QUEENSLAND FLOOD COMMISSION OF INQUIRY: ENGINEERS AUSTRALIA CONTRIBUTION

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Introduction

There were major floods in many areas of Queensland (as well as in other states) during January 2011, with significant flooding in Brisbane and south-east Queensland as well as in other parts of the state. With lives lost and considerable damage to private property and public infrastructure, the Queensland government convened a Commission of Inquiry to investigate the issues and consequences from the flood and to work towards learning lessons from the flooding to reduce the future vulnerability of the community to this type of disaster.

Engineers Australia, as the peak body representing engineers throughout Australia, took an interest both in the context of the application of engineering principles to flood management and also because of the extensive involvement of professional engineers in the issues and proceedings. Engineers Australia convened a committee to review the two reports prepared by the Commission, prepare a response to the Commission and also to help inform both Engineers Australia members and the general community of the important engineering issues raised by the floods and the means of managing this risk.

This paper outlines the background to the Commission as well as the position proposed by Engineers Australia to assist in floodplain management in Queensland.

Background on flood

While flooding is a natural part of Australia's environment, the widespread floods throughout Queensland and elsewhere in Australia caught many in the community by surprise. Perhaps a part of this surprise was the fact that it had been a long time since the last major flood in Brisbane, though floods had occurred elsewhere in the state in almost every year.

This was especially the case in Brisbane, where the most recent major flood was in 1974, more than 30 years ago. There was considerably more damage reported in Brisbane in 2011 than there was in 1974, because of the additional development in flood prone areas. Figure 1 shows the flood peaks for major floods in the Brisbane River from the 1840s to 2011. While it is clear that this series of flood peaks is not homogeneous, since major dams have been built in the catchment, considerable dredging has been carried out in the lower reaches of the river and there was been major catchment and floodplain changes, the flood in 2011 was significantly lower than floods that have occurred earlier in Brisbane's history. It is not strictly correct to compare floods from different periods of Brisbane's history, since river and catchment changes, especially the construction of major flood mitigation dams, have occurred. Therefore while the flood level in Brisbane was lower than floods that had occurred in earlier years, the 2011 flood would have been a higher level without the operation of flood mitigation dams.

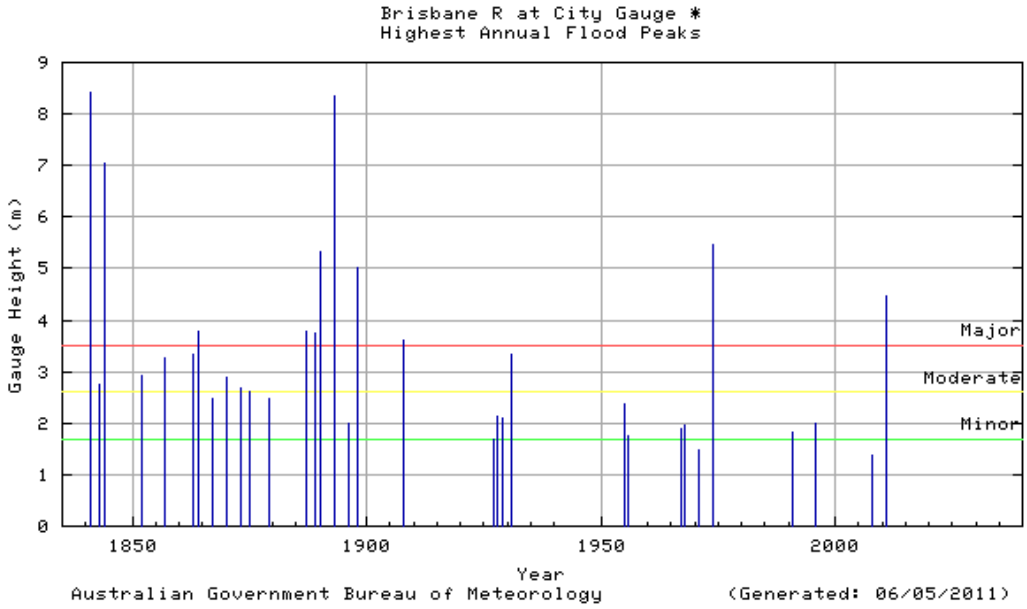

Figure 1: Flood Peaks in Brisbane River (Bureau of Meteorology)

An important issue that received considerable focus in the Commission Interim and Final reports was concerned with the operation of the flood mitigation dams in the catchment. Figure 2 shows the operation of Wivenhoe Dam during the flood.

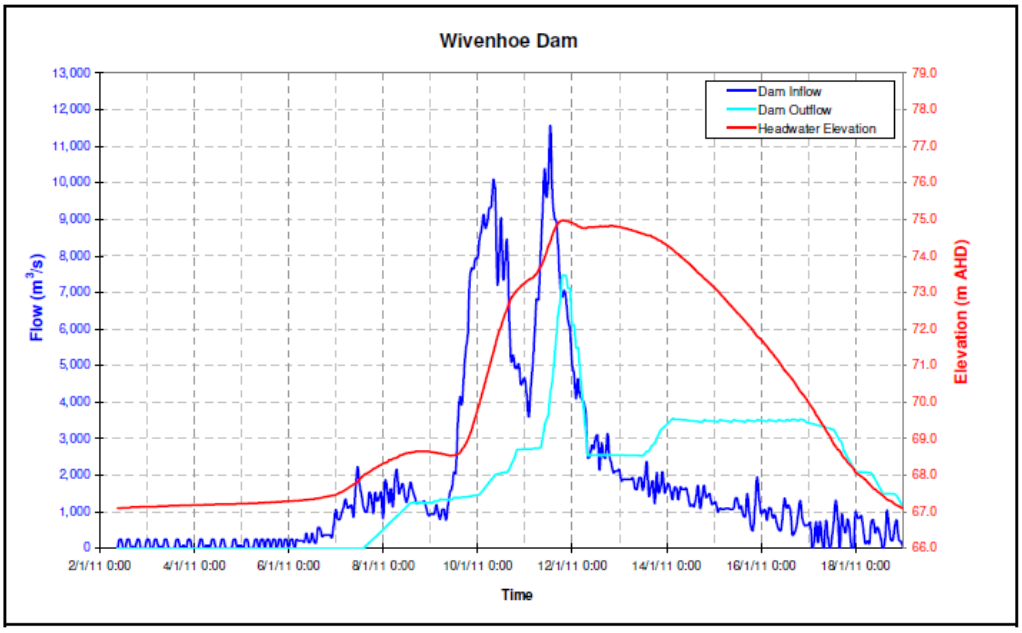

Figure 2: Wivenhoe Dam Operation (SEQWater)

The key factor in this flood was an inflow at the dam with significant volume as well as double peak, meaning that the flood mitigation operation of the dam was particularly difficult. In addition, the flood in Brisbane in 2011 included a significant contribution from Lockyer Creek and the Bremer River, downstream of Wivenhoe Dam, which was clearly not affected by the operation of the dam. The end result was

that the dam reduced the flood peak in Brisbane by the order of 2 m (as calculated by SEQWater), which means that if Wivenhoe Dam was not operational, the flood peak in Brisbane would have been much higher than it was in 1974, the largest flood for over 100 years.

While the Commission had a major focus on the Brisbane River, there was major flooding elsewhere in Queensland (and along the east coast of Australia). Figure 3 shows a plot of flood locations throughout the state during 2010/2011. While there was serious flooding in many parts of the state, especially in the south-east and central Queensland, many other regions, some with severe flood risk south as north Queensland and the Gold Coast for example, escaped with relatively minor flooding.

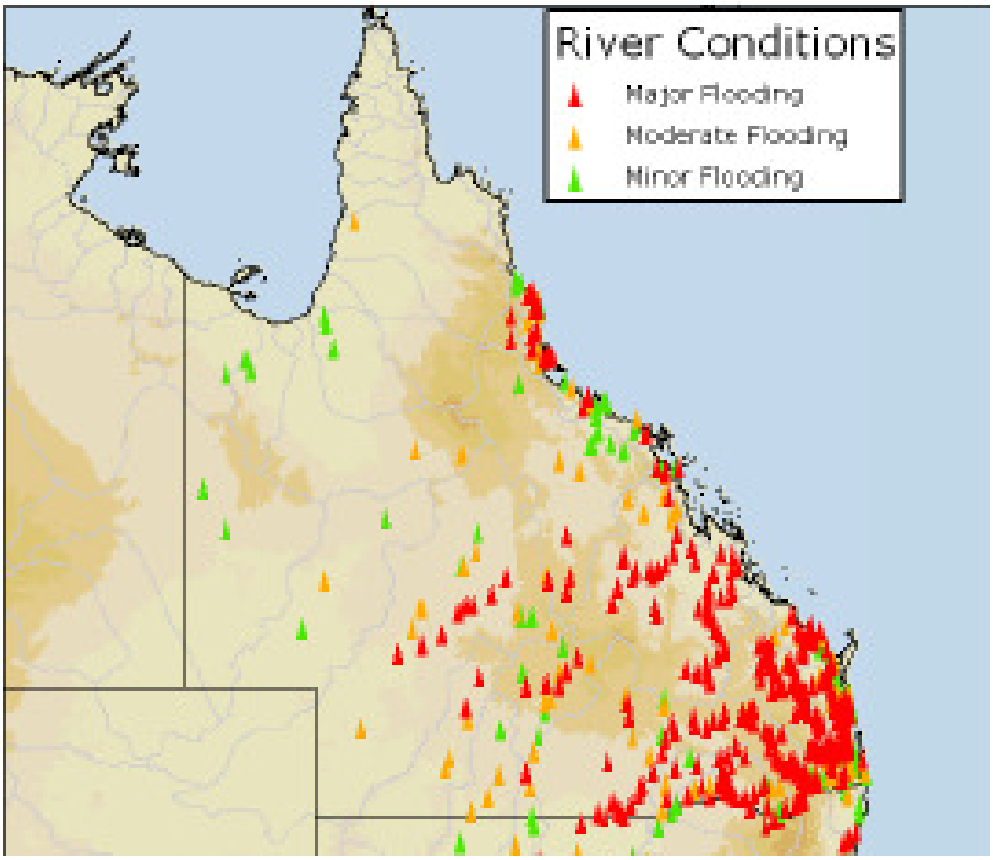

Figure 3: Flooding in Queensland - (2010/2011 (Bureau of Meteorology)

The most severe flooding was in Toowoomba and the Lockyer Valley, where extreme floods caused loss of life and extensive damage. Flooding in these locations was short duration, flood levels rose extremely quickly with little warning and there were high flood levels and extreme flow velocities. Figure 4 shows the flood levels in Lockyer Creek at Helidon, where the 2011 flood was 6 m higher than the previous record in 1974.

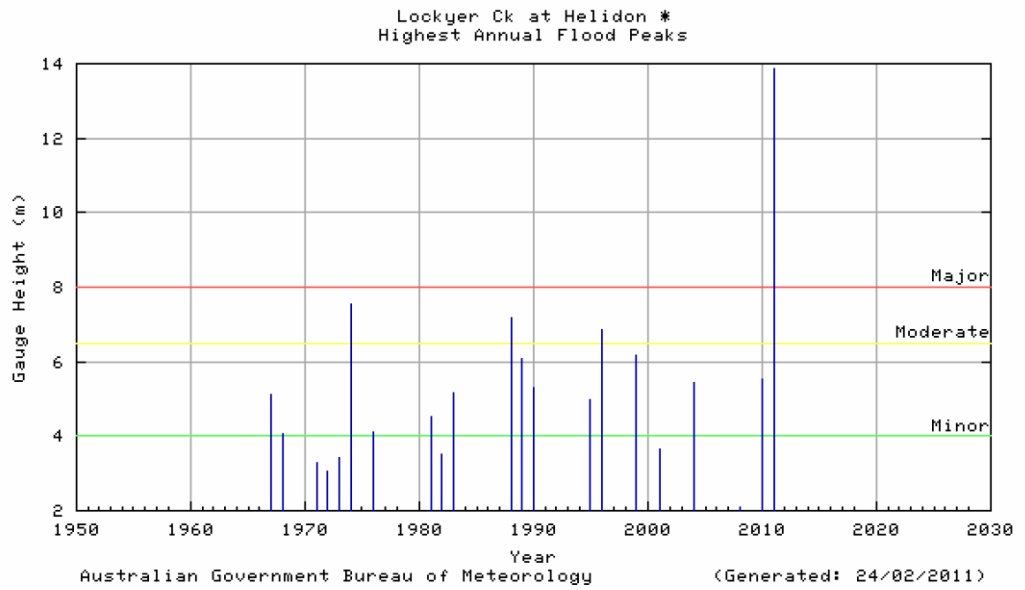

Figure 4: Flood peaks – Lockyer Creek at Helidon (Bureau of Meteorology)

Flood Commission of Inquiry

The Queensland government appointed a Commission of Inquiry with broad terms of reference on 17 January 2011 (which was only a matter of days after the flood peak in Brisbane). Flooding was continuing elsewhere in the state even as the Commission was established. Flooding continued for some time in Rockhampton for example where floods always extend for a considerable period of time. The Commission had hearings in Brisbane and in a number of regional areas where flood impacts had been severe. There were a large number of reports submitted from experts and members of the community and evidence was taken from a wide range of individuals and organisations.

The Commission was a legal process and a concern raised was the level of technical detail and expertise included in the Commission hearings and reports. While there were high quality technical documents and reports submitted to the Commission, the process was guided by the legal profession.

The Commission released two reports. The Interim Report was released in August 2011 and the main focus was concerned with recommendations for the following wet season and ensuring that the community was better prepared for the 2011-12 wet season. The Final Report was released in March 2012, with the primary aim of learning lessons from the flood and providing longer term recommendations to improve floodplain management in Queensland and reduce the risk to the community from flooding.

There were important recommendations related to floodplain management and planning as well as development and building considerations and critical infrastructure. These recommendations covered some important issues for Queensland, and if implemented fully would go some way to reducing the damage and disruption caused by flooding. In addition, one of the terms of reference for the Commission was to report on the performance of the insurance industry, which often draws comment following floods where damage occurs.

The government has been investigating and implementing these recommendations.

A major section of the Final Report was concerned with the operation of Wivenhoe and Somerset Dams, both of which operate to provide flood mitigation for Brisbane and other urban areas on the lower reaches of the Brisbane River as well as being the major water supply sources for south-east Queensland. The performance of the dams and the dam operators was a particular focus of media comment and potential further legal action remains a possibility. The Commission Final Report was not critical of the operation of the dams during the flood, but did find some concerns with the evidence presented by the dam operation engineers in reports prepared following the flood and also in the evidence given to the Commission. Three of the four flood operation engineers were referred to the Crime and Misconduct Commission, which subsequently found there was no case to answer. One of the engineers was found to have allowed his Queensland engineers registration to lapse and was not registered during the event. The Interim Report noted that this was a breach of the manual, but there was no suggestion that this lack of registration had any effect on the operation of the dams, the breach was technical. This engineer though was subsequently prosecuted by the Board of Professional Engineers, and fined. He is now reregistered.

The two reports by the Commission therefore were major documents with valuable data and recommendations. The reports though were legal documents and would have benefitted from more technical and engineering input. Even the inclusion of maps and graphs would have presented the complex technical material much more clearly.

Engineers Australia response

Engineers Australia convened a committee, which was organised as a sub-committee of the Queensland Division Committee.

The committee included a group of Engineers Australia members, who had particular skills in the general topics considered by the Commission. These covered floodplain management, risk assessment, operation of flood mitigation dams, hydrology and hydraulic modelling and flood prone infrastructure. Members of the committee were also independent of the specific Commission process and none appeared as witnesses at the Commission, though they all had specific expertise for the Engineers Australia committee. Most had considerable experience in the relevant fields both in Queensland and elsewhere in Australia and internationally, including relevant experience in the flood operation of the flood mitigation dams in the Brisbane River catchment.

The committee represented a range of interests and experience in all aspects of floodplain planning and management, flood operations and community impacts. Because of the short period of time possible in the preparation of the reports, it was impossible to consult widely during the deliberations, but some limited consultation was carried out, both with Engineers Australia and externally.

The committee produced two formal papers, following release of the Interim and Final Reports of the Commission.

The first paper was released in September 2011, in response to the Interim Report of the Commission. This paper contained specific comments on recommendations in the Interim Report, as well as more broad scale comments on floodplain

management in Queensland. The paper was submitted to the Commission of Inquiry.

The second paper was prepared after the release of the Final Report of the Commission in July 2012, and was focussed more closely on the lessons to be learnt from the floods, the commission findings and means of improving the community's response to future flood disasters. Since the Commission had completed its work by this stage, the paper was submitted to the government agency charged with the responsibility of implementing the Commission recommendations.

Both papers were distributed to Engineers Australia members throughout Queensland, as well as to selected stakeholders.

In addition, Engineers Australia released press releases to the media and provided spokespersons. There was some positive coverage of important issues. These were focussed particularly on ensuring that factually accurate material was available for the media, especially since some media reports were not entirely correct in technical details.

While members of Engineers Australia hold a wide range of views on this and other topics concerning engineering, and most engineers are employed in roles where there are strong vested interests, Engineers Australia does have a role to play in informing the community debate on topics related to engineering. The Engineers Australia contributions drew on a range of different opinions and worked hard to ensure that the comments were factual and also concerned the welfare of the community more than individual interest groups. There are still differences of opinion about the role that Engineers Australia played in this process, but most members of the profession have been satisfied with the contribution to the community debate. In addition, where media releases have been published, these have been excellent opportunities to raise the profile of factual debate.

Engineers Australia recommendations

The principal focus of Engineers Australia's papers was on learning lessons from the floods and making recommendations to improve floodplain management in Queensland, drawing on the skills and experience of Engineers Australia members. These suggestions were based principally on longer term planning and management and less on the more immediate issues, though there were comments made concerning the flood operation of the Brisbane River catchment flood mitigation dams.

In Queensland, floodplain management is principally the responsibility of local authorities, with a lesser contribution from the state government. The major recommendation of the committee was to suggest a stronger role for the state government, though still with a significant contribution from local authorities. The 2011 floods showed that there was a huge variation between different local authorities in the standard of their flood management policies, so raising the standards in some regions where there was significant flood risk, many of which had limited flood policies.

The operation of the flood mitigation dams in the Brisbane River catchment was a significant issue both for the Commission and also in the media and the community (which attributed a large part of the flood damage in Brisbane to the dam operation). In fact three of the four flood operation engineers were referred to the Crime and Misconduct Commission. While the Commission did comment on some

inconsistencies in their evidence, independent reviews of the flood mitigation operation showed that the operators did follow the defined procedures and did mitigate flood levels in Brisbane by a significant amount. This was supported to a greater extent later by the independent review by the United States Army Corps of Engineers and the US Bureau of Reclamation, which also supported the performance of the dam operation engineers. The Engineers Australia paper called for a clear acceptance of the facts and the independent reviews that had demonstrated the good performance of the dam operation under difficult circumstances. It was also not widely recognised in the media and the community that Wivenhoe and Somerset Dams comprise the main water supply storages for south-east Queensland and that concentration on flood mitigation could threaten the security of this supply. This was despite the drought crisis only a few years earlier, when there was considerable community concern that Wivenhoe Dam would become empty.

Among the wide ranging recommendations, there were some concerning levees. Levees have been recognised as a major concern in many floodplains leading to unintended and sometimes unexpected impacts on flood levels and flood flows and community disputes. This problem has been widely recognised and, while it was canvassed in the Commission report, clear recommendations were not included. Engineers Australia also suggested further investigations to work towards a workable solution for this highly important and contentious issue.

The principal conclusions of the Engineers Australia papers were the general conclusions expected for effective floodplain management and also suggestions to improve community understanding of flooding and flood risk. The conclusions were.

- Lessons learnt. It is important that the government and community should regard the flooding of 2011 as a valuable reminder that flooding is a natural part of Australia's environment and we need to learn to live with floods but work towards mitigating the damage by good planning and management.
- State responsibility. Flood management in Queensland has been the responsibility of local authorities, where there is a wide range of policies. Many local authorities had limited planning policies. Engineers Australia therefore recommended that the state government should play a larger role to bring planning in all regions of the state into a higher level of effectiveness.
- Flood design standards. Flood lines on a map for a defined flood event only comprise a part of floodplain planning. The planning process should consider a balance between the risk of flooding and the location, land use and type of infrastructure, indicating that different risk levels are appropriate for different types of development for example.
- Uncertainty and resilience. It needs to be recognised that a level of uncertainty exists in all aspects of flood assessments and planning, and resilience should be built into infrastructure.

The eight myths and realities about flooding in Queensland

During the progress of the Commission hearings and following the release of the Commission reports, there were many commonly held beliefs concerning flooding widely reported in the media. Engineers Australia prepared a set of "myths" to counter this publicity. These myths are focussed specifically on the Brisbane situation and on the outcomes of the Commission reports, but there are many that are probably widely held elsewhere.

1. **Myth:** Wivenhoe Dam was built only for flood mitigation.

Reality: Wivenhoe Dam was conceived as a water supply dam in the early 1970's. The devastating flood of 1974 provided the catalyst to proceed with construction and make Wivenhoe Dam larger than originally conceived to provide a dual role of water supply and flood mitigation.

2. **Myth:** The 2011 flood in Brisbane was unprecedented, and the flooding across Queensland was the worst experienced in history.
   Reality: The 2011 flood had a similar peak flow rate as the 1974 flood upstream of Wivenhoe Dam. The 2011 flood had similar flood volume to the 1893 flood. Flood levels in Ipswich and Brisbane were lower in the 2011 flood than the 1974 and 1893 floods, but the flood impacts from the 2011 flood were the worst in Queensland history because the State is more developed.

3. **Myth:** Properties located outside the defined flood line are "flood free".
   Reality: A defined flood line is the extent of flooding for a specifically selected flood probability or historical event. It is possible, though less probable, that flood events larger than the defined flood can occur.

4. **Myth:** The "average recurrence interval" of a flood indicates when the next flood of this size may occur.
   Reality: The recurrence interval is only a measure of probability of the flood and does not indicate that floods occur at defined intervals in history or in the future. Engineers Australia discourages use of average recurrence interval to define floods, and instead recommends that the definition of floods should be based on annual exceedance probability.

5. **Myth:** Levees or other structural flood mitigation could prevent flooding in Brisbane.
   Reality: Properly designed, constructed, and maintained levees can have a partially useful role to mitigate flooding up to a limit, but can be disastrous if they overtop or fail. Levees can also have adverse effects on levels and flow patterns elsewhere on the floodplain and this requires careful assessment in planning and management of levees.

6. **Myth:** Rainfall forecasts are accurate enough to allow dam operations to use them reliably.
   Reality: Dam operations need to carefully consider a range of complex factors including where, when, and how much rain falls across the dam catchment and catchments of downstream tributaries. The lack of accuracy of forecast rain amount is a concern for use in dam operations. It is possible that if large dam releases are made based on expectation of high forecast rainfall and if that rainfall does not actually occur, the flooding caused by dam releases could be viewed unnecessary and irresponsible.

7. **Myth:** An engineer who operates a gated dam controls strategies and makes decisions focusing mainly on the strategy of the operations.
   Reality: The reality is that the only thing the engineer can actually manage is the timing and magnitude of the spillway gate release rates. The conditions that affect strategy selection are influenced by many factors that the engineer cannot control, such as the magnitude of the flood into the dam, or flows occurring in tributaries downstream of the dam.

8. **Myth:** Other sources of water supply (such as desalination) can be as cheap and reliable as dams and have low environmental impacts.

Reality: The true costs of water supply include capital and operating costs and impacts to society and environment. Energy is a major cost for alternative water supplies such as desalination. Brine disposal is a significant environmental concern for desalination. The reliability of water supply is not only the certainty of having source water available, but also the reliability of the technology and equipment to produce and deliver water.

Conclusions

The 2011 floods in Brisbane, the Lockyer Valley and Toowoomba in particular and throughout Queensland in general were a warning to Queensland that flooding is a part of our environment and a lengthy period of limited flood damage should not lead us into complacency. The Queensland government acted quickly in establishing a Commission of Inquiry with broad terms of reference to ensure that the community learnt lessons from the flood disaster. The Commission report provided a range of recommendations, though the legal approach to the operation of the Commission with a lesser emphasis placed on the technical issues was a concern. The important thing is that the valuable lessons provided by the floods should be learnt and the community is better prepared when floods occur again as they inevitably will.

Engineering is a profession whose members have valuable skills as well as a critical role to play in planning, design and management of floods. Engineers Australia, as the peak body representing the profession in Australia, has seen its responsibility to assist in the community debate and to provide accurate and reliable input to this debate. The organisation therefore has been active in the debate, both with members of the organisation and also in the media and the community. Engineers Australia has maintained a non-political role and has supported good practice in floodplain management, which has gained a good response from members of the organisation, the media and the general community.

Acknowledgements

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The material in this paper represents the views of Engineers Australia and the committee appointed to provide Engineers Australia's response to the Commission and does not represent the policy or opinions of the employers of members of the committee.