




**Preliminary Structural Evaluation of Historic Water Main Valve Vaults for Rehabilitation Prioritization in Minneapolis**  
 ICRI Fall Convention – Cleveland, Ohio


Presented by:  
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### Presentation Outline


- Project Background
- Inspection Methods and Logistics
- Assessment Methods
- Observations
  - Types of Structures
  - Recurring Themes
- Critical Structures
- Next Steps



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### Project Background




- Minneapolis Drinking Water Supply History
  - 1871 - Pump Station #1 (untreated 2.5 MG/D)
  - 1885 - Pump Station #2 (43 MG/D)
  - 1910 - Chlorination Introduced
  - 1924 - First Sand Filter Plant Designed
  - 1927 - Sand Filter Plant Expanded
  - 2005 - Membrane Filtration Plant Opened
- Current Output
  - Average Drinking Water Output is 56 MG/D
  - Max Flow is 128 MG/D
  - Serves 510,000 People in Greater Minneapolis Area



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### Project Background

- 94 Valve Vaults for Water Lines 36" ID and Larger
- Double Disc Gate Valves, largest approximately 30 kips
- Preliminary Structural Evaluations Needed to Prioritize Repair Effort

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### Inspection Methods and Logistics

- Spring Inspections
  - 49 Vaults, 2 weeks
- Fall Inspections
  - 45 Remaining
- GIS Map / Route Planning
- Traffic Control
- Confined Space Entry
- 1 Lead Truck
- 1 Gate Truck
  - Attendant
  - Pipe Inspector
  - Structural Engineer





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### Inspection Methods and Logistics

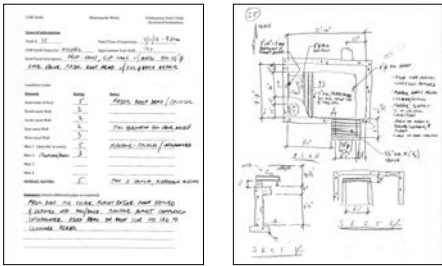
- Valve Inspection
  - Minneapolis Water Staff
- Structural Investigation
  - Major Structural Elements
  - Durability Issues
  - Global Stability
  - Acoustic Impact
  - Visual / Photographic
  - Field Sketch and Measurements





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### Inspection Methods and Logistics



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### Assessment Methods

- Structural Elements Rated
  - Walls
  - Roof
  - Concrete Beams
  - Steel Framing
  - Valve Box / Plug
  - Manhole
- Other Elements Rated
  - Pipe/Valve Pedestal
  - Rungs
- Overall Rating

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### Assessment Methods


5 Point Scale for Condition Rating (ACI 364.1R-10)

Rating	n	%	Description
1-Good	5	10%	No repairs required.
2-Fair	20	41%	Minor repairs required.
3-Moderate	10	20%	Moderate repairs required.
4-Poor	8	8%	Major repairs required.
5-Critical	6	12%	Unsafe or potentially hazardous.

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### 1 – Good Condition (5 of 49 Vaults)

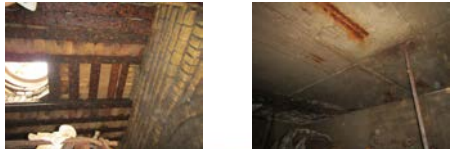
- No repair necessary.
- Structure is functioning as originally designed.



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### 2 – Fair Condition (20 of 49 Vaults)

- Minor local repair recommended.
- Structure is functioning as originally designed.
- Minor local delamination, spalling, corrosion, and/or cracking may be observed.



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### 3 – Moderate Condition (10 of 49)

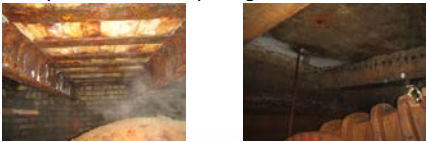
- Moderate local repair recommended.
- Some local elements may not be functioning as originally designed.
- Moderate local delamination, spalling, corrosion, and/or cracking is observed.



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### 4 – Poor Condition (8 of 49 Vaults)


- Major repair and further investigation is recommended.
- Severe distress and deterioration.
- Structure is not functioning as originally designed.
- Heavy delamination, spalling, and corrosion.



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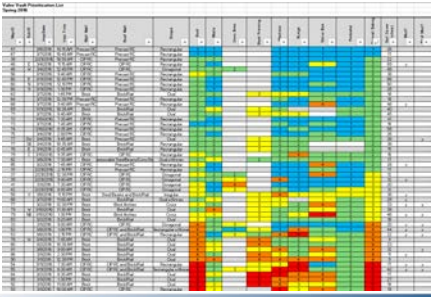
### 5 – Critical Condition (6 of 49)

- Unsafe or potentially hazardous.
- Major repairs recommended.
- Structure is not functioning as originally designed.
- Some structural elements may have failed.



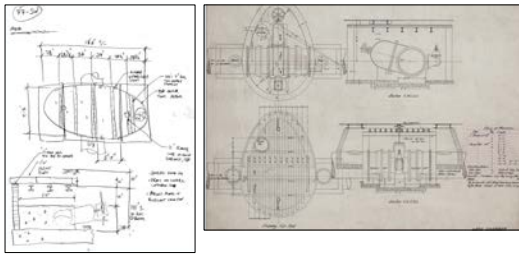
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### Assessment Methods - Prioritization List



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### Structure Type: Oval Brick (1888 – 1916)



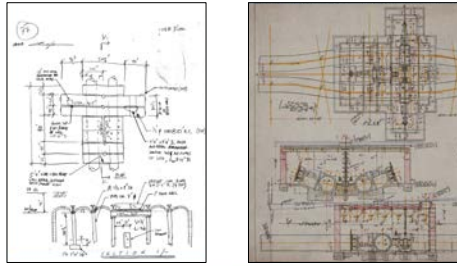
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### Structure Type: Oval Brick (1888 – 1916)




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### Structure Type: Cross-Shaped Brick (1897)



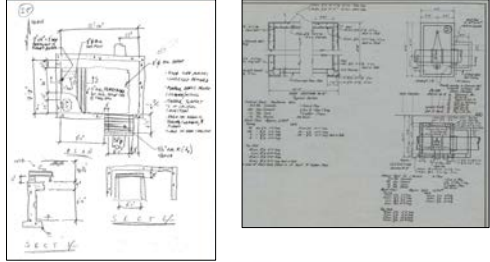
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Structure Type: Cross-Shaped Brick (1897)




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Structure Type: Rect. CIP (1910-1953)



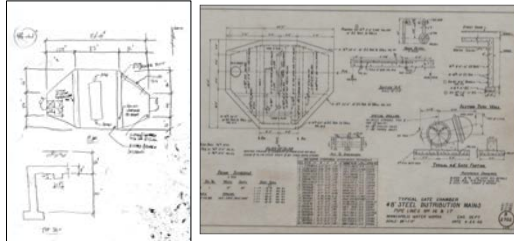
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Structure Type: Rect. CIP (1910-1953)




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Structure Type: Oct. CIP (1930-1950)



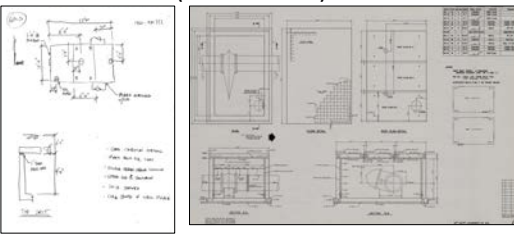
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Structure Type: Oct. CIP (1930-1950)




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Structure Type: CIP w/Precast Roof (1967 - 1981)



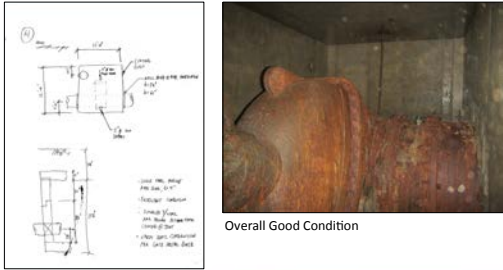
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### Structure Type: CIP w/Precast Roof (1967 - 1981)



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### Structure Type: Precast (1990 - 2002)



Overall Good Condition

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### Observations


#### Rating Breakdown by Structure Type

Date Range	#	Rating					Avg	Description	Shape
		1	2	3	4	5			
1888 - 1916	19	7	4	5	3	3.2	Brick & brick/rail roof	Oval (typ)	
1897	2	2				3.0	Brick & arched-brick roof	Cross	
1910 - 1953	7	1	1	2	3	3.7	Cast-in-place	Rectangular	
1930 - 1950	6	1	4	1		3.0	Cast-in-place	Octagonal	
1967 - 1981	11	2	9			1.8	CIP & precast roof	Rectangular	
1990 - 2002	4	2	2			1.5	Precast	Rectangular	

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### Observations

- Manhole Deterioration



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### Observations

- Corroded Framing



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### Observations

- Valve Boxes



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### Observations


- Major Roof Modifications



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### Observations

- Wall Penetrations



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### Observations

- Concrete Beam Corrosion



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### Observations

- Rebar Chairs



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### Observations

- Embed Items / Patching



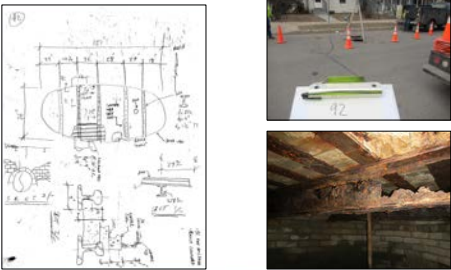
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### Observations – Recurring Themes

- Oval/Brick
  - Deteriorated Brick at Manhole
  - Walls Generally in Good Condition for Age
  - Steel Beams Heavily Corroded
  - Steel Rail Corroded, but in Fair to Moderate Condition
  - Post-installed penetrations
- CIP Concrete
  - Major Roof Demo
  - Walls in Good Condition
  - Beams/Slabs show moderate corrosion and spalling
  - Insufficient Cover
- Precast Concrete
  - Rebar Chairs without Plastic Tips
  - Patching Bug Holes, Form Ties, etc
  - Lifting Embeds
  - Core-drilled valve plug
- General
  - Previous Modification Work
  - Embedded Items
  - Penetrations
  - Deicing Salts and Chemicals, Corrosion at Manhole

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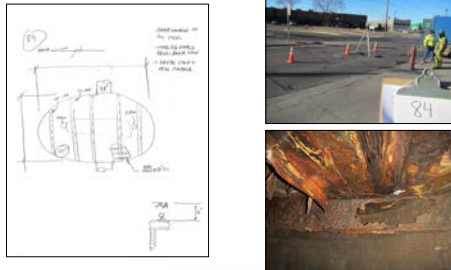
### Critical Vaults



42

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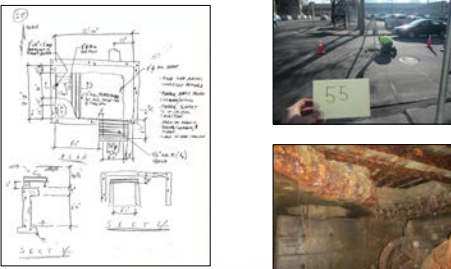
### Critical Vaults



84

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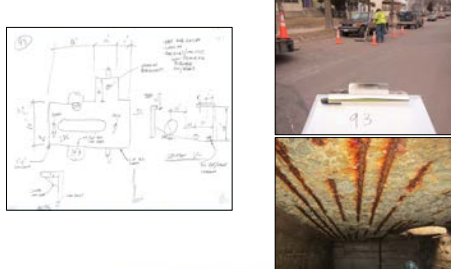
### Critical Vaults



55

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### Critical Vaults



93

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### Critical Vaults – Immediate Corrective Action

<h4>Steel Plates</h4>  	<h4>Timber Shoring</h4>  
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### Next Steps

- Prioritization of Rehabilitation for all 94 Vaults
- Proceed with Repair and Rehabilitation of 4's and 5's
- Follow with Repair of 3's
- Develop Preventative Inspection and Maintenance Program for all vaults

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Questions?



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