

# AER 2022 Dam Safety Program Report

Regulatory Oversight of the Structural Integrity of Energy Sector Dams

April 2023



#### **Alberta Energy Regulator**

AER 2022 Dam Safety Program Report: Regulatory Oversight of the Structural Integrity of Energy Sector Dams

April 2023

Published by Alberta Energy Regulator Suite 1000, 250 – 5 Street SW Calgary, Alberta T2P 0R4

Telephone: 403-297-8311 Inquiries (toll free): 1-855-297-8311 Email: <u>inquiries@aer.ca</u> Website: <u>www.aer.ca</u>

# Contents

Exe	ecutive	e Summaryiii
1	Introd	duction1
2	Back	ground1
	2.1	What is a Dam?1
	2.2	Consequence Classifications
3	Dam	s in Alberta3
4	Prog	ram Activities6
	4.1	Field Inspections
	4.2	Regulatory Submissions
	4.3	Safety Deficiencies and Observations7
	4.4	Noncompliances
	4.5	Incident Response
5	Com	nunication and Engagement
	5.1	Committees, Associations & Initiatives11
	5.2	External Outreach & Education11

# Figures

Figure 1. Timeline of notable regulatory milestones	1
Figure 2. A pond retained by multiple dams	2
Figure 3. Number of dams by consequence classification as of December 2022	4
Figure 4. Total number of dams by consequence classification	4
Figure 5. Breakdown of fluid types impounded by all dams, by per cent of total volume capacity	5
Figure 6. Distribution of dam consequence classifications by fluid type as of December 2022	5
Figure 7. Breakdown of regulatory submissions received in 2022	7
Figure 8. Map showing the location of ponds and dams in Alberta by consequence classification1	4

# Tables

Table 1. Consequence classification considerations	2
Table 2. Core program components and their frequency by consequence classification	6
Table 3. 2022 dam safety regulatory submissions, by consequence classification	7
Table 4. Summary of safety deficiencies and key observations in 2022	8
Table 5. Summary of noncompliances in 2022	. 10

# **Executive Summary**

The purpose of the AER dam safety program is to ensure energy dams are compliant throughout their life span, from design and construction to operations and decommissioning or closure. This dam safety report includes dam structural integrity compliance as per the <u>Alberta Dam and Canal Safety Directive</u>. This report summarizes the activities conducted and program metrics for 2022. It is part of the commitment by the AER to provide public information on the outcomes of the program, as recommended by the 2015 Auditor General of Alberta's report <u>Systems to Regulate Dam Safety</u>.



The total number of dams under AER jurisdiction increased to 243 by the end of 2022. We received 297 dam-related regulatory submissions and conducted 145 dam inspections. One critical safety deficiency (i.e., a deficiency that could lead to dam failure) was identified related to an incident reported for overtopping of a significant-consequence dam. The noncompliances related to this incident have been mitigated through an AER-approved action plan, and the circumstances that led to the noncompliances are under investigation. Of the thirty noncompliances identified, two were related to an extreme-consequence dam, three were related to a high-consequence dam, one was related to a low-consequence dam, and the rest were related to significant-consequence dams. Most noncompliances were administrative in nature, such as a failure to submit or update required documentation.

# 1 Introduction

In March 2014, the AER assumed responsibility from the Government of Alberta to regulate dams used in the development of Alberta's energy resources. The AER dam safety program was developed to meet the recommendations of the 2015 Auditor General of Alberta's report <u>Systems to Regulate Dam Safety</u> and continues to evolve. Figure 1 presents a timeline of notable regulatory milestones of the AER's dam safety program.



#### Figure 1. Timeline of notable regulatory milestones

## 2 Background

Dams related to energy resource development are regulated under Part 6 of the <u>Water (Ministerial)</u> <u>Regulation</u> and the <u>Alberta Dam and Canal Safety Directive</u>. These regulatory documents set the requirements dam owners must fulfil to design, construct, operate, manage, decommission, close, or abandon a dam.

#### 2.1 What is a Dam?

A dam is defined in section 1(1)(h) of the regulation as "a barrier that is designed and is or is to be constructed for the purpose of retaining, storing, or diverting water, including water containing another substance, fluid waste, or flowable tailings and includes all other works associated with such a barrier." Section 27(1) of the regulation states that a dam is regulated if it has a live storage capacity of 30 000 cubic metres or more and is greater than 2.5 metres high. Additionally, dams containing flowable tailings or structures with a consequence classification of "significant" or higher (see below) are also subject to the regulation's dam safety requirements regardless of their height or live storage capacity. Multiple dams may be in place to form a single reservoir or pond, as shown in figure 2.



#### Figure 2. A pond retained by multiple dams

#### 2.2 Consequence Classifications

In Alberta, regulatory requirements for a dam are based on its "consequence classification," which reflects the consequences should the dam fail. This is determined by a qualified professional retained by the dam owner and must be reviewed and accepted by the AER.

The directive specifies five consequence classes: low, significant, high, very high, and extreme. The classes are based on three categories for incremental consequence of failure: (i) loss of life; (ii) environmental and cultural values such as fisheries, wildlife habitat, endangered species, unique landscapes, and cultural sites; and (iii) infrastructure, economics, and other property, including public transportation and commercial facilities. Dams are classified based on the most severe potential consequence of failure among these three categories. Refer to table 1, which is adapted from schedule 1 of the directive and from the Canadian Dam Association *Dam Safety Guidelines*.

Classification	Loss of life	Environment and cultural values	Infrastructure, economics, and other property
Extreme	More than	Major loss to critical sites.	Extremely high losses affecting critical
	100	Restoration or compensation	infrastructure or some severe damage to
		impossible.	residential areas.
Very High	100 or fewer	Significant damage to critical sites.	Very high losses affecting important
		Restoration or compensation	infrastructure or some severe damage to
		possible but impractical.	residential areas.
High	10 or fewer	Significant damage to important	High losses affecting infrastructure or some
		sites. Restoration or compensation	severe damage to scattered residential
		highly possible.	buildings.

	Table 1.	Consequence	classification	considerations
--	----------	-------------	----------------	----------------

Classification	Loss of life	Environment and cultural values	Infrastructure, economics, and other property
Significant	Low potential	No significant damage to important	Low losses affecting limited infrastructure or
		sites. Restoration or compensation	some damage to locations used irregularly
		highly possible.	for temporary purposes.
Low	No possibility	Minimal short-term damage and no	Minimal losses mostly limited to dam
		long-term damage.	owner's property.

### 3 Dams in Alberta

At the end of 2022 there were a total of 243 dams in Alberta related to energy development. Most of the extreme- and very-high-consequence dams are associated with oil sands development in the Fort McMurray area. Lower-consequence dams are more commonly associated with coal mines and oil and gas development, mostly located in western Alberta. Dam locations province-wide are shown in figure 8. Note that for clarity in this figure, dams have been grouped by the pond they impound. Additional information for each pond is available in the interactive <u>Dam and Pond Map Viewer.</u> The number of dams by consequence classification is provided in figure 3.

Over time, the number of dams increase as additional projects come online or existing structures are found to meet dam criteria. The change over the last three years is shown in figure 4. In all, fifteen dams were added in 2022 and three dams were removed or delisted. A dam is delisted if it no longer meets the definition of a dam under the regulation (e.g., if a dam is replaced with a flow-through channel as part of an approved decommissioning plan). The fifteen dams added belong to coal, oil sand, and oil and gas sectors, of which five were new approved designs and ten were previously unidentified dams. The consequence classification for one oil and gas dam changed from low to significant following a consequence classification reassessment with an updated inundation analysis.

Oil sands tailings is by far the largest volume of all the fluids impounded at 96.6% of the total approved capacity across all energy-sector dams. This is shown in figure 5. The remaining volume, in descending order, is taken by fresh water, process-affected water, and coal tailings. The number of dams in each fluid category is shown in figure 6.



Figure 3. Number of dams by consequence classification as of December 2022



Figure 4. Total number of dams by consequence classification







Figure 6. Distribution of dam consequence classifications by fluid type as of December 2022

# 4 Program Activities

Dam safety program activities conducted by the AER include field inspections, reviews of regulatory submissions, tracking of safety deficiencies, ensuring compliance with regulatory requirements, and incident response. A summary of core program components and their scheduled frequencies, as dictated by the directive, is shown in table 2 below. All program activities conducted are tracked to ensure objectives are met, and performance metrics are reported to AER leadership.

	Proactive inspections		Proactive inspections Ann			Annual	Major	ajor document updates*		
Consequence	Every year	Every 3 years	Every 5 years	performance review	Every 3 years	Every 5 years	Every 10 years			
Extreme	$\checkmark$			$\checkmark$	$\checkmark$					
Very High	$\checkmark$			$\checkmark$	$\checkmark$					
High		$\checkmark$		$\checkmark$		$\checkmark$				
Significant			$\checkmark$	$\checkmark$			$\checkmark$			
Low			$\checkmark$	$\checkmark$	Only when	requested by	the AER.			

Table 2. Core	program com	ponents and	their frequer	ncy by conse	equence classification

\* "Major Documents" are those required by the directive, including consequence assessments, safety management plans, emergency management plans, and safety reviews. Refer to the directive for a more detailed description of each document type.

#### 4.1 Field Inspections

Our annual dam inspection plan is scheduled according to the frequencies outlined in table 2. All dams retaining tailings are required to be inspected annually regardless of their consequence classification, as per Alberta Environment and Parks Ministerial Order 10/2019. Additional inspection priorities may be identified throughout the year based on incident notifications or results from the review of regulatory submissions.

In 2022, a total of 145 dam inspections were planned and completed. All inspection results, including required follow up actions, were communicated to dam owners and resolved.

#### 4.2 Regulatory Submissions

Regulatory submissions include all documents a dam owner is required to provide under the directive. Notable submissions include the annual performance review report; dam safety report; emergency management plans (EMP); operation, maintenance, and surveillance manual (OMS); and consequence classifications.

We received 297 dam safety regulatory submissions in 2022, as summarized in figure 7 and table 3.



#### Figure 7. Breakdown of regulatory submissions received in 2022

Submission*	Low	Significant	High	Very high	Extreme	Total
Annual performance review report	40	46	29	3	28	146
Regulatory notifications	9	5	7	6	22	49
Operations, maintenance & surveillance manual	9	14	0	0	1	24
Emergency management plan	20	20	6	3	2	51
Dam safety review report	1	3	0	1	6	11
Dam safety management plan	8	8	0	0	0	16

#### Table 3. 2022 dam safety regulatory submissions, by consequence classification

\* Regulatory submissions may include one or more dams.

#### 4.3 Safety Deficiencies and Observations

Dam owners are accountable for the safety of their structures. The regulation outlines the responsibilities and accountabilities for dam owners and persons responsible. Throughout the lifespan of a dam, qualified professionals monitor and assess its performance to ensure it meets expected design criteria; report to the AER on observations, hazardous conditions, and safety deficiencies; and implement risk mitigation plans. Hazardous conditions may also be identified by the AER dam safety engineers while conducting dam safety inspections or submission reviews.

A "safety deficiency" means a hazardous condition that has the potential to develop into a critical safety deficiency over time. A "critical safety deficiency" means a hazardous condition that has the potential to lead to an imminent failure. The *Dam Safety Directive* requires owners to identify and report safety

deficiencies to the AER. They are also required to develop and implement measures to mitigate and manage risks posed by the deficiency. In addition to the identification of deficiencies by owners, AER dam safety engineers, while reviewing the annual performance report, may identify issues of sufficient significance with potential of becoming a safety deficiency if not mitigated. These are identified as "observations" (see table 4) and are documented and brought to the owner's attention for appropriate regulatory oversight.

In 2022, one critical safety deficiency and one safety deficiency were identified, and three observations were noted. As indicated in table 4, all safety deficiencies and observations identified in 2022 have either been addressed or are being managed in accordance with approved action plans.

Safety deficiency/ observation	Dam Consequence classification	Issue	Response
Critical Safety	Significant	Capacity was inadequate to	In progress.
Deficiency		safely pass the storm event	Operator is maintaining the water
Overtopping –		of May 2022. The dam was	level within the reservoir as outlined
Insufficient		designed for a historically	in their operations, maintenance,
conveyance/storage		lower storm event.	and surveillance manual.
capacity			A study is being conducted to
			update the design storm event the
			dam system must safely pass and to
			implement any corrective actions
			based on it.
Safety Deficiency	Extreme	During regular construction	In progress.
Off-specification		quality control and quality	The owner is addressing this issue
material detected		assurance monitoring, off-	and has obtained approval for a
		specification material was	change in dam geometry in order to
		detected by the owner in the	support the final approved dam
		structural zone of a tailings	height construction.
		dam.	
Observation	Extreme	Upper 1 m of fill material for	In progress.
Not meeting design		grading did not meet design	Operator is taking steps to bring the
specifications		specification due to high	material back to design
		water level.	specifications.

#### Table 4. Summary of safety deficiencies and observations in 2022

Safety deficiency/ observation	Dam Consequence classification	Issue	Response
Observation	Very High	Slumping at the toe	Resolved.
Slope instability		occurred during early	The slumping was assessed, and
		construction of an in-pit	the mitigation measures were
		dike.	approved by the AER and
			implemented by the dam owner. At
			no time was the integrity of the dam
			at risk. No other areas of the dam
			were affected by this issue.
Observation	Significant	Several significant cracks	Resolved.
Cracks on spillway		were observed on the	Operator installed instrumentation to
		concrete wing wall of the	regularly monitor these cracks.
		culvert spillway.	

#### 4.4 Noncompliances

As outlined in *Manual 013*, a notice of noncompliance is issued when the AER identifies a noncompliance. It communicates to a dam owner that it is noncompliant with a specific regulatory requirement, requests that it address the noncompliance, and it may include a recommended course of action that is expected to achieve compliance. It may also request a description of the cause and the measures being considered that would prevent further noncompliance. For noncompliances that can be corrected, the AER requests written confirmation from the regulated party when compliance has been achieved.

In 2022, thirty notices of noncompliance were issued to AER regulated dam owners, as summarized in table 5. All noncompliances identified in 2022 are being addressed by the dam owners, and either compliance has been achieved or is in progress. Of the thirty noncompliances identified, two were related to an extreme-consequence dam, three were related to high-consequence dams, one was related to a low-consequence dam, and the remaining were from significant-consequence dams.

#### 4.5 Incident Response

Dam owners are required to report any safety incident at a dam that has the potential to become a hazardous condition to the dam or pose a risk the downstream environment. Reportable incidents may include controlled or uncontrolled releases of the reservoir, overtopping, excessive seepage, failure of equipment, or contraventions of regulatory requirements. Dam incidents are uncommon, due in part to stringent dam safety regulatory requirements.

In 2022, the AER responded to one dam safety-related incident. The noncompliances related to this incident have been mitigated through an AER-approved action plan, and the circumstances that led to the noncompliances are under investigation by the AER. Refer to the <u>compliance dashboard</u> for further details.

		Dam		Status	
Category	Type*	Consequence classification	Number issued	Now compliant	ln proaress
Failure to submit	Dam safety review	Extreme	1	1	0
documents	Major design authorization	Extreme	1	1	0
	Annual performance	Significant	11	11	0
	review	Low	1	1	0
	Operations, maintenance,	Significant	1	0	1
	and surveillance plan	High	1	0	1
	Dam safety management	High	1	0	1
	plan				
	Emergency management	High	1	0	1
	plan				
Failure to comply with	Dam safety management	Significant	1	0	1
requirements around	plan				
document content and	Operations, maintenance,	Significant	3	2	1
major updates	and surveillance plan				
	Emergency management	Significant	4	2	2
	plan				
Failure to operate within	Operations, maintenance,	Significant	1	1	0
defined standards and	and surveillance plan				
procedures	Emergency management	Significant	2	2	0
	plan				
Failure to comply with	Action plan	Significant	1	1	0
corrective actions					
	Noncompliance total		30	22	8

Table 5. Summar	of noncompliances	in 2022
-----------------	-------------------	---------

\* Refer to the directive for a more detailed description of each document type.

## 5 Communication and Engagement

The AER dam safety program includes strategies for communicating and engaging with stakeholders, including dam owners, the public, academia, and the Government of Alberta. Our strategy includes external outreach & education, active participation in technical committees and associations, initiatives to enhance the regulatory regime of dams in Alberta, and ongoing communication with dam owners through inspection activities.

#### 5.1 Committees, Associations & Initiatives

Participation in technical committees and associations allows dam safety experts from Alberta, Canada, and around the world, to share their expertise and experiences. These forums ensure that Alberta is leading when it comes to providing regulatory oversight of dams.

The AER participates in technical committees and working groups of the Canadian Dam Association (CDA), including the Mining Dams Committee and Regulation of Dams Committee. The CDA publishes technical guidelines on best practices related to dam safety. The AER also participates in meetings hosted by the Dam Integrity Advisory Committee (DIAC) of the Alberta Chamber of Resources. The DIAC promotes best practices for the management of dams in Alberta.

In 2017 a conviction for an offence under section 227(j) of the *Environmental Protection Act* resulted in a creative sentence order to fund a dam safety research project. Over a five-year period, this funding was used for the Dam Safety Research Program at University of Alberta. The objective of this program was to aid in closing the knowledge gap surrounding the decommissioning and closure of tailings dams. The AER and industry experts worked with the university team throughout this project.

In 2022, the research project was completed after successfully achieving its objectives with the dissemination of research output, including fifteen published publications (theses, journals, and conference papers), additional submitted publications, and a final report to the AER. Over the course of this research project, the team presented at a number of technical conferences. In 2022, the CDA awarded of the research team the 2022 Published Paper Award of Excellence, which was presented at the annual CDA conference in Newfoundland.

#### 5.2 External Outreach & Education

External outreach and education are provided to stakeholders using a variety of forums and tools.

The AER's website provides information on ponds and their dams, the regulation of dams, and this <u>annual dam safety report</u>. The AER maintains an interactive map that provides the location of all ponds regulated by the AER, in addition to specific information such as dam owner, dam heights, fluid storage volumes, fluid types, and authorization documents.

Presentations provided by AER dam safety engineers allow the AER to inform stakeholders on the dam safety regulations in Alberta and the AER dam safety program. In 2022, the AER participated as an instructor in a short course on design and assessment of mine waste structures organized by the University of Alberta.

# Alberta Pond and Dam Consequence Classification Map





1:750,000



1:500,000

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community