



**TUALATIN VALLEY**  
WATER DISTRICT

# Host



**Carrie Pak, PE**  
**Chief Engineer**

# Anatomy and Physiology of Your Water Distribution System

## Presenter



**Pete Boone, PE, PLS**  
Water Operations  
Division Manager

## Water System Experts



**Joel Cary**  
Water Resources  
Division Manager



**Carrie Pak, PE**  
Chief Engineer

**Thank you for joining today's Talkin' Water Episode!**



**TUALATIN VALLEY**  
WATER DISTRICT

# Anatomy and Physiology of Your Water Distribution System

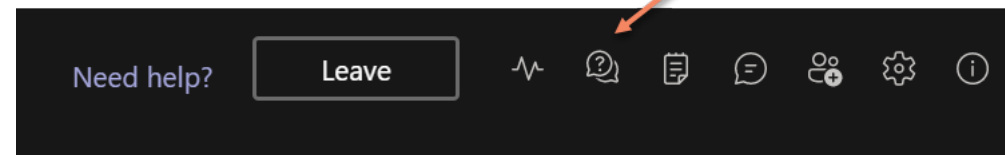
Wednesday, April 21, 2021

*How we deliver water from the source to your home*



Pete Boone, PE, PLS  
Water Operations Division Manager

**Please feel free to type Questions in the Chat.**



# anatomy

[ uh-nat-uh-mee ]

SHOW IPA



SEE SYNONYMS FOR *anatomy*

*noun*, plural **a·nat·o·mies**.

- 1 the science dealing with the structure of animals and plants.
- 2 the structure of an animal or plant, or of any of its parts.
- 3 dissection of all or part of an animal or plant in order to study its structure.
- 4 a plant or animal that has been or will be dissected, or a model of such a dissected organism.
- 5 a skeleton.
- 6 *Informal*. the human body.

# physiology

[ fiz-ee-ol-uh-jee ]

SHOW IPA



SEE SYNONYMS FOR *physiology* ON [THESAURUS.COM](https://www.thesaurus.com)

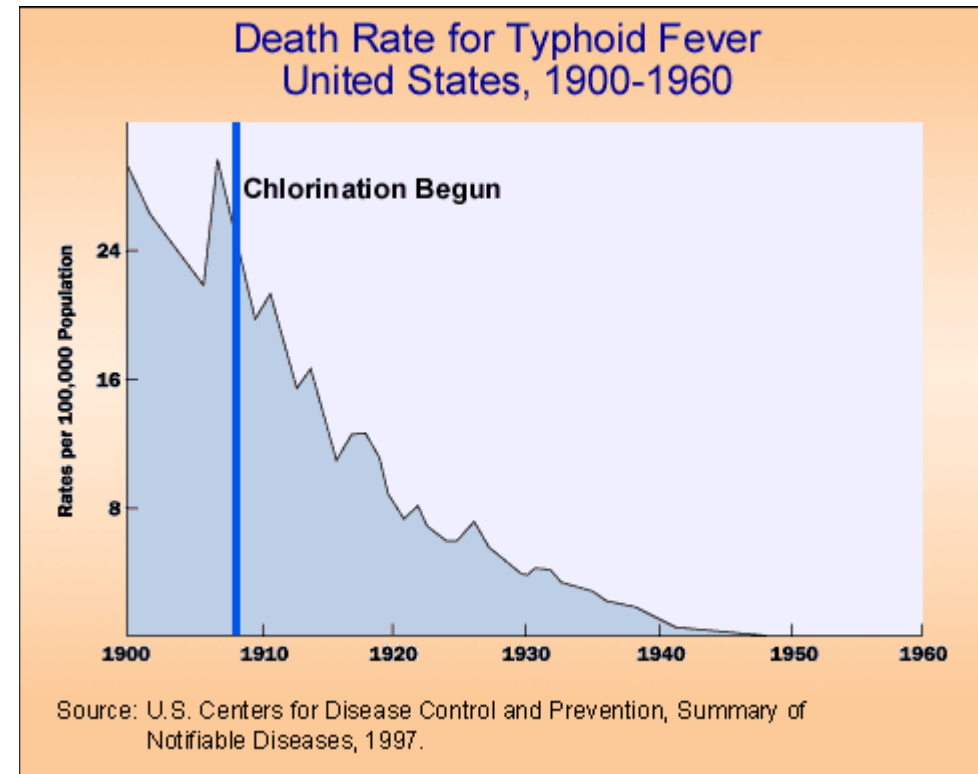
*noun*

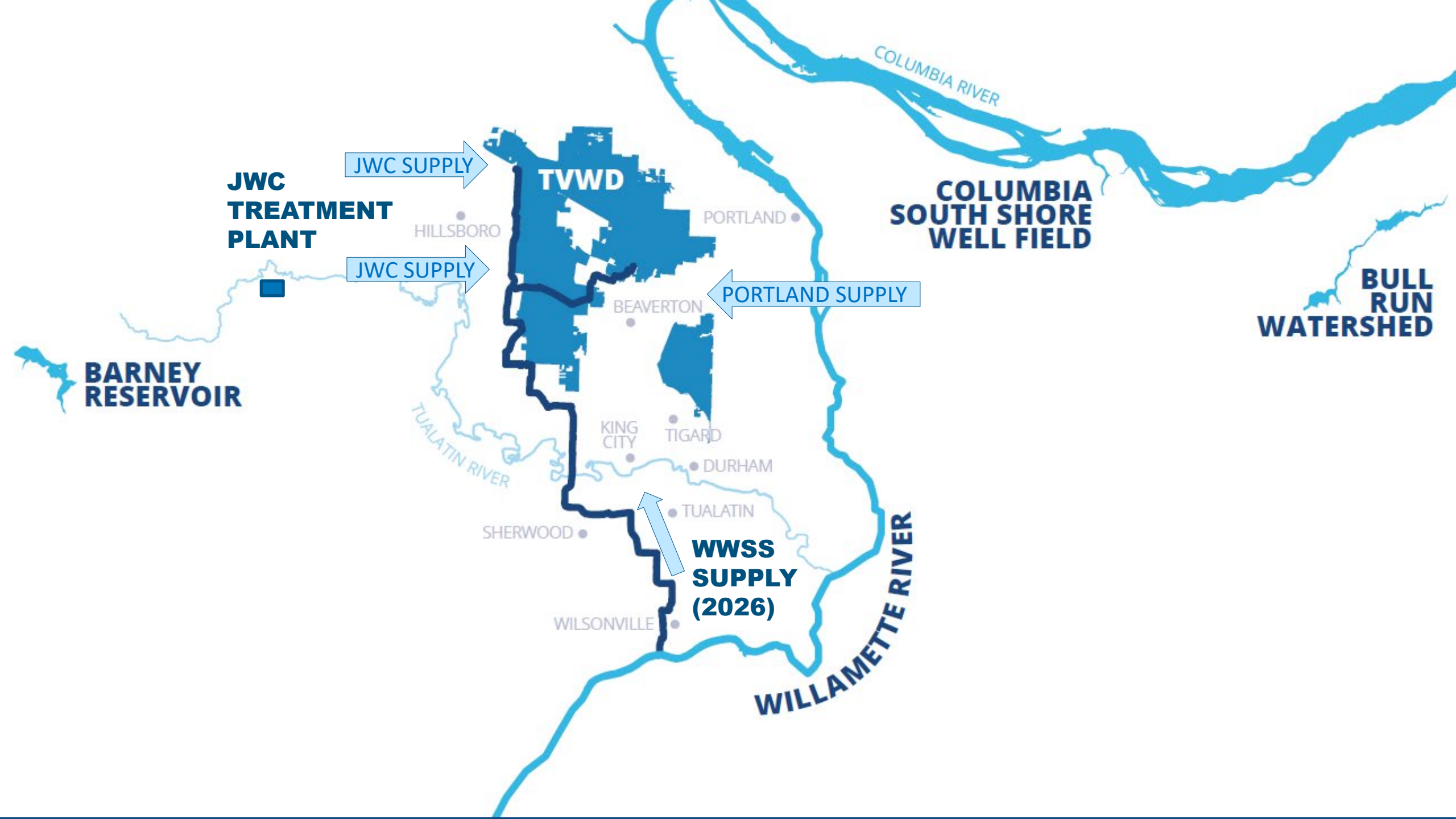
- 1 the branch of biology dealing with the functions and activities of living organisms and their parts, including all physical and chemical processes.
- 2 the organic processes or functions in an organism or in any of its parts.

# Chlorination of Drinking Water

- Prior to widespread use of chlorine, drinking water contaminated with bacteria, viruses, and microbes was a major source of disease in humans.
- Germany and England began chlorinating in 1890's.
- Jersey City was first in US to chlorinate in 1904.
- Chlorine provides a barrier against pathogens.
- Chlorine residual is typically 0.5-2.0 PPM and declines over time.

**One of the greatest public health advancements of the last century**





**JWC  
TREATMENT  
PLANT**

JWC SUPPLY

JWC SUPPLY

**TVWD**

HILLSBORO

PORTLAND

**COLUMBIA  
SOUTH SHORE  
WELL FIELD**

PORTLAND SUPPLY

BEAVERTON

**BULL  
RUN  
WATERSHED**

**BARNEY  
RESERVOIR**

TUALATIN RIVER

KING  
CITY

TIGARD

DURHAM

TUALATIN

SHERWOOD

**WWSS  
SUPPLY  
(2026)**

WILSONVILLE

**WILLAMETTE RIVER**

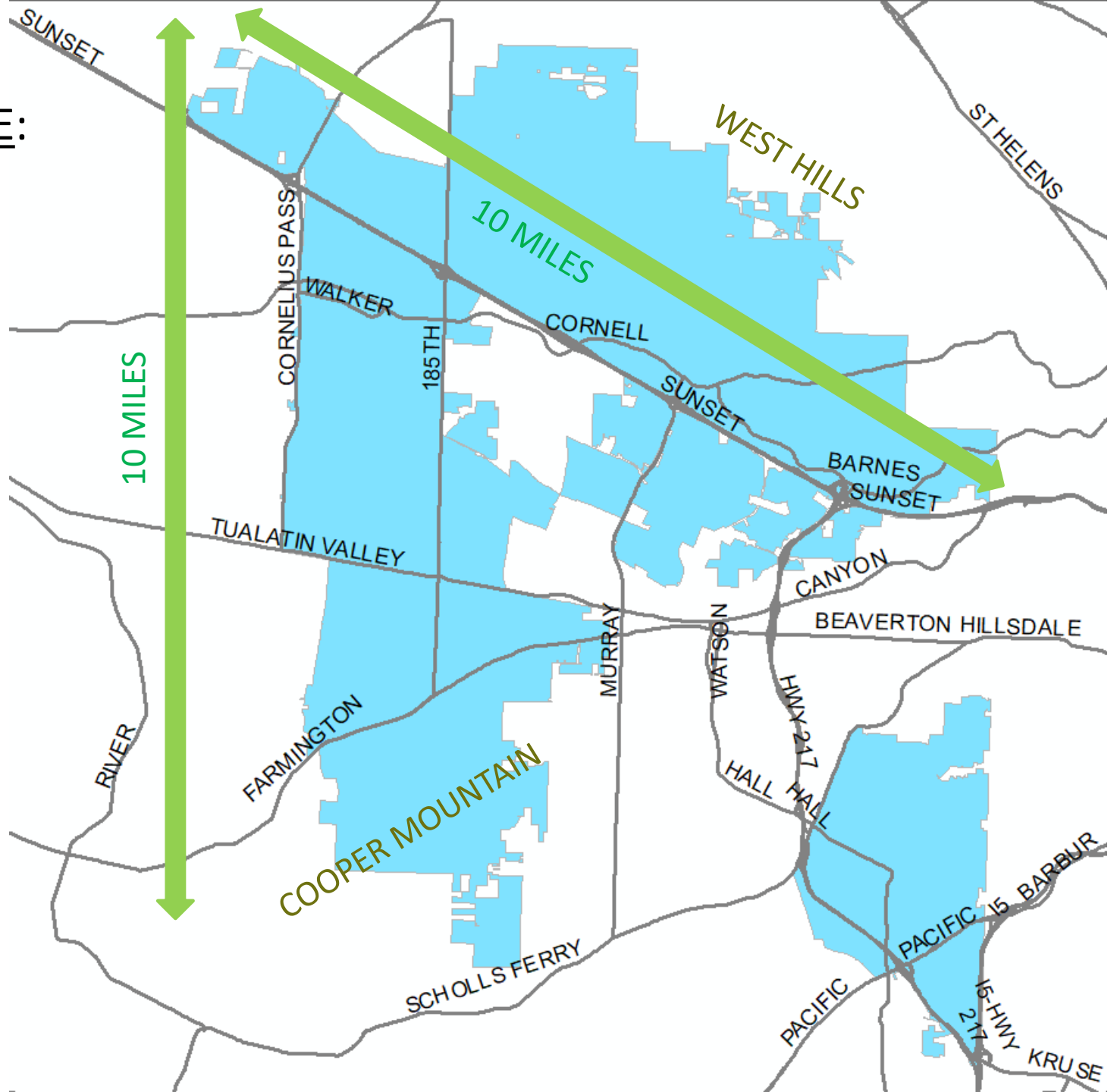
TVWD SERVICE AREA AT A GLANCE:

Area served: 45 square miles

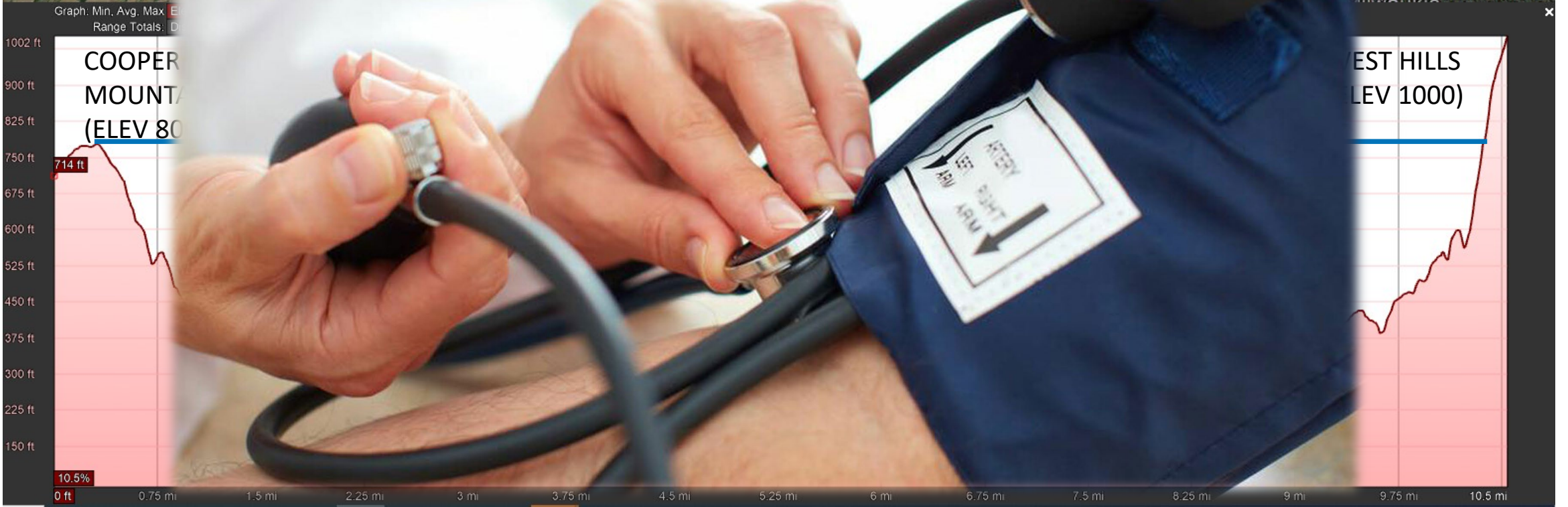
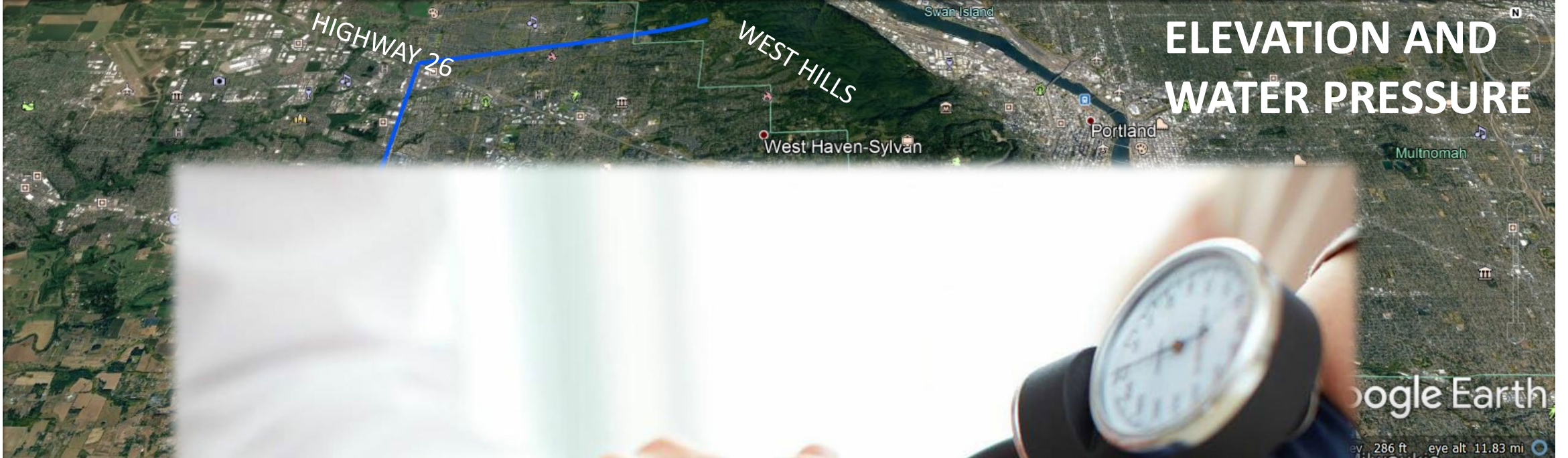
Population served: 230,000

Service connections: 60,000

95% residential



# ELEVATION AND WATER PRESSURE

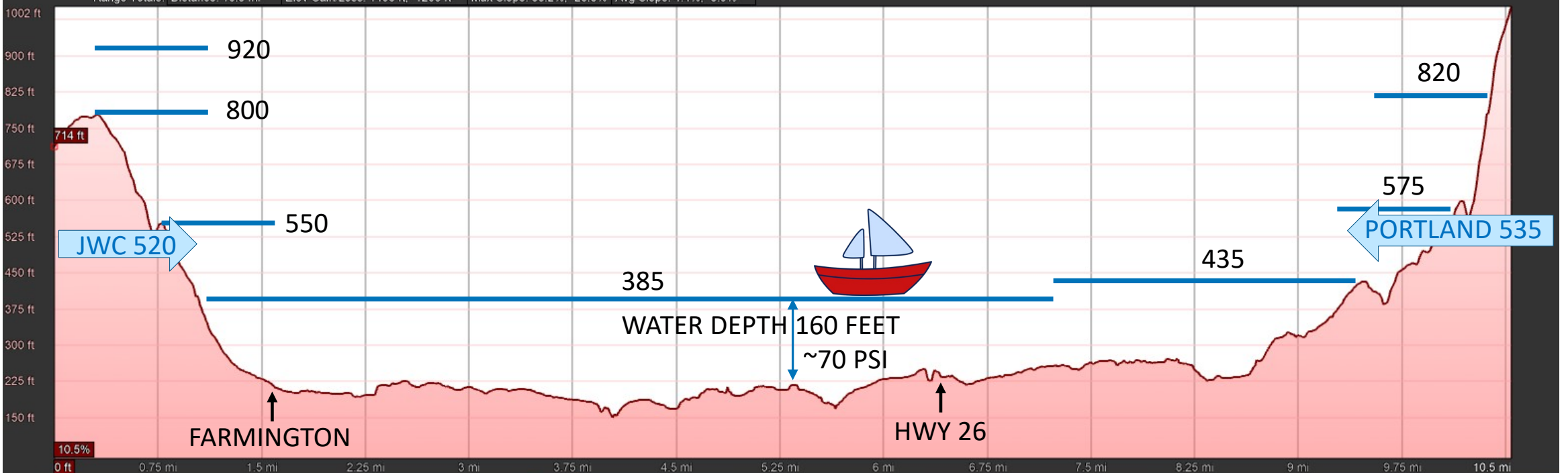


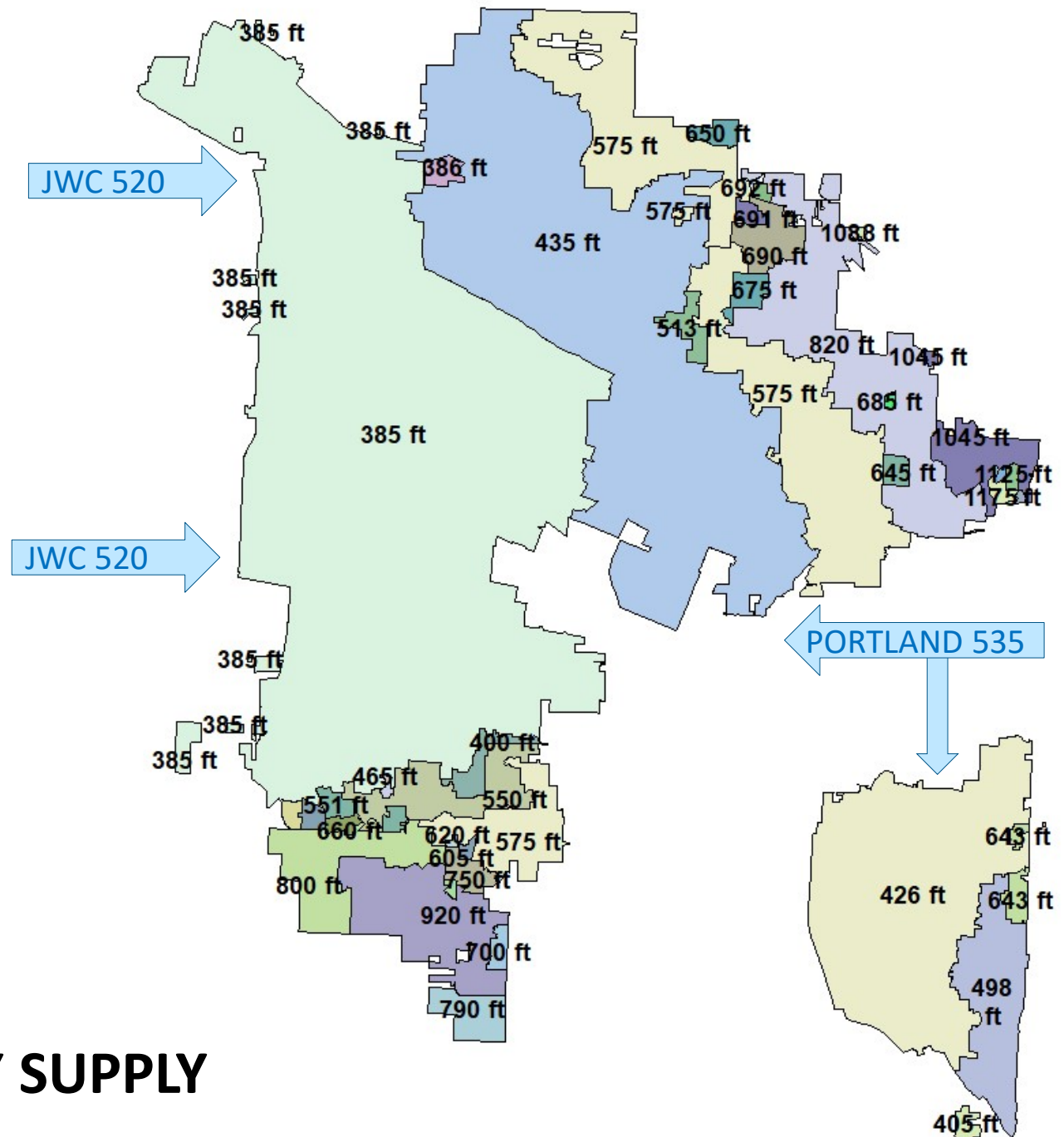


# ELEVATION AND PRESSURE ZONES

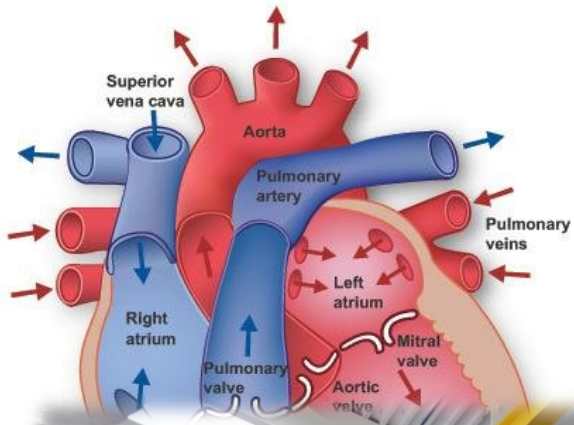


Graph: Min, Avg, Max Elevation: 150, 309, 1002 ft  
 Range Totals: Distance: 10.5 mi Elev Gain/Loss: 1496 ft, -1208 ft Max Slope: 38.2%, -23.8% Avg Slope: 4.4%, -3.9%

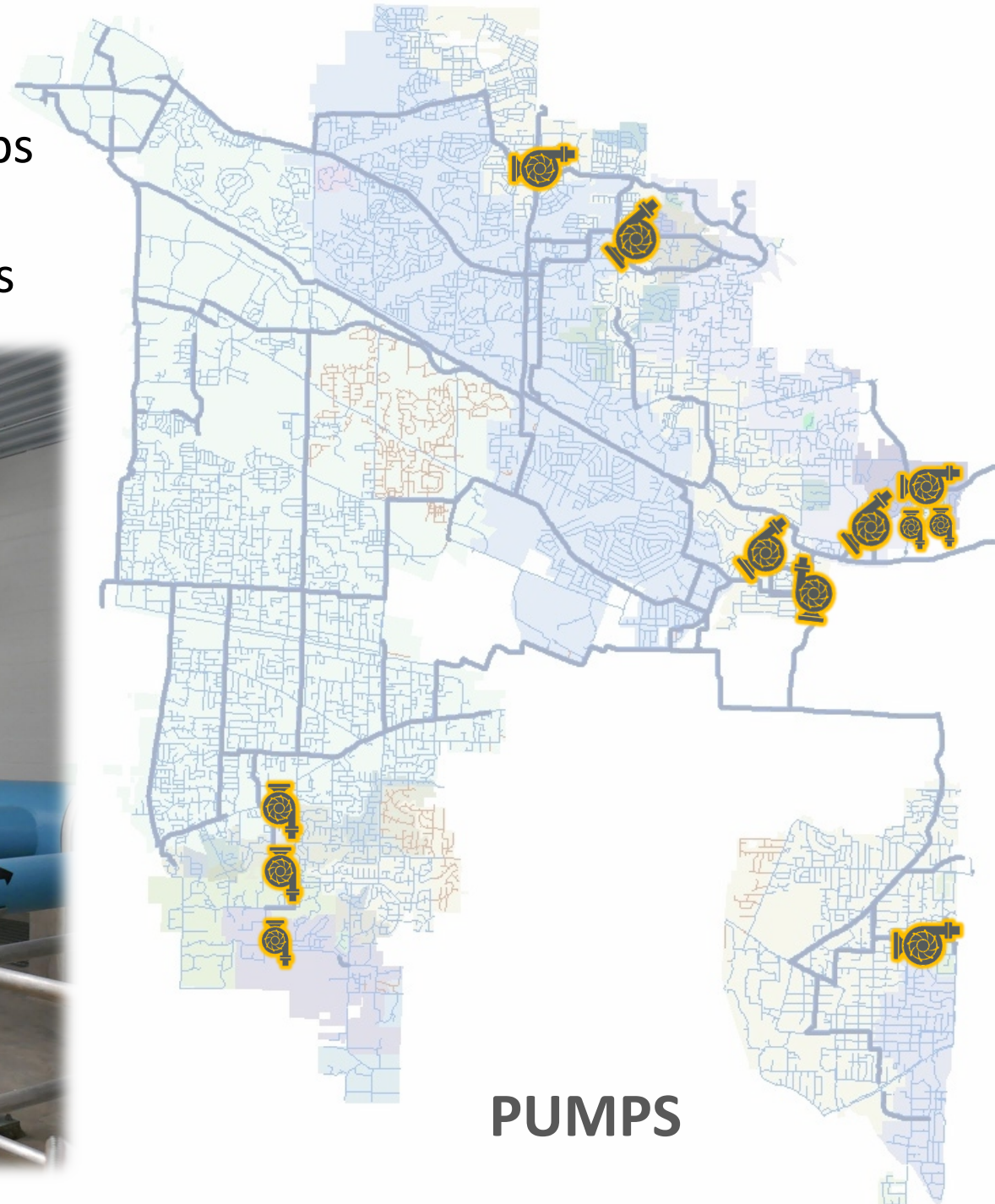




# PRESSURE ZONES & GRAVITY SUPPLY



13 pump stations  
Most with multiple pumps  
Driven by electricity  
Backup power generators



**PUMPS**

## 23 STORAGE RESERVOIRS



125,000 gallons to 10 million gallons  
67 million gallons total storage

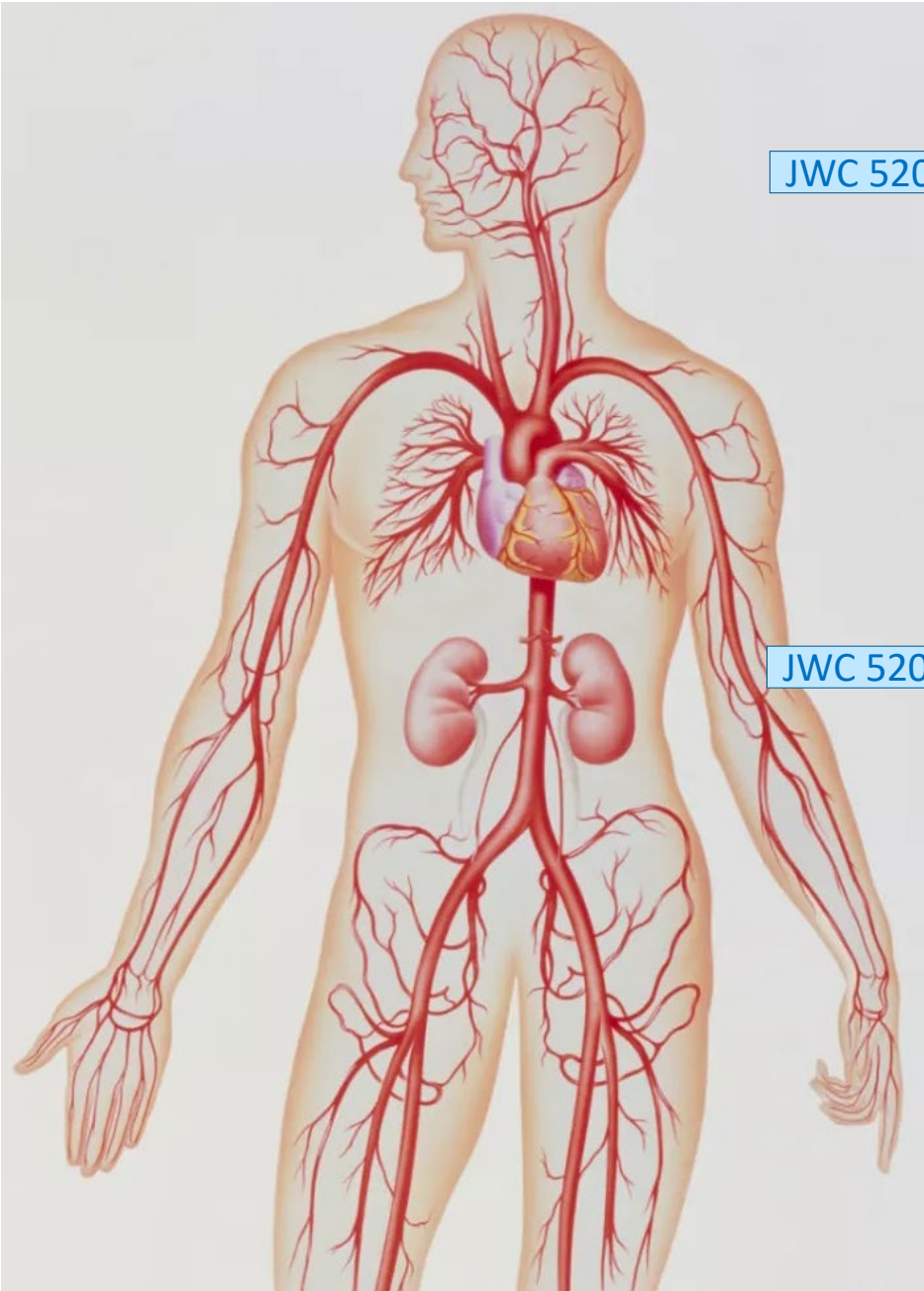
**Bigger is not necessarily better**



TVWD storage  
67 million gallons

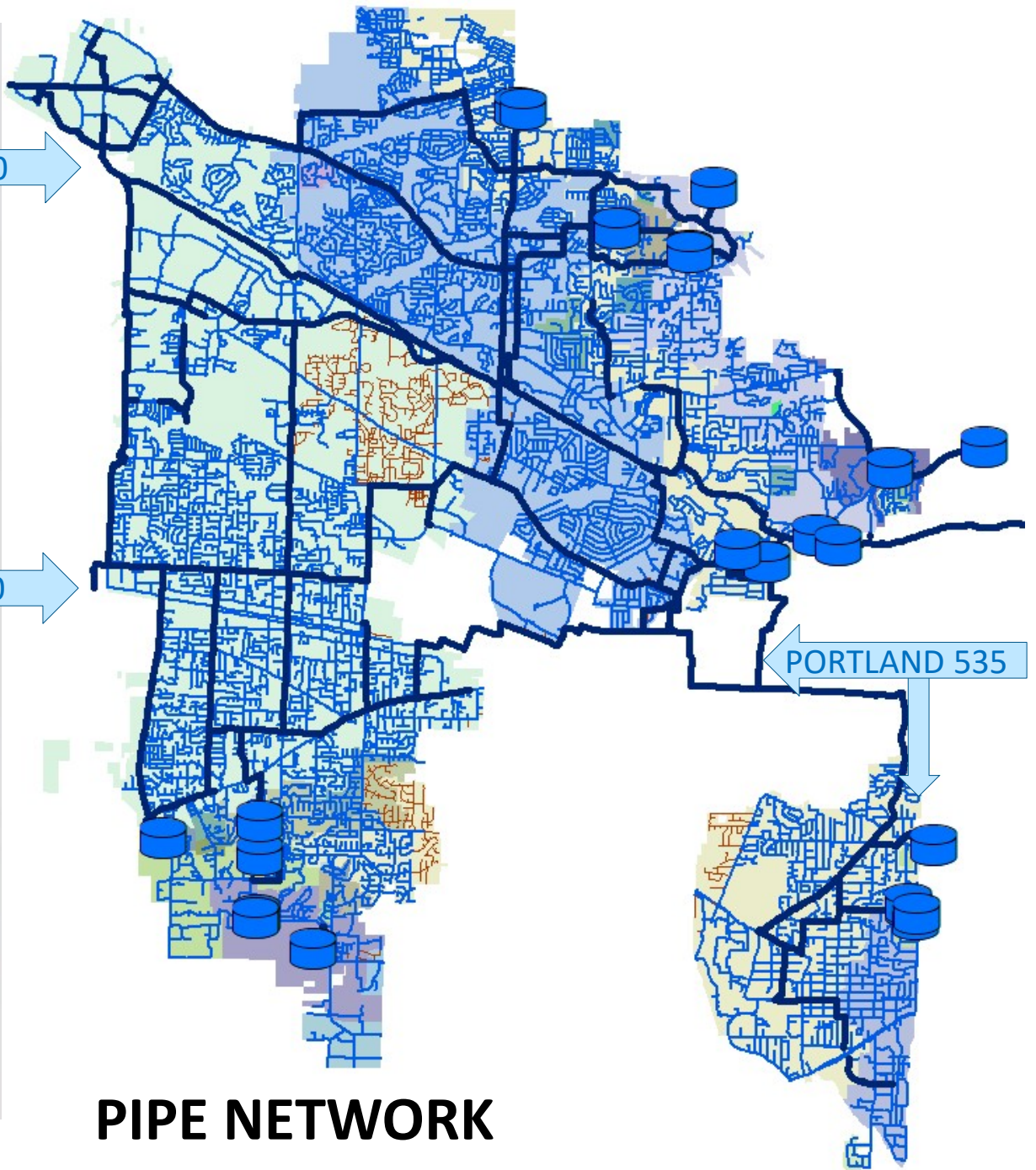
MODA Center  
200 million gallons





JWC 520

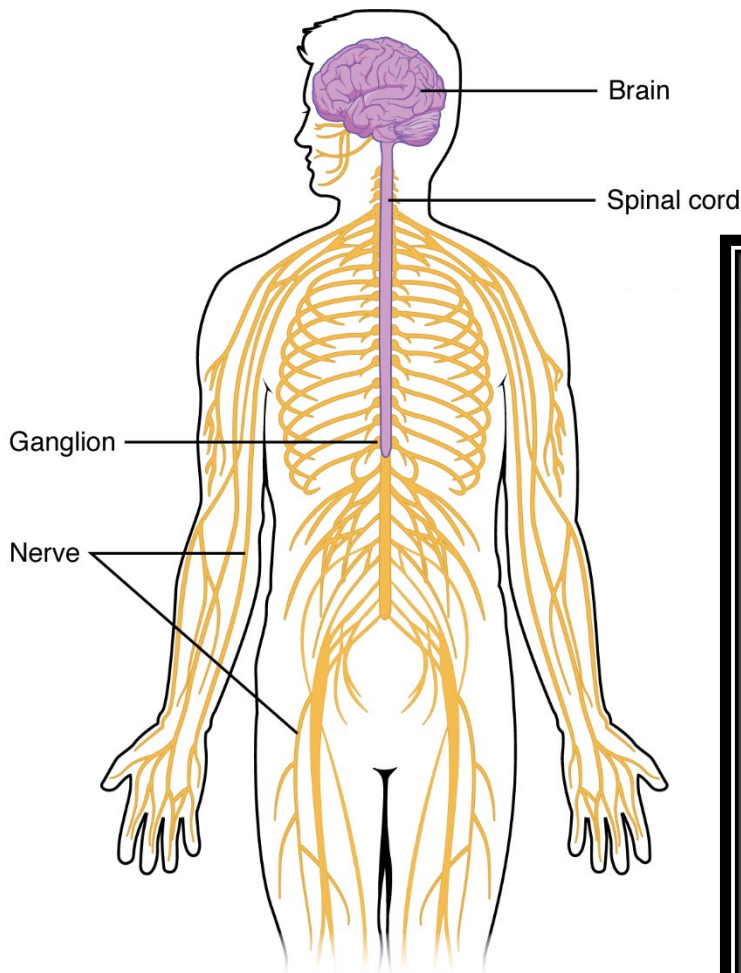
JWC 520



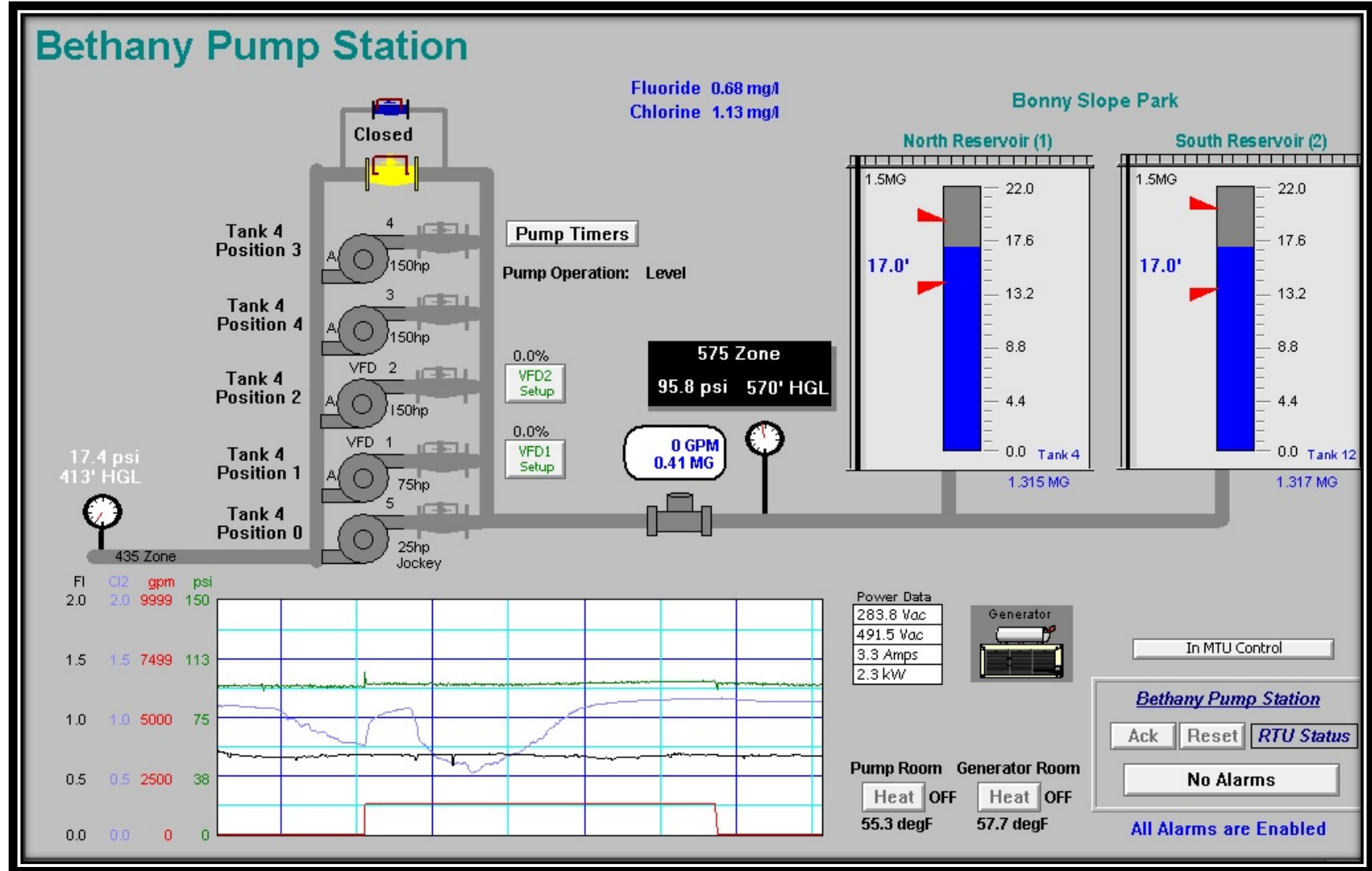
PORTLAND 535

**PIPE NETWORK**

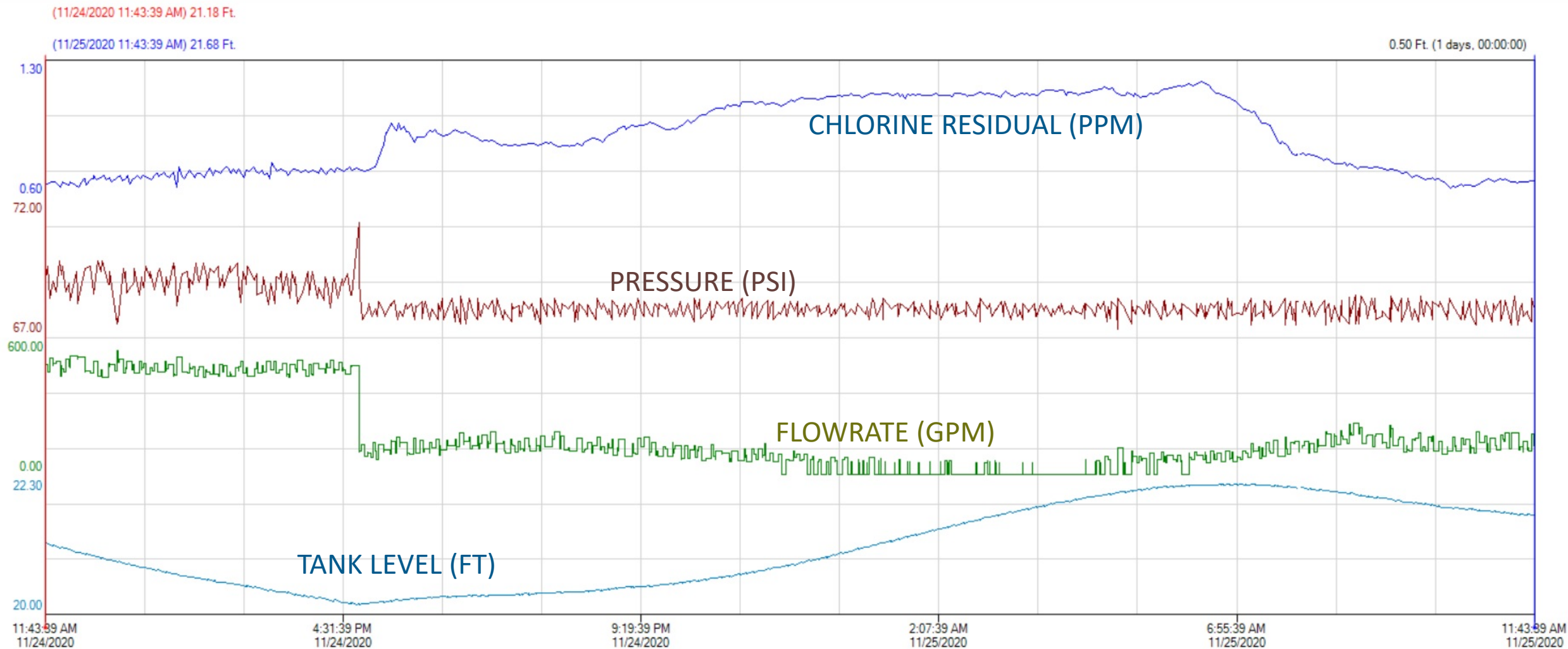
# SCADA - monitoring, control, automation



**SUPERVISORY  
CONTROL  
AND  
DATA  
ACQUISITION**



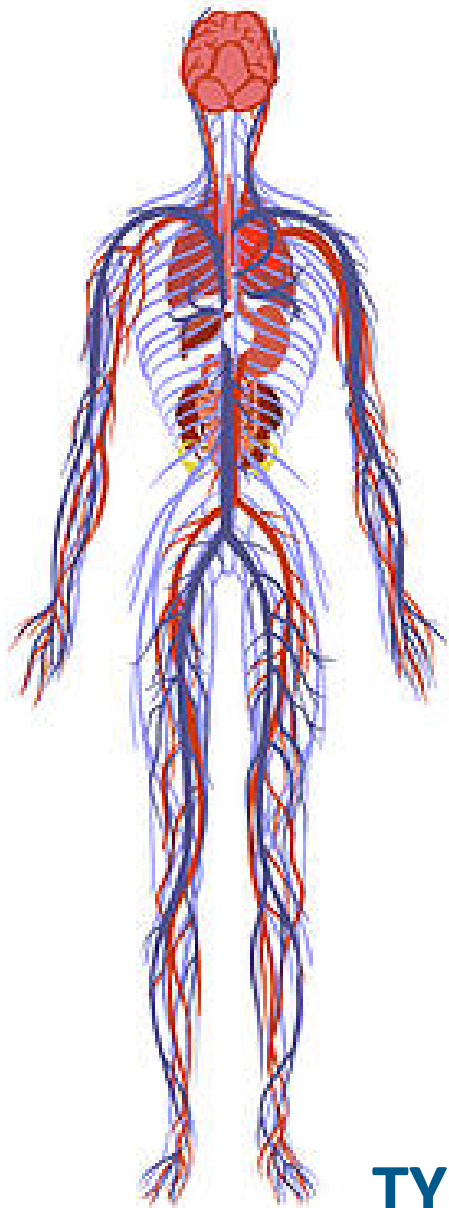
# SCADA



10.3.5.232:Cooper\_Level1 [BestFit - 00 00:07:47.451]

Tag Name	Description	Color	Number	Units
<input checked="" type="checkbox"/> Cooper_CI2	Cl2 Residual	Blue	1	mg/l
<input checked="" type="checkbox"/> Cooper_Mt_PSI	Pump Discharge Pressure	Red	2	psi
<input checked="" type="checkbox"/> Cooper_Mt_Flow	Pump Flow to closed zone	Green	3	GPM
<input checked="" type="checkbox"/> Cooper_Level1	Reservoir Level	Light Blue	4	Ft.





## SYSTEM SUMMARY (anatomy)

Supply

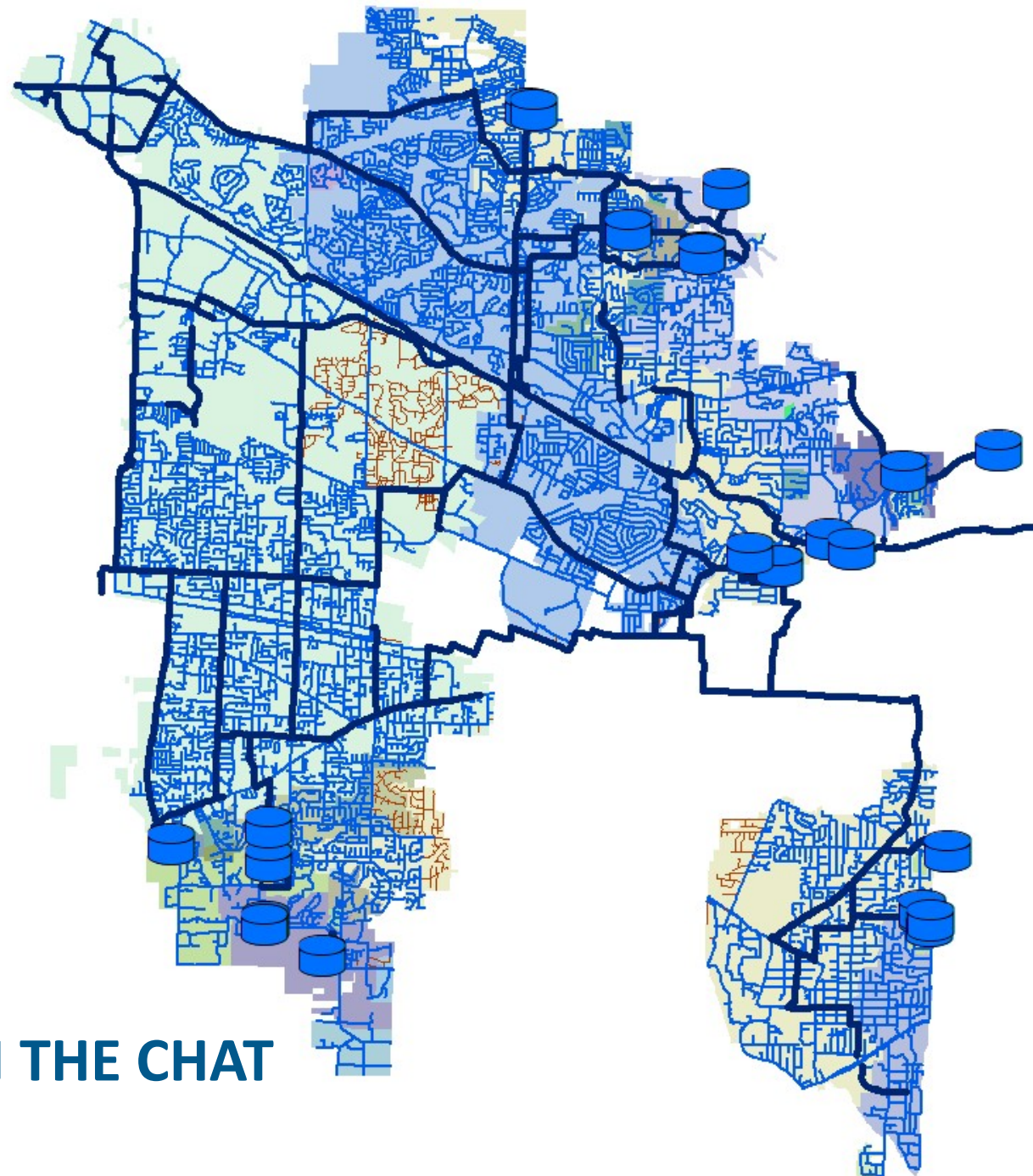
Storage

Pumping

Pressure zones

Pipe network

SCADA



**TYPE YOUR QUESTIONS IN THE CHAT**

# OPERATIONAL STRATEGY (physiology)

1. Manage supply to meet demand
2. Maintain adequate pressure
3. Maintain water quality
  - chlorine residual
  - water age
  - aesthetics
4. Minimize service disruptions



## DAILY DEMAND AND WATER AGE

Winter daily demand ~16 million gallons per day (MGD)

Summer daily demand is 35-45 MGD

Temperature, rain, and irrigation are big drivers

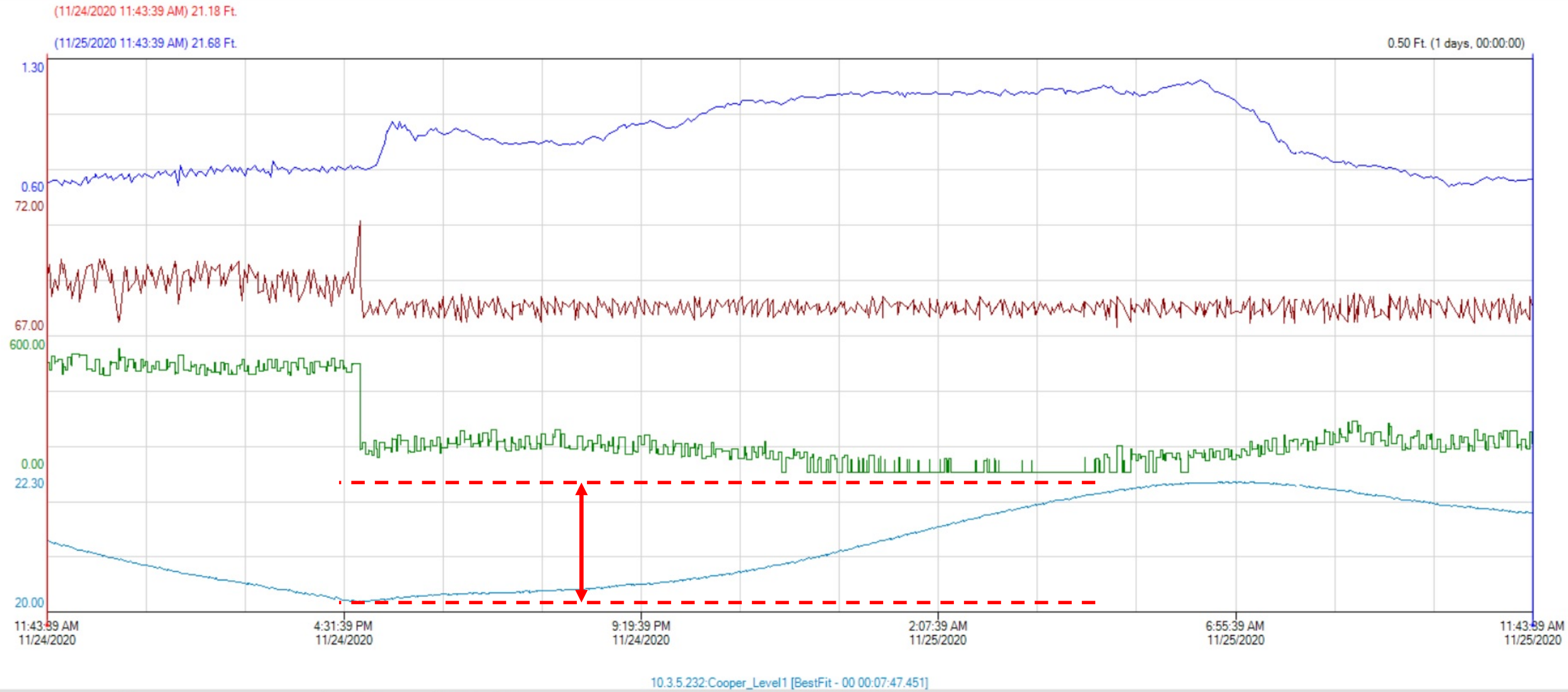
Water age tends to increase during low demand

Chlorine residual decreases over time

Remember that 67 MG of storage?



# CHLORINE RESIDUAL AND RESPIRATION



Tag Name	Description	Color	Number	Units
<input checked="" type="checkbox"/> Cooper_CI2	Cl2 Residual	Blue	1	mg/l
<input checked="" type="checkbox"/> Cooper_Mt_PSI	Pump Discharge Pressure	Red	2	psi
<input checked="" type="checkbox"/> Cooper_Mt_Flow	Pump Flow to closed zone	Green	3	GPM
<input checked="" type="checkbox"/> Cooper_Level1	Reservoir Level	Cyan	4	Rt.

# REACTION AND COMPENSATION

Under exertion, our bodies react and compensate by increasing pulse and breathing

As water system demand changes, tank levels rise and fall to make up differential

SCADA detects these changes and adjusts pumping as needed (automation)

Operators make changes to system settings when warranted (intervention)

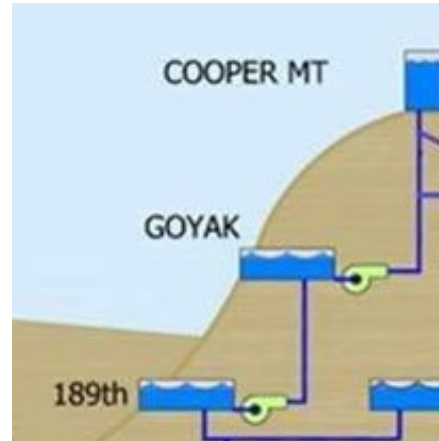
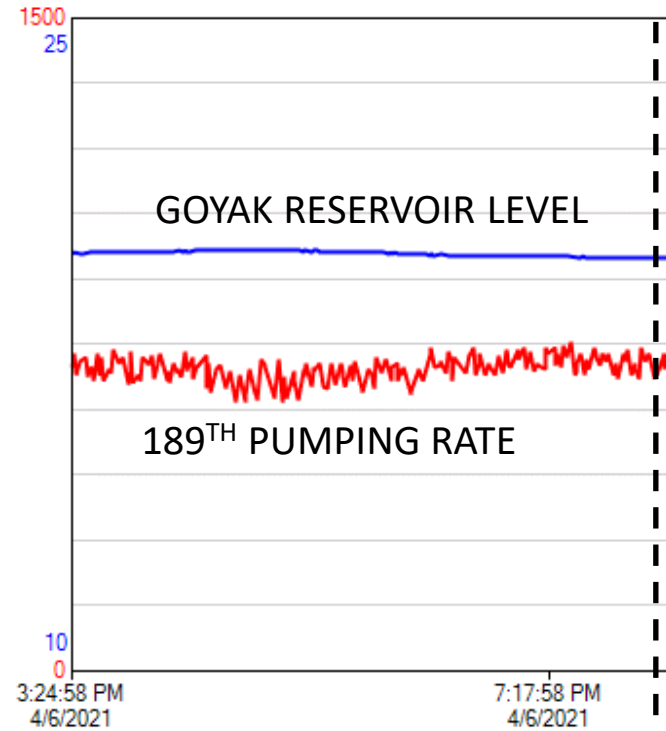


# MAIN BREAKS



# SCADA REACTED AND COMPENSATED

8PM-MAIN BREAK  
OCCURS ON SW  
SUMAC COURT

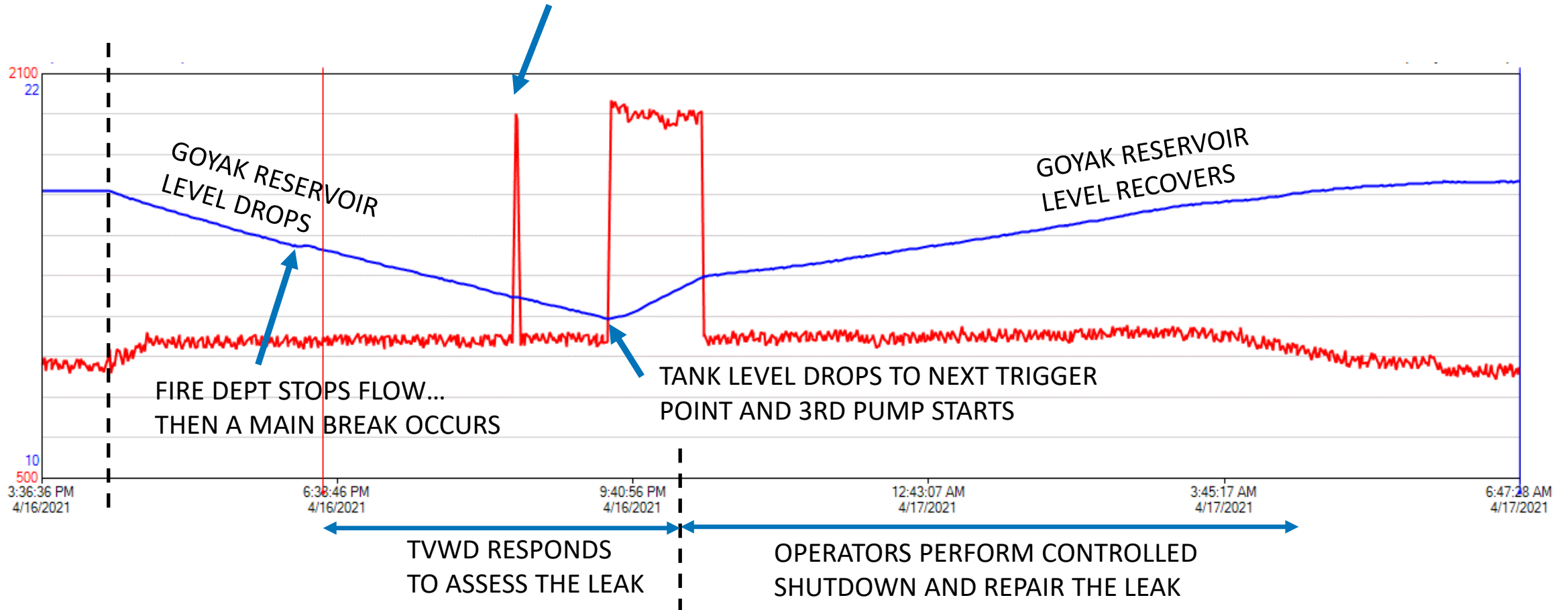


# FIRE FLOW, THEN A MAIN BREAK

## Friday, April 16

4PM-FIRE NEAR SW  
167<sup>TH</sup> AND OAK

TANK LEVEL DROPS TO TRIGGER POINT AND  
2ND PUMP STARTS BUT THEN TRIPS OUT





**Thank you to our dedicated operators!**





**TUALATIN VALLEY**  
WATER DISTRICT

# Now it's your turn! Any Questions?

## Today's Experts



**Pete Boone, PE, PLS**  
Water Operations  
Division Manager



**Carrie Pak, PE**  
Chief Engineer



**Joel Cary**  
Water Resources  
Division Manager

## How to contact us

Email: [Communications@tvwd.org](mailto:Communications@tvwd.org) | Phone: Call 503-848-3000 | Website: [www.tvwd.org](http://www.tvwd.org)



**TUALATIN VALLEY**  
WATER DISTRICT

# Thank you for joining us today!

**Join us for our next Talkin' Water:  
Efficient Outdoor Water Use  
May 19 from 12 – 1 p.m.**

**How to contact us**

**Email:**

**[Communications@tvwd.org](mailto:Communications@tvwd.org) |**

**Phone: Call 503-848-3000 |**

**Website: [www.tvwd.org](http://www.tvwd.org)**