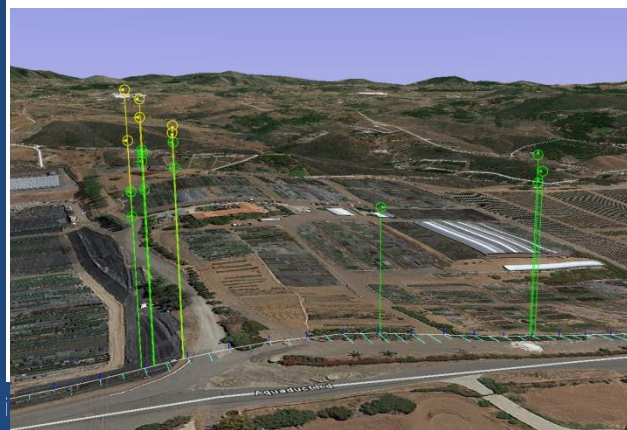
San Diego County Water Authority

ASSET MANAGEMENT PROGRAM

MANAGING A PCCP REHABILITATION PROGRAM

WATER RESEARCH FOUNDATION – LARGE PRESSURE PIPE STRUCTURAL REHABILITATION CONFERENCE

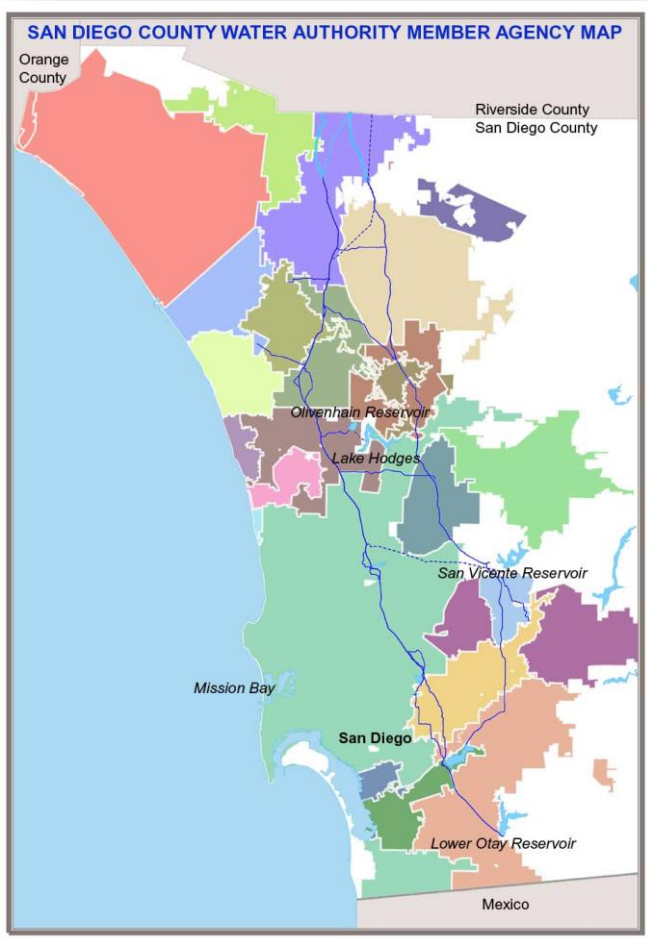
Nathan Faber, P.E.
Operations and Maintenance Manager
January 20, 2016






SAN DIEGO COUNTY WATER AUTHORITY

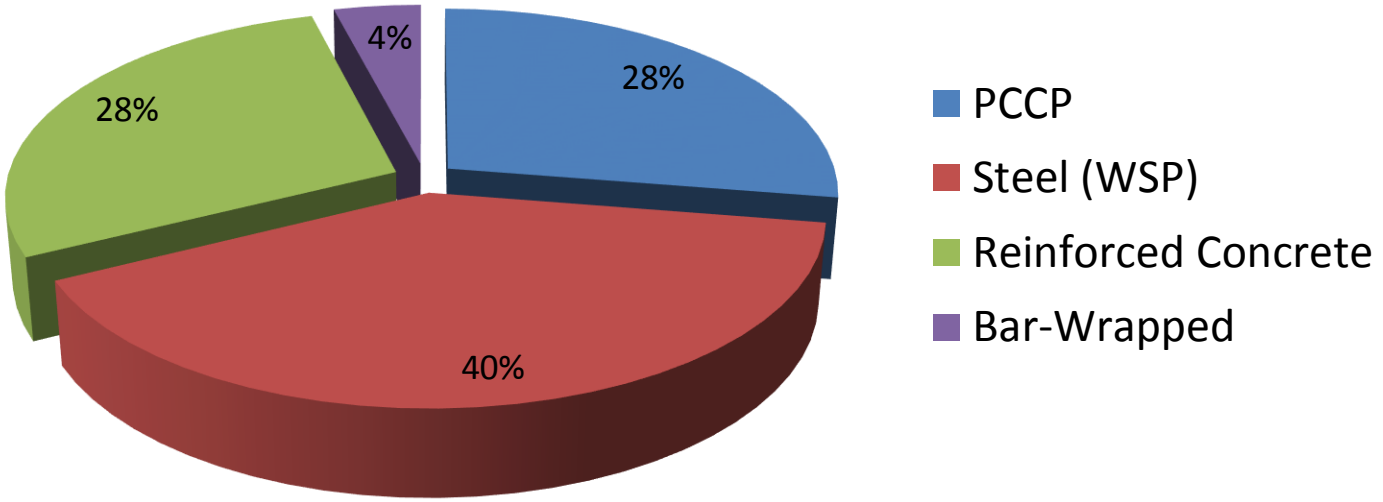
- Wholesale water agency
- Infrastructure
  - Reservoir
  - Water Treatment Plant
  - Hydroelectric
  - Pipelines: 300 miles



Water Authority System Map




Pipe Material	Length (miles)
Prestressed Concrete (PCCP)	82
Welded Steel (WSP)	120
Reinforced Concrete	86
Bar-Wrapped	12






PCCP FAILURES – 1979, 1980, 1982

FAMILIES ESCAPE INJURY

Huge Pipeline Bursts, Two Homes Flooded

A major pipeline of the San Diego Aqueduct near the Sweetwater Reservoir burst yesterday morning and flooded the homes of two Spring Valley residents.

The underground pipeline, 69 inches in diameter and carrying water from the Colorado River to the reservoir, ruptured at about 9:30 a.m. with a "roar like a tornado," a resident said.

Roberto C. Stanley of 166 Lakeview St. said he and his family were in bed when the huge pipe burst, cascading water high into the air. Authorities said no one was injured. "It sounded like a tidal wave or tornado," said Stanley, a computer systems analyst.

He said the water flooded his four bedroom home, located about 180 feet from the break, and he and his family were forced to leave. Water in some of the rooms reached a level of more than two feet. Stanley's next door neighbor, Albert Gomez of 168 Lakeview St., also reported flood damage to his home.

Pete Rios, public information officer for the San Diego County Water Authority, said the force of the water from the pipeline excavated a hole 20 feet across, 30 feet long and at least six feet deep.

Rios said no one was injured when the waterline burst and that water flow was brought under control in a matter of minutes through the use of valves along the line and at the reservoir. Repair crews, operating with cranes, digging equipment and bulldozers, were removing a 20 foot section of damaged line and will replace it with a new one.

Rios estimated it would take four to five days to repair the line. He said water will be supplied through alternate routes.

Dave Jones, left, and Bob Gonzales of the Otay Water District help dig out a section of a main pipeline of the San Diego Aqueduct that burst yesterday morning near the Sweetwater Reservoir in Spring Valley. Two homes were damaged by water when the 69-inch water line ruptured.

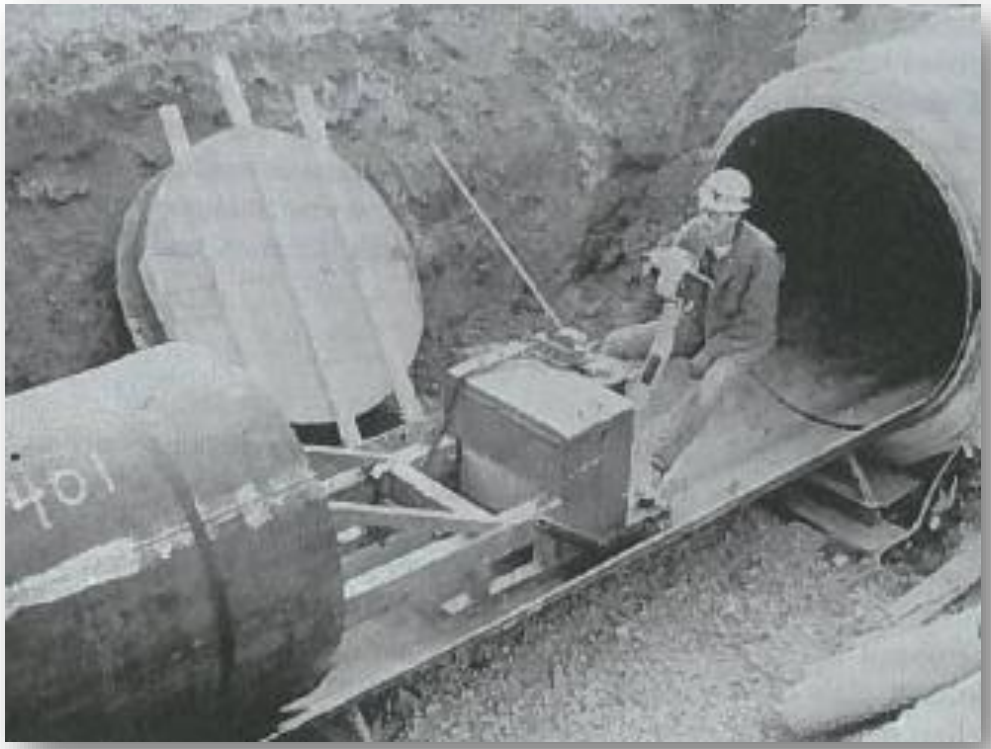
Newspaper Article

Pipe Damage




RELINING (SLIP LINING)

- Steel liners
- Limited Area
  - Single contract
  - High pressure
- Length: 5 miles



Steel Liners Inserted into Pipe (1982)




PCCP FAILURES – 1990 AND 1993

Internal - Cylinder Leak/Corrosion

Damaged Pipe




HEADLINES

Neighborhood fear renewed over pipeline

Break Raises Questions About Best Pipe Types

Three S.D. Districts Placed on Strict Water-Use Rules

■ **Emergency:** Break in major pipeline triggers Stage 4 alert; outdoor watering and washing of cars forbidden.

East County and South Bay could run dry

400,000 face water crisis here




AQUEDUCT PROTECTION PROGRAM

- Board established (1991)
  1. Inspect PCCP
  2. Evaluate service life
- Repair and replacement (1993)
  - Relining program
  - Planned all PCCP (82-miles)
  - Budget: $787M




PCCP FAILURES – 2006 AND 2008

Erosion Damage

Pipe Damage at Joint




RISK MANAGEMENT

- Data - few wire breaks
- Many factors
  1. Wire breaks (53%)
  2. Joints
  3. Surge events
  4. Installation/Manufacturing
  5. Design
  6. Third party damage
- Risk-Based decisions



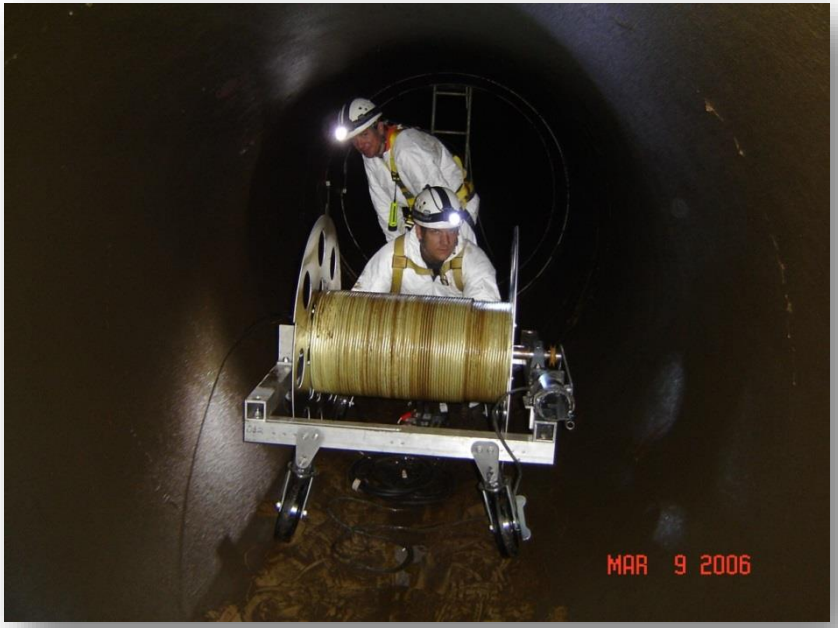

GATHERING DATA – PCCP

Condition Assessment Type	Data Confidence	Year Started
Visual – Internal	Low	1991
Sounding – Internal*	Low	1991
RFEC	Medium/High	1999
AFO	High	2006

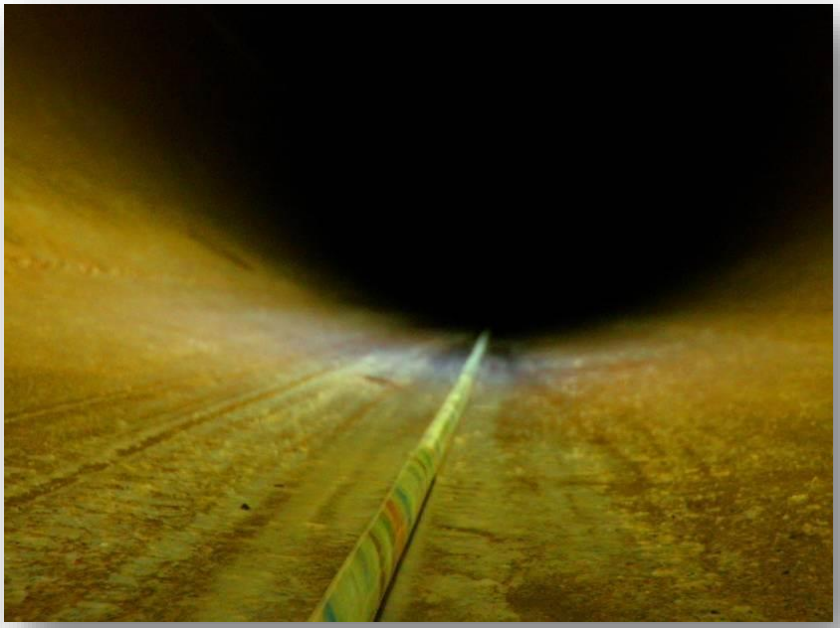
* Only used for targeted areas of concern




PCCP MONITORING



Fiber Optic Cable Installation



Fiber Optic Cable Inside Pipe

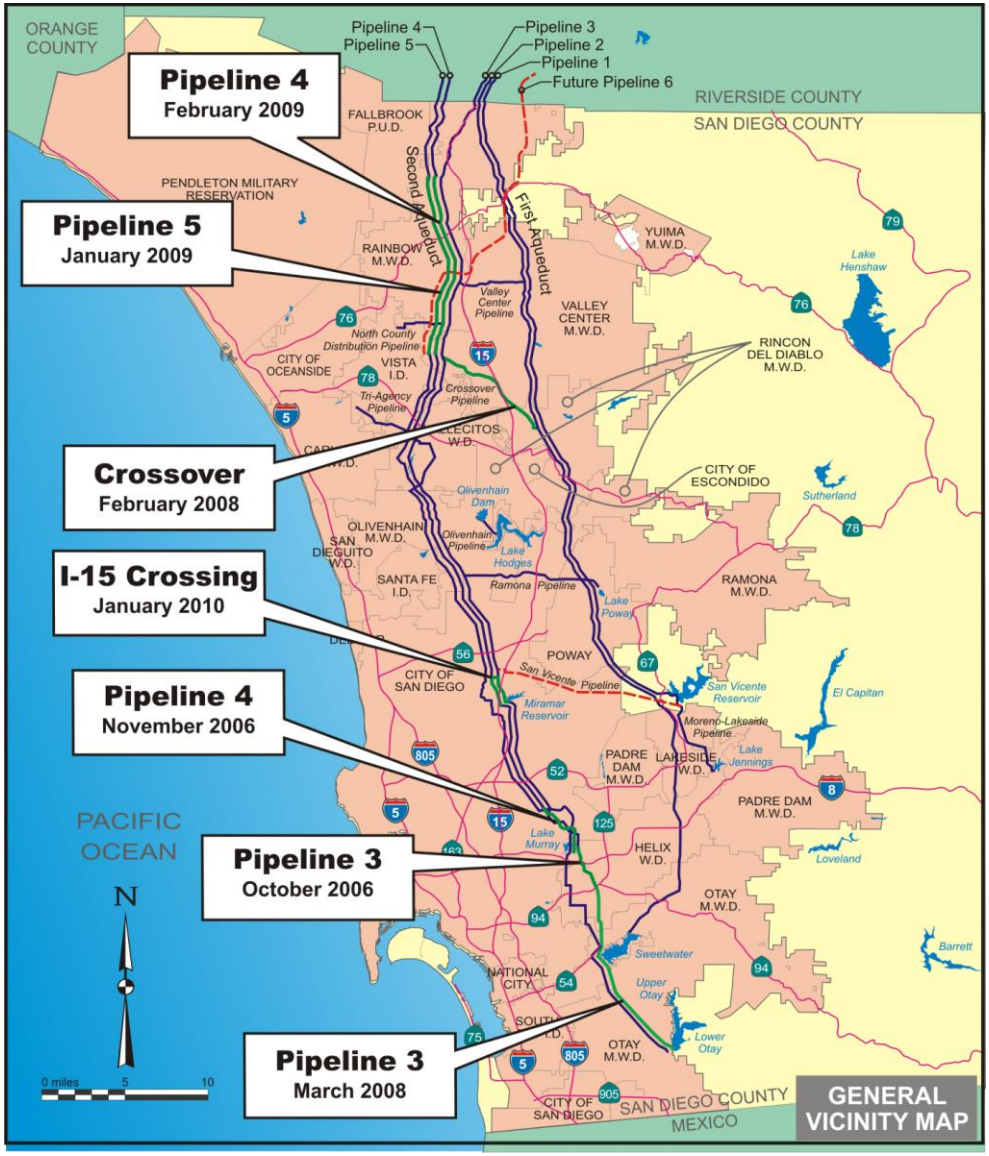
San Diego County Water Authority

ASSET MANAGEMENT PROGRAM




ACOUSTIC FIBER OPTIC MONITORING

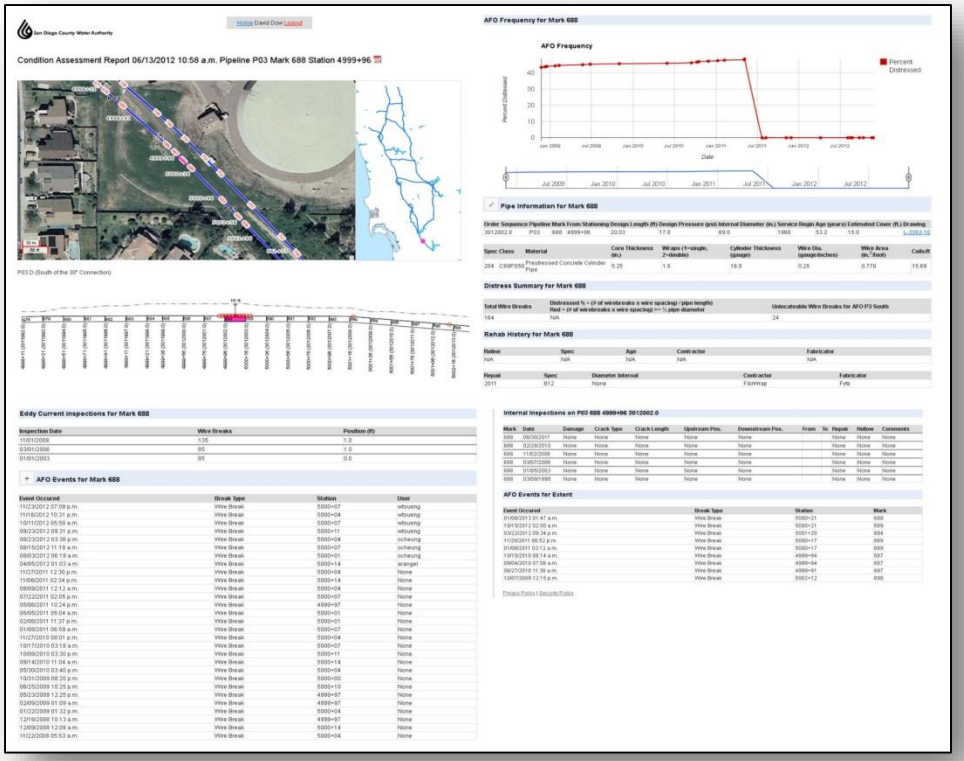
- 38-miles
- 7 Systems
- 1,300+ Wire Breaks
- $13M Total Costs






DATA MANAGEMENT

- Custom Open Source Database
- 60,000 pipe sections
- 66 major condition attributes
- 5 million data points



Condition Assessment Report

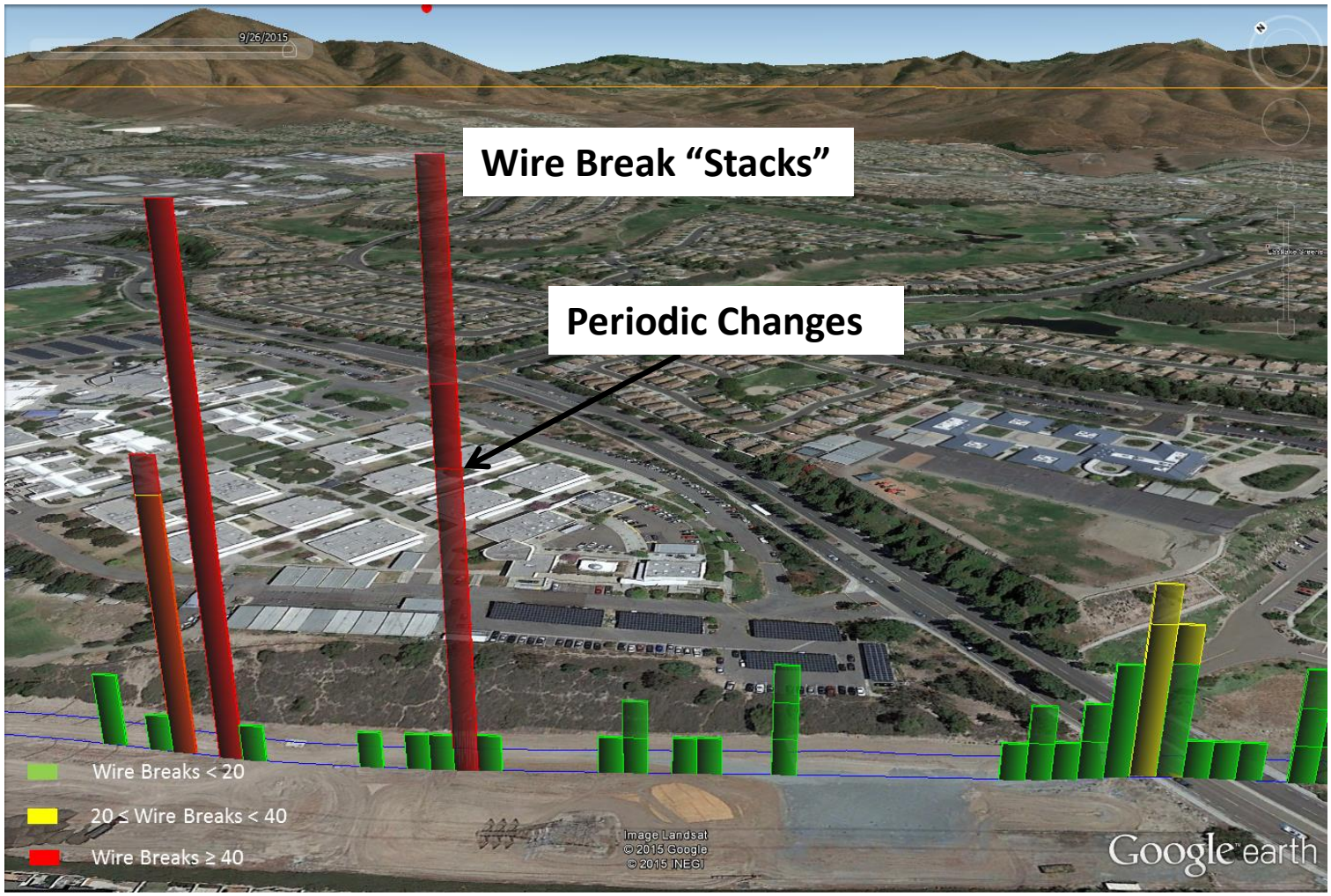



VISUALIZE DATA

- Google Earth
  1. Baseline Wire Breaks
  2. Wire Break Rate of change (activity)
  3. Consequence of Failure
- Determine Project Reaches

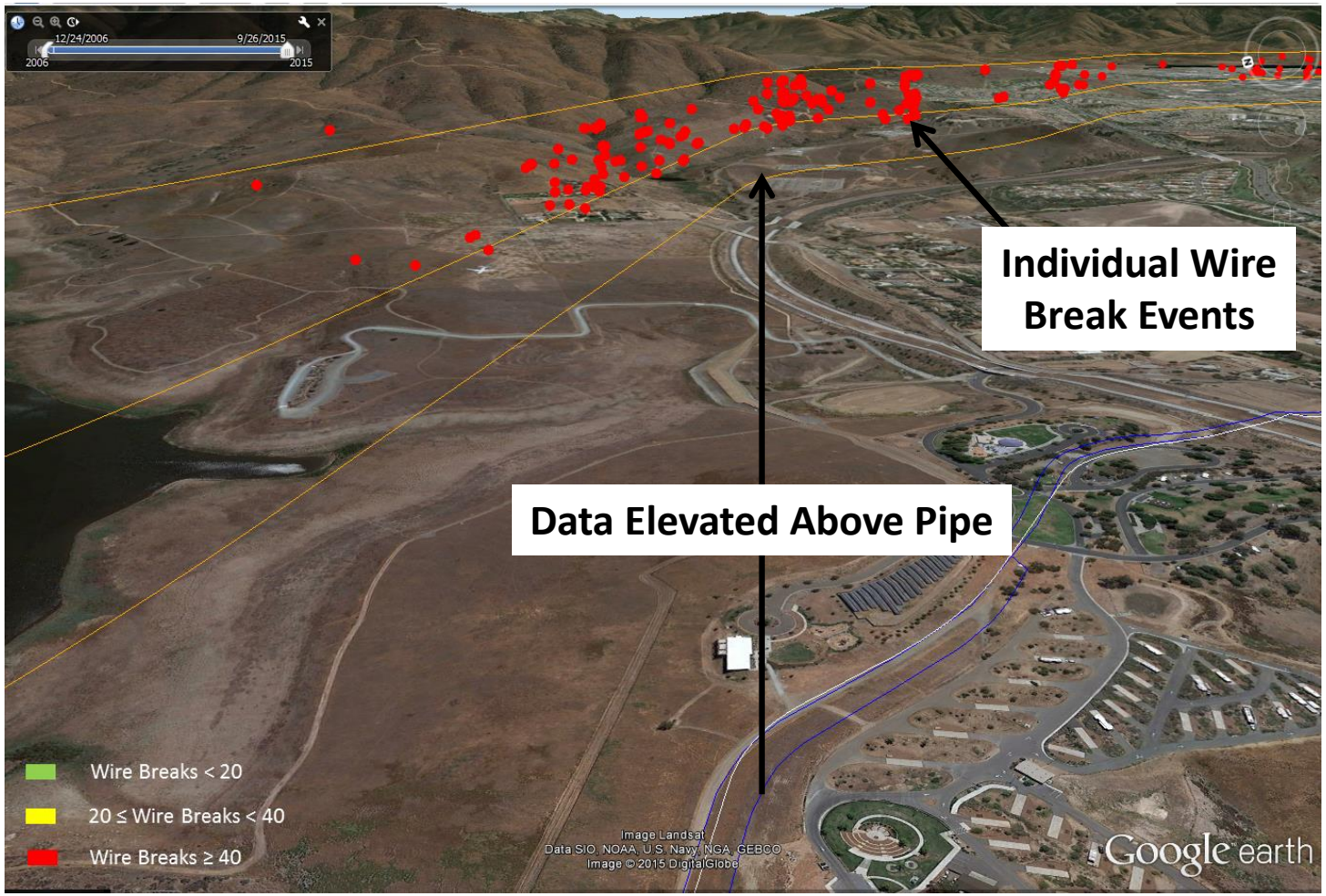



BASELINE WIRE BREAKS (3D)






WIRE BREAK RATE OF CHANGE (3D)






CONSEQUENCE OF FAILURE SCORE

1. Location
2. Other Utility Infrastructure
3. Water Authority Pipes

Future:

1. Drainage course
2. System Redundancy

CONSEQUENCE OF FAILURE (3D)




PROBABILITY OF FAILURE SCORE

1. Pressure
2. Maximum Wire Breaks
3. Rate of Change

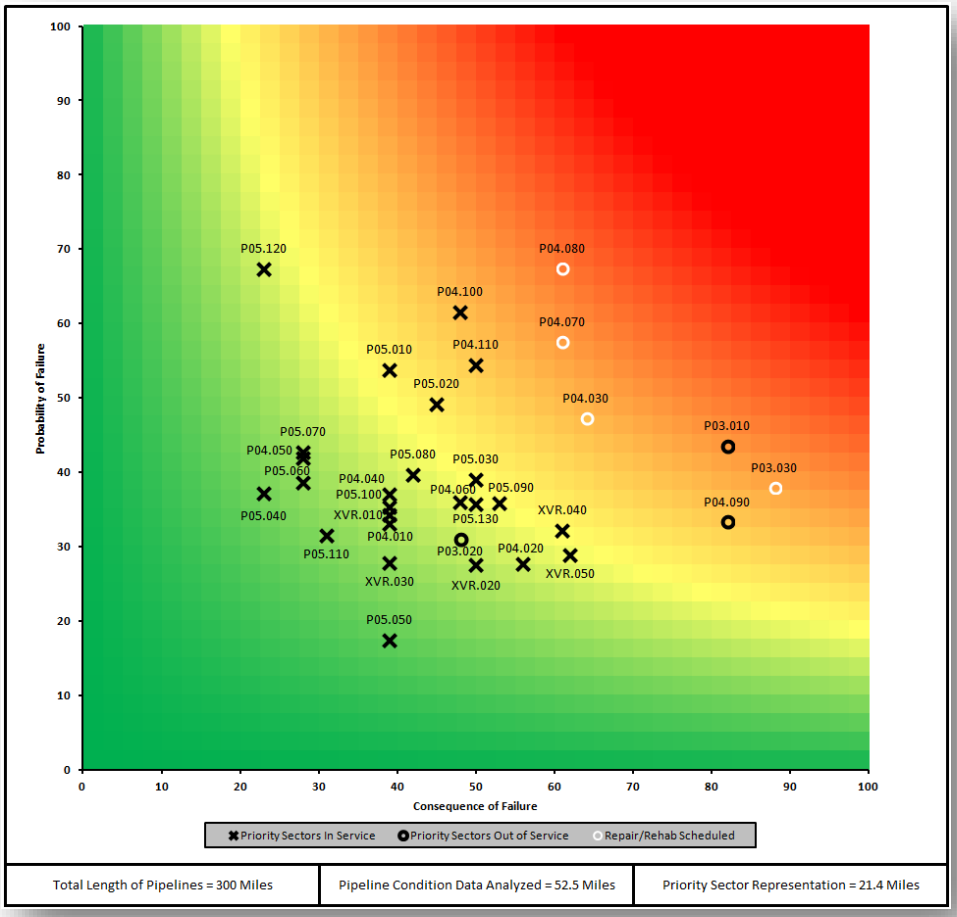
No wire breaks 0

↓

High Frequency 5




RISK MATRIX



Rehab projects identified



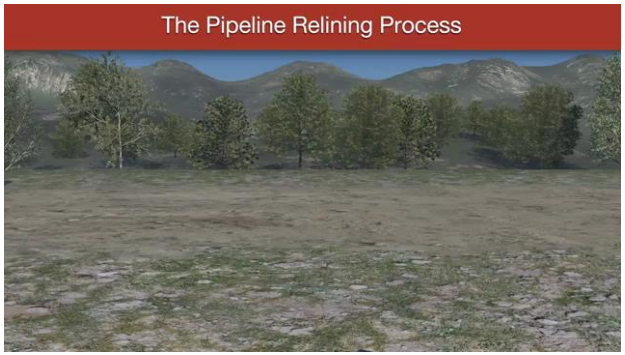

WATER AUTHORITY EXPERIENCE

- PCCP Failures, NOT JUST:
  - Wire breaks
  - One manufacturer
  - Class IV wire
- Sustainable Projects




PROJECT IDENTIFICATION

1. Large Scale Rehabilitation
2. Section Repairs
   - Long Term (Steel Replacement)
   - Short Term (Carbon Fiber Repair)



Pipeline Relining Video

Carbon Fiber Repair




PIPELINE MANAGEMENT COSTS

Budget	Cost	Rehab Length (miles)
Spent	$255 Million	40
Remaining	$206 Million	13
Deferred	**$326+ Million**	**29**

San Diego County Water Authority

ASSET MANAGEMENT PROGRAM

MANAGING A PCCP REHABILITATION PROGRAM

WATER RESEARCH FOUNDATION – LARGE PRESSURE PIPE STRUCTURAL REHABILITATION CONFERENCE

Nathan Faber, P.E.
Operations and Maintenance Manager
January 20, 2016