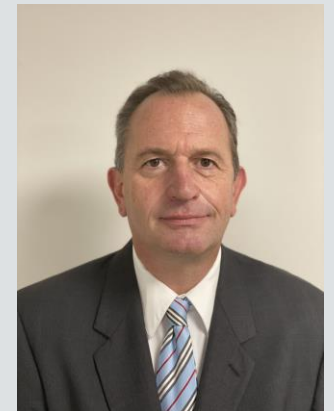




Cross-Connection Testing: Pressure Differential Approach and Case Studies

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Source: USGlass Magazine

Agenda

- What is a cross-connection ?
- Visual test
- Pressure differential test
- Case studies
- One more option
- Questions & Answers

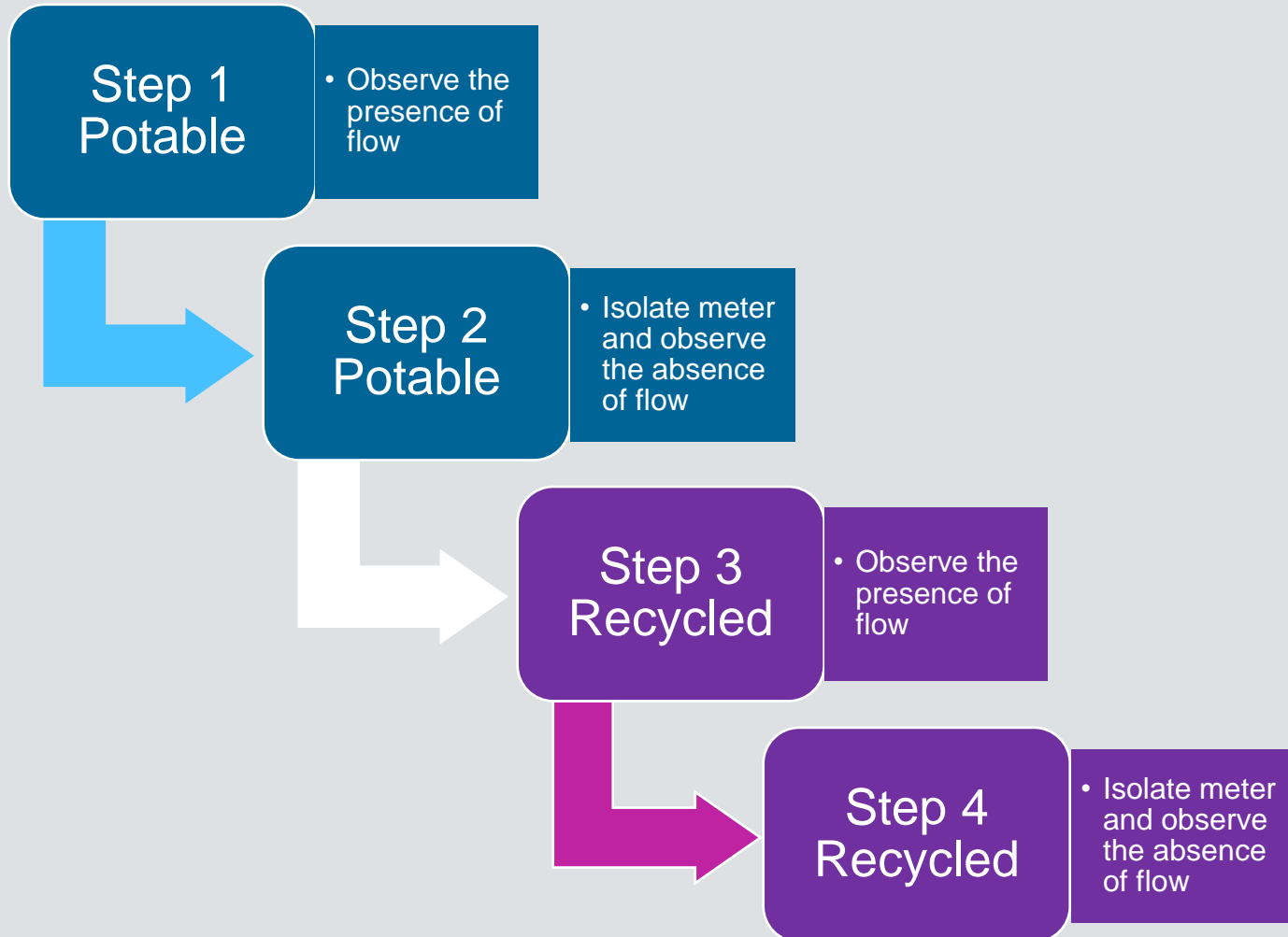


What is a Cross-Connection?

Any physical connection between a water system supplying drinking water and any source or system containing water that is not or cannot be approved for human consumption that could contaminate the potable water system.



Visual Test Approach



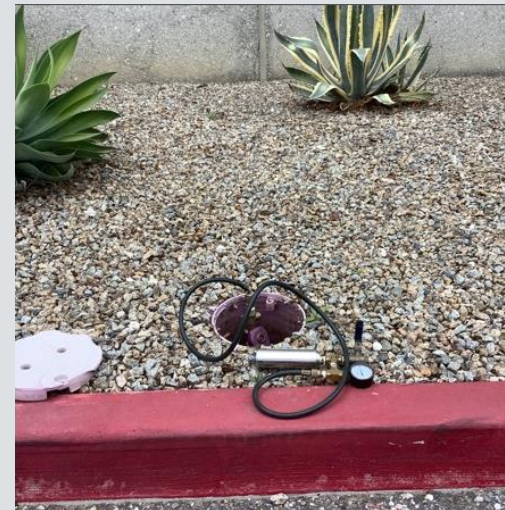
Visual Test Approach

- Need to know the location of all potable water fixtures
- Expensive – staffing
- Impact of current health and safety conditions
- Time consuming
- No actual data or records available to confirm tests results
- Dual source site – Not the SWRCB requested shutdown test
- Dual plumbed site – alternative to the pressure differential approach



Pressure Differential Approach

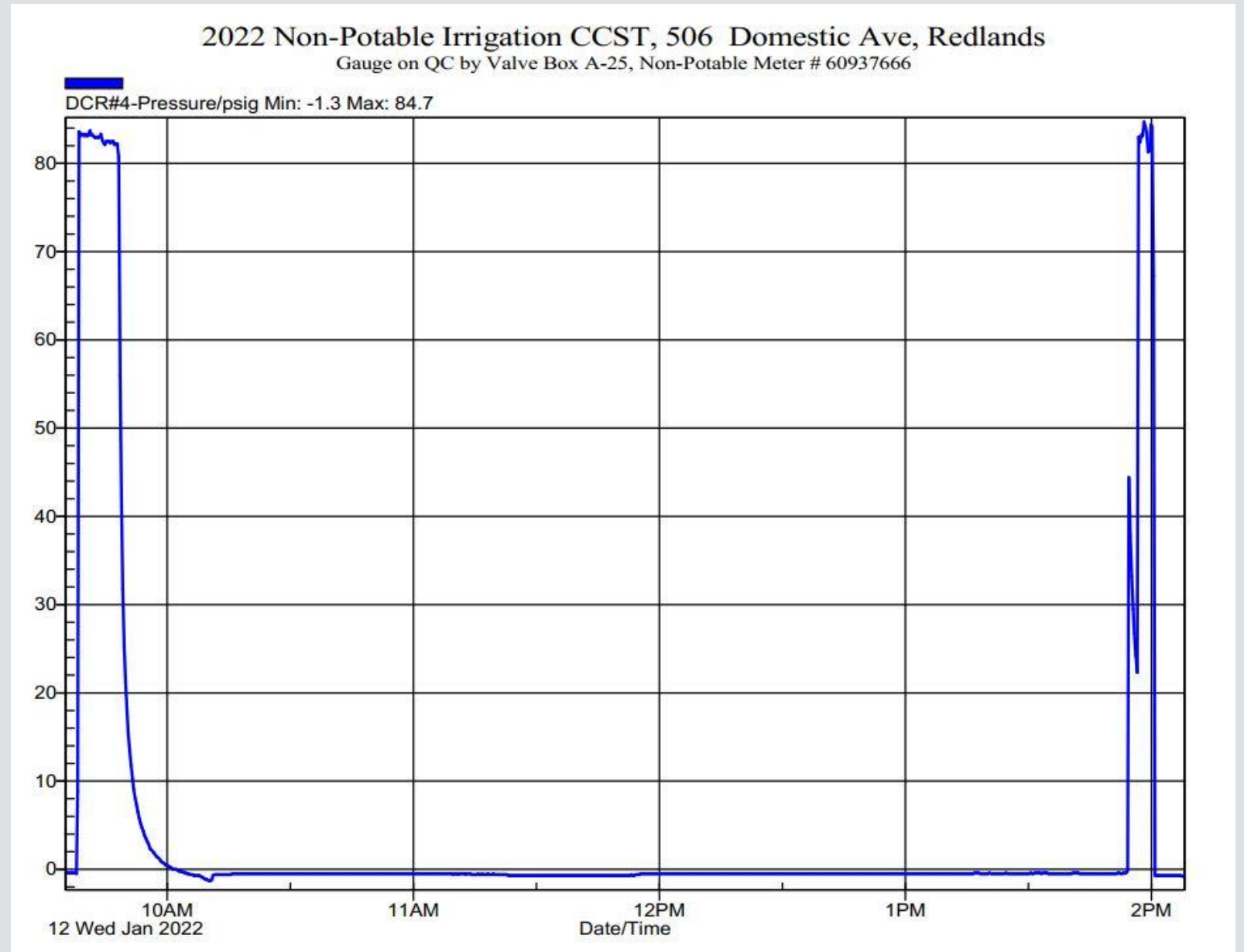
- Create and maintain a pressure differential between the two systems
- Monitor changes in pressure over a period of time using pressure gauges
- Two steps: In the first step, the potable system is left pressurized while the recycled water system is depressurized. The procedure is reversed in the second step.



Pressure Differential Approach

- Typically involves one cross-connection control specialist and a site representative
- Typical duration: 2-4 hours per system. Duration is determined by the local SWRCB District office and the Purveyor
- Provides actual records of the tests
- Dual source site: preferred method. All sites with a recycled water meter are subject to a, at least, quadrennial cross-connection shutdown test.
- Dual plumbed site: preferred method, if feasible

Test Result

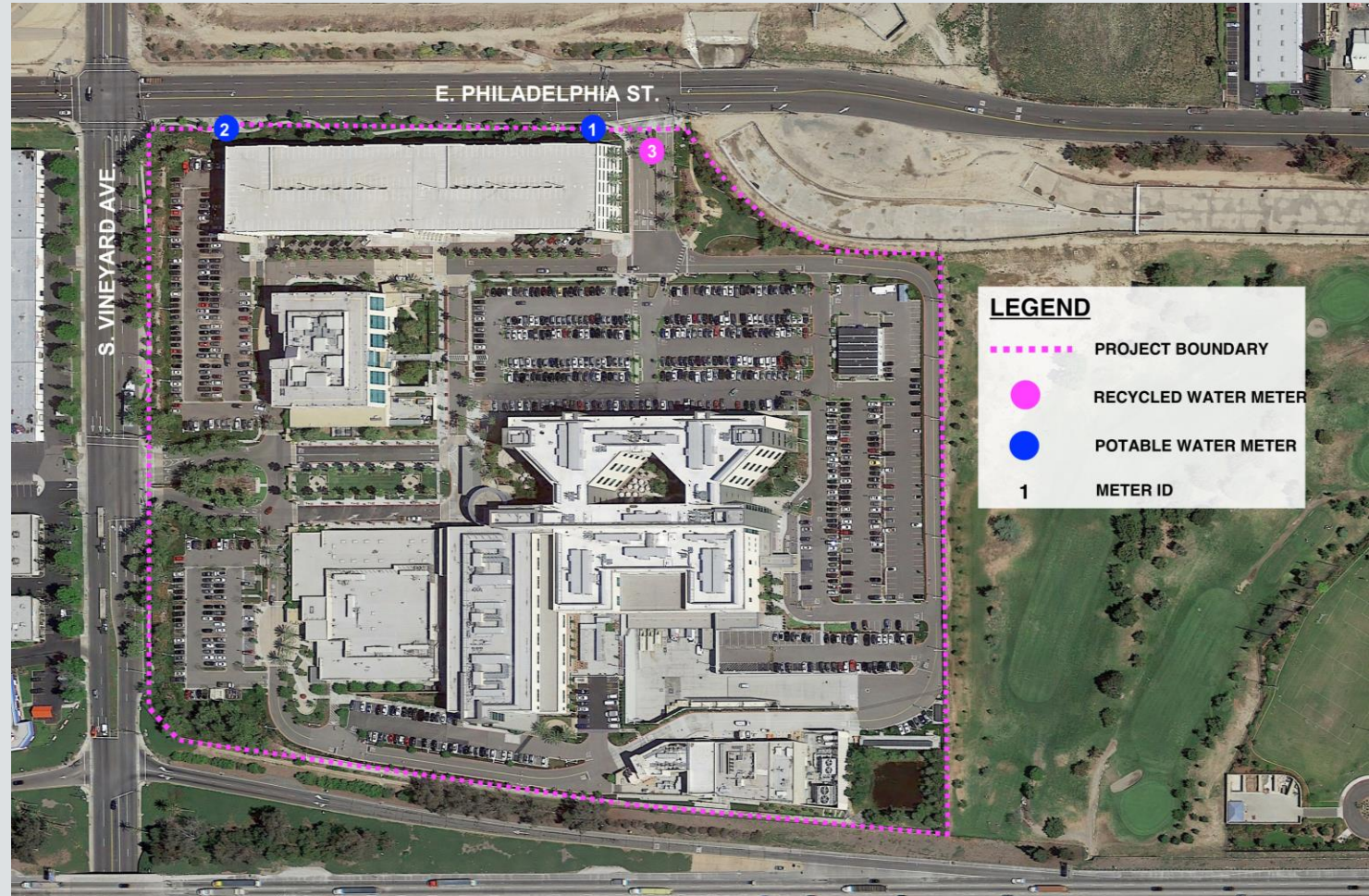


Case Studies

- Kaiser Hospital – City of Ontario (dual source site)
- Salesforce Tower – City of San Francisco (dual plumbed site)

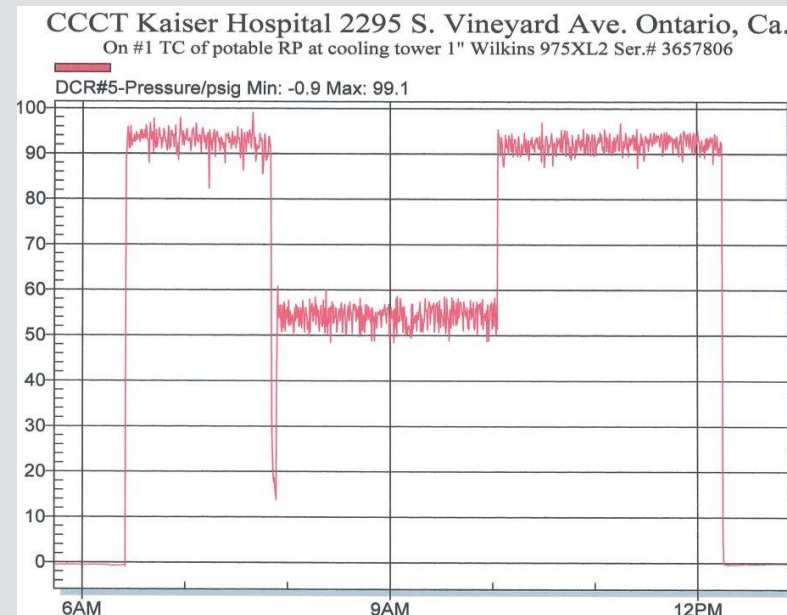
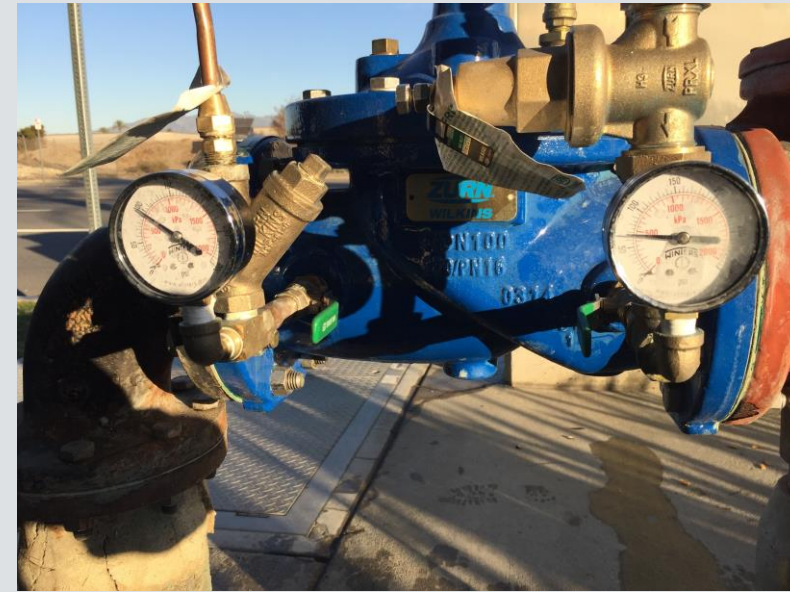
Kaiser Hospital

- Emergency rooms – domestic system cannot be isolated
- Typical pressure test not an option
- Conducted various meetings with hospital staff and the City to discuss alternatives
- SWRCB required a cross-connection test protocol to describe proposed approach



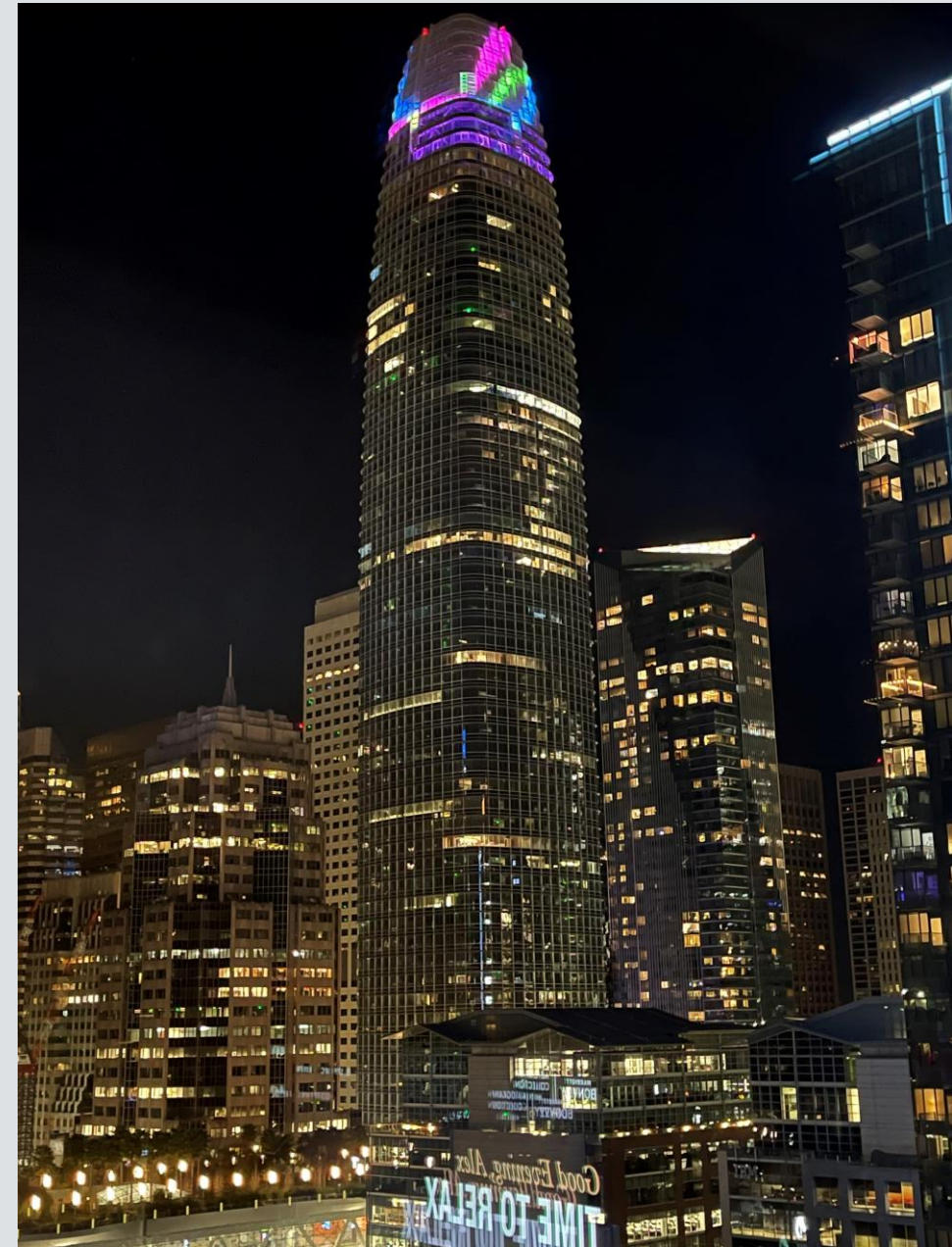
Kaiser Hospital

- Approach:
 - Isolate one potable meter
 - Install pressure reducing valve at the other meter backflow device
 - Create pressure differential by adjusting reducing valve to about 55 psi while RW system pressure is at 90 psi
 - Conduct a 2-hour modified potable water pressure test
 - Conduct a typical 2-hour recycled water pressure test



Salesforce Tower

- Located at 415 Mission Street, San Francisco
- 1,079-foot office skyscraper
- 1,600,000 square feet of commercial/office space
- 63 floors and three parking levels
- Current water use:
 - Potable water
 - Non-Potable: Rainwater and make-up recycled water for irrigation, cooling tower make-up water supply, and toilets/urinals



Blackwater Recycling System

- Aquacell membrane bioreactor system located in the P2 and P3 parking levels
- Will treat wastewater collected from sources such as hand basins, toilets/urinals, office kitchens and dishwashers, etc.
- Produces up to 30,000 gallons per day of tertiary treated recycled water
- RW will be blended, via an air gap, to the non-potable water system at the existing non-potable water storage tank



Cross-Connection Shutdown Test

- Last cross-connection test was conducted in 2018 when construction was completed (no tenants)
- Test was performed by the San Francisco Building Inspection Department following the San Francisco Public Utilities Commission (SFPUC) Manual for Cross-Connection Control (Manual) – Plumbing Test (Visual Test)
- 1,300 or more potable water fixtures were operated to confirm visually the presence / absence of flow
- New Cross-Connection Shutdown Test is required. Alternative to the visual test is needed for logistical reasons: access to suites is limited, cost (resources needed), and duration of the visual test.

Cross-Connection Shutdown Test

Visual Test

- Requires entering the buildings for observation of all potable water fixtures
- Challenging and time consuming
- Requires identifying and locating every fixture
- More subject to error as may miss some fixtures
- Fixtures that are inadvertently left on after test can lead to water damage
- Some areas of buildings may be difficult to access for security/privacy reasons
- COVID-19 related restrictions create additional hurdles and concerns when large groups of unknown people must enter a building to operate and observe all plumbing fixtures

Main Challenges

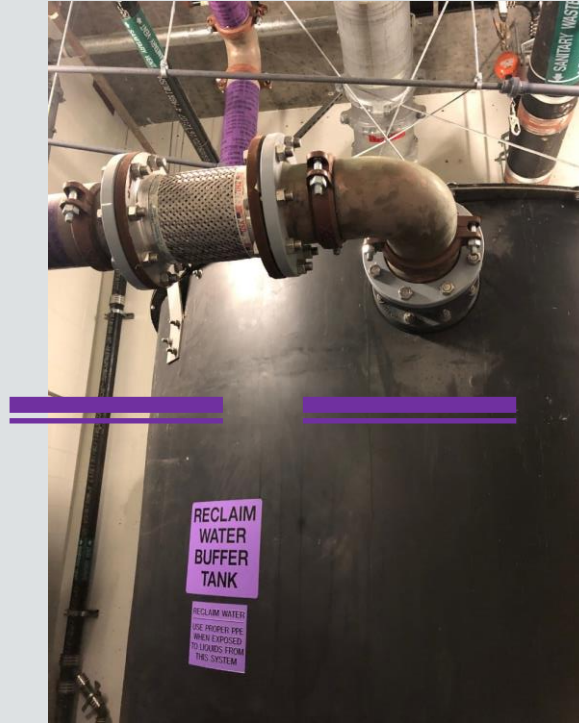
- Pressures on both systems are set to 420 psi (booster pumps)
- Height of the building prevents a typical pressure differential test (at POC) → no residual pressure in most of the building
- Testing at night to minimize impacts to tenants



Recycled Water Flow



RW and Potable
Water Backflows



3,750 gallons RW Tank

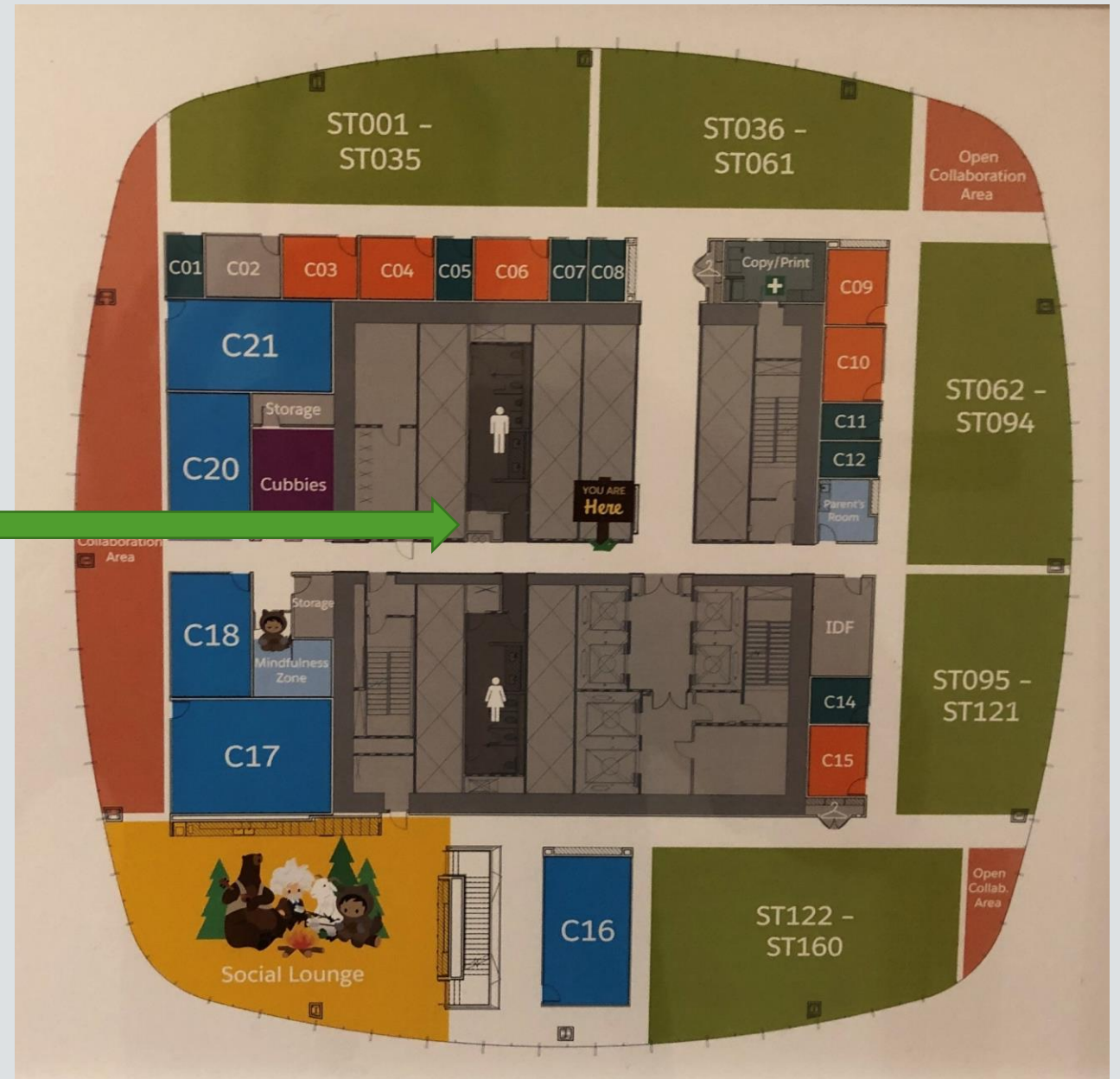


Booster Pumps (3) and
RW mainline to the building



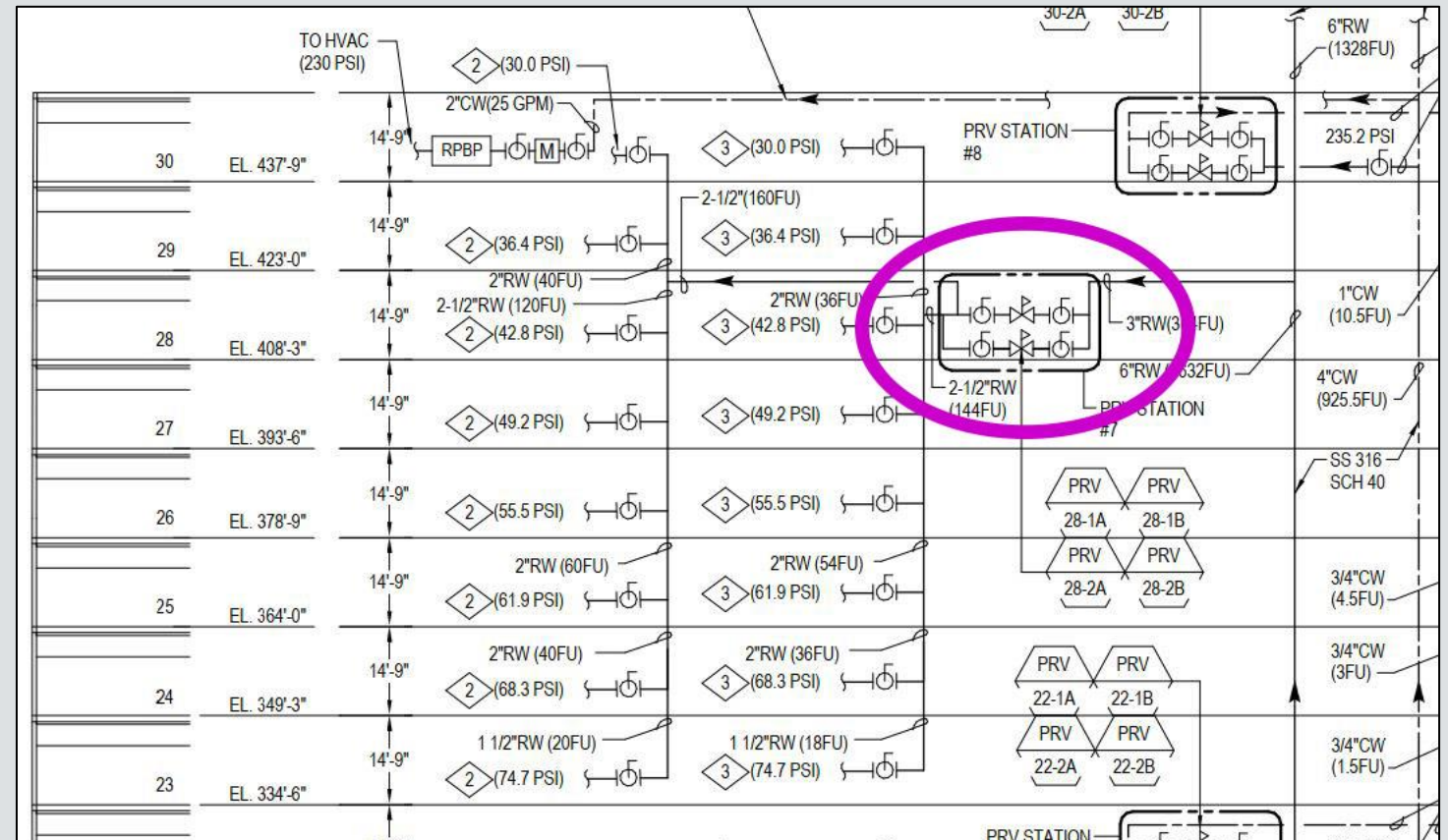
Water Fixtures

- Potable and recycled water piping systems are located in the men's restrooms (walls)
- Recycled water used only in bathrooms
- Potable water for the entire floor



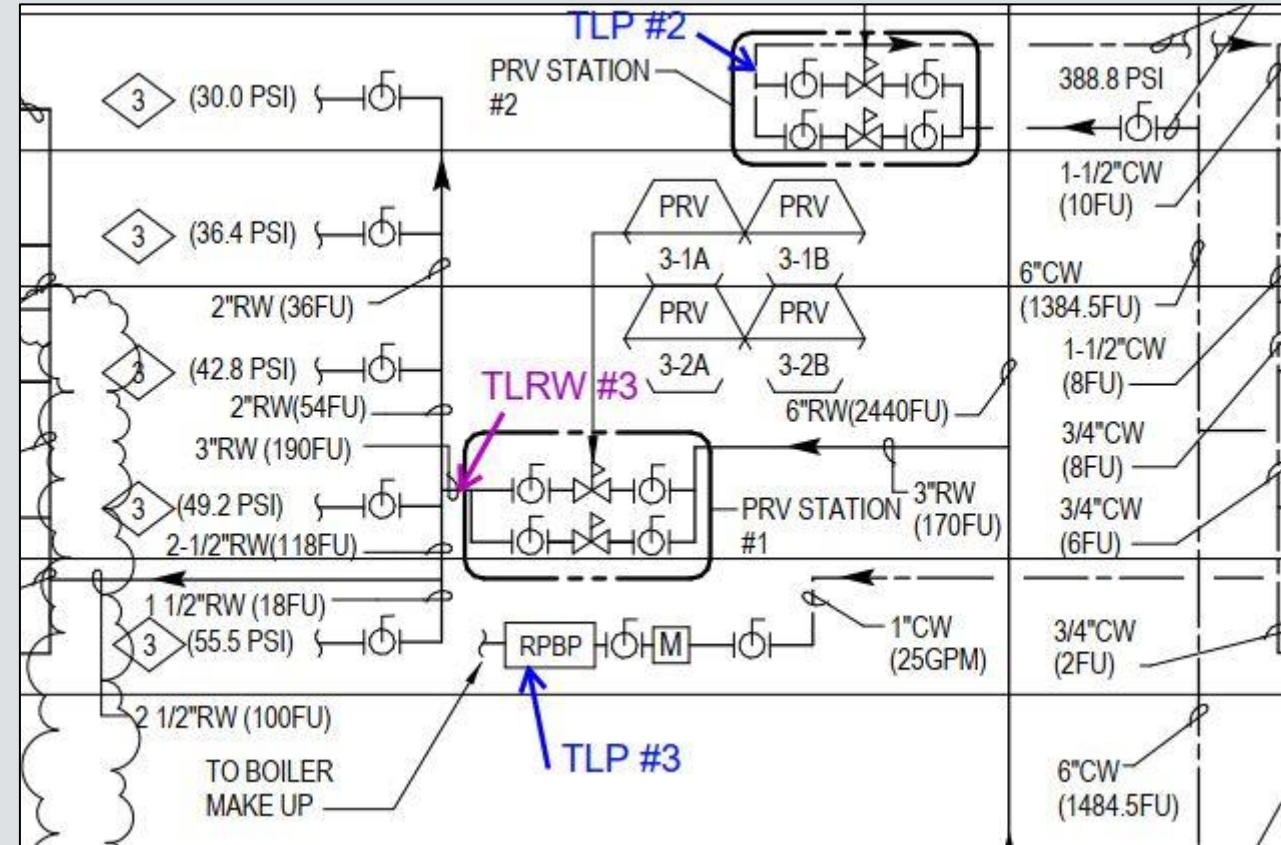
Facilities

- Pressure reducing valve serve / isolate 7 to 9 floors



Testing Protocol

- SFDPH requirement: Certified Cross-Connection Control Specialist
- Duration: 2-hour on both systems
- Approach:
 - Use digital pressure gauges
 - Typical pressure differential test for the irrigation system at backflow
 - Test building floors after the PRVs (Gauge fittings needed)
 - Change pressure settings of the PRVs
 - **System tested - lower**
 - **Other system - no changes**

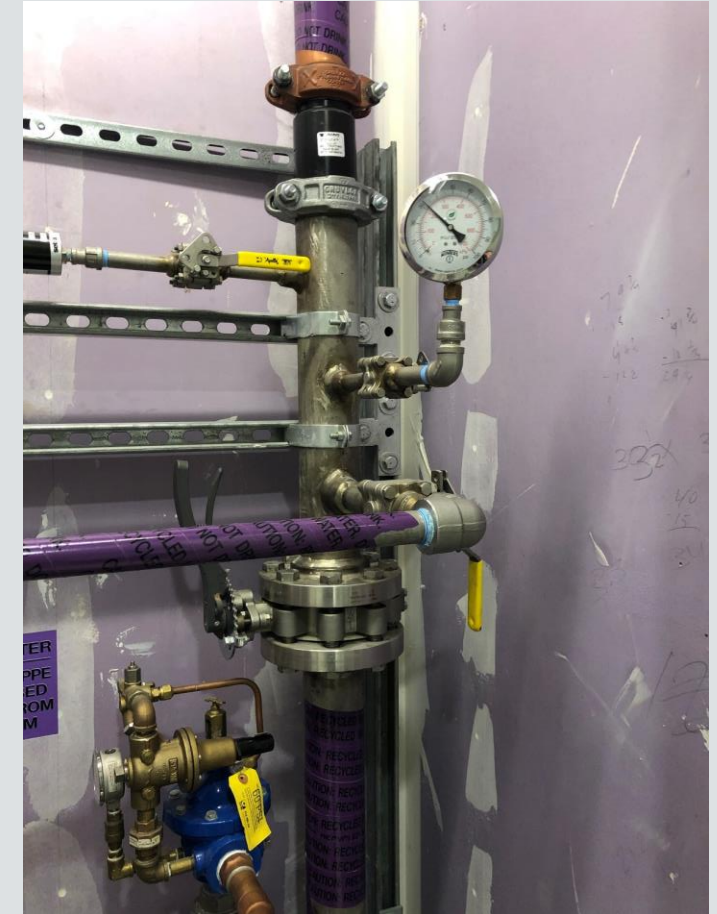


Testing Protocol Approach

- Protocol lists all the test point locations in the building

Table 5. Pressure Recorders Test Locations and Areas Tested

Test Location ID #	Pressure Recorder Location	Area Tested
Potable Water System		
TLP #1	#4 Test Cock of main RP #9367C room P1-86	Water facilities in parking structure and piping to the booster pump
TLP #2	After Station #2 PRV floor 6	Water facilities floors 2-6
TLP #3	#4 Test Cock of RP floor 2	Make-up water to Boiler fed from Station #2
TLP #4	After SOV Hot Water System floor 4	Hot water facilities floors 2-6
TLP #5	After Station #4 PRV floor 14	Water facilities floors 7-14



Testing Protocol Approach

- Testing Schedule and areas tested

Table 6. Proposed Schedule					
Day	Potable Test Locations (TLP #)	Start Time	Recycled Water Test Locations (TLRW #)	Start Time	Areas Tested
Monday	1–8	6 PM	1–5	9 PM	<ul style="list-style-type: none">• Potable fixtures and restroom in the parking structure• Recycled water irrigation at ground level• Piping to tank and booster pumps• Potable fixtures and restrooms floors 1–22
Tuesday	9–17	6 PM	6–8	9 PM	<ul style="list-style-type: none">• Potable fixtures and restrooms floors 23–46
Wednesday	18–24	6 PM	9–13	9 PM	<ul style="list-style-type: none">• Potable fixtures and restrooms floors 47–roof• Cooling tower

Pressure Gauges



Photo 6
TLRW #3 recycled water PRV located on floor 3 (floors 1-7)



Photo 5
TLP #3 potable water PRV located on floor 6 (floors 1-7)

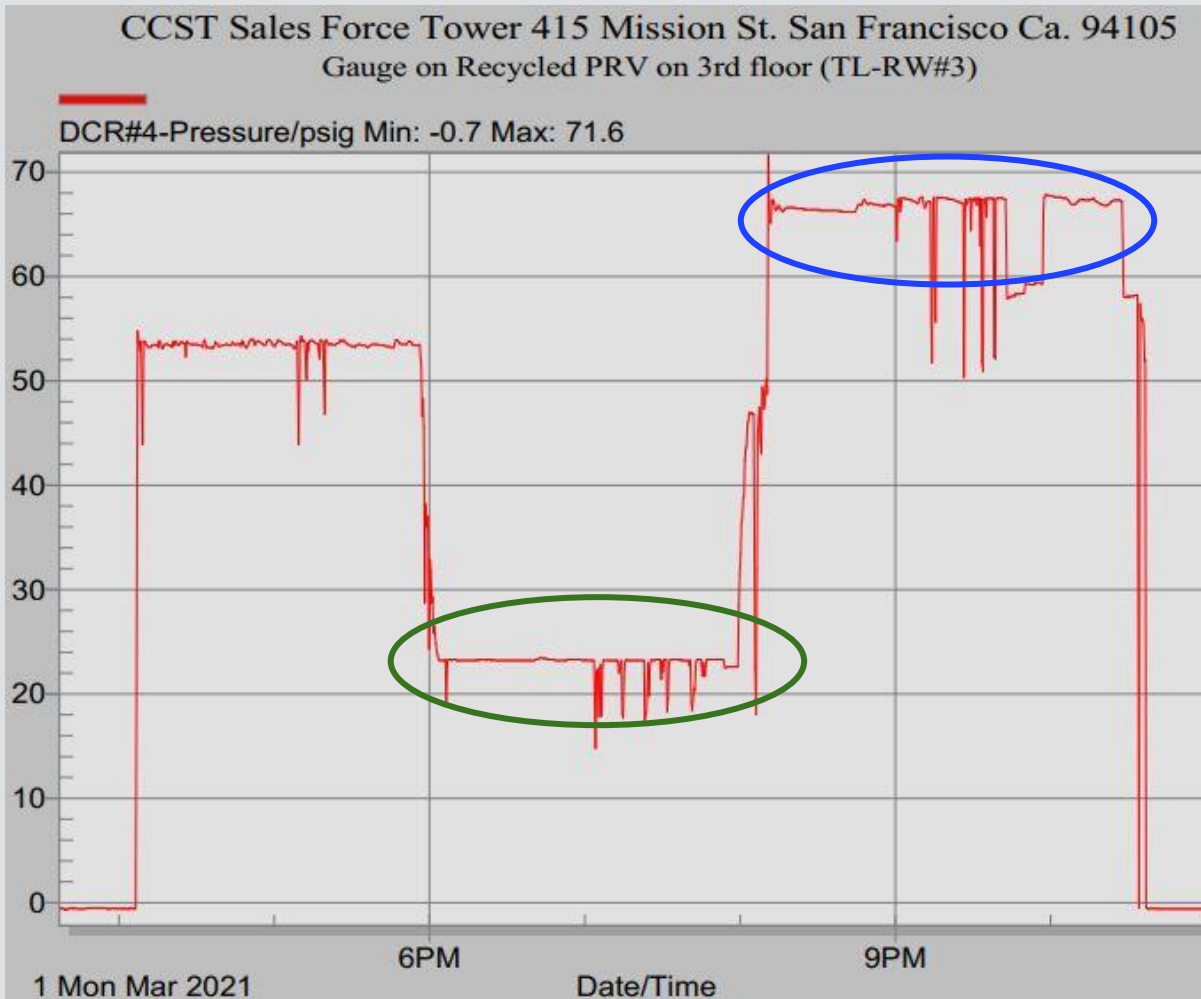
Test Results

Shutdown Test was conducted between March 1st - March 4th (Monday – Friday)

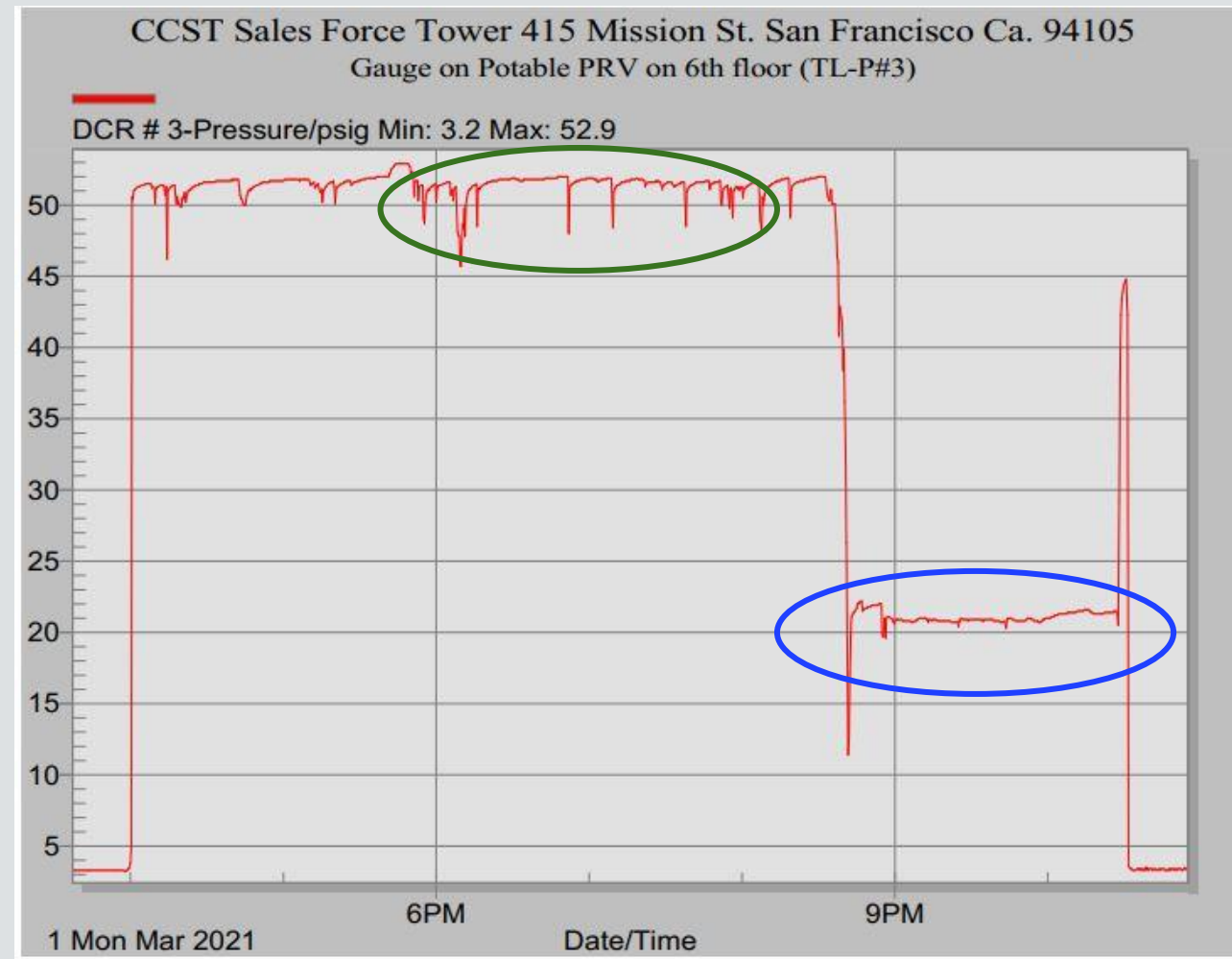
Test Point ID / Location	Initial Pressure, psi	Test Pressure, psi	Opposite System Pressure, psi	Result	Floors Tested
Potable System					
March 1, 2021					
TLP #1 / Ball valve fitting room P1-86	64	8	68	Pass	Parking Levels
March 1, 2021					
TLP #2 / hose bib near RP TC #1 in boiler room	79	48	54	Pass	1-7
TLP #3 / at PRV floor 6	54	22	54	Pass	1-7
TLP #4 / at PRV floor 14	49	26	45	Pass	8-14
March 2, 2021					
TLP #5 / at PRV floor 22	54	19	64	Pass	15-22
TLP #6 / at PRV floor 30	45	14	40	Pass	23-30
TLP #7 / Test done on 03/03					31-38
TLP #8 / TC #1 RP heat exchange room floor 35	61	40	60	Pass	31-38
TLP #9 / at PRV floor 37	43	25	60	Pass	31-38

Pressure Recorder Chart

Recycled Water



Potable Water



One More Option

- Dye Testing
 - One-way test – irrigation only
 - Potable system remains pressurized
 - Food-safe dye injected in the fully pressurized irrigation system or RW building piping
 - Operate irrigation valves/toilets and observe the presence of the dye
 - Operate potable system fixtures and observe the absence of dye
 - Difficult test / Last option



Questions?

