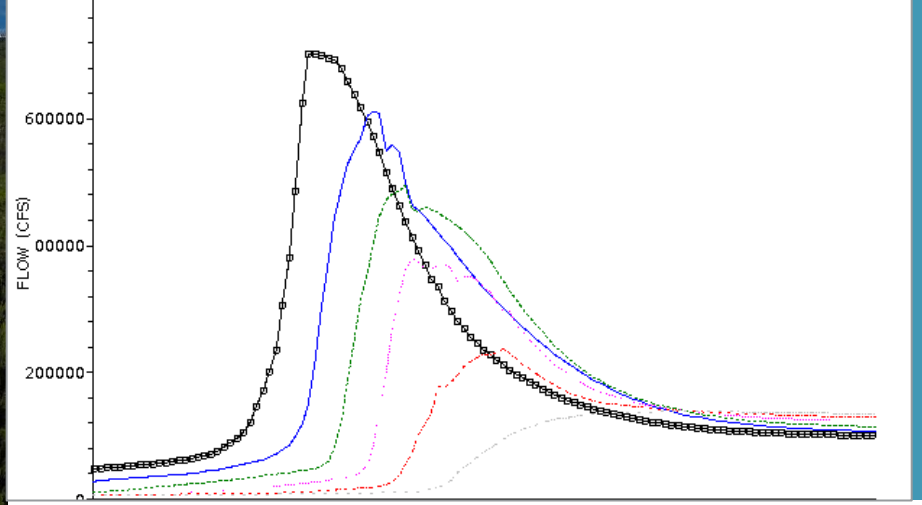
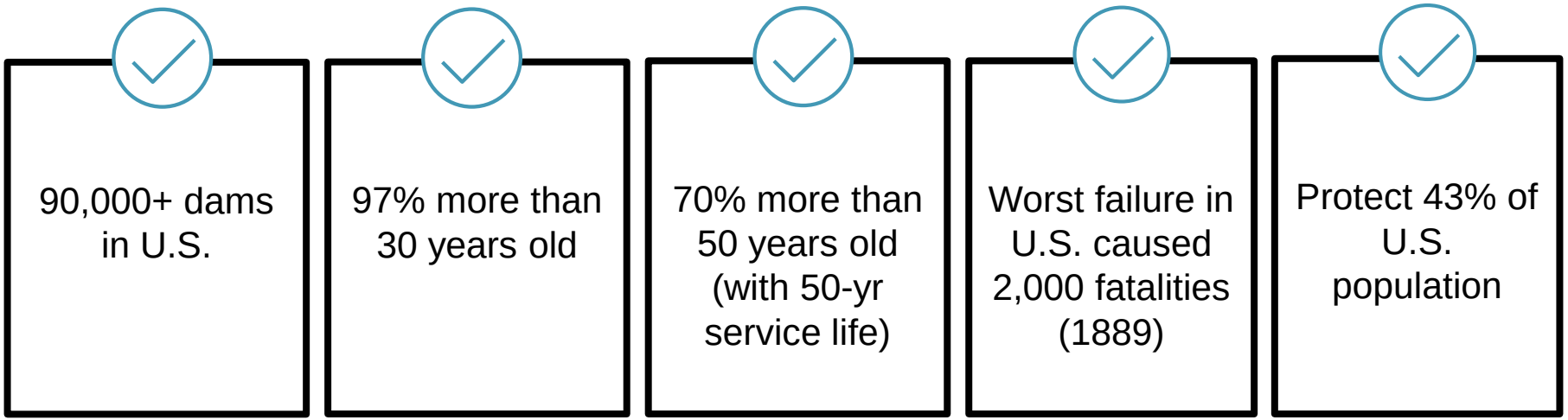


ESTIMATING CONSEQUENCES

Methods for estimating risk downstream of dams

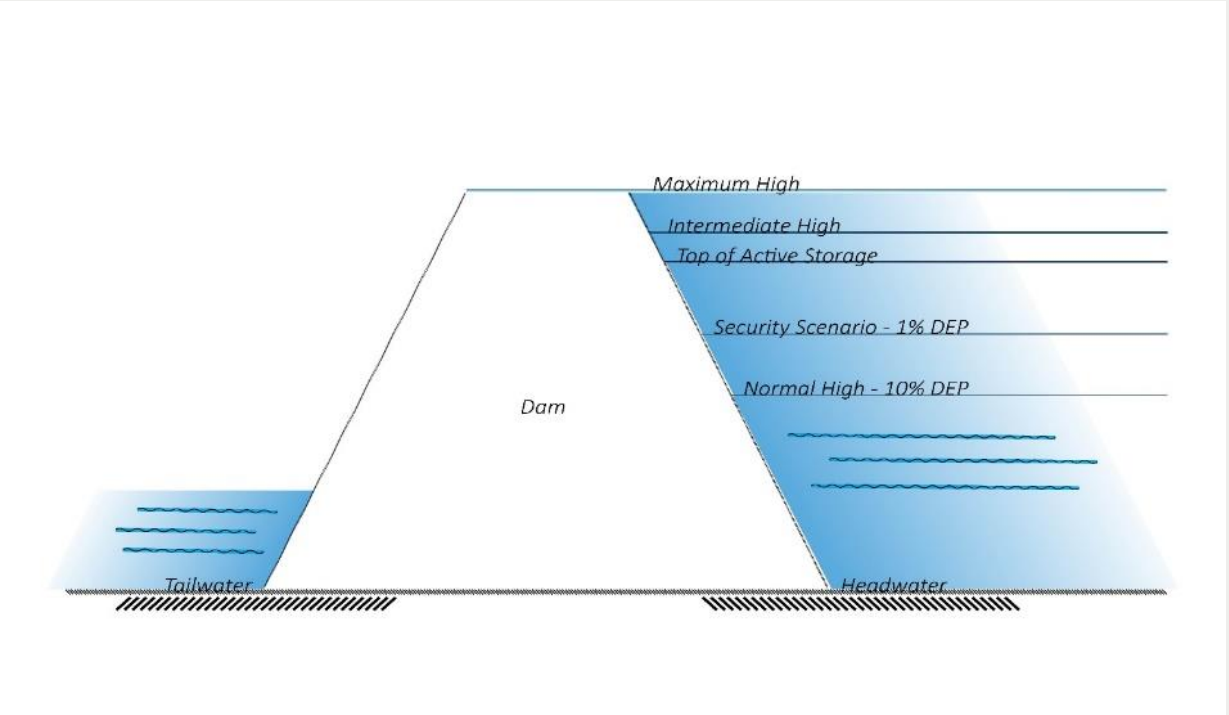
Josh Robbins

QUICK FACTS



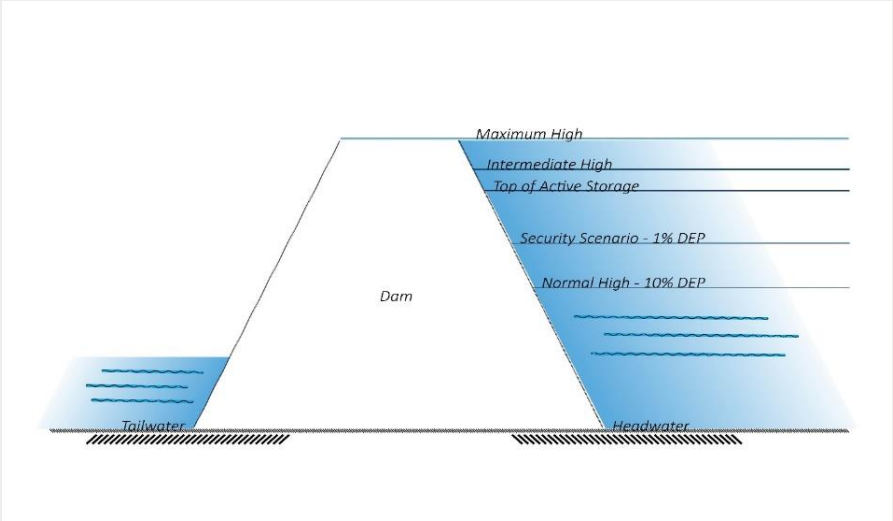
Source U.S. Army Corps of Engineers

THE DAM WILL HOLD BACK ALL THE WATER, RIGHT?



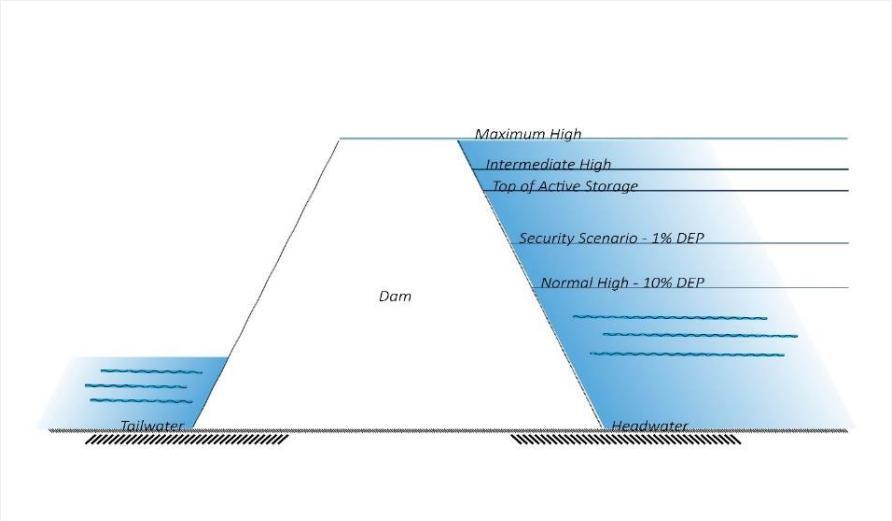
THE DAM WILL HOLD BACK ALL THE WATER, RIGHT?

- Process used to quantify risk



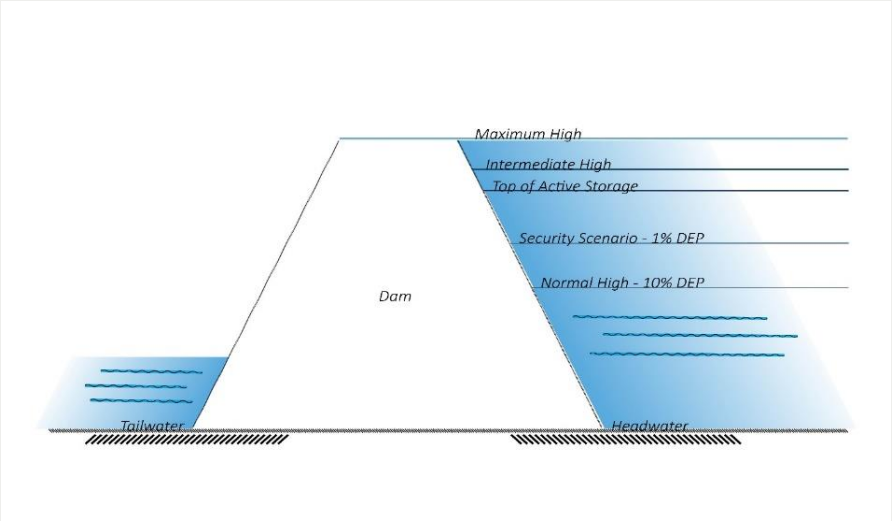
THE DAM WILL HOLD BACK ALL THE WATER, RIGHT?

- Process used to quantify risk
- Evaluate flooding scenarios



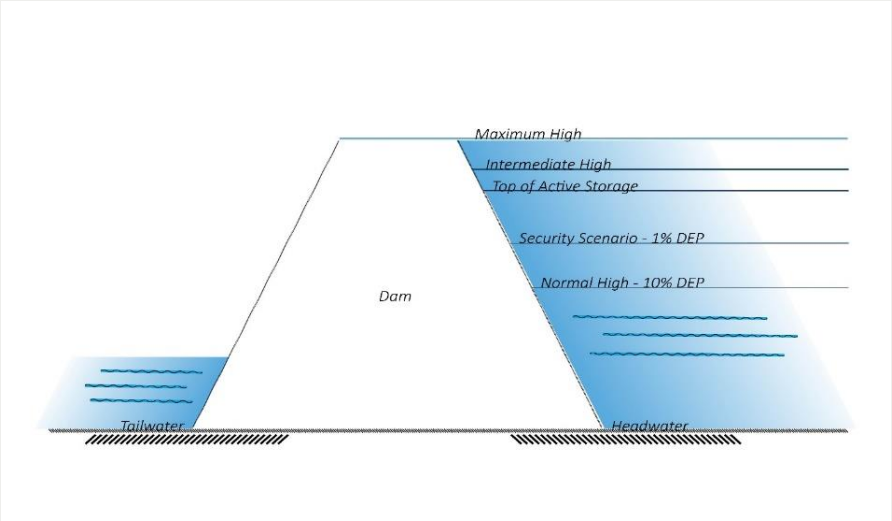
THE DAM WILL HOLD BACK ALL THE WATER, RIGHT?

- Process used to quantify risk
- Evaluate flooding scenarios
- Estimate risk (RCEM or LifeSim)



THE DAM WILL HOLD BACK ALL THE WATER, RIGHT?

- Process used to quantify risk
- Evaluate flooding scenarios
- Estimate risk (RCEM or LifeSim)
- Communicate risk



PROCESS USED TO QUANTIFY RISK

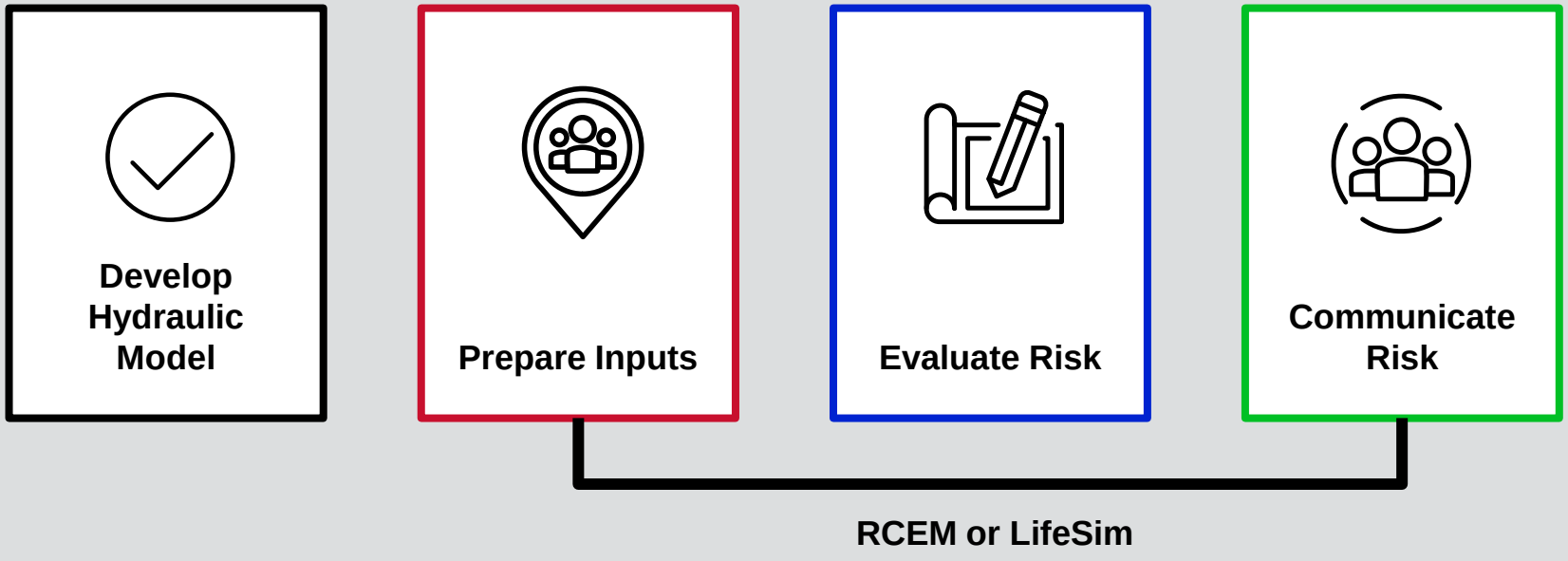
Develop Hydraulic Model

Prepare Inputs

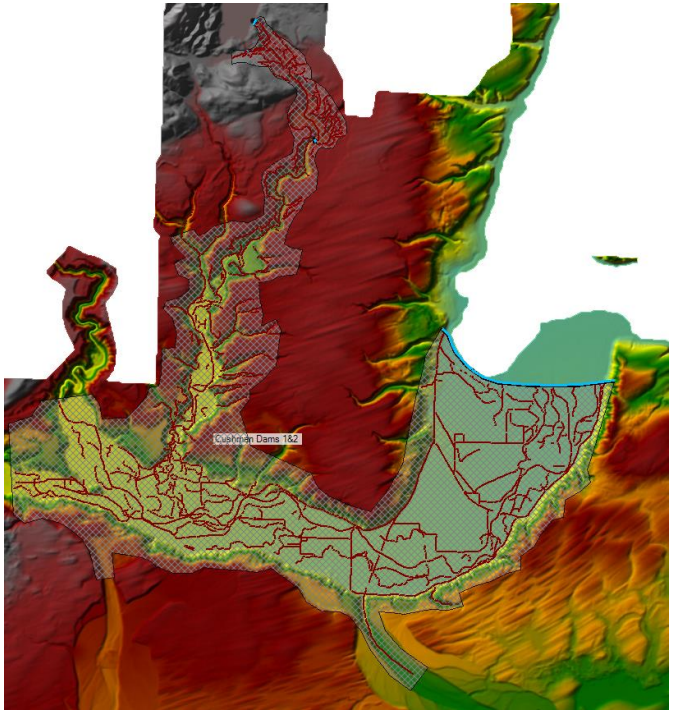
Evaluate Risk

Communicate Risk

PROCESS USED TO QUANTIFY RISK



DEVELOP HYDRAULIC MODEL



- Arrival time of flood wave

DEVELOP HYDRAULIC MODEL

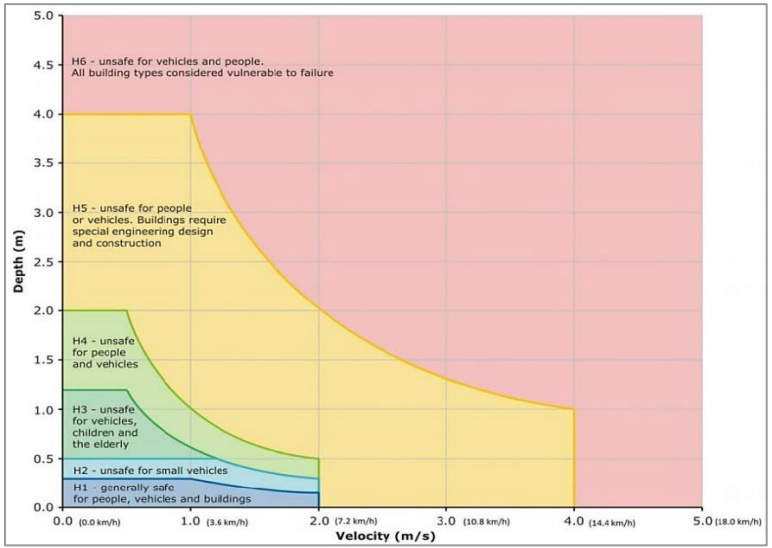


Figure courtesy of FEMA

- Arrival time of flood wave

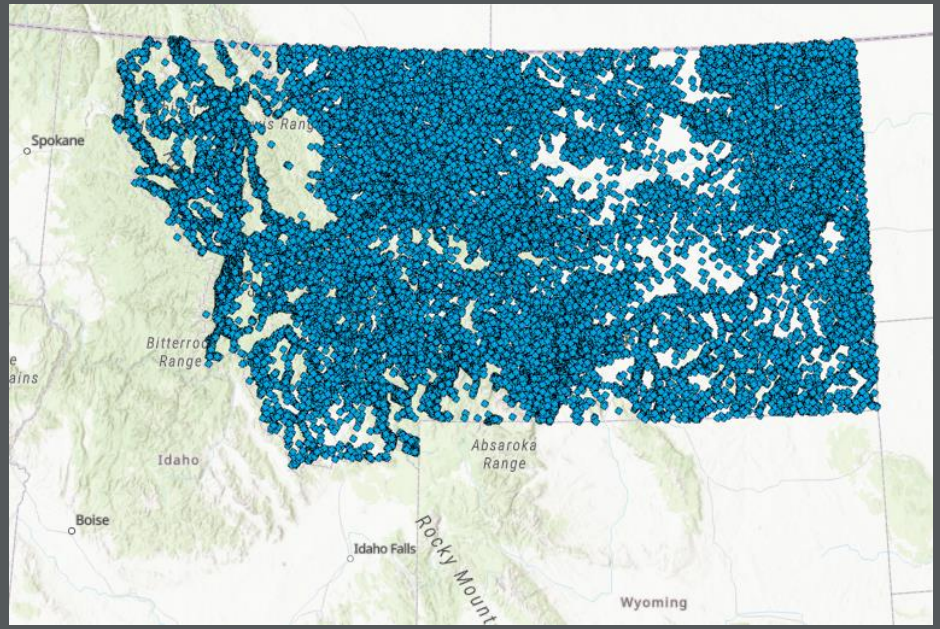
- Maximum depth and velocity results

RECLAMATION CONSEQUENCE ESTIMATING METHODOLOGY (RCEM)

PREPARE INPUTS

Reclamation Consequence Estimating Methodology (RCEM)

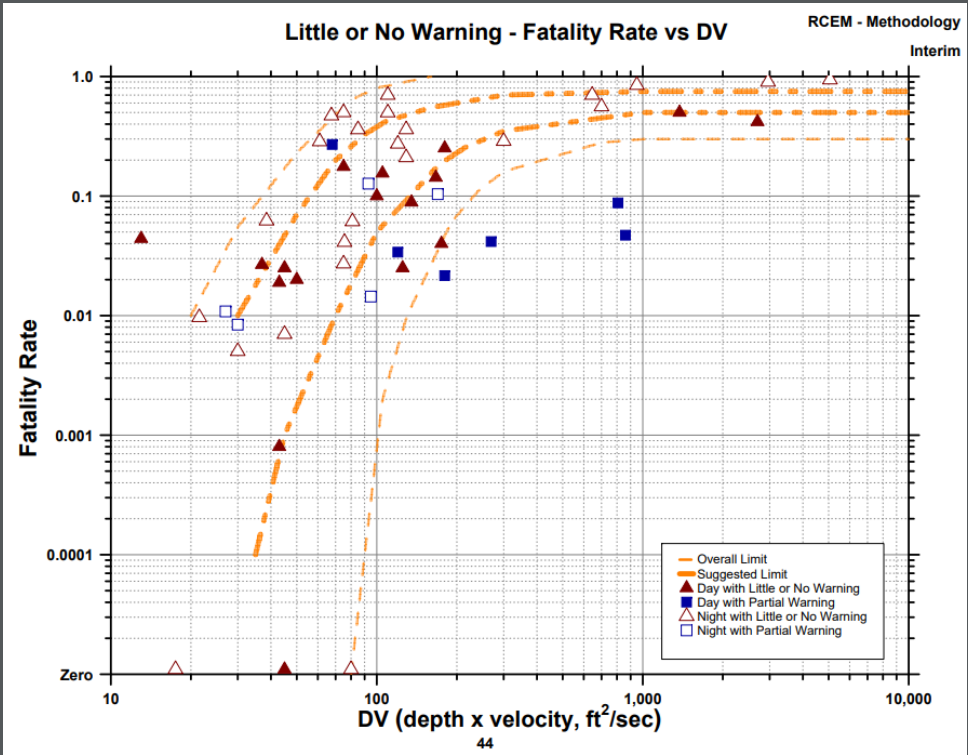
- Structure inventory with populations assigned to each structure.



EVALUATE RISK

Reclamation Consequence Estimating Methodology (RCEM)

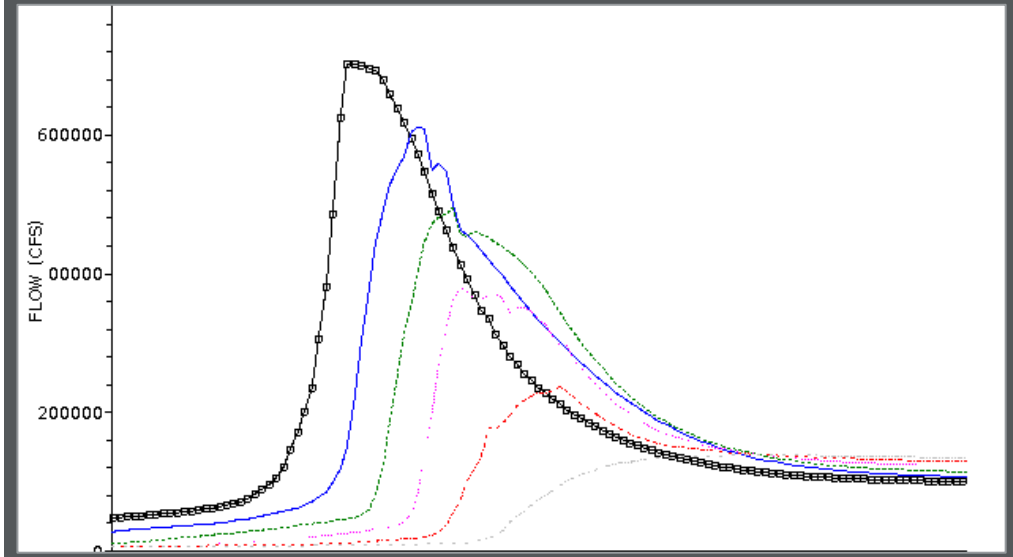
- Factors that influence risk:
  - Depth*Velocity (DV)



EVALUATE RISK

Reclamation Consequence Estimating Methodology (RCEM)

- Factors that influence risk:
  - Depth*Velocity (DV)
  - Arrival time of flood wave
  - Distance downstream of the dam



COMMUNICATE RISK

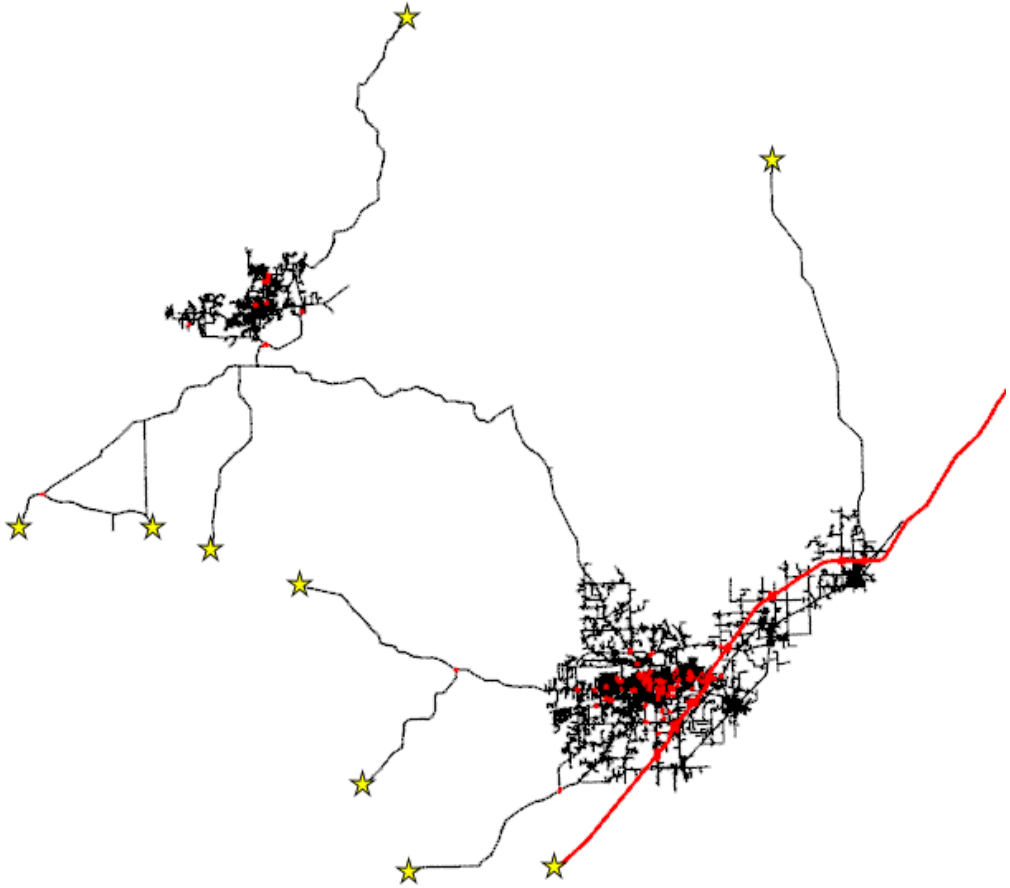
Reclamation Consequence Estimating Methodology (RCEM)

Reach	Warning Time (hr)	Population at Risk (PAR)	Fatality Rate	Loss of Life
1	0.5	500	0.02	10
2	0.5-1.5	2,600	0.003	8
3	1.5-4.5	7,800	0.0005	4
			Total	22

LIFESIM

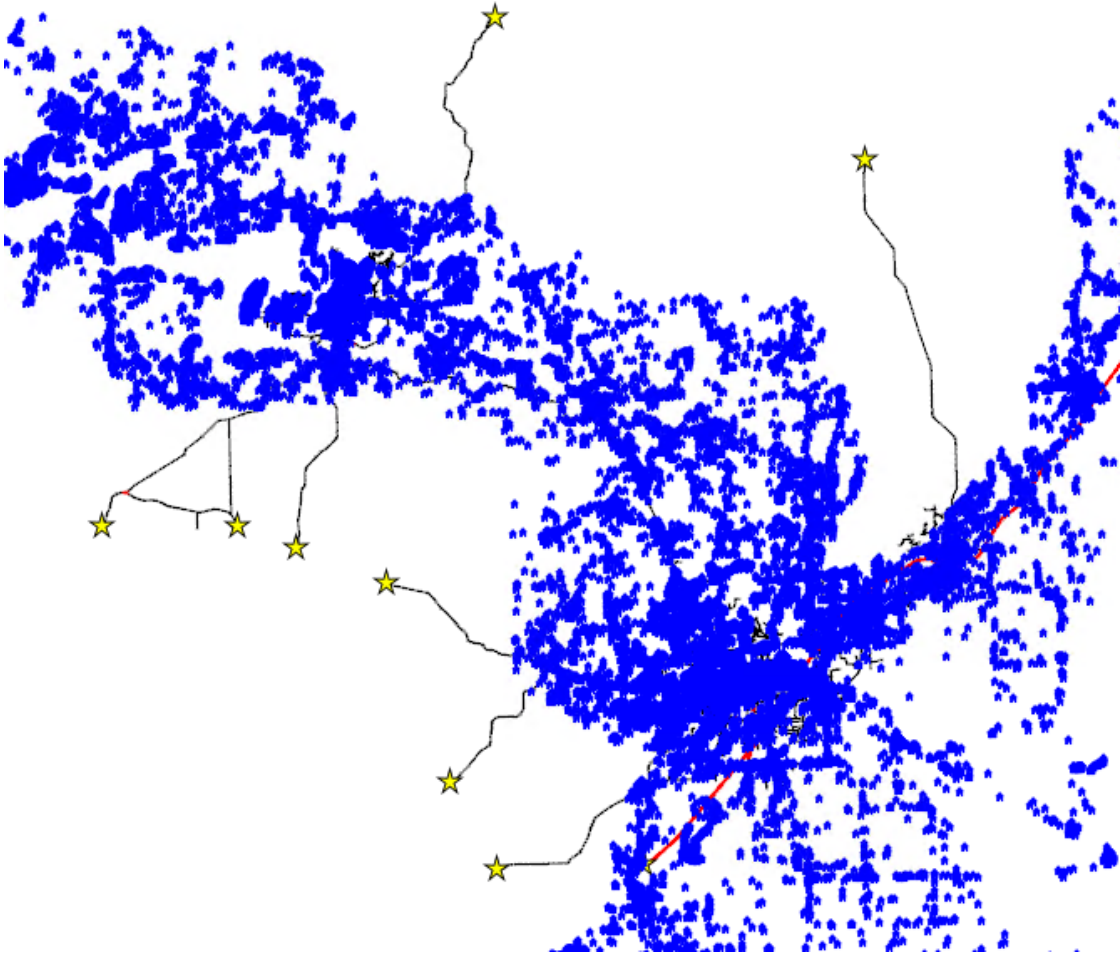
PREPARE INPUTS
LifeSim

- Road network – evacuation routes from homes to safety (LifeSim)
- Destinations to reach safety (LifeSim



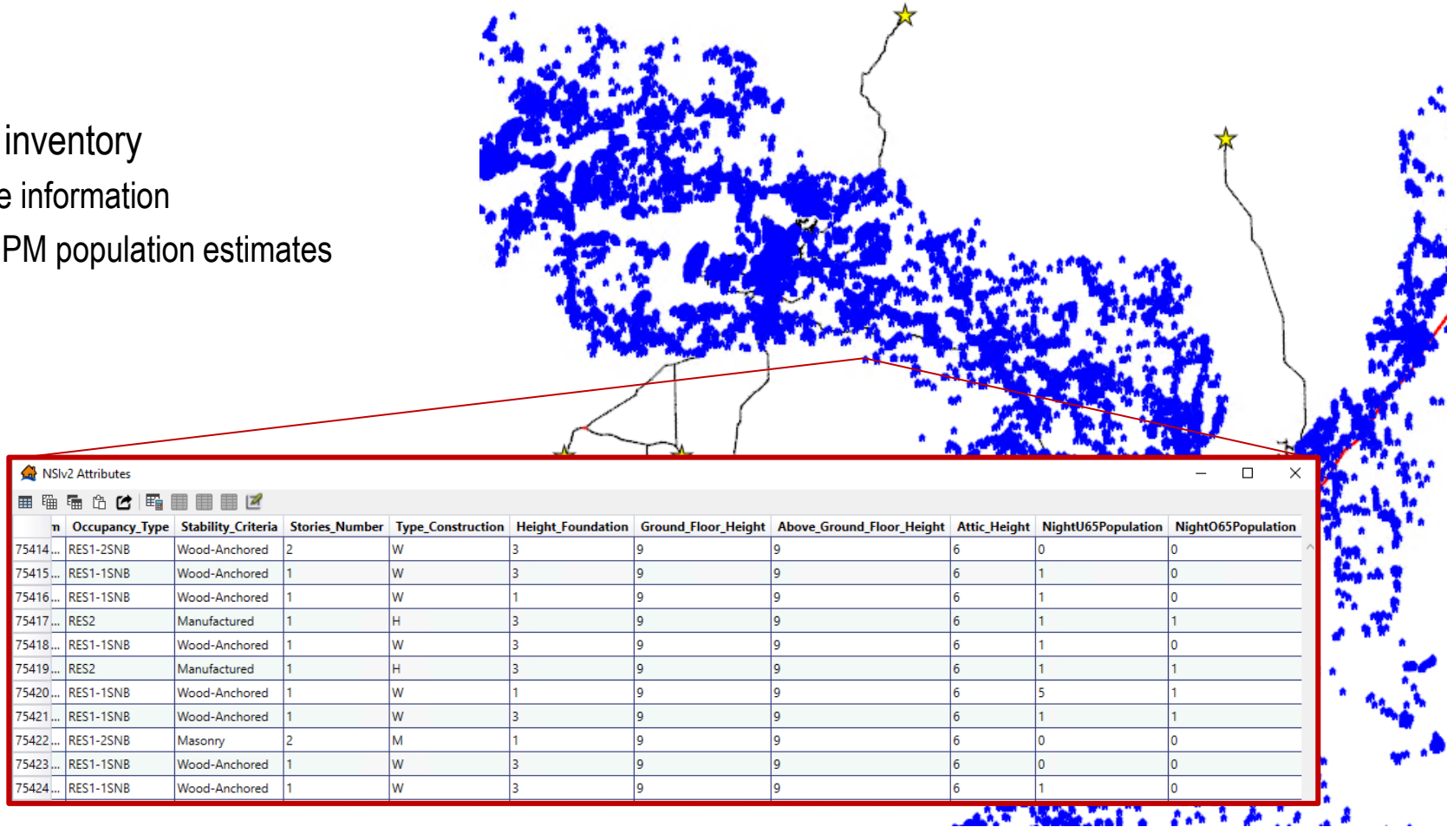
PREPARE INPUTS
LifeSim

- Structure inventory



PREPARE INPUTS
LifeSim

- Structure inventory
  - Structure information
  - AM and PM population estimates

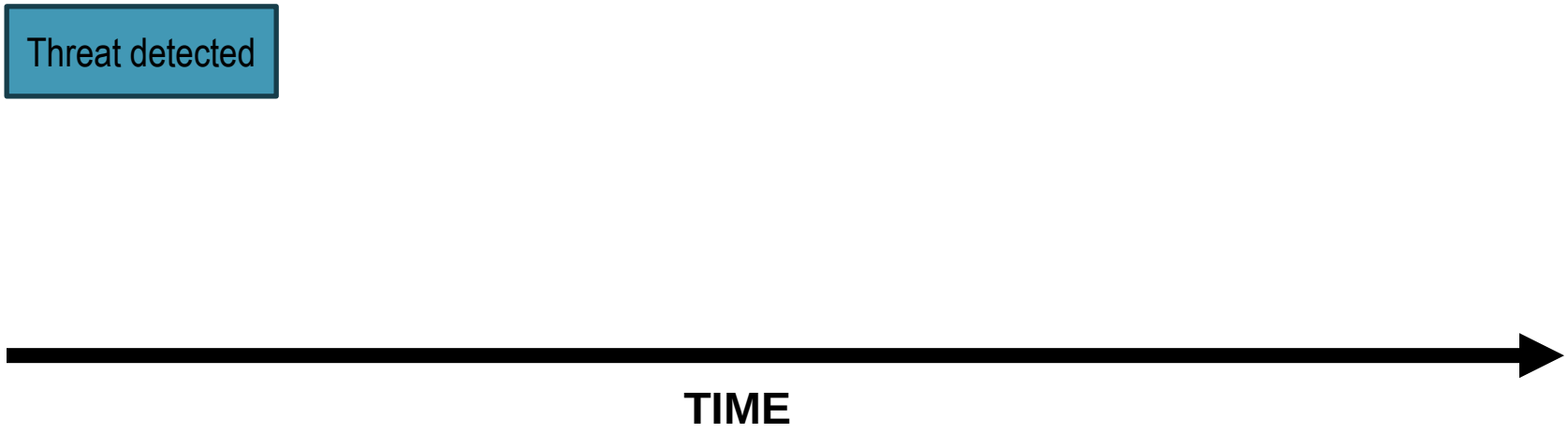


NSIv2 Attributes

	Occupancy_Type	Stability_Criteria	Stories_Number	Type_Construction	Height_Foundation	Ground_Floor_Height	Above_Ground_Floor_Height	Attic_Height	NightU65Population	NightO65Population
75414...	RES1-2SNB	Wood-Anchored	2	W	3	9	9	6	0	0
75415...	RES1-1SNB	Wood-Anchored	1	W	3	9	9	6	1	0
75416...	RES1-1SNB	Wood-Anchored	1	W	1	9	9	6	1	0
75417...	RES2	Manufactured	1	H	3	9	9	6	1	1
75418...	RES1-1SNB	Wood-Anchored	1	W	3	9	9	6	1	0
75419...	RES2	Manufactured	1	H	3	9	9	6	1	1
75420...	RES1-1SNB	Wood-Anchored	1	W	1	9	9	6	5	1
75421...	RES1-1SNB	Wood-Anchored	1	W	3	9	9	6	1	1
75422...	RES1-2SNB	Masonry	2	M	1	9	9	6	0	0
75423...	RES1-1SNB	Wood-Anchored	1	W	3	9	9	6	0	0
75424...	RES1-1SNB	Wood-Anchored	1	W	3	9	9	6	1	0

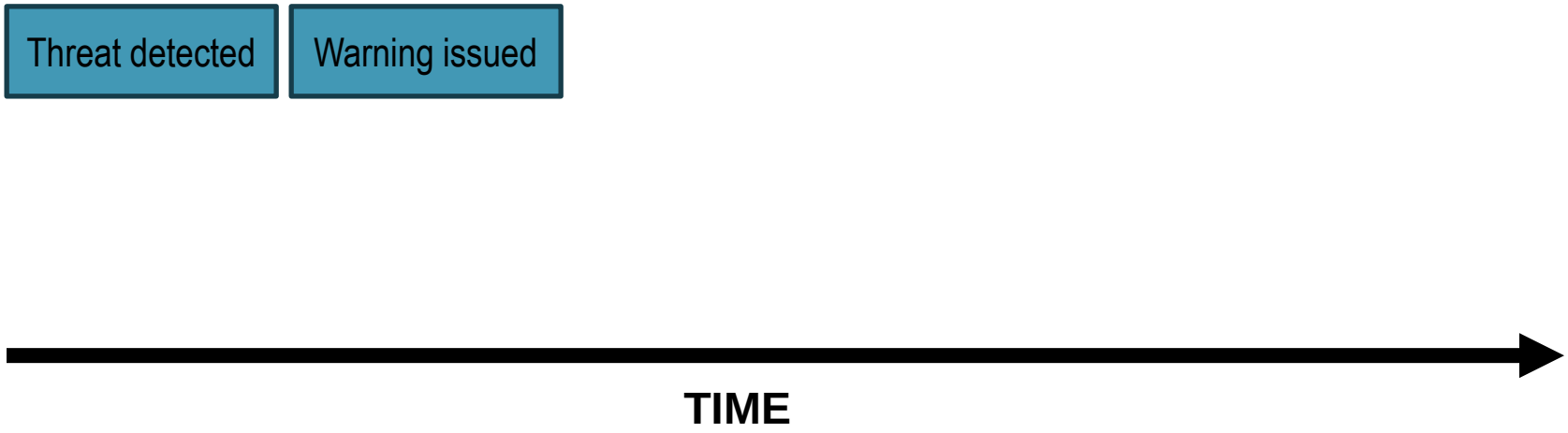
EVALUATE RISK

LifeSim



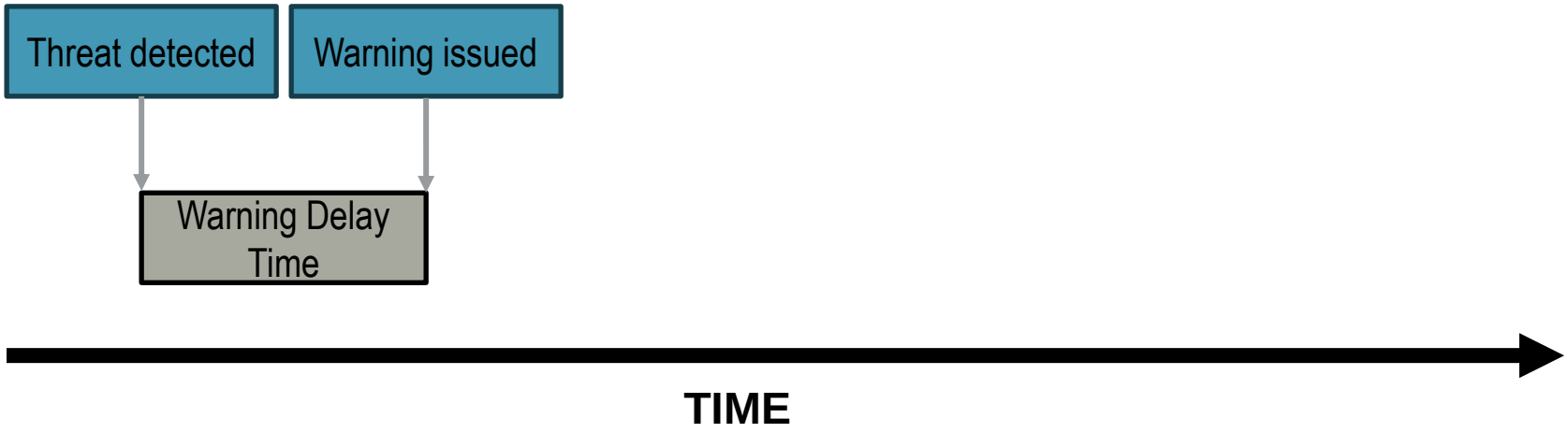
EVALUATE RISK

LifeSim



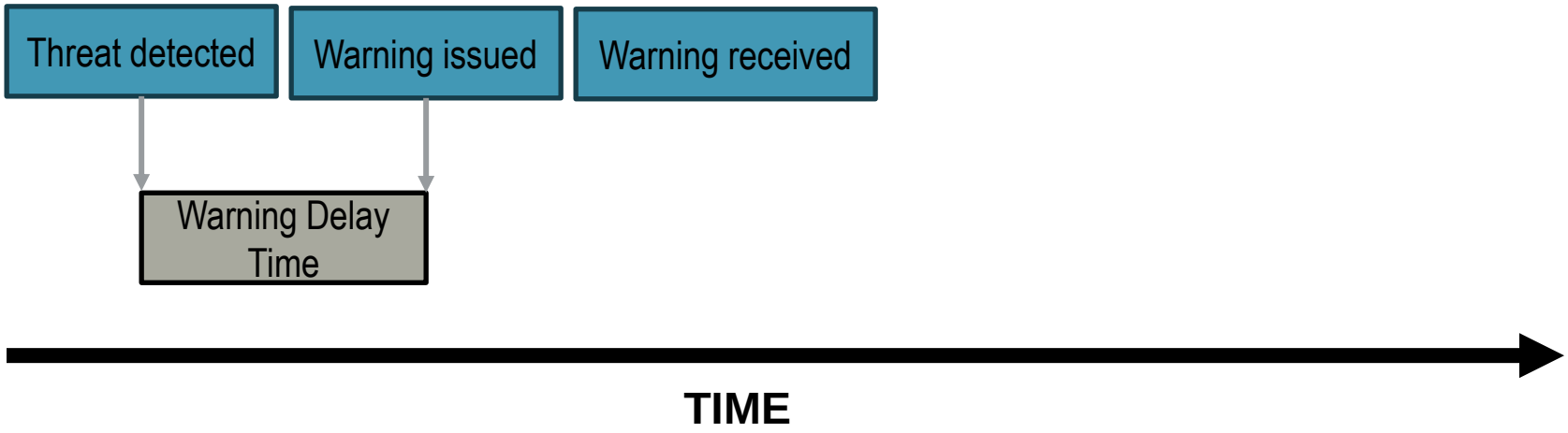
EVALUATE RISK

LifeSim



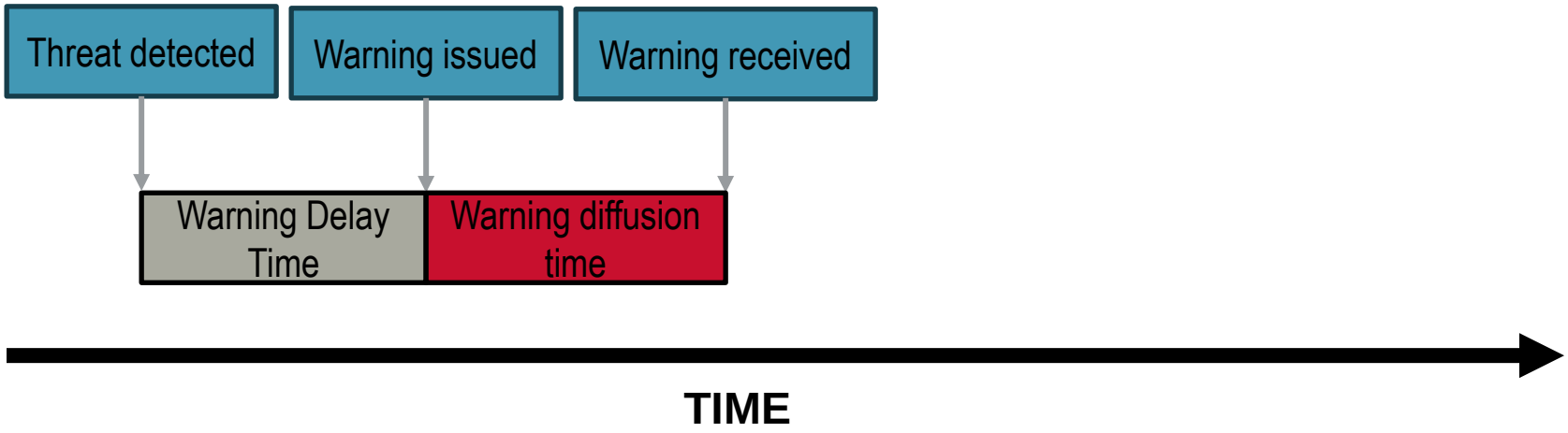
EVALUATE RISK

LifeSim



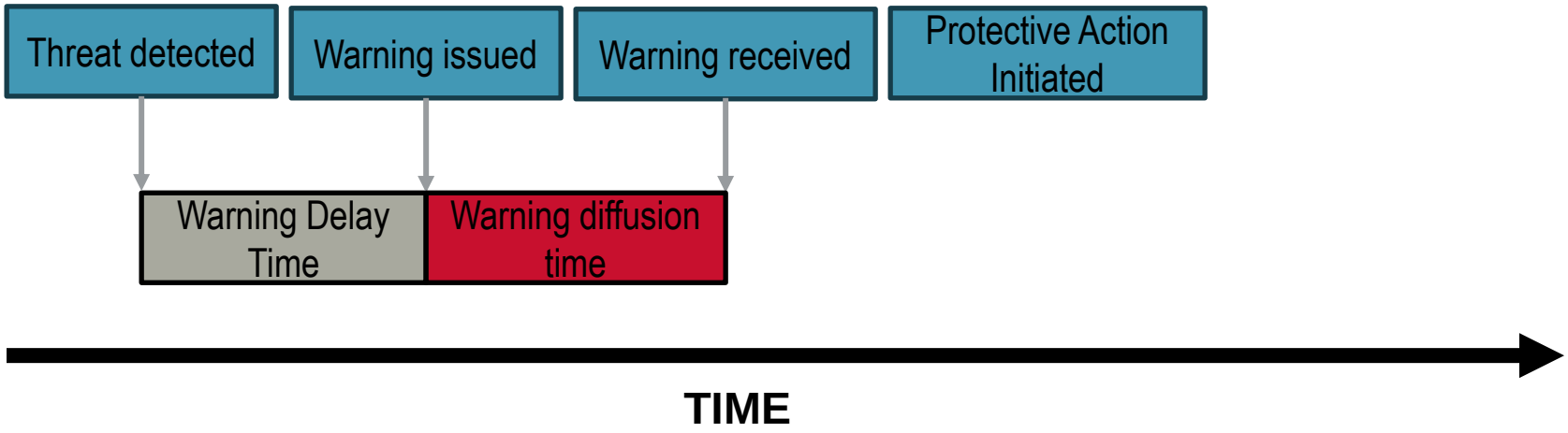
EVALUATE RISK

LifeSim



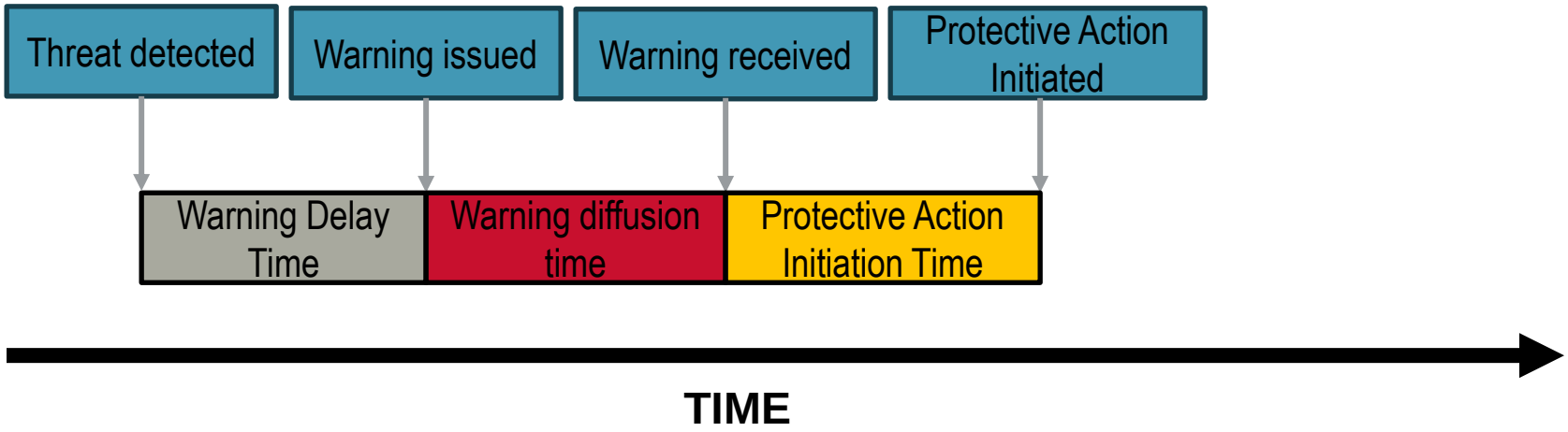
EVALUATE RISK

LifeSim



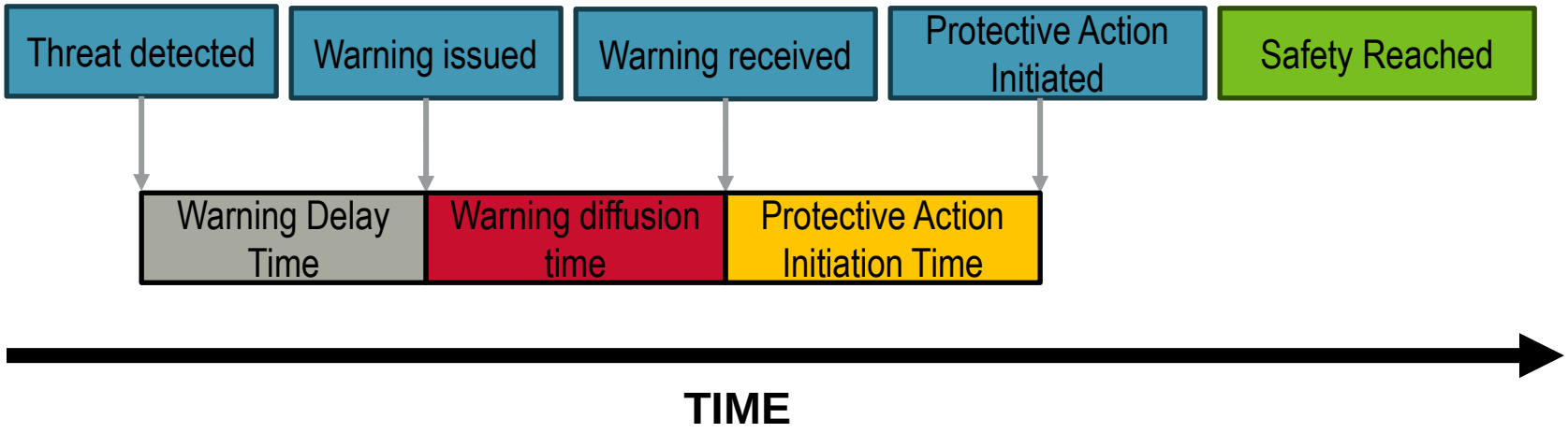
EVALUATE RISK

LifeSim



EVALUATE RISK

LifeSim



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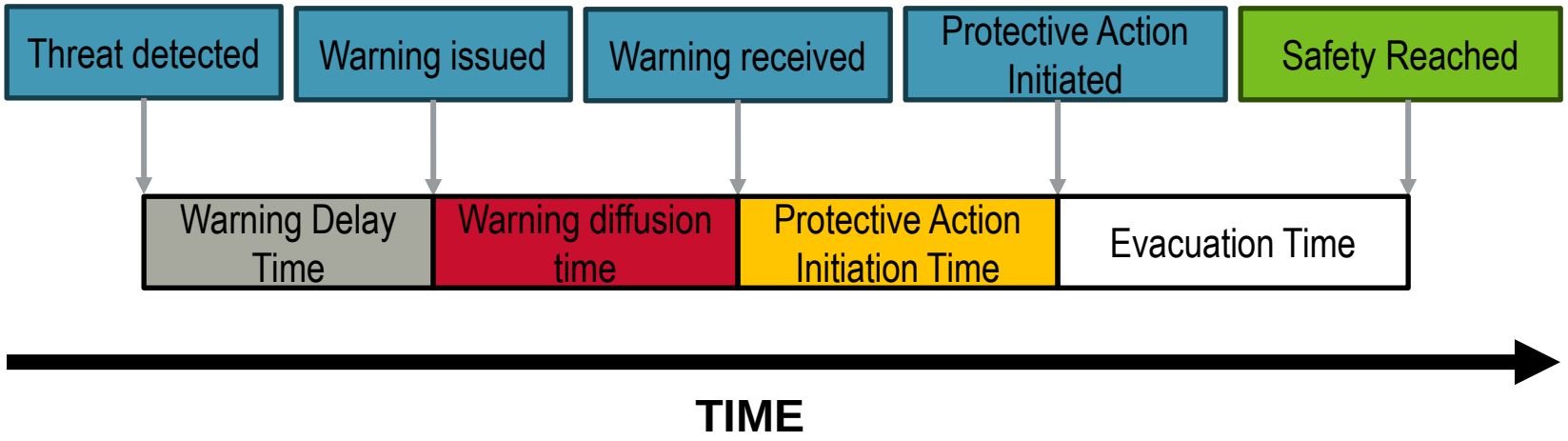
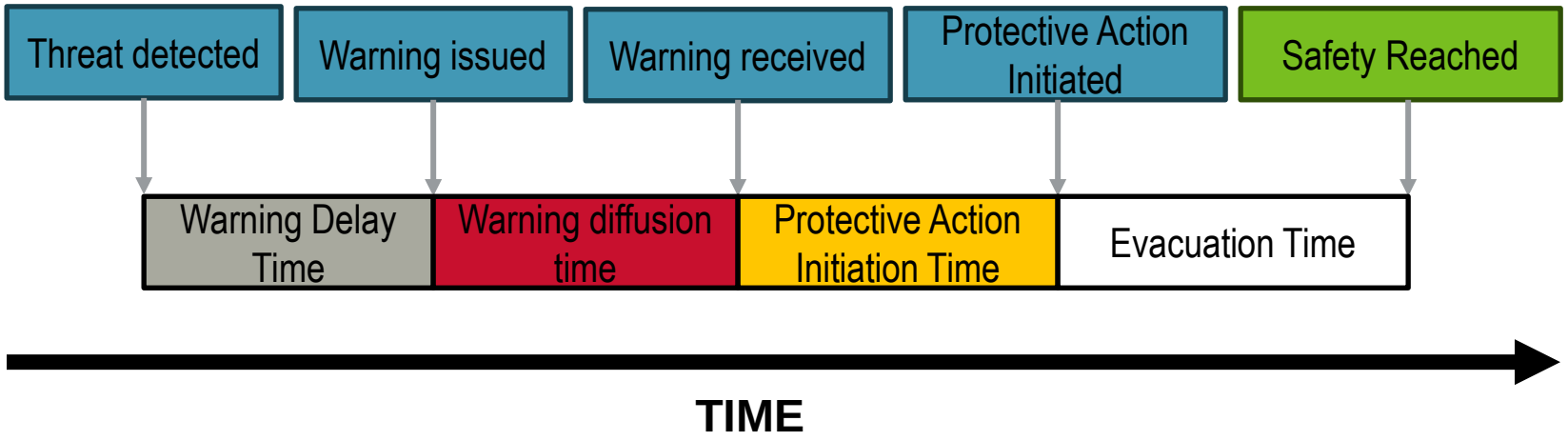
LifeSim



EVALUATE RISK

LifeSim



Flood wave simulated – are people and vehicles caught?

EVALUATE RISK
LifeSim

- Stability criteria for humans, vehicles and structures
  - What is the severity of the risk?

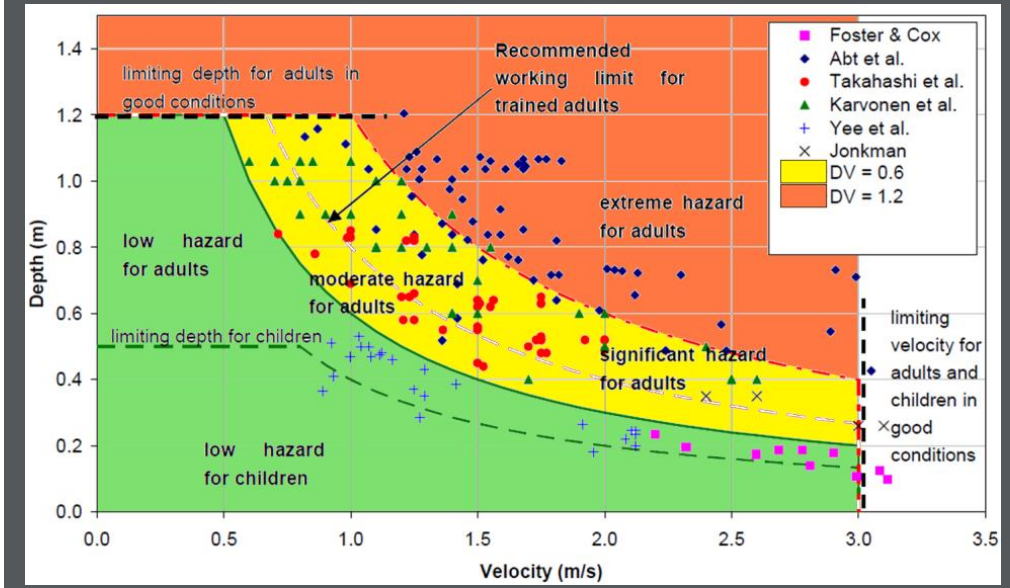


Figure courtesy of U.S. Army Corps of Engineers

EVALUATE RISK
LifeSim

- Stability criteria for humans, vehicles and structures
  - What is the severity of the risk?

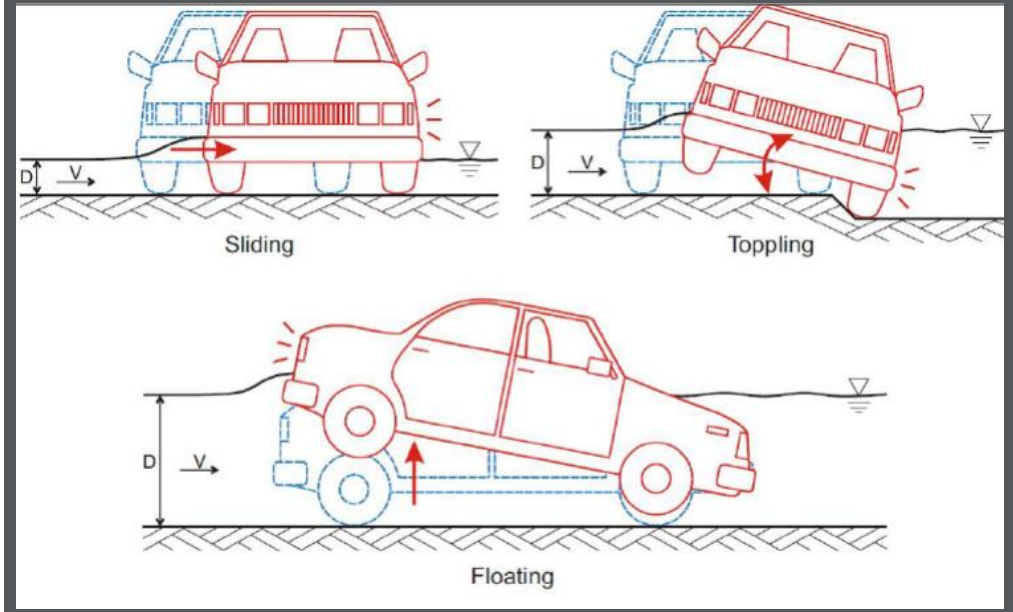


Figure courtesy of U.S. Army Corps of Engineers

COMMUNICATE RISK

LifeSim

- Program calculates the population at risk and loss of life
- Visualize the results of the simulation in plan view
  - Identify ‘hot spots’ with the greatest LOL
  - Progression of flood wave
  - Traffic

LOL	Risk Level
0-10	1
10-100	2
100-1000	3
1000-10000	4

RISK INFORMED DECISIONS

- Dam safety workshops
- Dam Operations
- Classify the hazard level of a dam
- Set priorities for maintenance and improvements

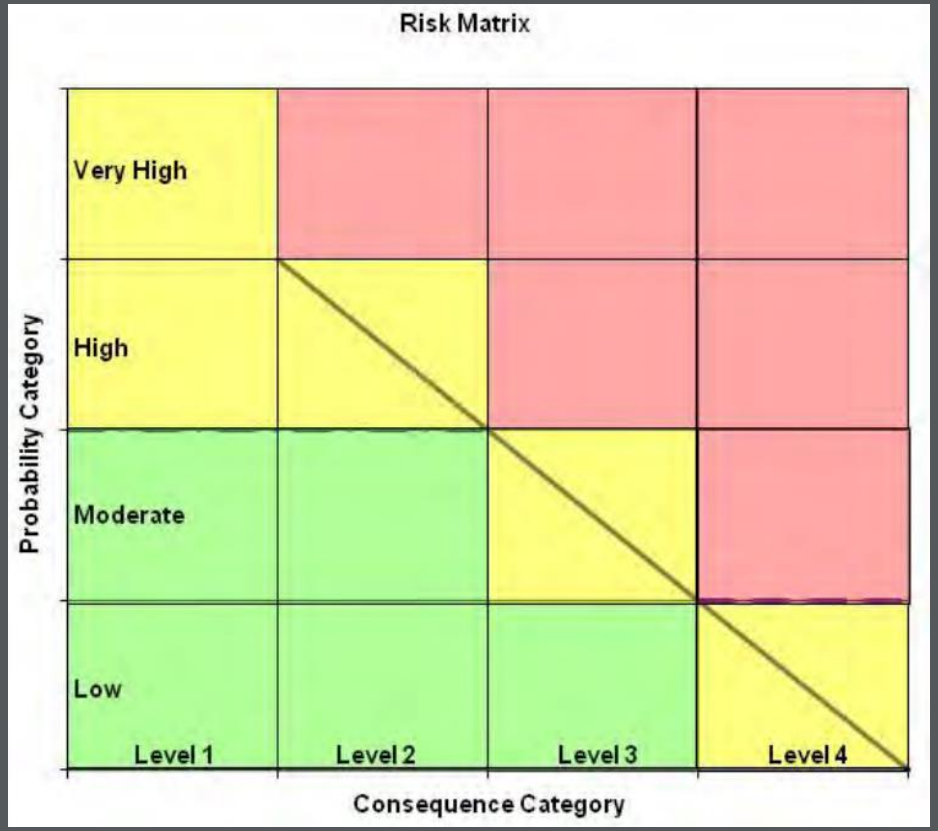


Figure courtesy of FERC

RISK INFORMED DECISIONS

- Dam safety workshops
- Dam Operations
- Classify the hazard level of a dam
- Set priorities for maintenance and improvements

LOL	Probability	Risk Level
5	High	1
50	High	2
300	Moderate	3
3000	moderate	4

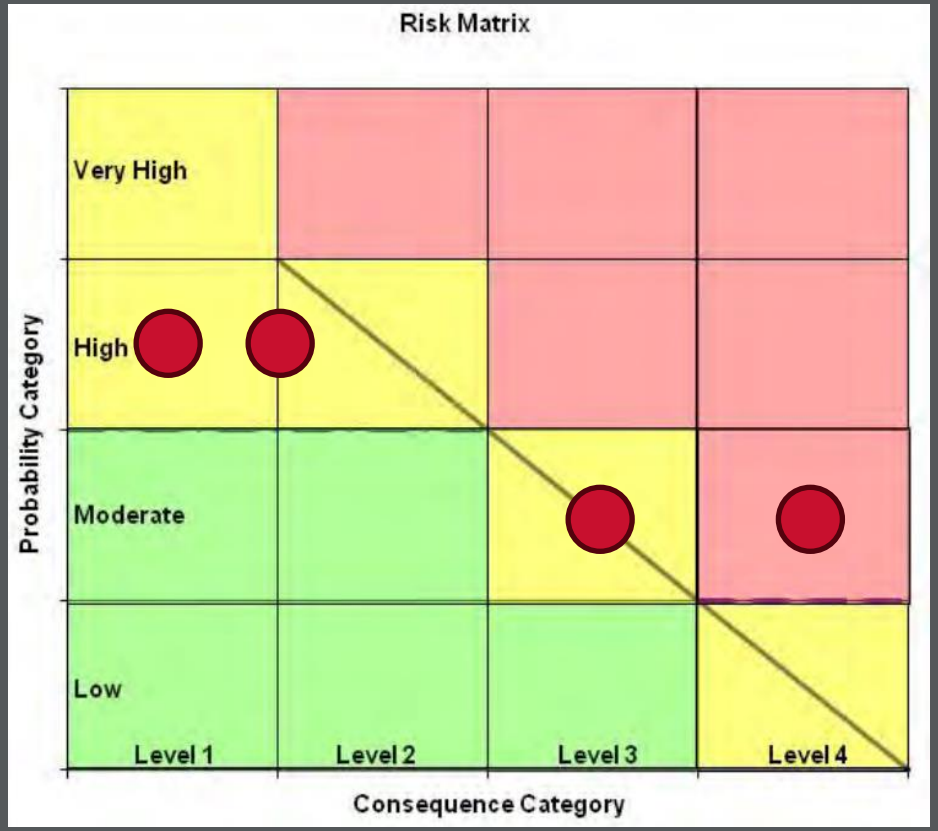


Figure courtesy of FERC