



**ACT**  
Government

Chief Minister, Treasury and  
Economic Development

# Dam Safety Compliance & Performance Report 2017/18

Name of dam: Googong Dam

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## Completing the annual report

A regulated utility owning, leasing or subleasing a dam listed under Section 69 of the Utilities (Technical Regulation) Act 2014 (the Act) is required under Section 6.2 of the Dam Safety Code 2014 to provide a written report annually to the Technical Regulator for that dam. The content and format of each report is as specified in this Excel workbook and the accompanying "Dam Safety Compliance & Performance Report - 2017/18 - Dictionary" document.

Information provided in this Annual Compliance and Performance Report will be used in the Technical Regulator's report required under s.80 of the Act. The Technical Regulator's report is required to be published.

### Instructions for completing this report:

- 1 Please refer to the explanatory notes provided on the first page of the accompanying "Dam Safety Compliance & Performance Report - 2017/18 - Dictionary" document.
- 2 Please indicate where material provided is confidential and not for general public release.
- 3 Completed annual reports must be received by the Technical Regulator by 30 September of the year of issue.
- 4 For enquiries please email [techregulator.utilities@act.gov.au](mailto:techregulator.utilities@act.gov.au) or call (02) 6207 0362

### Legend and data validation

#### Legend

- Green cells with white text indicate column headings
- Blank white cells beneath column headings can be used for additional comments
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- Blue cells indicate quantitative inputs
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- Blue text indicates a link to another page

#### Column heading

Enter comments in these cells

Enter qualitative data in these cells

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Notes for completing questions

Link to another page



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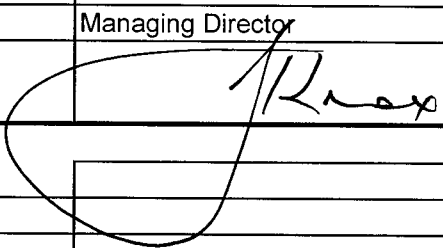
## General responses

**Note:** Responses should be provided in accordance with the Explanatory Notes and the List of Questions.

The authorising officer may use an electronic signature.

Each regulated utility need answer the "General response" questions on this sheet only once each year. If the information has already been supplied in the questionnaire for another dam, it need not be supplied again here - instead please indicate in which dam's questionnaire these questions have been answered:

General Responses were provided in Corin Dam

Number	Part	Question (short form)	Regulated Utility 2017/18 Response
<b>General</b>			
DS1	a	Corporate Approval (Y/N?)	Yes
DS1	b	Authorising officer name	John Knox
DS1	c	Authorising officer title / position	Managing Director
DS1	d	Authorising officer signature	
<b>Management of DSMSs</b>			
DS2	a	Responsible officer title	
DS2	b	Office for reporting title	
DS2	c	Qualifications and experience required	
DS2	d	Qualifications and experience actual	
DS2	e	Documentation of responsibilities (Y/N?)	
<b>Quality management of Dam Safety Management Systems (DSMSs)</b>			
DS3	a	Function level audit(Y/N?)	
DS3	b	Process and Validation level audits (Y/N?)	
<b>Training for dam safety</b>			

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Number	Part	Question (short form)	Regulated Utility 2017/18 Response
DS4	a	Training of personnel (Y/N?)	
DS4	b	Positions trained (list)	
DS4	c	Training dates (list)	
DS4	d	Positions not trained (list)	
<b>DSMS Documents</b>			
DS5		Archiving of documents (Y/N?)	
<b>Unscheduled and new dams</b>			
DS6	a	Unscheduled dams current (Y/N?)	
DS6	b	Unscheduled dams future (Y/N?)	

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## Dam specific responses

**Note:** Responses should be provided in accordance with the Explanatory Notes and the List of Questions.

Number	Part	Question (short form)	Regulated Utility 2017/18 Response
<b>Data file</b>			
DS7	a	Data file (Y/N?)	Yes
DS7	b	Data book (Y/N?)	Yes
<b>Sunny Day Classification</b>			
DS8	a	Sunny Day Consequence category	Extreme
DS8	b	Sunny Day Consequence basis ("PAR", "PLL" or "other")	PLL
DS8	c	Sunny Day Consequence value (value or consideration)	887
DS8	d	Sunny Day Consequence review date (date)	30/03/2015
DS8	e	Sunny Day Consequence next review (date/"Not Planned")	Not Planned
DS8	f	Sunny Day Consequence change (Y/N?)	No
<b>Flood Consequence Classification</b>			
DS9	a	Flood Consequence category	Extreme
DS9	b	Flood Consequence category basis ("PAR", "PLL" or "other")	PLL
DS9	c	Flood Consequence category (value or consideration)	1113
DS9	d	Flood Consequence category review date (date)	30/03/2015
DS9	e	Flood Consequence category next review (date/"Not Planned")	Not planned
DS9	f	Flood Consequence category change (Y/N?)	No
<b>Operation and maintenance manuals</b>			
DS10	a	O&M manual exists(Y/N?)	Yes
DS10	b	Date of most recent O&M manual revision?	13/05/2016
DS10	c	O&M manual is a controlled document (Y/N?)	Yes
DS10	d	O&M log (Y/N?)	Yes
<b>Operations issues - Flood</b>			
DS11	a	DCF – headwater level (m)	RL 674.5m AHD
DS11	b	DCF –discharge	10,100 m3/s
DS11	c	DCF – AEP	1:1,100,000

## Dam specific responses

Note: Responses should be provided in accordance with the Explanatory Notes and the List of Questions.

Number	Part	Question (short form)	Regulated Utility 2017/18 Response
DS11	d	Safe Flood Capacity – level (m)	RL 674.5 m AHD
DS11	e	Safe Flood Capacity - discharge	10,100 m3/s
DS11	f	Safe Flood Capacity (“AEP”/“PMPDF”/“PMF”)	PMF
DS11	g	Safe Flood Capacity (value of AEP/PMPDF/PMF)	PMF
DS11	h	Flood capacity (citation)	Googong Dam Risk Assessment - Final Report by SKM dated 30/03/2015
DS11	i	Flood events (#)	0
DS11	j	Worst Flood – date	0
DS11	k	Worst Flood – peak inflow	0
DS11	l	Worst Flood – peak outflow	0
DS11	m	Worst Flood – peak headwater	0
<b>Operations issues - Earthquake</b>			
DS12	a	Safe earthquake - PGA	0.347 g
DS12	b	Safe earthquake - AEP	1: 10,000
DS12	c	Earthquake capacity (citation)	2018
DS12	d	Earthquake (#)	No Event greater than MMI IV
DS12	e	Earthquake – date/“No Event”	No Event
DS12	f	Earthquake – intensity/“No Event”	No Event
DS12	g	Earthquake – shaking measured (state/“No Event”)	No Event
<b>Operations issues - General</b>			
DS13		Operating problems (Y/N?)	No
<b>Maintenance performance</b>			
DS14	a	Maintenance record (Y/N?)	No
DS14	b	Deferred Maintenance (Y/N?)	No
<b>Inspection of dams</b>			
DS15	a	Inspection regime (Y/N?)	Yes
DS15	b	Inspection frequency (Y/N?)	Yes
DS15	c	Inspection reports to suit dam (Y/N?)	Yes
DS15	d	Inspection reports minimum content (Y/N?)	Yes
DS15	e	Special/Emergency inspections (Y/N?)	No
DS15	f	Completion of inspections (Y/N?)	Yes
DS15	g	Inspection reports signed (Y/N?)	Yes
<b>Surveillance reports</b>			
DS16	a	Dam surveillance program submission (date)	30/09/2017
DS16	b	Latest Surveillance Report (citation)	Googong Dam Comprehensive Surveillance Report - May 2014

## Dam specific responses

**Note:** Responses should be provided in accordance with the Explanatory Notes and the List of Questions.

Number	Part	Question (short form)	Regulated Utility 2017/18 Response
DS16	c	Content of Surveillance Reports (Y/N?)	Yes
DS16	d	[Question for NSW Scheduled dams only]	See supplementary information
DS16	e	[Question for NSW Scheduled dams only]	See supplementary information
<b>Instrumentation</b>			
DS17	a	Available instrumentation (list)	Leakage weirs, ground water holes, seismo meter, accelerometer, water level sensors, gauge boards, deformation survey targets, rainfall gauge, inflow and outflow measuring gauging stations
DS17	b	Calibration of instrumentation (Y/N?)	Yes
<b>Monitoring of dams</b>			
DS18	a	Monitoring undertaken (describe)	Deformation survey, leakage, ground water measurements, seismometer monitoring, water levels, inflows, outflows, rainfall
DS18	b	Frequency of monitoring (Y/N?)	Yes
DS18	c	Monitoring of anchors (Y/N/"No Anchors"?)	No
DS18	d	Mechanical/electrical monitoring (Y/N?)	Yes
DS18	e	Monitoring records archived (Y/N?)	Yes
<b>Surveillance evaluation</b>			
DS19	a	Surveillance evaluation – personnel	Yes
DS19	b	Surveillance evaluation – frequency	Yes
DS19	c	Surveillance evaluation (Y/N?)	Yes
<b>Safety review</b>			
DS20	a	Latest safety review - date	Jan 2018
DS20	b	Peer reviewed comprehensive safety review (Y/N?)	Yes
DS20	c	Safety Review Report (citation)	Googong dam Comprehensive Safety Review by AECOM Jan 2018
DS20	d	Corresponding Separate Peer review Report (citation)	Letter report on Peer Review By Graeme Bell
DS20	e	Peer reviewed comprehensive safety review – availability	Yes
DS20	f	[Question for NSW Scheduled dams only]	See supplementary information
DS20	g	[Question for NSW Scheduled dams only]	See supplementary information
<b>Dam safety emergency plans</b>			
DS21	a	DSEP exists (Y/N?)	Yes
DS21	b	Date of latest DSEP update (citation)	Weatherstone P,(2018) Googong Dam - Dam Safety Emergency Plan v2.1, 16/04/2018
DS21	c	Latest DSEP test (citation)	Beresford C, Lloyd P, & Miller B, (2016) ACT/NSW Cross Boarder Exercise Report - Exercise Quid Facies, 25 July 2016
DS21	d	Draft DSEP submission (date)	10/10/2017

## Dam specific responses

**Note:** Responses should be provided in accordance with the Explanatory Notes and the List of Questions.

Number	Part	Question (short form)	Regulated Utility 2017/18 Response
DS21	e	Inundation mapping data submission (date)	15/06/2016
DS21	f	Inundation mapping data start (co-ordinates)	705420E, 6077976N
DS21	g	Inundation mapping data end (co-ordinates)	644561E, 6125626N
DS21	h	Inundation mapping data submission sheets (#)	11
DS21	i	DSEP contact list submission (date)	16/04/2018
DS21	j	Dam emergency event report submission (Y/N?)	No
<b>Security of dams</b>			
DS22	a	Security plan (Y/N?)	Yes
DS22	b	Security plan test/review (date)	6/03/2018
DS22	c	Security assessment (date)	31/01/2018
<b>Dam safety incidents</b>			
DS23		Dam safety incidents (Y/N?)	No
<b>Dam safety developments</b>			
DS24	a	Developments affecting dam safety (Y/N?)	No
DS24	b	Effect of any other dam (Y/N?)	No
<b>Modification of dams</b>			
DS25	a	Dam modifications (Y/N?)	No
DS25	b	Improvement due to modifications (Y/N/"No Modification"?)	No Modification
<b>Key documents</b>			
DS26	a	Design reports or safety reviews (Y/N?)	Yes
DS26	b	Safety reviews (citation)	Googong Dam Comprehensive Safety Review by AECOM Jan 2018
DS26	c	Construction reports (Y/N?)	Yes
DS26	d	WAE drawings (Y/N?)	Yes
DS26	e	Safety status ("A", "B" or "C")	A





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## Supplementary information

**Note:** Please reference each item with the relevant question.



**Tip :** Press Alt-Enter to start a new line in a cell.

Number	Part	Regulated Utility 2017/18 Response
DS14	a	Operate the DN1000 low level guard valve on a quarterly basis through the full range of movement - rescheduled to 2019-20 Operate the isolation valves on a quarterly basis through their full range of movement - rescheduled to 2019-20
DS14	b	Inspect and regrease anchor heads on the spillway crest - rescheduled to 2018-19 Install network of cameras/alarm systems for security and dam safety around critical components of the dam to enable the operators to monitor the condition and security of the dam - rescheduled 2019-20 Check and regrease the post tensioning load on the anchors on the spillway crest on a five-yearly basis - rescheduled to 2018-19 Place a protective sleeve over the sharp and ill-fitting corners of the handrails - rescheduled to 2018-19 Repair spillway concrete damage - rescheduled to 2018-19 Refurbish or replace discharge valve - rescheduled to 2018-19 Inspect and test cone valve including internal inspection with the valve fully open (upstream valve closed) to assess the condition of the sliding faces - planned for 2018-19 Operate both discharge valves on a quarterly basis through their full range of movement - planned for 2018-19 Evaluate the degree of deterioration of the extractable anchor straps on the reinforced earth retaining wall on the dam crest - rescheduled 2018-19
DS 16	d	See Attachment 1
Ds 16	e	See Attachment 2
DS 20	f	The safety review was sent to DS, NSW on 22/01/2018
DS 20	g	No response from DS, NSW

# Attachment 1



Dams Safety  
Committee

1 August 2014

Group Manager - Water  
ACTEW Water  
GPO Box 366  
Canberra ACT 2601  
**Ms Amanda Lewry**

Our ref: Googong

Your ref:

Dear Ms Lewry,

## Re: Googong Dam – Surveillance Report (May 2014)

The NSW Dams Safety Committee (DSC) at its August 2014 meeting endorsed the above referenced Surveillance Report received on 22<sup>nd</sup> May 2014. The DSC endorses ACTEW Water's program for implementation of the Report's recommendations.

Please ensure that the following items are appropriately addressed:

1. The daily dam inspections currently undertaken, as described in Sub-section 6.1 of the Report, are considered inadequate for daily routine inspections of an Extreme Sunny Day Consequence Category (SDCC) dam. Please ensure that a more thorough daily inspection of the dam embankment and downstream toe are undertaken, including completion of an inspection form, in accordance with the *ANCOLD Guidelines on Dam Safety Management, 2003* for an Extreme SDCC dam. This is particularly necessary, as an issue regarding piping was raised in the recent risk assessment, and as there are no piezometers located in the dam and therefore the phreatic surface is unknown
2. Await a controlled copy of the updated Dam Safety Emergency Plan (DSEP, Report's Recommendation 58) by August 2014
3. Include the findings of the additional studies (see Report's Recommendations 44 to 49 and 52) in the next Type 1 Surveillance Report due by May 2019.

Your continuing cooperation is appreciated. If there are any queries in regard to the above please do not hesitate to contact the undersigned.

Yours sincerely,

for Steve Knight  
Executive Engineer

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ARB 55 079 703 705

## Attachment 2

### DS 16 e Recommendations from 2014 Comprehensive Surveillance Report Googong Dam

Recommendation	Priority	Status	Maintenance Planned Timing	Comments
<b>Outstanding Items from the 2005 Surveillance Report</b>				
1 The anchor heads on the spillway crest should be inspected and regreased in 2005/2006. This maintenance work is still outstanding and should be completed as soon as possible.	P2	Planned for 2018/19 Progressing		Preliminary work completed.
<b>Outstanding Items from the 2012 Annual Inspection Report</b>				
2 Upgrade instrumentation at the dam.	P3			being considered as an efficiency improvement
3 Install telemetry facilities for the instrumentation.	P3			being considered as an efficiency improvement
4 Install network of cameras/alarm systems for security and dam safety around critical components of the dam to enable the operators to monitor the condition and security of the dam.	P3			being considered as an efficiency improvement
5 Investigate the security status of the dam precinct in view of the new development around Googong suburb. Note this is currently in progress.	P3	Security upgrade complete.		
<b>Recommendations from the 2014 Surveillance Report</b>				
<b>Inspections and Monitoring</b>				
<u>Spillway</u>				
6 The spillway channel and cascade has not been inspected up close (via rope access) since the end of the construction upgrade works in December 2010. An inspection should be undertaken when the reservoir storage level permits safe access. At this time the known spalling concrete defect in one location can be inspected and a repair procedure developed.		Inspection completed in 2017		
7 The post tensioning load on the anchors on the spillway crest should be checked and the heads regreased on a five-yearly basis. As the anchors have not been monitored since they were first installed, this task needs to be undertaken as soon as possible.	P2	Progressing to complete by mid 2019		
8 If the drains through the shotcrete slope protection on the access benches to the left of the spillway show signs of blockage, a thorough program of drainage inspection and maintenance should be undertaken.	P2	being inspected at 5 yearly		
<u>Intake Tower</u>				
9 The load rating for the intake tower access bridge is not displayed. This should be clearly displayed on the access gate.	P2	Completed		
10 Minor cracking as a result of apparent Alkali Aggregate Reaction (AAR) was evident in the intake tower bridge piers, intake tower crest, and on the external and internal walls of the tower. There is no current cause for concern but the AAR cracking on the concrete structures should be reviewed and compared between subsequent inspections (i.e. five yearly basis) by taking detailed photographs. If the cracking worsens remedial actions may be required.	P3	Planned for 2019		
11 The condition of the internal surfaces of the intake tower valves should be determined by endoscopic camera.	P3		Jun-19	This requires isolation of the intakes. This also needs contractor with ROV expertise.
12 The actuator switch on Intake Valve No. 4 has seized which renders this valve inoperable for electric operation. This should be repaired.	P3	All actuators have been replaced		
13 The gearbox and actuator gaskets are weeping and should be monitored. If this deteriorates into a noticeable leak (dripping) remedial action must be taken.	P3	All actuators have been replaced		
14 The paint on the bypass valves in the intake tower has been damaged in a number of areas resulting in corrosion forming. This should be monitored and remedial action taken when corrosion spreads under adjacent paint or grows deeper (it is best touched up when first noticed).	P3	Action is in progress		
15 Weeping gaskets on valve and actuator boxes in the intake tower should be monitored and repaired when weeping deteriorates into a leak (dripping).	P3	All actuators have been replaced		
<u>Saddle Dam</u>				
16 The longitudinal cracks in the sealed road on the Saddle Dam crest, whilst not believed to be indicative of a serious problem in the embankment, should be monitored by taking photographs and comparing with those from future inspections (on a five yearly basis) to record any changes to the condition of the cracks.		Included in 5 yearly inspections.		
<u>Instrumentation</u>				
17 Seepage readings from the weirs at the dam should be monitored daily to comply with the ANCOLD Guidelines on Dam Safety Management (2003).	P1	Actioned		
18 Normal movement surveys and control surveys should be conducted annually and every five years, respectively.	P1	Actioned		
<b>Maintenance</b>				
<u>Main Dam</u>				
19 Some weed growth was noted on the upstream slope of the main embankment within the rip rap rockfill and towards the crest. This was noted on the downstream slope also. The riprap/rockfill on both slopes should be maintained clear of any vegetation growth. It is noted that weed removal was in progress during the dam inspection.	P1	Completed		

Recommendation	Priority	Status	Maintenance Planned Timing	Comments
20 Whilst no excessive vegetation was noted to be growing along the upstream dam toe above the waterline, a minimum 5m vegetation free zone (bushes and trees) should be kept clear from the toe on the upstream slope.	P1	Completed		
21 Numerous trees and bushes were noted to be growing in close proximity to the embankment toe on the downstream abutment groins. All trees and bushes should be removed for a distance of at least 10m from the embankment toe on each downstream abutment.	P1	Completed		
22 The weeds/long grass at the downstream toe should be routinely cut low so as not to hinder observations in this area. Again it is noted that this was in progress at the time of the inspection.	P1	Completed		
<u>Intake Tower</u>				
23 The redundant electrical cables from under the intake tower bridge deck should be removed.	P3			
The following tasks should be undertaken on the overhead crane at the intake tower:		Completed		
• Apply grease to the cable drum and cable guide shafts;	P2	Completed		
• Clean the hook assembly and repaint;	P2	Completed		
24 • The crane number, load rating and class number must be clearly displayed on the crane; and	P1	Completed		
• It is recommended, but not a requirement, that all operations of the crane, e.g. load lifted, duration of lift, are noted in the logbook for future remaining service life calculation of the crane.	P3			
• If the crane is older than 7 years it must be assessed for continued safe use as required in AS 2550.1.	P1	Refurbished		
The intake tower screens and bulkheads require the following maintenance tasks:	P2			
• Remove the lifting frame and inspect for corrosion, damage and operation of all parts;	P2	Done in 2016		
25 • Apply markings to the lifting frame as required by AS 1418 (WLL, class number, identification number);	P2	Done in 2016		
• Remove the bulkheads and inspect for corrosion and damaged seals; and	P3	Done in 2016		
• Remove the screens and inspect for debris, corrosion and damage.	P3	Done in 2016		
26 The following tasks should be undertaken on the handrails, ladders and platforms on the intake tower:				
• Install a self-closing gate on the handrails around the tower access hatch;			Dec-18	This requires a review as to if a procedural modification should be in place in stead of physical modification.
• Install a chain or self-closing gate on the handrails providing access to the valve platforms;	P1	Planned	Dec-18	This requires a review as to if a procedural modification should be in place in stead of physical modification.
• Place a protective sleeve over the sharp and ill-fitting corners of the handrails to prevent injury;	P2	Planned	Sep-18	This is planned to be undertaken by external Contractor. This is intended to be included in scope of work planned for external contractor. (in scope of work provided to fit Resources)
• Apply markings (WLL) to the platform beams that serve as lifting beams in accordance with AS1418; and	P2	Planned	Jun-19	This is planned to be undertaken by External Crane Contractor. This needs to be checked with the suitability of inclusion in the crane contract James is working on.
• Apply the load rating (WLL) to the lifting trolleys and have them certified. Alternatively remove the trolleys and certify them only when they are needed.	P3		Jun-19	This is planned to be undertaken by External Crane Contractor. This needs to be checked with the suitability of inclusion in the crane contract James is working on.
27 All valves should be operated on a 3 monthly basis through their full range of movement. This will allow the gears and bearings to be adequately lubricated and operate the electrical motors for an extended period thereby testing the insulation of the various components.	P2	Being exercised quarterly	Jun-18	This needs to go into Annual Maintenance Plan 2018-19 which should be finalized by June 2018.
28 The hydraulic power unit for the low level outlet valve in the intake tower is in a fair condition but some of the valves and manifold blocks are corroded. These would benefit from the application of a rust preventative.	P2	Refurbished in 2018	Sep-18	This is planned to be undertaken by external Contractor. This is intended to be included in scope of work planned for external contractor. (in scope of work provided to Fit Resources)
The following further maintenance recommendations are made for the Intake Tower:				
29 • Have all electrical actuators serviced. This may not be necessary if all actuators are to be upgraded in near future.	P3	Actuators replaced		
• Install drip trays below hydraulic power units in tower and tunnel.	P2	Hydraulic power units have been refurbished	Dec-18	This will be requested from CMA if required.
• Install lamp test button in low level valve control panel.	P3		Dec-18	A task needs to be raised against Plant Delivery - Electrical
<u>Outlet Tunnel and Outlet Works</u>				
30 In several locations leakage through the outlet tunnel concrete is staining the pipework. This is a catalyst for corrosion and should be prevented by the installation of shields over the pipes.	P3	Pipe is covered at leaking points		
31 The DN1000 low level guard valve should be operated on a quarterly basis, through the full range of movement, to test the operating system and the valve.	P2	being actioned	Jun-18	This needs to go into Annual Maintenance Plan 2018-19 which should be finalized by June 2018.
32 A small section of exposed reinforcement that is corroding was noted on the concrete at the downstream tunnel portal entrance. This should be repaired.	P2	Actioned		
33 The chain on the air valve isolation valve actuator should be replaced and it should be ensured that the valve is open.	P2	Actioned	Sep-18	This will be verified by headworks.

	Recommendation	Priority	Status	Maintenance Planned Timing	Comments
34	The isolation valves should be operated on a quarterly basis through their full range of movement.	P2	being Actioned	Jun-18	This needs to go into Annual Maintenance Plan 2018-19 which should be finalized by June 2018.
35	The electrical actuator on the DN900 cone valve is unable to close the valve when opened further than 20mm open. The cone valve actuator should be serviced or replaced.	P1	Replaced		
36	The cone valve does not seal well and so the upstream butterfly valve is closed whenever the cone valve is not in use. Little of the cone valve could be observed; the valve should be inspected and tested in detail, including internal inspection with the valve fully open (upstream valve closed) to assess the condition of the sliding faces. Refurbishments should be made after the inspection, if necessary.	P2	Investigating	Jun-19	this requires investigation. Potential inclusion in scope for multi valve. It needs to go into Annual Maintenance Plan for exercising.
37	Both discharge valves should be operated on a quarterly basis through their full range of movement.	P2		Jun-19	this requires investigation. Potential inclusion in scope for multi valve. It needs to go into Annual Maintenance Plan for exercising.
<b>Saddle Dam</b>					
38	Trees and bushes were noted to be growing in close proximity to the upstream toe of the Saddle Dam embankment, and also within the riprap. The riprap should be maintained free of vegetation, and all trees and bushes within a minimum of 5m of the upstream embankment toe should be removed.	P1	Actioned		
39	Some small saplings were noted to be growing on the upper downstream right embankment of the Saddle Dam towards the toe. Furthermore notable sized trees are present along both abutments, only a few metres from the embankment toe. Any saplings growing on the downstream slope should be removed. Furthermore, any trees or bushes growing within the 10m zone downstream of the dam toe should also be cleared.	P1	Actioned		
40	The top soil and grass cover protection to the downstream face of the Saddle Dam should be reinstated.	P2	Actioned	Jun-19	This needs to go into Annual Maintenance Plan. To ensure inclusion in E&S scope for 2018/19
41	The vegetation growth at the toe of the Saddle Dam should be cut back or removed.	P2	Actioned		
42	The scoured out areas at the Saddle Dam toe should be reinstated.	P2	Actioned		
43	The surface runoff to the embankment toe could be limited in concentration by constructing a series of swales down each abutment groin, to direct runoff away from the toe at different levels. This would help prevent the scour at the embankment toe.	P3	Actioned		
<b>Other</b>					
44	The upstream side of the reinforced earth retaining wall on the dam crest is backfilled with impervious fill up to RL673.5m AHD. This level is approximately 1m below PMF level. The criticality of this deficiency should be reviewed, depending on the outcome of this review upgrade works may be required.	P3	Addressed in Safety Review completed in 2018		Googong Dam Safety Review Section 9.5.4 covers the assessment of the RE wall. Piping through the RE wall was included as a failure mode (GOO-F4) in the Risk Assessment (section 12.0), which showed the probability for this failure mode was very low (3.2 <sup>-11</sup> ) due to the low probability of flood levels reaching the base of the RE Wall block.
45	None of the extractable anchor straps on the reinforced earth retaining wall on the dam crest have been removed to evaluate the degree of deterioration of the straps to date. Reinforced Earth has advised that two straps should be extracted for examination at 25, 40, 60, 80 and 100 years respectively. Given the wall was constructed in 1991; the first two straps should therefore be removed in 2016.	P3	Planned to test with anchor testing		Extraction and testing is included in project MM10238
46	There is no blanket drain under the random fill placed as part of the Saddle Dam raising on the downstream shoulder of the embankment. The chimney filter in the Saddle Dam also extends to full supply level only. These deficiencies in the raised Saddle Dam design need to be reviewed, with consideration given to upgrading the embankment.	P3	Addressed in Safety Review completed in 2018		Googong Dam Safety Review Section 12.5, AECOM conclude the estimated risks associated with piping above the top of the filter zones are negligibly small.  In Section 14.2, Concept design and costings were developed for constructing a full height filter buttress for the Saddle Dam to test the ALARP principle. AECOM conclude that upgrading the embankment does not satisfy the principles of ALARP; Googong Saddle Dam already plots at a risk position more than one order of magnitude below the ANCOLD defined limit of tolerability and there would be a negligibly small incremental reduction in risk resulting from an upgrade
47	The method in which the pseudo static analysis of the dam was undertaken in the 1988 Dam Safety Review does not meet the criteria of current analysis methods. Furthermore no seismic hazard assessment has been undertaken specifically for the Googong Dam site to confirm the earthquake loading to be used in the pseudo static analysis. It is recommended that a) the seismic hazard assessment be undertaken for Googong Dam, and b) the results of this be used to complete an earthquake stability analysis of the dam.	P3	Addressed in Safety Review completed in 2018		
48	The stability analysis for the Saddle Dam, undertaken as part of the 1988 Dam Safety Review, was assessed for a raised embankment with a reinforced earth retaining wall on the crest. This does not reflect the current arrangement of the dam, and therefore the Saddle Dam stability should be reassessed.	P3	Addressed in Safety Review completed in 2018		
49	There is some confusion with regards to the stability analysis results for the reinforced earth retaining wall, with two sets of stability data presented in the Draft Googong Dam Remedial Works Design Report. One set of data has some factors of safety of less than 1. Given the only review of the crest wall was made 23 years ago when it was designed, it is recommended that the stability of the structure be reviewed again.	P3	Addressed in Safety Review completed in 2018		
	The dam intake tower should be able to withstand ground accelerations corresponding to the 1 in 475 year seismic event.		Addressed in Safety Review completed in 2018		

Recommendation		Priority	Status	Maintenance Planned Timing	Comments
50	The analysis undertaken to date suggests the intake tower would collapse under seismic loads corresponding to a 1 in 2,500 event; however the return period of this seismic event was based on seismicity data not specific to the Googong Dam site. It is recommended that the peak ground acceleration for the 1 in 475 year seismic event for the dam site be confirmed, after which the ability of the tower to withstand this loading can be assessed. Further analysis and strengthening works may be required, depending on the outcomes of this.	P3	Addressed in Safety Review completed in 2018		
51	The intake tower foundation rock anchors are required for both earthquake stability and buoyancy control, and the durability of these anchors is critical to their effective life span. It is not possible to inspect the anchors without intrusive investigation works. It is recommended that following the assessment of the intake tower seismic stability, and any analysis that results from this (where required), that the durability of the intake tower anchors be reviewed.	P3	Addressed in Safety Review completed in 2018		
52	SKM, authors of the dam risk study, highlighted that some of the assessments in the study were based on incomplete information or on assumptions, and that ACTEW Water should consider undertaking further studies to provide more robust information. This would allow an update of the risk study at a future date. Of the suggested studies highlighted, the following were not covered elsewhere in this report: 1. <i>'Improved estimates of the probable loss of life and dambreak inundation extents, depths and velocities. The modelling techniques used in the current project are based on application of one-dimensional modelling and the Graham (1999)</i> 2. <i>Much of the original material grading data has been lost and so a robust assessment of filter compatibility in the main embankment and saddle dam was difficult. ACTEW Water could consider undertaking drilling, sampling and materials testing in both the main embankment and saddle dam to provide more comprehensive grading data to support future assessments.'</i>	P3	Addressed in Safety Review completed in 2018		
			Will be included in next review.		Googong Dam Safety Review section 2.2, AECOM consider it highly unlikely that changes in PLL estimation would result in a change in Googong consequence category
	We also recommend that ACTEW consider undertaking these studies/investigations to improve the reliability of the risk study results.		Addressed in Safety Review completed in 2018		
53	Due to the amended valve layout to include the mini hydro station, a detailed review of the outlet works should be undertaken to determine the revised capacity of the system to confirm it meets operation requirements, and to verify that velocities through the valves are within their design range.	P3			
54	The cause of the cracking of the outlet works right hand reinforced concrete retaining wall should be investigated, and a suitable patching procedure designed before undertaking any repair works.	P3	A project to address this is progressing		
55	Some components of the Surveillance Procedures document were not up to date, and did not reflect current practices at the dam. This document should be updated as soon as possible.	P1	Done		
56	There are several sections in the O&M Manual that describe the same surveillance and maintenance strategies/requirements, and some are not specific to the equipment at the dam. To make the document easier to read it is recommended that the surveillance and maintenance requirements are stated in only one section and that they should be specific to the equipment at the dam.	P3	Addressed in revised version		
57	A gap analysis is required for the O&M Manual to review what information is missing in terms of operating procedures and maintenance activities for all components of the dam. The missing information should then be included in the document.	P3	O&M Manual revised		
58	The flood hydrology and consequences of failure has recently been re-evaluated for Googong Dam. This information should be updated in the DSEP, including the flood maps.	P1	Done		
59	A desktop test of the DSEP was undertaken in 2013 by an external facilitator. Any recommendations from this testing should be incorporated into the DSEP. The DSEP should continue to be tested at five yearly intervals.	P1	Done		
60	Previous survey of the plunge pool did not match up well with the survey datum used on site during construction of the spillway and plunge pool upgrade. As such the results of the survey were erroneous (showing erosion where no erosion has occurred). It is recommended that the survey data be reviewed by the surveyor to see if this can be corrected to match up better with the site datum. Otherwise at the time of the next plunge pool survey, it should be ensured the survey datum matches that used on	P3			
			Planned to be carried out in 2019		

Completed and Actioned Items