The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation.

Prepared/Presented by Jesse Morrill-Winter, Nick Lutz, and Nick Applegate

9 January 2020
FRM-PCX – WE’RE HERE TO HELP!!!

...BUT WE NEED YOUR HELP TOO!

The Goal:

- Timely webinars on specific topics that can help you and your FRM study RIGHT NOW!
- Provide individual presentations/training to teams on specific topics relevant for your FRM study
- Provide individual support to teams to help work through specific FRM challenges

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The “so-what”: Life Safety Risk Assessments need to be scalable to an appropriate level of detail for relevant Planning decisions


The 1st FRM PCX Webinar on Incorporating Life Safety in FRM Planning (Aug ‘19) can be found here: https://planning.erdc.dren.mil/toolbox/resources.cfm?Id=0&WId=491&Option=Planning%20Webinars

The goal of this presentation is to answer the following questions:

- What are the critical items in the life safety policy that study teams need to know about?
- What is incremental risk why are the Tolerable Risk Guidelines (TRG’s) important?
- How does a life safety focused risk assessment differ from an economic focused analysis?
- When/how should teams incorporate a risk assessment into the planning process?
- What is the appropriate level of risk assessment and what are the options?
- Where can the team find assistance in conducting life safety studies?
• Purpose of Risk Assessment:
  • To understand all factors that drive the risk (Hazard, Performance, & Consequence).
  • Have sufficient level of detail to clearly understand the factors that are driving the risk.
  • Allows for proper structural/non-structural measures to be evaluated in the study.
FLOOD RISK FRAMEWORK

- Purpose of Risk Assessment:
  - To understand all factors that drive the risk (Hazard, Performance, & Consequence).
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  - Allows for proper structural/non-structural measures to be evaluated in the study.

RISK = f (HAZARD, PERFORMANCE, CONSEQUENCE)
RESIDUAL RISK VS. INCREMENTAL RISK VS. NON-BREACH RISK

Residual Risk (aka “Flood Risk”) – The risk at any point in time (incl. incremental and non-breach). There are no “targets” to meet for residual risk. Just try to do some good! Consider as other non-monetary benefits for formulation, evaluation and comparison.

Incremental Risk – Risk to the floodplain/downstream occupants that can be attributed to the presence of the levee or dam. Difference between Breach and non-breach risk. Have predetermined agency guidelines that any USACE structure should meet, known as the “Tolerable Risk Guidelines (TRGs).”

Non-breach Risk – The risk in the floodplain/downstream area even if the levee or dam functions as intended
The levee does the best overall good for reducing life safety residual risk (4 annual lives lost to 1 annual life lost, BUT…)
- The levee also introduces incremental risk that wasn’t present pre-project and we must assess this risk!
The levee does the best overall good for reducing life safety residual risk (4 annual lives lost to 1 annual life lost, BUT…

- The levee also introduces **incremental risk** that wasn’t present pre-project and we must assess this risk!

---

**EXAMPLE - RESIDUAL RISK VS. INCREMENTAL LIFE LOSS**

<table>
<thead>
<tr>
<th>Project Condition</th>
<th>Annualized Life Loss (Residual Risk)</th>
<th>Breach/Non-Perform Life Loss</th>
<th>Non-Breach Life Loss</th>
<th>Incremental Life Loss (Breach/Non-Perform minus Non-breach)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Levee (pre-project)</td>
<td>4</td>
<td>N/A</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>Bypass</td>
<td>2</td>
<td>N/A</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Levee</td>
<td>1</td>
<td>75</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
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</tr>
<tr>
<td>Bypass</td>
<td>2</td>
<td>N/A</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Levee</td>
<td>1</td>
<td>75</td>
<td>5</td>
<td>70</td>
</tr>
</tbody>
</table>
LIFE SAFETY POLICY - PB 2019-04 REVIEW

All studies:
- Identify potential risks to life safety in the problems, opportunities, and/or objectives, as appropriate, early in the study.

- Floodplain Management Plan
  - Encourage early development by Non-Fed partners
  - Should include Emergency Action Plan

- Level of detail in data collection and modeling efforts should be commensurate with the uncertainty, complexity of the problem and cost of addressing risks.

- Always consider the RESIDUAL RISK related to life safety.
LIFE SAFETY POLICY - PB 2019-04 REVIEW (CONT.)

Studies with existing and/or proposed Levee Systems and Dams:

- Must consider **incremental risk**

- Goal is to achieve all 4 TRG’s
  - PDT should include specific objectives regarding achieving TRG’s
  - One alternative must be identified that addresses TRG’s 1 and 4

- If new levees or dams are recommended, a life safety risk assessment on the TSP is required.

- Modifications to existing dams or levees require **coordination of the relevant senior oversight group (SOG)**

- Planning and Dam/Levee Safety must coordinate and communicate vertically and horizontally!
  - PDT must **engage the district Dam/Levee Safety Officer and Dam/Levee Safety Program Manager** throughout the study.

- A trained facilitator, **endorsed by the RMC**, will be assigned to lead the life safety risk assessment
LIFE SAFETY POLICY – ECB 2019-15 REVIEW

Studies with existing and/or proposed Levee Systems and Dams:

- BLUF: ECB 2019-15 guides us in risk-informed design of features/plans that we’ve formulated following Planning Policy (incl. PB 2019-04).

- Hold life safety paramount

- A technical lead should be assigned to each study (IAW ECB 2015-18)

- Use Risk Assessments to Guide Improved Design Decisions
  - Designs will consider, refine, and evaluate structural and nonstructural measures to manage overtopping resilience per ECB 2019-8

- Scale risk assessments to the magnitude of the decision

- Since the formal application of risk-informed design is a new requirement, the risk assessments must be scaled to fit within the constraints of current schedules and budgets
  - New start studies will need to fully scope and comply
<table>
<thead>
<tr>
<th>TRG</th>
<th>Description</th>
<th>Evaluation Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Understanding the Risk</td>
<td>Evaluation of Societal Life Risk, Evaluation of Individual Life Risk,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evaluation of Economic Risk, Evaluation of Environmental Risk</td>
</tr>
<tr>
<td>2</td>
<td>Building Risk Awareness</td>
<td>will be determined qualitatively</td>
</tr>
<tr>
<td>3</td>
<td>Fulfilling Daily Responsibilities</td>
<td>determined qualitatively</td>
</tr>
<tr>
<td>4</td>
<td>Actions to Reduce Risk</td>
<td>(1) Have appropriate actions been taken to reduce risks?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2) Could any action reasonably be taken that would reduce risks further?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3) What is the cost to reduce the risk and how much is the risk reduced?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4) Should action be evaluated in a detailed study?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5) Is there demonstrated progress towards implementing risk reduction measures?</td>
</tr>
</tbody>
</table>
F-N PLOTS

• f̅N
  • Not a cuss word
  • Not that complicated
  • It’s simply a illustrative diagram delineated by order of magnitude divisions that is used in quantitative risk assessments to indicate when incremental societal and individual risks may exceed established tolerable risk guidelines.
  • Easy!
F-N PLOTS

• But...why?
  • Mostly precedent and equity

Bureau of Reclamation (2011) “Rationale Used to Develop Reclamation’s Dam Safety Public Protection Guidelines.”
F-N PLOTS

- Demystifying the matrix
  - Y axis (on the left) is the annual chance of a bad thing
F-N PLOTS

- Demystifying the matrix
  - Y axis (on the left) is the annual chance of a bad thing
  - Notation, it’s just counting the zeros

<table>
<thead>
<tr>
<th>Scientific</th>
<th>Probability</th>
<th>Decimal</th>
<th>Recurrence</th>
</tr>
</thead>
<tbody>
<tr>
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<td>100%</td>
<td>1.00</td>
<td>1</td>
</tr>
<tr>
<td>1.00E-01</td>
<td>10%</td>
<td>0.1</td>
<td>10</td>
</tr>
<tr>
<td>1.00E-02</td>
<td>1%</td>
<td>0.01</td>
<td>100</td>
</tr>
<tr>
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<td>1.00E-04</td>
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<td>0.0001</td>
<td>10,000</td>
</tr>
<tr>
<td>1.00E-05</td>
<td>0.001%</td>
<td>0.00001</td>
<td>100,000</td>
</tr>
<tr>
<td>1.00E-06</td>
<td>0.0001%</td>
<td>0.000001</td>
<td>1,000,000</td>
</tr>
</tbody>
</table>
F-N PLOTS

- Demystifying the matrix
  - Y axis (on the left) is the annual chance of a bad thing
  - X axis (the bottom) is the life loss that would happen if failure happens
  - Together they give you a quantitative risk assessment: Average Annual Life Loss (AALL)
  - If that risk is higher than one of the dashed lines...you may have an issue
F-N PLOTS

- With and without comparison
  - If your risk is high, you’ll need to find alternatives to reduce it
  - If an alternative is not practicable...
    - Practicable means environmentally acceptable, engineering feasible, and economic efficient
    - It’s not enough to say the option isn’t popular
    - You’ll have to make the case for why
LIFE SAFETY RISK ASSESSMENT FLOW CHART
FOR PLANNING STUDIES

Does incremental risk affect my study?

Is existing data available?
• Probability and consequences?

Is data sufficient to assess TRG’s and make decisions?

Selecting a plan other than NED?

Develop NED Policy Exception Memo and get approval from ASA(CW and...)

Ensure full documentation of Risk Assessment in Final Report

CONDUCT A NEW RISK ASSESSMENT!
• Consider the following risk assessment options in order from small to large scope

Qualitative Risk Assessment
• Appropriate during early planning phases/iterations leading to AMM
• Utilize existing quantitative data to inform assessment

Levee Screening Tool (LST)
• Appropriate during early planning phase and/or where life safety risk is moderate
• May not be appropriate for high risk study areas with complex flood patterns and failure modes

Scaled Semi-Quantitative Risk Assessment (“SQRA-lite”)
• Appropriate after AMM milestone for studies with moderate to high life safety risk
• Condensed version of Full SQRA
• Utilize available H&S/Geotech inputs from the NED economic analysis to the maximum extent possible

Full SQRA Analysis
• Appropriate after AMM milestone for studies with high life safety risk and/or significant investments
• Especially those studies where we are recommending a life safety plan beyond NED

Quantitative Risk Assessment
• Typically NOT appropriate during a planning study

OPTION 1 (SMALLEST SCOPE)

OPTION 2

OPTION 3

OPTION 4

OPTION 5 (LARGEST SCOPE)
EVALUATING LIFE RISK
As is the case with many analyses made in geotechnical engineering practice, the true value of the analysis often lies in the insights and understandings that come from careful formulation of the problem.” – Needham, 2017
LIFE LOSS ESTIMATION – ESSENTIAL ELEMENTS

Initial distribution of people
Redistribution of people
  – Warning
  – Response
  – Evacuation potential

Flood characteristics
  – Arrival time, depth, velocity
Shelter provided by final location
Fatality rates
Potential for indirect life loss

Evacuation Effectiveness
REDISTRIBUTION OF PAR

- Threat Detected or Notification Received
- Warning Issued
- Warning Received
- Protective Action Initiated

[TIME]

- Warning Delay Time
- Warning Diffusion Time
- Protective Action Initiation Time
SHELTER AND FATALITY RATE ZONES

High Hazard:
- Stability criteria or submergence criteria of the person (if out in the open), the vehicle (if caught while evacuation), or the structure (if not mobilized) has been exceeded. In that situation, the victims are typically swept downstream, buried in a collapsed building, or trapped underwater.

Low Hazard:
- Exposed to relatively calm floodwaters, where their stability or the stability of their shelter is not at risk. A hazard exists due to the potential for bad things to happen when people come in contact with water in locations not meant for such an interaction.
WARNING AND MOBILIZATION

Not Warned

Warned

Mobilized

Caught Vehicle

Caught Structure
CHOOSE METRICS WISELY, OR THEY CAN LEAD YOU ASTRAY
Life Risk vs Performance

HAZARDS
What are the hazards and how likely are they to occur?

PERFORMANCE
How will the levee perform in the face of these hazards?

CONSEQUENCE
Who and what are in harm’s way?
How susceptible to harm are they?
How much harm is caused?

RISK = f (HAZARD, PERFORMANCE, CONSEQUENCE)
Life Risk vs. PAR

Rank - PAR (Population at Risk)

Rank - Life Risk (Expected Annual Life Loss)
Life Risk vs. PAR

HAZARDS
What are the hazards and how likely are they to occur?

PERFORMANCE
How will the levee perform in the face of these hazards?

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Who and what are in harm’s way?
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How much harm is caused?

RISK = f (HAZARD, PERFORMANCE, CONSEQUENCE)
Life Risk vs. Economic Risk (EAD)

R² = 0.9255
Life Risk vs. Economic Risk (EAD)

**HAZARDS**
What are the hazards and how likely are they to occur?

**PERFORMANCE**
How will the levee perform in the face of these hazards?

**CONSEQUENCE**
Who and what are in harm’s way? How susceptible to harm are they? How much harm is caused?

RISK = f (HAZARD, PERFORMANCE, CONSEQUENCE)
HALFTIME QUESTIONS?

• Any big questions before we get into the different types of risk assessments???
QUALITATIVE RISK ASSESSMENT

• Appropriate during initial planning phases/iterations
• Utilizes Quantitative data, just doesn’t do additional modeling
  – Assess available data and key risk indicators
    • Existing LST data
    • PA’s/SQRA’s/etc.
    • Warning Times
    • Exposed PAR (> 2ft, > 9ft)
    • Flood Arrival Times
    • Evacuation times
    • Depth of Flooding
    • Velocity of Flooding
    • Probability of Failure
  – Can use PFMA Template
  • Etc.

– If there are very few indicators of high life safety risk, the qualitative assessment MAY be the only assessment needed during feasibility.
LEVEE SCREENING TOOL
LEVEE SCREENING APPROACH - CONSEQUENCES

• Initial data distribution
• Population re-distribution
• Depths, fatality rates, and consequences
### Exposure Curves Example

**Census Block**
- Population = 250
- Total Value = $10,000

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Percent Area</th>
<th>Aggregate Value ($)</th>
<th>Aggregate Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.5</td>
<td>5</td>
<td>500</td>
<td>12.5</td>
</tr>
<tr>
<td>1</td>
<td>17</td>
<td>2200</td>
<td>55</td>
</tr>
<tr>
<td>1.5</td>
<td>63</td>
<td>9000</td>
<td>225</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>10000</td>
<td>250</td>
</tr>
</tbody>
</table>
LST RESULTS– FATALITY RATE COMPUTATION TAB

1. Evacuation Effectiveness Factors

- Evacuation Effectiveness (Breach Prior to Overtopping) = 0.7081
- Overall Evacuation Effectiveness Factor (day) = 0.7081
- Overall Evacuation Effectiveness Factor (night) = 0.7081
- Evacuation Effectiveness (Overtopping)
  - Overall Evacuation Effectiveness Factor (day) = 0.8330
  - Overall Evacuation Effectiveness Factor (night) = 0.8330

52% Ineffective

Average Overtopping

98% Effective

Average Prior to Overtopping
3. Consequence Results Summary

Population at Risk (Day) 96,170
Population at Risk (Night) 127,857

Breach Prior to Overtopping
Threatened Population (Day) 28,077
Threatened Population (Night) 37,281
Loss of Life (Day) 126.02
Loss of Life (Night) 184.72

Overtopping
Threatened Population (Day) 16,950.35
Threatened Population (Night) 21,325.33
Loss of Life (Day) 72.08
Loss of Life (Night) 105.66

Exposure Values
Day 0.45
Night 0.55

Exposure Weighted Life Loss Estimates
Estimated Loss of Life (Breach Prior to Overtopping) 158.3
Estimated Loss of Life (Overtopping) 90.55

Summary
Weighted Fatality Rate (%) 0.45%
Loss of Life as % of PAR 0.13%
Property Damages (in 1000s) $6,216,947.87
Number of Structures Inundated 42,636
LST RESULTS – RISK RESULTS

LIFE RISK MATRIX

Annual Exceedance Probability vs. Average Life Loss

Prior to Overlapping - Very High Risk (1)
Overlapping - Moderate Risk (3)
RISK ASSESSMENT PROCESS

HAZARDS
What are the hazards and how likely are they to occur?

PERFORMANCE
How will the levee perform in the face of these hazards?

CONSEQUENCE
Who and what are in harm’s way?
How susceptible to harm are they?
How much harm is caused?

RISK = f (HAZARD, PERFORMANCE, CONSEQUENCE)
SQRA

- A Semi-Quantitative Risk Assessment (SQRA) provides information
  - Background information
  - Potential Failure Mode Analysis
  - Risk Assessment
- How do you do one?
  - Recruit a risk cadre (expensive)
  - Use the framework (scalable)
- What makes it “Semi”?
  - There’s usually a lot of subjectivity
  - There’s usually not a lot of “nodal probabilities”
  - Not the full range, focus is on a critical load
• PFMA/SQRA
• List of ways a project could fail
• Order of magnitude probability of failure
• Order of magnitude consequences
SQRA: BASICS OF CONSEQUENCES MODELING

- Hydraulics
  - Arrival times and velocity matter, not just max depths
SQRA: BASICS OF CONSEQUENCES MODELING

- Inventory
  - Must estimate Population at-Risk (PAR), not just structure values
SQRA: BASICS OF CONSEQUENCES MODELING

- Life Loss Assumptions
  - Warning

![Study Hydrograph](image)
SQRA: BASICS OF CONSEQUENCES MODELING

- Life Loss Assumptions
- Evacuation
SQRA: BASICS OF CONSEQUENCES MODELING

- Life Loss Assumptions
  - Fatality

Structural Submergence Criteria

- Chance
  - Chance Zone Start (ft): Under 65: 15, Over 65: 6
- Compromised
  - Compromised Zone Start (ft): Under 65: 13, Over 65: 4
- Safe
  - Safe Zone Start (ft): Under 65: 2, Over 65: 2

Structural Stability Criteria

- Depth (ft) vs. Velocity (ft/s)
SQRA: BASICS OF CONSEQUENCES MODELING

• Life Loss Results
SQRA: OUTCOMES OF PROCESS

- Categorical Ratings of Existing Risk
  - Life Loss informed by modeling
  - Qualitative issues also considered
    - Indirect Life Loss
    - PFM specific considerations not modeled
    - Etc.
USING SQRAS FOR PLANNING PURPOSES

• Existing and Future Conditions
  • Background Data, Risk Plots
• Formulation
  • Address Failure Modes and/or Consequences
• Evaluation
  • Assess categorical rating changes (Probability and consequences)
• Comparison
  • “Benefits” and “Costs”, Trade-offs
• Selecting a Plan
  • Meeting TRGs, metrics, exceptional circumstances
SQRA: ALTERNATIVE COMPARISON

No Action

Structural

Non Structural
### Scaled SQRA Risk Assessment – Menu of Major Inputs

#### Life Loss Inputs

<table>
<thead>
<tr>
<th>Low Detail</th>
<th>High Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floodplains</td>
<td>FEMA / FIS</td>
</tr>
<tr>
<td>Exposed PAR</td>
<td>Census</td>
</tr>
<tr>
<td>Warn/Evacuation</td>
<td>Expert Judgment</td>
</tr>
<tr>
<td>Fatality Rates</td>
<td>Expert Judgment</td>
</tr>
</tbody>
</table>

- FEMA / FIS
- Water Surface Elev at TOL
- Breach Simulations
- NS1
- NS12
- Custom
- LST Range
- LifeSim
- Jonkman Curve
- LifeSim Modeled
- Elicitation Based

#### Probability Inputs

<table>
<thead>
<tr>
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<th>High Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage-Frequency</td>
<td>FEMA / FIS</td>
</tr>
<tr>
<td>Probable Failure Modes</td>
<td>Professional Judgment (less data/people)</td>
</tr>
</tbody>
</table>

- FEMA / FIS
- FWOP modeling
- Study/Plan specific modeling
- Expert Elicitation (more data/people)
# Example - Scaled SQRA Risk Assessment – Menu of Major Inputs

## Life Loss Inputs
- **Floodplains**
  - Low Detail: FEMA / FIS
  - High Detail: Water Surface Elev at TOL, Breach Simulations
- **Exposed PAR**
  - Low Detail: Census
  - High Detail: NSI1, NSI2, Custom
- **Warn/Evacuation**
  - Low Detail: Expert Judgment
  - High Detail: LST Range, LifeSim, Elicitation Based
- **Fatality Rates**
  - Low Detail: Expert Judgment
  - High Detail: Jonkman Curve, LifeSim Modeled

## Probability Inputs
- **Stage-Frequency**
  - Low Detail: FEMA / FIS
  - High Detail: FWOP modeling, Study/Plan specific modeling
- **Probable Failure Modes**
  - Low Detail: Professional Judgment (less data/people)
  - High Detail: Expert Elicitation (more data/people)
EXAMPLE SCALED SQRA
EXAMPLE SCALED SQRA

3,000 PAR
85% Mobilization Rate
450 Exposed PAR
EXAMPLE SCALED SQRA

3,000 PAR
85% Mobilization Rate
450 Exposed PAR
0.22% Fatality Rate
Life Loss = 1
EXAMPLE SCALED SQRA

LIFE RISK MATRIX

- Recurrence vs. Average Life Loss
- Generally Life Safety Risks
  - Do not meet TM 5
  - More discussion is needed related to individual life risk
- More examination is needed
- Individual Life Risk Line

- Recurrence vs. Average Life Loss
- Generally Life Safety Risks
  - Meet TM 5
  - More examination is needed related to individual life risk
- More examination is needed
- Individual Life Risk Line
QUANTITATIVE ANALYSIS

- Higher resolution
- Typically not necessary during feasibility
- Engineering investigations
  - Failure tree
  - Nodal probabilities
- Consequences
  - Additional breaches
  - Roadway Evacuation
  - Interviewing EMAs
  - Detailed FWAC
  - Measuring transfers
DECISION MAKING AND LIFE LOSS

- If you’re going to justify based on life loss, expect extra scrutiny
  - TRG, LL reduction, Residual Risk

<table>
<thead>
<tr>
<th>Metric</th>
<th>No Action</th>
<th>Buyout</th>
<th>Wall + Emb</th>
<th>Just Wall</th>
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<tbody>
<tr>
<td>AALL</td>
<td>0.34</td>
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<tr>
<td>Implementation Cost</td>
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<td>Annualized Cost</td>
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<td>BCR</td>
<td>N/A</td>
<td>0.10</td>
<td>0.02</td>
<td>0.03</td>
</tr>
</tbody>
</table>
DECISION MAKING AND LIFE LOSS

• Even if you justify based on economics, you still have life safety concerns
  • Reduced life safety risk
  • Or, induced risk elsewhere in the system

• Releasing to public
  • Talk to your team and SOG
  • But in general:
    • Communicating residual risk is important
    • Little reason for showing breach locations, etc

• ER 1105-2-101

h. All project increments comprise different risk management alternatives represented by the tradeoffs among engineering performance, project cost, economic and environmental resilience, and life loss consequences. These increments contain differences in flood damage reduced, residual risk, local and federal project cost, impacts to the environment, and life loss. USACE must effectively communicate to local sponsors and residents so they understand these tradeoffs and can participate fully in informing the decision-making process.
HELPFUL TOOLS AND FUTURE LESSONS

• Data and Software
  • National Structure Inventory
  • HEC-LifeSim
  • Warning Guidebook
• Classes
  • HEC-LifeSim
  • Consequence Analysis
  • Best Practices
• Good Contacts
  • Your Levee Safety Officer & Dam Safety Officer
    • Required to engage them
  • National Centers
    • Risk Management Center
    • Dam Safety Modification Mandatory Center of Expertise
    • Levee Safety Center
    • Modeling Mapping and Consequences Production Center
• Senior Oversight members
• Consequences Working Group
REVIEW REQUIREMENTS

• The same as the rest of your Feasibility study!
• Regardless of what type of Risk Assessment is used, it is important to complete a risk assessment that is defendable and credible.
• It is important that review plan identify the risk assessment (of whatever type) so that the RMO can verify appropriate reviewers have been assigned.
The “so-what”: Life safety risk assessments are required when incremental risk is present.


Key Takeaways:

- Tolerable Risk Guidelines (TRG’s) ONLY APPLY TO INCREMENTAL RISK!

- Risk assessments must include BOTH probability and consequences
  - Plot on f-N Chart and assess TRG’s without and with project

- Risk assessments are scalable and should always utilize available data when possible
  - Start with a small scope and work your way up if necessary
QUESTIONS / FEEDBACK?

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Please contact us with:

- Questions?
- Comments?
- Recommendations for improvement?