From:	NSW Government
To:	Flood Inquiry
Subject:	Floods Inquiry
Date:	Friday, 24 June 2022 1:46:08 PM
Attachments:	20220624_1 PL to NSW Flood Inquiry-F2 w Attachment.pdf

Your details

Title	Mr
First name	PETER
Last name	LEAH
Email	
Postcode	2320

Submission details

I am making this submission as	A member of the general public
Submission type	I am making a personal submission
Consent to make submission public	I give my consent for this submission to be made public

Share your experience or tell your story

Terms of Reference (optional)

The Inquiry welcomes submissions that address the particular matters identified in its Terms of Reference

1.2 Preparation and planning	Refer submission.

Supporting documents or images

Attach files	• 20220624_1 PL to NSW Flood Inquiry-F2 w Attachment.pdf

24 June 2022

Ref: 20220624_1 PL to NSW Flood Inquiry-F2

2022 NSW Flood Inquiry
https://www.nsw.gov.au/flood-inquiry-submissions-portal#toc-flood-inquiry-submission

Attention: Secretary to the Inquiry

Submission by Peter Andrew Leah to the 2022 NSW Flood Inquiry

Dear Sir / Madam,

I am not a resident of any area affected by the 2022 NSW floods, have no relatives or friends in such areas, and was not directly impacted by the floods. This said I am a professional geoscientist of 35 years experience in the mining industry with expertise in the discovery and evaluation of natural resources, analysis of geomorphology, project management, risk assessment, social and environmental impact assessment, and management of compliance with statutory obligations.

This brief submission focuses on the matter of: “Preparation and planning”.

In relation to risk assessment and risk reporting I am stuck by what should be, but appears not to be, a similarity of approach of differing applicable NSW regulators and administrators to the management of risk associated with prescribed dams (failure of) (generally in NSW and in the mining industry in particular) and the management of risk associated with artificial levees, whether constructed or still not constructed, that separate population centres from rivers – being risks associated with the absence of, or catastrophic failure of, or the overtopping of such structures. During and subsequent to the 2022 floods numerous stakeholders made public comments referring to a number of individual flood events as 1 in a 100 to one in 1000 year events. Contemporaneous reporting advised that, sadly, 4 people had lost their lives in one of the floods events at Lismore when the levees were breached.

The mining industry works hard to maintain very high standards of social and environmental performance. It would be unthinkable for the mining industry to engineer and plan for a 1 in 1000 year prescribed dam failure event with a societal impact of 4 deaths. Policy published by the NSW Government on 18/3/2022 (during the envelope of the 2022 floods) (attached here) directs the mining industry to put engineering and mitigation systems in place to reduce such prospective death toll to a circa 1 in 25,000 year event. Clearly there is a major disconnect between the risk management and engineering and reporting and work program systems in place that apply to prescribed dams and the apparently lesser standards deployed by NSW state and local governments in the protection of (generally far larger) communities from riverine flooding.

It is recommended that the inquiry consider recommending:

1. Development and gazettal of a standard for the assessment and management of societal risk from riverine flooding in areas in need of protection by appropriate constructed levees - and the definition of appropriate safety thresholds in relation to the management of that risk. Such thresholds should be no less than those currently in place for prescribed dams;

2. Mandatory application of that risk assessment to the entire state by local government jurisdiction – with periodic review and re-fresh as appropriate;
3. The “prescribing” of all identified levees (whether existing or not) critical to the protection of communities from riverine flooding;
4. Annual reporting by State and Local Government entities of:
    a. the risk profile of all “prescribed” levees”;
    b. the scheduling and costing of works on “prescribed levees” on a transparent basis so as to best and most cost effectively reduce their “in aggregate” risk profile;
    c. works completed on “prescribed levees” by state and local government during the reporting period, and the reduction in their risk profile secured.

Please contact me as below if you have any queries in relation to this matter.

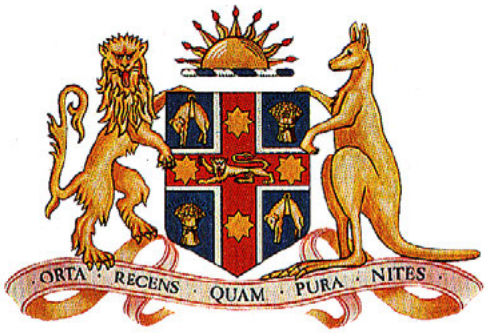
Yours Faithfully

Peter Andrew Leah

Bolwarra Heights NSW 2320

ATTACHMENT 1

20220318_3 NSW Dams Safety New South Wales - Declared dams consequence category assessment and determination methodology for Dams Safety Act 2015



Government Gazette

of the State of

New South Wales

Number 113–Electricity and Water
Friday, 18 March 2022

The New South Wales Government Gazette is the permanent public record of official NSW Government notices. It also contains local council, non-government and other notices.

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ISSN 2201-7534

By Authority
Government Printer

Dams Safety New South Wales

Societal and individual risk rating methodology

for

Dams Safety Act 2015

Part 1 Preliminary

1 Background

The *Dams Safety Regulation 2019* requires the owner of a declared dam to set out in a report the societal and individual risk rating of the dam (or proposed dam) calculated in accordance with this methodology.

Part 2 Dam societal and individual risk rating calculation for an existing or proposed declared dam

2 Societal risk rating

(1) As part of the risk management framework, all foreseeable dam failure scenarios (or credible modes of failure) that involve potential fatalities must be identified and societal risk calculated for each scenario. The societal risk rating is then determined as follows:

Societal risk rating = F_n x N

Where:

F_n is the *estimated annual probability of failure of a dam with the best estimate loss of life ≥ N*

N is the estimated number of fatalities due to dam failure

(2) In determining the societal risk rating, F-N is either plotted on the graph in Figure 1 for existing dams or plotted on the graph in Figure 2 for proposed dams and major augmentations to existing dams.

Note: A method for determining the F-N plot on the graph is described in Australian National Committee on Large Dams (ANCOLD) Guidelines on Risk Assessment, Appendix I.

(3) The societal risk rating is the highest value on the line plotted on the graph in accordance with 2 (2) above.

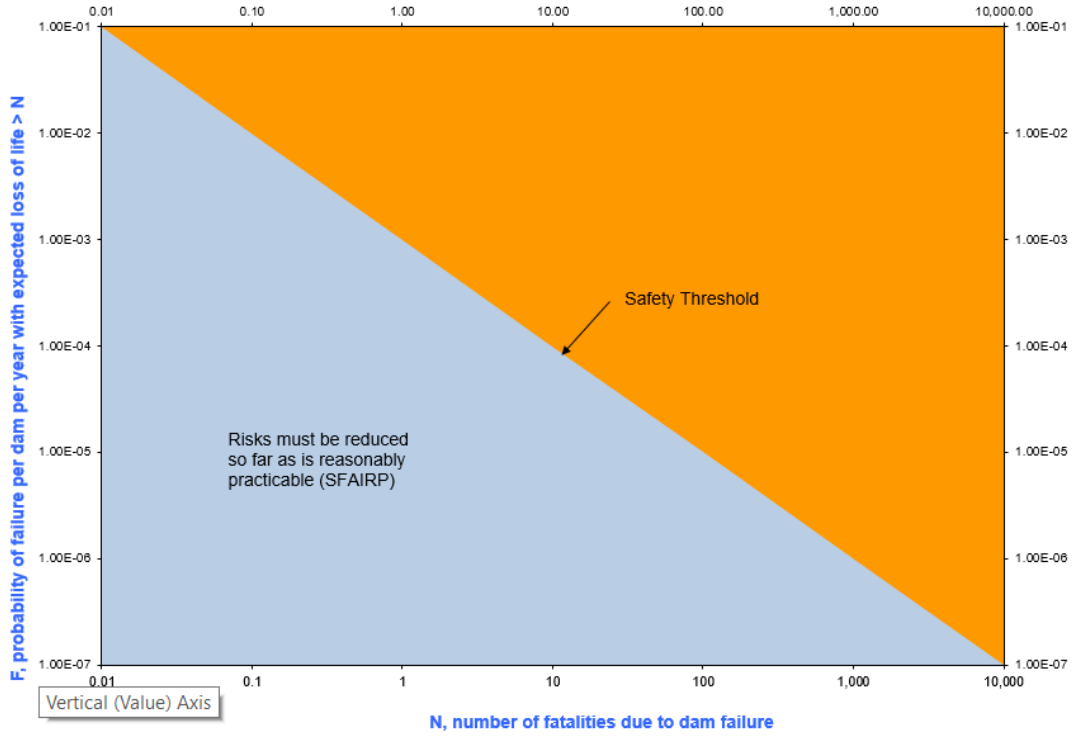

Figure 1. Societal safety threshold for existing dams

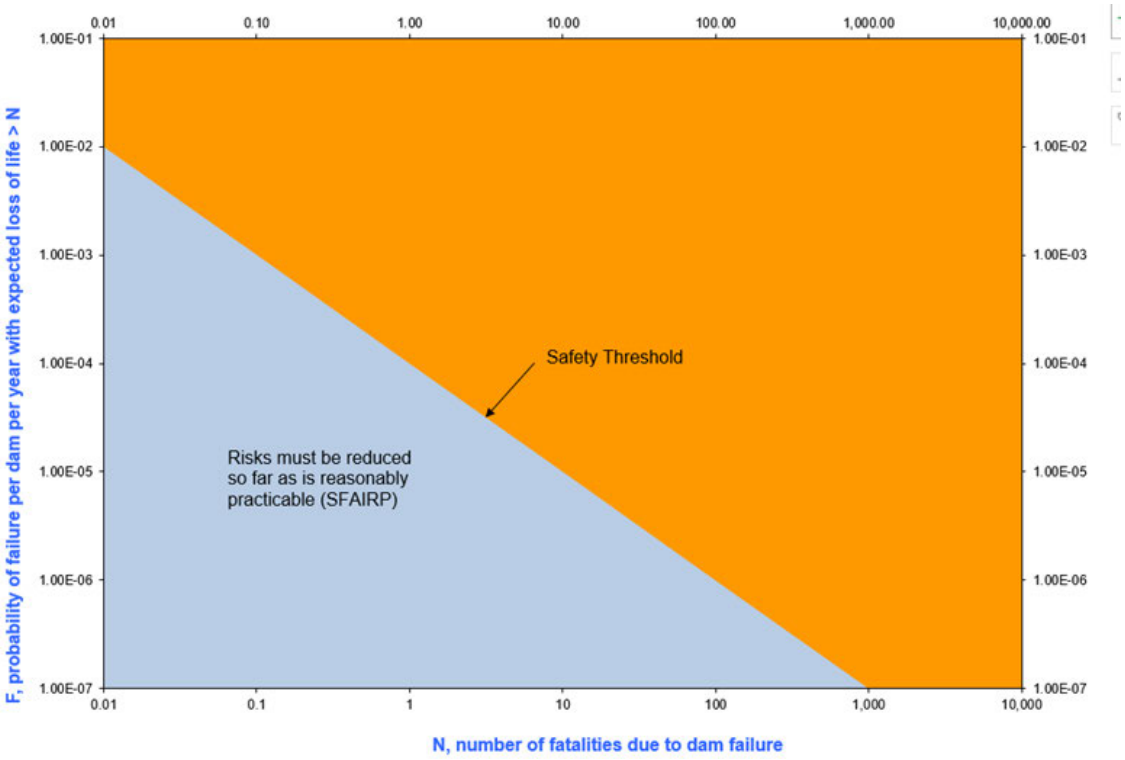

Figure 2. Societal safety threshold for proposed dams and major augmentations to existing dams

3 Determination of estimated annual probability of failure of a dam

(1) All foreseeable hazards and credible failure scenarios adversely affecting the safety of the dam must be identified.

(2) The estimated annual probability of failure of the dam, $F_{n,}$ must be calculated as a result of quantitative risk analysis involving accepted methods related to each failure scenario. Accepted methods include historical performance and event tree analyses.

(3) Other methods recommended by ANCOLD may also be used or other alternative methods accepted by a competent person.

4 Determination of the estimated number of fatalities due to dam failure

Care must be taken to ensure that the method used is applicable to the dam or basin and the flooding situation being assessed, and that appropriate fatality rates are used.

The number of fatalities due to dam failure must be calculated using the following method:

(1) determine the dam failure scenarios that will be evaluated (loss of life estimates are needed for both failure of the dam during normal weather conditions and failure of the dam during flood conditions – the 'sunny day' and 'flood' conditions),

(2) determine time categories for which loss of life estimates are needed (the number of people at risk downstream may be influenced by seasonality, day of week, or time of day factors),

(3) determine when dam failure warnings would be initiated (analysis of dam failure warning times and how they would affect loss of life),

(4) determine area flooded for each dam failure scenario,

(5) estimate the number of people at risk for each dam failure scenario and time category,

(6) apply empirically-based equations or methods for estimating the number of fatalities, and

(7) evaluate the uncertainty associated with the determination of the number of fatalities.

5 Acceptable methods for calculation of the estimated number of fatalities due to dam failure

The methods described in the following are acceptable methods for calculation of the number of fatalities estimated due to dam failure, in accordance with section 5:

(1) Graham, W J, 1999, *A Procedure for Estimating Loss of Life Caused by Dam Failure*, DSO-99-06, U.S. Department of the Interior, Bureau of Reclamation, Denver,

Colorado. https://www.usbr.gov/ssle/damsafety/TechDev/DSOTechDev/DSO-99-06.pdf

When using Graham's method for estimating loss of life, the criterion boundary from low to medium flood severity should be D ≥ 3m and DV ≥ 4.6m^2/s. The criterion boundary from medium to high flood severity should be DV ≥ 15m^2/s and the maximum rate of rise ≥ 3m per 5 minute period (i.e. too rapidly to allow people a reasonable chance to escape).

(2) United States Bureau of Reclamation (USBR), *RCEM – Reclamation Consequence Estimating Methodology (2015): Guidelines for Estimating Life Loss for Dam Safety Risk Analysis*.

(3) Developed and already-applied software modelling systems that involve spatially-distributed, dynamic simulations for estimating potential loss of life (PLL) loss from natural and dam failure floods; particularly for very large and high or extreme consequence category dams with an expected large estimated loss of life.

(4) Other methods recommended by ANCOLD may also be used or other alternative methods accepted by a competent person.

6 Individual risk rating

(1) An individual risk rating must be determined for the dam and is defined as the increment of risk to the life of the person because of the dam.

Note: A person (or group) located within the inundation area closest to the dam failure may not be "most at risk" if the exposure factor is low. A person (or group) further downstream with a higher exposure factor may actually be at greater risk.

(2) As part of the risk management framework, all foreseeable dam failure scenarios (or credible modes of failure) that involve potential fatalities must be identified and individual risk estimated for each scenario.

The estimate of individual risk needs to consider the following factors:

(a) exposure factor (EF) – the proportion of the time the person or group most at risk is within the dam break inundation extent

(b) time of day factor (TF) – based on the time awake and asleep

(c) warning and evacuation factor (WEF) – this represents the conditional probability that the person or group most at risk does not evacuate either due to insufficient warning or because they elect not to evacuate. This considers the available warning time and the ability of the person or group most at risk to be able to evacuate, and

(d) fatality factor (FF) – based on the severity of flooding and the expected shelter for the individual most at risk.

(3) The equation to be used to estimate individual risk in failure scenarios is:

$IR_{fs} = (f \times EF_{day} \times TF_{day} \times WEF_{day} \times FF) + (f \times EF_{night} \times TF_{night} \times WEF_{night} \times FF)$

Where f is the estimated annual probability of failure

(4) The individual risk rating is the highest of the estimated individual risk for the dam failure scenarios (IR_{fs}).

(5) Other methods for determining individual risk recommended by ANCOLD may also be used or other alternative methods accepted by a competent person.

Dams Safety New South Wales

Declared dams consequence category assessment and determination methodology

for

Dams Safety Act 2015

Part 1 Preliminary

1 Background

The *Dams Safety Regulation 2019* requires that:

- an owner of a declared dam must ensure that the consequence category of the dam is assessed by a competent person, and
- the consequence category assessment must be carried out using this methodology.

Part 2 Declared dam consequence category assessment and determination

2 Consequence category assessment

(1) A dam consequence category assessment must be based on either a potential loss of life (PLL) assessment in the manner prescribed by Table 1 of this methodology or a population at risk (PAR) assessment in the manner prescribed by Table 2 of this methodology.

(2) If a consequence category assessment based on PLL is different from a consequence category assessment based on PAR for a dam, the consequence category assessment based on PLL must be used to determine the consequence category.

(3) The assessment of consequence category must include, but not be limited to:

(a) identification of the scenarios which represent the potential for dam failure,

(b) an estimate of the downstream inundation characteristics for these scenarios,

(c) an estimate of the potential loss of life (PLL) or estimate of the population at risk (PAR) for these scenarios

(d) an estimate of the severity of the 'damage and loss' grouped as required by section 5 of this methodology for these scenarios, including infrastructure (section 6 Table 3A), environmental (section 7 Table 3B), and health and social (section 8 Table 3C) considerations, and

(e) an uncertainty and sensitivity analysis for the scenarios.

(4) In the identification and analysis of the scenarios in (3) above, two types of dam failure must be considered:

(a) failures that occur without any attendant natural flooding, giving rise to the 'Sunny Day' Consequence Category (SDCC), and

(b) failures that occur in association with a natural flood, giving rise to the Flood Consequence Category (FCC). The FCC should be based on the incremental consequence over natural flood and be limited to above a 300mm increment.

(5) The higher of the SDCC and FCC must be used to determine the consequence category of the dam.

(6) In calculating the PLL and PAR, account is to be taken of workers on site, itinerant as well as non-itinerant persons.

(7) It is acknowledged that the tables 1 and table 2 are based on the Australian National Committee on Large Dams (ANCOLD) *Guidelines on the Consequence Categories for Dams (October 2012)*. In determining the consequence category of a dam, dam owners should follow Australian National Committee on Large Dams (ANCOLD) Guidelines on the Consequence Categories for Dams (October 2012) unless otherwise indicated in this methodology.

Notes

(1) The SDCC is normally used to determine design standards for seismic stability and the FCC is used in order to determine the flood capacity required for a declared dam. All other design requirements, (eg. internal erosion, conduit security etc.) usually involve consideration of the dam's SDCC.

(2) Routine inspection and monitoring frequencies are normally based on the SDCC.

3 Consequence category determination based on potential loss of life

(1) For the purposes of 2 (1), the following table (Table 1) must be used to determine a consequence category based on the PLL method.

Table 1

Potential Loss of Life (PLL)	**Severity of Damage and Loss**			
	Minor	**Medium**	**Major**	**Catastrophic**
Less than 0.1	Very Low	Low	Significant	High C
0.1 to less than 1	Significant	Significant	High C	High B
1 to less than 5		High C	High B	High A
5 to less than 50		High A (where PLL is 5 or above and less than 10, can be reduced to High B)	High A	Extreme
50 or more			Extreme	Extreme

(2) The following methods may be used as the basis for calculation of the PLL:

(a) The method described in the following publication: Graham, W J, 1999, *A Procedure for Estimating Loss of Life Caused by Dam Failure, DSO-99-06, U.S. Department of the Interior, Bureau of Reclamation, Denver, Colorado*. https://www.usbr.gov/ssle/damsafety/TechDev/DSOTechDev/DSO-99-06.pdf When using Graham's method for estimating loss of life, the criterion boundary from low to medium flood severity should be D ≥ 3m and DV ≥ 4.6m^2/s. The criterion boundary from medium to high flood severity should be DV ≥ 15m^2/s and the maximum rate of rise ≥ 3m per 5 minute period (i.e. too rapidly to allow people a reasonable chance to escape).

(b) United States Bureau of Reclamation (USBR), RCEM – Reclamation Consequence Estimating Methodology (2015): Guidelines for Estimating Life Loss for Dam Safety Risk Analysis.

(c) Developed and already- applied software modelling systems that involve spatially-distributed, dynamic simulations for estimating potential loss of life (PLL) loss from natural and dam failure floods; particularly for very large and high or extreme consequence category dams with an expected large estimated loss of life.

(d) Other methods recommended by ANCOLD may also be used or other alternative methods accepted by a competent person.

4 Consequence category determination based on population at risk

(1) For the purposes of 2 (1), the following table (Table 2) must be used to determine a consequence category based on the PAR method.

Table 2

Population at Risk (PAR)	**Severity of Damage and Loss**			
	Minor	**Medium**	**Major**	**Catastrophic**
Less than 1	Very Low	Low	Significant	High C
1 to 9	Significant or High C, if there is a potential for one or more lives being lost	Significant or High C, if there is a potential for one or more lives being lost	High C	High B
10 to 99	High C	High C	High B	High A
100 to 999		High B	High A	Extreme
1,000 or more			Extreme	Extreme

(2) The population at risk (PAR) is defined as all persons who would be significantly exposed to floodwaters within the natural flood, or dambreak zone, if they took no

action to evacuate. This allows for the estimation of the PAR for natural flooding (without dam failure). This also applies to dams that impound contents other than water.

5 Consequence category assessment – criteria to be used for estimating severity of damage and loss

(1) For consequence assessment purposes, the potential severity of the damage and losses must be grouped into like consequences related to:

(a) estimated total infrastructure cost,

(b) estimated environmental impacts, and

(c) estimated health and social impacts.

(2) Evidence must be documented to justify the determination for all elements of Table 3A (one element), Table 3B (5 elements) and Table 3C (eight elements).

(3) The severity level of each of these potential damages and losses must be determined to be either: minor, medium, major or catastrophic, in accordance with Table 3A, Table 3B and Table 3C.

(4) The highest potential severity of the three consequence groups identified in 5 (1) must be used in Table 1 or Table 2 for the determination of the consequence category of the dam.

6 Consequence category assessment – criteria to be used for estimating total infrastructure costs for the purposes of 5 (1)

(1) Total estimated infrastructure costs must be considered for residential and commercial, as well as community infrastructure. Costs associated with replacement or repair to the dam must also be included.

(2) The potential severity of the estimated infrastructure costs must be established in the manner prescribed by the following Table 3A.

Table 3A

Type	Minor	Medium	Major	Catastrophic
Residential, Commercial, Community Infrastructure, Dam replacement or repair cost	<$10M	$10M to $100M	$100M to $1B	>$1B

7 Consequence category assessment – criteria to be used for estimating environmental impacts for the purposes of 5 (1)

The potential severity of the estimated environmental impacts must be established in the manner prescribed by the following Table 3B.

Table 3B

Type	Minor	Medium	Major	Catastrophic
Duration of recovery	<1 year	1 to 5 years	5 to 20 years	>20 years
Waters	Discharge from dambreak would not contaminate waters	Discharge from dambreak would contaminate waters	Discharge from dambreak would significantly contaminate waters	Discharge from dambreak would contaminate waters over a very long period
Ecosystems	Discharge from dambreak is not expected to impact on ecosystems. Remediation possible	Discharge from dambreak would have short term impacts on ecosystems with natural recovery expected.	Discharge from dambreak would have significant impacts on ecosystems with natural recovery expected to take many years	Discharge from dambreak would have significant long term or permanent impacts on ecosystems. Remediation unlikely.
Endangered Ecological Communities and Threatened Species	Minimal damage expected. Recovery within one year	Losses expected to be recovered over a number of years	Severe impacts. Recovery will take many years	Permanent loss or damage to endangered ecological communities or threatened species
Material detained by a tailings/ash dam	Benign solid/liquid	Saline liquid/ unsightly solid contents	Acid contents	Highly reactive/toxic contents

8 Consequence category assessment – criteria to be used for estimating health and social impacts for the purposes of 5 (1)

The potential severity of the estimated health and social impacts must be established in the manner prescribed by the following Table 3C.

Table 3C

Type	Minor	Medium	Major	Catastrophic
Human health (eg by contamination of water, lack of water or release of sewage or toxins)	<100 people affected	100 to 1000 people affected	>1000 to 10000 people affected for greater than one month	>10,000 people affected for a year or more
Loss of services to the community (eg water, gas, electricity, communications or transport)	<100 people affected	100 to 1000 people affected	>1000 to 10,000 people affected for greater than one month	>10,000 people affected for a year or more
Emergency services organisations staff or volunteers deployment	<1000 person days	1000 to 10,000 person days	>10,000 to 100,000 person days	>100,000 person days
Dislocation of people	Persons required to move from their homes for a period of <100 person months	Persons required to move from their homes for a period of 100 to 1000 person months	Persons required to move from their homes for a period of >1000 to 10,000 person months	Persons required to move from their homes for a period >10,000 person months
Dislocation of businesses	Businesses cease trading for <20 business months	Businesses cease trading for 20 to 200 business months	Businesses cease trading for 200 to 2000 business months	Businesses cease trading for >2000 business months and numerous business failures
Employment affected	<100 jobs affected	100 to 1000 jobs affected	>1000 to 10,000 jobs affected	>10,000 jobs affected

Loss of heritage	Some physical damage to a local heritage item	Significant physical damage to a local heritage item	Significant physical damage to a heritage item registered under the Heritage Act 1977 (NSW) or that is the subject of an interim heritage order under that Act;	Loss of a heritage item registered under the Heritage Act 1977 (NSW) or that is the subject of an interim heritage order under that Act; Significant physical damage to a place included in the Commonwealth Heritage List within the meaning of the Environment Protection and Biodiversity Conservation Act 1999 of the Commonwealth or a property inscribed on the World Heritage List within the meaning of that Act
Loss of recreational facility	Damage to a recreational area or facility of local significance	Loss of a recreational area or facility of State significance	Loss of a recreational area or facility of national significance	Loss of a recreational area or facility of national and international significance