Visual Inspections of Outlet and Drain Conduits on a 5-year Cycle

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In this presentation….

- **Introduction**

In this presentation….

- Introduction
- **Brief history of dams in Montana**

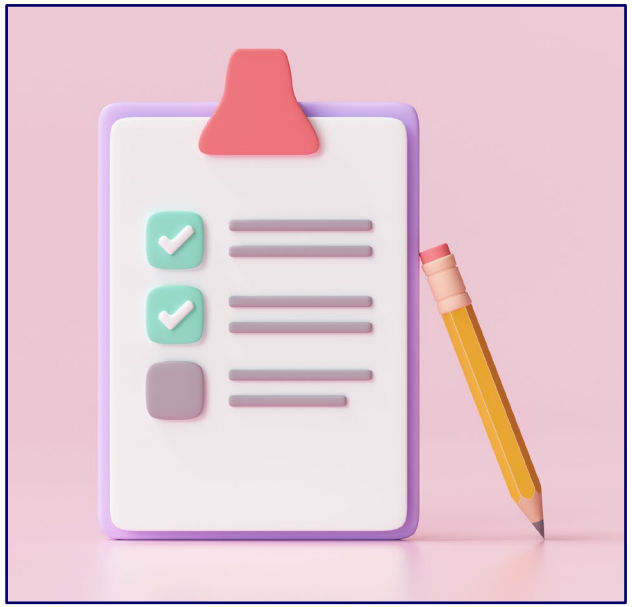
In this presentation….

- Introduction
- Brief history of dams in Montana
- **Case Studies**

Microsoft stock photo

Introduction

Montana currently requires high hazard dam owners to have the outlet and drain conduits on their dams inspected every 5 years, congruent with their 5-year safety evaluations (permit renewal).



Microsoft stock photo

Introduction

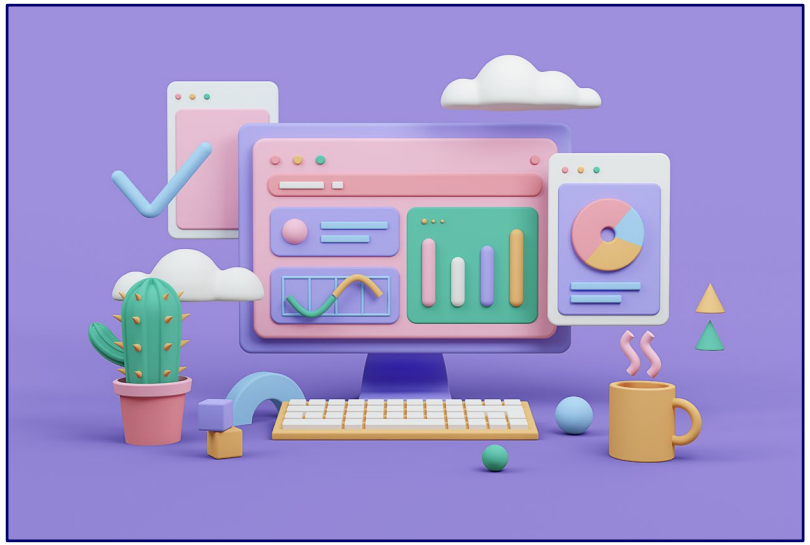
Why does Montana require outlet and drain conduit inspections every 5-years?

Microsoft stock photo

Microsoft stock photo

Introduction

While this high frequency has been questioned, the Montana Dam Safety program has found an alarming statistic.



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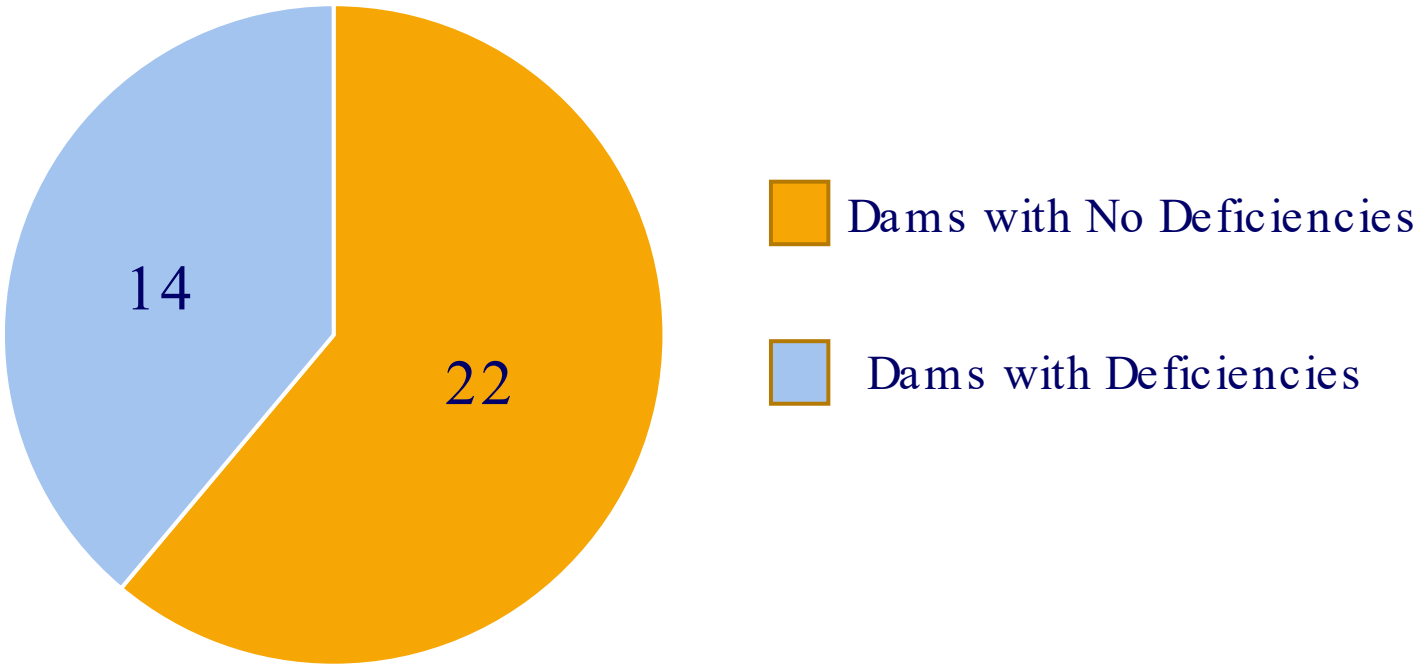
Introduction

Between 2020 and 2023, the Montana Dam Safety program inspected around 36 different structures (conduits/drains).

Introduction

Of those 36 structures (conduits/drains), almost 40% (14) were found to be deficient.



Introduction

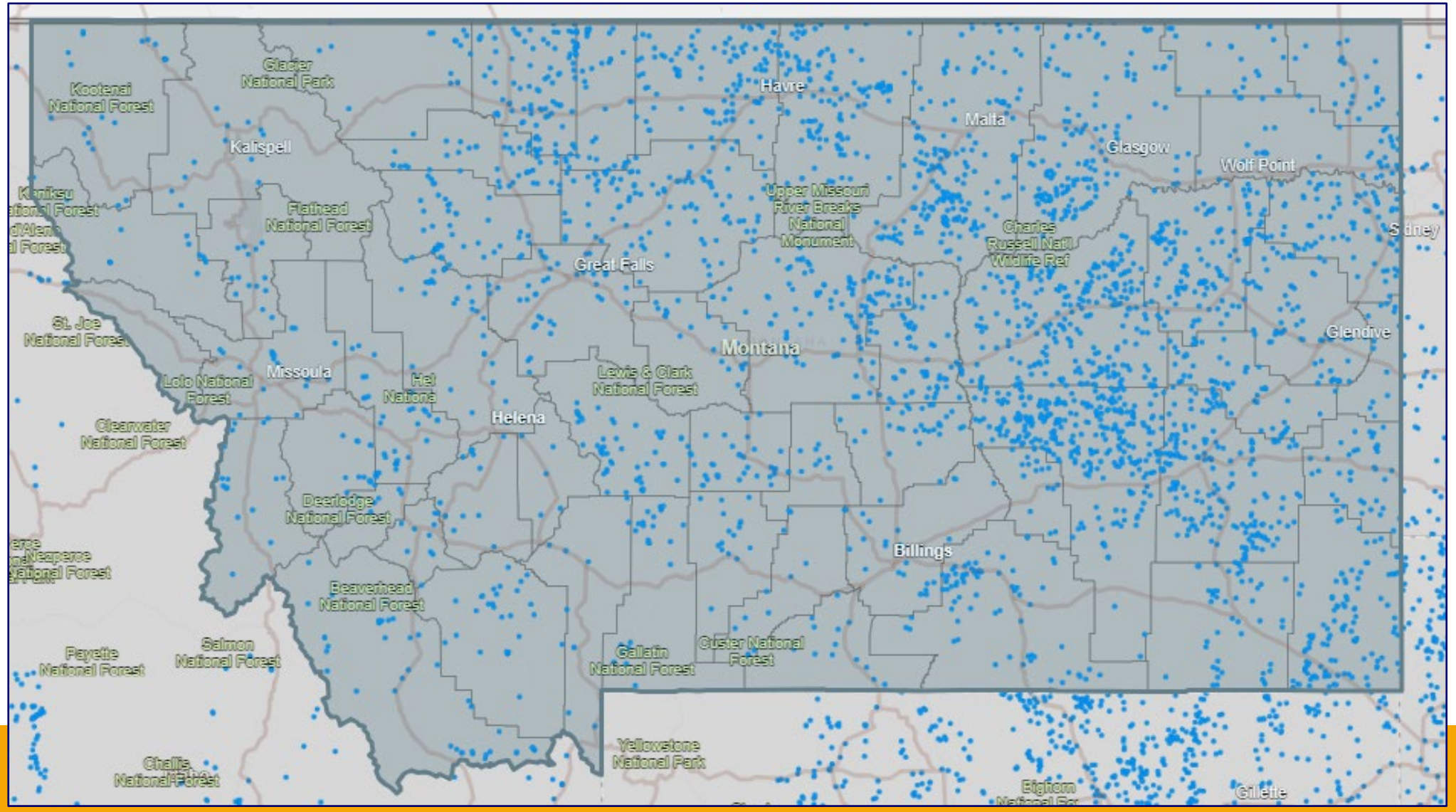
Deficiencies found include inoperable gates, deterioration of CMP, worrisome cracks in concrete, and concerning pipe deflection.

Introduction

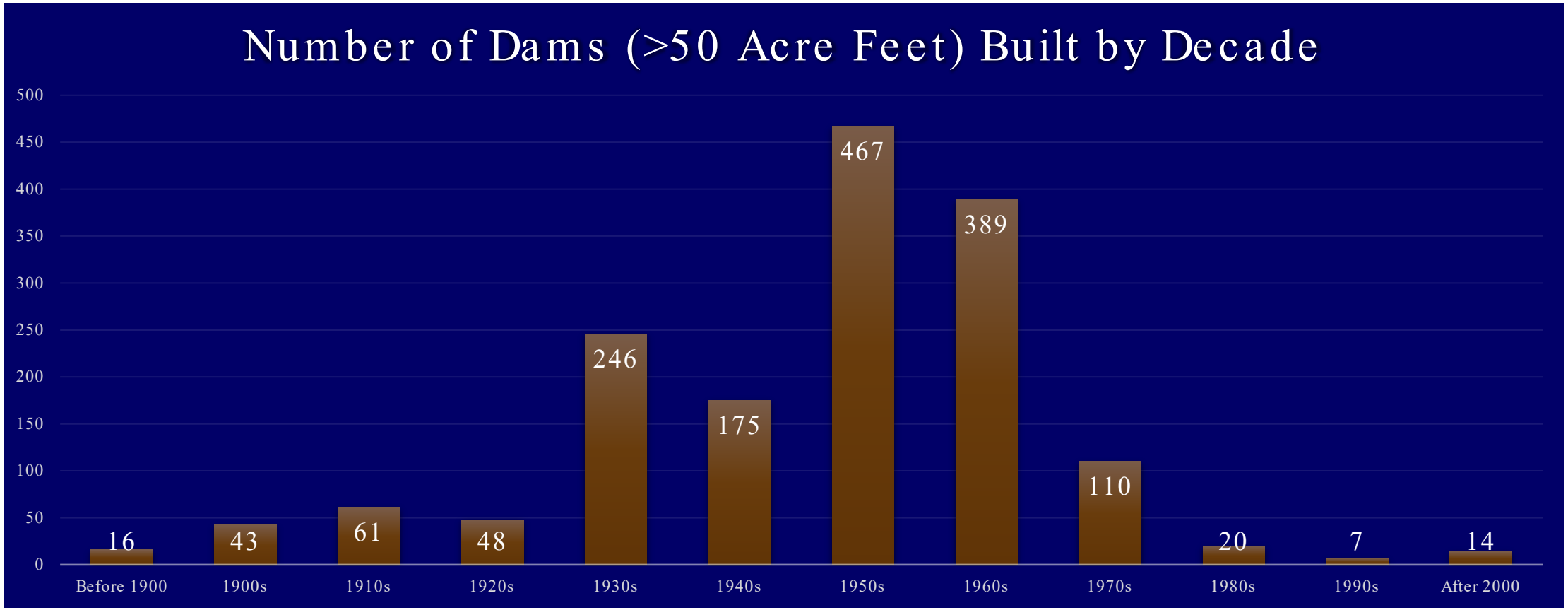
The main concern is that five years ago many of these structures looked okay.

Microsoft stock photo

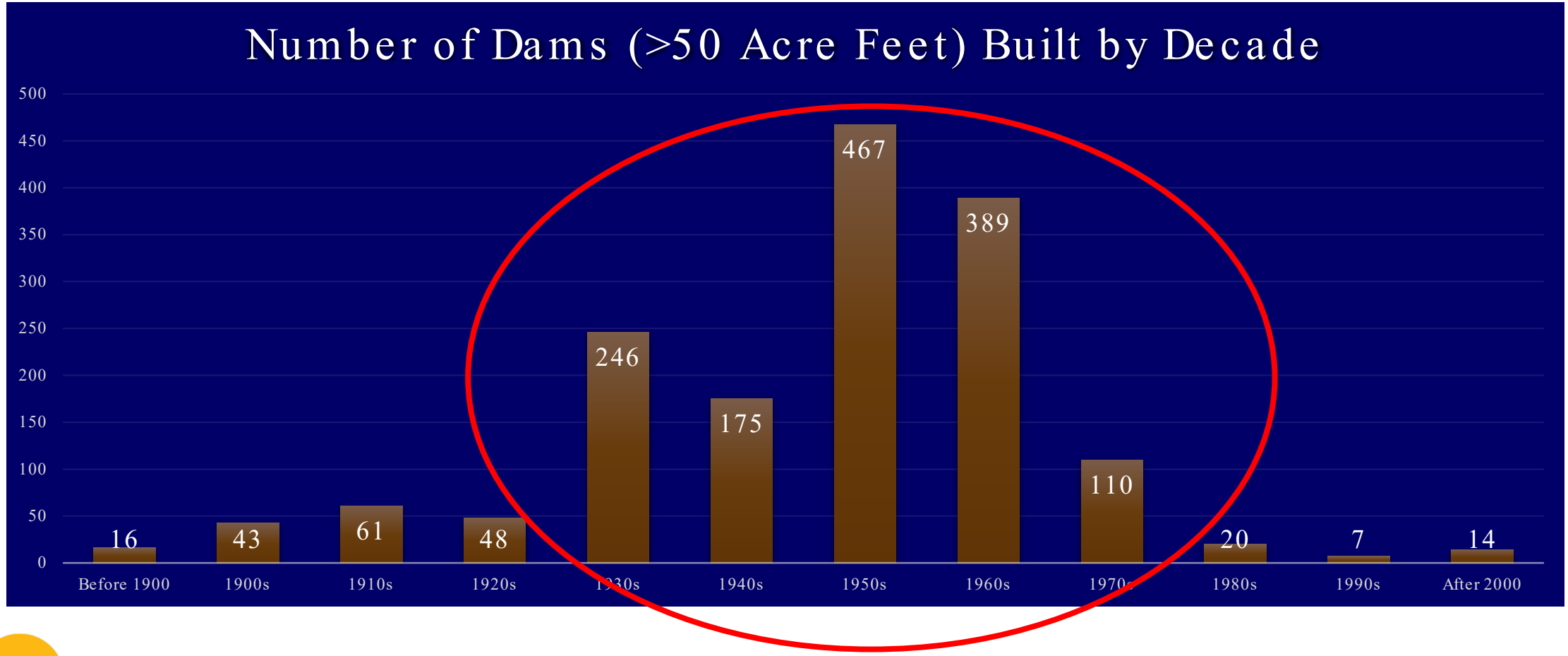
History of Montana Dams



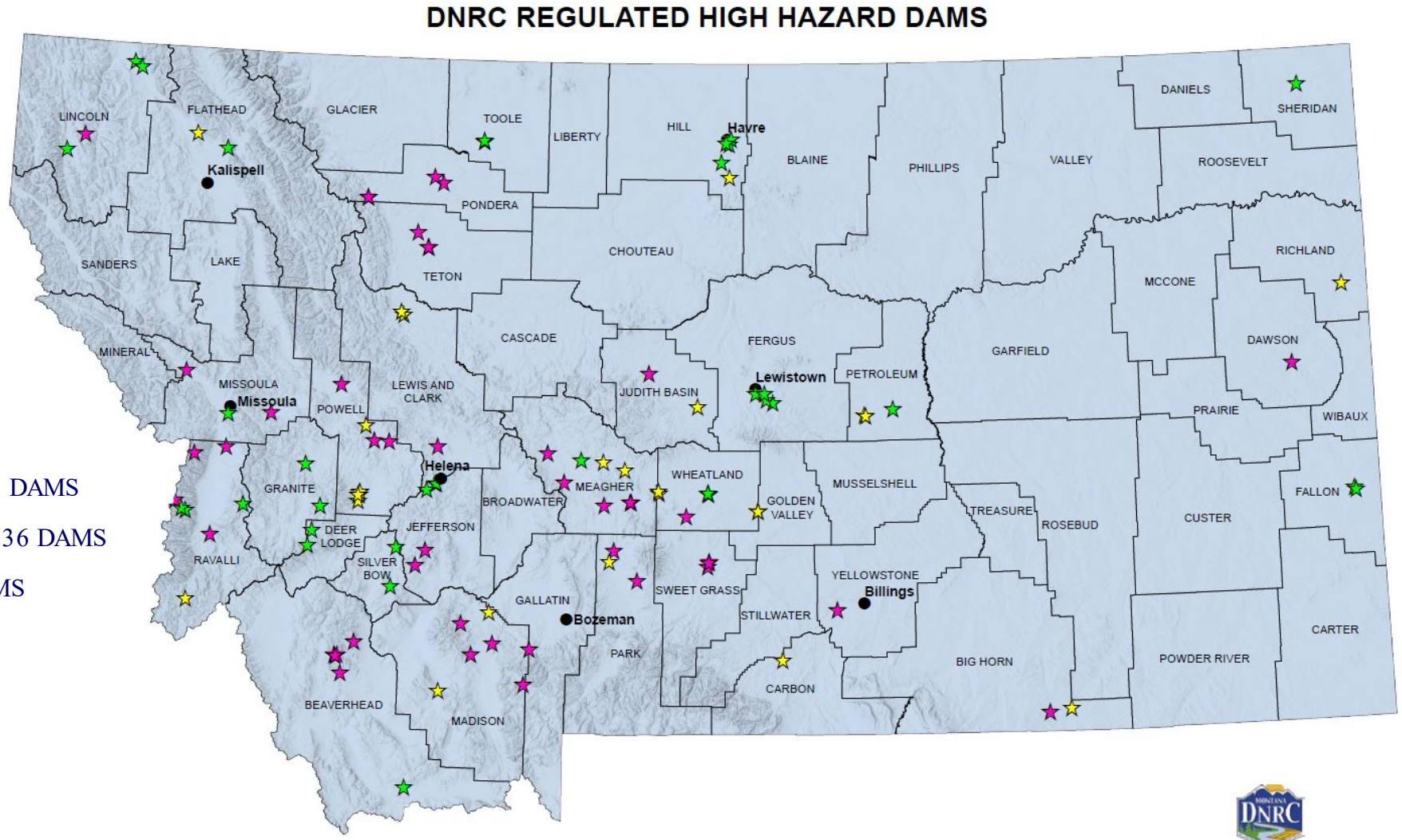
History of Montana Dams



History of Montana Dams



History of Montana Dams

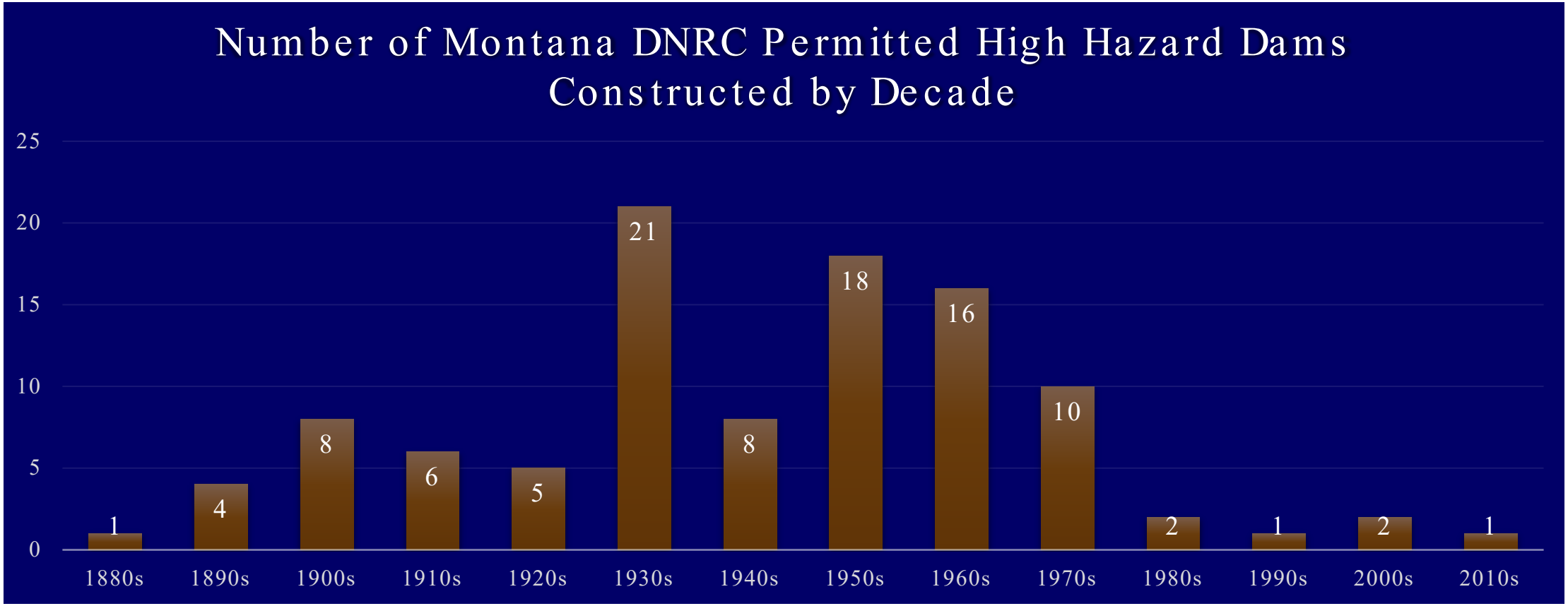


Legend

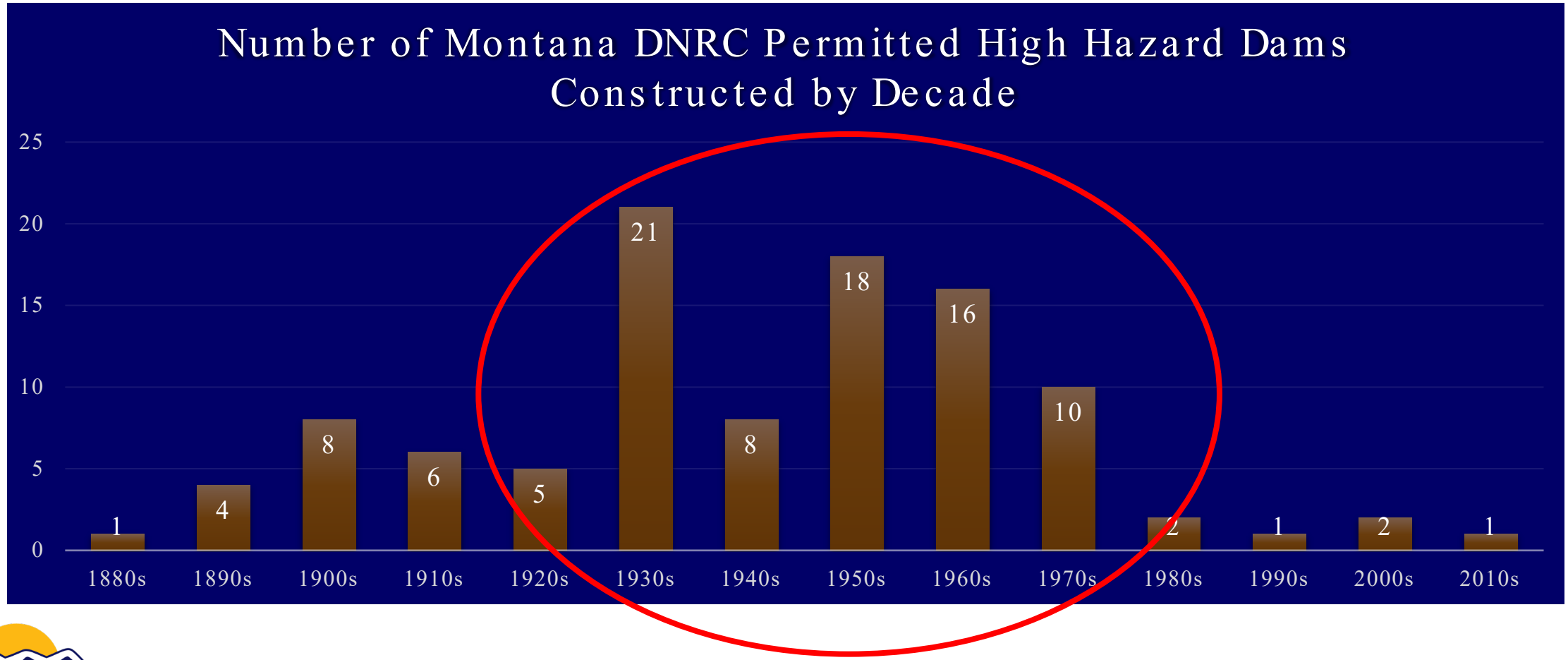
- PRIVATELY OWNED – 45 DAMS
- LOCAL GOVERNMENT – 36 DAMS
- STATE OWNED – 23 DAMS

CREATED: JANUARY 17, 2023

History of Montana Dams



History of Montana Dams

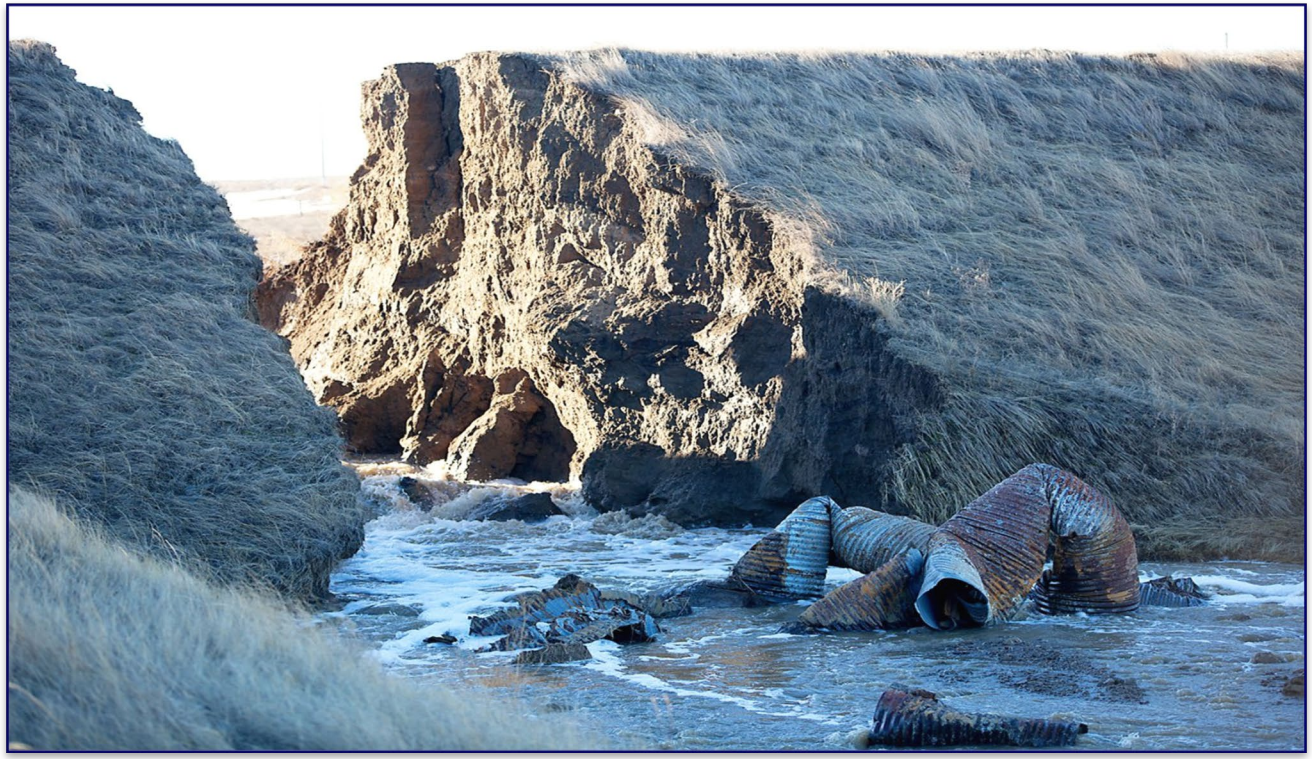


History of Montana Dams

- Types of materials used for conduits:
  - Concrete
  - Plastic
  - Iron
  - Welded Steel
  - Aluminum
  - Wood
  - Masonry
  - Corrugated Metal Pipe (CMP)

History of Montana Dams

- CMP first used in the 1890s
- Many embankment dam failures are associated with CMP
- The design life for CMP is around 50 to 75 years



Case Study #1 Dam in Beaverhead County

- Originally built in 1903
- Conduit was part CMP and part Concrete
- ~120’ in length

Case Study #1 Dam in Beaverhead County

2012

2012

Case Study #1 Dam in Beaverhead County

2016

Case Study #2 Dam in Meagher County

- **Originally built in 1936**

Case Study #2 Dam in Meagher County

- Originally built in 1936
- **Original outlet conduit is a 12” precast concrete pipe**

Case Study #2 Dam in Meagher County

- Originally built in 1936
- Original outlet conduit is a 12” precast concrete pipe
- **Extensions to the outlet conduit consists of 15” CMP**

Case Study #2 Dam in Meagher County

Outlet Inspections

- 1995
- 2000
- 2005
- 2016
- 2022

Case Study #2 Dam in Meagher County

Outlet Inspections

- **1995**
- **2000**

84 Feet 1995

84 Feet 2000

Case Study #2 Dam in Meagher County

Outlet Inspections

- 1995
- 2000
- **2005**

Case Study #2 Dam in Meagher County

Outlet Inspections

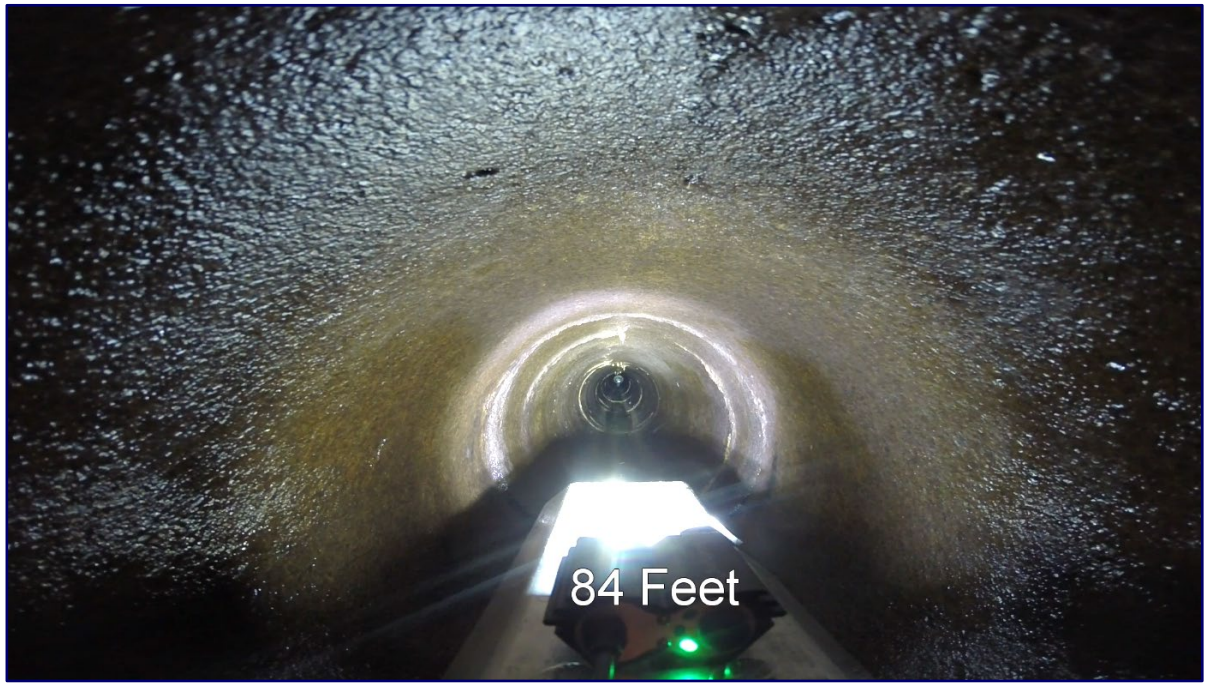
- 1995
- 2000
- 2005
- **Current**

Case Study #2 Dam in Meagher County

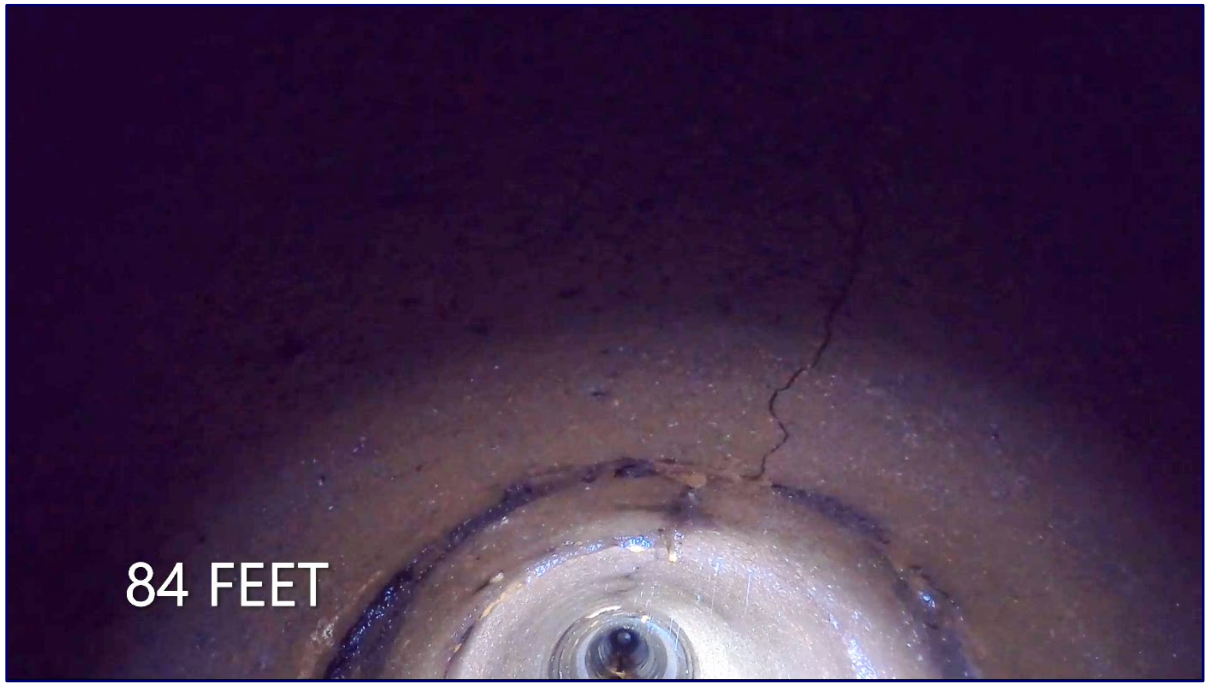
2016

2022

Case Study #2 Dam in Meagher County

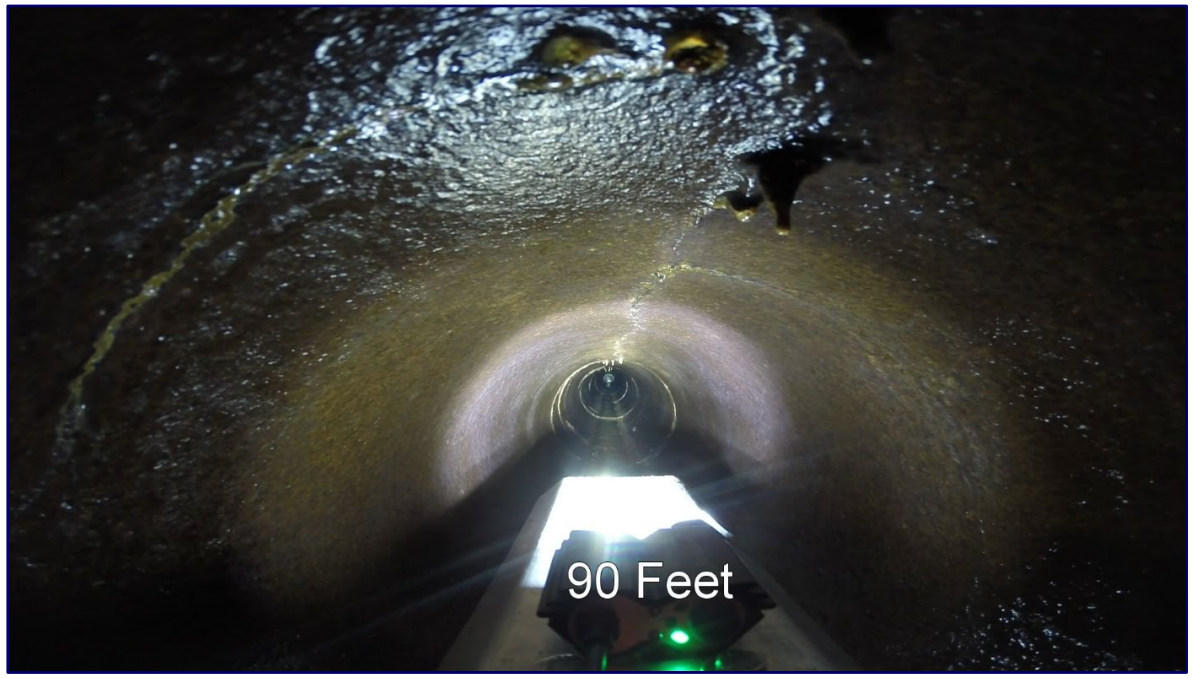


2016



2022

Case Study #2 Dam in Meagher County

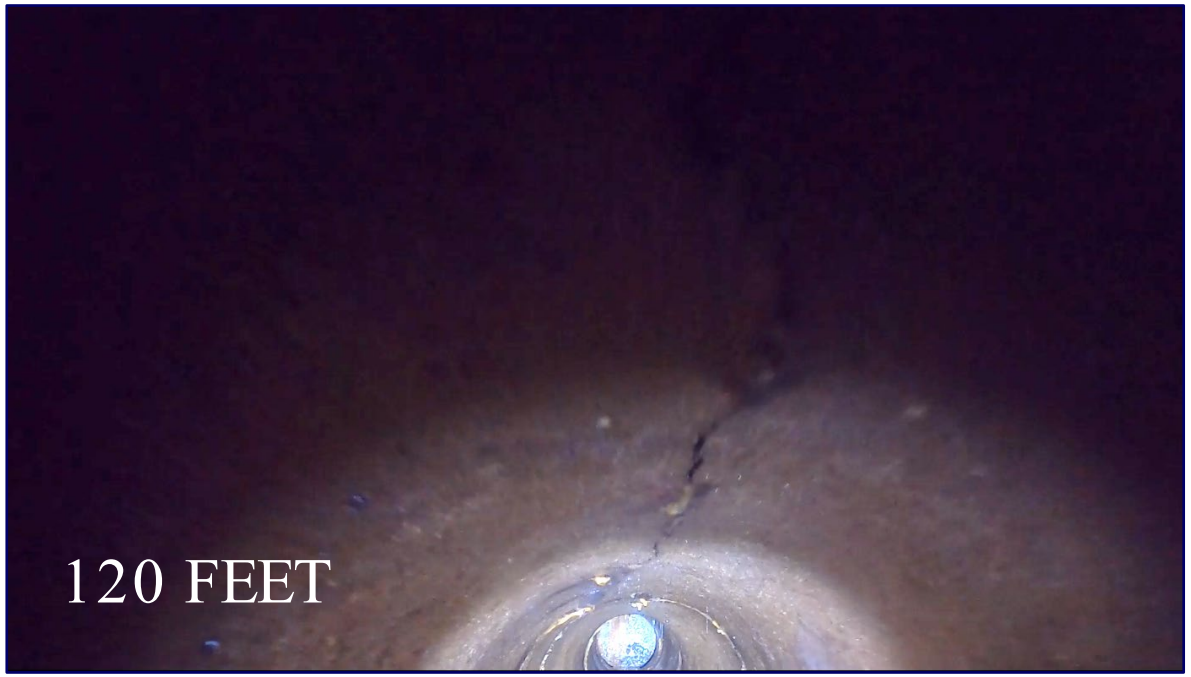


2016

2022

Case Study #2 Dam in Meagher County

2016



2022

Case Study #3 Dam in Ravalli County

- **Built in 1927**

Dam Crest

Case Study #3 Dam in Ravalli County

- Built in 1927
- **Outlet is about 145’ in length**

Case Study #3 Dam in Ravalli County

- Built in 1927
- Outlet is about 145’ in length
- **Constructed of both 12” CMP and 10” concrete pipe**

Case Study #3 Dam in Ravalli County

- **CMP**

Case Study #3 Dam in Ravalli County

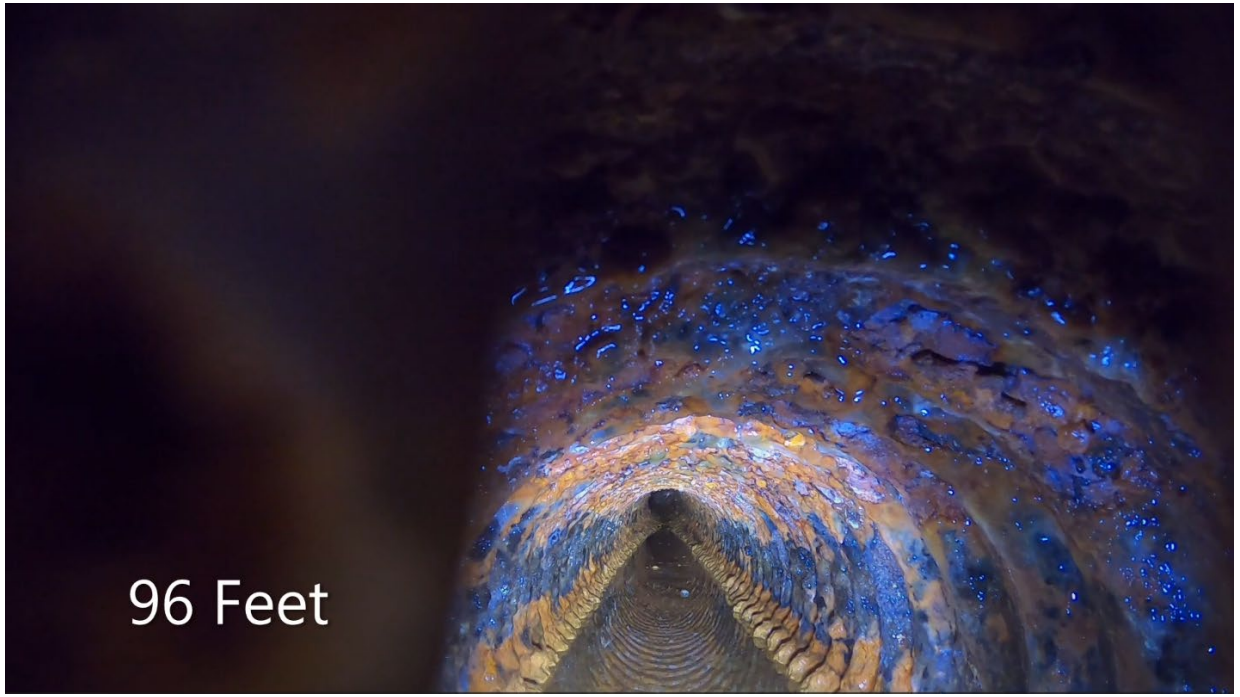
- CMP
- **Concrete**

Case Study #3 Dam in Ravalli County

- CMP
- Concrete
- **CMP**

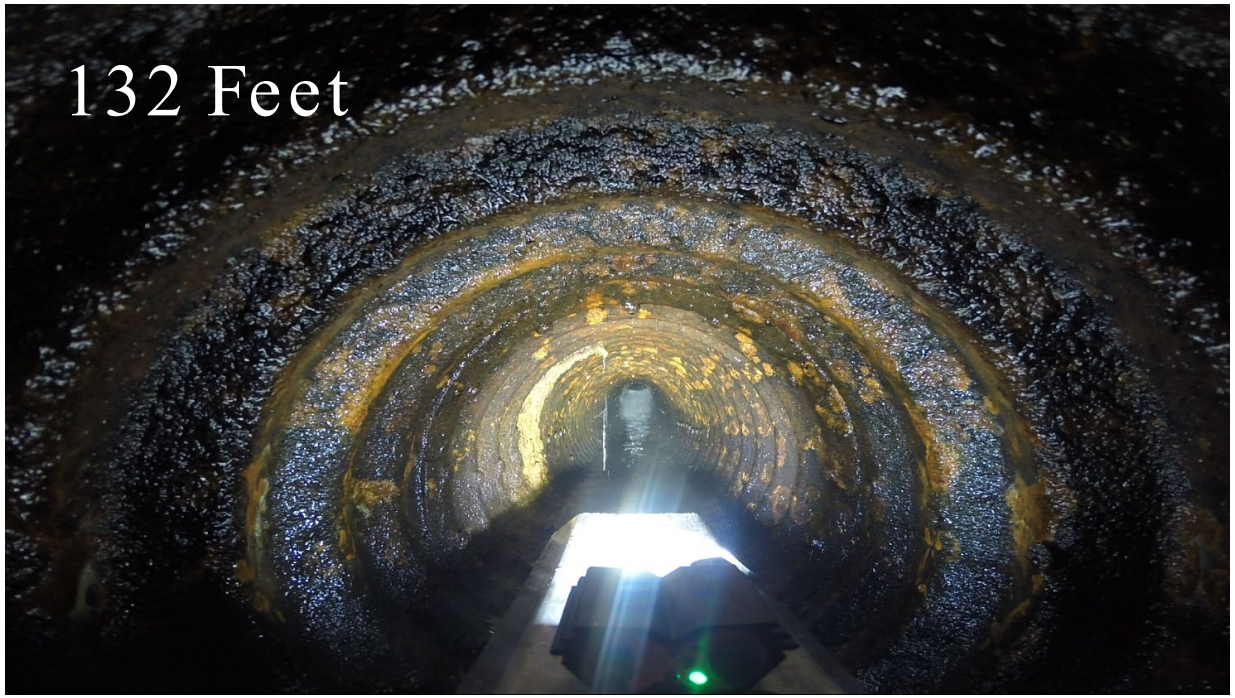
Case Study #3 Dam in Ravalli County

2017

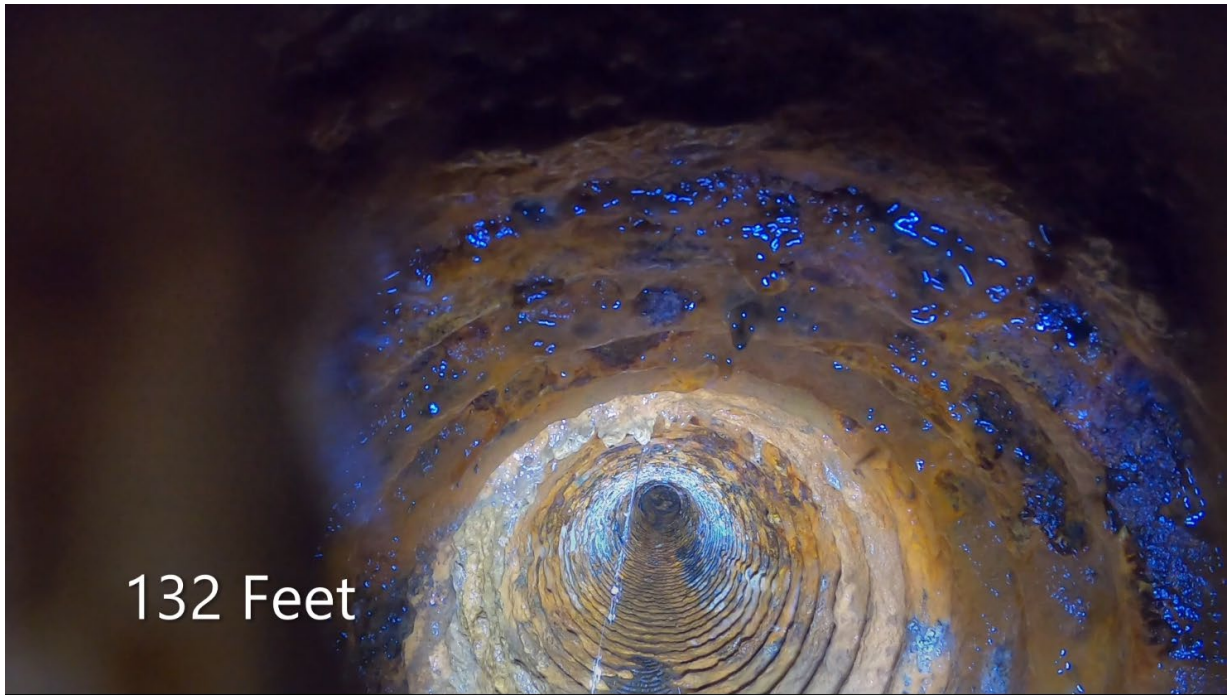


2021

Case Study #3 Dam in Ravalli County



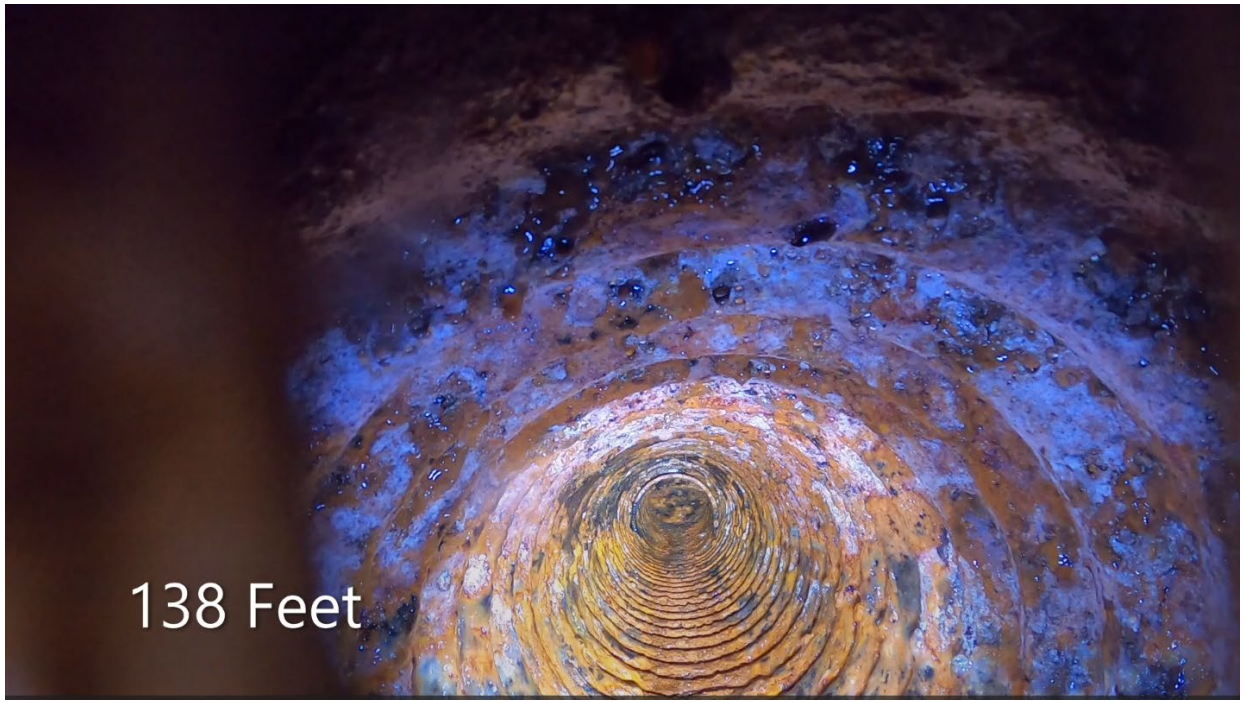
2017



2021

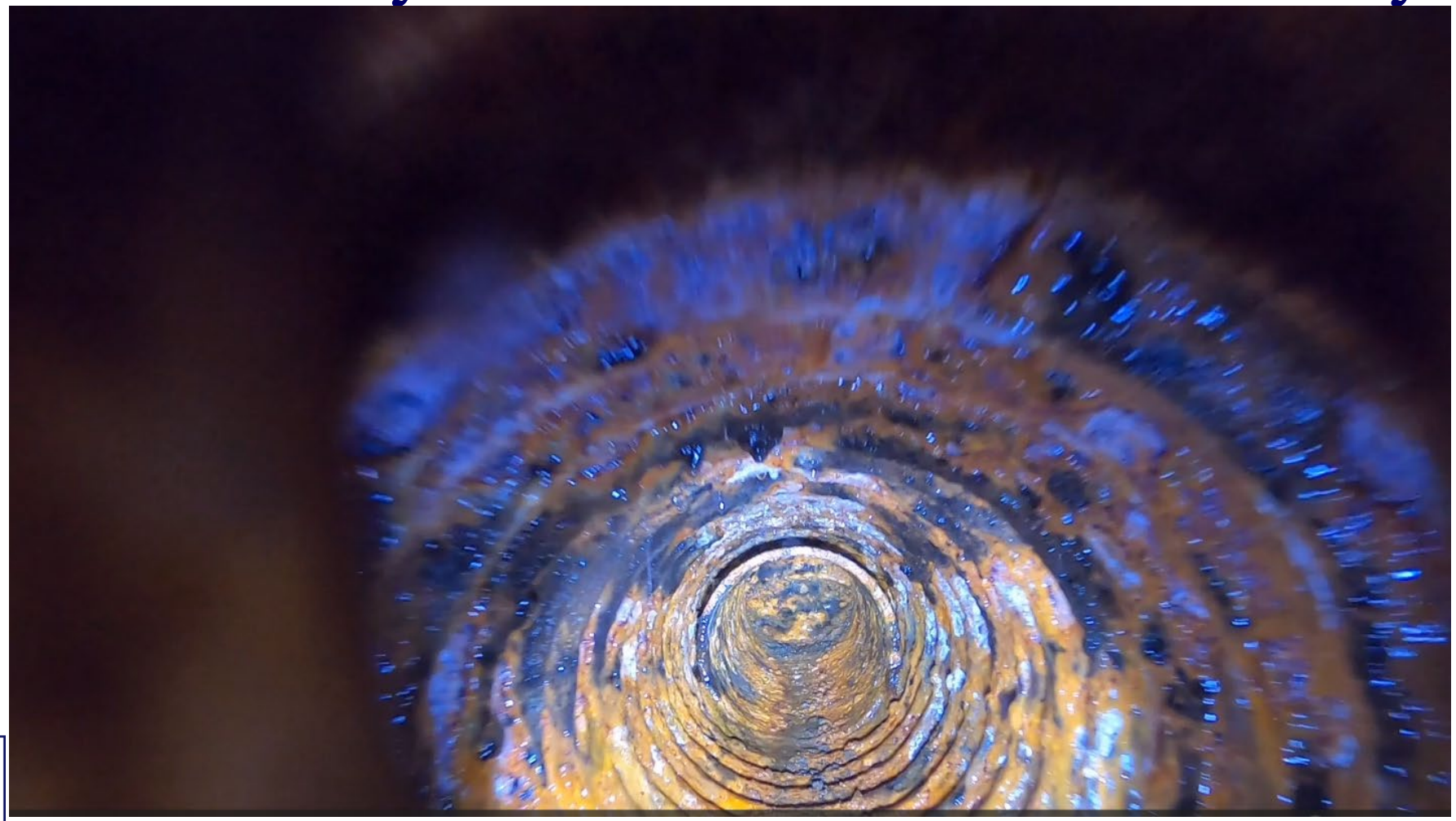
Case Study #3 Dam in Ravalli County

2017



2021

Case Study #3 Dam in Ravalli County



2021

Case Study #4 Dam in Yellowstone County

- **Built in the 1960s**

Case Study #4 Dam in Yellowstone County

- Built in the 1960s
- **Outlet is an 18” CMP**

Case Study #4 Dam in Yellowstone County

- An inspection of the pipe was conducted during a field tour/workshop in 2015
- 60 Feet

Case Study #4 Dam in Yellowstone County

- An inspection of the pipe was conducted during a field tour/workshop in 2015
- 66 Feet

Case Study #4 Dam in Yellowstone County

- 2018 Inspection
- 60 Feet

Case Study #4 Dam in Yellowstone County

- 2018 Inspection
- 66 Feet

Case Study #4 Dam in Yellowstone County

2015

2018

Case Study #4 Dam in Yellowstone County

2015

2018

Case Study #4 Dam in Yellowstone County

Case Study #4 Dam in Yellowstone County

Case Study #4 Dam in Yellowstone County

Case Study #4 Dam in Yellowstone County

Case Study #4 Dam in Yellowstone County

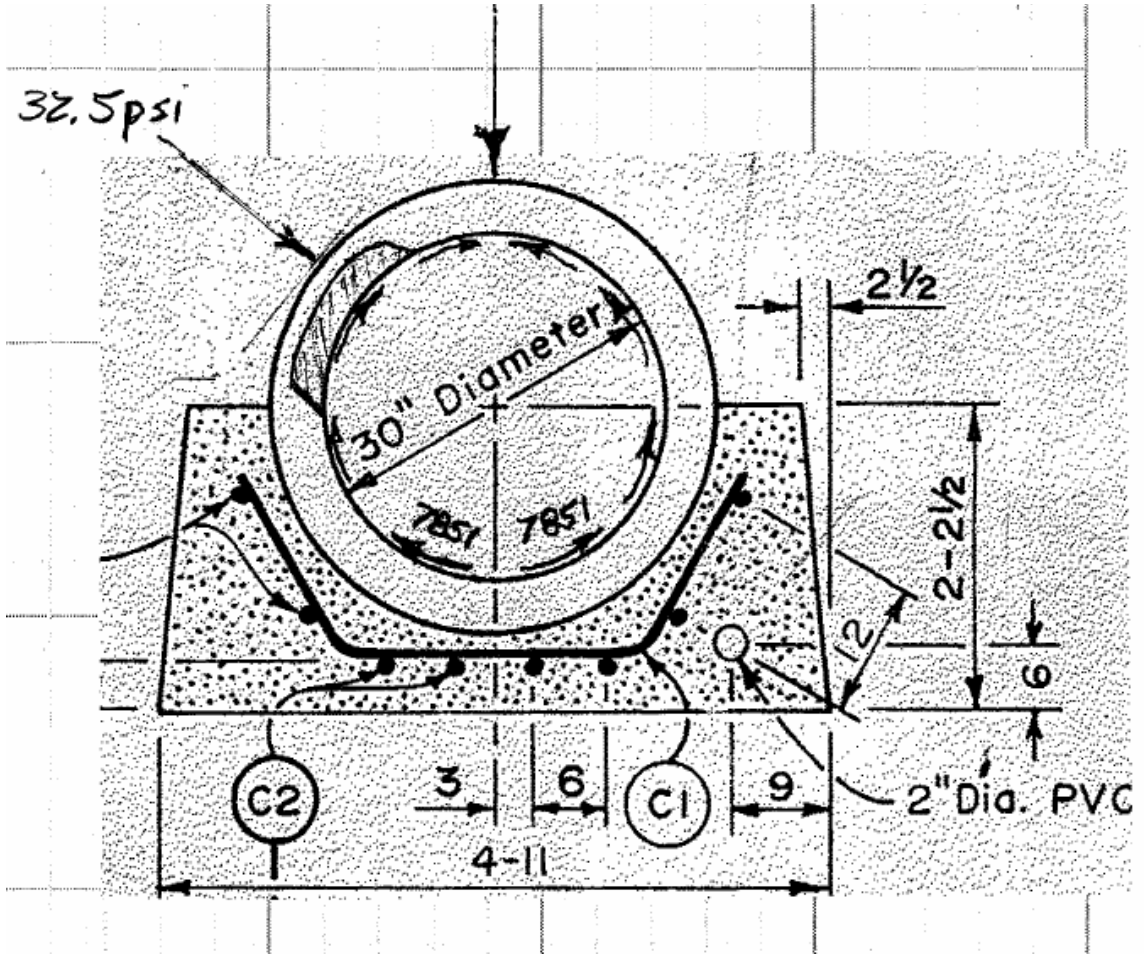
- The outlet pipe was abandoned with flowable fill
- An 18” HDPE high-level outlet conduit was built in early 2021

Case Study #5 Dam in Fergus County

- Built by the NRCS in 1977

Case Study #5 Dam in Fergus County

- Built by the NRCS in 1977
- **Outlet is a 30” Prestressed Concrete Cylinder Pipe**



Case Study #5 Dam in Fergus County

- **Inspection conducted in 2015**

Case Study #5 Dam in Fergus County

- **During the inspection, a hole was found in the concrete exposing the steel cylinder**

Case Study #5 Dam in Fergus County

- During the inspection, a hole was found in the concrete exposing the steel cylinder
- **It was located about 133’ from the downstream end of the outlet**

Case Study #5 Dam in Fergus County

- During the inspection, a hole was found in the concrete exposing the steel cylinder
- It was located about 133’ from the downstream end of the outlet

Case Study #5 Dam in Fergus County

- **NRCS put in a temporary patch**

Case Study #5 Dam in Fergus County

- NRCS put in a temporary patch
- **Later placed an expander as a permanent solution**

What did we learn?

- **Deficiencies are found before they develop into something serious**

What did we learn?

- Deficiencies are found before they develop into something serious
- **Time**

What did we learn?

- Deficiencies are found before they develop into something serious
- Time
- **The State of Montana has an outlet sled that can be used (at no cost) by engineers to conduct inspections – currently looking into a 360 camera.**

QUESTIONS?

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*Images and photos, unless otherwise stated, were taken by DNRC personnel.