

# **Mine Tailings Fundamentals: Current Technology and Practice for Mine Tailings Facilities Operations and Closure Part 2 – Mine Tailings Facility Reclamation and Closure**

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# Mine Tailings – Upstream, Centerline and Downstream Construction (Corrected)

EPA Tech Report Design and Evaluation of Tailings Dams  
incorrectly cites Vick

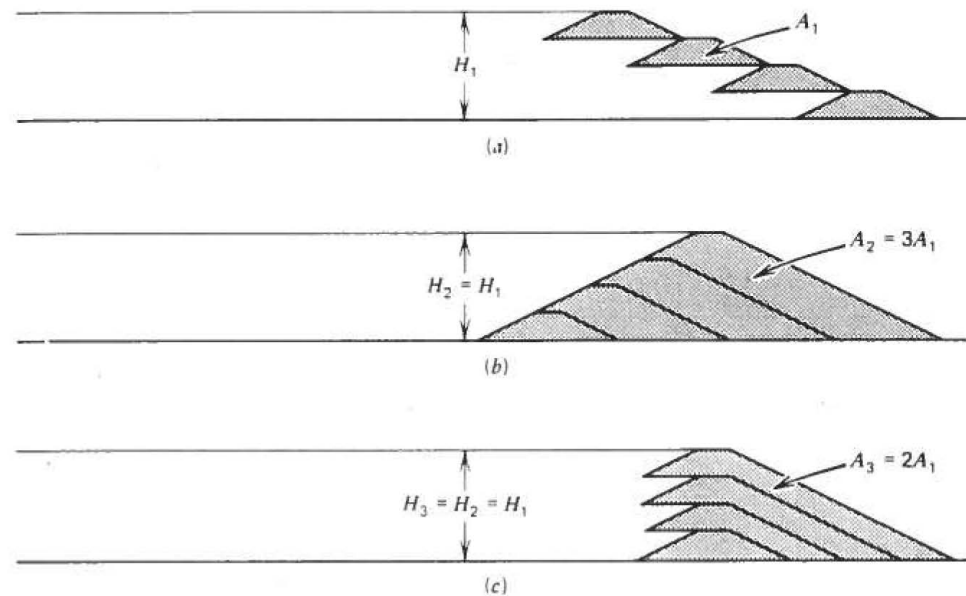


Figure 3.7 Comparison of fill volumes for various embankment types. (a) Upstream. (b) Downstream or water-retention type. (c) Centerline.

Vick, 1994, Planning, Design, and Analysis of Tailings Dams  
Mine Tailings Fundamentals: Part 1 EPA CLU-IN  
Webinar May 20, 2015

# Montana Metal Mine Reclamation Act Response to Mount Polley.

<http://leg.mt.gov/bills/2015/billpdf/SB0409.pdf>

AN ACT REVISING METAL MINE RECLAMATION LAWS; ESTABLISHING STANDARDS FOR TAILINGS STORAGE FACILITIES; ESTABLISHING A FEE; DEFINING TERMS; CREATING INDEPENDENT REVIEW PANELS; PROVIDING FOR REVIEWS AND INSPECTIONS; PROVIDING ENFORCEMENT; AMENDING SECTIONS 82-4-301, 82-4-303, 82-4-305, 82-4-335, 82-4-336, 82-4-337, AND 82-4-342, MCA; AND PROVIDING AN APPLICABILITY DATE.

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# What happens when tailings facilities are closed?

- Designing for Closure
- Decommissioning and Reclamation
- Drainage/draindown/long term seepage
- Settling
- Lined Impoundments
- Covers





# Mine Tailings – Designing for Closure

In planning for closure, there are four key objectives that must be considered:

1. protect public health and safety;
2. alleviate or eliminate environmental damage;
3. achieve a productive use of the land, or a return to its original condition or an acceptable alternative; and,
4. to the extent achievable, provide for sustainability of social and economic benefits resulting from mine development and operations.

*From Mine Closure, Infomine E-Book, Robertson and Shaw*

Design for closure requires that the full mine-life cycle, from development to closure, be considered in the design of the mine components so that the desired mine closure conditions are achieved. Design for closure should also consider the potential, practical, and financial implications of temporary halting of operations or of early closure of the mine.

*From GARD Guide*

# Mine Tailings – Designing for Closure

It is convenient to consider potential impacts in four groupings:

1. Physical stability - buildings, structures, workings, pit slopes, underground openings etc. must be stable and not move so as to eliminate any hazard to the public health and safety or material erosion to the terrestrial or aquatic receiving environment at concentrations that are harmful. Engineered structures must not deteriorate and fail.
2. Geochemical stability - minerals, metals and 'other' contaminants must be stable, that is, must not leach and/or migrate into the receiving environment at concentrations that are harmful. Weathering oxidation and leaching processes must not transport contaminants, in excessive concentrations, into the environment. Surface waters and groundwater must be protected against adverse environmental impacts resulting from mining and processing activities.
3. Land use - the closed mine site should be rehabilitated to pre-mining conditions or conditions that are compatible with the surrounding lands or achieves an agreed alternative productive land use. Generally the former requires the land to be aesthetically similar to the surroundings and capable of supporting a self-sustaining ecosystem typical of the area.
4. Sustainable development - elements of mine development that contribute to (impact) the sustainability of social and economic benefit, post mining, should be maintained and transferred to succeeding custodians.



# Mine Tailings – Decommissioning and Reclamation

Application of Dam Safety Guidelines to Mining Dams (CDA 2014)

“Closure is the process of establishing a configuration for the dam with the objective of achieving long-term physical, chemical, ecological and social stability and a sustainable, environmentally appropriate after use. This configuration can be achieved during or after mine operations.”

CDA Identifies Three Main Phases of Mine Tailings Facility Closure

1. Transition
2. Closure - Active Care, and
3. Closure - Passive Care

# Mine Tailings – Decommissioning and Reclamation

## Phases of Mine Tailings Facility Closure

### 1. Transition

- Commences when facility has reached capacity and ceases to be operated or when the mine or processing operation is terminated permanently.
- Activities are undertaken during this period to prepare the facility for Closure - Active Care or Closure- Passive Care.
  - Breaching dam
  - Modifying the dam, spillway and discharge structures to accommodate water covers and treatment
  - Modifying the dam, spillway and discharge structures to remove and not allow a pond to remain on surface while passing storm events.
  - Installation of reclamation covers

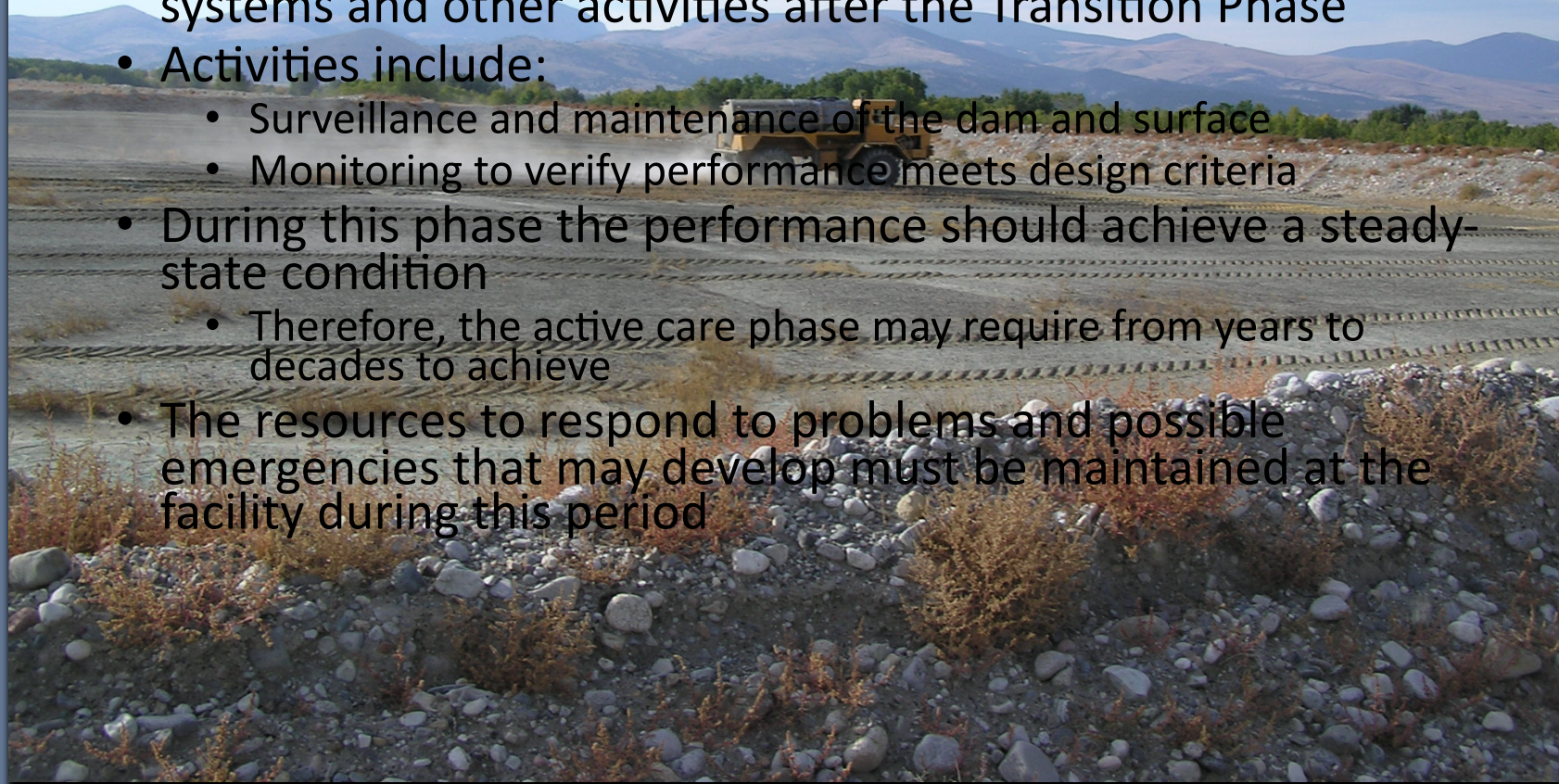


# Mine Tailings – Decommissioning and Reclamation

## Phases of Mine Tailings Facility Closure

### 2. Closure - Active Care

- Involves active care of a facility, including monitoring, inspection, water management, operation of water treatment systems and other activities after the Transition Phase
- Activities include:
  - Surveillance and maintenance of the dam and surface
  - Monitoring to verify performance meets design criteria
- During this phase the performance should achieve a steady-state condition
  - Therefore, the active care phase may require from years to decades to achieve
- The resources to respond to problems and possible emergencies that may develop must be maintained at the facility during this period





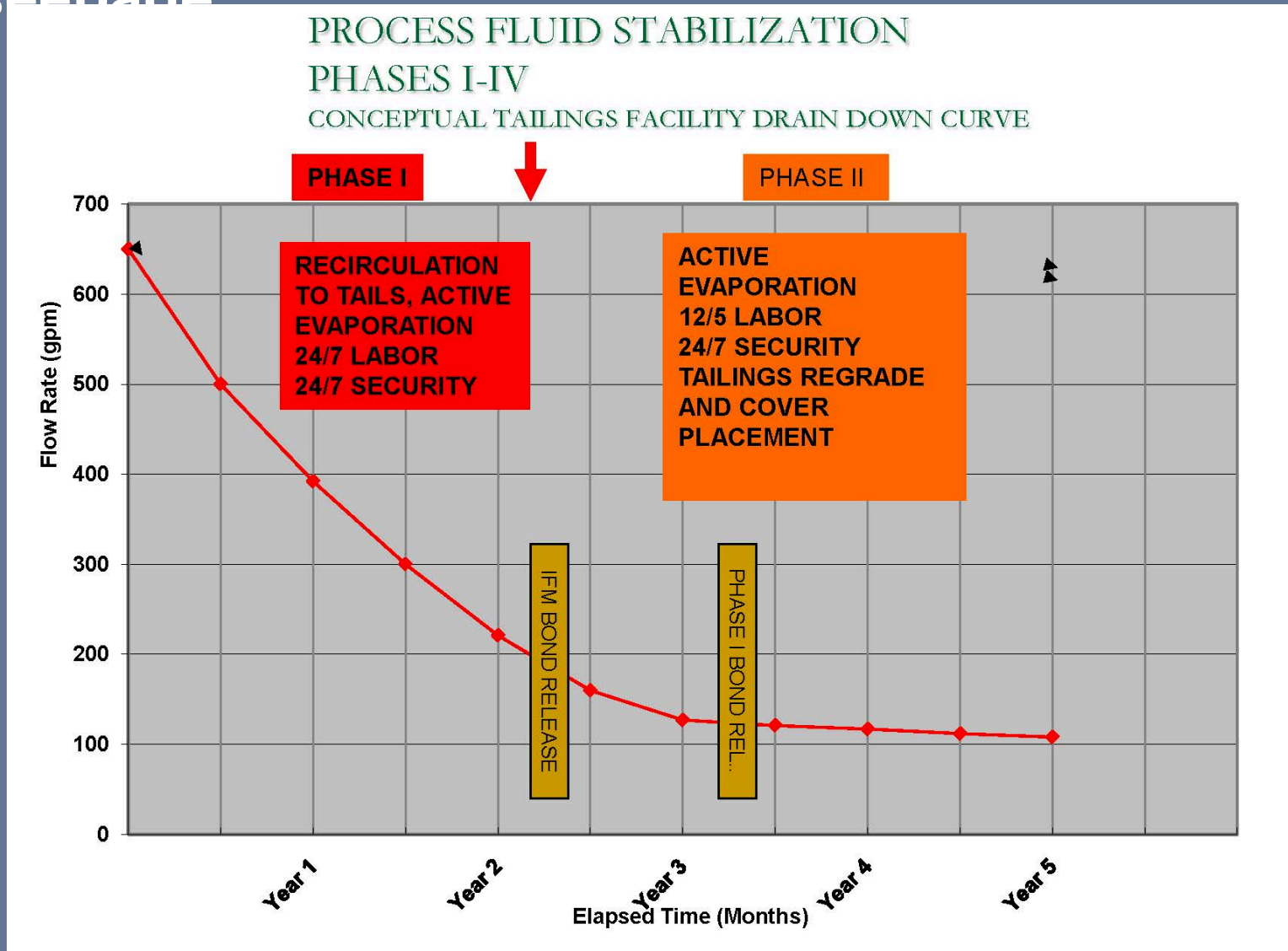
# Mine Tailings – Decommissioning and Reclamation

## Phases of Mine Tailings Facility Closure

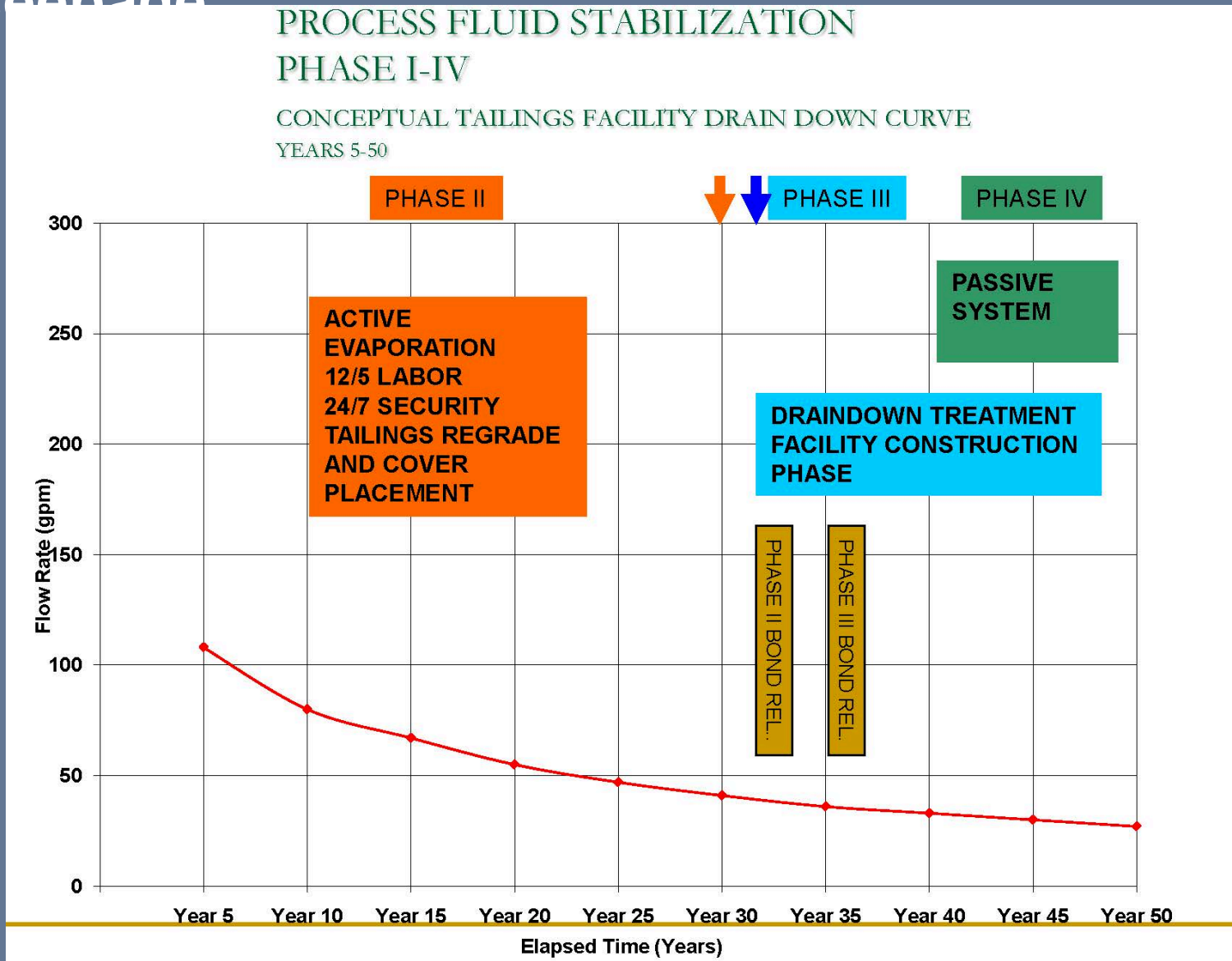
### 3. Closure-Passive Care

- No active operation of the mining dam and no changes to the mining dam are expected to occur.
- Steady-state condition has been demonstrated and sufficient experience gained together with monitoring to demonstrate that no further intervention is required.
- Passive Care phase still requires some level of inspection, dam safety reviews, and emergency response. Passive Care is not walk away.
- If events require a facility thought to be in passive care to undergo significant modification (e.g. toe berm construction) then it returns to the transition phase.

# What happens when tailings facilities are closed? Drainage/draindown/long term seepage



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# What happens when tailings facilities are closed?

## Settling/Settlement

- Settling describes the process of consolidation which relates to the rate of pore water pressure dissipation under constant load
- Important implications for static and dynamic stability and seepage
- As excess pore water is dissipated, the soil matrix (tailings) becomes denser, the void ratio (volume of voids to volume solids) becomes smaller, resulting in changes in the surface
  - Cracking
  - Differential Settlement
- Wick drains are commonly used to dissipate excess pore water pressure speeding rate of consolidation

# What happens when tailings facilities are closed?

## Lined Impoundments

- Often seen as best practice however:
  - Liners leak
  - Liners will fail as compared to geomorphic time
  - Liners have the potential to contain water and contribute to potential instability particularly over the long-term
  - The presence of a liner in most cases incorporates a long-term commitment to surveillance and maintenance
  - The use of liners should be avoided – if liners are necessary a preferred option is dry tailings





**QUESTIONS? COMMENTS?**