



## Hazelwood Mine Fire Inquiry

### Joint Expert Report – 3 December 2015

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#### *Terms of Reference 8 and 9: Options for mine rehabilitation*

#### ATTENDEES

Name	Role
Emeritus Professor Jim Galvin	Chair, Technical Review Board
Professor Rae Mackay	Professor of Geotechnical and Hydrogeological Engineering and Director, Geotechnical and Hydrogeological Engineering Research Group (GHERG), Federation University Australia
Dr Chris Haberfield	Principal Geotechnical Engineer and Principal, Golder Associates
Dr Clint McCullough	Associate and Principal Environmental Scientist, Golder Associates
Adjunct Professor Timothy Sullivan	Principal, Pells Sullivan Meynink
Mr Greg Hoxley	Principal Hydrogeologist, Jacobs Group (Australia)

#### REFERENCES USED IN THIS DOCUMENT

**'Sullivan'** is a reference to the statement to the Inquiry dated November 2015 by Timothy Sullivan.

**'Jacobs report 16/11/15'** is a reference to the report by Jacobs dated 16 November 2015 to the Inquiry entitled 'Review of Future Rehabilitation Options for Loy Yang, Hazelwood and Yallourn Mines in the Latrobe Valley'.

**'Jacobs report 26/10/15'** is a reference to the report by Jacobs dated 26 October 2015 to the Inquiry entitled 'Analysis of potential coordination and planning models for the Latrobe Valley brown coal mines'.

**'Galvin'** is a reference to the statement to the Inquiry dated 24 November 2015 by Jim Galvin.

**'Mackay'** is a reference to the statement to the Inquiry dated 27 November 2015 to the Inquiry by Rae Mackay.

## QUESTIONS OF THE GROUP

All members of the group agreed that for the purposes of their feedback, they have viewed all of the issues regarding rehabilitation within the broader context of mine closure. Closure planning is a life-of-mine consideration.

### 1. Rehabilitation objectives and principles

Do you agree that the following list of objectives and principles for the rehabilitation of open cut coal mines in the Latrobe Valley is appropriate for each of the three mines? Are there others that should be added? (adapted from Sullivan, 127):

- a. Ensure statutory requirements are met;
- b. Convert the area to a safe and stable condition as a long term objective;
- c. Ensure that the condition of the mine post closure maximises public safety;
- d. Minimise erosion;
- e. Recognises that the physical attributes of the particular site ultimately constrain what can be achieved;
- f. While recognising that absolute standards for safety are not prescribed, agree on objectives for the landform associated with the final land use including stability aspects;
- g. Rehabilitate the land in accordance with post-mining land uses which are practical, achievable and compatible with the surrounding areas;
- h. Develop well-defined rehabilitation plans;
- i. Develop and create appropriate landforms that will behave in a predictable manner;
- j. Consult stakeholders including the local community to:
- k. develop a closure plan that clearly defines the post-closure land use; and
- l. agree success criteria;
- m. Rehabilitate progressively, but in a manner that is commensurate with the rate of mining and the nature of the mining operation;
- n. Undertake research into land and water aspects of rehabilitation;
- o. Use appropriate technologies to reduce negative impacts; and
- p. Monitor, review and report on performance.

Expert	Response
	All group members generally agreed on the basis that these are objectives, not criteria.
<b>Galvin</b>	Agree, with the qualifier that safety is expanded to 'health and safety'.
<b>Mackay</b>	Agree, with the qualifier that an objective on management of fire risk be added.
<b>Haberfield</b>	Agree, with the qualifier that these are 'general principles' rather than 'objectives and principles'. Terminology such as maximise/minimise should be removed and replaced with tolerable risk – which needs to be defined.  (h) change 'well defined' for 'appropriately defined commensurate with the stage

	of the mine closure plan’. (j)(ii) Should not use ‘agree’ as it is unlikely that consensus will be attained.
<b>McCullough</b>	Agreed with qualifications: These points all need to fit within an aim: final land use. There are issues with terms minimise/maximise – these are problematic, and should focus on tolerable risk. Agree, noting that this is an incomplete list, with other variables which could be added. Stakeholders to be engaged in determining final land use. ICMM/international guidelines provide mechanisms to this end.
<b>Sullivan</b>	Agree, with the qualifier that objectives on health and safety and management of fire risk are added.
<b>Hoxley</b>	Agree, with suggested additions: <ul style="list-style-type: none"> <li>- Sequencing and timing needs to be added and resolved.</li> <li>- Add a principle on effective water management.</li> <li>- Add an objective on management of fire risk.</li> </ul>

## 2. Rehabilitation must be site specific

Do you agree that the setting of a mine is:

- a. fundamental to most aspects of rehabilitation?
- b. the most important question to be addressed at the start of any planning for achievable final landforms?
- c. essential for considerations of the final land uses(s)? (Sullivan, 111).

Expert	Response
<b>Galvin</b>	Agree.
<b>Mackay</b>	Agree.
<b>Haberfield</b>	Consider setting to be bio-physical and socioeconomic context across multiple scales Change (b) to ‘desirable and practicably achievable landforms’
<b>McCullough</b>	Consider setting to be bio-physical and socioeconomic context across multiple scales Change (b) to ‘desirable and practicably achievable landforms’
<b>Sullivan</b>	Agree.
<b>Hoxley</b>	Agree, noting that the setting is broader than physical, and includes elements such as the biological and environmental setting

## 3. 3H:1V as a preferred slope

Do you agree that:

- a. there is no scientific evidence to support 3H:1V as a preferred long term slope for all rehabilitated mine slopes in the Latrobe Valley?

- b. the origin of the 3H:1V slopes is uncertain. It would appear to be a slope angle largely derived from precedent practice with mining in the Latrobe Valley? (Sullivan, 135; see also Galvin 20)
- c. a more specific criterion for factors of safety that can be applied to site and batter specific conditions may be more appropriate to facilitate achievement of final landforms? (Jacobs 16/11/15 report, 125)

Expert	Response
	<p>The group agrees that for (a) the word 'preferred' is inappropriate. The group suggests more appropriate words along the lines of 'generally accepted' or 'generally adopted', acknowledging that 3H:1V is prescribed in some documents.</p> <p>The group agrees that for (c), 'factors of safety' is not the most appropriate term. The group has reinterpreted this term to mean: 'a site-specific risk-based design is required for each mine and each batter to facilitate the achievement of final landforms'. The group has answered the following questions on that basis.</p>
<b>Galvin</b>	<p>(a) &amp; (b) Agreed, but qualified that it should be called 'scientific and engineering evidence base'.</p> <p>(c) Agreed, on the basis of the revised definition.</p>
<b>Mackay</b>	<p>(a) &amp; (b) Agreed and concur with the other comments made. There needs to be detailed reflection on all slopes in order to demonstrate what the actual best value per slope should be.</p>
<b>Haberfield</b>	<p>(a) &amp; (b) Agreed and concur with the other comments made.</p> <p>(c) Agreed, on the basis of the revised definition.</p>
<b>McCullough</b>	<p>(a) &amp; (b) Agreed, with the qualifier that it is unlikely to be appropriate for final rehabilitation at closure. This value illustrates the danger of prescriptive regulation, as it is the incorrect KPI.</p> <p>(c) Agreed, on the basis of the revised definition.</p>
<b>Sullivan</b>	<p>(a) &amp; (b) Agree with Galvin.</p> <p>(c) Agreed, on the basis of the revised definition.</p>
<b>Hoxley</b>	<p>(a) &amp; (b) Agreed and concur with the other comments made.</p> <p>(c) Agreed, on the basis of the revised definition.</p>

#### 4. Options

- a. Do you agree with Jacobs that there are only two viable long term rehabilitation options for each of the three mines, being to:
- i. partially backfill below the water table; or
  - ii. create a pit lake? (Jacobs 16/11/15 report, pages 123-126)
- b. Do you agree that the current rehabilitation plans contained in each mine's workplan generally align with Jacobs' concept of a partial backfill below the water table level?
- c. Do you agree that the Jacobs report (16/11/15) appropriately identifies the risks and control measures relevant to the rehabilitation options discussed?

Expert	Response
	<p>The group considers the two Jacobs models to be variants of the one basic outcome, which is that the pit bottom of all mines will be filled with backfill and water to varying degrees. It is important that the Inquiry and the public understand that the water level in each of the mine voids will differ. In response to (c), the group believes that, generally, the risk assessment is at a very high, broad-brush level, and is consistent with Jacobs' brief from the Inquiry. However the risk assessment falls well short of the standard required in order to properly assess the risks and controls for an option.</p>
<b>Galvin</b>	<p>(a) Agree based on group's comment above.  (b) Agree within the meaning of 'generally'.  (c) Agree based on group's comment above.</p>
<b>Mackay</b>	<p>(a) Agree based on group's comment above.  (b) Generally agree.  (c) Agree based on group's comment above.</p>
<b>Haberfield</b>	<p>(a) Agree based on group's comment above.  (b) Generally agree for Hazelwood.  (c) Agree based on group's comment above.</p>
<b>McCullough</b>	<p>(a) Agree based on group's comment above. As per his written statement, he believes we should use internationally defined terminology.  (b) Agree for Hazelwood.  (c) Agree based on group's comment above.</p>
<b>Sullivan</b>	<p>(a) Agree based on group's comment above.  (b) Agree.  (c) Agree based on group's comment above.</p>
<b>Hoxley</b>	<p>(a) Agree and accept the group's comment above.  (b) Agree.  (c) Agree based on group's comment above.</p>

## 5. Research needs

- a. Do you agree that the proximity of the Latrobe Valley mines to people and infrastructure, the specific geotechnical characteristics of the geological materials, the geological setting, climate, hydrology and the significant thickness of the coal seams are some of the factors that do not make it possible to rely on translating research from elsewhere without first testing and tailoring the research findings to the specifics of the Latrobe Valley? (Mackay, 5)
- b. Do you agree that:
  - i. all relevant agencies and departments that can affect and be affected by the rehabilitation of the mines need to work together and with the mine owners to deliver a beneficial outcome?
  - ii. management of the interactions between the mines and the regional environment and population will involve significant planning decisions with wide-ranging implications for the Latrobe Valley?

- iii. an example of (ii) is water allocation. There need to be decisions made by planning authorities around the issue of water allocation and water quality management to achieve the goals of rehabilitation? (Mackay, 19)

Expert	Response
	In (b)(i), the group has rephrased 'need to work together' to mean 'will need to work together'.
<b>Galvin</b>	(a) Agree. (b)(i) Agree. (b)(ii) Agree. (b)(iii) Agree.
<b>Mackay</b>	(a) Agree within the intended context of applied knowledge from elsewhere being transferred. (b)(i) Agree. (b)(ii) Agree. (b)(iii) Agree.
<b>Haberfield</b>	(a) Agree, with the qualifier that 'research findings' should be replaced with 'knowledge'. (b)(i) Agree. (b)(ii) Agree. (b)(iii) Agree.
<b>McCullough</b>	(a) Agree, with the qualifier that 'research findings' should be replaced with 'knowledge'. There is extensive knowledge that can be used in the Latrobe Valley context. (b)(i) Agree. (b)(ii) Agree. (b)(iii) Agree.
<b>Sullivan</b>	(a) Agree. (b)(i) Agree. (b)(ii) Agree. (b)(iii) Agree.
<b>Hoxley</b>	(a) Agree. (b)(i) Agree. (b)(ii) Agree. (b)(iii) Agree.

## 6. Safe and stable

Do you agree that:

- a. there is no clear and universally applicable meaning of the terms 'safe' and 'stable' in the context of mine rehabilitation?

- b. there need to be clear acceptance criteria developed for the mines to apply to demonstrate long term safety and stability? (Mackay, 10; Sullivan 103-109)

Expert	Response
	(a) All members of the group agrees that there is no universal definition of what 'safe and stable' means. (b) Therefore, there currently are no clear acceptance criteria.

## 7. Approved rehabilitation plans

Do you agree that the approved rehabilitation plans of the Latrobe Valley brown coal mines:

- a. are largely conceptual and, therefore, only constitute an early first step in developing the final designs? (Mackay, 6)
- b. do not deal adequately with the complex stability issues that impact on both progressive and final rehabilitation? (Galvin, 9)
- c. fall well short of what could reasonably be considered as adequate for achieving long term safe and stable batters from a ground control perspective? (Galvin, 15)

Expert	Response
	The group notes that the question is in the context of the approved rehabilitation plans. While detailed engineering studies are in progress at some mines, the scientific understanding of key issues is not yet well developed.
<b>Galvin</b>	(a) Agree. (b) Agree. (c) Agree.
<b>Mackay</b>	(a) Agree. (b) Agree. (c) Agree.
<b>Haberfield</b>	(a) Agree. (b) Agree. (c) Agree.
<b>McCullough</b>	(a) Agree. (b) Agree. (c) Agree.
<b>Sullivan</b>	(a) Agree. (b) Agree. (c) Agree.
<b>Hoxley</b>	(a) Agree. (b) Agree. (c) Agree.

## 8. Future needs

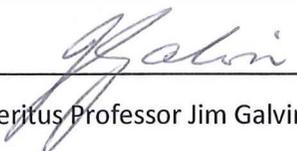
Do you agree that:

- a. there is a significant body of work that needs to be completed before there is adequate knowledge of the requirements for safely rehabilitating the mines and, hence, for developing the conceptual plans referred to in question 7 into successful operational plans?
- b. this investigation process would be significantly enhanced by the mines (and other stakeholders) sharing relevant information, data and research? (Mackay 20)
- c. the State government needs to be more proactive in adopting contemporary rehabilitation policies and practices, in promoting research and collaboration between all stakeholders, in conditioning Work Plan approvals, and in regulatory oversight of rehabilitation? (Galvin, 29)
- d. because there are significant gaps in knowledge about the future conditions that will influence the safety and stability of the mines over the long term, rehabilitation plans must allow for an extended period of monitoring and maintenance in order to effectively manage both expected and unexpected changes to conditions? (Mackay, 7)
- e. the capacity for one mine site to implement its proposed final landform is greatly influenced by the rehabilitation decisions and actions taken at the other mines due to the collective water and physical material requirements? (Jacobs 16/11/15 report at page 16)
- f. the mines are sufficiently close to each other that an integrated rehabilitation plan for all three Latrobe Valley mines is desirable (Mackay, 22)
- g. there is a need for coordination in relation to a number of aspects of rehabilitation including:
  - i. viability of moving material between mines and/or accessing materials from another source;
  - ii. managing valuable and scarce water resources;
  - iii. planning for potential climate change impacts;
  - iv. responding to changes in the timing of mine closures;
  - v. providing for community safety, especially safe and stable final landforms;
  - vi. transitioning to beneficial and productive post mining land uses to support future economic growth;
  - vii. fostering community liveability and amenity; and
  - viii. continuing mine rehabilitation planning and execution. (Jacobs 26/10/15 report at page 1).

Expert	Response
	For (a), the group would like to expand 'body of work that needs to be completed' to 'body of work that needs to be completed, reviewed and synthesised'. Expand 'successful operational

<p>plans' to 'successful operational and closure plans'.</p> <p>For (g), the group is in agreement on the need to coordinate objectives and activities to achieve an integrated rehabilitation plan. There are various levels of agreement by group members on the extent to which some of the aspects will require coordination.</p>	
<b>Galvin</b>	<p>(a) Agree.</p> <p>(b) Agree.</p> <p>(c) Agree.</p> <p>(d) Agree.</p> <p>(e) Agree.</p> <p>(f) Agree.</p> <p>(g) Agree.</p>
<b>Mackay</b>	<p>(a) Agree.</p> <p>(b) Agree.</p> <p>(c) Agree.</p> <p>(d) Agree.</p> <p>(e) Agree.</p> <p>(f) Agree.</p> <p>(g) Agree.</p>
<b>Haberfield</b>	<p>(a) Agree.</p> <p>(b) Agree.</p> <p>(c) Agree, noting McCullough's comments below.</p> <p>(d) Agree, noting McCullough's comments below.</p> <p>(e) Agree, noting that 'greatly' is not defined, so is not required.</p> <p>(f) Agree.</p> <p>(g) Agree.</p>
<b>McCullough</b>	<p>(a) Agree.</p> <p>(b) Agree.</p> <p>(c) Agree, noting that in being more proactive the government should not necessarily be more prescriptive.</p> <p>(d) Agree, but replace 'must' with 'might'.</p> <p>(e) Agree, noting that some variables will influence at a major degree, and some will influence at a minor degree.</p> <p>(f) Agree.</p> <p>(g) Agree to all, except (vi) as beneficial land uses are not necessarily productive; therefore suggests removing 'productive'.</p>
<b>Sullivan</b>	<p>(a) Agree.</p> <p>(b) Agree.</p> <p>(c) Agree.</p> <p>(d) Agree.</p> <p>(e) Agree.</p> <p>(f) Agree.</p> <p>(g) Agree.</p>

<b>Hoxley</b>	(a) Agree. (b) Agree. (c) Agree. (d) Agree. (e) Agree. (f) Agree. (g) Agree.
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Emeritus Professor Jim Galvin



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Professor Rae Mackay



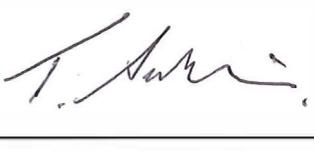
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Dr Chris Haberfield



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Dr Clint McCullough



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Adjunct Professor Tim Sullivan



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Mr Greg Hoxley