

RECLAMATION

Managing Water in the West

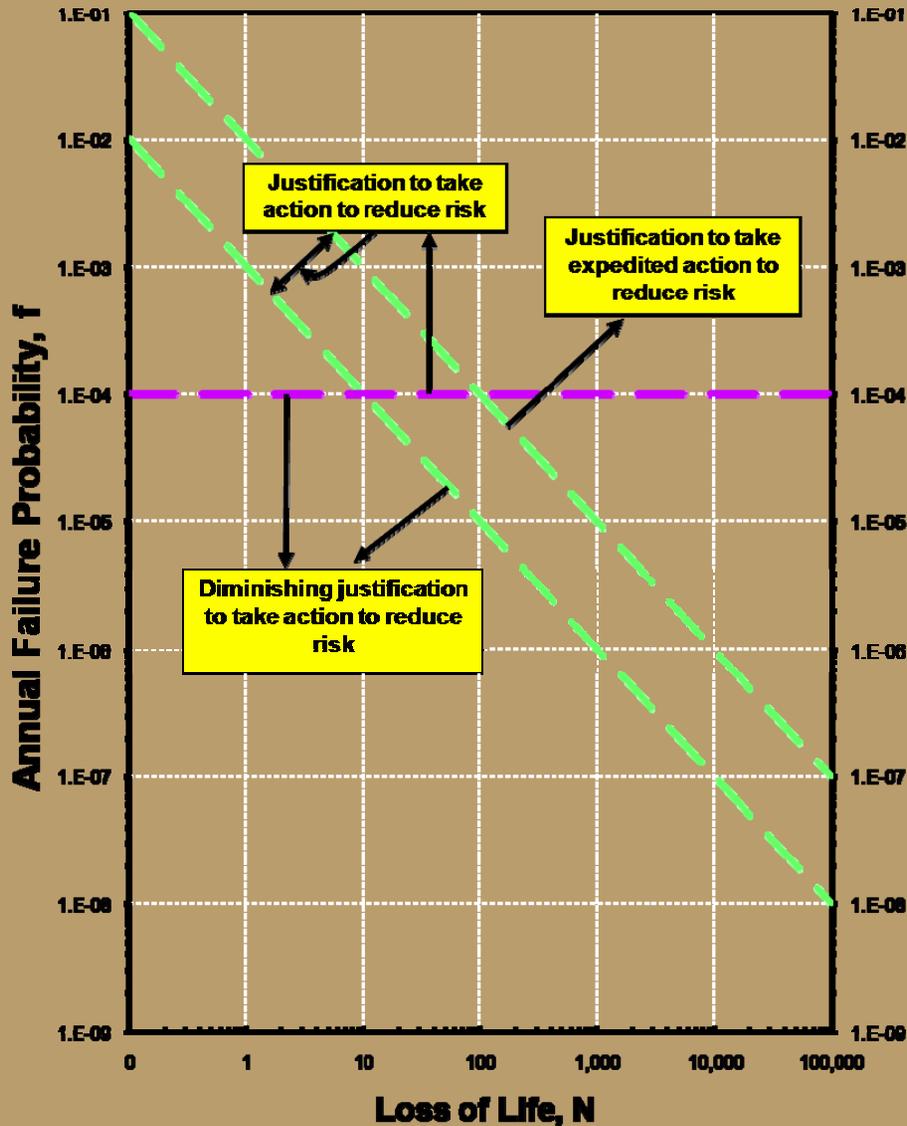
**Using risk to inform decisions,
prioritize resources, and measure
performance for water resources
facilities at the Bureau of
Reclamation**

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U.S. Department of the Interior
Bureau of Reclamation

Public Protection Guidelines



GUIDELINES FOR ACHIEVING PUBLIC PROTECTION IN DAM SAFETY DECISIONMAKING



UNITED STATES DEPARTMENT OF THE INTERIOR
Bureau of Reclamation
Denver, Colorado

June 15, 2003

(Replaces Interim Guidelines dated April 4, 1997)

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Reclamation Safety of Dams Act

“ In order to preserve the structural safety of Bureau of Reclamation dams and related facilities, the Secretary of the Interior is authorized to perform such modifications as he determines to be **reasonably required.** “

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Missions

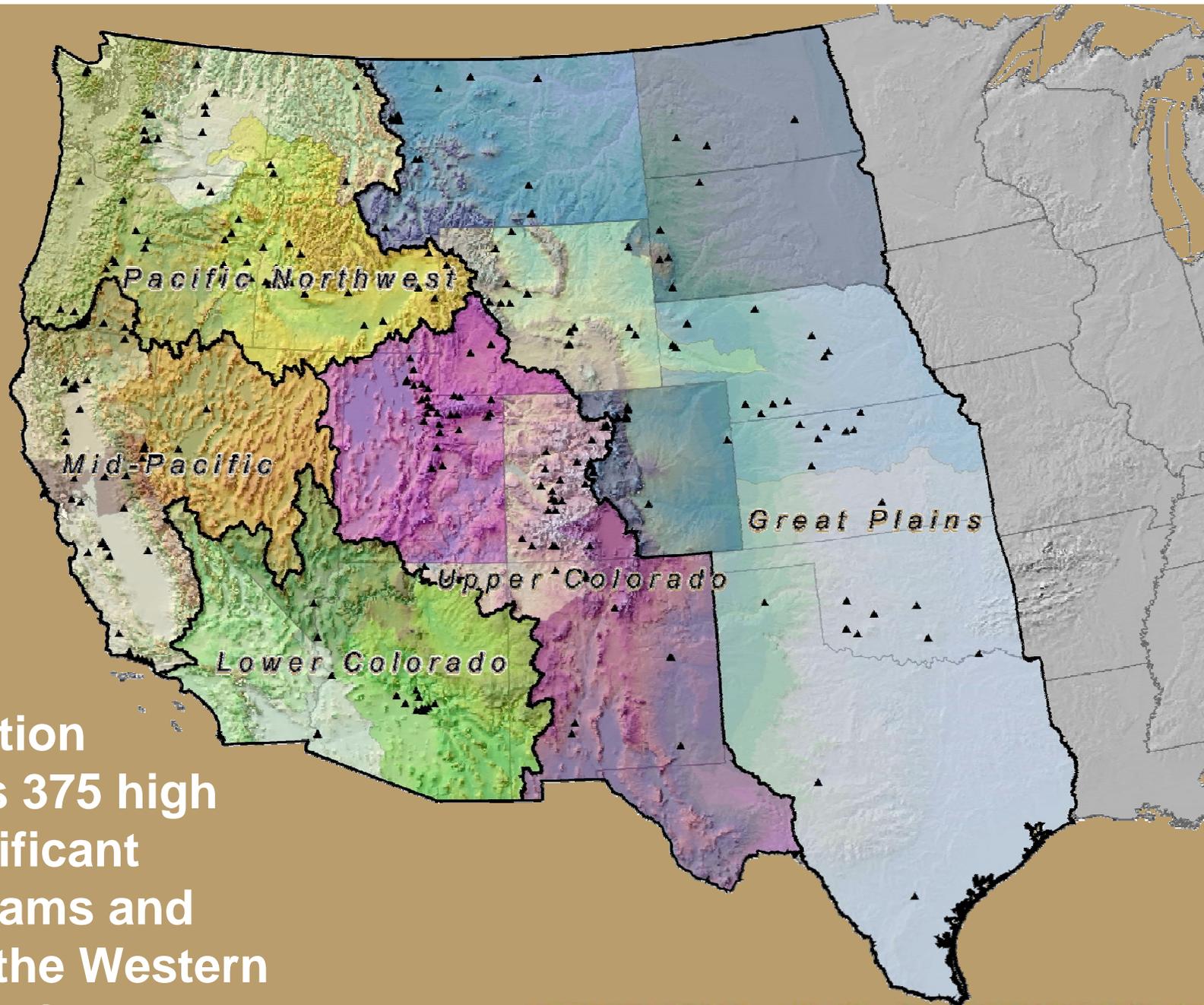
Reclamation's Mission

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American Public. Reclamation is responsible for **reliably delivering water and power** to its stakeholders.

Dam Safety's Mission

The mission of Reclamation's Dam Safety Program is "To ensure that Reclamation facilities do not present **unreasonable risks to the public**, public safety, property, and/or the environment."

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Reclamation
manages 375 high
and significant
hazard dams and
dikes in the Western
17 United States

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From the Public Protection Guidelines...

“This document addresses the incorporation of risk evaluation measures into the Dam Safety decision making process. One key aspect of water resources decision making is that the process almost always requires the evaluation of **multiple objectives** such as national economic development benefits which can be derived from additional capital investment, public safety, resource protection, and consideration of social concerns.”

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Objectives

- **Primary**
 - Agency Mission: Deliver water and power
 - Public Safety Responsibility: Minimize risk
 - Responsible Government: Minimize cost
- **Others**
 - Maintain technical expertise
 - Minimize impacts on the environment
 - Maintain consistency
 - Meet ESA requirements

Dam Safety Program

- Each Dam and Dike is an asset
- Each Dam and Dike is also a potential liability
- Within the confines of its mission, Reclamation's Dam Safety Program strives to minimize the liability borne by the organization by supporting sound decision making and by reducing risks in the most economically efficient manner

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Risk Assessments

- **Comprehensive Facility Review**
 - Senior engineer develops failure modes and assessment of risk
 - If issues are identified then SOD recommendations are generated and tracked
- **Issue Evaluation**
 - Investigations and studies performed to further assess issues
 - Team level evaluation of risks
- **Corrective Action & Risk Reduction**
 - Studies conducted to determine most appropriate and efficient means of reducing risks
- **Risk Reduction Verification**
 - Studies to verify the effectiveness of risk reduction activities

Basis for Decision Making

- Decisions are made using the actual **risk estimate** and **the case** made to justify the risk estimate
- Technical Report for each assessment includes:
 - Factors that led to risk estimate
 - Discussion of the uncertainties
 - Strength and weaknesses of the estimate
- This information is used to “make the case” to an internal technical advisory panel and to the decision makers

Basis for Decision Making

- Intended to give decision makers adequate information to make an informed decision
- Every decision is documented and signed by all Decision Makers

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Organization

Regional Director



Area Manager

Dam Safety Office

Together, the “Triad” balances the safety, operation, and economics of each individual dam.

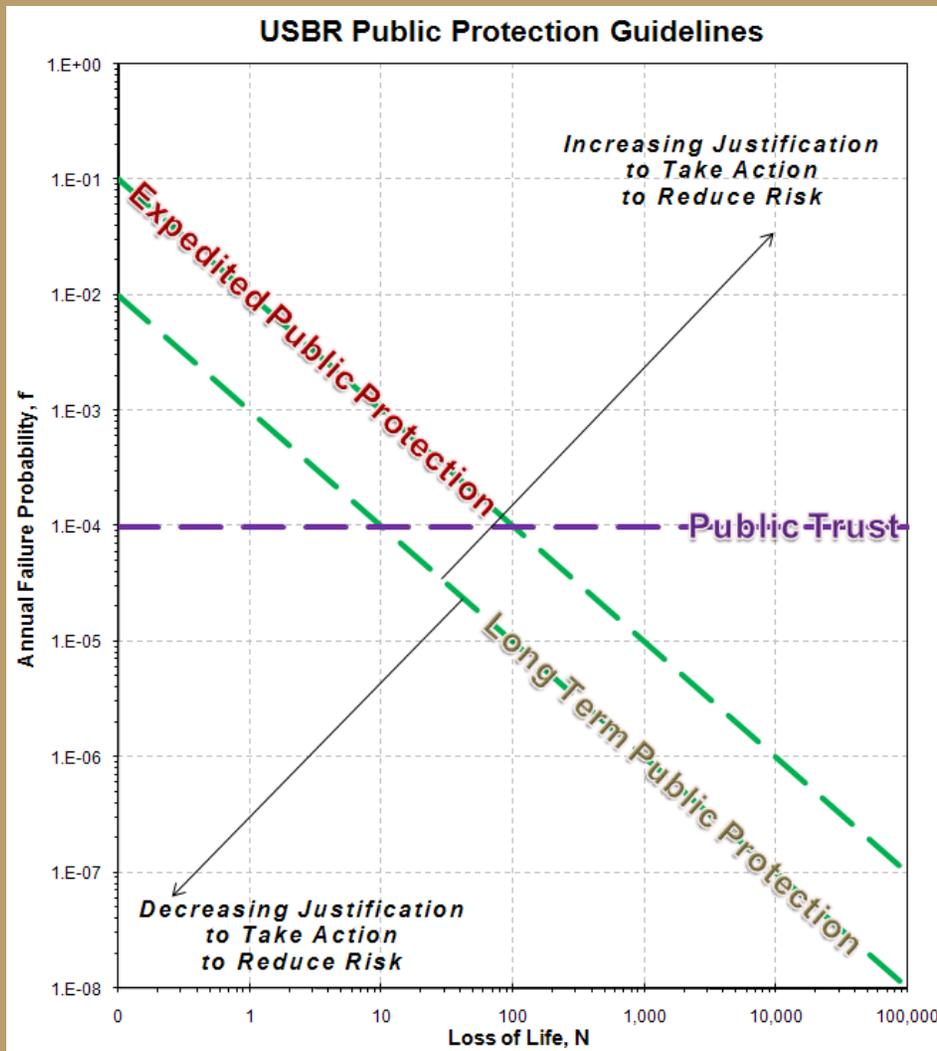
They are advised by a team of technical staff and operations staff.

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Public Protection Guidelines

- Establish risk-based framework for Dam Safety decision making
- Establishes framework for incorporating both subjective and objective information
- Provision for developing failure modes
- Multiple risk objectives
 - Societal Risk
 - Individual Risk
 - Probability of Failure
- Level of estimate

Risk Estimates Related to Tolerable Risks



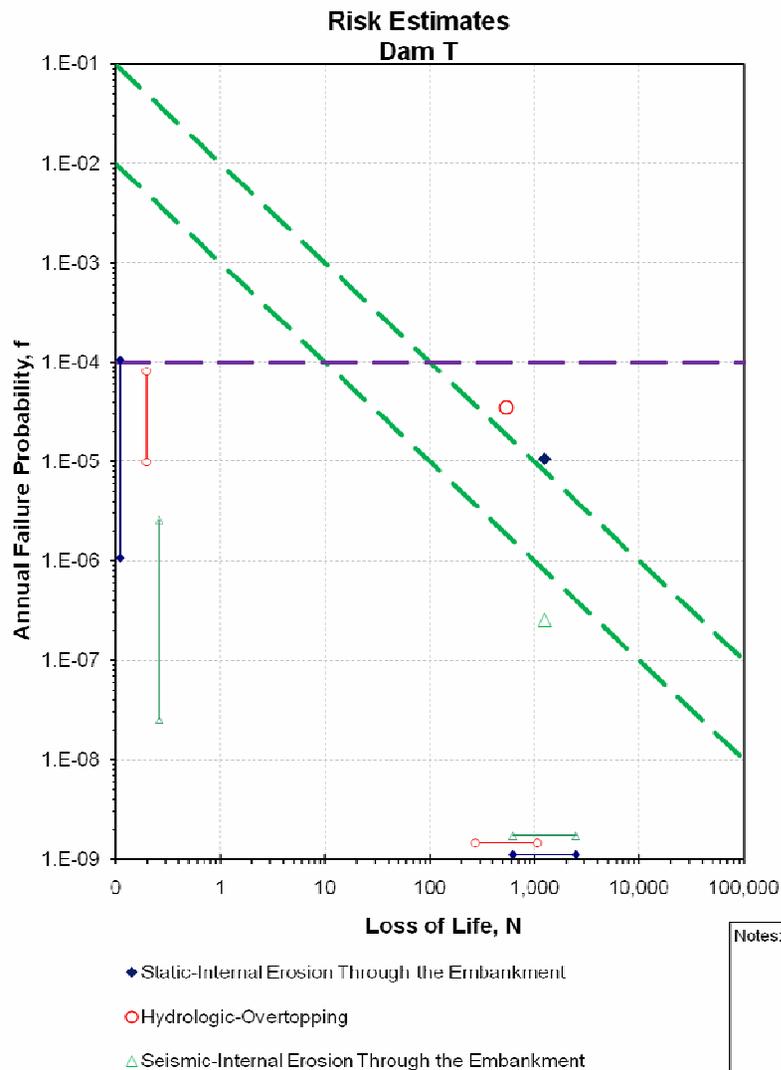
Reclamation uses these tolerable risk guidelines as goals for achieving public protection

Thresholds used to justify action to reduce risk:

- Expedited public protection
 - ALL mean estimate $> 1/100$
- Long-term public protection
 - ALL mean estimate $> 1/1,000$
- Public Trust
 - APF mean estimate $> 1/10,000$

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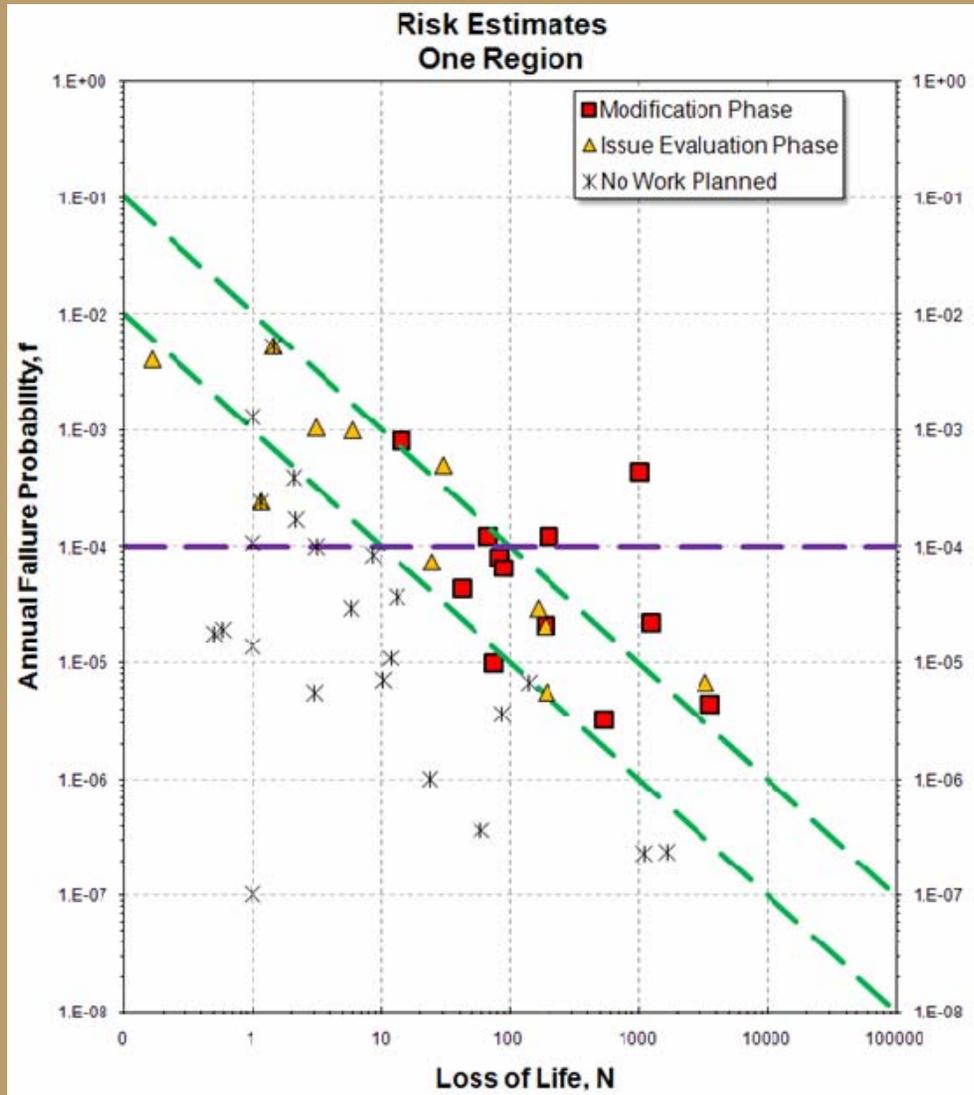
Decision Making



- The mean risk estimate for each failure mode is portrayed
- Decisions are primarily based on mean risk estimate for each failure mode as compared to our threshold values however,
- For individual failure modes, numerical risk estimates should be weighted equally with the “case” that has been made
- Uncertainty associated with each estimate is considered in the decision process

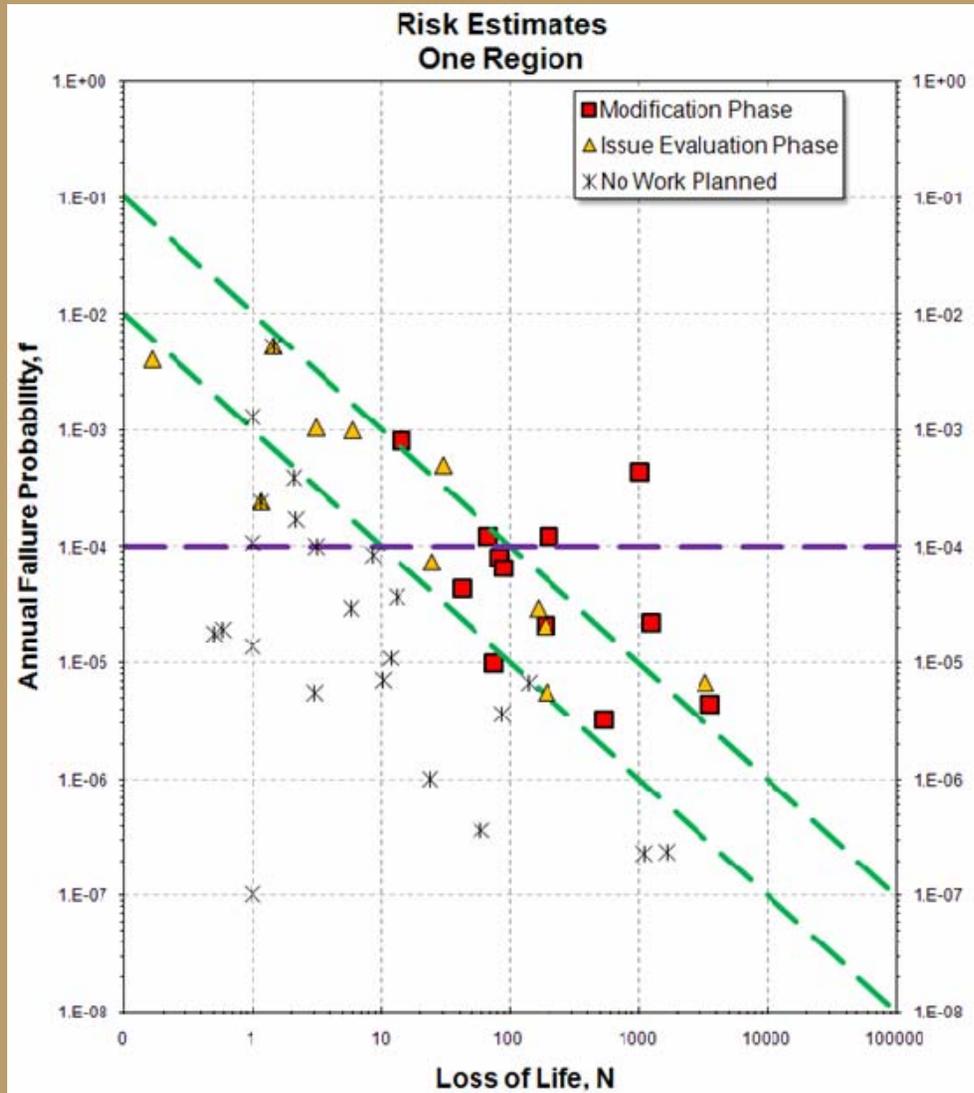
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Prioritization



- Studies are prioritized based on the sum of the mean estimates of ALL for a facility
- Entire inventory is prioritized
- Issue Evaluation & Modification Phases

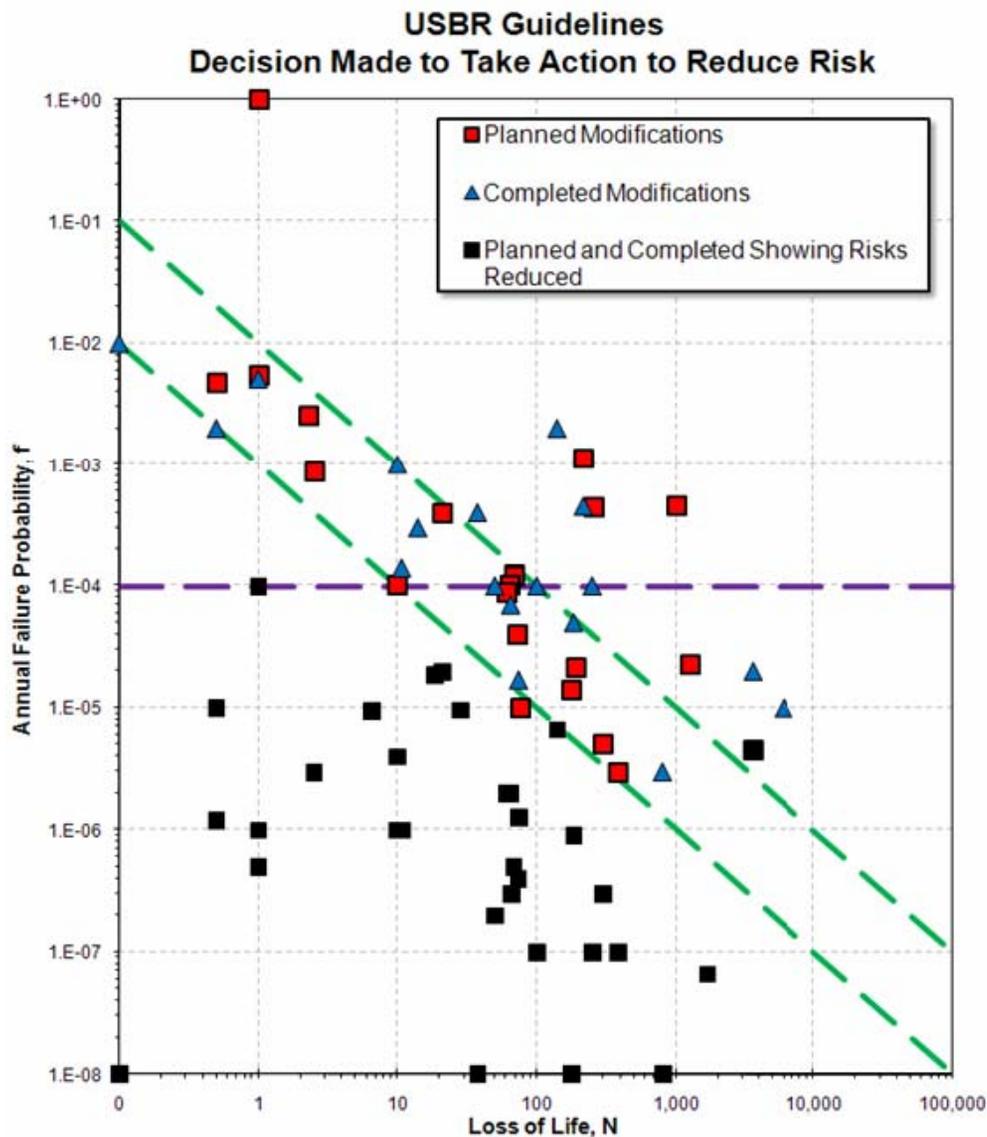
Prioritization



- Where risks hover near thresholds, high consequences are involved, or failure modes have large uncertainties, decisions are more difficult and require conscious attention
- As higher risks projects are identified some ongoing projects are delayed.

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Program Risk



- Decisions to reduce risk are prioritized based on the total risk
- Objective is to reduce risk to a tolerable level
- Target is to reduce ALL to below 1/10,000
- Planned Risk Reductions shown

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Decision Process

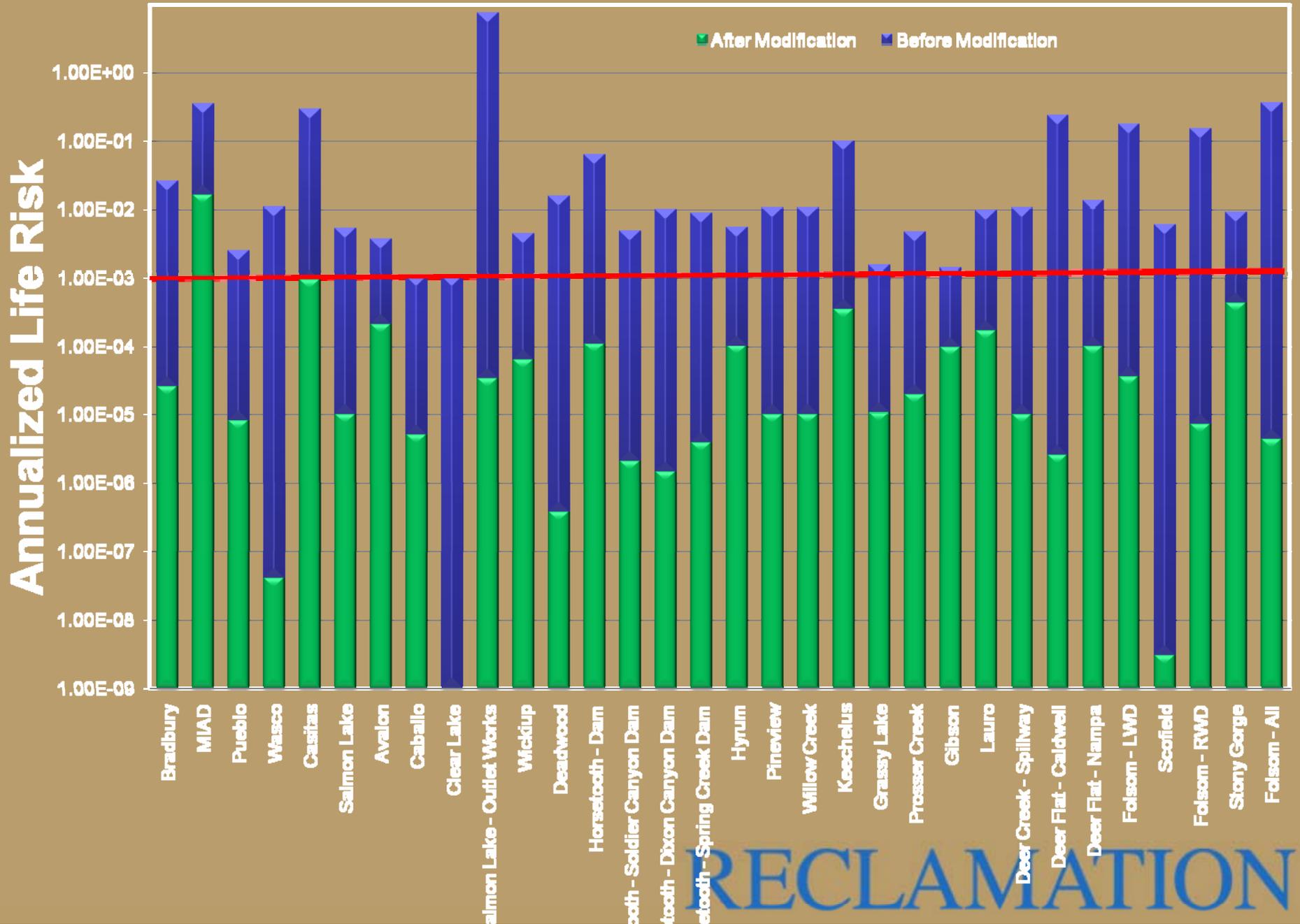
- Program prioritized based upon total risk to a structure
- Decisions made for each individual failure mode
 - Based primarily on annualized loss of life
 - Heavily considers annualized likelihood of failure
- Decisions recommended by technical team including a senior level review
- All factors used to make the decision are documented
- Decisions made by group of decision makers

Goals and Performance Measures

- 1. Reduce Average ALL over the entire portfolio by 5% per year**
 - Measures how effectively we reduce risk at high risk dams
- 2. Completion of Facility Reviews - 42 per year**
 - Measures ability to accomplish routine activities
- 3. Facility Reliability Rating**
 - Measures ability to operate the facilities reliably and in a manner that ensures the safety of each dam
- 4. Decisions documents completed in timely manner**
 - Measures ability to make decisions
- 5. Completions of SOD recommendations**
 - Measures effectiveness in addressing deficiencies

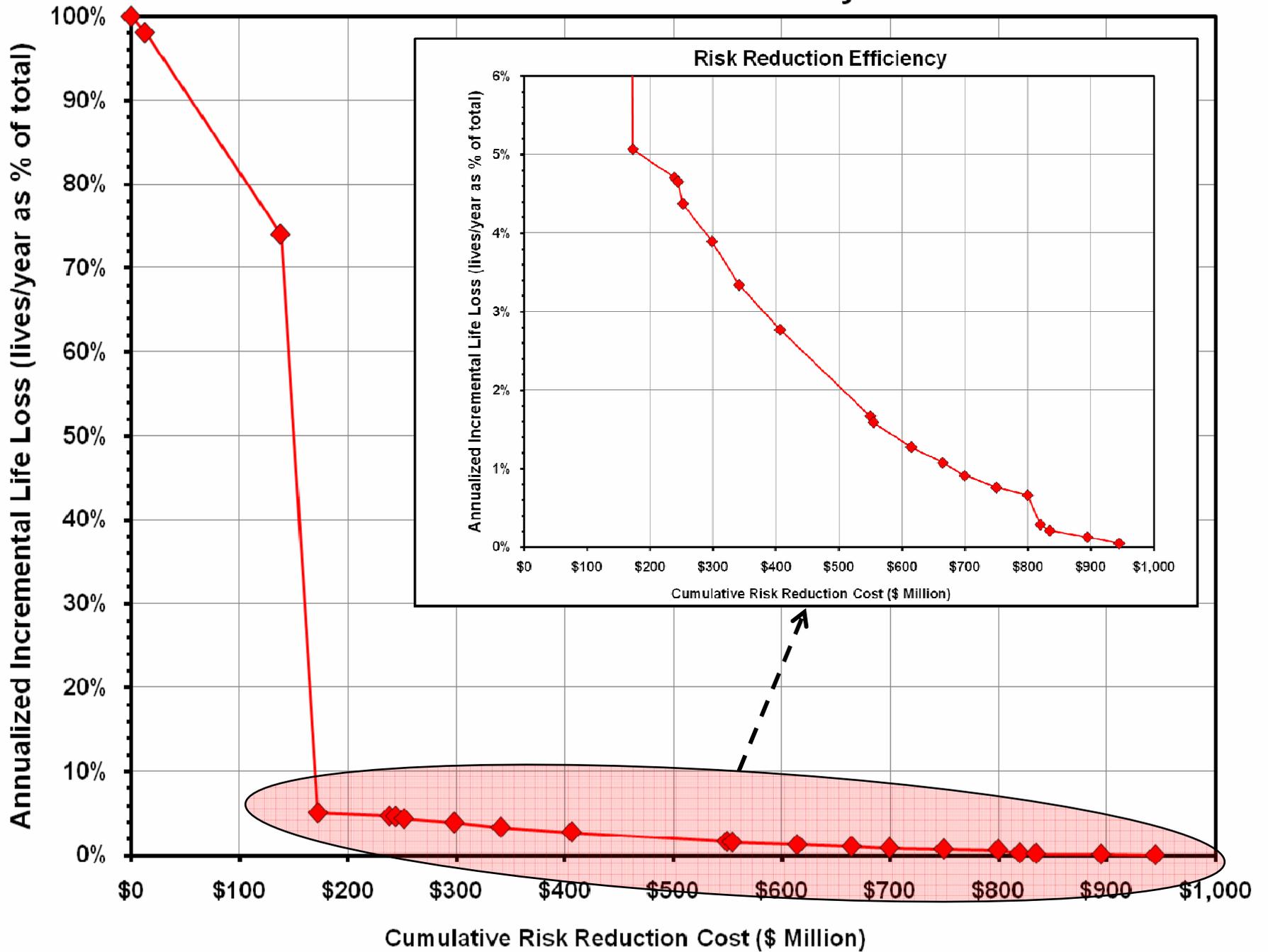
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Dam Safety Modifications 1996-2007



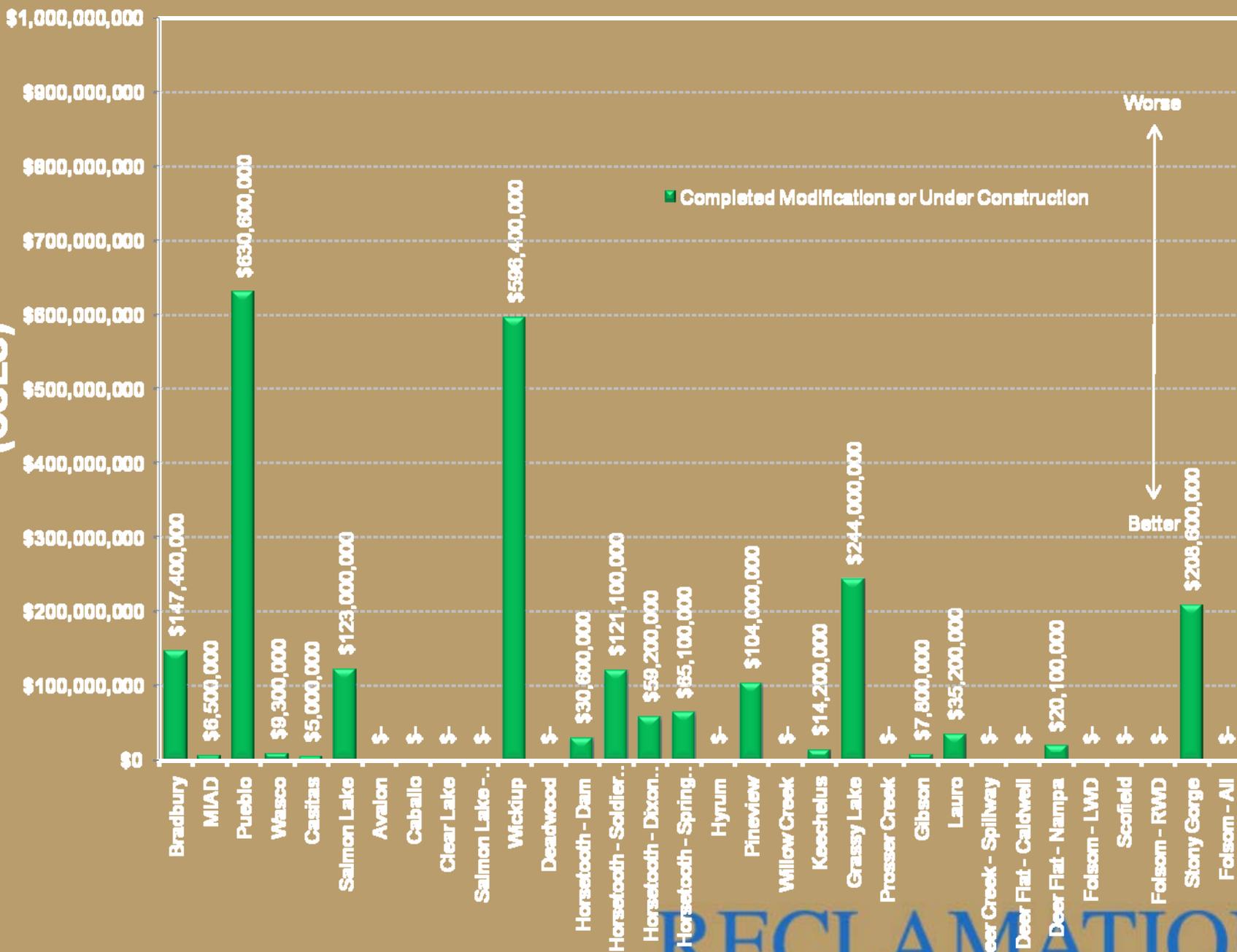
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Risk Reduction Efficiency



ACSLS USBR Dams

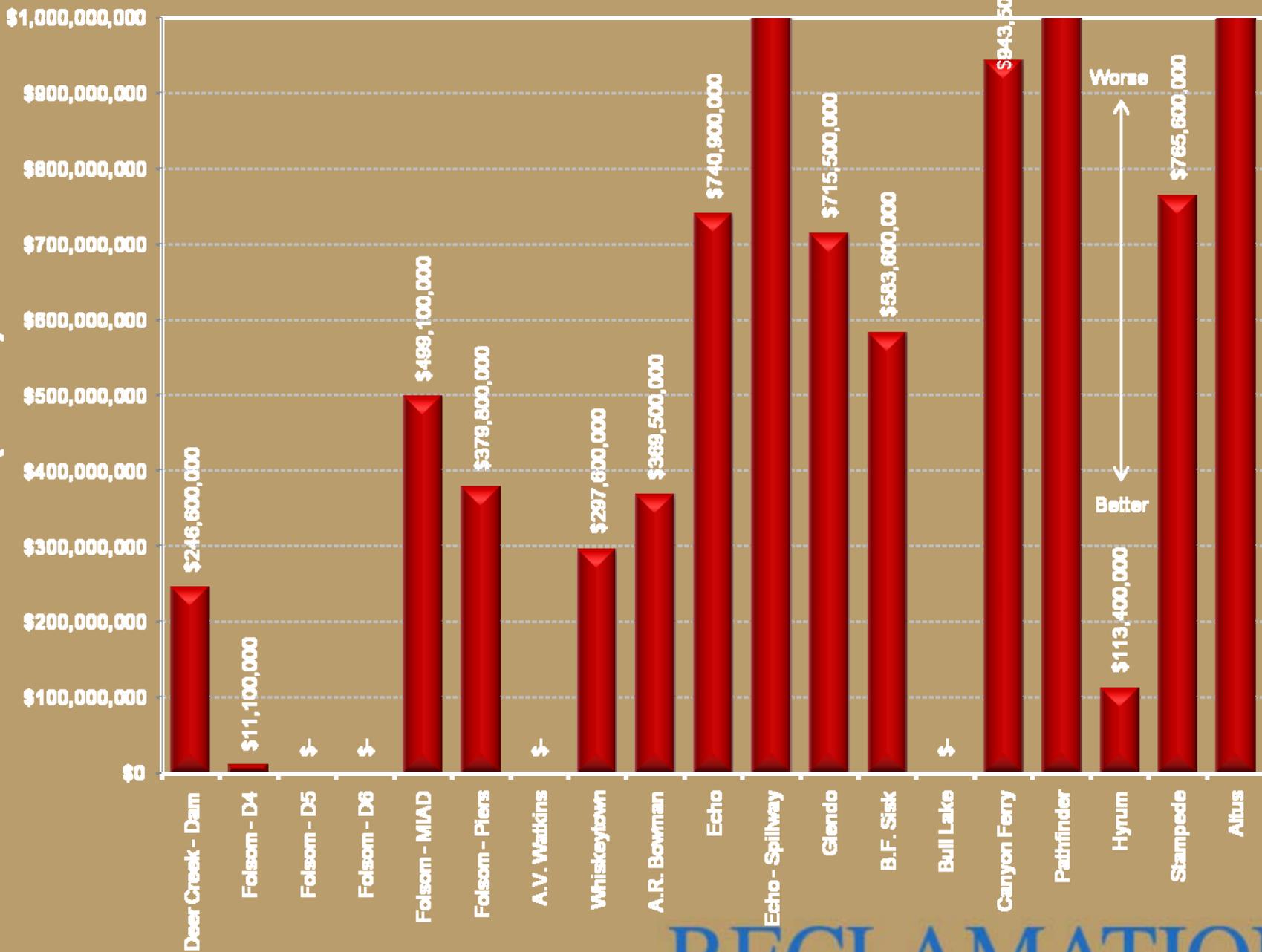
Adjusted Cost per Statistical Life Saved (CSLS)



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ACSLS USBR Dams

Adjusted Cost per Statistical Life Saved (CSLS)



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Risk-Informed Decisions

- **Limited funds**
 - Where can the funds be most efficiently expended to protect the population downstream of our facilities?
- **Understanding Uncertainty**
 - How much do we really know about a structure?
 - Will it affect our understanding about its health?

Closing Remarks

- Risk estimates focused on identified failure modes are more easily understood by decision makers, senior management, our customers and the public
- Risk is now the primary justification for prioritizing and pursuing work activities
- Lastly, risk is a convincing tool to explain why the dam safety program takes actions and how funds are being expended