

21 Tanks, 3 Concerns, 1 Opportunity

City of Klamath Falls Storage Resiliency Planning

2018 PNWS-AWWA

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Tacoma, WA

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Addressing Multiple Project Objectives

- **Seismic risk**
- **Storage asset security**
- **Overall condition assessment**
- **Asset focus vs. System focus**
 - Address individual and network deficiencies
 - Maximize investment
 - Reduce O&M
 - Increase system resiliency
 - Simplify operation
 - Recast the structure of the system
 - Maintain level-of-service



The System Today

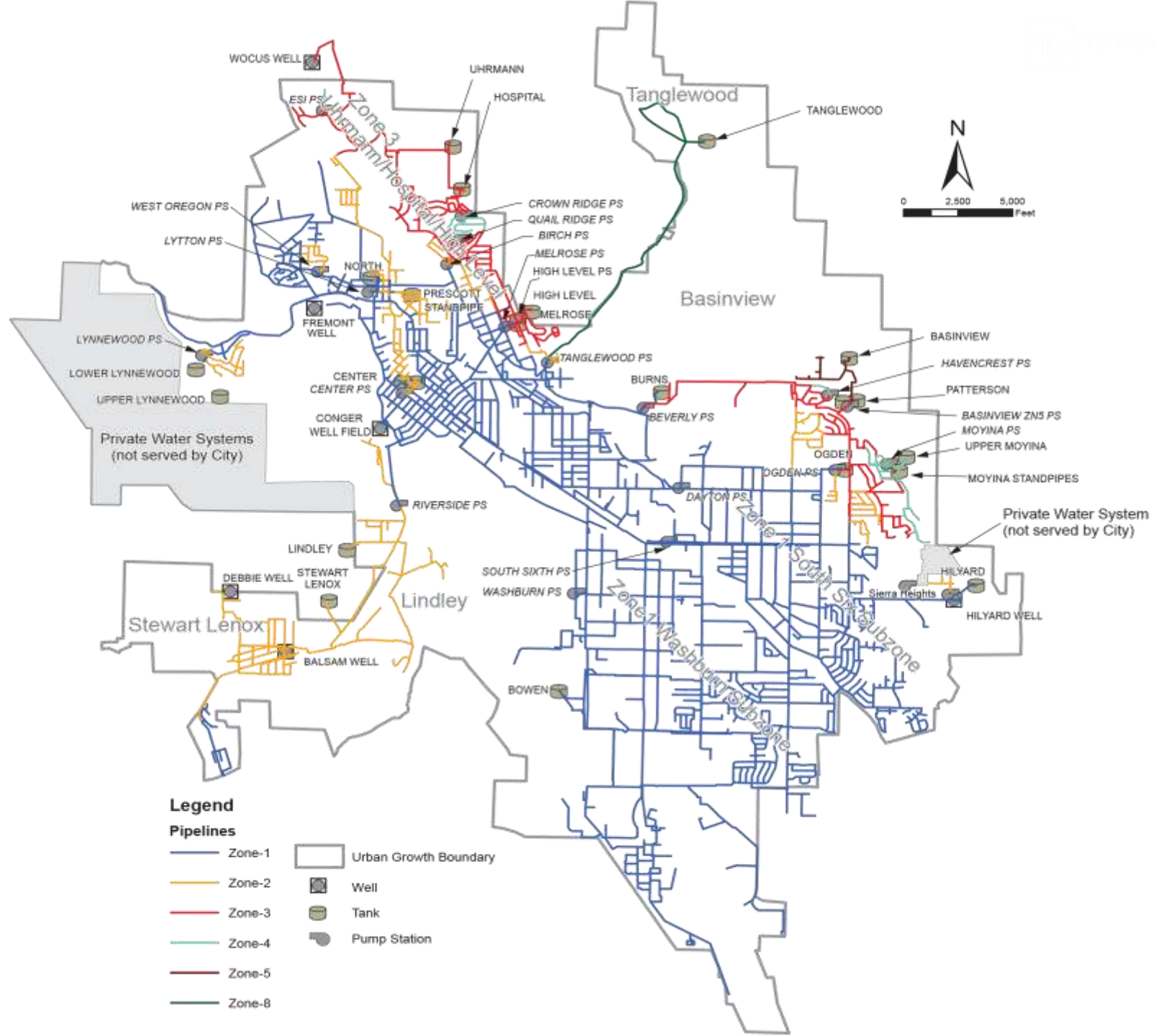
- **5 operational pressure zones**
 - **21 steel tanks**
 - 18 welded, 3 riveted
 - 0.13 to 1.46 MGD
 - 23 to 90 years in age
 - **Total storage of 16.4 MG, a deficit of 5.5 to 8.8 MG**
 - **Oldest tanks in system on operational critical path**
 - **Elevation of the tanks within a zone varies only by a couple feet**
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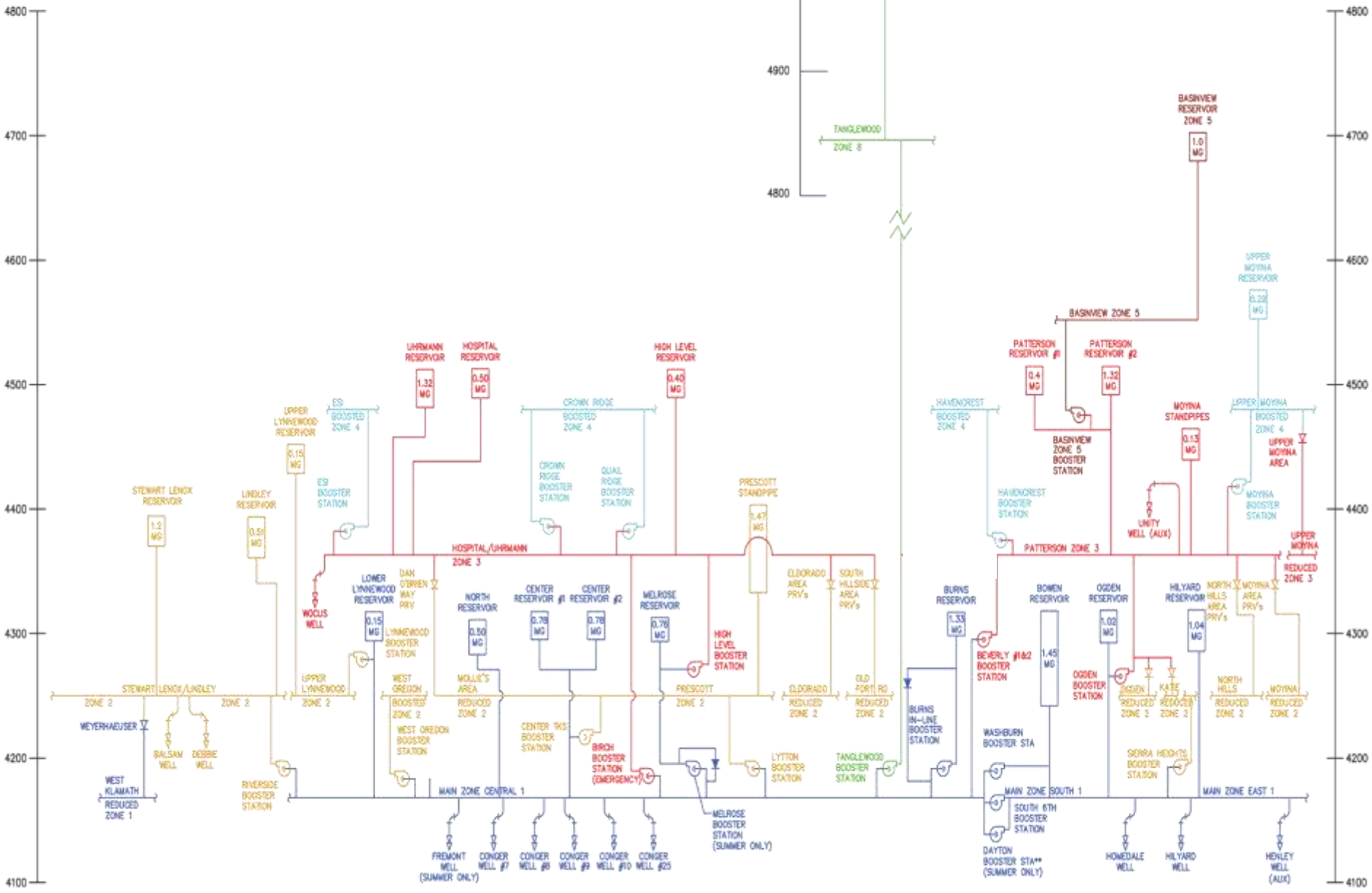















Objectives, Criteria, Data, and Analysis

- Integrated seismic, security and condition improvements
 - Prioritization and performance criteria workshop
 - Asset field evaluation
 - Desk top analysis of available design and as-built docs
 - Determination of seismic design event
 - Structural performance assets to design event
 - System hydraulic modeling
 - CIP development
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The Criteria

- **Minimum pressure of 40 psi; 20 psi under fire flow**
 - **Emergency storage = 70% of max day demand (22.4 MG)**
 - **Seismic resiliency at MCE**
 - **Security criteria**
 - Protection of water quality
 - Restriction of access to hatches
 - Record of unauthorized access
 - Restriction of site access
 - **AWWA D100, OSHA, ODWR guidance**
 - **10 year touch-up; 35 year recoating schedule**
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What Are Your Criteria?

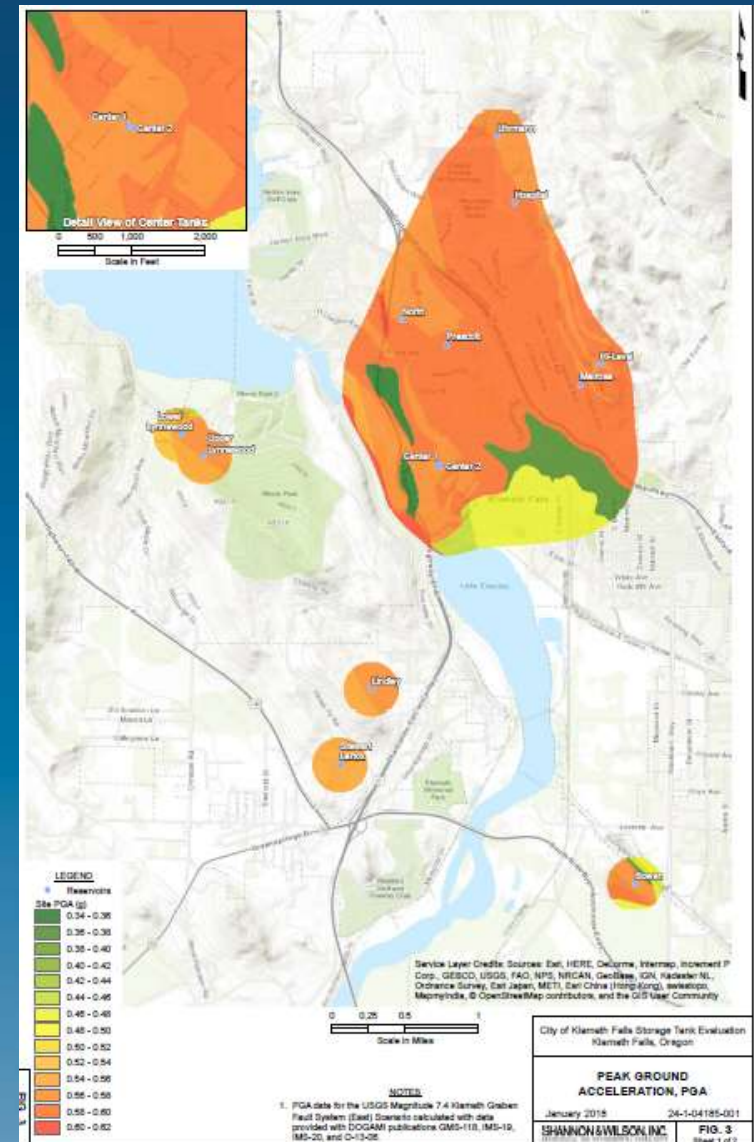
- Emergency storage capacity?
 - Security Design Basis Threat?
 - Seismic MCE?
 - Recoating schedule?
 - What are the idiosyncrasies of your system today?
 - Where are the opportunities for efficiencies in your system?
 - Where are you throwing good money at bad investments?
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Address the Reality of the Situation

- The greatest seismic threat to the system is a M 7.4 local event, not a 9.0 CSZ
 - Tank recoating has not progressed according to industry standards
 - The system has evolved through acquisition, rather than long-term vision.
 - Storage deficit assumes only 12 - hour outage
 - Emergency storage assumes localized, controlled emergency, not system-wide.
 - Small capacity tanks will lose contents quickly.
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Seismic Condition

- ORP event M 9.0 at CSZ
- Klamath Falls MCE 7.4 at Klamath Graben Fault
- Greatest geotechnical threat from cut landslides adjacent to tanks



What is Your System's Geotechnical Condition?

- Do you know the geotechnical conditions of your sites?
- What is the MCE for your system? Why should you care?
- Are there site risks to you tanks?



Structural Condition

- 66% of assets built before 1990
- 13 of 21 lacked flexible I/O connections
- All lacked sufficient freeboard
- Newest tank did not meet shell compression standards
- Settlement and overturn risk at two sites




What is Your System's Structural Condition?

- What assets are older than 1990?
- How many of your facilities have flexible connections?
- Can you make operational changes to minimize seismic damage?
- Have you looked past newer facilities?



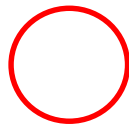
Security Condition

- Evidence of unauthorized access at all sites
 - No secure perimeters or inappropriate materials
 - Not all ladders secured
 - No surveillance, lighting, or alarms
 - No evidence of tampering with water supply
 - Pilot surveillance installations planned
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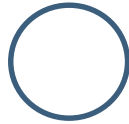
What is Your System's Security Condition?

- What is your DBT?
- Is there evidence of unauthorized access to assets?
- Do you have adequate security measures for the DBT?
- Do you have multi-level security?

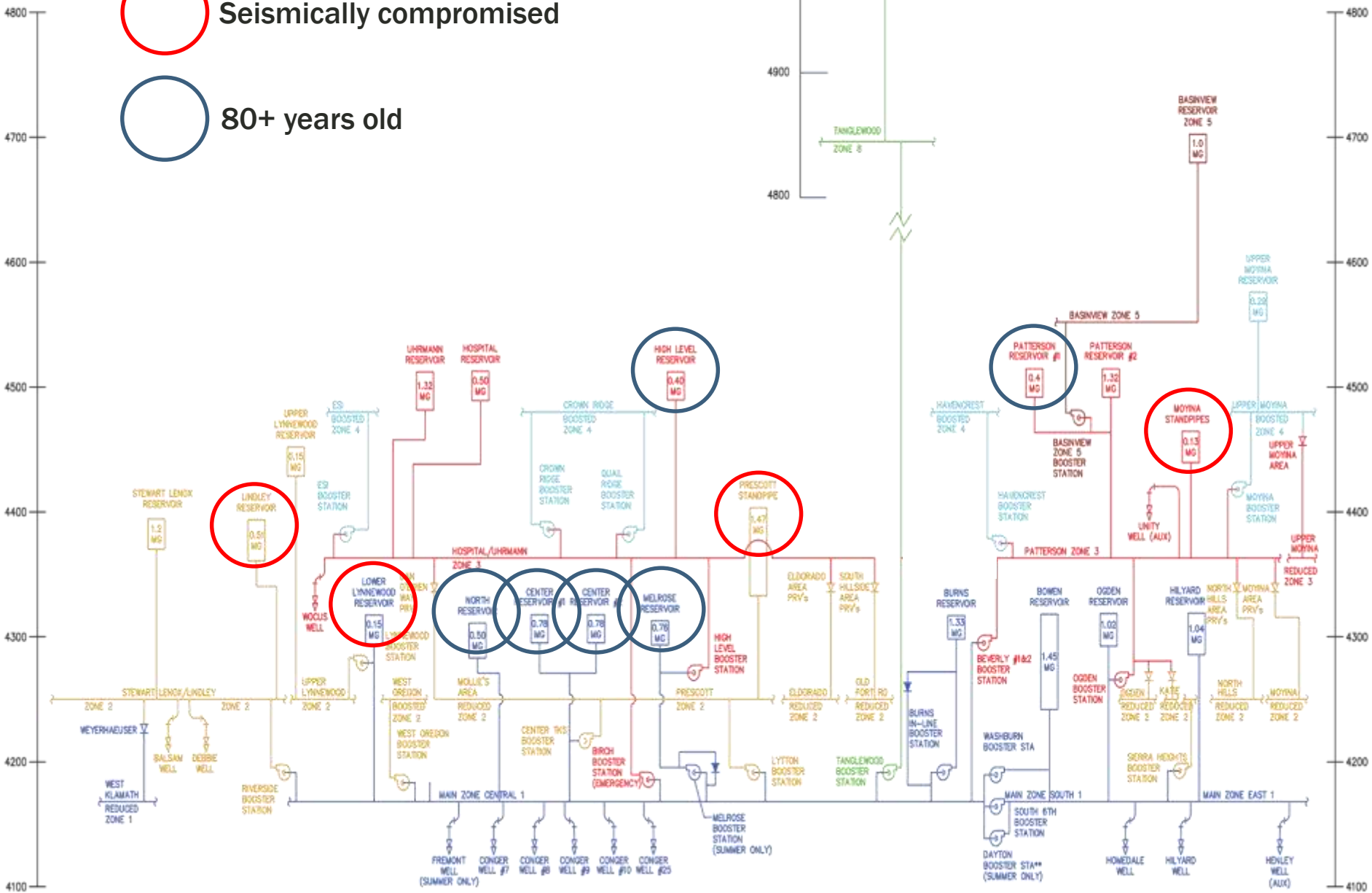




Seismically compromised



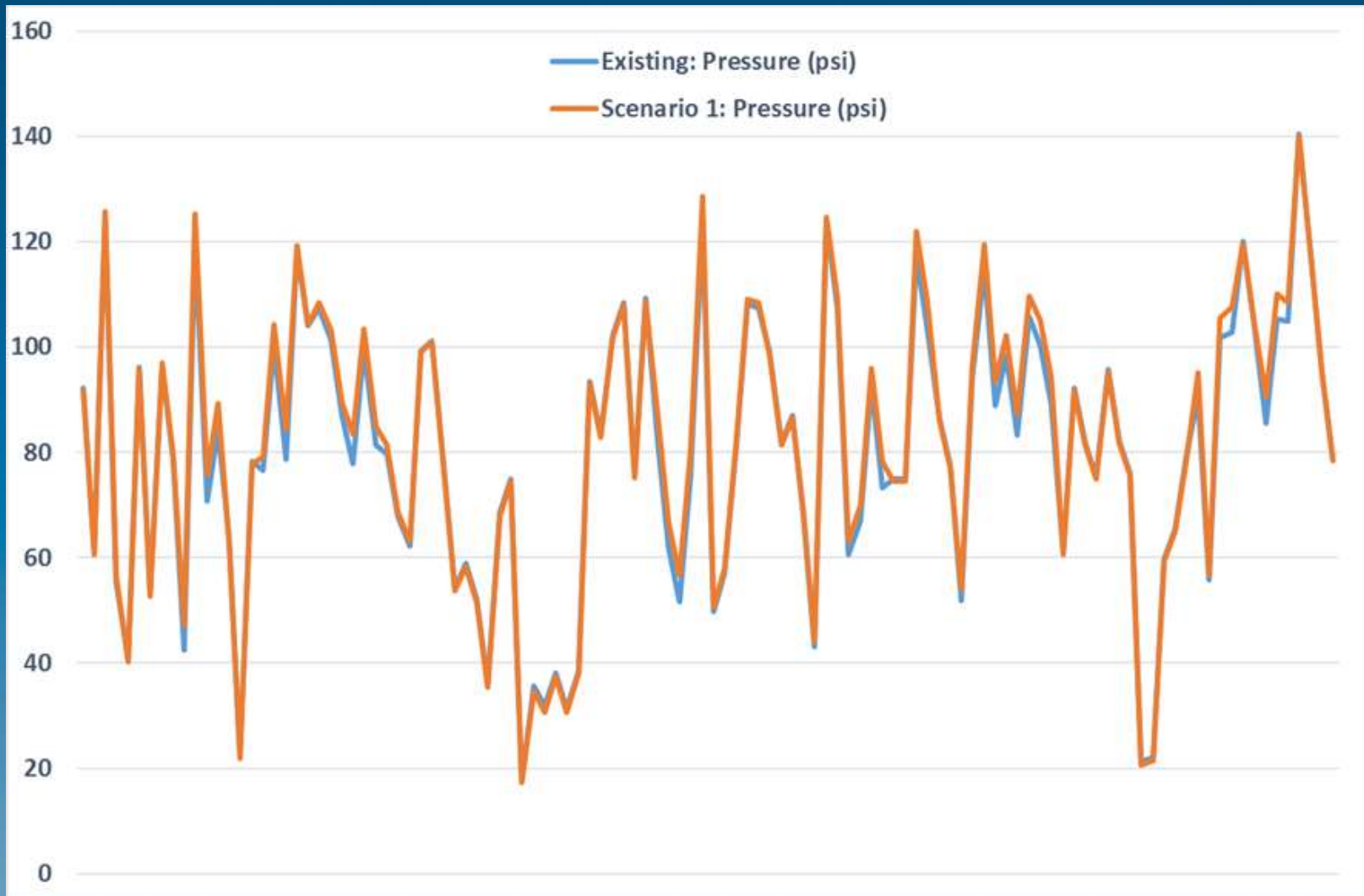
80+ years old



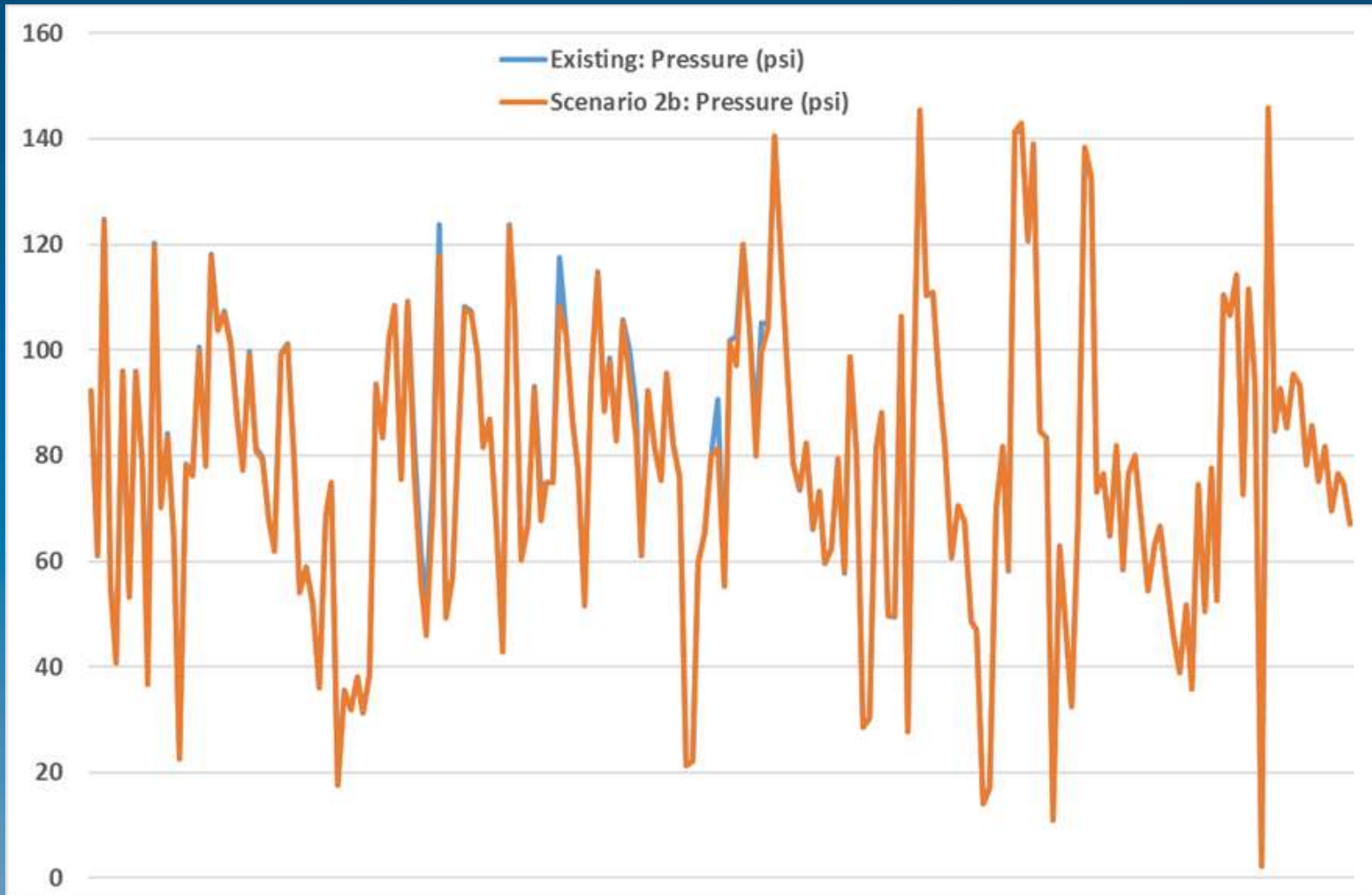
System Reconfiguration Scenarios

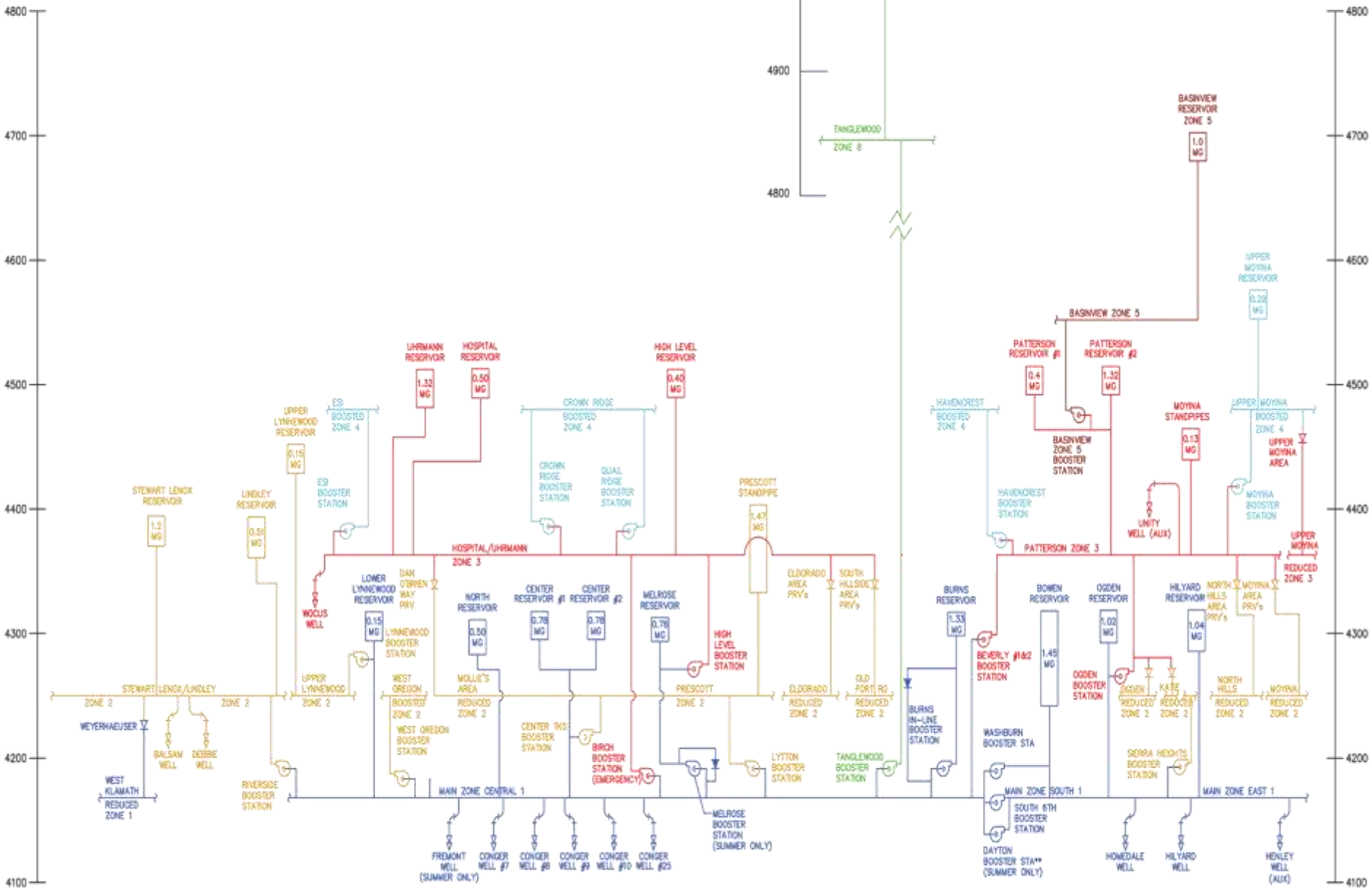
Proposed Improvement	Assets Removed
Replace High Level Tank with 3.0 MG tank	Hospital
Replace Center 1 & 2 with 2 - 5.0 MG tanks Upgrade/Convert Melrose Booster Station to New High Level Booster Station	<ul style="list-style-type: none"> • Center 1 & 2 • North • Melrose • High Level Booster Station • Lower Lynnwood
Decommission Patterson #1 Decommission Lower Moyina	<ul style="list-style-type: none"> • Patterson 1 • Lower Moyina

Scenario 1 Model Results



Scenario 2 Model Results





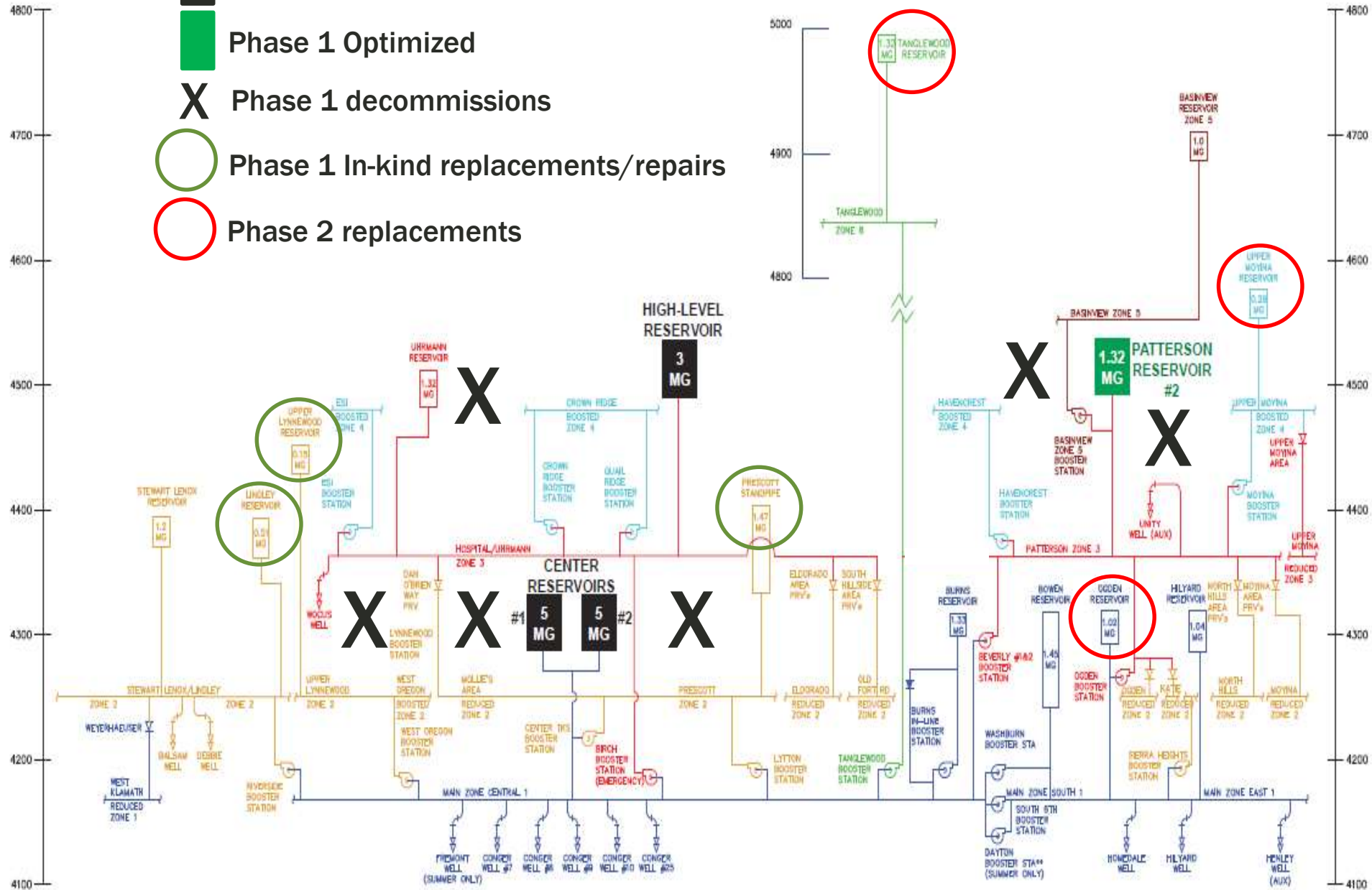
Phase 1 increased replacements

Phase 1 Optimized

Phase 1 decommissions

Phase 1 In-kind replacements/repairs

Phase 2 replacements



Maximizing Investment with Holistic Solutions

Reconfiguration	Replaced/Maximized Assets	Assets Removed from System	Storage Capacity Impact	LOS Impact
High Level Tank replaced with 3.0 MG tank	New seismically resilient asset High Tank	Hospital	+2.1 MG to Zone 3	None
Center 1 & 2 replaced with 2 - 5.0 MG tanks Melrose Booster Station converted to High Level Booster Station	<ul style="list-style-type: none"> • Two new seismically resilient Center Tanks • New seismically resilient booster station 	North Lower Lynnwood Melrose	+7.2 MG to Zone 1	None
Decommission Patterson #1 and Lower Moyina	Patterson #2 capacity maximized	Patterson 1 Lower Moyina	- 0.1 MG to Zone 3	None


3 resilient tanks added, 6 at-risk tanks removed, 1 tank optimized , 9.2 MG capacity added

Step Back to See The Forest

- Do you know your seismic vulnerabilities?
- Where are your seismically vulnerable assets in the system?
- What asset common issues can you package for improvement?
- Are you meeting your regular maintenance schedules?
- Do you have redundancy or repetition?
- What operational changes can you make to protect your assets?



The Path Ahead

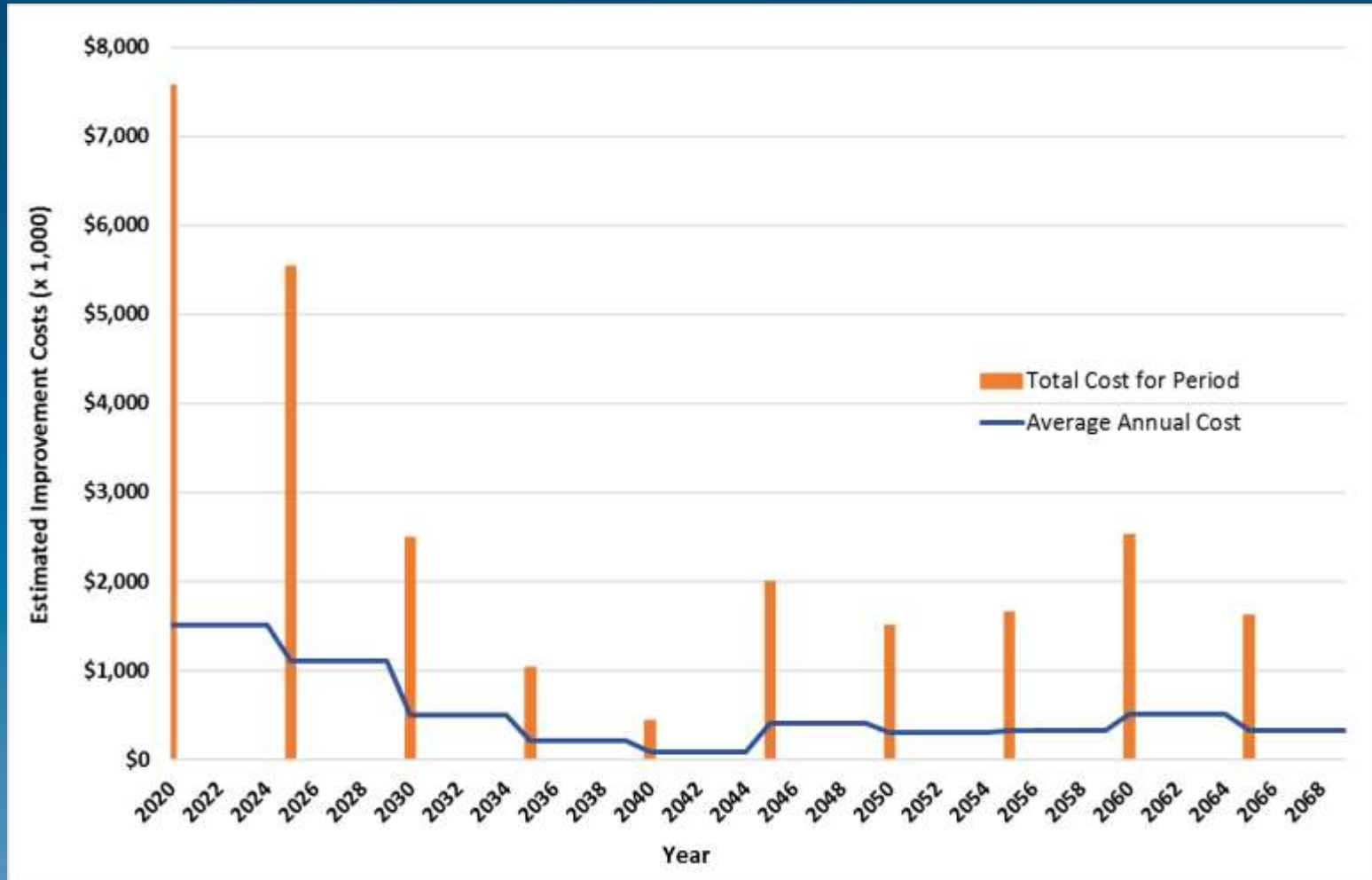
- **Balance of current needs and 50-year resiliency target**
 - **In 10 years, total assets reduced by 28%**
 - O&M, staff time, security, recoating, replacement
 - **Operational improvements save \$3M in resiliency upgrades**
 - **2020-2025: 2 replaced and 5 removed: \$7.4M**
 - **2026-30: 3 replaced (2 as like), 1 repaired, 1 removed: \$4.8M**
 - **2031-55: 3 like-for-like tanks replaced**
 - **By 2030 the full system meets seismic code and prepared for maximum credible event (MCE)**
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Looking Forward Is Most Cost Effective

Cost to Upgrade Existing Assets	Cost to Upgrade or Replace with Like Capacity	Cost to Upgrade or Replace with Increased Capacity and Decommissioning
\$8.7M (assuming Ops. modifications)	\$11.0M	\$11.3M



Storage CIP Cost Distribution



Includes replacement, seismic upgrade, security, and recoating

More Water, Fewer Assets, Greater Reliability

	2018 System	2030 System
Total Number of Assets	21	15
Assets Resilient to Design Event (per 2000 code)	1 (5%)	15 (100%)
Total Storage Capacity	16.4 MG	25.6 MG
Average Asset Capacity	0.8 MG	1.9 MG
Typical Period Between Recoating	Unknown	30-35 Years

- Over the next twenty years what improvements would you make?
- Given fifty years, and an opportunity to optimize your system, what would you do?
- How does looking at the system in its entirety change your plan?

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Questions

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