Fluid Futures: Navigating Water Infrastructure Challenges

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AGENDA

1 GEI Overview

2 Why Capital Needs Assessments

3 Case Study: Reservoir and Booster Stations

4 Questions

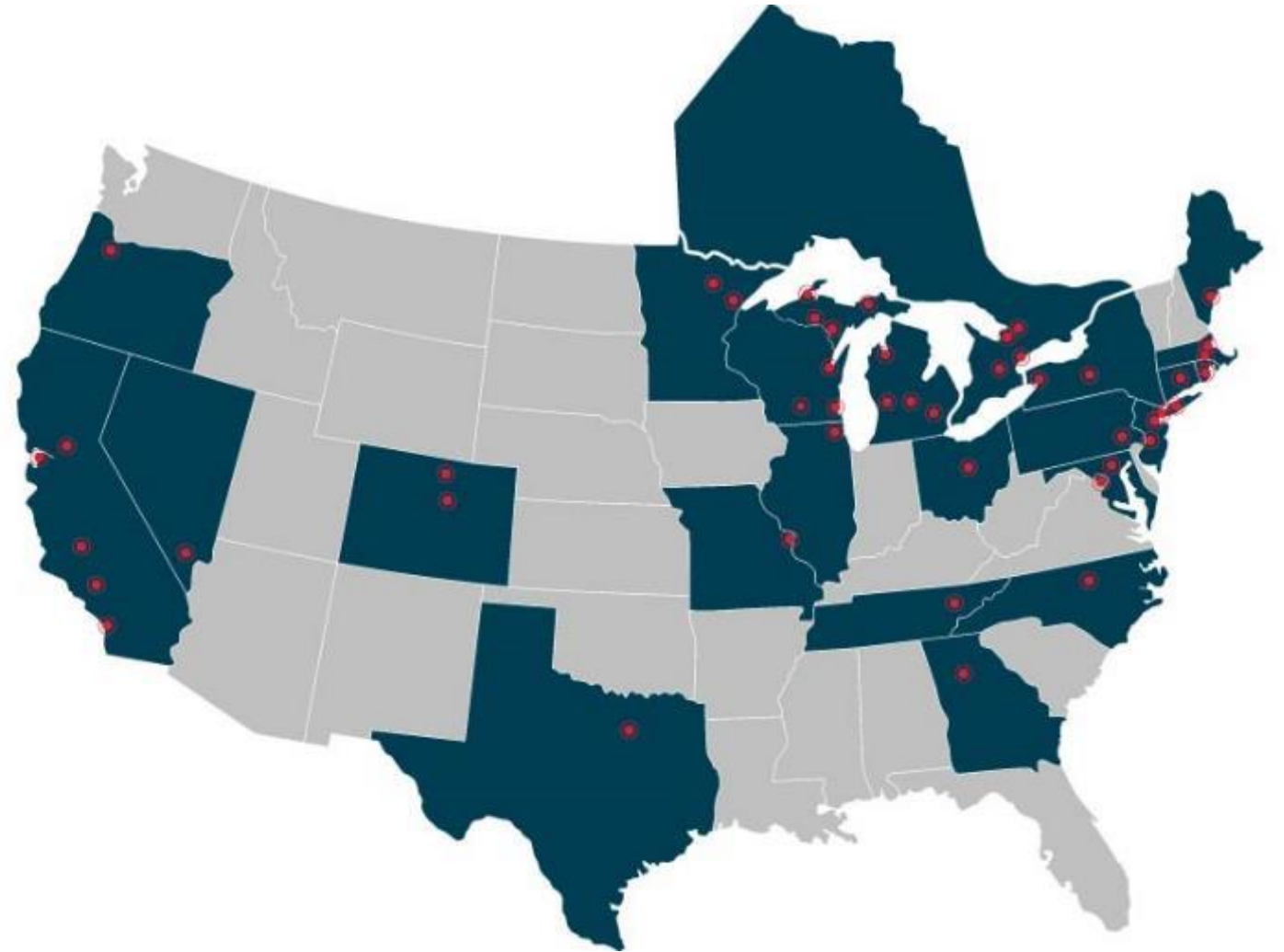GEI Overview

GEI Office Locations

54
Offices located throughout North America

PRACTICE AREAS

Environmental

Compliance
Permitting
Due Diligence
Characterization
Remediation
Risk Assessment
Restoration
Asbestos
Demolition
Brownfields
In-Water & Uplands

Geotechnical

Foundations
Construction Services
Geotechnical Testing
Slope Stability and Repair
Geophysics
Excavation Support
Settlement Analysis
Failure Analysis
Earthquake Engineering
Ground Improvement

Civil Design

Civil Engineering
Geostructural
Structural
Water
Design Build
Construction Support

Water Resources

Conveyance
Flood Control
Water Management
Water Supply and Storage
Water Resources Support
Hydropower

Construction Services

Construction Management
Field Engineering,
Observation &
Inspection
Instrumentation &
Monitoring Materials
Testing
Nondestructive Testing

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# Capital Needs Assessments

Water Management

Capital Needs Assessments (CNA): Introduction and Importance

Holistic approach that includes Operations, Maintenance, Asset Management, Engineering and Finance.

Determine necessary investments for maintenance, repair, and upgrades.

Understand current condition of assets, forecast future needs, and allocate appropriate resources.

Benefits: potential to reduce likelihood of failure (LOF), extending remaining useful life of assets and ensuring operational continuity.

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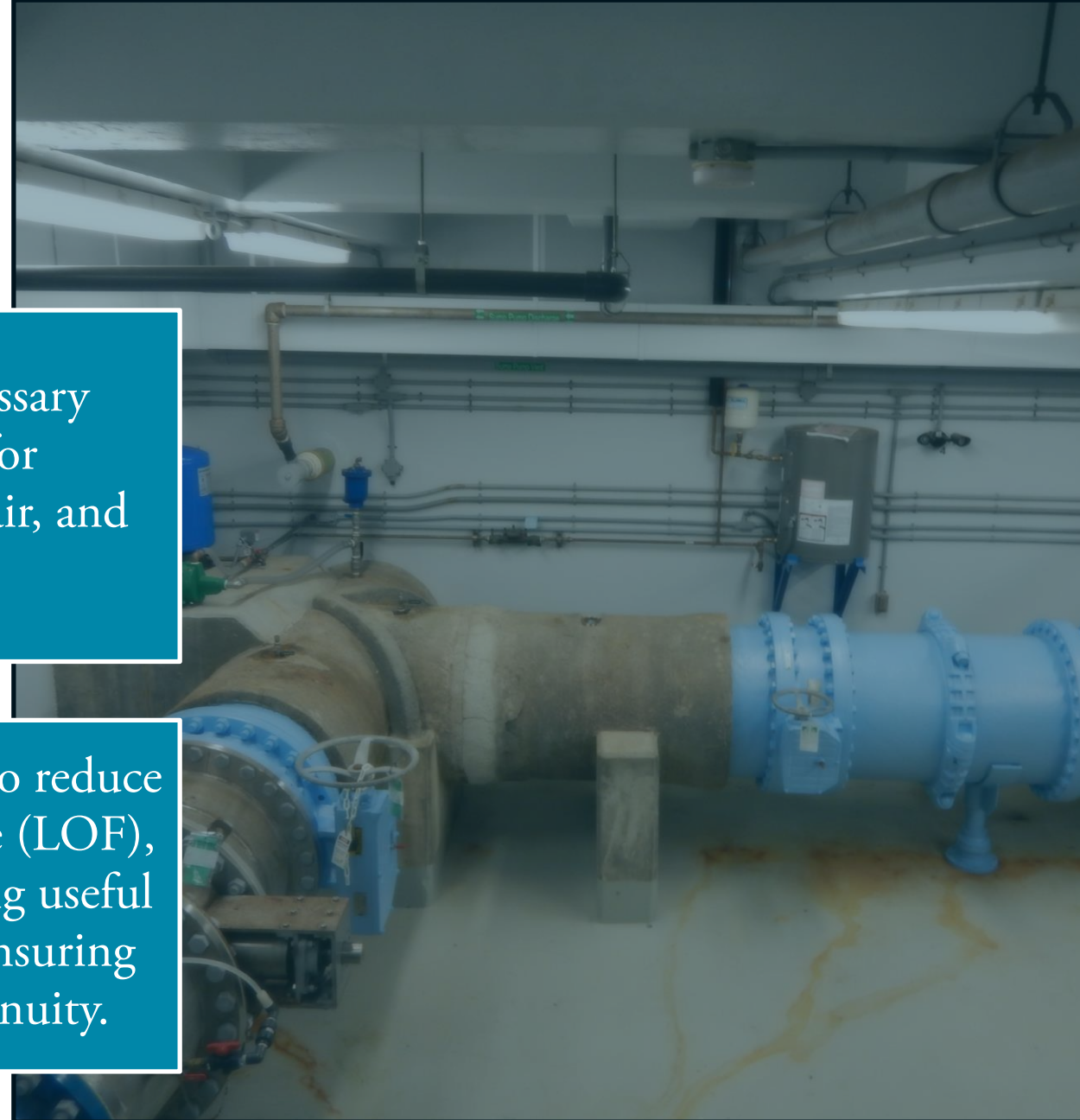
CNA: Identifying Priorities

The process of identifying and prioritizing critical areas for investment involves several key steps →

This is a continuously evolving process and differs on a client-to-client basis based on multiple factors. These phases will be reviewed in more detail.
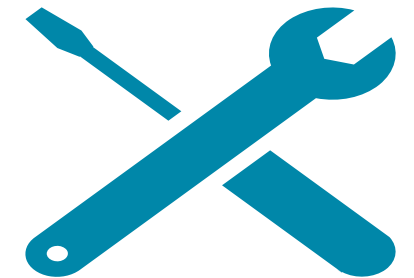
Data Collection

Condition Assessment
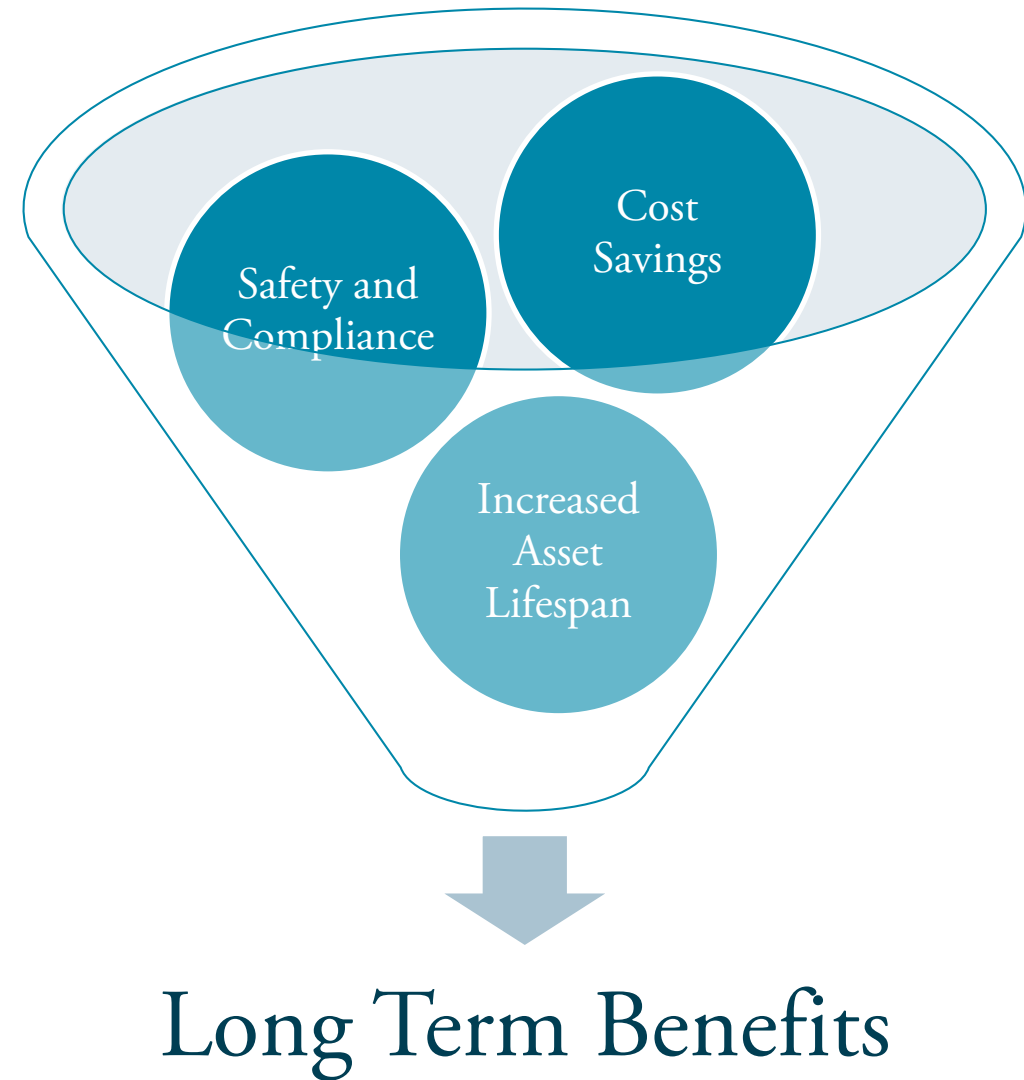
Risk Analysis

Prioritization Criteria

Stakeholder Input

Maintenance Review

Benefits of Enhanced Strategic Planning

- Allows organizations to plan and budget more effectively.
- Provides a clear roadmap for future investments

Safety and Compliance

Cost Savings

Increased Asset Lifespan

Long Term Benefits

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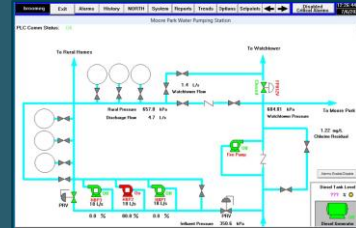# Additional Benefits of Enhanced Strategic Planning

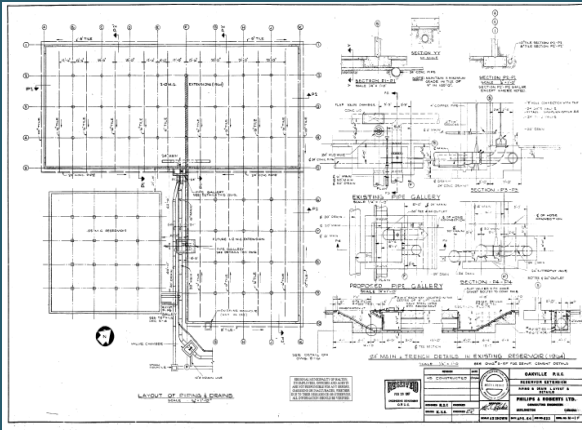- Increased Operational Efficiency
  - Minimize downtime (maintain LOS)
  - Understanding critical / high risk assets
  - O&M feedback fed into capital plans
  - Introduction of new technology
- Sustainable Practices
  - Maximizing remaining useful life of assets
  - Replacing assets with modern like-for-like equivalents (i.e., LED lightbulbs)
  - Reduces environmental impact of AM practices

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Case Study:

CNA of Drinking Water Reservoir and Booster Stations

Data Collection

- RFI
  - Previous Assessments (CNA, Arc-Flash, DSS, any other trade specific studies)
  - Asset Listing (CMMS extract, if possible)
  - Drawings / SCADA
  - Previous/Current Capital Projects
  - PM activities
- Emphasis on workshop with O&M staff to discuss past and present station issues.
  - Site visits will never full encapsulate the full operation of a plant or station.
  - Can validate and confirm identified issues while one site.
  - Develops trust and buy-in for future projects as issues that are brought up are included in capital projects.

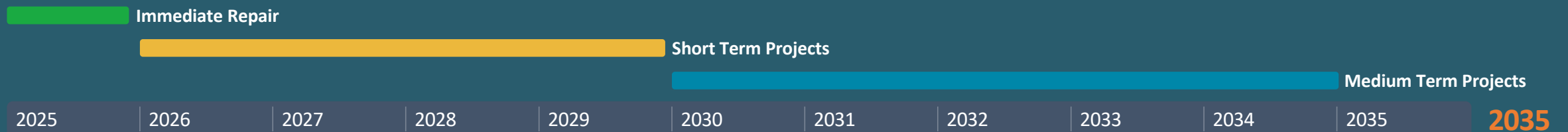| Equipment	Description	Functional Loc.
202264	VALVE CHECK #1 POTABLE WATER LINE 2	H-P-WD-NW-OF-MSRX
202265	VALVE CHECK #2 POTABLE WATER LINE 2	H-P-WD-NW-OF-MSRX
202266	TRANSMITTER LEVEL RESERVOIR	H-P-WD-NW-OF-MSRX
202267	PUMP #1 SAMPLE	H-P-WD-NW-OF-MSRX
203451	MSRRES1GV RESERVOIR (OLD/NEW) ISO. VALVE	H-P-WD-NW-OF-MSRX
210547	VALVE ISOLATION #1 FLOW TO CHECK VALVE	H-P-WD-NW-OF-MSRX
210548	VALVE ISOLATION #2 FLOW FROM CHK. VLV.	H-P-WD-NW-OF-MSRX
210549	VALVE ISOLATION #3	H-P-WD-NW-OF-MSRX
210550	VALVE ISOLATION #4	H-P-WD-NW-OF-MSRX
210551	HEATER UNIT #1	H-P-WD-NW-OF-MSRX

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Condition Rating and 10 Year Capital Forecast

- Assigning condition score based on field investigation and information from data collection phase.
- Assets are identified for **repair, replacement or both** (depending on service life of asset)

Score	Category	Physical Condition Rating
1	Excellent	New or recently rehabilitated infrastructure. Well maintained and in excellent condition.
2	Very Good	Infrastructure is in the early stage of its useful life. Acceptable condition with some deterioration. May require some minor maintenance.
3	Good	Infrastructure is in the mid-stage of its useful life. May show slight signs of deterioration. May require maintenance.
4	Fair	Infrastructure in later stage of its useful life. May show minor deterioration. May require on-going monitoring and major maintenance or rehabilitation.
5	Poor	Infrastructure in end-stage of its useful life. May show major deterioration or condition may be critical. May require extensive monitoring, rehabilitation and/or replacement.

- Projects are broken down into immediate need, short term need and medium-term need.

Immediate Repair

Short Term Projects

Medium Term Projects

2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | **2035**

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Site Inspections: LiDAR

3D Mapping:

- Capturing precise measurements and topographical data.

Scans and Point Cloud:

- Can be used to generates accurate drawings, floor plans, and 3-D renderings. Allows for immersive virtual tours.

High Accuracy:

- LiDAR provides highly accurate data, with a range of technologies and settings that will enhance the quality of the data points collected.

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Site Inspections: LiDAR

Structural Analysis:

- **Detecting Deficiencies**

- **Condition Snapshot**

Efficiency and Safety:

- **Time-Efficiency:**

  - Enhanced speed of LiDAR data collection

  - Reduces the number of staff required for entry.

Site Inspections: Drone

Accessibility and Safety:
- **Access to Hard-to-Reach Areas**
- **Safety Improvements:** By using drones, the need for scaffolding or ladders is minimized, reducing the risk of accidents and injuries.

Detailed and Accurate Data
- **Rapid Data Collection**
- **Real-Time Analysis**
- **High-Resolution Imaging**: Drones equipped with high-resolution cameras provide detailed images that can reveal even minor defects.


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Scope Change: Structural Issue

Structural issue identified at critical facility. Temporary shoring was required immediately.

Station was added to scope of project. Area of concern was scanned and saved in Matterport. This scan was used in tender package, to verify measurements, and for a pre and post installation reference file.

Allowed multiple technical staff to review, measure, plan and execute on a temporary shoring design without having to go to site multiple times.
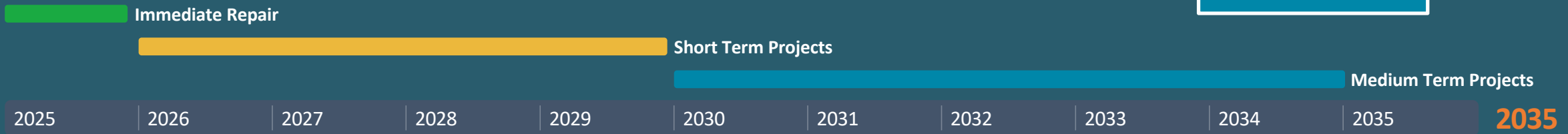
The temporary post was installed within the timeframe of the overall CNA project timeline.

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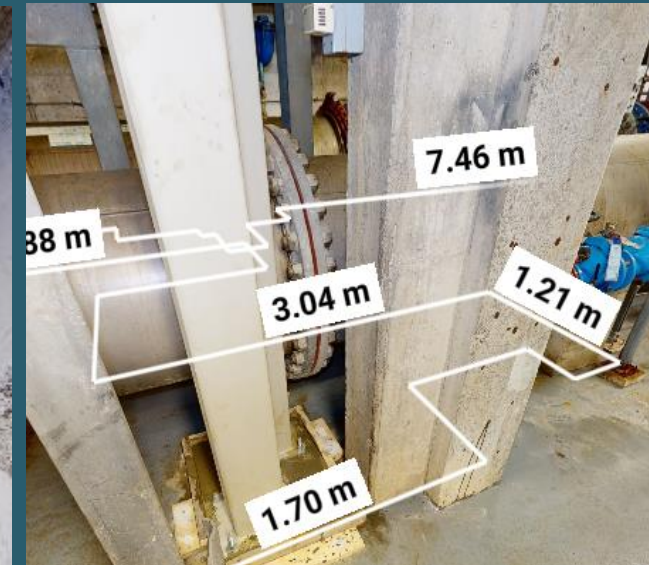
Criticality and Risk: Prioritization for Capital Spend

- If everything is critical, nothing is

- Repair and replacement projects in the 1-5 year window are added to a risk register.

- Each project is populated with:
  - Level of Asset Hierarchy (goes back to AMP)
  - Failure Mode, Root Cause and Root Cause Category
  - Consequence of Failure, Likelihood of Failure and Likelihood reasoning.

- Allows risk-based prioritization of upcoming projects.

Risk Categories

- Cost
- Health & Safety
- Availability/Reliability
- Extent
- Legislative
- Environment
- Redundancy Factor
- Redundancy Profile

Risk Score

25
50
26
10
83

Immediate Repair

Short Term Projects

Medium Term Projects

2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | **2035**

Preventative Maintenance Strategy

Objective: Optimize maintenance tasks for critical infrastructure to extend asset life, reduce costs, and enhance system reliability.
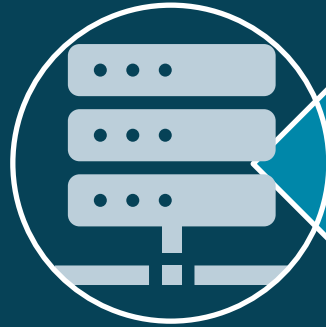
Scope: Review and streamline maintenance practices across multiple facilities, including water, wastewater, and other utility systems.

Approach: Utilize Reliability-Centered Maintenance (RCM) methodologies and integrate data from SAP and other CMMS systems for a comprehensive analysis.

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PM Strategy: Key Steps

Data Integration & Setup:

- Centralized data management using SQL and MS Access.
- Standardized maintenance and failure mode data

Analysis & Optimization:

- Mapped procedures to failure modes and asset categories
- Shifted from time-based to condition-based maintenance
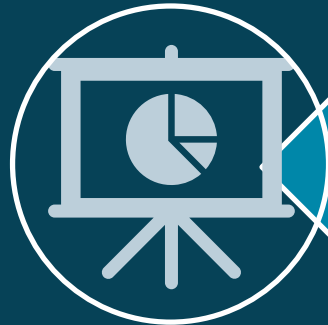
Quality Assurance & Validation:

- Refined strategies based on stakeholder feedback and analysis.
- Ensured data consistency across multiple sources.

PM Strategy: Results

Enhanced Maintenance Strategy:

- Transitioned to condition-based maintenance
- Improved accuracy of asset registries and maintenance plans

Data-Driven Decisions:

- Centralized database
- Identified and resolved data inconsistencies, duplicates, and gaps in maintenance records.

Challenges & Learnings:

- Managing diverse data sources required extensive validation efforts.

Capital Needs Assessment: Results

Stations Assessed: 6

# of Assets Assessed: 2352

Total value of assets assessed: $652M

Total number of assets recommended for repair or replacement over 10-year period: 1,108

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Integration of condition-based monitoring technologies

Adoption of green building standards

Focus on resilience and adaptation

Questions