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Canadian Dam Association
Association canadienne des barrages

The Increasing Number of Tailings Facility Failures: Navigating the Decade 2020-2029

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Differences between Tailings Dams and Water Reservoir Dams:

- A water reservoir dam is an asset to its owner, while a tailings dam is a cost to its owner
- There is no technical reason for tailings dams to fail at a rate different than that of water reservoir dams

Assumptions:

- Tailings dams are estimated to fail at a rate approximately 5-10 times that of water supply reservoirs
- It is estimated that ½ of the worlds tailings dam are constructed by the upstream method
- As demand for metals increases, the number and size of mines will increase
- As the grade of ore gradually decreases, the amount of waste produced per unit of metal produced increases

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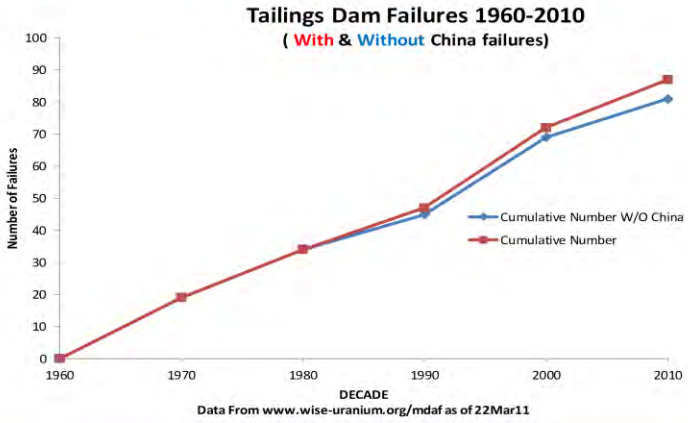
The last census includes more than 58,000 large dams according the definition of ICOLD (height at least of 15 m above the foundation or above 5 m with a capacity above 3 million of m3).

2010


Tailings Dam Failures 1960-2010
(With & Without China failures)
Number of Failures
100
90
80
70
60
50
40
30
20
10
0
1960
1970
1980
1990
2000
2010
DECADE
Cumulative Number W/O China
Cumulative Number
Data From www.wise-uranium.org/mdaf as of 22Mar11

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2015

TSF FAILURE CODE CLASSIFICATIONS (Chambers, Jul15, rev Mar18)	
Very Serious Tailings Dam Failures	Multiple loss of life and/or release of ≥ 1,000,000 m^3 total discharge, and/or release travel of 20 km or more
Serious Tailings Dam Failures	Loss of life and/or release of ≥ 100,000 m^3 discharge
Other Tailings Dam Failures	Engineering/facility failures other than those classified as Very Serious or Serious, no loss of life
Waste-Related Accidents	Related facility tailings failures (e.g. sinkholes, pipelines), and non-tailings incidents (e.g. mine plug failures, waste rock failures, etc.)

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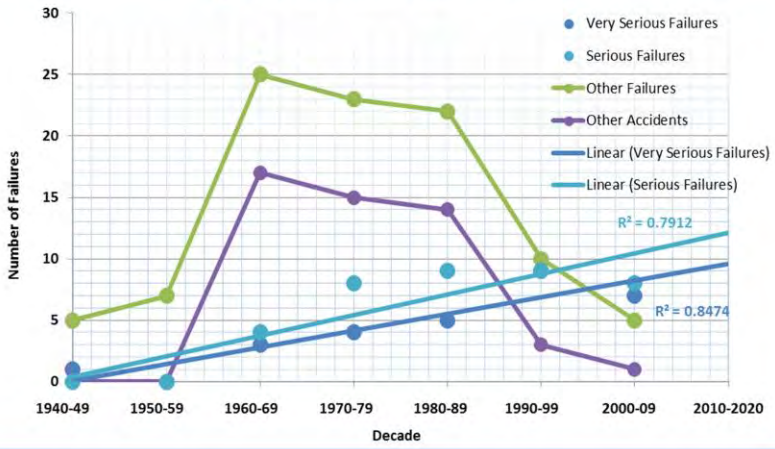
ICOLD Definition of a Large Dam
A dam with a height of 15 metres or greater from lowest foundation to crest or a dam between 5 metres and 15 metres impounding more than 3 million cubic metres.

2015

Figure 6.1 Failure Predictions By Trend Line



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2019

Figure 2: Failure Predictions with Linear Fit

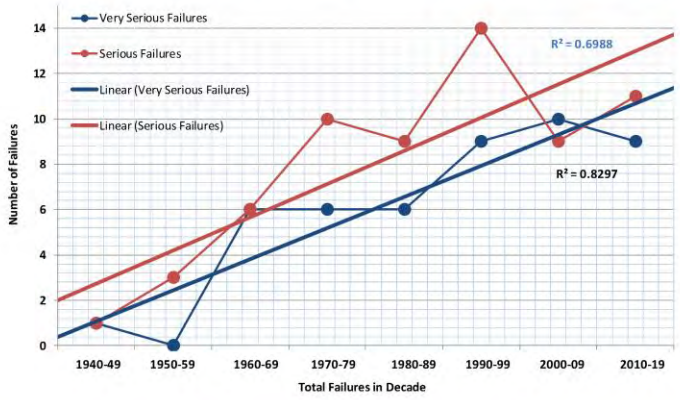

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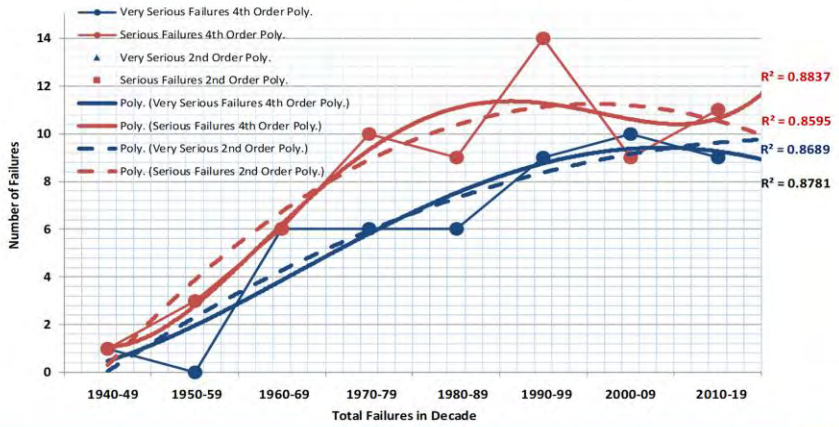
Figure 2: Failure Predictions with 2nd & 4th Order Polynomial Fits



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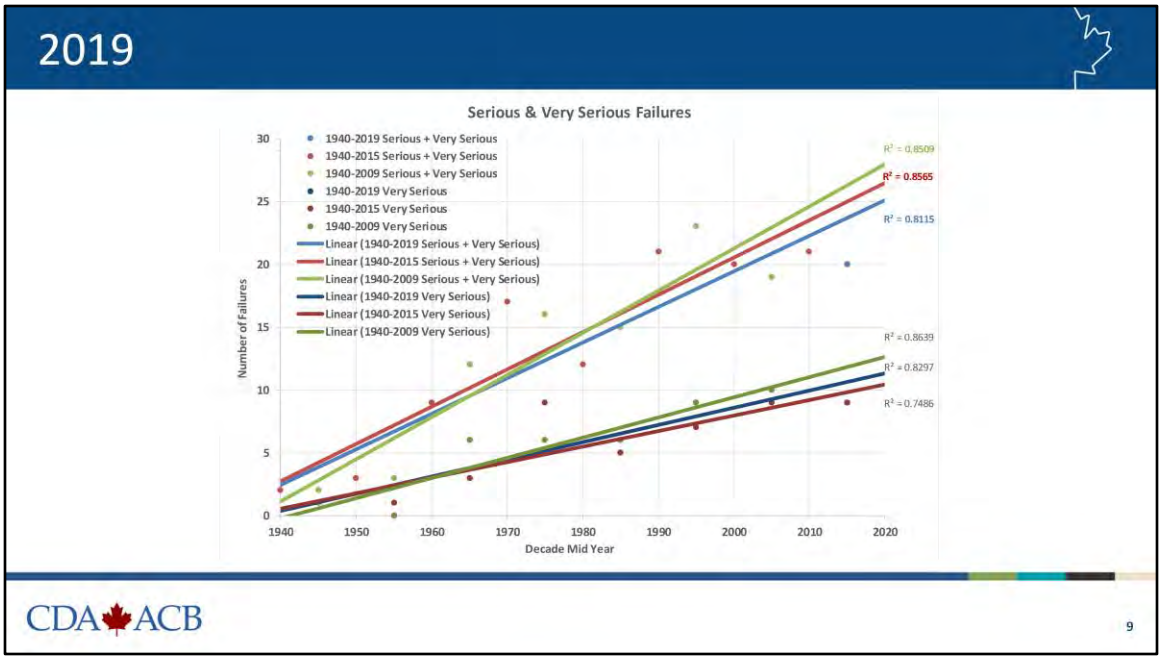
- There are approximately 30% more Serious Failures than Very Serious Failures
- RAISES 2 FUNDAMENTAL CONCERNS:

1. Failure Trend over the period analyzed is essentially the same (but failure frequency is rising)

2. Even if the "decrease" in the trend over the past decade is real, it would take another ~70 years to reduce the failure rate by a factor of 5. (Assumes a water reservoir dam failure rate of 1×10^{-6} and 58,000 dams worldwide)



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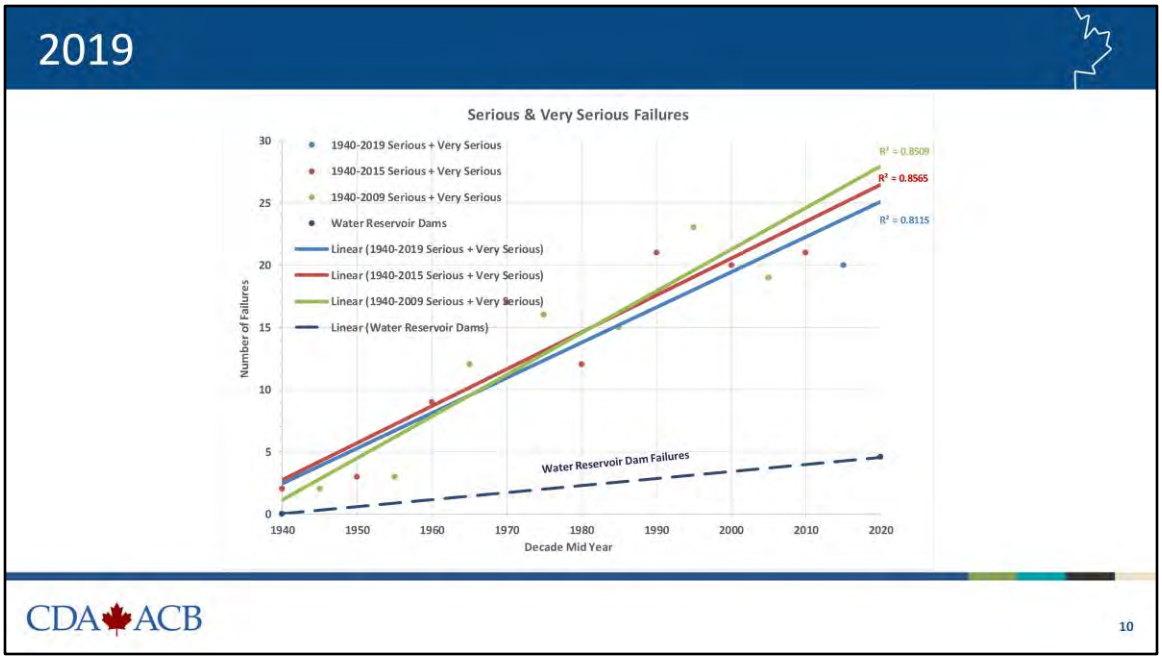

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Conclusion: The rate of serious tailings dam failures is relatively constant, even for the 5 years post-Mt Polley

Deduction: If the rate of failures remains the same, and the number of tailings impoundments increases (and become larger, then the number of large failures will continue to increase.

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Considerations for Navigating the Decade 2020-2029 (page 1 of 3)

- Find an organization to put together a data base on tailings dams and tailings dam failures (dam type, height, length, construction material, etc.) so that we can understand the nature of the problem.
- Find a mechanism to organize an international source for catastrophic tailings dam failure insurance. Requiring financial assurance for a catastrophic event would only make the mining industry comply with financial surety requirements that are already levied on similar businesses, like the oil & gas and chemical industries. Right now, mining is getting a big economic break by avoiding a financial surety for catastrophic failures. The industry itself would probably be the best source to organize this funding assurance.
- Make independent tailings review boards truly independent by making their proceedings, or at least their determinations, transparent. There are some entities that argue that the deliberations and recommendations from independent tailings review boards and an operating company should remain confidential in order to foster open dialog (MAC 2017). But if a company can chose to ignore the recommendation of an independent tailings review board, the publics only backstop is regulatory oversight – which didn't work in the recent instances of catastrophic tailings dam failures in Minas Gerais and British Columbia.

Considerations for Navigating the Decade 2020-2029 (page 2 of 3)

- Make dry closure the starting point for all waste impoundments, even for tailings deposited in wet impoundments. Wet closures, even for potentially acid-generating waste, should only be undertaken if it can be demonstrated through formal risk assessment that the long-term risk to public safety is less with a wet closure than with a dry closure. The Mount Polley Expert Panel noted: "*... the Mount Polley failure shows why physical stability must remain foremost and cannot be compromised. ... No method for achieving chemical stability can succeed without first ensuring physical stability: chemical stability requires above all else that the tailings stay in one place.*" (Expert Panel 2015)

- Make public safety explicitly the primary (but not the only) consideration in tailings dam risk assessment. Until safety is explicitly made the primary consideration for the design, construction, operation, and closure of tailings dams, cost will continue dominate the process. Here observing human nature is important. For example, it is logical to convince ourselves that upstream-type dam construction can be done safely, that we understand all of the important engineering factors. But in following this path we are in essence assigning a risk to future generations to which they have no input. We build them, but they will ultimately need to take care of them.

Considerations for Navigating the Decade 2020-2029 (page 3 of 3)

- Recognize that human factors must be taken into proper consideration in dam design. Anytime there are people involved in a process, they will inevitably make mistakes. Dam design should minimize the dependence on human involvement, for example the need for long-term monitoring and maintenance, and maximize redundancy for dam safety features. The Mount Polley Expert Panel noted: "*Tailings dams are complex systems that have evolved over the years. They are also unforgiving systems, in terms of the number of things that have to go right. Their reliability is contingent on consistently flawless execution in planning, in subsurface investigation, in analysis and design, in construction quality, in operational diligence, in monitoring, in regulatory actions, and in risk management at every level. All of these activities are subject to human error. Human error is often, if not always, found to play a key role in technological failures. And human error will always be with us, as much as we might wish it to be otherwise.*" (Expert Panel 2015).

- Significantly restrict, perhaps eliminate, the use of upstream-type dam construction. There is too much risk with upstream-type construction in areas with more than low seismic risk, or in areas with net-precipitation

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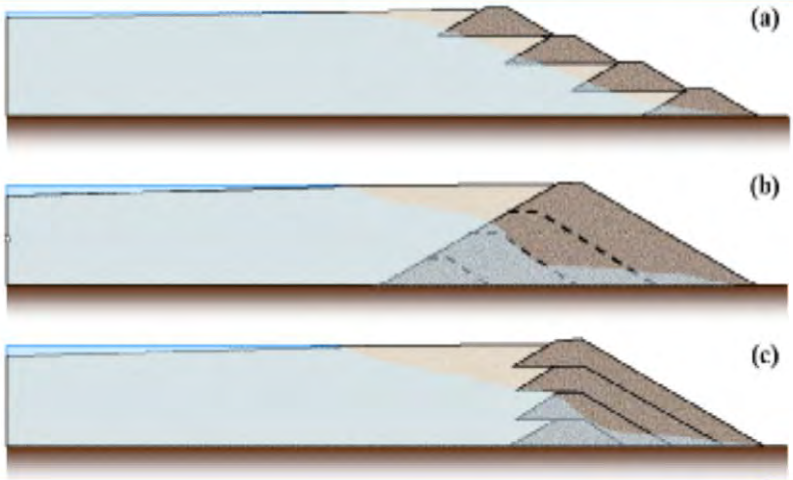
QUESTIONS?



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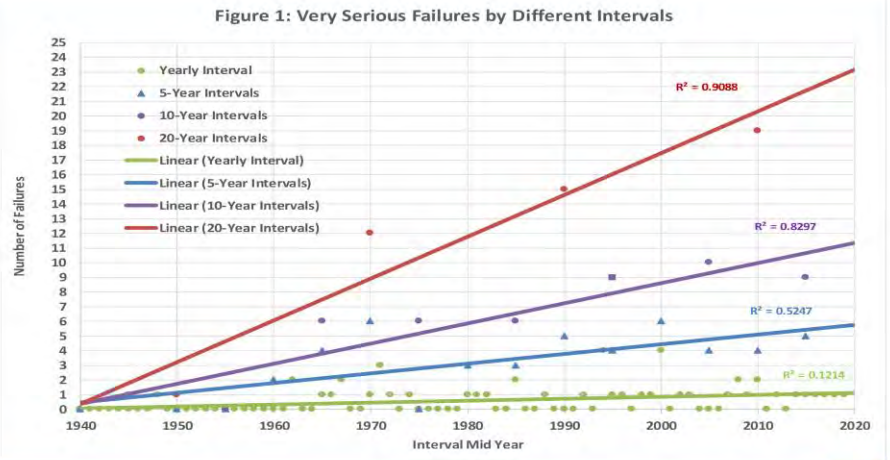
Figure 1: Very Serious Failures by Different Intervals
Number of Failures
Interval Mid Year
Yearly Interval
5-Year Intervals
10-Year Intervals
20-Year Intervals
Linear (Yearly Interval)
Linear (5-Year Intervals)
Linear (10-Year Intervals)
Linear (20-Year Intervals)
R² = 0.9088
R² = 0.8297
R² = 0.5247
R² = 0.1214
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
1940 1950 1960 1970 1980 1990 2000 2010 2020

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