse impact on the environment, although there was no evidence as to specific adverse effects.

*Section 269(4)(k) – whether the public right and interest will be prejudiced*

[618] In *Sinclair v Maryborough Mining Warden*<sup>148</sup>, the High Court said, in relation to the public interest test imposed by regulation 39(2)(a) of the *Mining Regulations 1971*, that the Court's task was<sup>149</sup>:

“Any consideration of the public interest for the purposes of reg. 39(2)(a) should, I think, involve the weighing of benefits and detriments. In this task a warden will not be required to pursue his own enquiries; he may confine himself to the material placed before him by the parties ... In some special context questions of the public interest may not involve this process of weighing against each other conflicting merits and demerits; where however the concept of the public interest occurs as a factor in the grant or refusal by the Crown of a mining lease it can, I think, have only this meaning.”

[619] In the course of my consideration of the objections above, I have weighed up the potential advantages and disadvantages of the proposed mine. I have concluded that, in each case, the objection was not sufficient to warrant a recommendation that the mining lease applications be refused.

[620] My conclusions in this regard are, I consider, relevant to a consideration of whether the public right and interest will be prejudiced by the grant of the MLs. The evidence is that major economic benefits will flow from the project to the local region, Queensland and Australia. Those benefits will come at the cost of environmental damage as set out above. Conditions will be imposed on the applicant which should result in the adverse environmental impacts being appropriately managed and mitigated. That being the case, I have concluded that, subject to further conditions being imposed in relation to the BTF as proposed, the adverse impacts of the mine will be outweighed by the economic benefits flowing from it and, therefore, I consider that the public interest will not be prejudiced by the mine.

*Section 269(4)(l) – whether any good reason has been shown for a refusal to grant the mining lease*

[621] My discussion of the evidence given concerning the first respondent's objections includes a detailed consideration of the reasons for and against the grant of the mining leases. Given my conclusions in relation to each of those matters, my opinion is that, subject to the inclusion of the proposed recommendations about the BTF, there is no good reason to refuse the grant of the MLs.

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<sup>148</sup> (1975) 123 CLR 473  
<sup>149</sup> At 485, per Stephen J.

*Section 269(4)(m) – taking into consideration the current and prospective uses of that land, whether the proposed mining operation is an appropriate land use*

[622] The land within the ML areas has in the past been used for grazing. That land will no longer be available for grazing for an extended period of time, and some areas will be withdrawn permanently. However, the evidence is that the land is mineralised and that the mineral resource will be appropriately exploited. In those circumstances, I consider that the proposed mining operation is an appropriate land use.

### **Section 191 of the *Environmental Protection Act 1994***

[623] Section 191 of the EPA requires the Court to consider certain matters in making an objections decision. Those matters have been considered where relevant in the course of these reasons and it is not necessary to repeat my conclusions on those issues in detail.

[624] I have concluded that:

- the threat to the DSC and the WCP are likely to be appropriately managed by the conditions imposed in the draft EA and the EPBCA approval;
- further conditions should be inserted into the draft EA to protect the BTF;
- there will be no increase in Scope 3 emissions as a result of the mine
- the Scope 1 and Scope 2 emissions generated by the project will account for 0.01% of the world's or 0.25% of Australia's remaining carbon budget having regard to the 2°C target. There was no evidence beyond that as to the impact of those emissions on the environment.

[625] Although there will be environmental damage caused by the mine, I consider that the adverse consequences are outweighed by the benefits that will flow from the development of the mine.

### **Final Conclusions**

[626] I have considered the evidence in some detail and have come to the conclusions set out above. My overall conclusion is that I should recommend that the mining lease applications be granted and the environmental authority application be approved, subject to the inclusion of additional conditions relating to the protection of the BTF as set out in the Orders.

### **ORDERS**

1. Pursuant to s 269(1) of the *Mineral Resources Act 1989*, I recommend to the Honourable the Minister administering the *Mineral Resources Act 1989* that, subject to the inclusion of additional conditions in the environmental authority as set out in Order 2 below, mining leases 70441, 70505 and 70506 be granted over the application area.
2. Pursuant to s 190(1)(a)(ii) of the *Environmental Protection Act 1994*, I recommend to the administering authority that the environmental authority be issued in the terms of the draft environmental authority issued on 28 August 2014, subject to the insertion of the following conditions into the BTF Species Management Plan referred to in Condition I6 of the environmental authority:

- (a)
- i. monitoring of water bodies should be conducted over at least a six hour period commencing from dawn in order to accurately capture utilization of the watering points;
  - ii. detailed botanical assessment should be focussed on all BTF siting locations to record habitat values within those locations;
  - iii. more effort should be placed into actively locating BTF and collecting information on their movements across the project and offset areas;
  - iv. call playback should be used when BTF are encountered to assist in gaining a more complete identification of birds present in the local area;
  - v. specific surveys targeting breeding be undertaken to provide details on locations and habitat values in breeding areas;
  - vi. persons undertaking the survey/monitoring should be experienced ecologists with sound understanding of the BTF and its habitats;
  - vii. any future revision of the current survey and monitoring programs should be developed in consultation with researchers from the BTF recovery team and independently peer reviewed.
- (b) The research management plan include provision for funding a research project to determine the correlation between water source, woody habitat and *Poaceae* food resources across the MLA areas and the proposed offset areas, to determine the interrelationships between these factors.
- (c) The research management plan include a provision that the Ten Mile Bore and its surrounds be investigated to determine whether that area maintains an important function in sustaining the BTF population.
3. Orders 1 and 2 above will not be made final until 17 December 2015 at 4:00 pm, or until such further Order of the Court, so as to allow the parties to make any submissions to the Court as to why the conditions set out in Order 2 should not be included in the environmental authority.
  4. I direct the Registrar of the Land Court to provide a copy of these reasons to the Honourable the Minister administering the *Mineral Resources Act 1989* and to the administering authority under the *Environmental Protection Act 1994* and to direct those persons' attention specifically to my observations in [583] – [586].

**CAC MacDONALD**  
**PRESIDENT OF THE LAND COURT**