PRESSURE REDUCING STATION & VALVE REPLACEMENT PROJECT

SAN DIEGO, CALIFORNIA

CALIFORNIA-NEVADA SECTION
American Water Works Association

2013 ANNUAL FALL CONFERENCE

SACRAMENTO, CA

OCTOBER 2, 2013

SANTA FE IRRIGATION DISTRICT
Est. 1923

PSOMAS

DISTRICT BACKGROUND

SFID established 1923 as irrigation district for local farmers

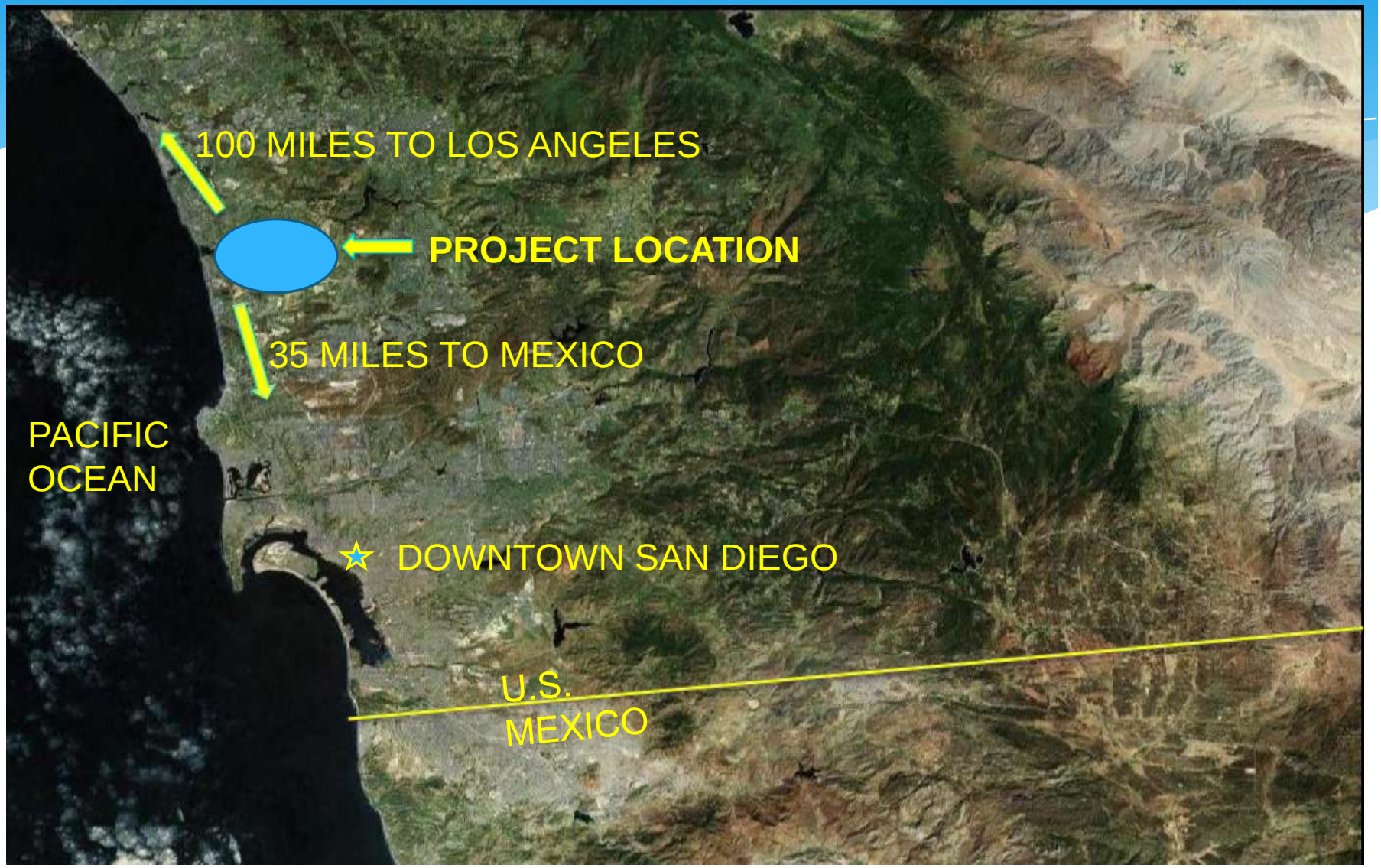
Currently serves 3 communities

* City of Solana Beach
* Fairbanks Ranch
* Rancho Santa Fe
* Exclusive area. High end homes

Approximately 21,300 customers on 10,200 acres of land

Average 13,500 ac-ft of potable water and 430 ac-ft recycled water/year

VICINITY MAP



DISTRICT MAP (2010)

WTP EL 520

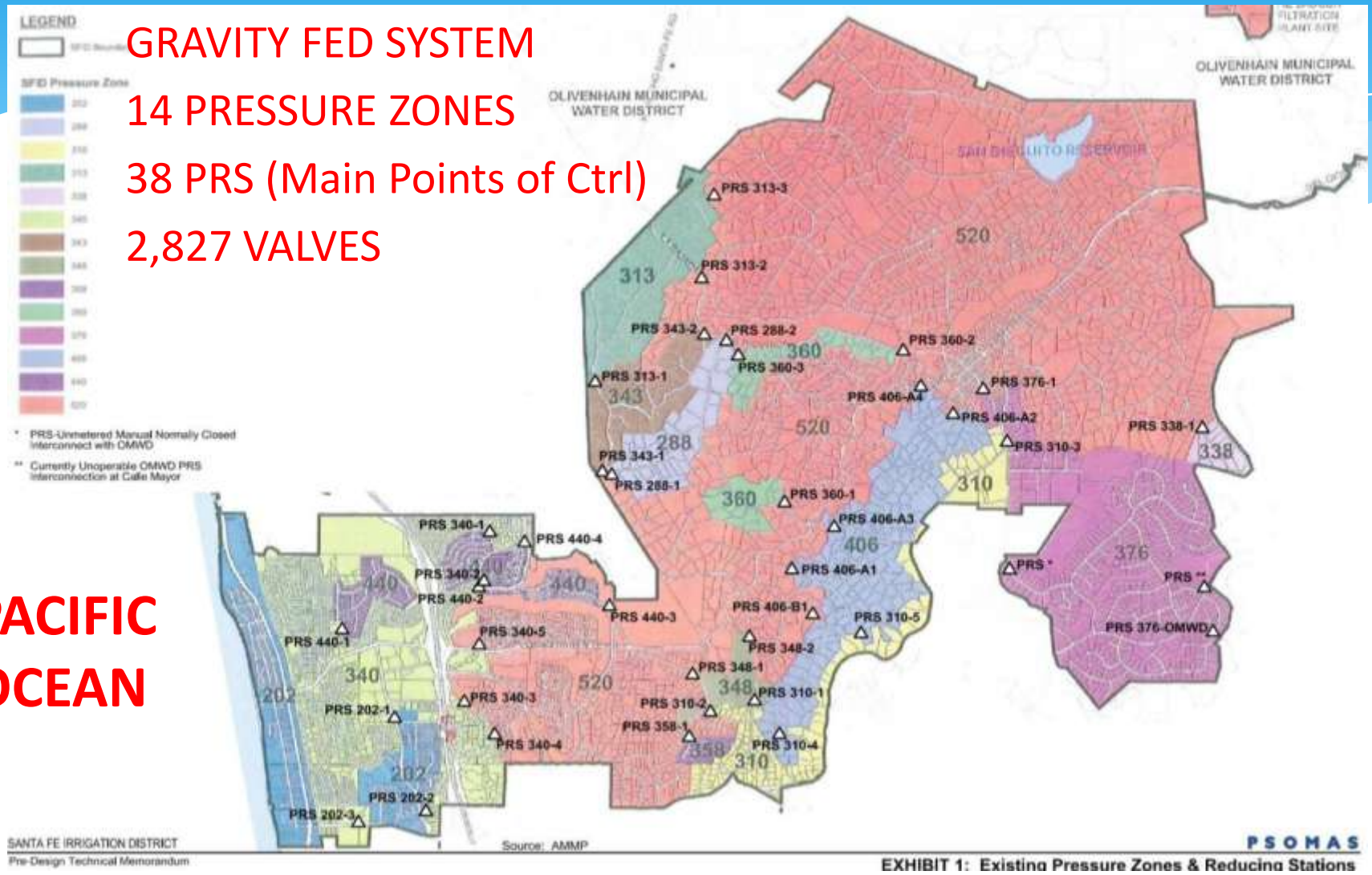
GRAVITY FED SYSTEM

14 PRESSURE ZONES

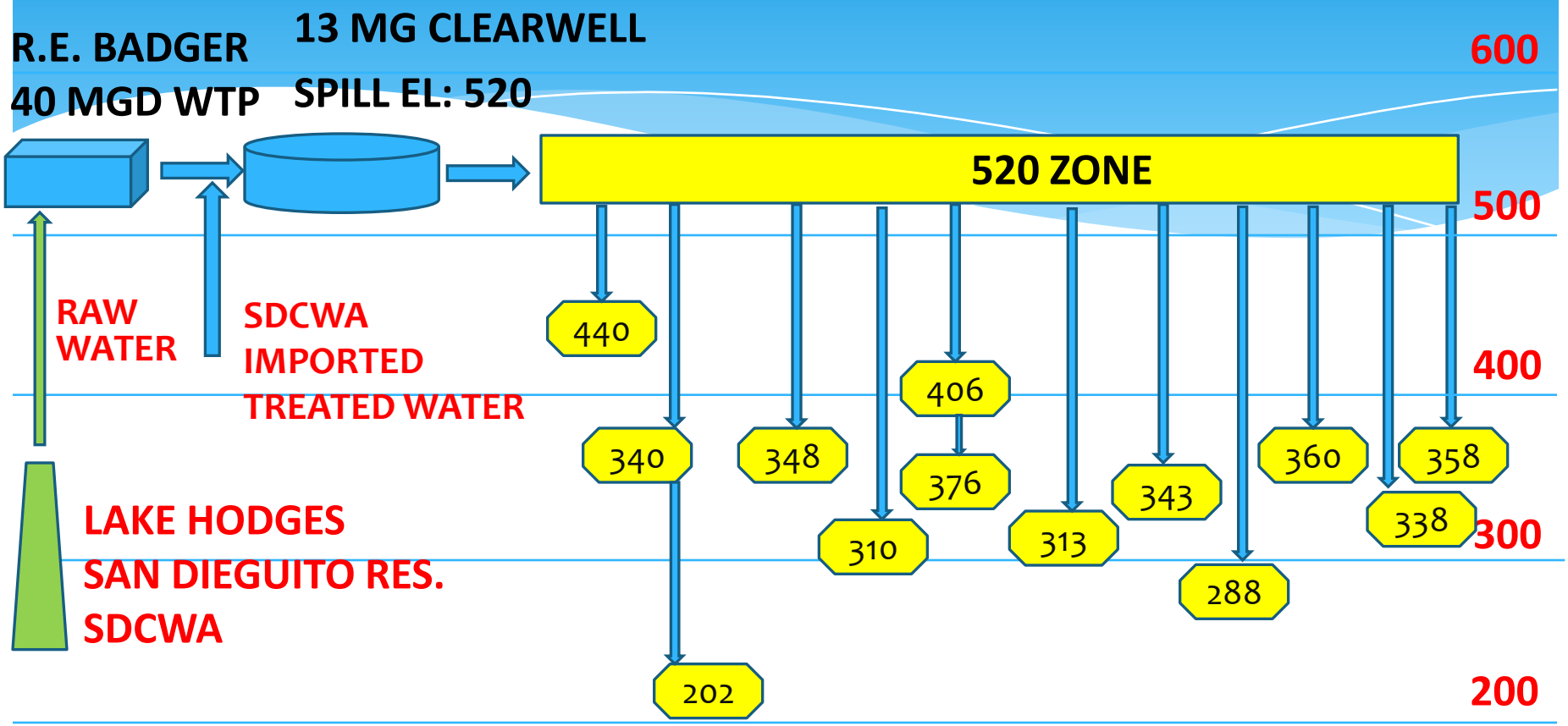
38 PRS (Main Points of Ctrl)

2,827 VALVES

PACIFIC OCEAN



FLOW CHART (2010)



14 TOTAL PRESSURE ZONES

38 PRESSURE REDUCING STATIONS

NUMEROUS INTERCONNECTIONS

PROJECT INFORMATION

PROJECT DESCRIPTION:

* Replace 75 backbone isolation valves
* Replace 43 PRS isolation valves
* Install 30 new Air Release Valves (ARV)
* Replace 10 existing Pressure Reducing Stations (PRS)

PROJECT GOALS:

* Replace aging infrastructure (>50 years old)
* Improve water system operation
* Improve worker safety
* Improve ability to shutdown pipelines without impacting a large # of parcels

PROJECT BACKGROUND

ISOLATION VALVES

* BROKEN, LEAKING. BFV's, GV's, PV's

AIR RELEASE VALVES

* MANUAL OR DON'T EXIST AT HIGH POINTS
* AIR POCKETS IN LINES
  * Reduces capacity

PRS

* NO POWER, NO TELEMETRY, UNSAFE, LEAKING JOINTS, 6' CLEAR HEIGHT, IN ROADS

VALVES

DISTRICT IDENTIFIED AS HIGH PRIORITY

ORIGINAL GOALS

* REPLACE ALL VALVES WITH GV's
* UTILIZE EXISTING TEES
* MINIMIZE REPLACEMENT COSTS

VALVES

DESIGN CHALLENGE

LARGE GV's MOUNTED HORIZONTAL

* Sizes up to 36" Diameter. >6' TALL
* District didn't want horizontal mounting
* Did not want rubber seated BFV's

SOLUTION

USE METAL SEATED BFV's

* Heavier duty
* San Diego County Water Authority (SDCWA) had been using for years

VALVES

DESIGN CHALLENGE

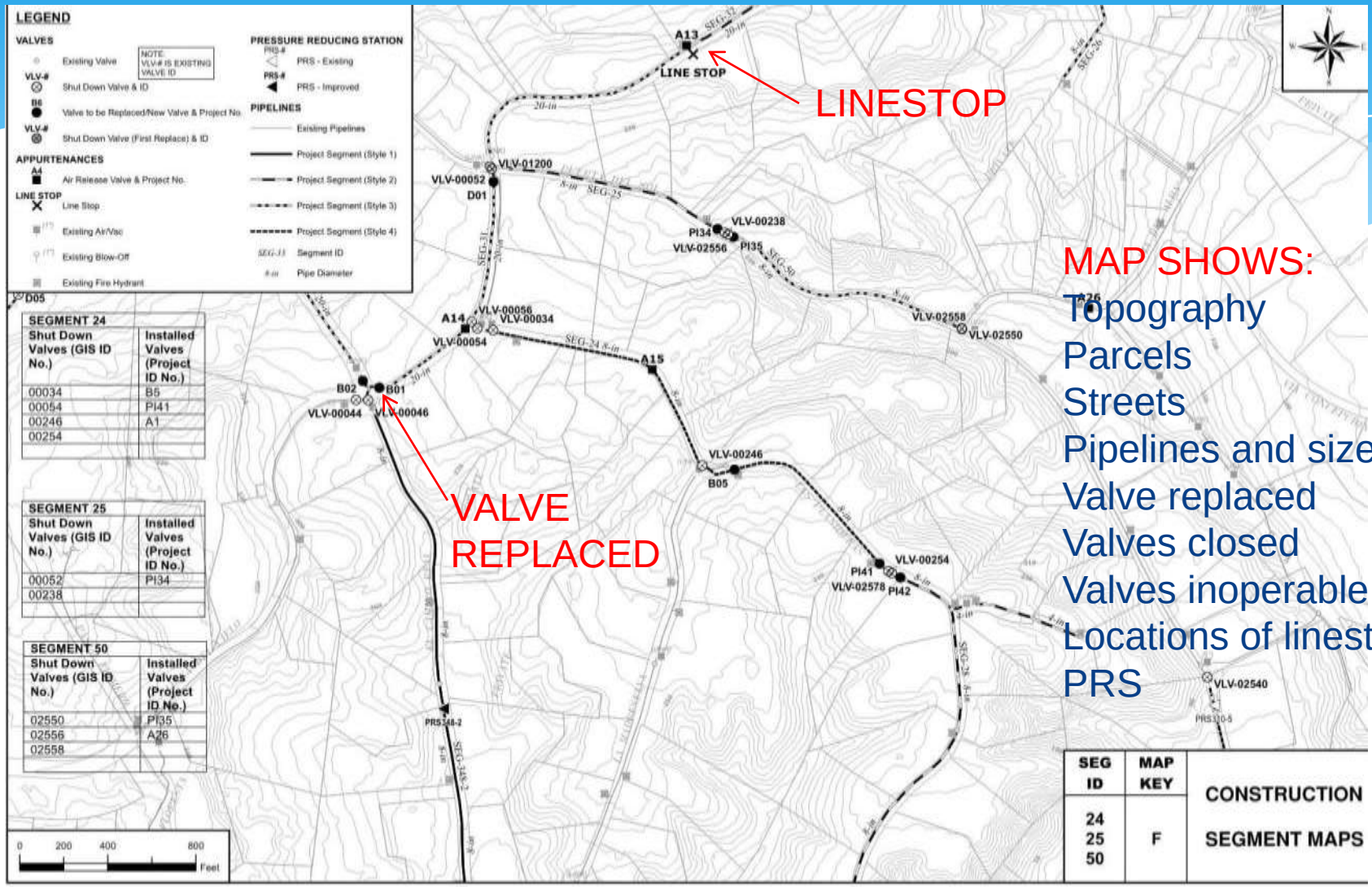
Determine Shutdown Areas (District criteria)

* Pipelines out of service <24 hrs
* Contractor to install valve between 8:00am and 2:00pm
* Only allowed on Tuesdays/Thursdays
* Faulty valves resulted in large areas to shutdown

Solution

* Prepare shutdown area exhibits
* Determine time to drain pipe. < 2 hours okay. > 2 hours required smaller area or linestop

SHUTDOWN MAP

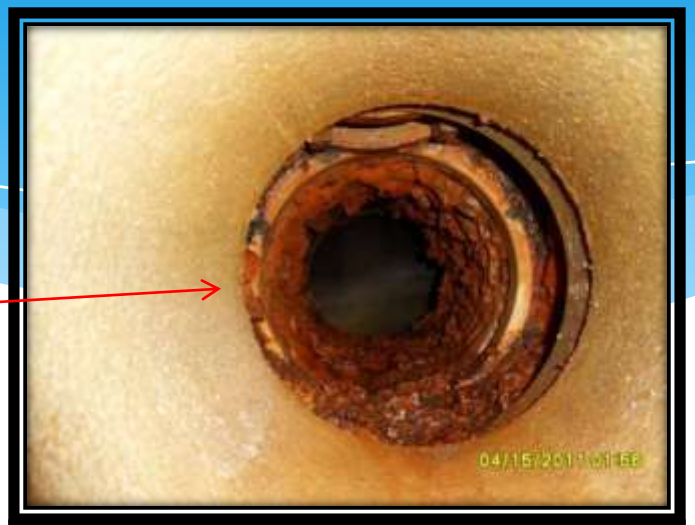


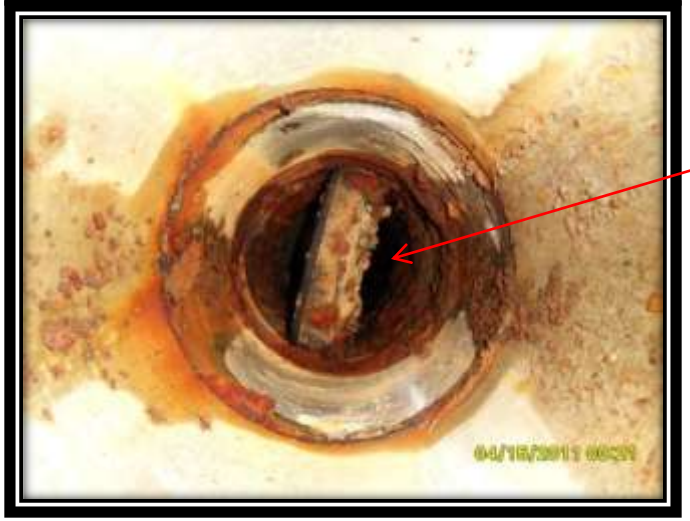
MAP SHOWS:

- Topography
- Parcels
- Streets
- Pipelines and sizes
- Valve replaced
- Valves closed
- Valves inoperable
- Locations of linestops
- PRS

VALVES

GV





BFV

VALVES IN POOR CONDITION

VALVES

CONSTRUCTION CHALLENGES

CAST IRON FITTINGS IN POOR CONDITION

* ENDED UP REPLACING FITTINGS AND ADDING VALVES

BFV's INSTALLED WITH INCORRECT ACTUATOR

* DIG UP AND REPLACE

LINESTOPS BROKE 2 ACP PIPELINES

* EMERGENCY REPAIRS
* REQUIRED REDESIGN OF LINESTOP EQUIPMENT

VALVE CONSTRUCTION

NEW VALVES

AC PIPE IN GOOD CONDITION

EX TEE ASSEMBLIES REMOVED

VALVE CONSTRUCTION

BEFORE

AFTE
R

LINESTOP

PRESSURE REDUCING STATIONS

* Primary point of control of system
* Protect downstream piping from excess pressure
* Lead, Secondary or Emergency

ORIGINAL GOALS

* Replace and upgrade stations
* Improve safety, operation and maintenance
* Improve control at each PRS

EXISTING PRS

* WITHIN ROADWAY
* UNSAFE, DIRTY, DIFFICULT ACCESS
* NO POWER, TELEMETRY
* <6’ CLEAR HEIGHT INSIDE. AVG WORKER HEIGHT 6’-1”
* MISERABLE FOR O&M STAFF

EXISTING PRS

PRS Unsafe location

* Speeds approaching 60 mph
* Blind curves
* Busy intersections

PRESSURE REDUCING STATIONS

DESIGN INFORMATION

- Lead stations: Primary/bypass valve combination to handle flows, from MinDD to FF with another zone PRS out of service.
  - Bypass valves sized for minimum possible flows:
    - 50% of estimated MinDD, assuming all PRS in zone operating. Margin of error ensures valve small enough
    - Large enough to handle some ADD
  - Primary valves sized for maximum flows:
    - MaxDD + FF + % of downstream zone MaxDD flows with another PRS out of service.
    - If lower zone PRS fed directly from station, need Max. flow rate through that PRS
      - If lower zone larger, flow could be higher than for higher zone PRS
    - Primary valve small enough to open prior to Bypass valve reaching max. flow peak, providing good overlap of flow capacities.
      - Avoid being in a "wide open" position during max. flow

PRESSURE REDUCING STATIONS

DESIGN INFORMATION (CONTINUED)

* Secondary stations open during PH demands, set to lower HGL
* Emergency stations open during severe HGL drop such as FF
  * Design worst case with fire at a hydrant near PRS and closest other PRS out of service
* For all stations, must decide whether to design for theoretical flows or modeled flows
  * Upstream pipeline conditions could mean actual flows considerably less than theoretical. Must decide if going to upsize pipelines or not.
* Avoiding cavitation a top priority
* Try and combine pressure zones and eliminate PRS's.

PRESSURE REDUCING STATIONS

DESIGN INFORMATION (CONTINUED)

* Consider flow demands from lower zones when determining design flow rates
* Maintain pressures
  * 50 psi residual during ADD
  * 40 psi residual during PH
  * 20 psi residual during FF

EMERGENCY PRS

* Designing PRS much more than sizing valves.
  * Analyze the entire water system if possible.
* Hydraulic modeling of various scenarios with other PRS out of service crucial.

PRESSURE REDUCING STATIONS

DESIGN INFORMATION (CONTINUED)

* Primary valve HGL setting 3-5 psi lower than bypass valve.
  * Allows bypass to handle low flows without primary valve trying to open causing valve chatter
* Emergency station HGL setting lower than zone HGL
  * Stations only open during severe HGL drop
* Determine if need check feature on pressure reducing valve
  * If upstream HGL severely depressed during FF, may need to back feed. No check feature.
  * If upstream HGL only depressed for flows >FF, such as pipe rupture, then don't want to back feed. Use check feature.
* If using a pressure relief valve (PRV), setting to be 10 psi higher than primary valve downstream HGL.
  * Locate PRV on low pressure side of station

PRESSURE REDUCING STATIONS

DESIGN INFORMATION (CONTINUED)

Considered the following

* Above ground stations
  * Required easements
  * Architectural review committee would create problems and delays

ORIGINAL ABOVE GROUND PRS LAYOUT

- Below ground stations
  - Concrete: District concerned about water intrusion
  - Wanted a monolithic structure

PRESSURE REDUCING STATIONS

RESULTS

* The ultimate solution was to provide a packaged, below ground PRS with steel enclosure.
* Contains:
  * Primary valve, Bypass valve (Where needed)
  * Remote pressure control and flow monitoring tied to SCADA at WTP
  * Lighting, ventilation, dehumidifier
  * More space inside station
  * Located outside of roads

PRS INSTALLATION

OFFLOADING STATION. PLACING IN PIT

PRS INSTALLATION

OFFLOADING STATION. PLACING IN PIT

PRS FEATURES

FINISHED PRS

RTU

ABOVE GROUND PRESSURE READOUT

PRS FEATURES

STAIRS

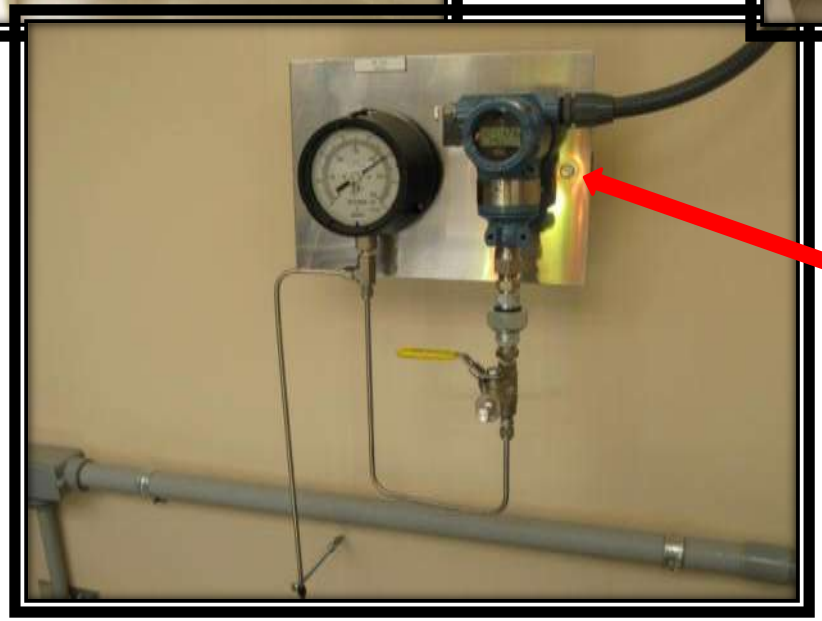
PRIMARY PRV

PZ LABEL

PRS FEATURES

MAINLINE
STRAINER

PRV



PRESSURE
READOUT

PRS FEATURES

MOTORIZED OPERATOR

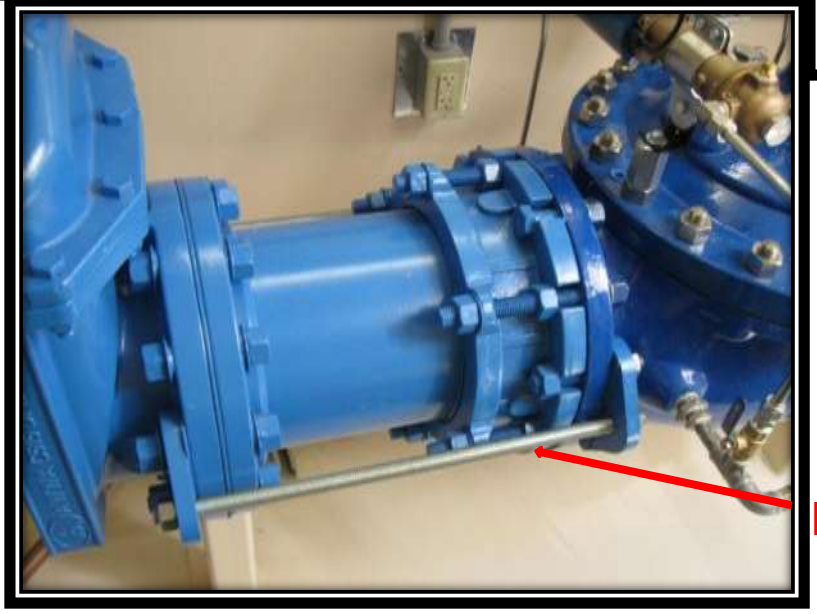
PRESSURE RELIEF VALVE

BYPASS PRV

PRS FEATURES

DPT

INTRUSION ALARM



FCA & THRUST RODS

VALVES

SUMMARY OF VALVES PROBLEMS/SOLUTIONS

PROBLEM	SOLUTION
Cast iron fittings in poor condition	Ultimately removed all cast iron fittings and replaced with ductile iron fittings
Tee connections with one valve	Replace entire assembly with tee connection and 3 valves
Existing valves one size smaller than main line creating head loss in system	New valves same size as main line
Manual air release valves	Replaced with automatic combination air/vacuum valves (CAV). Improved hydraulics and helps prevent vacuum collapse
High points with no air release valve contained air pockets	Added CAV's at high points eliminating air pockets and reducing system head losses
Minimize shutdown size	Limit pipe draining to 2 hours max. If > 2 hours, use linestop.

PRESSURE REDUCING STATIONS

SUMMARY OF PRS PROBLEMS/SOLUTIONS

PROBLEM (EXISTING STATIONS)	SOLUTION (PROPOSED STATIONS)
In paved road. Dangerous.	Located outside paved area
Leaking joints in concrete. Standing water	Steel structure. No joints. Sump pump
6’ clear height. Required bending down	7’ clear height
Very limited space inside	Improved clearances to service PRS
No lighting, ventilation, dehumidifier	All provided
No power, telemetry	Power provided. Telemetry connection to WTP
No remote pressure reduction control	Staff can remotely reduce pressures during low flow hours to minimize water usage
No flow monitoring	Staff can remotely monitor flows and compare with meter readings to identify leaks.

PRESSURE REDUCING STATIONS

SUMMARY OF PRS PROBLEMS/SOLUTIONS

PROBLEM (EXISTING STATIONS)	SOLUTION (PROPOSED STATIONS)
Vertical ladders	Angled stairs provide easier access
Minimal security	Intrusion alarm, lockable hatch door
No redundant valves	Mainline strainer reduces risk of debris making a valve stick open
Access through 2’ manhole lid	3’x6’ hatch
38 PRS in 14 pressure zones	35 PRS in 12 pressure zones

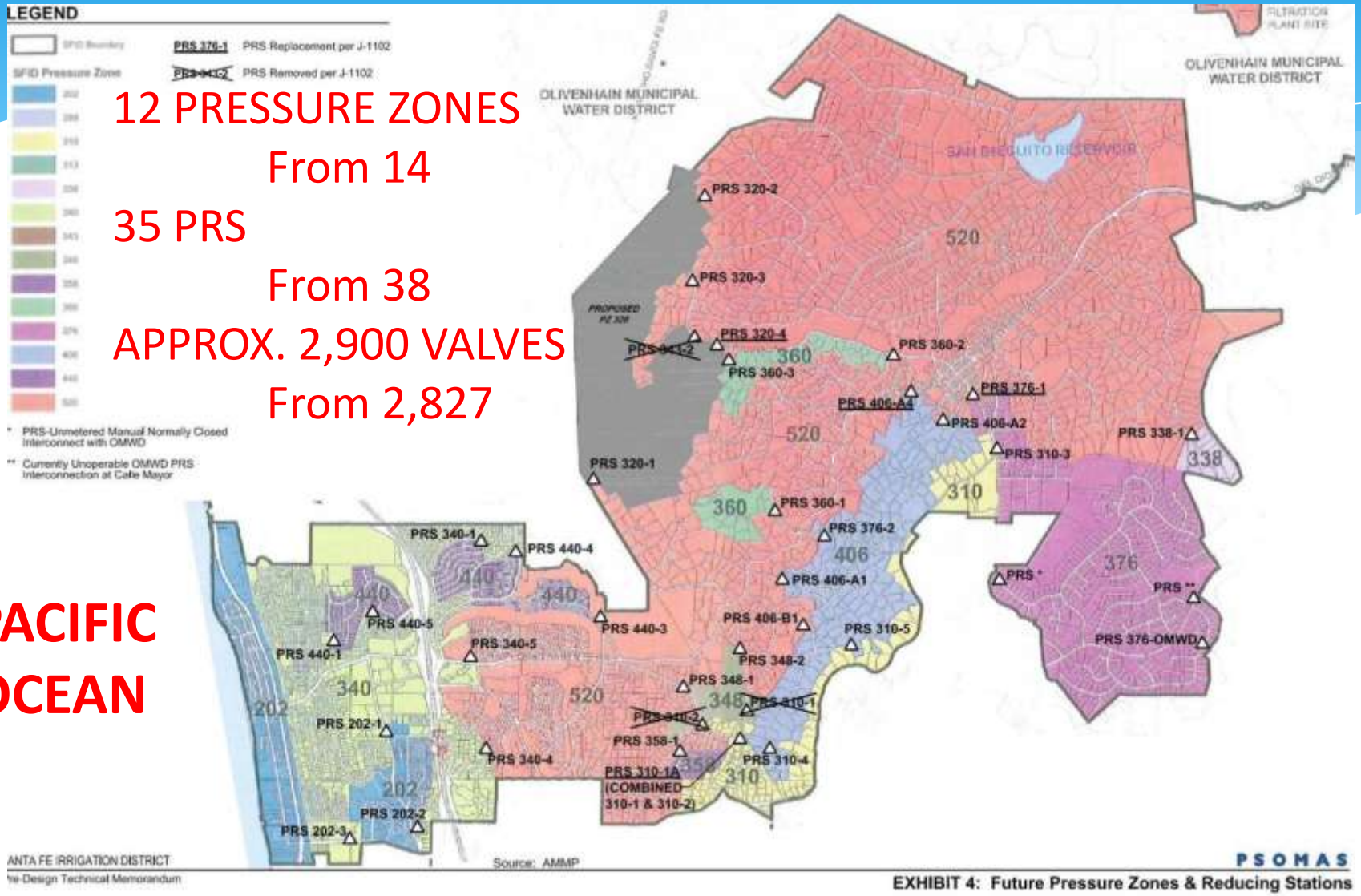
CONCLUSIONS

GOALS MET

* Isolation valve replacements and additions improve system operation, allow better control and reduce headlosses.
* Approximately 200 new valves installed.
* CAV installations reduce air accumulation in pipes, reduce head losses and protect against vacuum collapse.
* PRS installations improve safety, maintenance, operation and provide modern equipment remotely controlled via SCADA. Reduce water usage and help identify leaking pipes.
* Merged 3 pressure zones to 1 and eliminated 3 PRS.

DISTRICT MAP (2012)

WTP EL 520



LESSONS LEARNED

* Reconsider RTU above ground.
  * Majority of public complaints due to this
* Never assume cast iron fittings in good shape.
  * All were in poor shape
* Don't under estimate the importance of system wide hydraulic modeling when designing a PRS.
  * Look to combine zones and eliminate stations
* KISS rule (Keep It Simple Stupid)
  * Originally looked at electronic solenoid controlled valves with extensive pilotry. More expensive, more complex.
  * Ended up with simple motor controlled valves with less pilotry.
* ACP is a decent pipe material
  * 50-60 year old pipe in surprisingly good shape

QUESTIONS