

Dam Safety 101

National Dam Safety Program Technical Seminar | E8535



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Dam Safety 101 (2)

- The Basics
- The Problems
- The Data
- The Decisions

The Basics

The Basics (2)

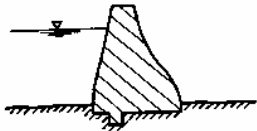
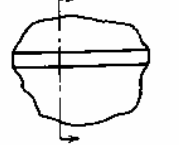
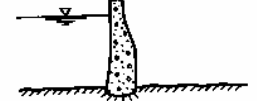
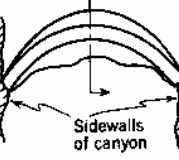
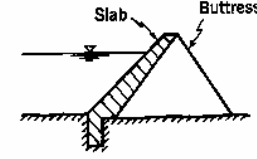
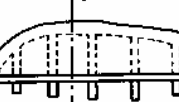
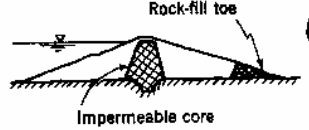
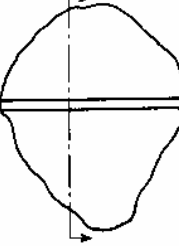
- What is a dam?
- What are the different types?
- What are they made of?
- How does it work?
- Why do we have them?



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The Basics (3)

- What is a dam?
- What are the different types?
- What are they made of?
- How does it work?
- Why do we have them?

Type	Material	Sectional View	Plan (Top View)
Gravity	Concrete, rubble masonry		
Arch	Concrete		
Buttress	Concrete also timber and steel)		
Embankment	Earth or rock		



The Basics (4)

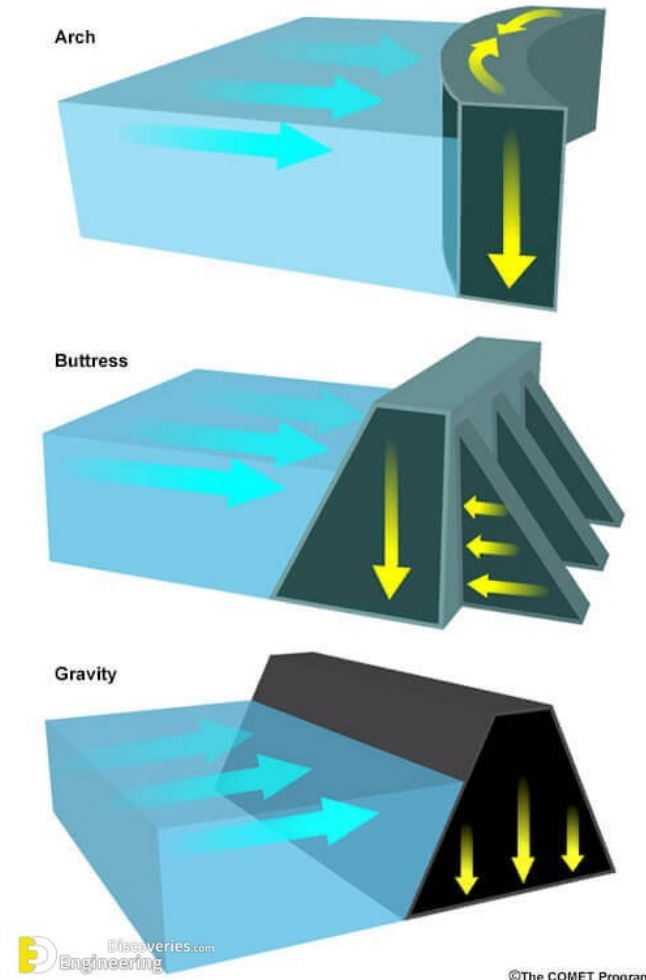
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The Basics (5)

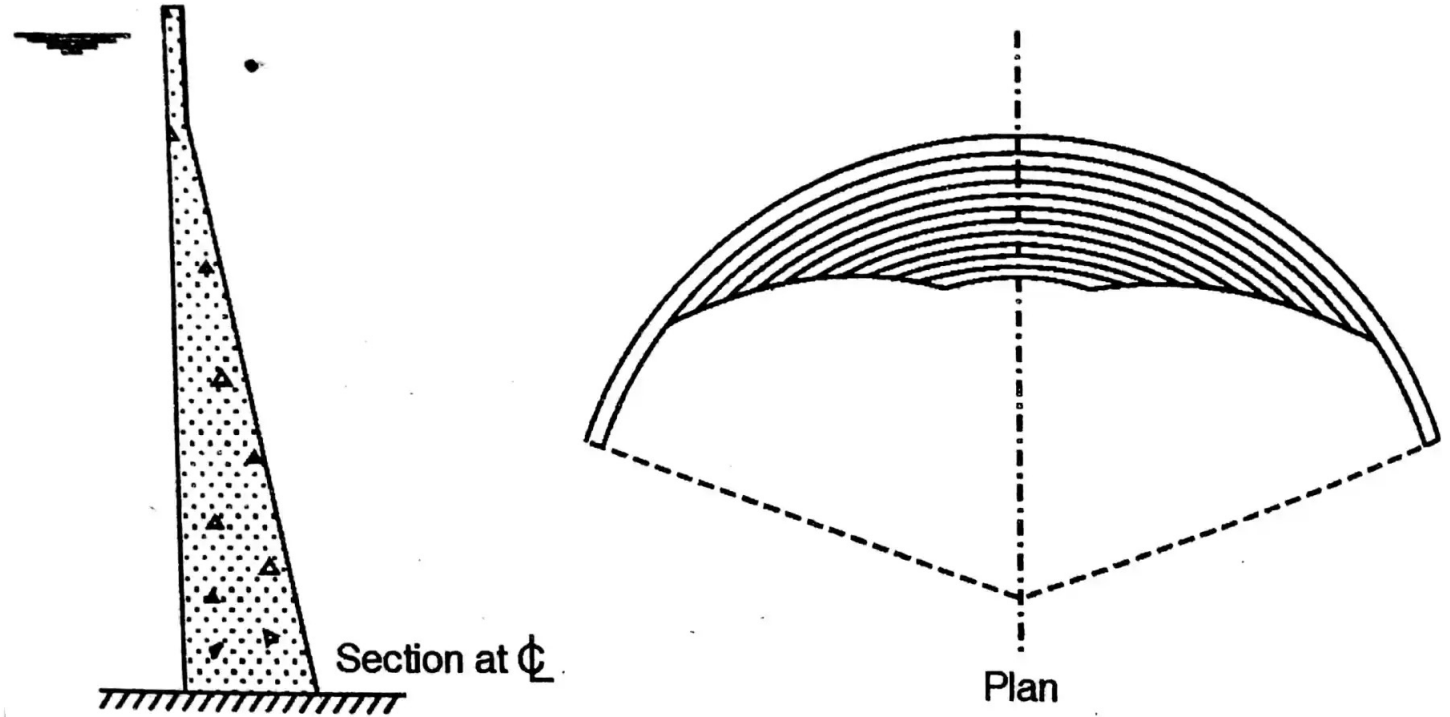
- What is a dam?
- What are the different types?
- What are they made of?
- How does it work?
- Why do we have them?



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The Basics – Arch Dams

- What is a dam?
- What are the different types?
- What are they made of?
- How does it work?
- Why do we have them?



Materials, Types & How it works

- Concrete double arch dam
- Concrete single arch dam
- Cobble/masonry single arch dam



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Materials, Types & How it works (2)

- Concrete double arch dam
- Concrete single arch dam
- Cobble/masonry single arch dam



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Materials, Types & How it works (3)

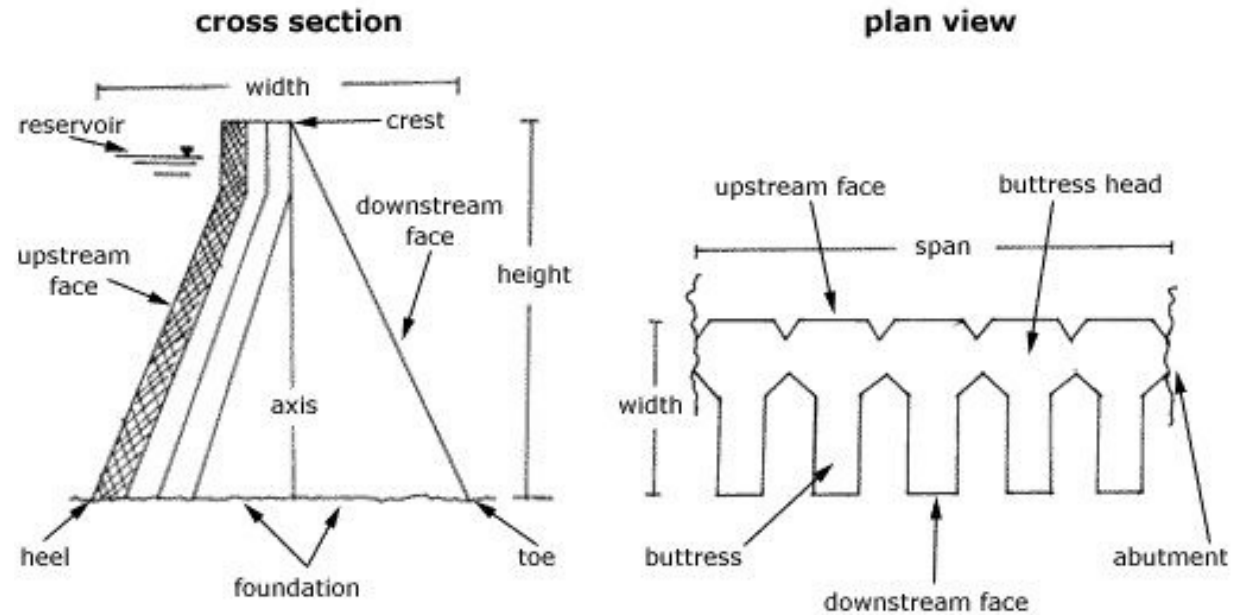
- Concrete double arch dam
- Concrete single arch dam
- Cobble/masonry single arch dam



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The Basics – Buttress Dams

- What is a dam?
- What are the different types?
- What are they made of?
- How does it work?
- Why do we have them?



Materials, Types & How it works (4)

- Concrete buttress dam
- Steel buttress dam
- Cobble/masonry buttress dam
- Wood stave/timber crib dam



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Materials, Types & How it works (5)

- Concrete buttress dam
- Steel buttress dam
- Cobble/masonry buttress dam
- Wood stave/timber crib dam



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Materials, Types & How it works (6)

- Concrete buttress dam
- Steel buttress dam
- Cobble/masonry buttress dam
- Wood stave/timber crib dam



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Materials, Types & How it works (7)

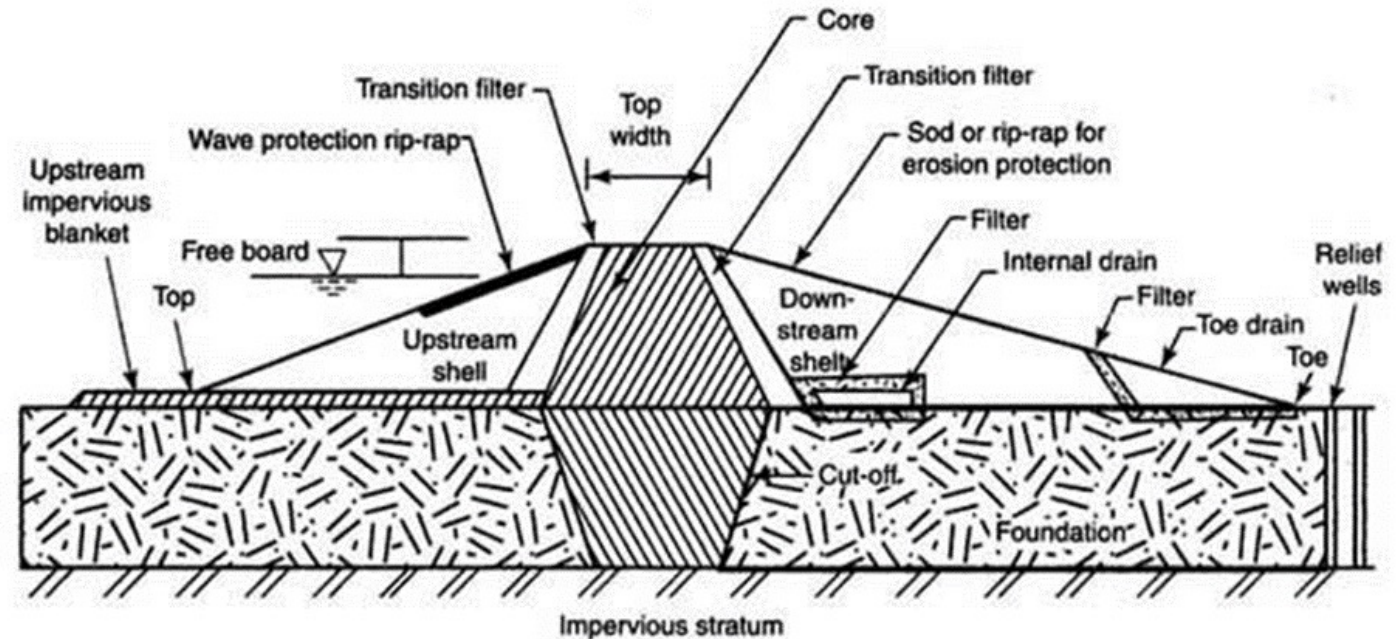
- Concrete buttress dam
- Steel buttress dam
- Cobble/masonry buttress dam
- Wood stave/timber crib dam



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The Basics – Gravity Dams

- What is a dam?
- What are the different types?
- What are they made of?
- How does it work?
- Why do we have them?



Note : Not all of the above ordinarily would be incorporated in any one dam



Materials, Types & How it works (8)

- Earthen embankment gravity dam
- Rock fill embankment gravity dam
- Mass concrete gravity dam
- RCC gravity dam
- Cobble gravity dam
- Masonry gravity dam



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Materials, Types & How it works (9)

- Earthen embankment gravity dam
- Rock fill embankment gravity dam
- Mass concrete gravity dam
- RCC gravity dam
- Cobble gravity dam
- Masonry gravity dam



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Materials, Types & How it works (10)

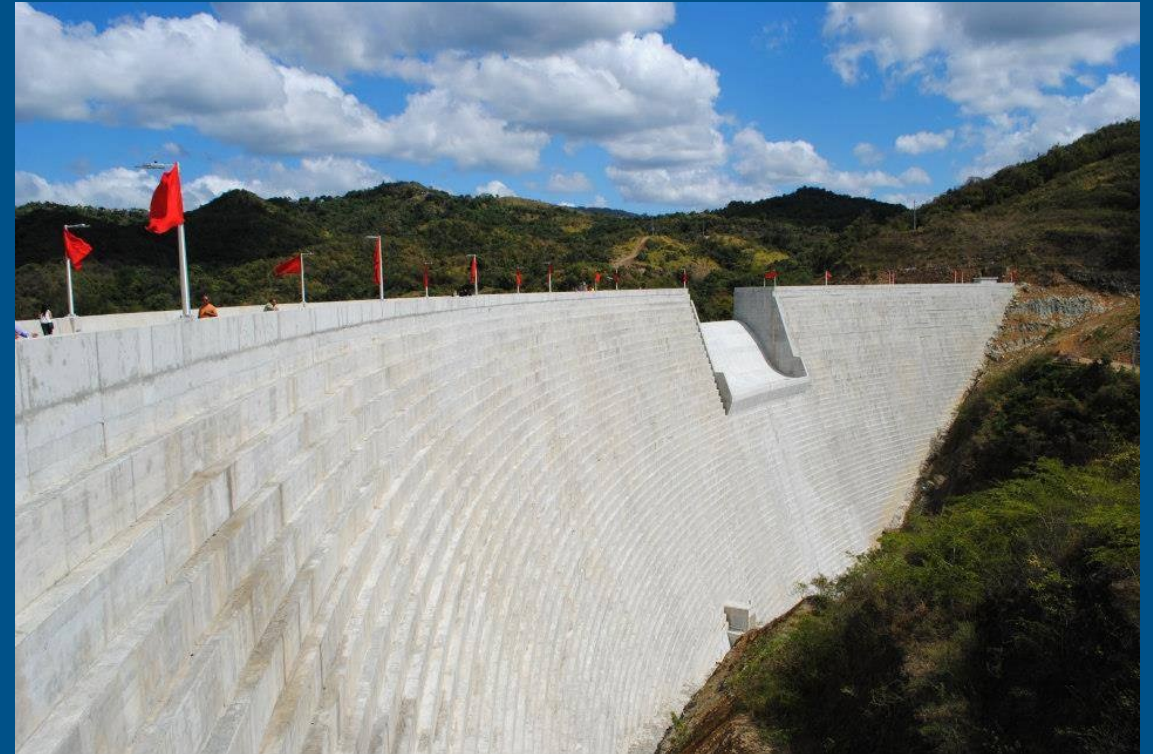
- Earthen embankment gravity dam
- Rock fill embankment gravity dam
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- Cobble gravity dam
- Masonry gravity dam



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Materials, Types & How it works (11)

- Earthen embankment gravity dam
- Rock fill embankment gravity dam
- Mass concrete gravity dam
- RCC gravity dam
- Cobble gravity dam
- Masonry gravity dam



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Materials, Types & How it works (12)

- Earthen embankment gravity dam
- Rock fill embankment gravity dam
- Mass concrete gravity dam
- RCC gravity dam
- Cobble/Masonry gravity dam
- Stacked cobble gravity dam
- Stacked rock gravity dam



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Materials, Types & How it works (13)

- Earthen embankment gravity dam
- Rock fill embankment gravity dam
- Mass concrete gravity dam
- RCC gravity dam
- Cobble/Masonry gravity dam
- Stacked cobble gravity dam
- Stacked rock gravity dam



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Materials, Types & How it works (14)

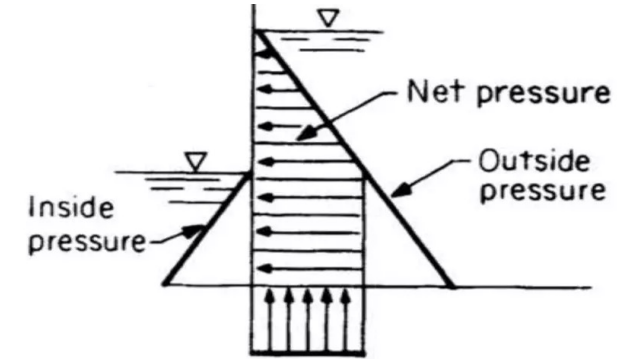
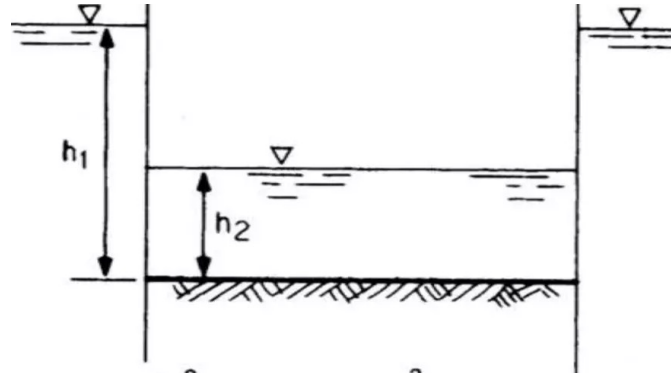
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- Stacked rock gravity dam



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The Basics – Other Dams

- What is a dam?
- What are the different types?
- What are they made of?
- How does it work?
- Why do we have them?



Materials, Types & How it works (15)

- Sheet Pile Cofferdam
- Braced Cofferdams
- Inflatable rubber dam
- Mass timber/arch dam



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Materials, Types & How it works (16)

- Sheet Pile Cofferdam
- Braced Cofferdams
- Inflatable rubber dam
- Mass timber/arch dam



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Materials, Types & How it works (17)

- Sheet Pile Cofferdam
- Braced Cofferdams
- Inflatable rubber dam
- Mass timber/arch dam



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Materials, Types & How it works (18)

- Sheet Pile Cofferdam
- Braced Cofferdams
- Inflatable rubber dam
- Mass timber/arch dam



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The Basics (6)

- What is a dam?
- What are the different types?
- What are they made of?
- How does it work?
- Why do we have them?



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The Basics (7)

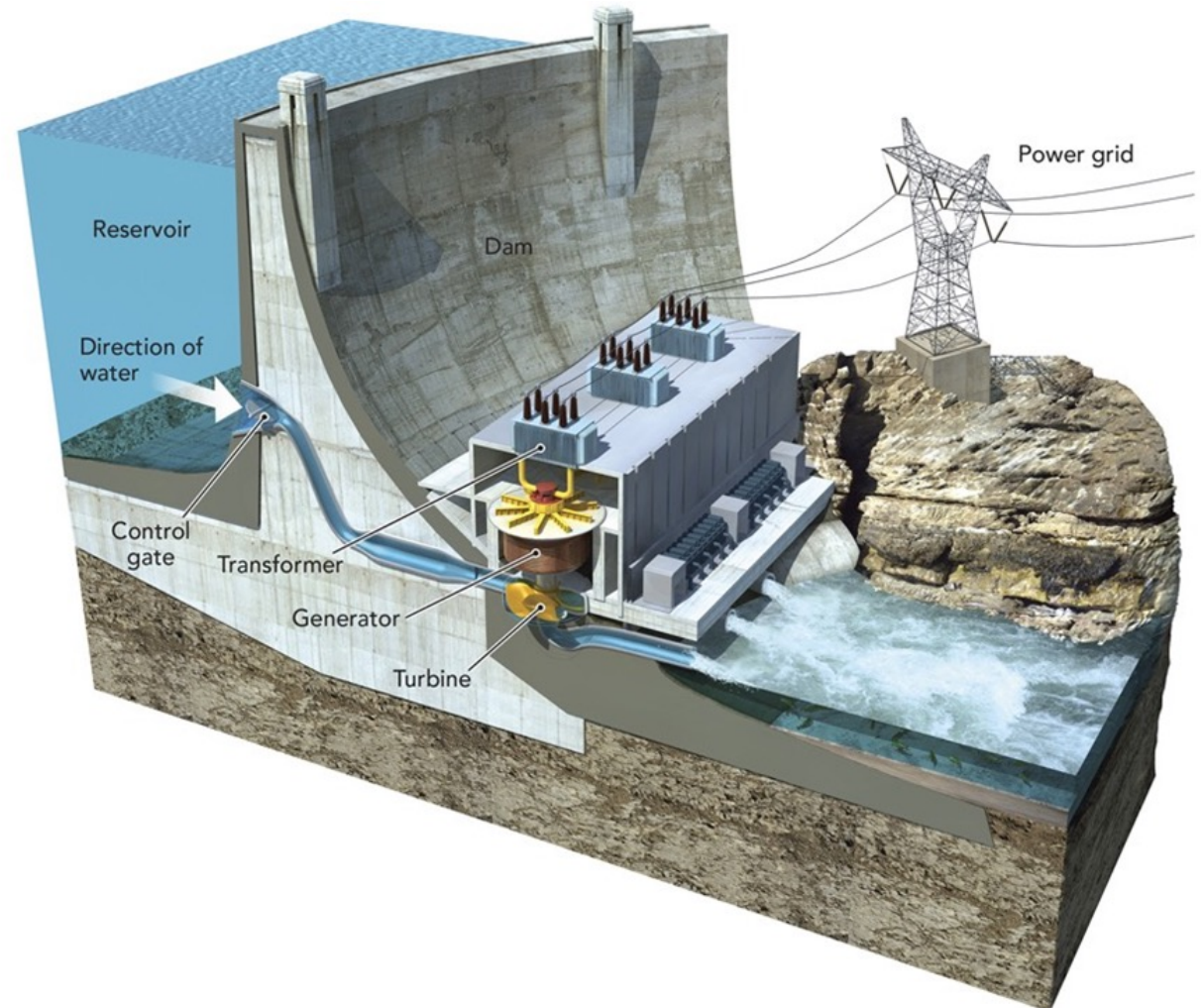
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- Why do we have them?



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The Basics (8)

- What is a dam?
- What are the different types?
- What are they made of?
- How does it work?
- Why do we have them?



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The Problems

The Problems (2)

- What is a failure?
- What are the causes of failure?
- What are potential failure modes?
- What happens when they fail?
- What can we do?



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Failure:

- “An uncontrolled release of water”

The Problems (3)

- What is a failure?
- What are the causes of failure?
- What are potential failure modes?
- What happens when they fail?
- What can we do?

Cyclic changes in reservoir elevation and temperature combined with time that affect the health of the dam

Poor design, construction or maintenance practices

Humans- ignoring data/observations



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The Problems (4)

- What is a failure?
- What are the causes of failure?
- What are potential failure modes?
- What happens when they fail?
- What can we do?

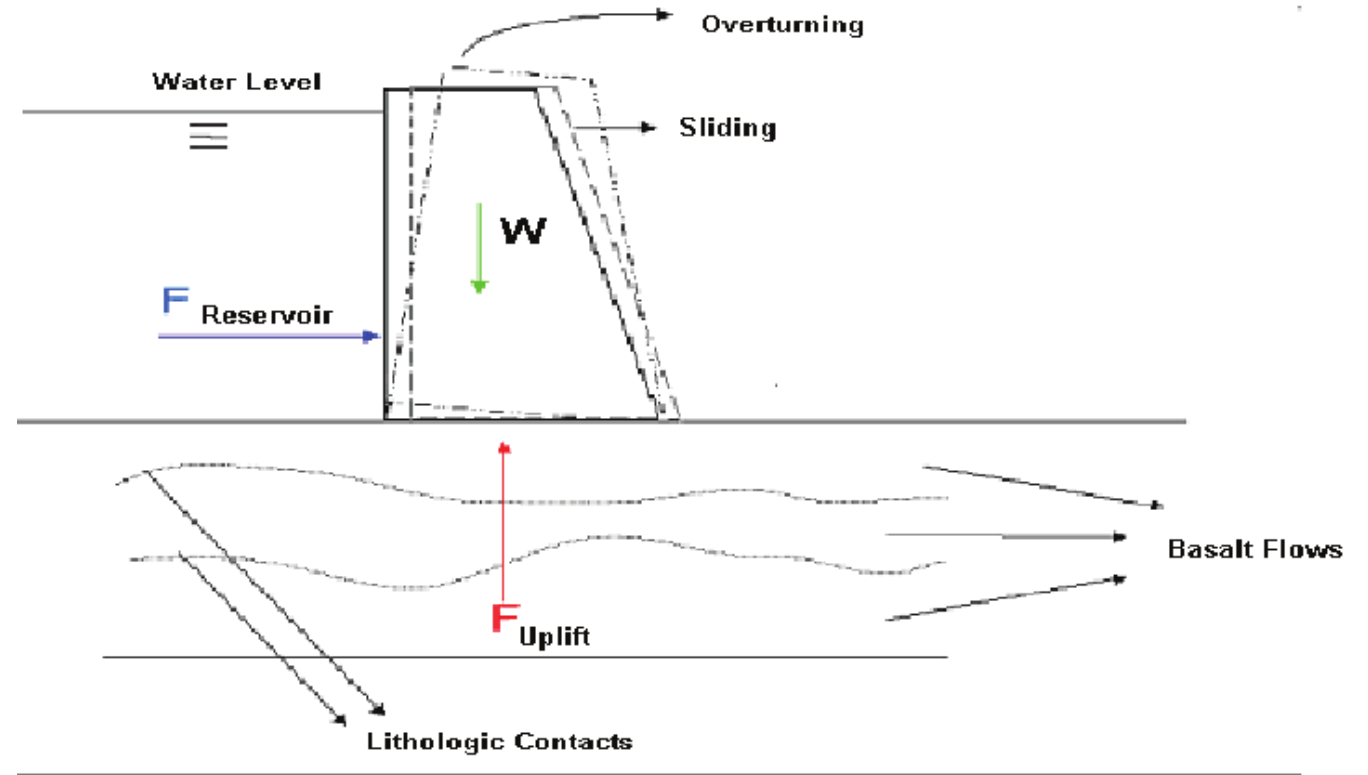
To err is human, to kill a dam is also human- Sharon



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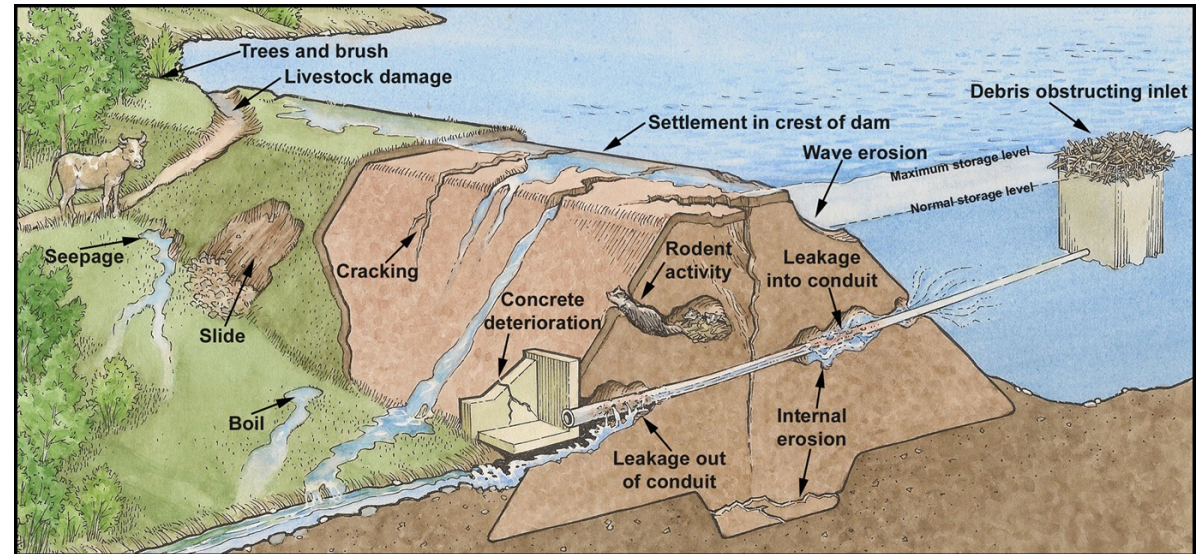
The Problems (5)

- What is a failure?
- What are the causes of failure?
- What are potential failure modes?
- What happens when they fail?
- What can we do?



The Problems (6)

- What is a failure?
- What are the causes of failure?
- What are potential failure modes?
- What happens when they fail?
- What can we do?



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Failure Modes

- Overtopping
- Seepage/Piping
- Boils
- Design Flaw
- Delamination/Insufficient Strength
- Uplift
- Delayed Maintenance



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Failure Mechanisms

- Overtopping
- Seepage/Piping
- Boils
- Design Flaw
- Delamination/Insufficient Strength
- Uplift
- Delayed Maintenance



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Failure Mechanisms (2)

- Overtopping
- Seepage/Piping
- Boils
- Design Flaw
- Delamination/Insufficient Strength
- Uplift
- Delayed Maintenance



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Failure Mechanisms (3)

- Overtopping
- Seepage/Piping
- Boils
- Design Flaw
- Delamination/Insufficient Strength
- Uplift
- Delayed Maintenance



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Failure Mechanisms (4)

- Overtopping
- Seepage/Piping
- Boils
- Design Flaw
- Delamination/Insufficient Strength
- Uplift
- Delayed Maintenance



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Failure Mechanisms (5)

- Overtopping
- Seepage/Piping
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Failure Mechanisms (6)

- Overtopping
- Seepage/Piping
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The Problems (7)

- What is a failure?
- What are the causes of failure?
- What are potential failure modes?
- What happens when they fail?
- What can we do?



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The Problems (8)

- What is a failure?
- What are the causes of failure?
- What are potential failure modes?
- What happens when they fail?
- What can we do?



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The Problems (9)

- What is a failure?
- What are the causes of failure?
- What are potential failure modes?
- What happens when they fail?
- What can we do?



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The Problems (10)

- What is a failure?
- What are the causes of failure?
- What are potential failure modes?
- What happens when they fail?
- What can we do?



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The Problems (11)

- What is a failure?
- What are the causes of failure?
- What are potential failure modes?
- What happens when they fail?
- What can we do?



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The Problems (12)

- What is a failure?
- What are the causes of failure?
- What are potential failure modes?
- What happens when they fail?
- What can we do?



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The Problems (13)

- What is a failure?
- What are the causes of failure?
- What are potential failure modes?
- What happens when they fail?
- What can we do?



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The Problems (14)

- What is a failure?
- What are the causes of failure?
- What are potential failure modes?
- What happens when they fail?
- What can we do?



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The Problems (15)

- What is a failure?
- What are the causes of failure?
- What are potential failure modes?
- What happens when they fail?
- What can we do?



The Data

The Data (2)

- How do Potential Failure Modes guide the monitoring?
- What types of monitoring is there?
- What can we learn from the data?
- What does the data not tell me?
- What are leading indicators of failure?



The Data (3)

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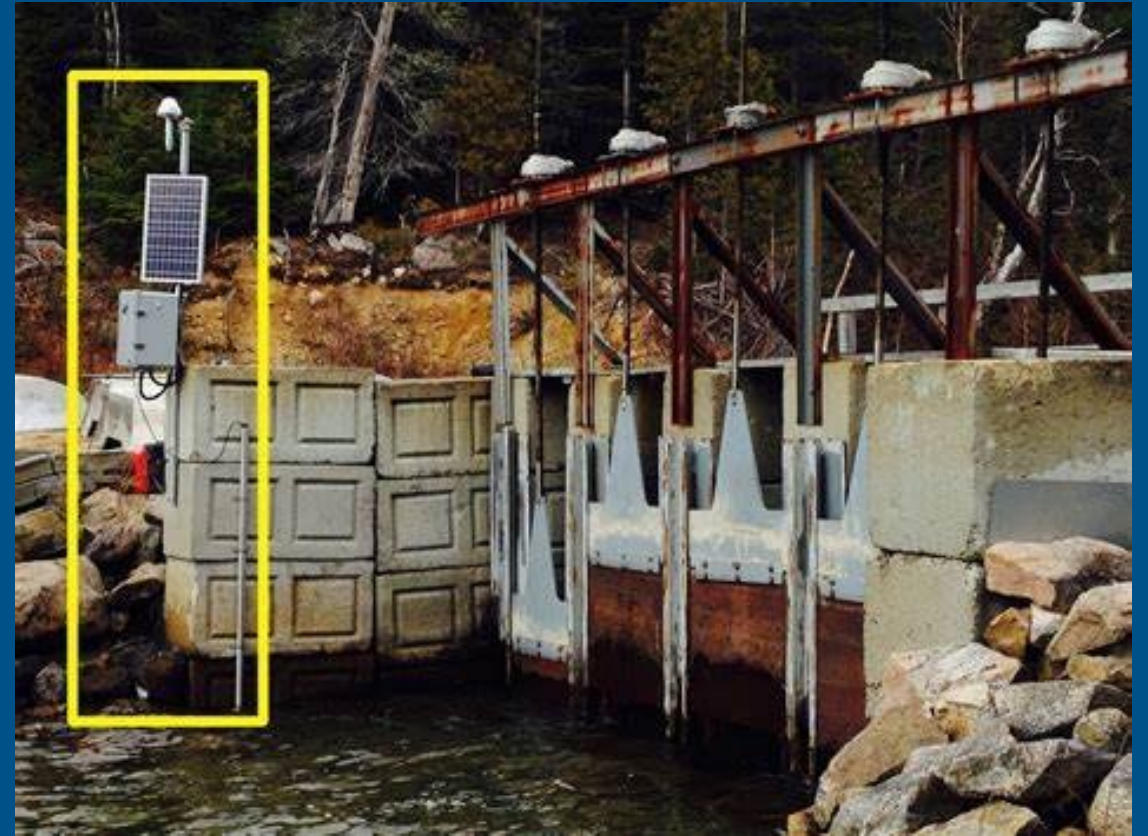
Surveillance & Monitoring

- In-person inspections
- Remote inspections
- Survey
- Weirs
- Piezometers
- Inclinerometers
- Crack Gages



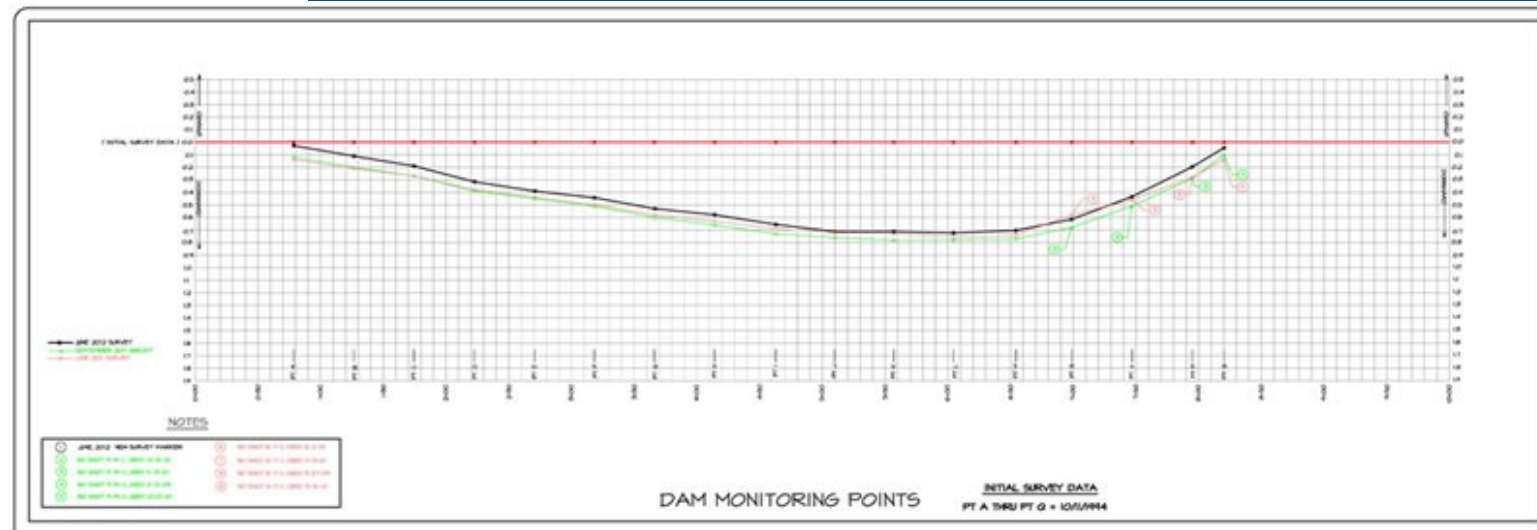
Surveillance & Monitoring (2)

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Surveillance & Monitoring (3)

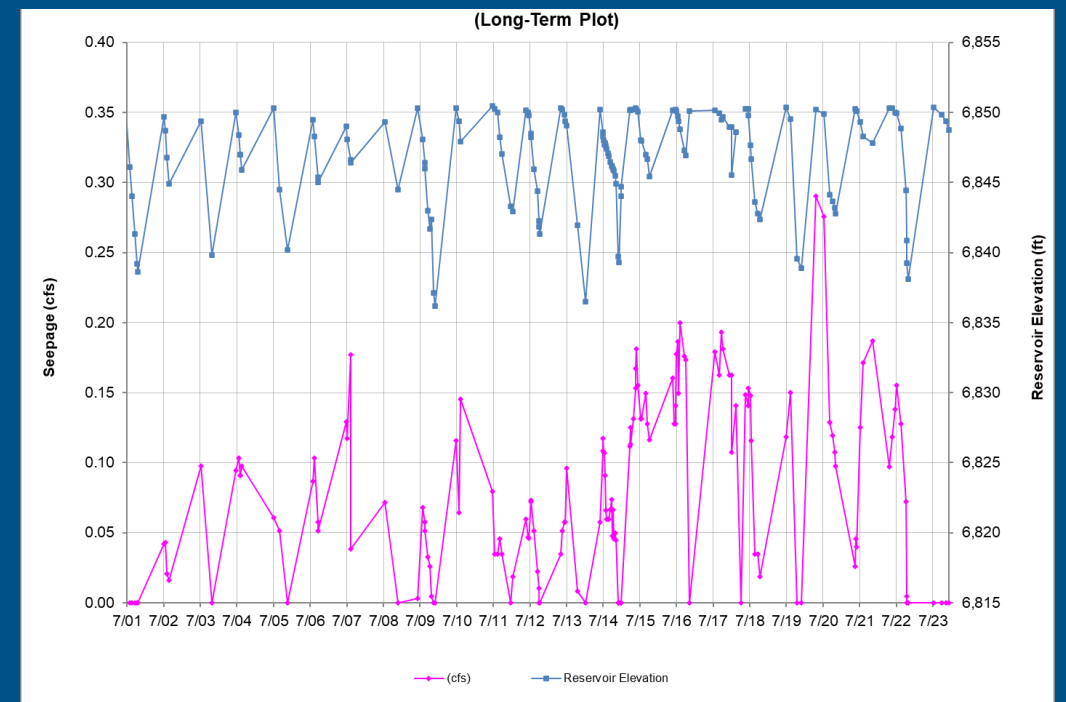
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Surveillance & Monitoring (4)

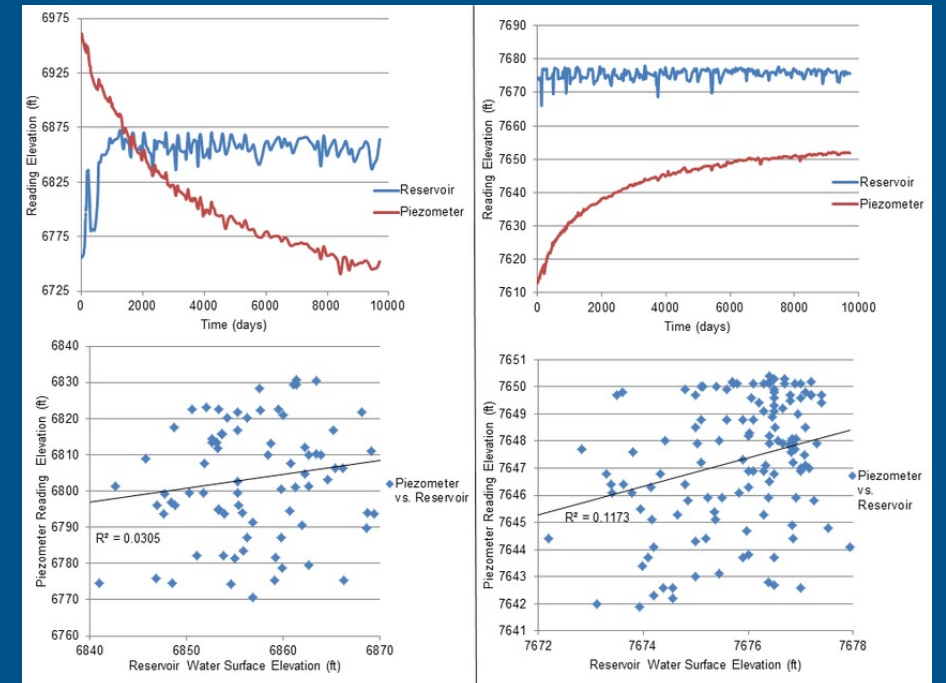
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Surveillance & Monitoring (5)

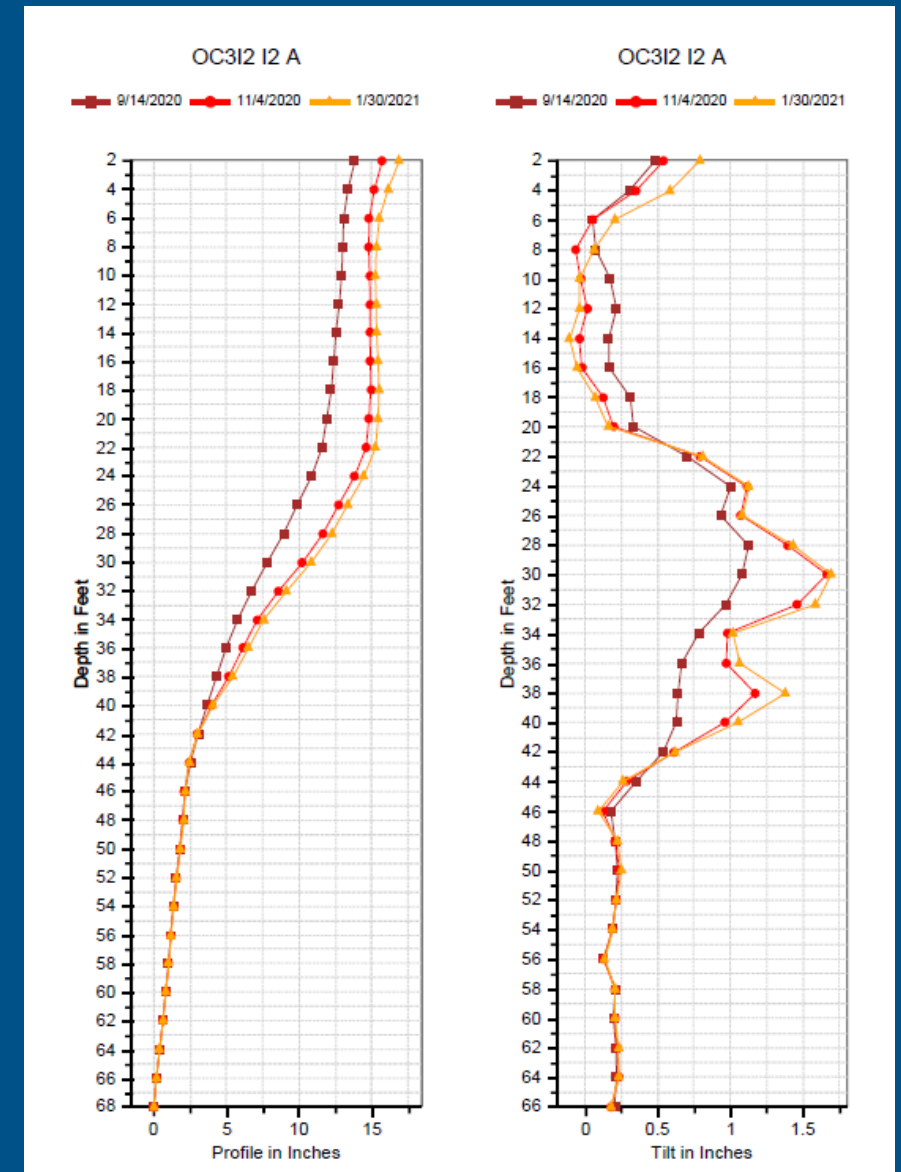
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Surveillance & Monitoring (6)

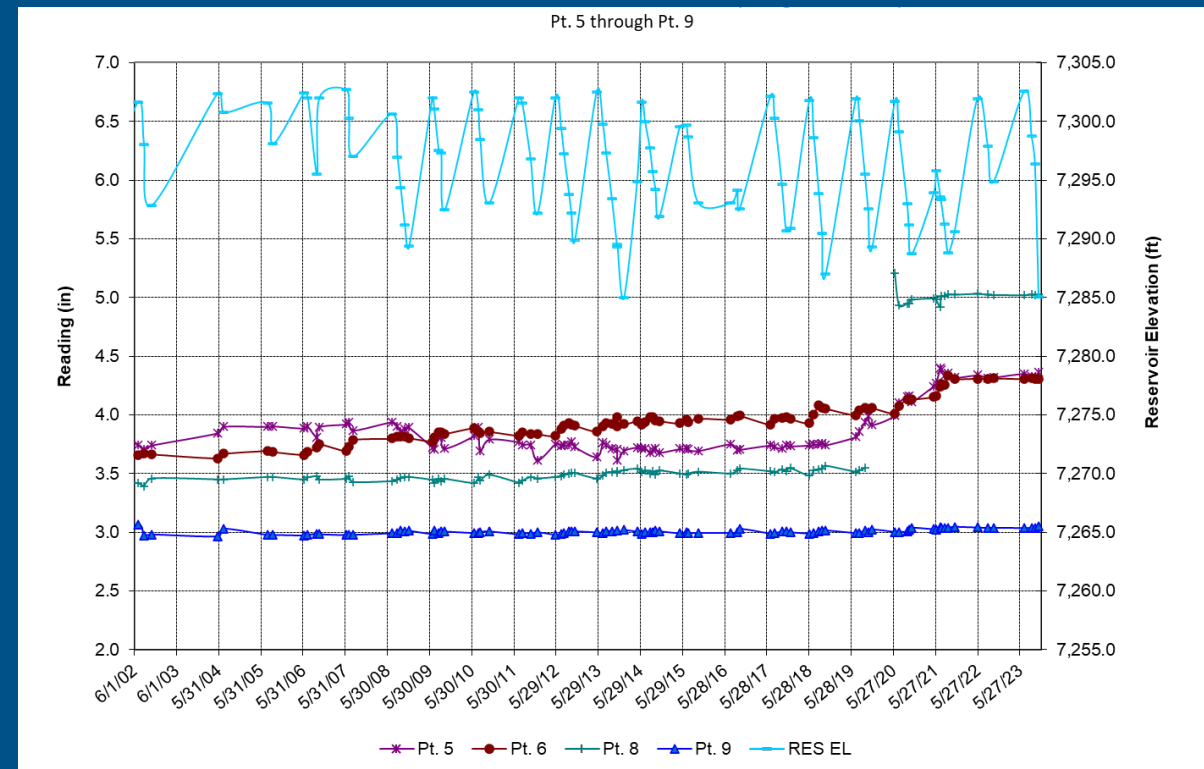
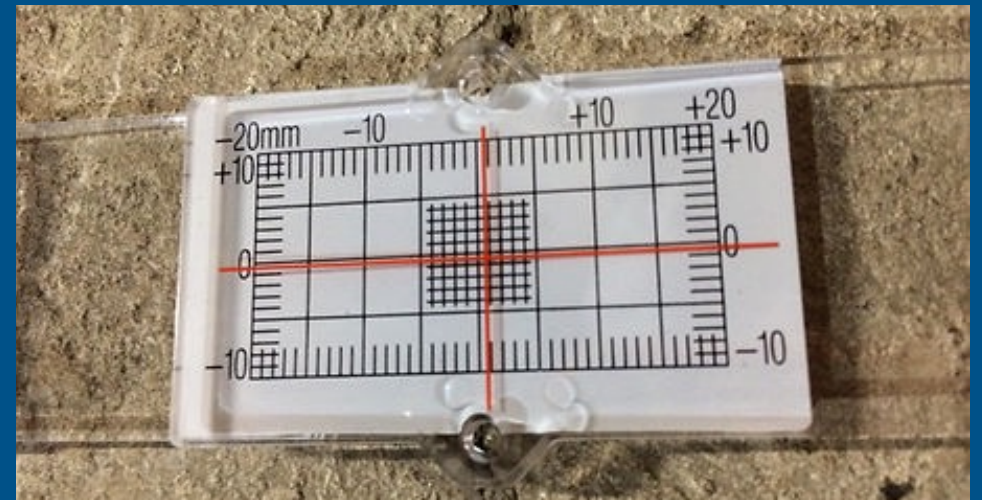
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Surveillance & Monitoring (7)

- In-person inspections
- Remote inspections
- Survey
- Weirs
- Piezometers
- Inclinerometers
- Crack Gages



The Data (4)

- How do Potential Failure Modes guide the monitoring?
- What types of monitoring is there?
- **What can we learn from the data?**
- What does the data not tell me?
- What are leading indicators of failure?

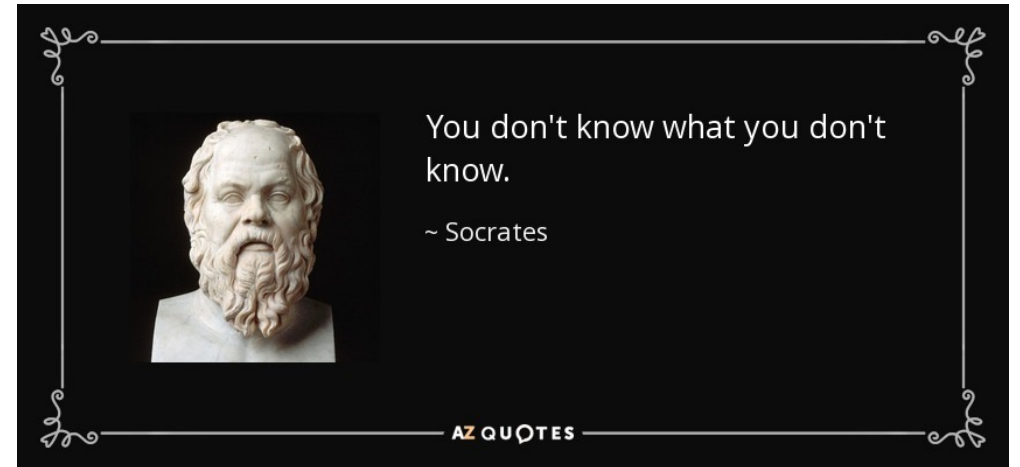
Instrumentation data informs us to the overall health of the dam, by discrete snapshots, in response to changes in temperature, time and reservoir elevation -Sharon



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The Data (5)

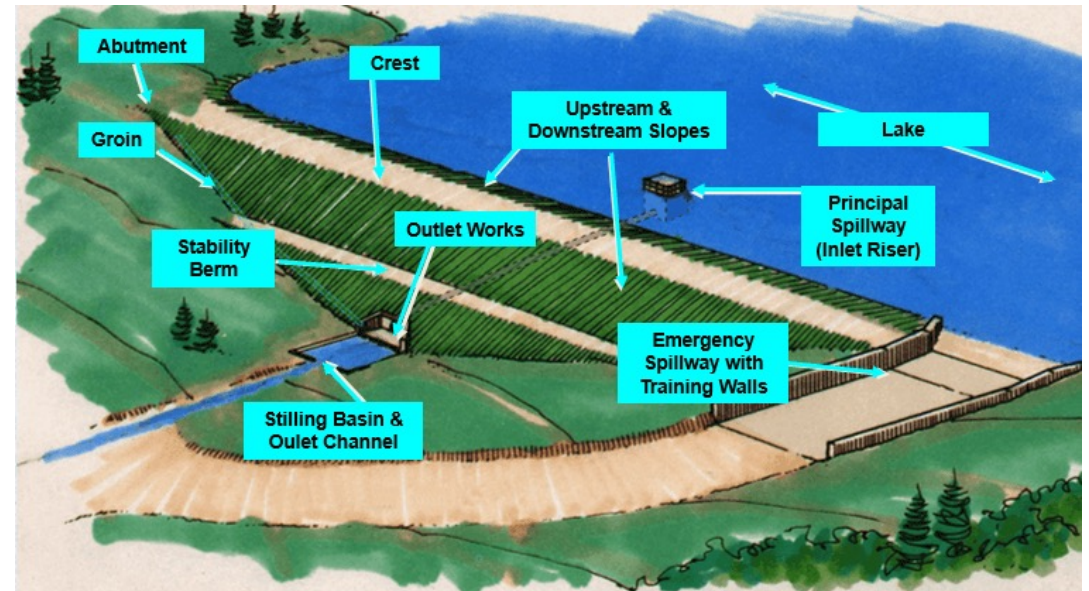
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- What types of monitoring is there?
- What can we learn from the data?
- What does the data not tell me?
- What are leading indicators of failure?



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The Decisions

The Decisions (2)

- When do you build a dam?
- When do you repair a dam?
- When do you remove a dam?



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The Decisions (3)

- When do you build a dam?
- When do you repair a dam?
- When do you remove a dam?



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The Decisions (4)

- When do you build a dam?
- When do you repair a dam?
- When do you remove a dam?



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Thank You!

Contact Information

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National Market Leader – Dams & Hydropower
sharon.roach@meadhunt.com



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