Tailings Engineer of Record (EOR)

Oil Sands Dam Safety Practice in Alberta Canada Regarding the EOR

GBA – Tailings EOR Workshop

Denver, Colorado

Jeremy Boswell

Thurber Engineering, Calgary

January 26, 2017

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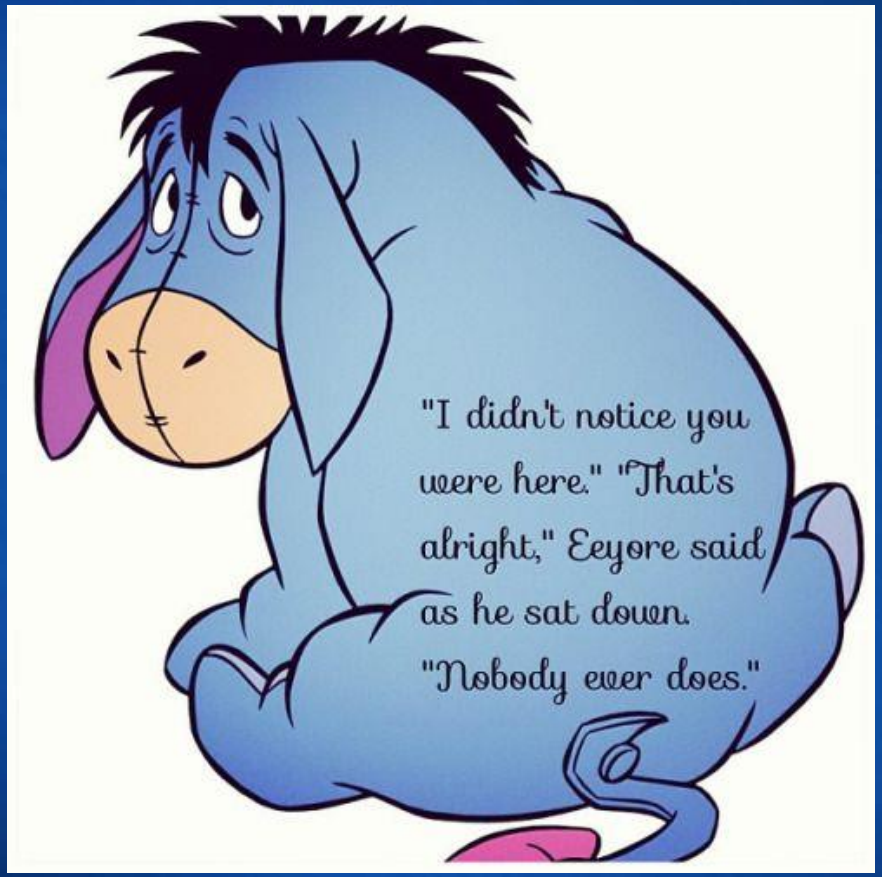
EOR is not Eeyore



The days when the EOR was neglected are over…

With apologies and reference to A.A.Milne: Winnie the Pooh

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Outline

- Introduction to the Oil Sands
- Background to recent changes in tailings regulation and practice within the Oil Sands
- AB DIAC - DSE/M, EOR and DOR
- Alberta Dam Safety
- Dam Safety Inspections by the Alberta Energy Regulator
- CDA defined responsibilities for Dam Owners
- Conclusion

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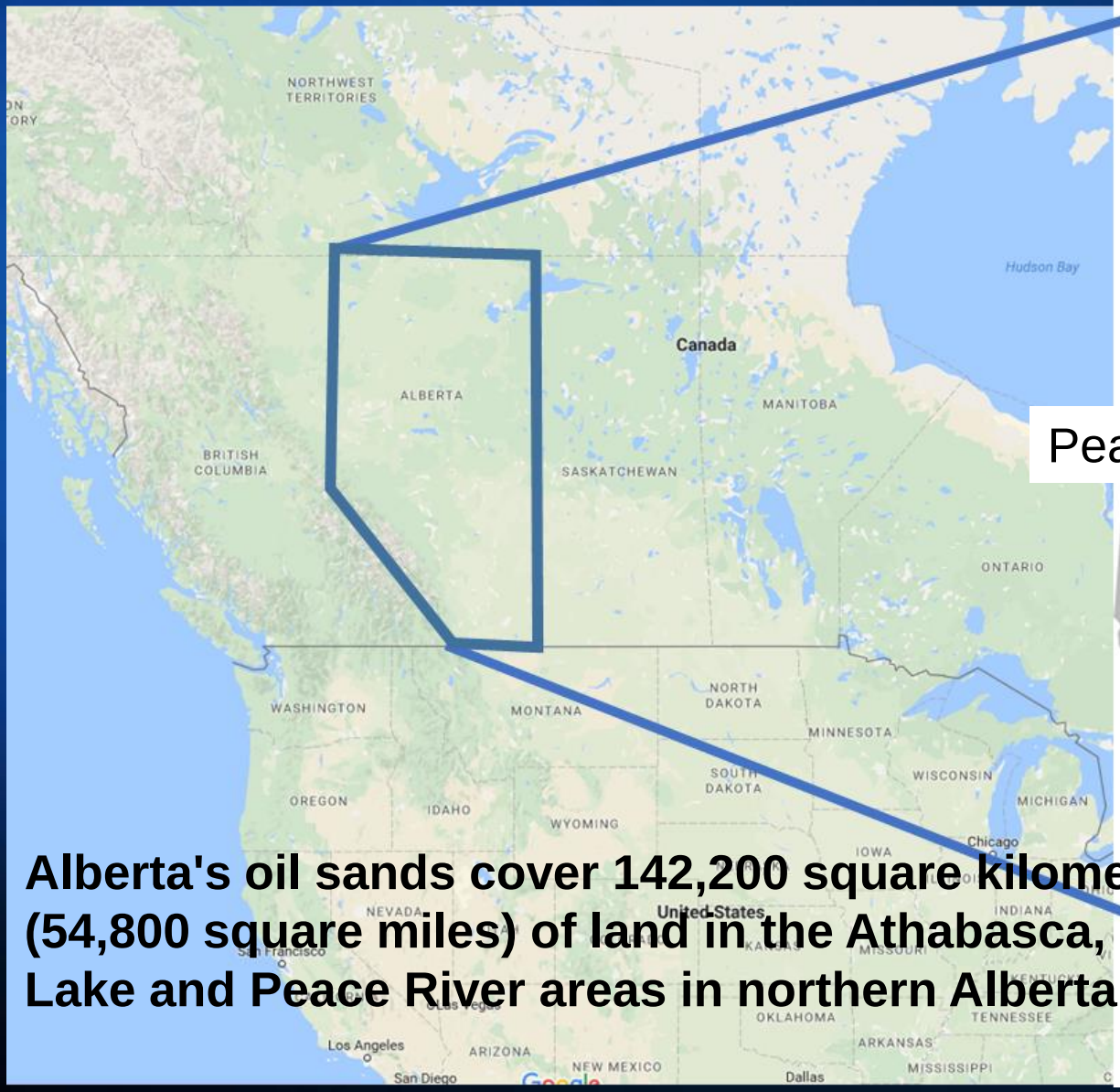
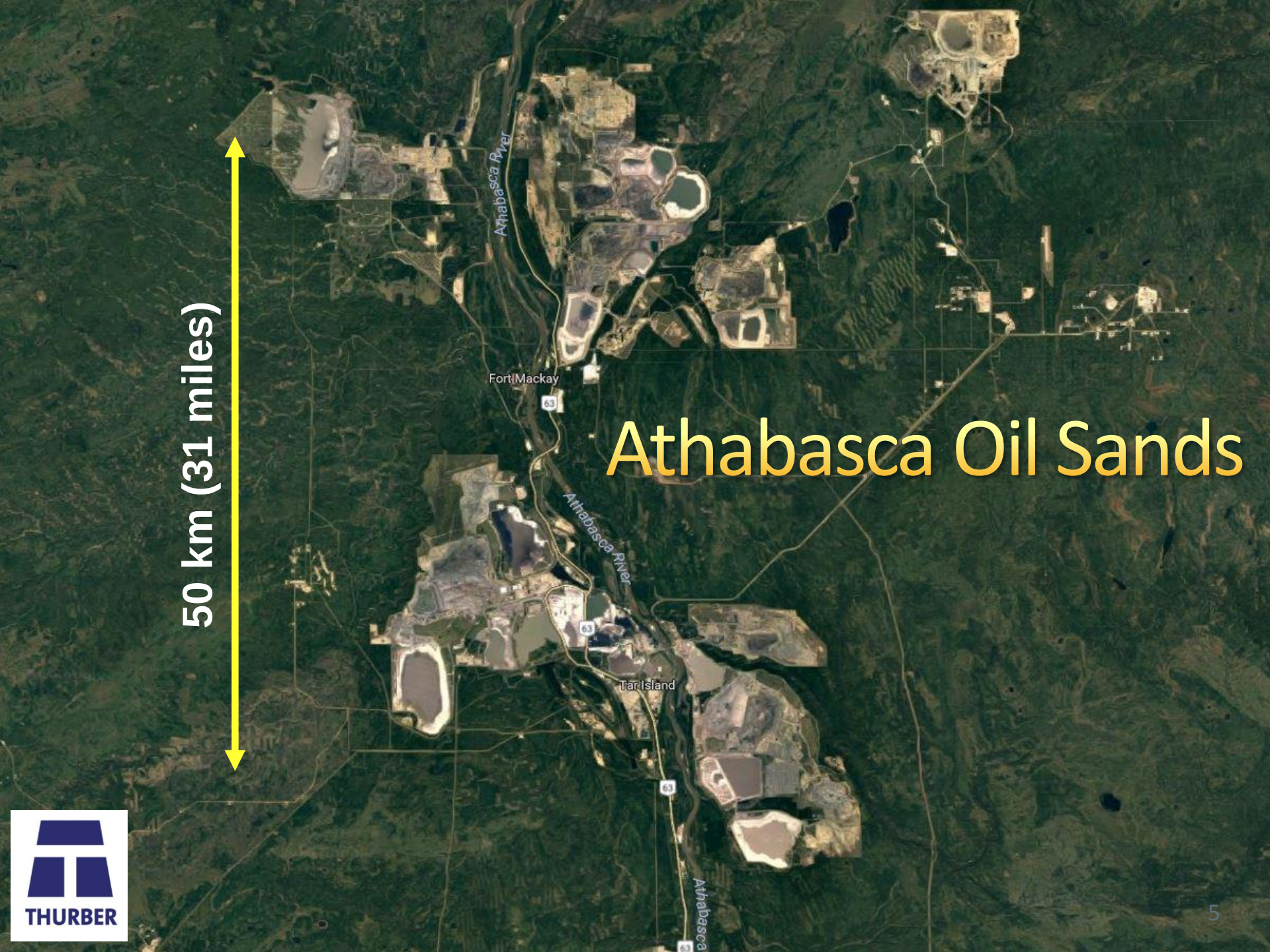
Where are the Oil Sands?



Alberta's oil sands cover 142,200 square kilometres (54,800 square miles) of land in the Athabasca, Cold Lake and Peace River areas in northern Alberta.



Athabasca Oil Sands

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Background to Recent Changes in Tailings Regulation

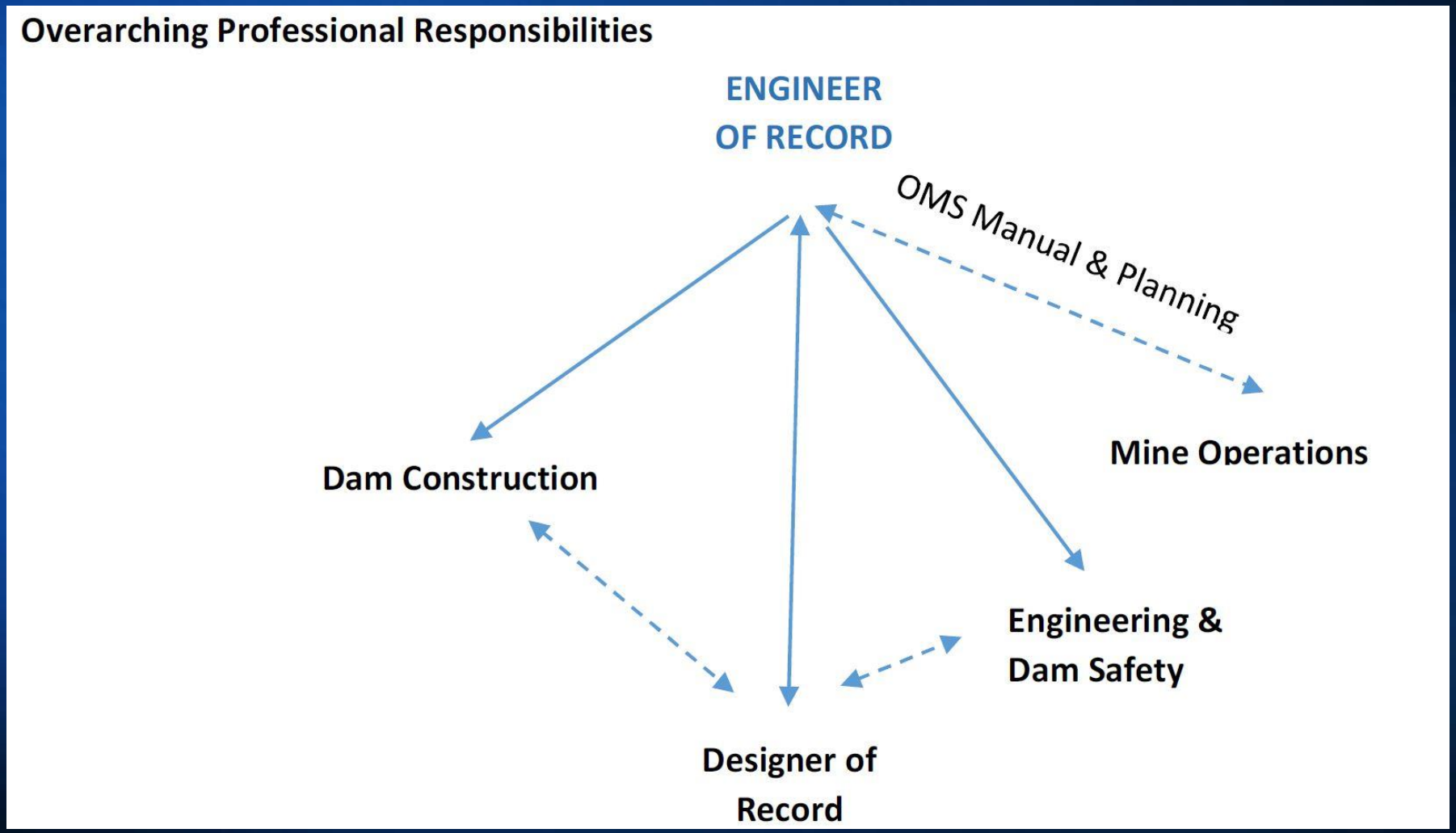
- Aug 4, 2014: Mount Polley Tailings Breach in neighbouring BC, Canada
  - Independent Expert Panel makes substantial recommendations regarding changes to the industry: **"business-as-usual" cannot continue**
- Significant changes are made to local regulations and industry guidelines
  - BC Government
  - Canadian Dam Association (CDA)
  - Mining Association of Canada (MAC)
  - The Alberta Chamber of Resources Dam Integrity Advisory Committee (AB DIAC) is formed

Photo courtesy Macleans

Alberta Chamber of Resources
Dam Integrity Advisory Committee (AB DIAC)

- Nov 9 & 10, 2014. Plenary workshop in Calgary
- Four working groups formed
- Primary focus of Working Group 1 is:
  - Engineer of Record
    - Definitions
    - Roles and responsibilities
- Collaboration and cross-pollination with other working groups in CDA, MAC, GBA
- Among many actions, an important role is agreed in Alberta – to provide industry support to government and regulator
- Work is ongoing

EOR – Clarification of Roles



Objectives
- in defining engineering roles

- To provide for clear, continuous and holistic accountability for the safe design, construction, operation and performance of a dam
- To provide example definitions for the Dam Safety Engineer/Manager, Engineer of Record, and Designer of Record
- To ensure clarity on the responsibilities, while allowing for flexibility in discharging these responsibilities

- Notes:
  - One person may be responsible for multiple dams
  - Frequent turnover of staff in key dam safety roles introduces risk - individuals to retain role for a minimum of 5 years, to provide continuity and retention of history and experience

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Dam Safety Engineer/Manager (DSE/M)

- Retains overall accountability to coordinate the responsibilities of the departments, engineering disciplines and individuals with roles that may directly or indirectly affect the safe function of the dam, avoiding gaps between accountabilities
- Ensures that the risks from all hazards that could affect the safety of the dam are appropriately managed
- Sets company policy to ensure all dam safety regulatory requirements are fulfilled
- Ensures that qualified people undertake all dam safety work
- Implements and manages an Independent Review Board (IRB)
- Should be an employee of the dam owner
- May be registered professional engineer, but could also be a non engineering manager (not a consensus view on this item)

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Engineer of Record (EOR)

- Revised CDA definition (not yet published):

"The Engineer of Record is defined as the professional engineer responsible for assuring that the dam is safe, in that it is designed and constructed in accordance with the current state of practice and applicable regulations, statutes, guidelines, codes, and standards."

- The EOR is the engineer with primary accountability for the safe construction, operation and performance of a dam
- The EOR must be a registered professional engineer in Alberta
- The EOR should have a relevant engineering degree and have a minimum of 10 years of experience in the design, construction, performance evaluation and/or operation of dams
- The EOR and DOR may be employed by the owner or by a consultant
- EOR retains qualified third-party engineers to undertake Dam Safety Reviews (DSRs) at the required intervals, and addressing any deficiencies that are identified in the DSR

Engineer of Record – Accountability

- Ensuring that the structure is constructed and operated in accordance with the design requirements, regulatory requirements, industry standards, and Company Quality Management System (QMS), and evaluating and approving or rejecting any deviations from the design
- Verifying that the structure performance is in accordance with the design expectations and safety standards, and implementing any mitigation or remediation that is required to maintain the safety and function of the structure
- Preparing and submitting all necessary documentation and performance reporting, including:
  - Annual Construction and Performance Reports
  - Operations, Maintenance and Surveillance Manuals (OMS)
  - Emergency Preparedness and Response Plans (EPP and ERP)
  - Flood inundation studies
  - As-built reports and drawings

Engineer of Record – Authority

- An important principle is that accountability and authority must go together
- Definitions of the role and responsibility of the EOR should not give the EOR final responsibility for the safety of the dam without having the authority to order and direct the work required to ensure the safety of the dam

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Designer of Record (DOR)

- The Designer of Record (DOR) is the engineer with primary accountability for the integrity and completeness of the dam design, which is compliant with the regulatory requirements, industry standards, and the corporate QMS
- The DOR must be a registered professional engineer in Alberta
- The DOR should have a relevant engineering degree and have a minimum of 10 years of experience in the design, construction, performance evaluation and/or operation of dams
- The DOR may be employed by the owner or by a consultant

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Designer of Record – Accountability

- Characterizing the site conditions, including performing or designing foundation investigations, fill characterization, laboratory testing and selection of design parameters
- Preparing the design documents, drawings and records
- Preparing the instrumentation plans and performance monitoring requirements
- Preparing the construction drawings
- Supporting the EOR to verify that the structure performance is in accordance with the design expectations and designing any mitigation or remediation that is required to maintain the safety and function of the structure

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EOR – Individual or Company? Internal or External?

- MAC guide to Management of Tailings Facilities does not specifically define whether EOR should or should not be an individual or a company
- EOR typically ensures the design and operational guidelines for the tailings facility are consistent with the policy and commitment for the individual TSF
- It is essential that there be clarity at each site as to the roles, responsibilities and authority between these individuals, and these should be defined in the OMS manual
- For "Syncrude Oil Sand tailings dams (this may be similar to other Oil Sand companies), the EOR is considered to be an individual, internal to the company and on-site. Not only is the EOR involved with the design, but also in the construction and operation of the dam. This gives the individual first hand knowledge of the operational challenges and construction history of the dam. Since the EOR is on site, frequent inspections are done and most importantly, can readily inspect the facility after significant storm events." – Provided by Wayne Mimura, Syncrude

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Alberta Dam Safety

- CDA – The Canadian Dam Association – group of dam owners, operators, regulators, engineers and others who share the goal of advancing knowledge and practices related to dams
- AER – Alberta Energy Regulator – responsible for enforcement of dam safety and regulatory compliance for Oil Sands mining
- AEP – Alberta Environment and Parks – responsible for updating Alberta dam safety regulations
- DIAC – Dam Integrity Advisory Committee – mandated by the Alberta Chamber of Resources to consider current and emerging issues related to the responsible operation of resource sector dams in Alberta

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AER – Dam Safety Inspections

- Dam Safety is a new program for AER with first inspections performed in 2015, in response to the Auditor General's report on the province's dam safety program
- By June 30, 2018 all dam owners are required to complete dam safety submissions (ACPR's, DSR's, OMS', and EPP's (extreme and very high consequence dam owners are submitting according to the new requirements by June 30, 2017)
- AER engineers risk assessed all dams in the energy portfolio in April 2016 by assuming poor or very poor conditions for dams with data gaps

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AER – Dam Safety Inspections

- To assess energy dams every 5 years. Where data gaps exist, the risk assessment will be repeated in 2018
- AER will audit specified (Annual Surveillance Plan) dam owner Dam Safety Management Systems (DSMS's) every year to ensure the owner programs are appropriate (fit for purpose) for dam safety. AER provides audit results and advice to each dam owner
- The risk assessment considers inputs from industry self-assessments, AER engineers' assessments, inspection, desk top reviews and audits of DSMS's. These inputs are captured in the horizontal axis 'Performance' numerically and judgementally. So the result is a measure of the risk associated with individual dams, dam owner DSMS's, and sorted vertically by consequence class

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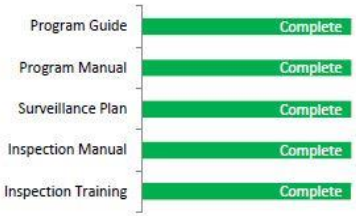
DAM SAFETY PROGRAM SNAPSHOT
OCTOBER 2016 FOR DIAC MTG NOV 8

Goals & Measures

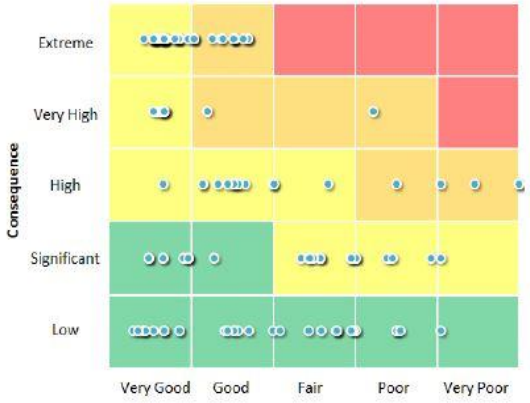
- Establish Risked based surveillance plan for each mining program
- Develop a registry of all ponds, dams and impoundments.
- Develop and employ a risk ranking tool to assign a risk rating to a dam
- Each dam is assigned to a qualified engineer or inspector who will receive dam safety specific training.
- Publish internal and external reports on the dam safety program.
- Develop a dam safety program guide, program manual, inspection manual and training program.

Dam Risk Registry

Program Documents



Overall Risk Profile

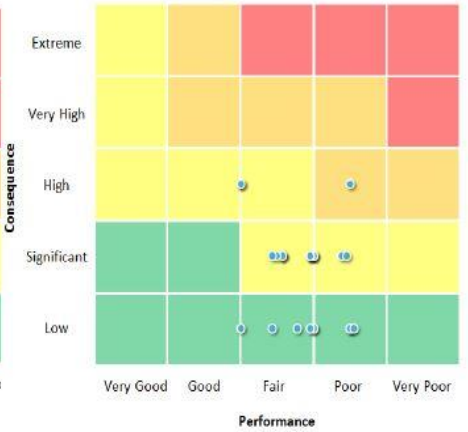


Risk data is from April 2016. There are significant data gaps for coal, and oil and gas.

Where there are data gaps AER assumes condition are poor, or worse.

Oilsands

Oil & Gas



Coal

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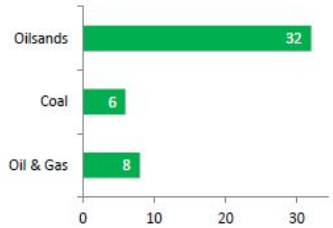
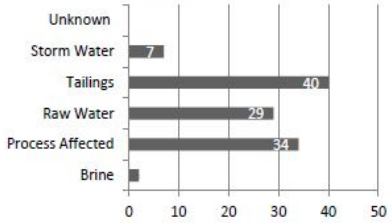
DAM SAFETY – OCTOBER RESULTS

#Ponds

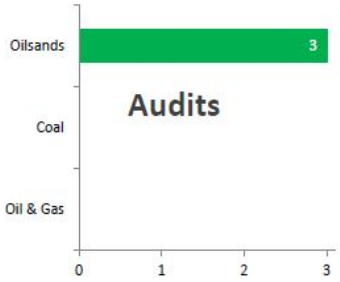
Inspections



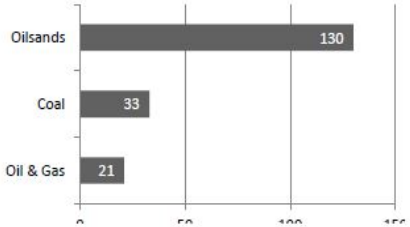
#Pond Types



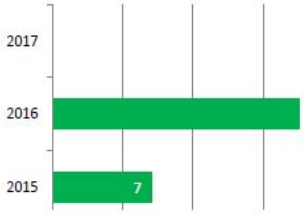
Audits



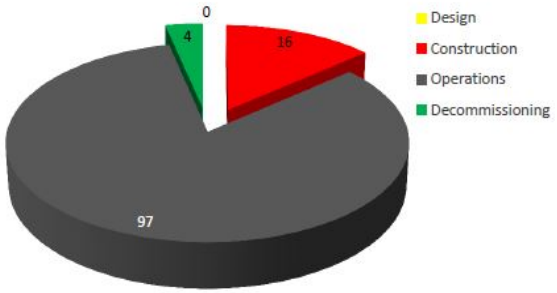
#Dams



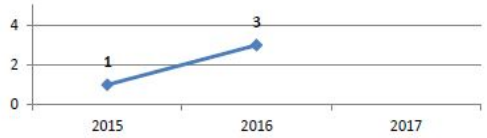
Trained Inspectors



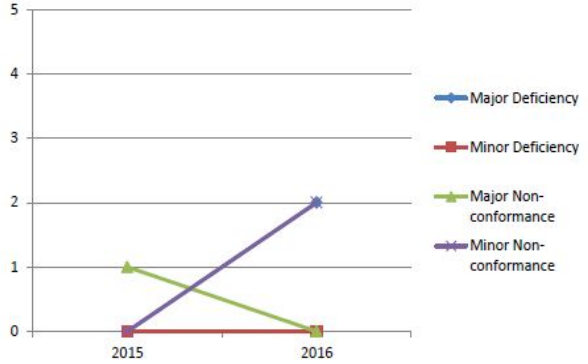
Life Cycle Phases (ponds)



of Non-Compliances



Deficiencies & Non Conformance



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International Council on Mining and Metals (ICMM)

- 23 of the world's largest mining and metals companies
- Recognised the significant role of mine tailings in mining risk
- After Samarco (and Mount Polley), ICMM’s members unanimously agreed to a commitment to leadership in environmental and safety performance within the industry
- A global review of TSF standards, guidelines and risk controls

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Photo by: Ricardo Moraes

CDA defined responsibilities for Dam Owners

- The “Dam Owner” is the person or legal entity, including a company, organization, government department, public utility, or corporation that is responsible for the safety of the dam.
- This person or legal entity may hold:
  i. A government license or lease to operate the dam
  ii. The legal title to the dam site, the dam, and/or the reservoir, or
  iii. Both
- The Owner is ultimately responsible for the safety of the dam

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CDA: Dam Owner - Responsibilities

- Understanding the risks created by the dam
- Developing policies, plans and procedures necessary for complying with the requirements of the applicable dam safety statutes, regulations and good practice
- Providing all resources necessary to design, construct, operate, maintain, repair and manage the dam
- Providing all resources necessary for decommissioning, closure, reclamation
- Hiring personnel qualified to coordinate, manage, operate and decommission or close the dam in a safe manner
- Hiring personnel qualified to design and steward the safety of the dam throughout its life phases, and supporting those roles effectively
- Hiring personnel and/or retaining construction contractors that are qualified to undertake construction, repairs, and modifications

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Dam Owner - Responsibilities

- Ensuring that satisfactory policies, provisions and succession plans are in place to maintain continuity of responsibilities and fulfillment of funding requirements
- Ensuring that the OMS Manual, and Emergency Response Plans are in place, and reviewed and updated regularly
- Ensuring that the OMS Manual includes clear definition of roles, responsibilities and authority of all key positions (Owner, Dam Safety Manager, EOR, Designer of Record and others)
- Overseeing and maintaining an effective dam safety surveillance program
- Maintaining historical records related to the dam, and ensuring that all relevant reports, files, knowledge are available to the EOR
- Communicating effectively with the EOR regarding potential changes to the dam, operations, maintenance, surveillance or instrumentation
- Developing and implementing training programs

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Acknowledgements

- Inputs from my colleagues at the Alberta Dam Integrity Advisory Committee, and from the global tailings industry
- High standards of dam safety demonstrated by the Alberta Oil Sands
- Material provided regarding dam safety inspections by the Alberta Energy Regulator
- Support and ideas from my colleagues at Thurber Engineering

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Some Useful Websites

- www.cda.ca (dam safety guidelines)
- www.acr-alberta.com/AboutACR/Committees/DamIntegrity/tabid/333/Default.aspx (Alberta Dam Integrity Advisory Committee)
- www.mining.ca (General guidance regarding tailings management)
- www.aep.alberta.ca (Responsible for updating AB dam safety regulations)
- www.aer.ca (Enforcement of dam safety and regulatory compliance for Oil Sands mining)

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Conclusion

"To date, all tailings containment structures in the Oil Sands industry have been managed in a safe manner and it is of interest to describe and understand the dam system that has arisen.

It is the view of the writer that the dam safety system applied to the Alberta Oil Sands industry is the best in the world."

Dr. N.R. Morgenstern, Vale, CO, T&MW 2010

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