Lessons Learned from 140+ Dam Assessments (in Texas)

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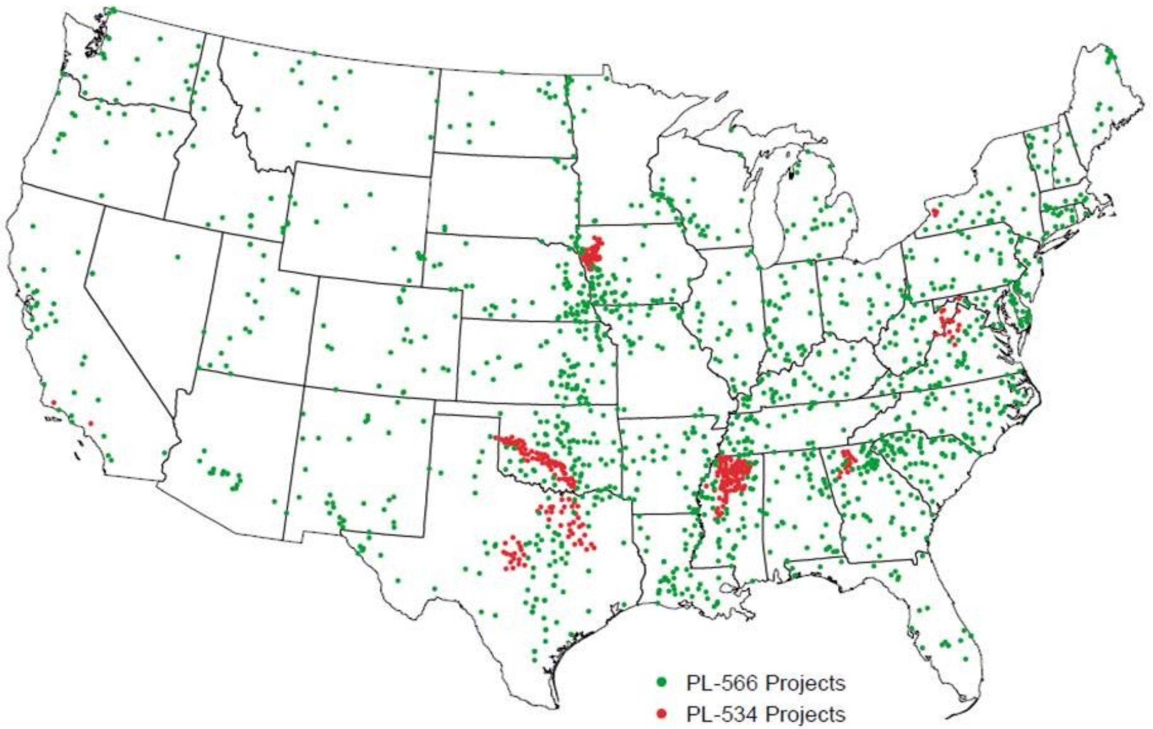
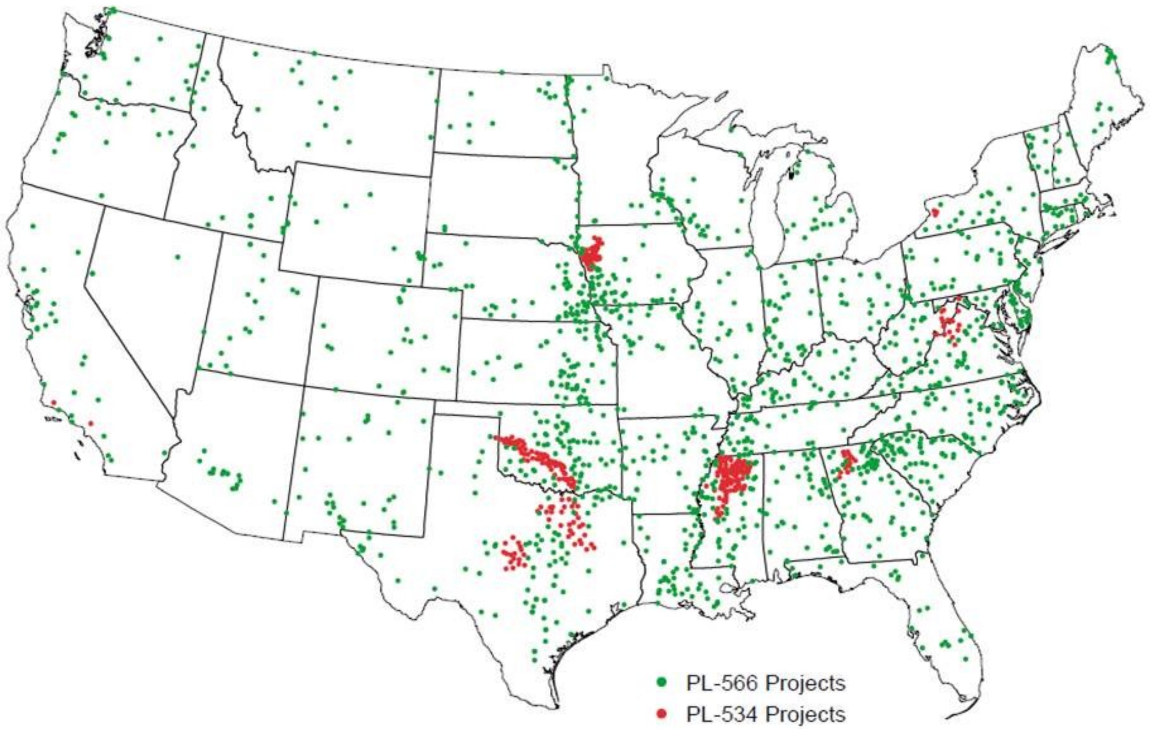
History of USDA-NRCS Dams

- Flood Control Act (PL 78-534) (1944)
- Watershed Protection and Flood Prevention Act (PL 83-566) (1954)
- Program Purpose
  - preventing damage from erosion, floodwater and sediment
  - furthering the conservation development, utilization, and disposal of water
  - further the conservation and proper utilization of land



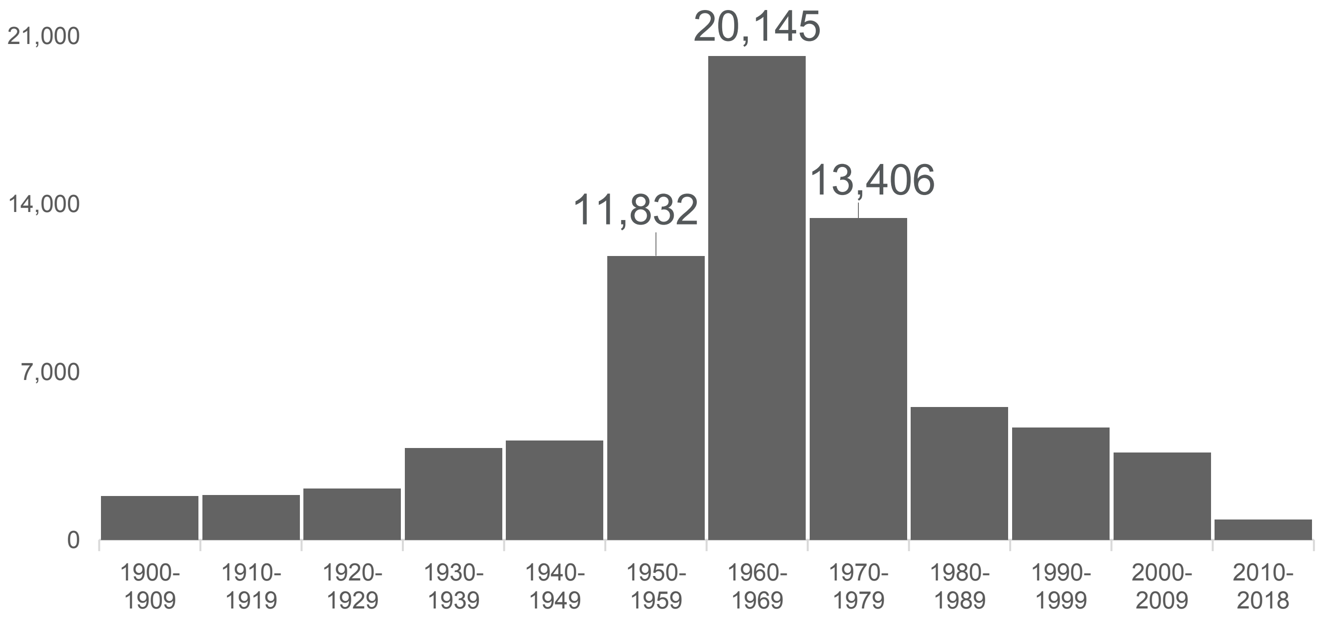
History of USDA-NRCS Dams

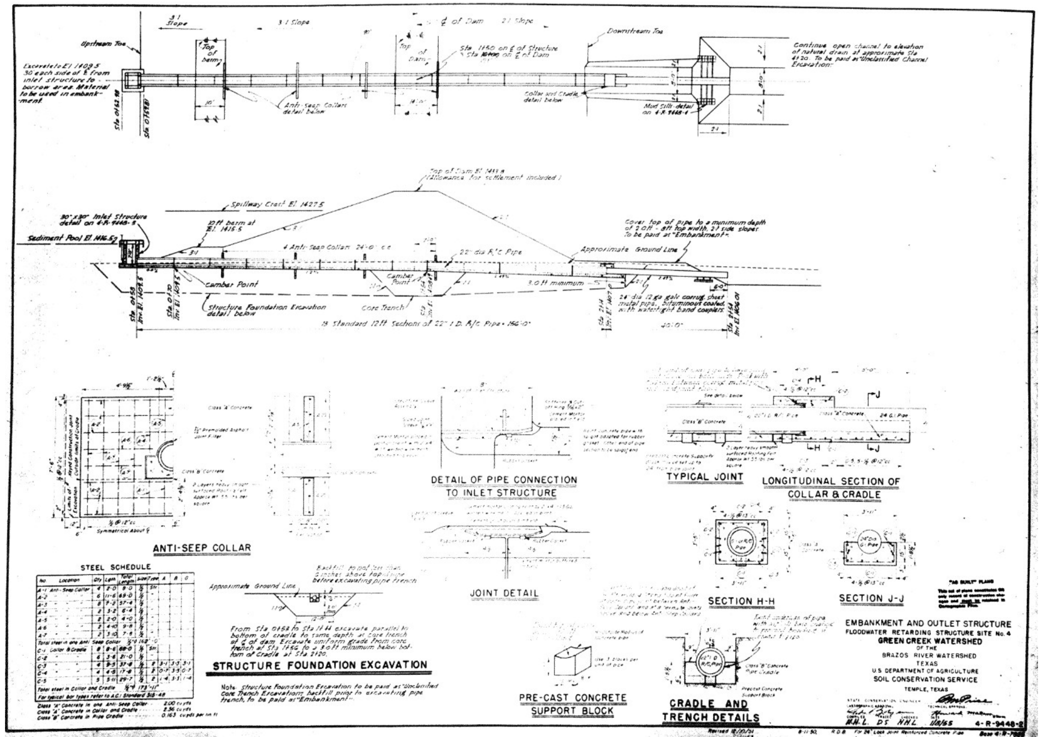
- Small Watershed Program (<250k acres)
- 20% of benefits must be related to agriculture
- 100% Federally funded (planning, engineering, construction)
- Land rights – Not included
- Local sponsors required
  - O&M agreement
  - Easements



Present Day

- Number of NRCS Dams
  - ~12,000 dams nationwide
  - 3,000 dams in Texas
- Typical service life of 50 years
- Increasing downstream hazard potential
- Watershed Rehabilitation Program
  - Federal cost share
  - First step – Dam Assessment





Dam Assessments

1. Site Visit
2. Hydrologic Analysis
3. Hydraulic Adequacy Evaluation
4. Breach Modeling
5. Hazard Classification Review
6. Risk Indexes
7. Proposed Modifications / Alternatives
8. Comprehensive Assessment Report

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sht 3 of 3	SEISMIC FAILURE SCENARIO (ver. 2013-01)			NID ID	NM00000
Structures (Elevated) Impacted by Potential Breach	Number of Structures: Inundation Depth Above Natural Ground <2.0 Ft	Number of Structures: Inundation Depth Above Natural Ground >=2.0 Ft.	Total	PAR per Exposure with Inundation Depths >=2.0 Ft.	PAR
Mobile Homes	0	0		3	
Seasonal Use RV's	0	0		2	
Other	0	0			
Structures (With Foundations) Impacted by Potential Breach	Number of Structures: Inundation Depth Above Natural Ground <1.0 Ft	Number of Structures: Inundation Depth Above Natural Ground >=1.0 Ft.	Total	PAR per Exposure with Inundation Depths >=1.0 Ft.	PAR
Homes	0	0		3	
Seasonal Use Homes and Cabins	0	0		1.5	
Duplexes	0	0		5	
Apartments	0	0			
Commercial Buildings	0	0			
Schools (In Use)	0	0			

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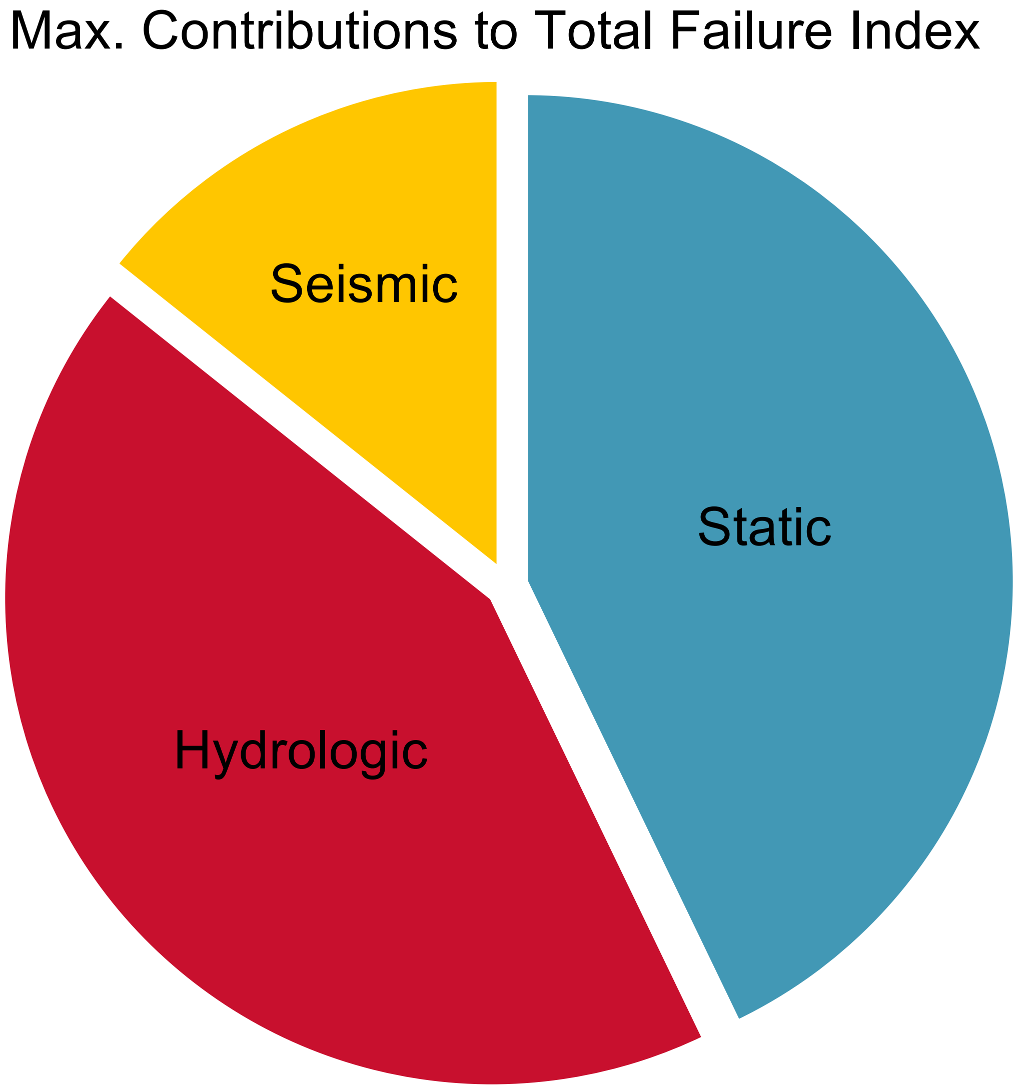
Lessons Learned - Trends

Risk Indexes

- Qualitative Approach – U.S. BOR 2000
- Requirement for funding
- Total Failure Index (max score: 700)
  - Seismic (100)
  - Hydrologic (300)
  - Static Failure (300)

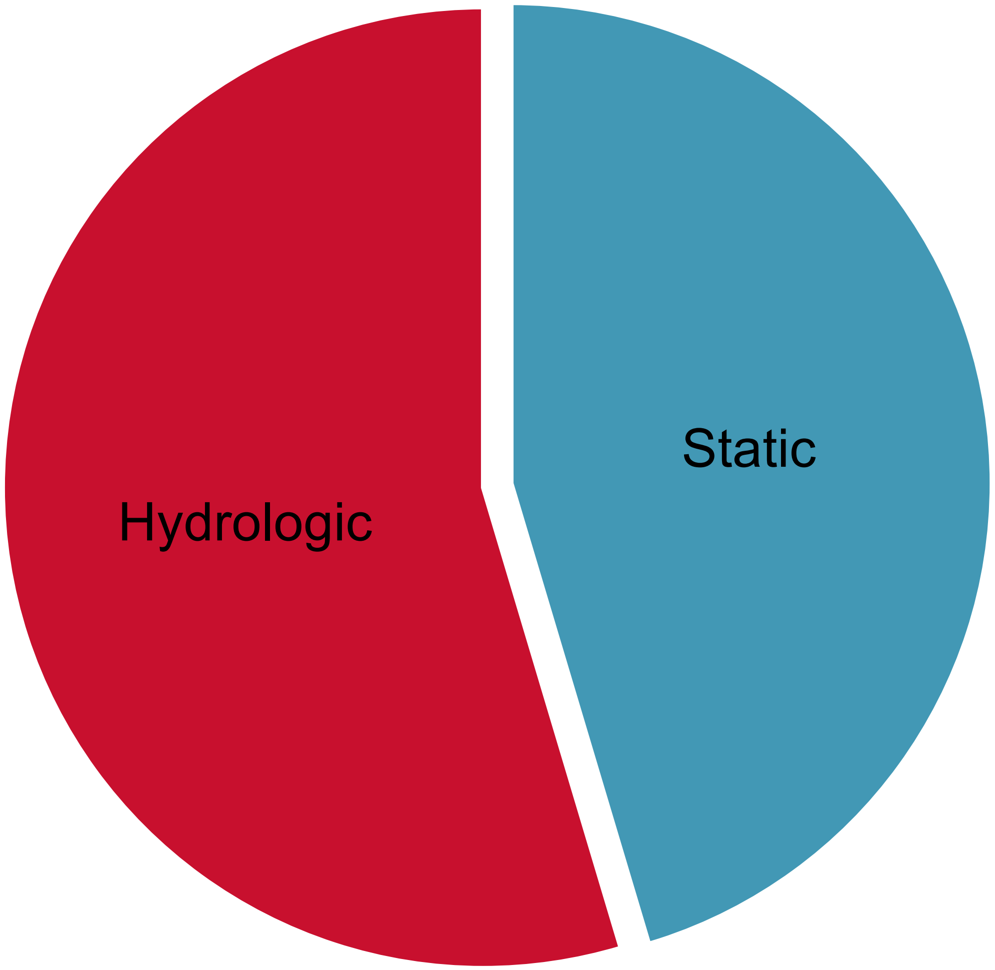


Lessons Learned - Trends

Risk Indexes

- Evaluation of Dams in Texas
  - Avg. Total Failure Index – 206 / 700
  - Avg. Seismic Failure Index – 0 / 100
  - Avg. Static Failure Index – 93 / 300
  - Avg. Hydrologic Failure Index – 113 / 300

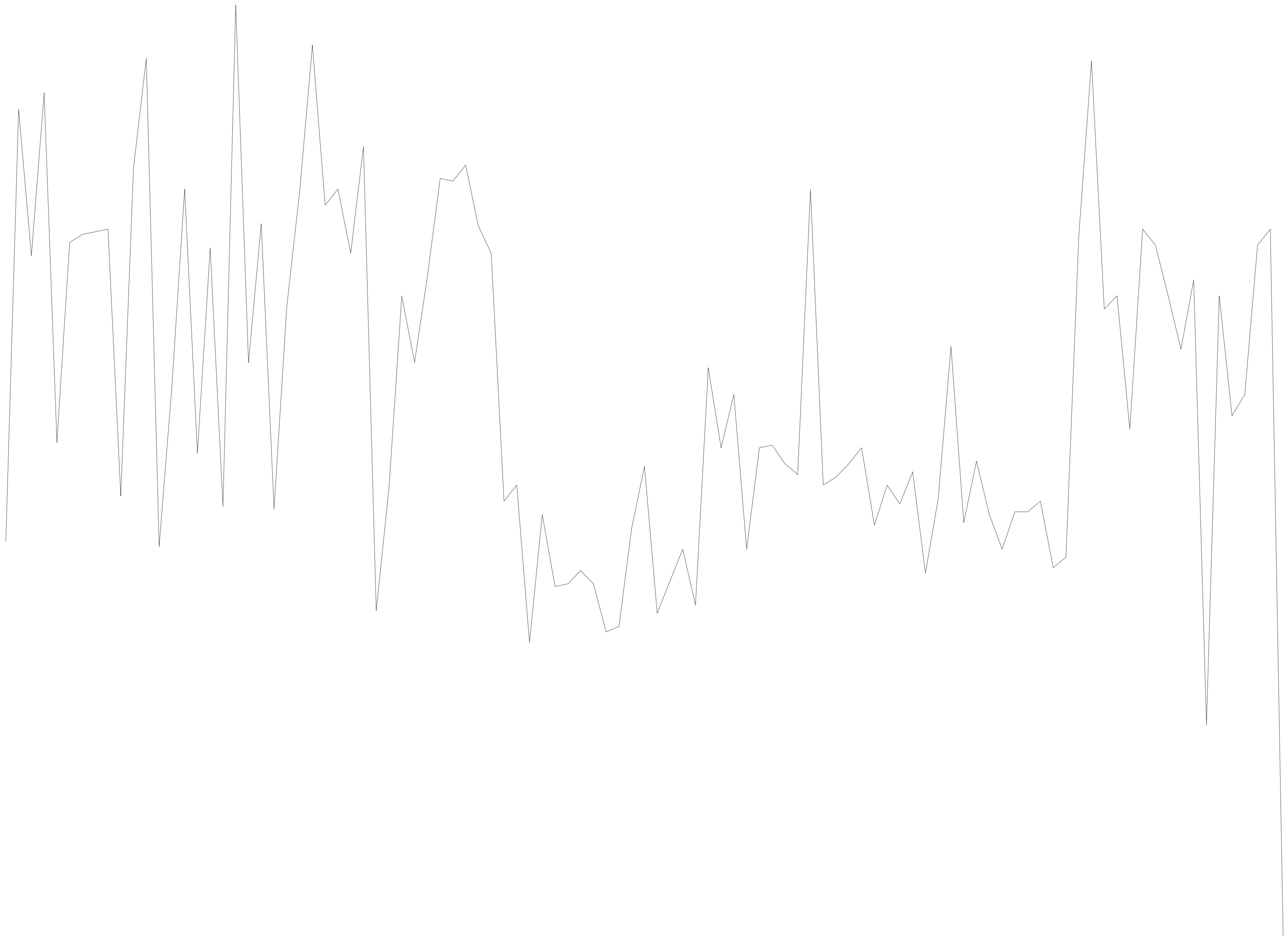
Average Contribution to Total Failure Index



Lessons Learned - Trends

Risk Indexes

- Evaluation of Dams in Texas
    - Max. Total Failure Index – 349 / 700
    - Max. Seismic Failure Index – 0 / 100
    - Max. Static Failure Index – 171 / 300
    - Max. Hydrologic Failure Index – 224 / 300



Lessons Learned - Trends

Risk Indexes

- Max. Static Failure Index – 171 / 300
- Driving Factors
    - Condition of Dam
    - Karst Features
    - Visible Seepage
    - Reservoir Filling History

Lessons Learned - Trends

Risk Indexes

- Max. Hydrologic Failure Index – 224 / 300
- Two Failure Modes
  - Overtopping
  - Aux. Spillway Breach
- Driving Factors
  - New Probable Maximum Precipitation (PMP)
  - Small drainage areas
  - Small diameter conduits

Lessons Learned - Trends

Risk Indexes

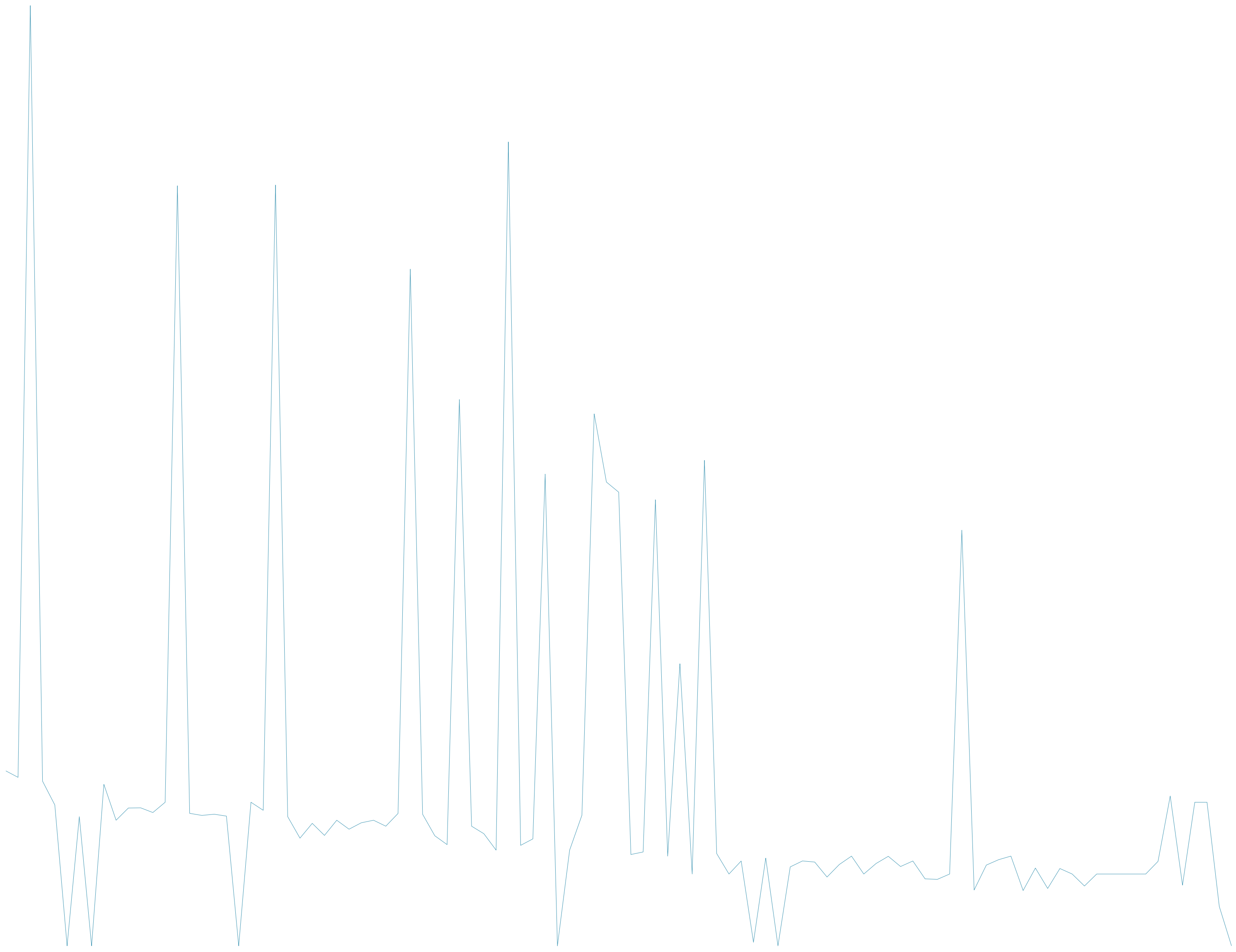
- Life Safety is Paramount
- Total Risk Index = Failure Index X $\underbrace{\text{Fatality Rate X Population-At-Risk}}_{\text{Consequences}}$

- Failure Index – Between 0 and 700
- Fatality Rate – Between 0.0003 and 0.04
- Total Risk Index – Between 0 and 28 **(Multiplied by PAR)**

Lessons Learned - Trends

Risk Indexes

- Most dams have low Risk Index for their respective PAR
- Driving Factors
  - Low Failure Indexes
  - Remoteness of downstream PAR
  - Low flood severity (lower depth/velocities)



Lessons Learned - Trends

Rehabilitation Alternatives

Upsizing the Principal Spillway

AND

Widening the Auxiliary Spillway

OR

Raising the Top of Dam

OR

RCC Spillway or Labyrinth Weir

Lessons Learned - Trends

Rehabilitation Alternatives

- Widening the Auxiliary Spillway
  - Typically requires excessive width
  - Physical constraints
  - $2M - $4M
    - Includes new PS
    - Seepage diaphragm
    - Flattening of D/S slope
    - Armoring of AS

Lessons Learned - Trends

Rehabilitation Alternatives

- Raising the Top of Dam
  - Limited high-ground to tie into
  - Often need to armor AS
  - $3M - $6M
    - Includes new PS
    - Seepage diaphragm
    - Flattening of D/S slope
    - Armoring of AS

Lessons Learned - Trends

Rehabilitation Alternatives

- RCC Spillway or Labyrinth Weir Spillway
  - Abandon existing AS
  - $7.5M - $15M
    - Includes new PS
    - Seepage diaphragm
    - Flattening of D/S slope

Key Take-aways

- Dam assessments are key step towards funding for dam rehabilitation
- Risk indexes are required for Federal cost-share funding
- Limited ways for a Sponsor to reduce risk outside of proper maintenance
- Sample data indicates dams in Texas are relatively good condition overall
- Hydraulic capacity and aux. spillway erosion is risk-driving factor
- Most feasible alternative for increasing hydraulic capacity often includes new principal spillway and/or dam raise

Thank you!

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