Environment Compliance Report

Coal ash dams and emplacements

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Environment Protection Authority

This environment compliance audit for coal ash dams and emplacements was undertaken by the Environmental Audit Section, Environment Protection Authority. For technical information on the matters discussed in this report, please contact the Environmental Audit Section on (02) 9995 5000.

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Executive summary

The NSW Environment Protection Authority (EPA) has completed a compliance audit program on coal ash dams and emplacements in NSW. Compliance audits of coal ash dams or emplacements of seven coal fired power stations were completed between 2016 and 2017. This report contains a summary of the audit findings.

The audits assessed compliance with:

- conditions on the issued environment protection licences (EPLs) that relate to the coal ash dam and/or emplacement
- the legislative requirements of the *Protection of the Environment Operations Act 1997* and Protection of the Environment Operations (General) Regulation 2009 for Pollution Incident Response Management Plans, in relation to the coal ash dam/emplacement.

The objective of the audit program was to assess licensees' level of compliance with these requirements and to improve their environmental performance.

Overall, licensees were complying with 80% of the audited requirements; however, eight non-compliances were risk-assessed as having moderate environmental significance. Whilst these non-compliances required immediate attention by licensees, all non-compliances identified must be addressed by licensees and the audits present an opportunity for improvement to coal ash dam/emplacement practices.

The findings of the audits demonstrate that the compliance and environmental performance of coal ash dams and emplacement could be improved by:

- ensuring dam water levels are effectively managed to prevent the pollution of waters
- developing and implementing consistent operational documentation and procedures
- ensuring regular maintenance of critical plant and equipment is carried out.

The findings of the audits and examples of good practice in this summary report provide valuable information to help coal fired power plants improve their environmental performance in relation to their coal ash dams and emplacements.

1 Introduction

1.1 What is coal ash?

Coal ash is the waste generated from burning coal to generate electricity. Most of the electricity generated in Australia is produced by power stations in which electric generators are driven by steam produced from the burning of coal. The most common fuel used in NSW is black coal (DSEWPC 2012).

Ash is produced from two sources in the electricity generation process:

- Fly ash is the particulate matter produced in gas streams from the combustion process. It is captured by electrostatic precipitators or fabric filters.
- Bottom ash is the ash extracted from the bottom of the boiler.

Ash is composed of modified coal mineral matter, i.e. primarily compounds of silicon, aluminium, iron, calcium, manganese, potassium, sodium and titanium which form a matrix for traces of compounds of other metals (DSEWPC 2012). Ash composition depends on the coal properties, combustion technology and combustion conditions (DSEWPC 2012). The ash is transported to ash dams as a slurry or paste, or dry to an emplacement.

1.2 Why choose coal ash dams and emplacements for audit?

Sectors and activities targeted in the EPA's environmental compliance audit programs are chosen through an assessment of major environmental and community concerns, and EPA corporate objectives and strategies.

In December 2014, the United States Environmental Protection Agency (US EPA) released a rule, or set of standards, covering ash dams or emplacements used to store coal ash from power stations in the United States of America, the *Disposal of Coal Combustion Residuals from Electric Utilities, Final Rule*. The rule was initiated after a large coal ash spill in 2008 at a power plant in Tennessee. The spill flooded more than 300 acres of land destroying houses and releasing coal ash into waterways. Considering this rule, the NSW EPA determined it would be appropriate to review the management of coal ash dams and emplacements in NSW. Coal ash dams and emplacements have not previously been audited under the EPA's sector based audit program or been included in recent focused compliance audit programs.

Coal ash dams are essentially tailings dams; the primary objective is for the ash and stored water to remain contained. The Australian National Committee on Large Dams (ANCOLD 2012) outlines the primary objectives for the design of a tailings storage facility (TSF) as including: the safe and stable containment of tailings and contaminants; the safe management of decant and rainfall runoff; and the management of seepage. The NSW Dams Safety Committee (DSC) has adopted in principle the ANCOLD Guidelines on Dam Safety Management (2003) and Tailings Dams (2012).

Environmental harm associated with tailings dams includes: uncontrolled release of the tailings and/or water by collapse or failure of the dam embankment; uncontrolled release of pollutants through discharge over the spillway or seepage; operational failure such as through pipe burst or pump failure; and emission of dust (ANCOLD 2012).

1.3 Regulatory responsibilities for coal ash dams in NSW

The EPA has regulatory responsibilities under the *Protection of the Environment Operations Act 1997* (POEO Act) for surface water pollution, groundwater pollution and air pollution from

dams in NSW. The DSC is a statutory authority created under the *Dams Safety Act 1978*[1] (DS Act) to oversee the safety of dams in NSW and to prevent significant uncontrolled loss of their storages. The DSC regulates the safety of prescribed dams under the DS Act which are classified Extreme, High and Significant Consequence Category dams and Low Consequence Category Dams over 15 metres high. Generally, the DSC prescribes and sets requirements for dams storing water or other liquefiable materials that pose a significant potential threat to the interests of the community (including environmental effects) (DSC 2015).

[1] The Dam Safety Bill 2015 assented to in 2015 has not yet commenced (except Clause 5 of Schedule 2); when the Act commences, the DSC will become Dam Safety NSW.

2 Audit methodology

2.1 Objective, scope and criteria

The objective of the audit program was to assess each licensee's compliance with the regulatory requirements relating to coal ash dams and emplacements and to improve licensee awareness and understanding of environmental and compliance issues.

The scope of each audit included an examination of activities undertaken at the premises in relation to the coal ash dam and/or emplacement and surface water management. Dust management was also included in the scope for the two premises which had dry emplacements and were located in western NSW. Any impacts of the dams or emplacements on groundwater was not included in the scope of the audits.

In relation to the temporal scope, the operating conditions were assessed for the 24-hour period prior to the end of the audit inspection. The temporal scope for limit, monitoring and reporting conditions and supporting documentary evidence was generally 24 months until the end of the audit inspection.

The audit criteria (the requirements against which the auditor assesses audit evidence) were:

- conditions attached to the relevant environment protection licence (EPL) that related to the coal ash dam and/or emplacement and associated surface water management. Dust management was also included for the two premises located in western NSW
- the legislative requirements for Pollution Incident Response Management Plans (PIRPMPs) in Part 5.7A of the POEO Act and Chapter 7, Part 3A of the Protection of the Environment Operations (General) Regulation 2009 (POEO General Regulation), in relation to the coal ash dam and/or emplacement.

2.2 Procedure

The compliance audits were undertaken in accordance with the procedures and protocols outlined in the *Compliance Audit Handbook* (DEC 2006). Each of the site audit inspections was conducted unannounced. When an audit is completed, the findings are presented to the audited organisation in an individual compliance audit report. These individual reports are publicly available on the EPA's public register, which can be accessed via the EPA licences, applications and notices search page.

The audits provide an assessment of the licensee's compliance with the audit criteria. Audit findings were based on information from EPA files, information supplied by site representatives and observations made during audit inspections.

The audit reports contain an action program outlining any non-compliance, recommended actions and agreed timeframes which licensees must meet. EPA officers follow up on compliance audits to ensure licensees are implementing the actions required in the report by the agreed target date.

The findings presented in this summary report are a collation of the findings presented in the individual compliance audit reports.

2.3 Analysing the risks

The risks associated with the non-compliances identified were assessed and coded according to environmental significance (Table 1).

Non-compliances assessed as 'code red' suggest they are of considerable environmental significance and therefore must be dealt with as a matter of priority. 'Code orange' risk assessments for non-compliance pose a significant risk of harm to the environment, but can be given a lower priority than red risk assessments. A non-compliance assessed as 'code yellow' suggests that it could receive a lower priority but should still be addressed.

Table 1: Risk analysis matrix

		Likelihood of environmental harm occurring		
		Certain	Likely	Less likely
Level of environmental impact	High	Code RED	Code RED	Code ORANGE
	Moderate	Code RED	Code ORANGE	Code YELLOW
	Low	Code ORANGE	Code YELLOW	Code YELLOW

There are also several licence conditions such as those relating to administration, monitoring and reporting requirements that do not have a direct environmental significance, but are still important to the integrity of the regulatory system. Non-compliances with these conditions are allocated a blue colour code.

2.4 Premises audited

Seven premises were selected for audit:

- the five operational coal-fired power stations in NSW with an annual generating capacity of >4000 gigawatt-hours
- two sites with ash dams/emplacements where the associated power station is no longer operating.

These premises are listed in Table 2 and their locations are shown in Figure 1.

Table 2: Premises audited with dams/emplacements where coal ash can be disposed

EPL number	Licensee	Premises	Dam/ emplacement	Sunny day Consequence Category[1] (SDCC)	Flood Consequence Category[1] (FCC)
761	Sunset Power International Pty Ltd (transferred from Delta Electricity on 8/12/2015)	Vales Point Power Station and Coal Unloader	Vales Point Ash Dam	Significant	Significant
779	AGL Macquarie Pty Ltd	Bayswater Power Station	Bayswater Ash Dam	Significant	Significant
			Ravensworth Void 5	Low	Significant
1429	Origin Energy Eraring Pty Ltd	Eraring Power Station	Eraring Ash Dam	Significant	Significant
2122	AGL Macquarie Pty Limited	Liddell Power Station	Liddell Ash Dam	Significant	Significant
			Drayton Ash Levee	High C	Low
13007	Energy Australia NSW Pty Ltd	Mt Piper Power Station	Dry emplacement	Not a prescribed dam	
Ash dams with power station not operational					
759	Delta Electricity	Munmorah Power Station	Munmorah Ash Dam	Low	Significant
766	Energy Australia NSW Pty Ltd	Wallerawang Power Station	Sawyers Creek Coal Ash Dam	High A	High C
			Dry emplacement	Not a prescribed dam	

[1] Consequence Categories at the time of the audit inspection from the DSC Database, as defined in the glossary. The higher of the SDCC or FCC is used to determine the need for prescription of a dam and type of surveillance report required. SDCC is usually used for determination of the frequency of a dam's routine surveillance (i.e. inspection and monitoring); FCC is used to determine the flood capacity required for a prescribed dam.

Apart from Munmorah Power Station, all premises hold EPLs under Schedule 1 of the POEO Act for Electricity Generation (general electricity works) with a capacity to generate more than 30 megawatts of electrical power and the fee based activity of 'generation of electrical power from coal'. Munmorah Power Station, which is no longer operating, is not licensed as a scheduled activity but is licensed for a 'Miscellaneous licensed discharge to waters (at any time)'of >1000 megalitres (ML) discharged.

All the operational power stations other than Mt Piper dispose of ash by pumping it as a slurry to a purpose-built ash dam adjacent to the power station. Mt Piper uses a dry method for ash disposal in an emplacement. The Wallerawang Power Station, in addition to disposing of ash by pumping it as a slurry to an ash dam, also uses a dry method for disposal of ash in an emplacement.

All the coal ash dams audited (not the emplacements) were prescribed dams and their Consequence Categories are shown in Table 2.

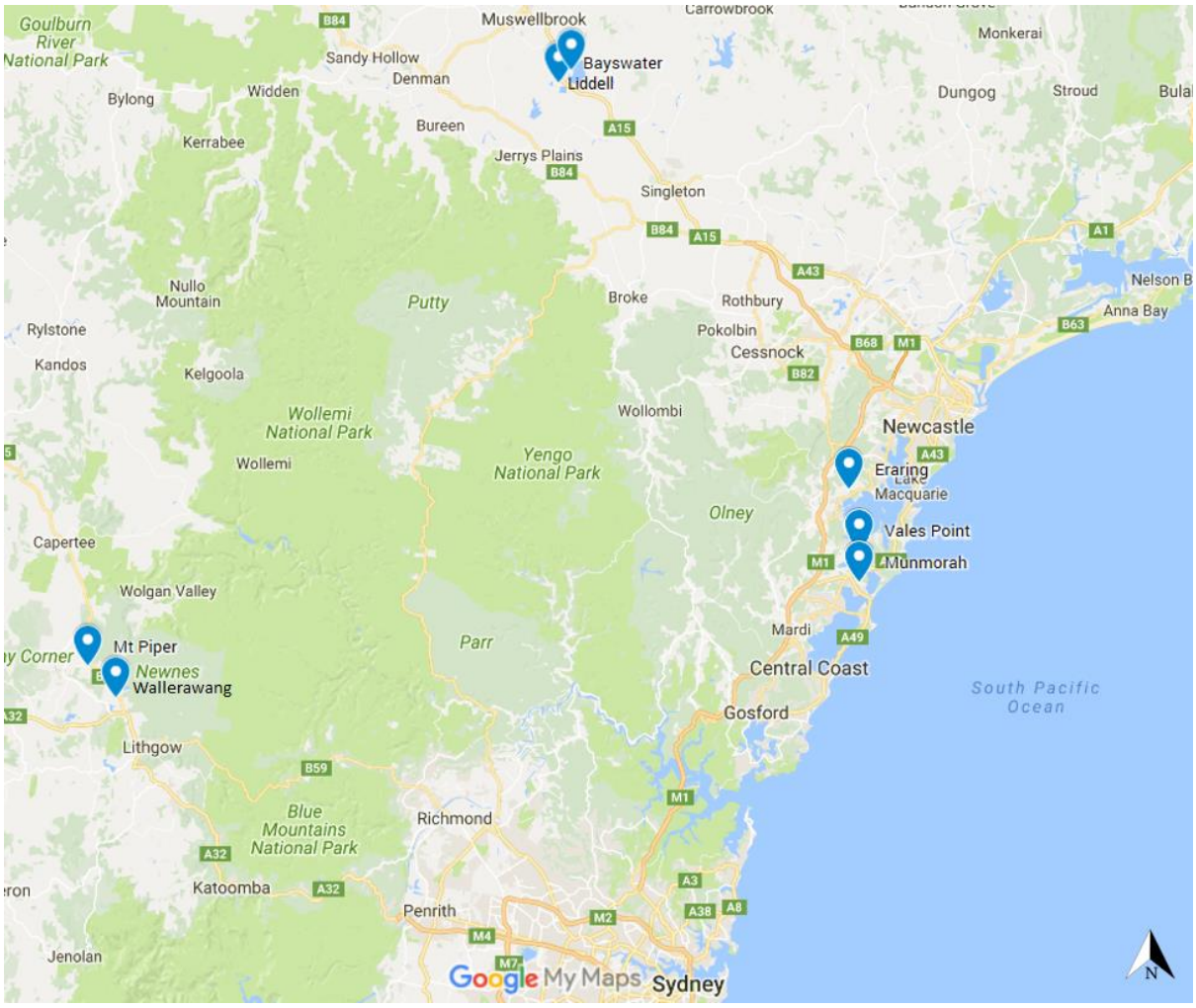

Figure 1: Locations of audited premises

3 Audit findings

3.1 Overview of audit findings

Compliance assessments against the audit criteria (conditions of the EPL or legislative requirements for PIRMPs) for the seven audits have been collated and the results are summarised in Table 3 and Figure 2. The non-compliances are shown in each colour-coded category as determined as part of each audit using the risk-analysis matrix (Table 1). Of the 416 assessments made against the criteria, 335 were assessed as compliant, 55 were non-compliant and 26 could not be determined due to reasons such as insufficient information being available to the auditor.

Table 3: Summary of assessments

Assessment of compliance	COMPLIANT	CODE RED non-compliance	CODE ORANGE non-compliance	CODE YELLOW non-compliance	CODE BLUE non-compliance	Not determined	Total no. of assessments
No. of assessments	335	0	8	11	36	26	**416**

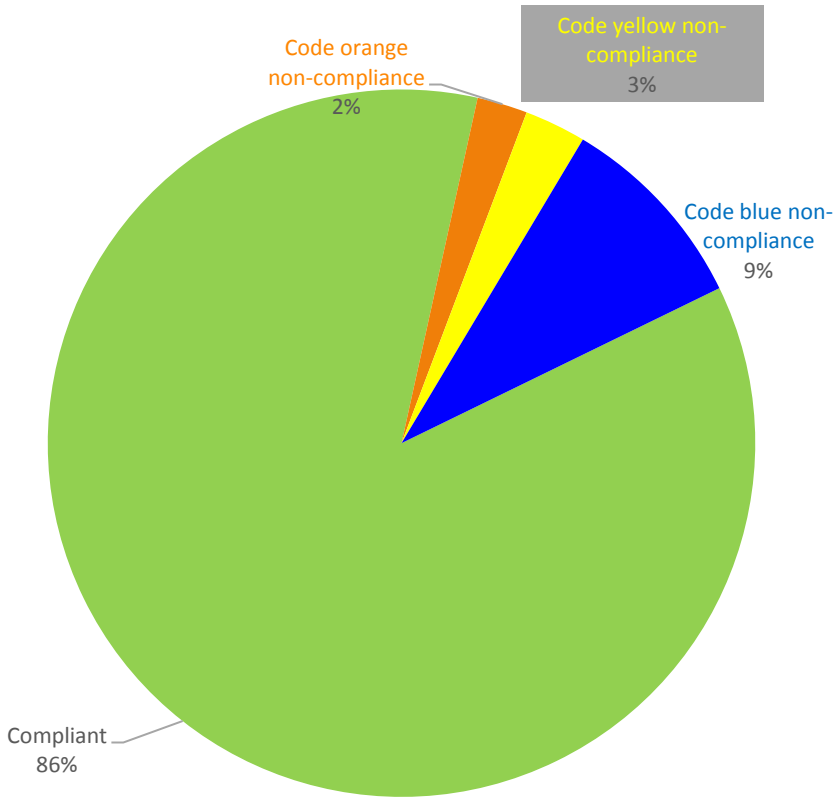

Figure 2: Assessment of compliance*

*Not including assessments that were not determined.

The number of non-compliances identified at each premises ranged from three to 17 and the compliance performance against the summarised criteria is shown in Figure 3. These findings are described in detail in the following sections.

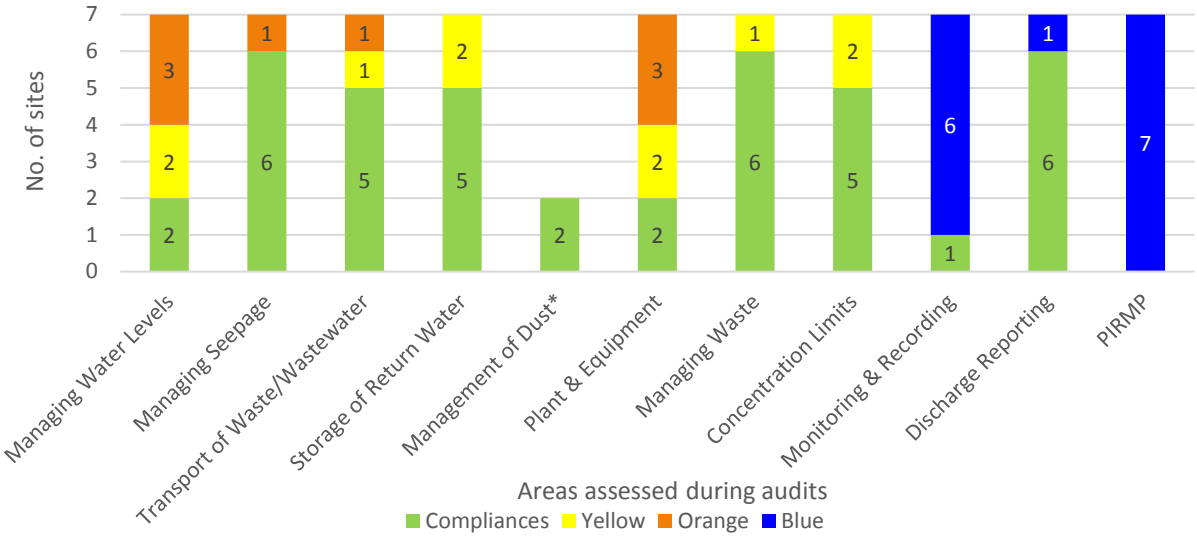

Figure 3: Compliance performance of premises

*Management of dust was only assessed at two premises.

Managing water levels – The two premises with dry ash emplacements were assessed on the management of wastewater generated from the ash emplacement area.

Transport of Waste/Coal Ash Wastewater – The two premises with dry ash emplacements were assessed on the transport of dry ash to the ash emplacement.

3.2 Managing the water levels in the coal ash dam

Water levels in coal ash dams must be managed to prevent the pollution of waters and land by uncontrolled discharges and dam failures. Uncontrolled discharges may arise from overflow of the spillway or, in extreme cases, overtopping of the dam wall which may lead to dam failure (ANCOLD 2012). Balancing the water inflows and outflows in a coal ash dam is critical to the management of the dam to prevent environmental harm. A water balance should be carried out when designing the dam and regularly revised during the operation of the dam due to changes that may occur such as in catchment inflow and operations (ANCOLD 2012). Inflows include water contained in the slurry, rainfall, wastewater and stormwater run-on; outflows include return water, evaporation and seepage (DITR 2007). Coal ash dams should be designed to contain the solid and liquid inputs and a design storm event (ANCOLD 2012). The DSC normally requires that tailings dams have an emergency spillway or some other method of managing floods (DSC 2012).

Controls to minimise stormwater run-on include siting of the dam in an area with minimal catchment area (this would occur during the design phase) and installation, operation and maintenance of bunds and diversion drains (ERR 2015). Diversion drains intercept and divert stormwater that otherwise would flow into the dam (see Figure 4). Diverting clean stormwater around contaminated areas reduces the amount of contaminated water that needs to be managed and ensures a dam's storage capacity is available for the ash and for storm events.

Water inflow to the dam can also be controlled by lowering the water content of the coal ash slurry. The coal ash is usually thickened at the processing plant prior to pumping to the storage facility. Adjusting operational parameters to produce a thicker slurry or paste reduces the amount of water entering the dam; however, this must be monitored to ensure it does not cause other impacts, such as issues with the slurry's transport, or dust issues.

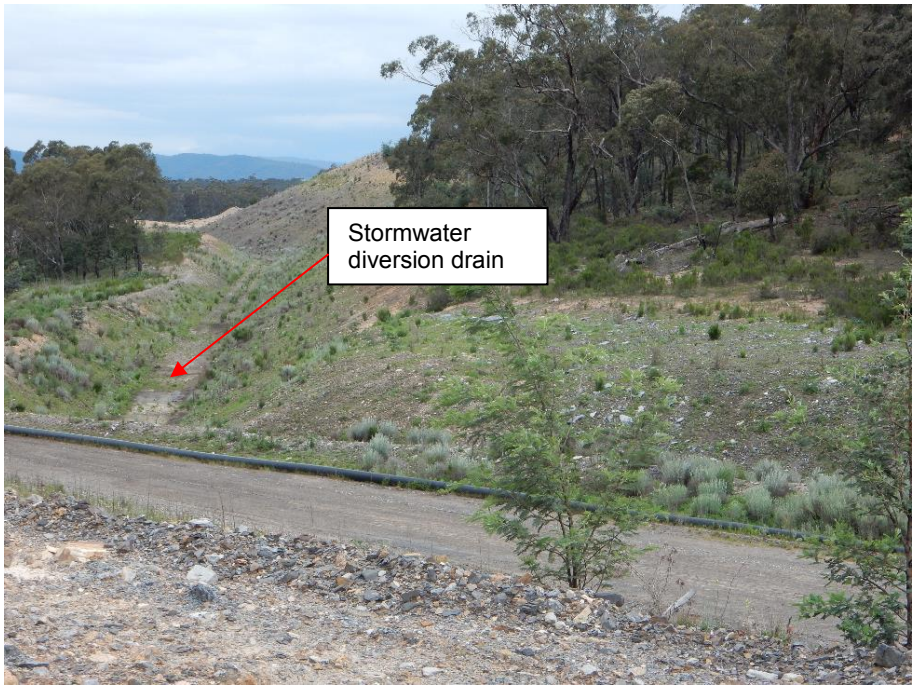

Figure 4: Stormwater diversion drain

Water collected on the dam must be managed appropriately by:

- removing water to ensure adequate freeboard is maintained, including capacity for storm events, and to reduce seepage through the dam walls
- considering the need to retain adequate water levels to prevent the exposure of the deposited ash causing dust emissions.

Dams are designed to be operated to have a minimum freeboard to contain a design storm event without discharge. Owners of all prescribed tailings dams are required to meet the flood capacity requirements of the DSC guidance sheet DSC3B, *Acceptable Flood Capacity for Dams* (DSC 2010) and operational flood criteria in guidance sheet DSC3F, *Tailings Dams* (DSC 2012). All prescribed dams are required by the DSC to have operation and maintenance manuals in place. These manuals are developed by the dam owner and include target operating water levels.

Maintenance of an adequate freeboard is imperative to ensure there is capacity for storm events, daily inflows and unforeseen events, without discharging (ANCOLD 2012). The dam should have a visible marker or measure to indicate water levels and the level should be continuously monitored (see Figure 5). Procedures should stipulate the maximum operating level (target operating level), required freeboard levels and mitigating actions to be taken when the required freeboard is compromised. Operators should be trained in managing and monitoring the water levels and water management system.

A decant or return water system to recover excess water in the dam is critical to managing the water levels. Decant facilities can include pumped systems or gravity collection systems (ANCOLD 2012). The water collected is stored in dams or tanks or pumped straight to the ash slurry process for reuse. In some cases, surplus return water is permitted to be discharged as a controlled discharge with cooling water. Two of the licensees audited had a specific condition which permitted uncontrolled discharge from the ash dam only after a rain event of a specified size and duration or during emergency conditions.

Figure 5: Coal ash dam with water level marker

Key considerations for managing water levels include ensuring:

- critical equipment including pumps, valves and drains is maintained and operating effectively and pumps are appropriately sized
- back-up pumps, back-up power and other such contingencies are in place and in working order
- employees are trained and competent in the operation of the water management system
- operating procedures are up to date, accurate and implemented
- the ability to accurately measure and report the volume of water contained in dams
- emergency procedures are in place.

Two aspects of managing the water levels were considered when assessing whether water levels were being managed in a competent manner. These aspects were the control of stormwater run-on to the dam, and minimising water levels in the dam to prevent uncontrolled discharges to surface waters. This activity was assessed as not being carried out in a manner that will prevent the pollution of surface water at **five** of the six premises audited that were using coal ash dams.

The following issues were identified:

- Inadequate equipment/ equipment failure – One site's pump-out system was operating with only one pump instead of two as required to ensure adequate capacity in the system for the design storm event. At another site the blowdown (the process of drawing out liquid to remove impurities) was operating at 16% of the maximum allowable limit, an inefficiency of more than 80%.
- Inconsistent target water levels in operating procedures – One site had different target water levels in their different operating documents. A lack of clear instructions for operators can lead to inadequate capacity being provided in the dam. Operating procedures should be constantly updated and consistent across all operating documents.
- Not following operating procedures – Four sites did not follow their own operating procedures. This included failure to operate blowdown, or pump out at specified water levels, and not following monitoring frequency and logging of water levels.

- Excessive water levels – Three sites had water levels well above their specified target levels.
- Unregulated spillway design – The spillway design of one site impedes the ability to control the water level in the dam.

The two premises with dry ash emplacements were both assessed as adequately managing the wastewater generated from the ash emplacement area.

3.3 Managing seepage from the dam walls to prevent surface water pollution

Some level of seepage is likely to occur from dams as the impounded water seeks paths of least resistance through the embankment, floor and foundation. Coal ash dam seepage, if not properly controlled, can cause the pollution of waters and can also lead to seepage-induced failure of the dam (FEMA 2007).

Controls to manage seepage include barrier and collection systems such as impermeable liners, filters, trenches, drainage systems and collection wells (see Figure 6) (ANCOLD 2012). Routine maintenance and monitoring of dam walls should be carried out, as well as monitoring of seepage quality and volume. Minimising the amount of water collected in the ash dam will also reduce seepage. Collected seepage must not be discharged to waters. Operators generally pump the seepage water back onto the ash dam and therefore proper operation and maintenance of pumping systems is imperative.

Managing seepage from dam walls to prevent surface water pollution was assessed as not being carried out adequately at only one of the six premises audited using a dam. At this premises, seepage from at least six locations was discharging to surface waters.

Note that any seepage to groundwater was not assessed as part of this audit program.

Figure 6: Seepage collection drain

3.4 Transport of waste/wastewater to the dam or emplacement and return water from the dam

Coal ash is mixed with water and typically transported from the power station as a slurry to the coal ash dam by pipeline (see Figures 7 and 8). The pipelines can extend over long distances. Plants also run a return water line, returning water from the coal ash dam or a retention dam to a storage tank near the plant. Return water from the dam is reused in the ash transport system and is a means of lowering the water level in the coal ash dam.

Figure 7: Pipelines for ash slurry

Figure 8: Ash slurry pipeline and valves to coal ash dam

Dry coal ash is transported from the power station to the coal ash emplacement by heavy haulage vehicles or by conveyor. During transport, care must be taken to ensure that the load of dry coal ash is covered and does not emit dust. Two of the premises audited were using dry ash disposal.

Risks to the environment from transport of coal ash slurry/wastewater are from spills due to leaks, breaks or clearing of blockages (DIIS 2016). This can be significant depending on the size of the spill and the sensitivity of the receiving environment.

Regular monitoring, inspection and maintenance of the pipeline is a crucial preventative control. This can include:

- visual inspection of the pipeline for leaks and condition of the pipeline
- differential pressure sensors or flow measurement instrumentation and alarms to alert operators of any pipeline failures (DIIS 2016).

Operators must ensure that action is taken to address identified issues.

Controls to contain any spills include:

- sleeving the pipes with larger diameter pipes, particularly where pipes cross sensitive environments such as waterways
- secondary containment corridors, such as bunds, along the pipeline (DIIS2016).

Procedures, inspection and maintenance records should provide clear instructions for operators and demonstrate that the monitoring and maintenance program is being implemented.

The transport of coal ash slurry and/or return water was not being carried out adequately at two of the six audited premises using pipelines. The issues identified were:

- An ash slurry pipeline was leaking at one of the premises and an incident had occurred prior to the inspection involving failure of the return water line. Some pipelines run to another site over a distance of 15 kilometres without secondary containment. The licensee advised that visual inspections are carried out daily but inspection records were infrequent and inconsistent.
- An incident of pipeline failure had occurred at the premises where dust slurry entered a stormwater drain.

It is noted that at both these sites, corrective actions had been considered and budgeted for but had not been carried out at the time of the audit. No issues were identified with the transport of dry ash to the emplacements at the two premises audited.

3.5 Storage of return water collected from the coal ash dam

Water that is collected from the coal ash dam is usually returned to the plant for reuse and stored in tanks (see Figure 9). The environmental risks associated with return water storage in tanks are leaks, spills, overflows or failure of the storage tank, leading to pollution of waters and land. Controls to address these risks include bunding or secondary containment of the tanks, regular maintenance, inspections such as for tank integrity, and monitoring systems such as high and low level meters and alarms (DECC 2007).

The storage of return water was assessed as inadequate at two of the six premises audited that were storing return water. At both premises the return water storage tank did not have any secondary containment or other management system in place to minimise or prevent the pollution of surface water in the event of a spill/leak/overflow from the tank.

Figure 9: Return water storage tank in background without secondary containment (sewage tank is in foreground)

3.6 Management of dust from the ash emplacements

Dust emissions from coal ash emplacements must be controlled due to the potential impacts of airborne particulates and contaminants on human health and the surrounding environment including water quality. The ash is delivered from the power station by heavy haulage vehicles or conveyor to the work face of the emplacement, where it is placed into position and then spread and shaped by a dozer. A dozer and roller are used to compact the ash. Controls include ensuring the surface is wet, spraying with water and/or suppressants, covering the surface with a veneer or gravel, using silt trap barriers, and compacting and rehabilitating the area as soon as possible (see Figure 10) (DIIS 2016). Monitoring of the quality of air is undertaken at the coal emplacement areas to ensure the controls in place are effective in minimising any dust emissions.

The activity of managing dust was assessed at the two premises located in the central west region and that had dry coal ash emplacements. No issues were identified with the management of dust at these two premises.

Figure 10: Dry ash emplacement with water sprays

3.7 Maintenance and operation of plant and equipment

Coal ash dams and emplacements and associated plant and equipment must be maintained in a proper and efficient condition and operated in a proper and efficient manner, to prevent pollution occurring. An effective inspection and maintenance program should be implemented including scheduled and preventative maintenance, which will assist in preventing incidents occurring. A system should be in place for recording inspections and maintenance and acting on identified issues.

One of the premises was assessed as not operating the dam in a proper and efficient manner due to the failure to operate the dam to prevent overflows. This site had overflows 90% of the time, contrary to the licensee's documented objective 'to minimise overflow of ash water to lakes'.

Issues in relation to maintenance of plant and equipment were identified at five of the seven premises audited. At three of the premises, these non-compliances related to the transport system. This included the following issues:

- An isolation valve for return water was leaking, and had been for a considerable amount of time as indicated by algal growth. The site's operation and maintenance manual stated that valves should be test operated on a regular basis, involving the opening/closing of the appropriate valve to ascertain ease of operation and ensure the valve gate is sealing properly with no leakage.
- The manifold serving the return water pumps was leaking and had been for a period as also indicated by algal growth (see Figure 11). The leaking manifold had been identified and reported as part of the daily inspection protocol but no works order was raised or maintenance work carried out.
- A faulty flange had resulted in leaking coal ash slurry which had not been adequately attended to. A temporary maintenance arrangement had been observed to divert the slurry away; however, this was likely to cause soil pollution.
- Lack of maintenance of the pipeline resulted in an ash spill on the day of the audit inspection.

Figure 11: Return water pump manifold leak

Other issues identified were:

- Weather monitoring equipment was not maintained as the tipping bucket for precipitation was not functioning.
- Flow meters had not been calibrated within the 12-month schedule.
- The spill kit for the diesel pump was not maintained as rubbish was observed in it.

Operators should implement and adhere to a regular routine inspection and maintenance program and ensure that issues identified are addressed in a timely manner to assist in preventing incidents occurring.

3.8 Managing waste

Waste generated on the premises must be stored and disposed of in a manner that does not pollute the environment. Apart from coal ash, some other wastes generated on power station premises are permitted to be disposed of in the ash dam or emplacement. All licensees audited were disposing of wastes in the ash dam or emplacement as permitted by their licences.

One non-compliance was identified in relation to a waste condition that requires all wastes generated and stored on the premises to be assessed and classified in accordance with the NSW EPA *Waste Classification Guidelines* (2014). The licensee did not include a waste classification for each waste in their monthly waste reports.

3.9 Concentration limits

EPLs can specify concentration limits of pollutants permitted to be discharged. Concentration limits are in place to minimise environmental impacts. Monitoring and sampling for pollutant concentrations is imperative to ensure discharges are within the limits. If limits are not being met, treatment, storage or alternative disposal methods must be employed.

Concentration limits were exceeded at two of the premises audited:

- Two non-compliances related to pH, with one premises having at least nine instances of pH levels outside the allowable levels.
- One of the premises had an exceedance for sulphate. This premises had at least five instances where sulphate levels exceeded the concentration limit, with the highest being 600mg/L above the allowable concentration limit.

3.10 Monitoring and recording conditions

Monitoring is an important management tool that should be used to help minimise environmental impacts associated with activities. It can be used to collect information to characterise changes in environmental emissions and to enable appropriate action to be taken when data indicates that the quantity and/or nature of emissions are changing (DECW 2009). It is important to record monitoring and performance data to enable analysis and assessment and to make informed decisions about site operations. Monitoring in relation to coal ash dams is vital because of the pollutant potential of any discharges from the dam.

Fifteen non-compliances were identified with monitoring requirements:

- The following monitoring information was not recorded as required:
  - the time that samples were collected (three sites)
  - the location where samples were taken (three sites)
  - the name of the person who undertook the sample (one site)
  - the concentration of pollutants in the required units of measure (one site).
- Four of the premises did not carry out monitoring for the concentration of a pollutant discharged according to the *Approved Methods* publication (DEC 2004).
- Two of the premises did not monitor the volume of the discharge at the required frequency (continuous or daily).
- One of the premises did not monitor the concentration of pollutants discharged at the required frequency.

3.11 Discharge reporting

Some EPLs require licensees to notify and report specific information to the EPA if an overflow discharge occurs. One premises was assessed as non-compliant because of the inadequacy of information provided to the EPA following a discharge event. This included:

- failure to report the type, volume and concentration of every pollutant discharged
- failure to provide details of any measures taken or proposed to be taken to prevent or mitigate against a recurrence of such an event.

3.12 Pollution Incident Response Management Plans

All holders of an EPL are required to prepare, maintain and implement a Pollution Incident Response Management Plan (PIRMP). The specific requirements for PIRMPs are set out in Part 5.7A of the POEO Act and Part 3A of the POEO General Regulation. In summary, the requirements that relate to PIRMPs are:

- All holders of EPLs must prepare a PIRMP (s.153A, POEO Act).
- The PIRMP must include the information detailed in the POEO Act (s.153C) and be in the form required by the POEO General Regulation (cl.98B).
- EPL holders must keep the PIRMP at the premises to which the EPL relates. In the case of transporters of trackable waste and operators of mobile plant, the PIRMP must be kept at the location where the relevant activity is taking place (s.153D, POEO Act).
- Holders of EPLs must test the PIRMP in accordance with the POEO General Regulation (cl.98E).
- If a pollution incident occurs in the course of an activity so that material harm to the environment is caused or threatened, the EPL holder must immediately implement the plan (s.153F, POEO Act).

There were 19 non-compliances relating to PIRMPs. Issues identified were failure to:

- describe the incident notification procedure (one site)
- include an adequate map of the premises and surrounding areas – key information such as location of potential pollutants, area most likely affected by pollution incident, and location of stormwater drains were not shown (five sites)
- include a complete pollutant inventory of all pollutants onsite – this included coal ash slurry and return water that were not mentioned (three sites)
- thoroughly describe potential hazardous incidents related to the coal ash dam (three sites)
- include the names of key contact personnel associated with enacting the PIRMP (two sites)
- review the PIRMP within one month of a pollution incident occurring (two sites)
- include a complete list of maximum quantities of pollutants stored on site – the maximum quantity for the volume of pollutants stored in ponds on the site was not included (one site)
- include the contact details of relevant authorities – this should include the EPA, local council, Ministry of Health, SafeWork, Fire and Rescue NSW (one site)
- include the dates the plan had been tested and the names of persons who carried out the test (one site).

3.13 Other issues identified

The program also identified several issues of environmental concern which did not strictly relate to the scope of the audit or assessments of compliance. The following further observations were noted:

- At three of the premises, there were several documents relating to the operation and management of the ash dams including plans and manuals, but these were not always consistent, accurate and current. Documentation to support the operation, monitoring and maintenance of the dam should be consolidated, accurate and current. The licensee must ensure that the required actions and procedures are being carried out and that personnel are kept abreast of any changes. There should be an ongoing review process, including reviewing monitoring results, surveillance reports, the operations and maintenance manual, and dam design and stormwater capacities, to ensure the effective operation of the dam.

- A wastewater pipe was leaking. Although this was occurring in an area which would flow to the ash dam, the discharge may cause soil and/or groundwater contamination.
- The siting of a weather station and dust gauges was not as per the Australian Standards and therefore the data collected may not be accurate.
- Maintenance issues associated with the ash dam's crest and spillway approach channel were identified including erosion and overgrown vegetation.
- Fly ash was observed to have been deposited and spread on a borrow pit without any cover being applied, with the potential to generate dust emissions.
- Water runoff from the coal stockpile area was entering the ash dam and the licensee was not aware of the water quality.
- While cleaning solutions are permitted to be discharged to the ash dam under one of the EPLs, the boiler blowdown water from a prescribed chemical clean of one boiler had a high concentration and quantity of ammonia and acids.
- The relevant authorities that should be notified in the event of a pollution incident were not consistently listed in two of the PIRMPs.
- One of the licensees had not published their monitoring results within 14 days of the licensee obtaining the data, as required under section 66 (6) of POEO Act.

3.14 Good practices observed during the audits

The following are noted as good practices observed within the scope of the audit:

- One licensee had in place an environmental SCADA system for monitoring of activities on their premises in relation to the ash dam system, such as ash dam levels, the seepage toe drain and other dam levels. The system is equipped with alarms which alert operators to issues such as weir overflows, pollutant exceedances, pH and oil on water. An environmental specific system uses the same alarms and tags as those received from the operational system. Where an issue is identified by the system, the problem is investigated and if required an incident is raised with corrective actions in the licensee's maintenance software program.
- The PIRMP in place of one licensee was thorough in capturing the risks in relation to the coal ash dam and the licensee also undertook testing of ash pipeline failure scenarios.
- One of the licensees that uses dry ash disposal had an effective dust management system in place with regular dust monitoring at the boundary of the premises and at numerous locations including nearby sensitive receivers. Other good practices observed include conditioning the ash, transporting the ash on a covered conveyor from the power station to an onsite storage silo, and adjusting the operations according to weather conditions. The sprinkler system's water application rate is adjusted daily to suit weather conditions. Where sprinklers cannot be applied, water carts are commonly used. Water is applied across the entire exposed area (uncapped areas) of the ash repository. Where these are not effective the working face of the ash emplacement is reduced.

4 After the audits

The EPA has required the licensees audited as part of this program to rectify any non-compliances identified and will continue to follow up to make sure they are complying with their licence requirements.

Since the individual audit reports were finalised, most of the required actions have been completed by the licensees audited in this program, to ensure that compliance is achieved. In many cases the comments received from licensees as part of the audit process indicated that they had already commenced a review of their processes and procedures to improve performance and address non-compliances.

Actions taken include: repairing plant and equipment, improving stormwater drainage systems, installing a back-up diesel pump, and updating documentation; however progress, within the required timeframes, is still being made on some of the required actions. The actions that are still in progress relate to some licensees liaising and negotiating pollution reduction programs with the EPA about the management of water levels in the coal ash dam, the transport of coal ash wastewater, and the transport of the return water in a manner that will prevent pollution.

5 Related initiatives

The following related initiatives may also assist relevant stakeholders in the management of environmental issues associated with dams and coal ash.

5.1 Resource recovery

The EPA has issued a resource recovery order and resource recovery exemption for coal ash and blended coal ash. Under the Protection of the Environment Operations (Waste) Regulation 2014 (2014 Waste Regulation), the EPA has the power to grant exemption from some regulatory requirements, where it can be demonstrated that the use of the waste is bona-fide, fit-for-purpose and causes no harm to the environment or human health, rather than a means of waste disposal. In such a case, the EPA issues two separate documents: a resource recovery order and a resource recovery exemption.

Many of the sites audited were not disposing of all their ash or were reclaiming a proportion of the ash from their dams for use in products such as road and construction materials. Advantages of reusing the material include reducing the environmental impacts of the dam or emplacement and the need to enlarge the footprint of the dam/emplacement; however, to use the ash as a resource, generators, processors and consumers must comply with the requirements set out in the resource recovery order and exemption.

The resource recovery order under Part 9, Clause 93 of the 2014 Waste Regulation ('the coal ash order 2014') imposes the requirements that must be met by suppliers of coal ash and blended coal ash to which 'the coal ash exemption 2014' applies. The EPA imposes requirements on the generator and processor. These requirements include sampling, testing, ensuring the chemical and other attributes of the coal ash are within specified levels, record keeping and notifications.

The resource recovery exemption under clauses 91 and 92 of the 2014 Waste Regulation ('the coal ash exemption 2014') exempts a consumer of coal ash or blended coal ash from certain requirements under the POEO Act and 2014 Waste Regulation in relation to the application of that waste to land, provided the consumer complies with the conditions of the exemption. The exemption should be read in conjunction with 'the coal ash order 2014'.

Compliance with 'the coal ash order 2014' and 'the coal ash exemption 2014' was not assessed as part of this audit program.

5.2 Mine dams

In August 2016, the EPA commenced a joint compliance audit program on the management of mine dams with the Department of Planning and Environment (DPE) and the Division of Resources and Energy (DRE).

The focus of the program was on the environmental management of tailings, wastewater holding and sedimentation dams at NSW mines, and how industry is minimising or preventing the impact of these dam facilities on the environment. In addition to assessing compliance with regulatory requirements, the project aimed to improve industry's awareness and understanding of environmental and compliance issues in relation to the environmental management of dam facilities.

The project audited 14 mine sites regulated by the EPA, DPE and DRE with the majority having more than one type of dam facility. The summary report will be available mid-2017.

5.3 Polymetallic mines

Between December 2014 and February 2015, the EPA conducted audits on the polymetallic mining industry. The objective of the program was to assess the level of compliance with

EPLs and to improve licensee awareness and understanding of environmental and compliance issues, including the management of their dams.

Altogether six polymetallic mines were audited, representing over 30% of the polymetallic mining licences in NSW.

The EPA detailed the audit outcomes in the Environment Compliance Report: Polymetallic mines.

6 Glossary

ANCOLD	Australian National Committee on Large Dams
Audit	A systematic, independent and documented verification process of objectively obtaining and valuating audit evidence to determine whether specified criteria are met
Audit criteria	The requirements against which the auditor compares collected audit evidence. Criteria may include regulatory requirements, standards, guidelines or any other specified requirements.
Audit evidence	Evidence collected for the purpose of assessing compliance, including documentary evidence and any evidence collected during an audit inspection of the premises, such as auditor's observations, photographs, videos and evidence provided by the licensee during interviews
Audit inspection	The step in the audit process where auditors visit the licensed premises to conduct meetings, interviews, observation of the operational systems, and collect evidence against which compliance will be assessed
Audit scope	The extent and boundaries of the audit such as locations, organisational units, activities and processes to be audited, and the time period covered by the audit
Coal ash	Ash that is produced as a waste product from the burning of coal
Coal ash dam	Dam which holds coal ash that is stored in a liquid or slurry form
Coal ash emplacement	Place where dry coal ash is disposed of
Code blue	A non-compliance for licence conditions that do not have a direct environmental significance, but are still important to the integrity of the regulatory system. These conditions relate to administrative, monitoring and reporting requirements.
Code orange	A non-compliance of environmental significance; however, remedying the non-compliance can be given a lower priority than a red risk assessment
Code red	A non-compliance of considerable environmental significance which therefore must be dealt with as a matter of priority
Code yellow	A non-compliance which could receive a lower priority than a red or orange risk code, but the non-compliance is still important and must be addressed
Compliance	There is sufficient and appropriate evidence to demonstrate the particular requirement has been complied with and is within the scope of the audit.
Consequence Category	'Consequence Categories' have been adopted by ANCOLD and the DSC for the classification of potential impacts resulting from a dam failure. The DSC assigns Consequence Categories to a dam according to the seriousness and magnitude of the adverse consequences affecting the community's interests, including environmental effects, which could be expected to result from that dam's failure. In assigning such Consequence Categories, no account is taken of the likelihood of dam failure. Two types of dam failure are recognised for the purposes of determining a dam's Consequence Category: • failures that occur without any attendant natural flooding, giving rise to the 'Sunny Day' Consequence Category (SDCC) • failures that occur in association with a natural flood, giving rise to the Flood Consequence Category (DSC 2015).

DSC	Dam Safety Committee (NSW)
Environment protection licence (EPL)	A licence that authorises the carrying out of scheduled activities or controls pollution arising from non-scheduled activities, being a licence issued under Chapter 3 of the *Protection of the Environment Operations Act 1997* and in force
Environmental harm	Includes any direct or indirect alteration of the environment that has the effect of degrading the environment and, without limiting the generality of the above, includes any act or omission that results in pollution
Facility	Any premises where scheduled or non-scheduled activities are undertaken
Freeboard	The vertical distance between a water level within a dam and a critical design level; for tailings dams, there are various freeboards provided for different purposes (see ANCOLD 2012 and DSC 2010)
Licence conditions	Stipulations listed on the EPL outlining the requirements which the licensee must comply with
Licensed premises	Any premises where a scheduled activity is undertaken for which the licensee has obtained a licence to do so
Monitoring	Monitoring generally means to be aware of the state of a system. The process of monitoring involves data collection, data analysis and interpretation of the data to determine the state of the system and how the system is changing.
Monitoring data	Data collected for the purpose of characterising changes in an event as the result of a direct observation or experiment. The facts are usually numbers that reflect the result of a measurement determined from observations or experiments.
Monitoring frequency	The frequency at which licensees are required to collect samples, as required by their EPL
Non-compliance	Clear evidence has been collected to demonstrate the particular requirement has not been complied with and is within the scope of the audit.
Not applicable	The particular requirement is not relevant to the licensee's facilities or operating conditions or the scope of the audit.
Not determined	Insufficient evidence is available to allow an evidence-based assessment of compliance to be made.
Overburden	Matter, made up of soil, gravel, and other loose materials, that covers the surface of a mine site (also called waste or spoil)
Pollution	Water pollution, air pollution, noise pollution or land pollution
Public register	The public register under section 308 of the POEO Act is an online searchable database and contains: • environment protection licences • applications for new licences and to transfer or vary existing licences • environment protection and noise control notices • convictions in prosecutions under the POEO Act • results of civil proceedings • licence review information (submissions regarding licence review can be made at any time) • exemptions from the provisions of the POEO Act or regulations • approvals granted under clause 9 of the POEO (Control of Burning) Regulation • approvals granted under clause 7A of the POEO (Clean Air) Regulation.

Remedial action/action program	An action or series of actions that the licensee is required to undertake to correct an identified non-compliance; it is issued in association with an expected completion date
Scheduled activity	An activity listed in Schedule 1 of the POEO Act
Scheduled (premises)	A premises (as defined in the POEO Act) on which an activity listed in Schedule 1 of the POEO Act is carried out. The person or company undertaking the activity is required to hold an Environment Protection Licence to carry out the activity. Premises includes: • a building or structure or • land or a place (whether enclosed or built on or not) or • a mobile plant, vehicle, vessel or aircraft.
Tailings	A mixture of water and finely ground rock that is left over once mineral concentrate is removed
Tailings storage facility	A large area, usually located in a natural hollow or valley; in most cases, dam walls are constructed to contain the tailings material. Once placed in a storage facility, the finely ground rock and water that together make up tailings will separate. The solids portion of the tailings will settle to the bottom. The tailings water will accumulate at the surface.

7 References and further reading

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