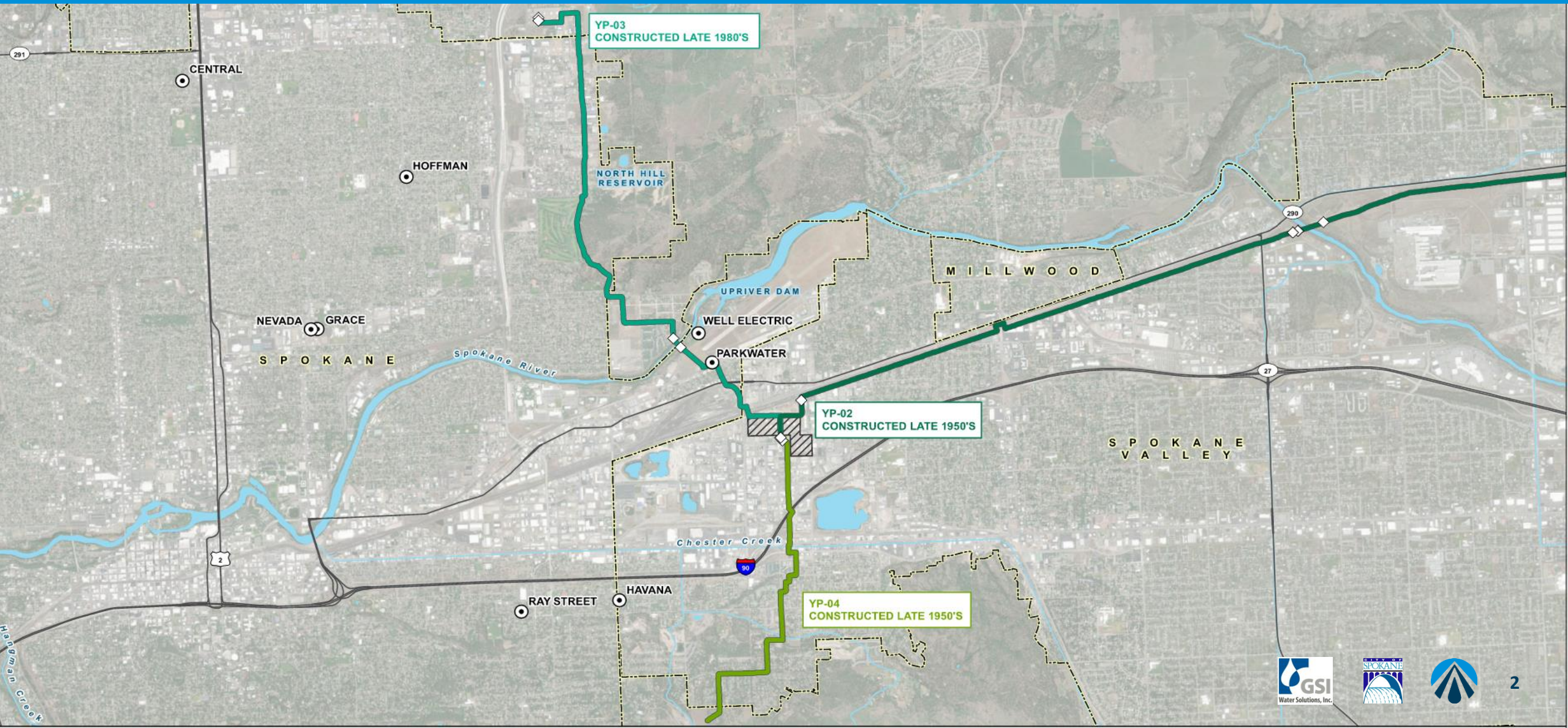


Emergency Planning for Potential Petroleum Pipeline Breaks to Protect Public Health in Spokane

What would we do if we found petroleum in our well water?

The Project



The Project

The project
evaluated:



Supply
Limitations

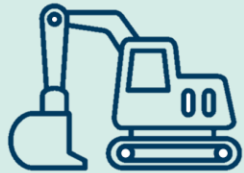


Aquifer
Vulnerability



Reservoir
Resilience

Project
outcomes:



Infrastructure
Improvements



Operations



Communication
& Planning

Introductions



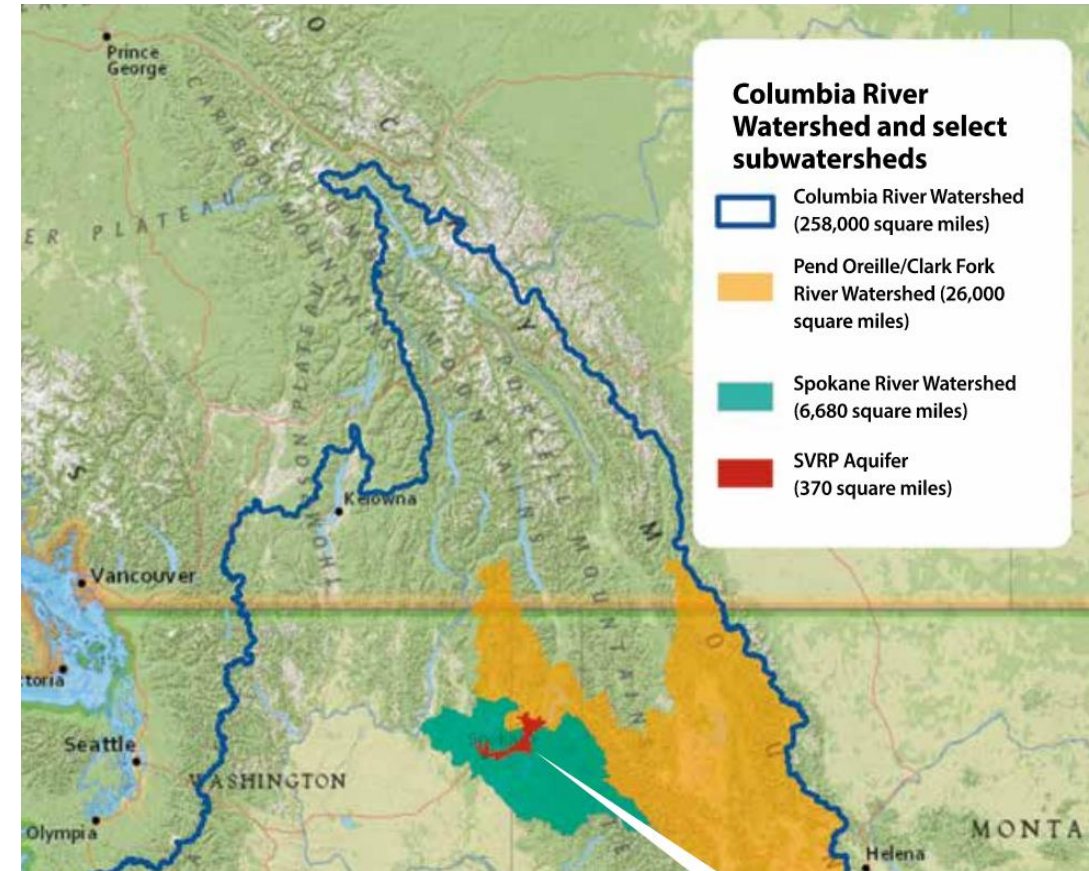
Elisheva Walters: Consor
Distribution System Modeler



Jim Sakamoto: Principal City of
Spokane Water Department
Engineer



John Porcello: GSI Water Solutions
Groundwater Hydrologist



Agenda



Summary of the City of Spokane Water System



Summary of the Yellowstone Pipeline



Collaborative Stakeholder Engagement

Coordination between the City and Phillips 66



The Emergency Scenarios

How a petroleum leak could shut down City wells



Groundwater & Distribution System Modeling

Analysis of impacts to City operations



Distribution System Contamination Response Plan

The City's plan to mitigate risk



Summary of the City of Spokane Water System



Summary of the Yellowstone Pipeline



Collaborative Stakeholder Engagement

Coordination between the City and Phillips 66

James Sakamoto, P.E.

City of Spokane Water &
Hydroelectric Department





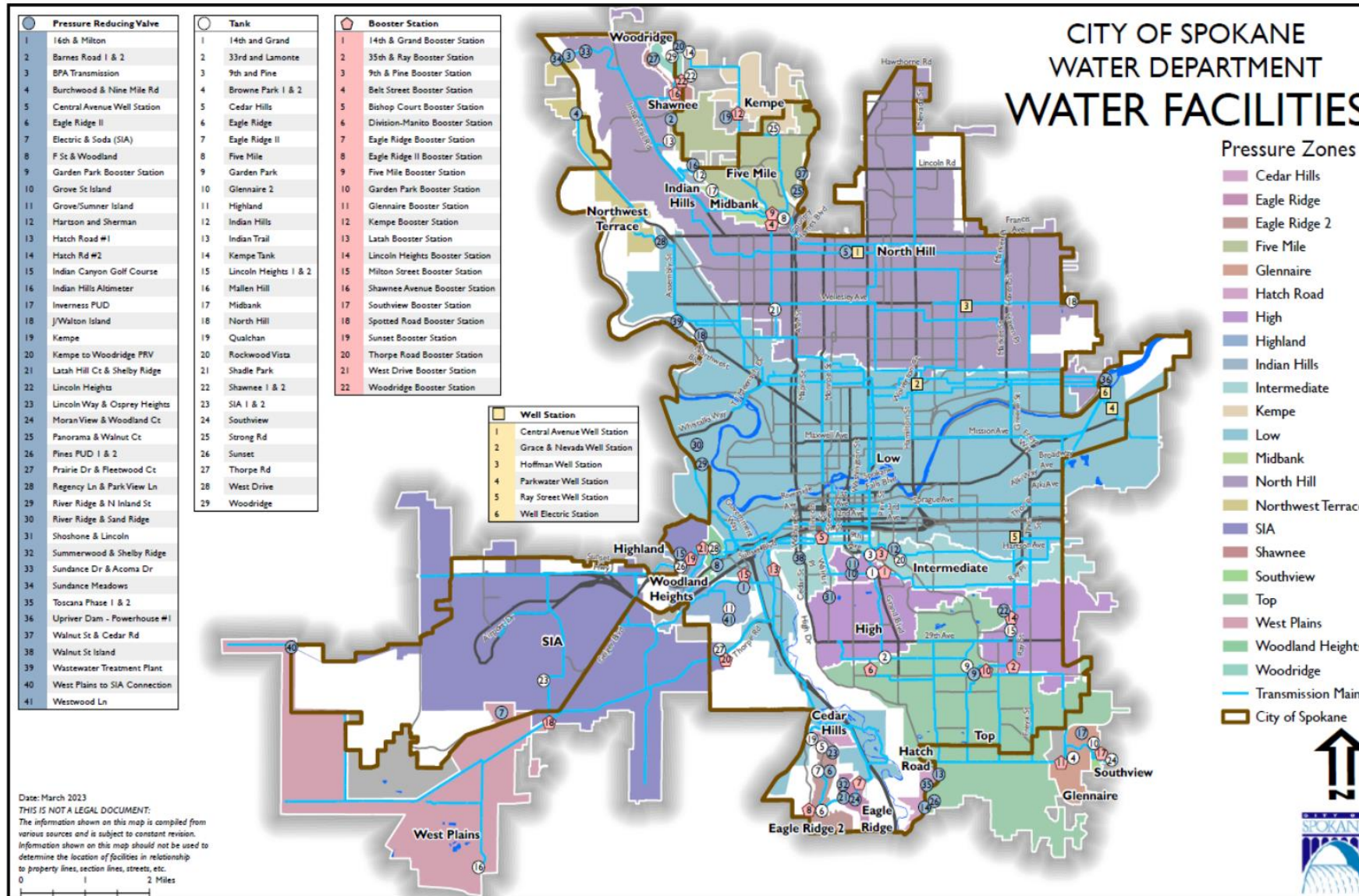
City of Spokane Water System

- Established: 1883
- Largest Group A Water System Spokane County
- Service Area Population – 251K
- 87K Service Connections
- Annual Production – 23 Billion Gallons





City of Spokane Water System





City of Spokane Water System

City of Spokane Water System History Timeline

1883

The City purchased a private water system that was serving the downtown area. The original system comprised a water-driven pump installed in the Echo Flour Mill on Havermale Island to serve Spokane River water to a few customers in the new city. Some of the cast iron water mains constructed for this system continue to be used today.



1905

Continued population growth and pollution in the Spokane River drove a search for an alternative source of high-quality potable water. Groundwater discovered during construction of the Upriver facility was evaluated and considered as a potential new supply source for development.



1910-1925

Additional groundwater wells completed in the SVRP aquifer were constructed at the Upriver facility/Well Electric Well Station. This well station consists of two 48-foot diameter caisson wells with four pumps (two vertical line shaft turbines and two centrifugal) ranging in size between 900- and 1,000-horsepower.

1936

The timber crib dam upstream of the Upriver facility was replaced with a taller concrete dam. Water in the reservoir behind the new dam was diverted to a new hydroelectric powerhouse, which powered electric motors that drove pumps installed in the groundwater wells.



1938

Hoffman Well Station acquired by the City from Great Northern Railway. This well station houses two 16-foot diameter caisson wells. Under full operating conditions, each well is equipped with a 600-horsepower vertical line shaft turbine pump. One of the wells has been out of service since 1993.

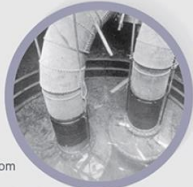


1884

The pumping plant was relocated and a second pump was added to serve the expanding city.

1896

Upriver pumping facility began operation. The Upriver facility was located approximately five miles upstream of the City and constructed to address a growing population and deteriorating water quality in the Spokane River near the City. Pumps delivering water from the new facility to the City's customers were mechanically powered by water routed from a reservoir, created by a timber crib dam upstream of the facility. Groundwater encountered during construction was a nuisance and was overlooked as a potential supply source at the time.



1907

The first well was constructed at the Upriver facility to withdraw water from the newly discovered groundwater source, ending the City's use of the Spokane River as a municipal source of supply. The groundwater source was later named the Spokane Valley-Rathdrum Prairie (SVRP) aquifer.



1920

Caisson production wells at the City's Hoffman Well Station were constructed as water supply sources for the Great Northern Railway before transferring ownership to the City.



1937

Ray Street Well Station constructed. This well station houses two 24-foot-diameter caisson wells and three 900-horsepower pumps, with two pumps in one well and a single pump in the second well.

1949

Parkwater Well Station constructed. This well station houses eight pumps in four 18-foot diameter wells. The pumps are vertical line shaft turbines ranging in size between 600- and 1,000- horsepower.



1956

Nevada Well Station constructed. This well station houses a single caisson well equipped with two 400-horsepower submersible pumps and two 800-horsepower vertical line shaft turbine pumps.

1967

The City's Water Department began serving water to customers outside city limits.



1995

The Water Department replaced the City's last uncovered reservoir with two covered concrete tank reservoirs, protecting the water system from potential contaminants.

2021

The City continues to use the SVRP aquifer as its sole source of potable water. Once the Havana Wellfield Station is complete, the City's water system will have eight well stations with 20 wells and 33 well pumps, 25 booster pump stations with 72 booster pumps, 23 pressure zones with 34 reservoirs, and more than 1,100 miles of water pipes.

1950

Grace Well Station constructed. This well station houses one 18-foot diameter caisson well with two 900-horsepower pumps.



1959

Central Well Station constructed. This well station has two 7-foot diameter caisson wells with two 450-horsepower submersible pumps in each well.



1981-1984

Major improvements at the Upriver facility increased the hydroelectric generating capacity of the three existing generators from 1.3 to 2.0 megawatts each and added a second powerhouse with two additional 5.58 megawatt generators. The hydroelectric power generation allows the City's Water Department to sell power during times of low electrical demand from the City's water pumps. Revenue from power sales offset the cost of pumping water to help keep customers' water rates low and affordable.

2018

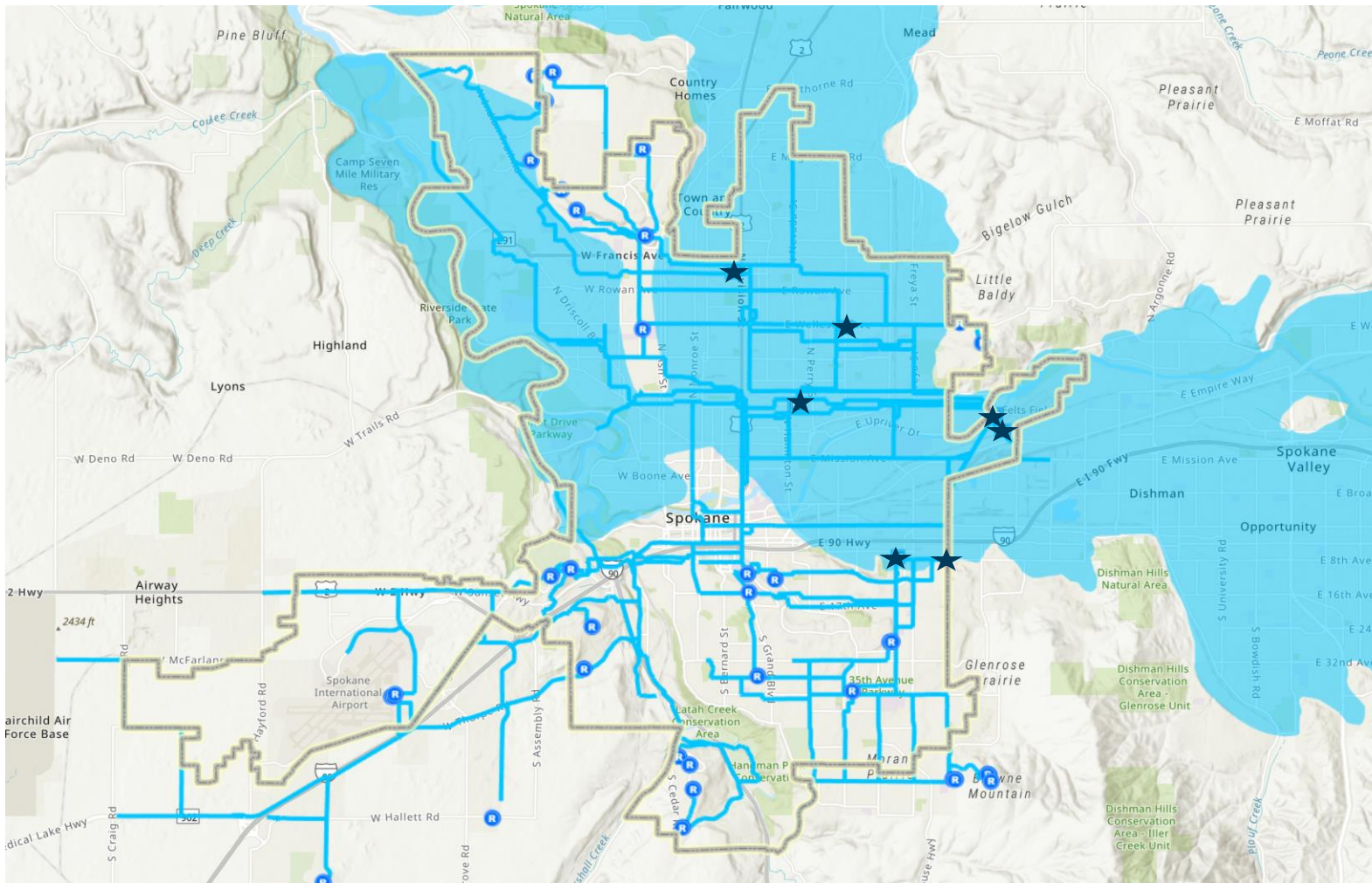
Havana Wellfield wells drilled and constructed. The wellfield consists of six 24-inch diameter vertical wells completed in the SVRP aquifer. Each well is capable of producing 3,750 gallons per minute. Final design and construction of the well station is currently in progress (as of fall 2021).





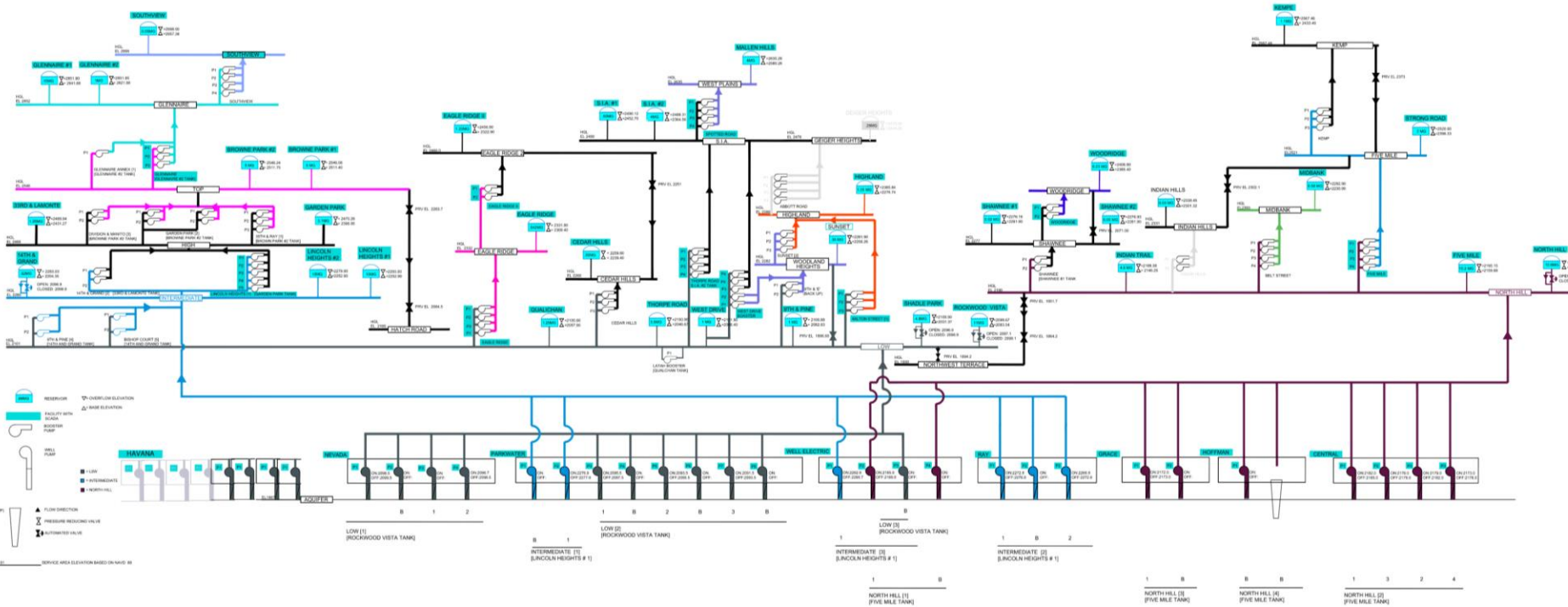
City of Spokane Water System

Spokane Valley – Rathdrum Prairie Aquifer



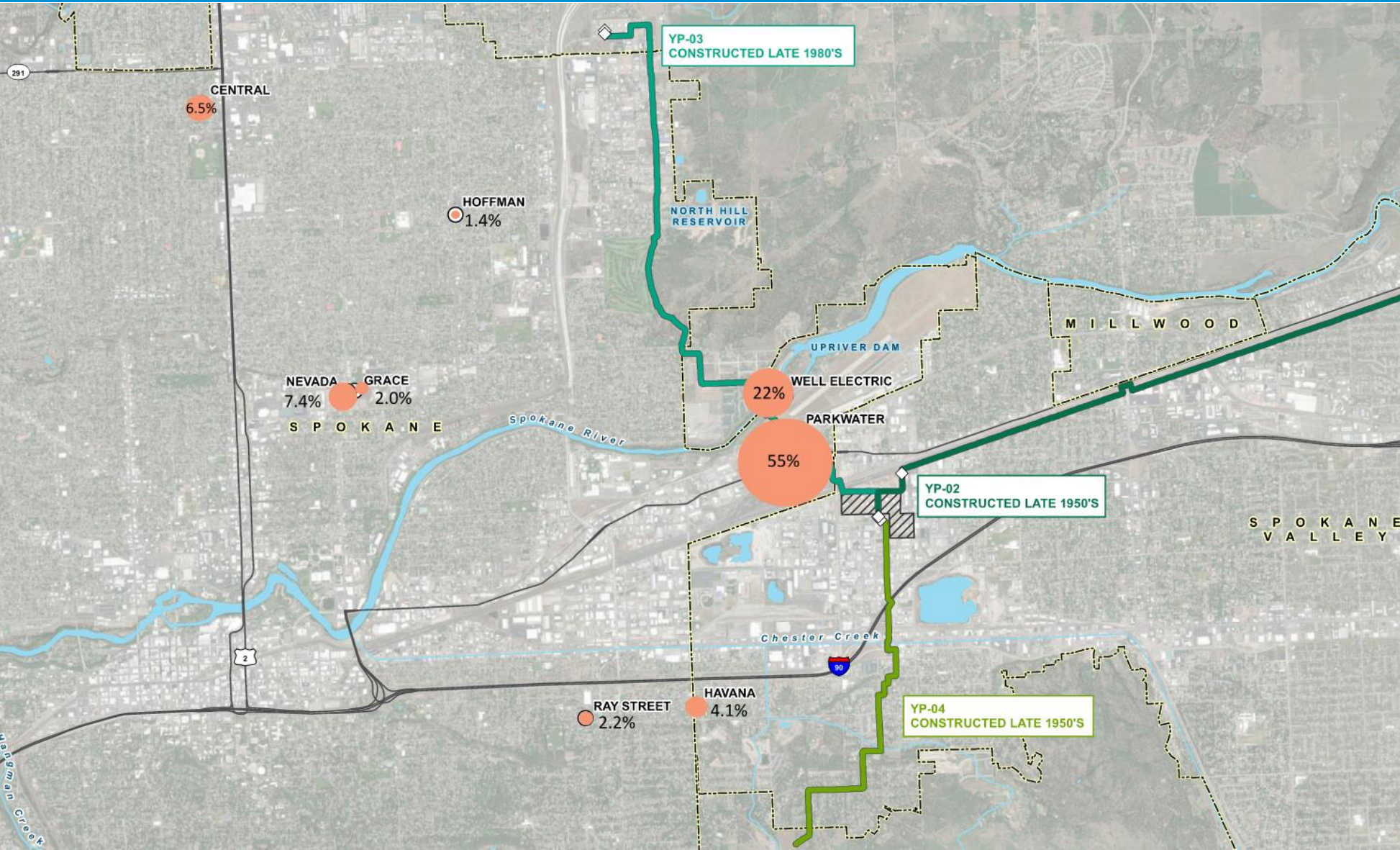


City of Spokane Water System





City of Spokane Water System

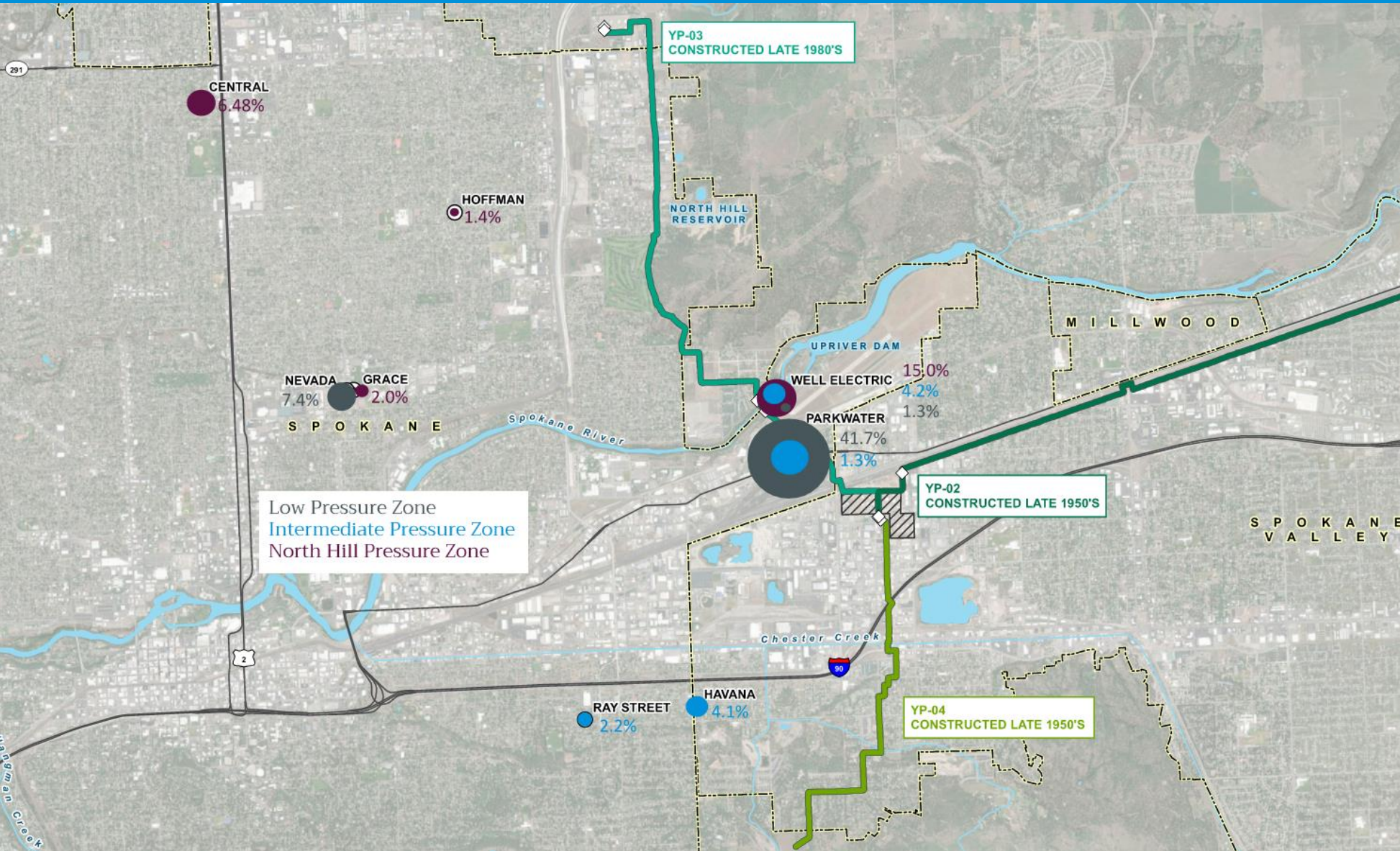


City of Spokane Well Stations

(2024 Annual
Production)



City of Spokane Water System

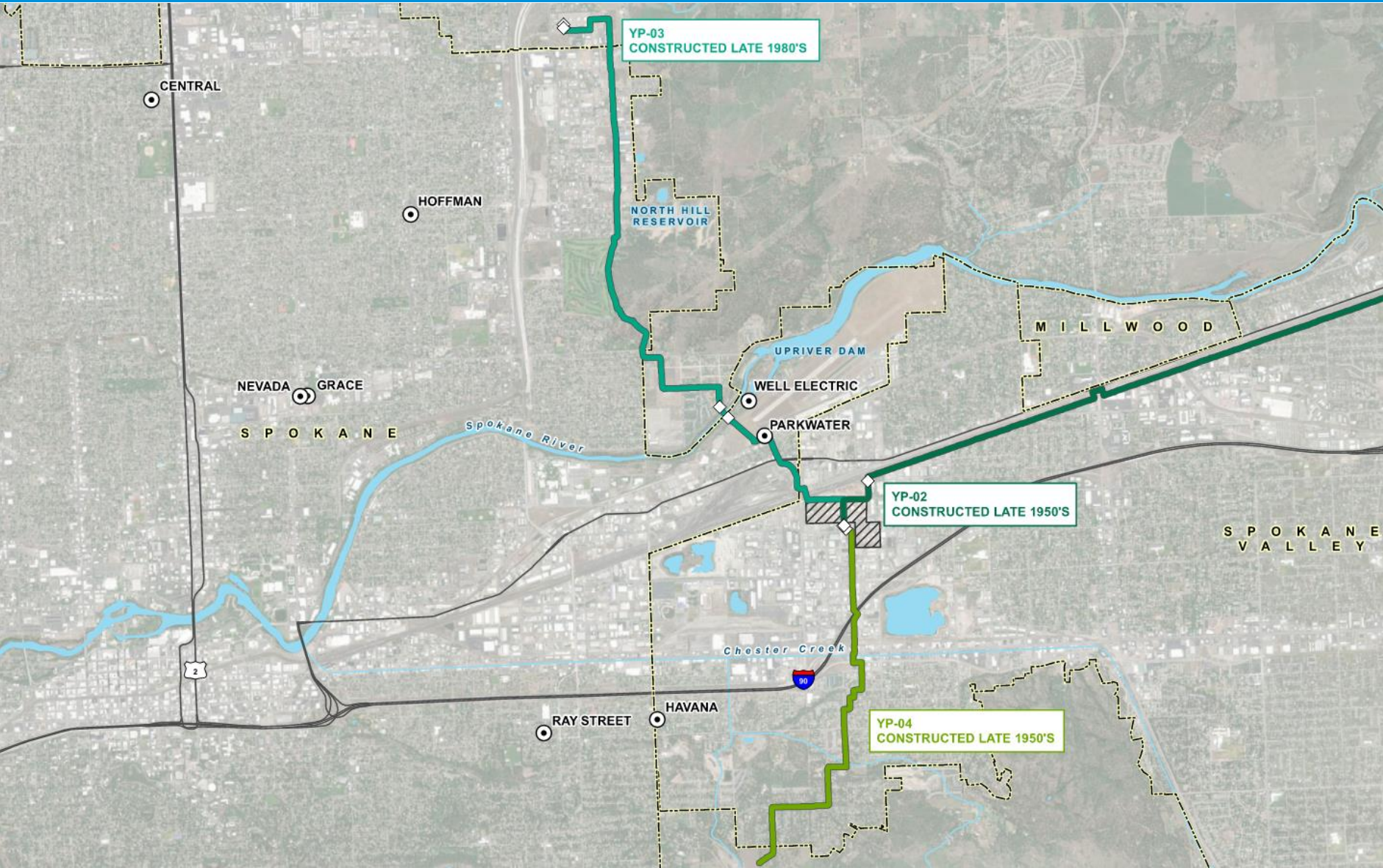


City of Spokane Well Stations

(2024 Annual Production by Primary Pressure Zone)



Yellowstone Pipeline – Phillips 66



Yellowstone Pipeline Company

- Franchise granted in 1954
- Currently owned by Phillips 66, Exxon Mobile and Energy Transfer
- Products Delivered
 - Gasoline (40%)
 - Diesel (40%)
 - Jet Fuel (20%)



Yellowstone Pipeline – Phillips 66

Yellowstone Pipeline Company – Phillips 66

- Franchise Agreement
 - 15 Year Renewal Period
 - New franchise negotiations 2008 – Granted Jan 2022
- Franchise Negotiations
 - Acknowledgement of the SVRP Aquifer as a Sole Source Drinking Water Supply
 - \$75,000 Commitment for Study
- Vulnerability Assessment
 - Original Scope 2018
 - Assessment kickoff, February 2023
 - Final report December 2024





The Emergency Scenarios

How a petroleum leak could shut down City wells



Groundwater Modeling

Analysis of impacts to City operations

John Porcello, R.G., L.H.G

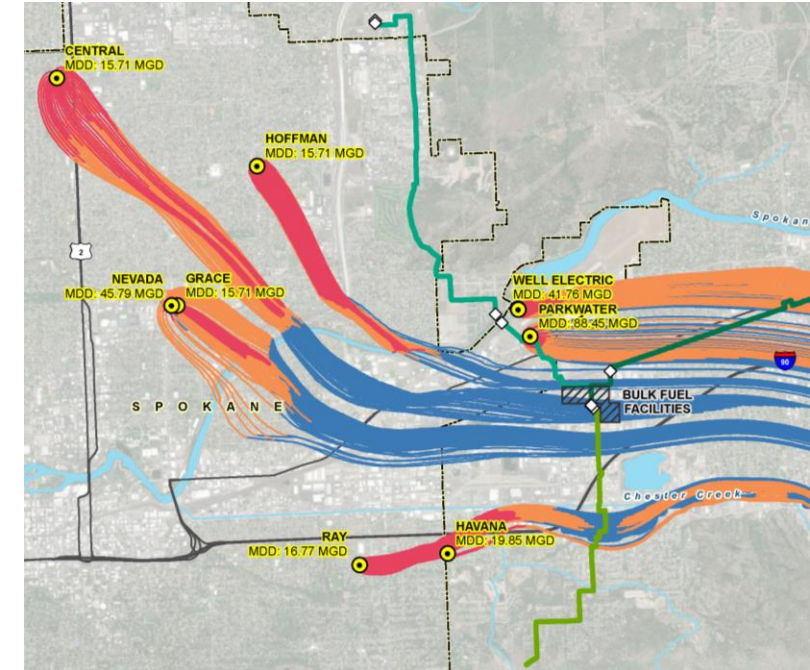
GSI Water Solutions
Groundwater Hydrologist





Evaluating Vulnerability of the City's Groundwater Supply Wells

- Understanding contaminant travel in the aquifer
 - Capture zones for individual wells
 - Non-emergency conditions and changes when a well goes offline
 - Groundwater flowpaths from beneath the pipeline
 - Where does a contaminant go once it reaches the water table?
 - How long does it take for a contaminant to reach a City well?
- Understanding supply limitations when a well goes offline because of contamination
 - Capacity limitations of other wells
 - Demands in the three primary pressure zones for the water distribution system





Demand Projections (mgd) Evaluated in the Groundwater Model

WATER DEMAND SCENARIO	ADD	MDD
Recent Historical Usage (Average for 2015 through 2020)	63.60	141.30
20-Year Projection with 2070–2099 Climate Change	91.47	186.42
50-Year Projection (Modest Level of Demand)		
▪ Demographics: Baseline		
▪ Conservation: Standard		
▪ Climate Change: Aggressive (RCP 8.5, 2070–2099)	95.32	217.40
50-Year Projection (High Level of Demand)		
▪ Demographics: High Growth/High Commercial		
▪ Conservation: No Change from Current Conditions	127.06	259.75
▪ Climate Change: Aggressive (RCP 8.5, 2070–2099)		

Notes

All values are in units of millions of gallons per day (mgd).

ADD = average day demand MDD = maximum day demand

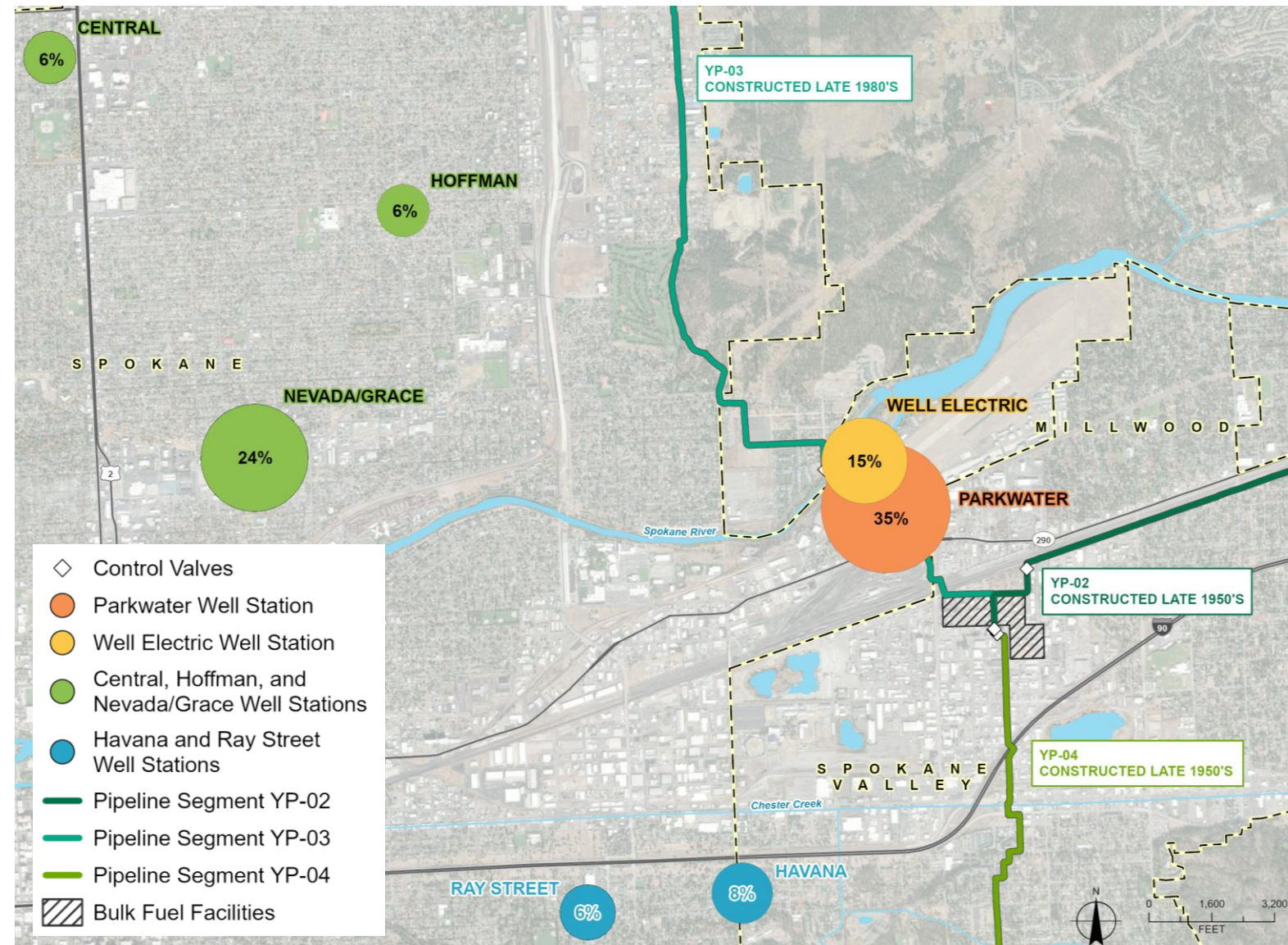
RCP = Representative Concentration Pathway for future global greenhouse gas emissions



Pumping Analysis: Non-Emergency Conditions (2072 Demands)

Distribution:

- 50% = Eastern Wells
- 14% = Southern Wells
- 36% = Western Wells

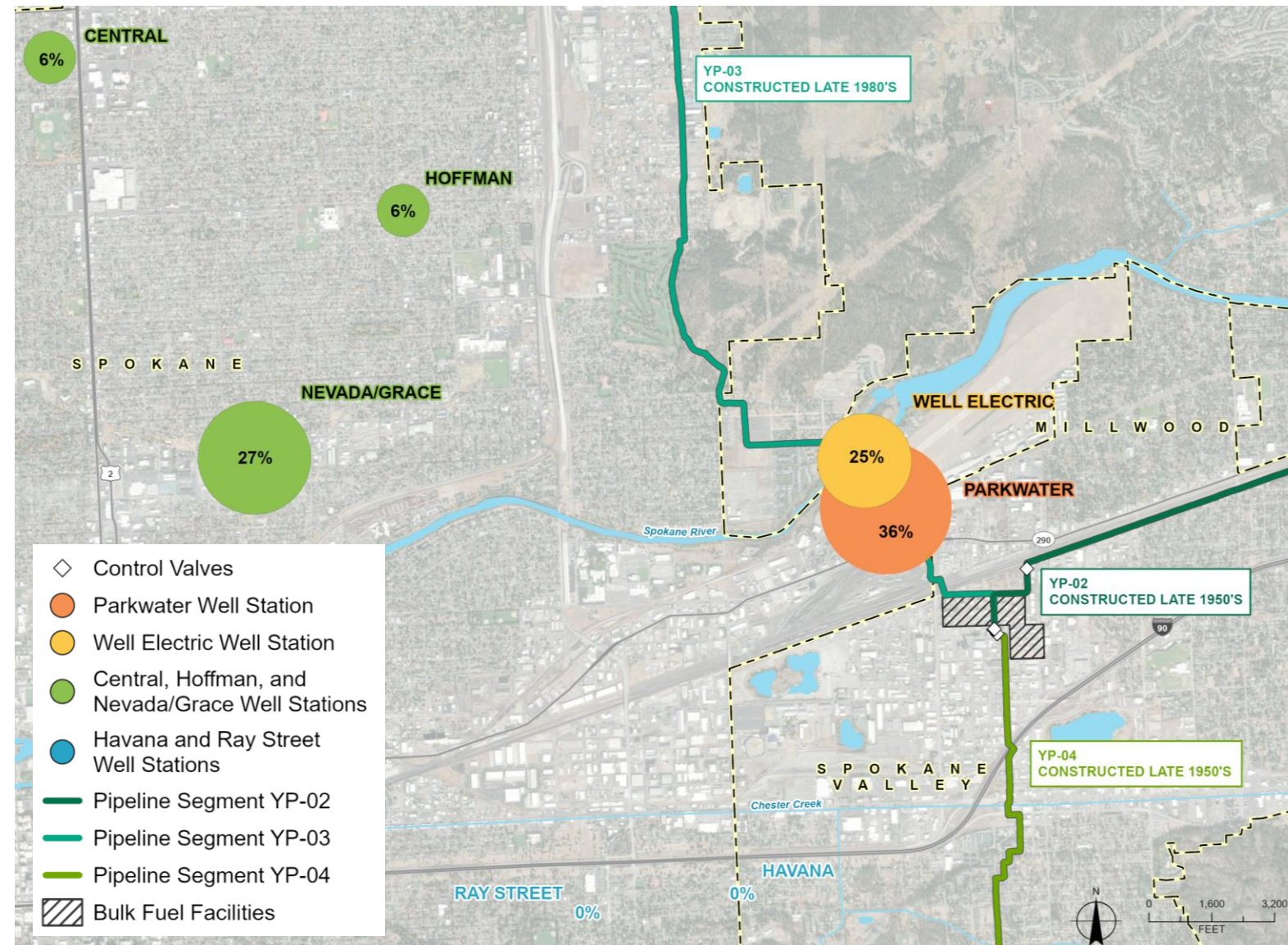




Pumping Analysis: Ray and Havana Offline

Distribution:

- 61% = Eastern Wells
- 0% = Southern Wells
- 39% = Western Wells

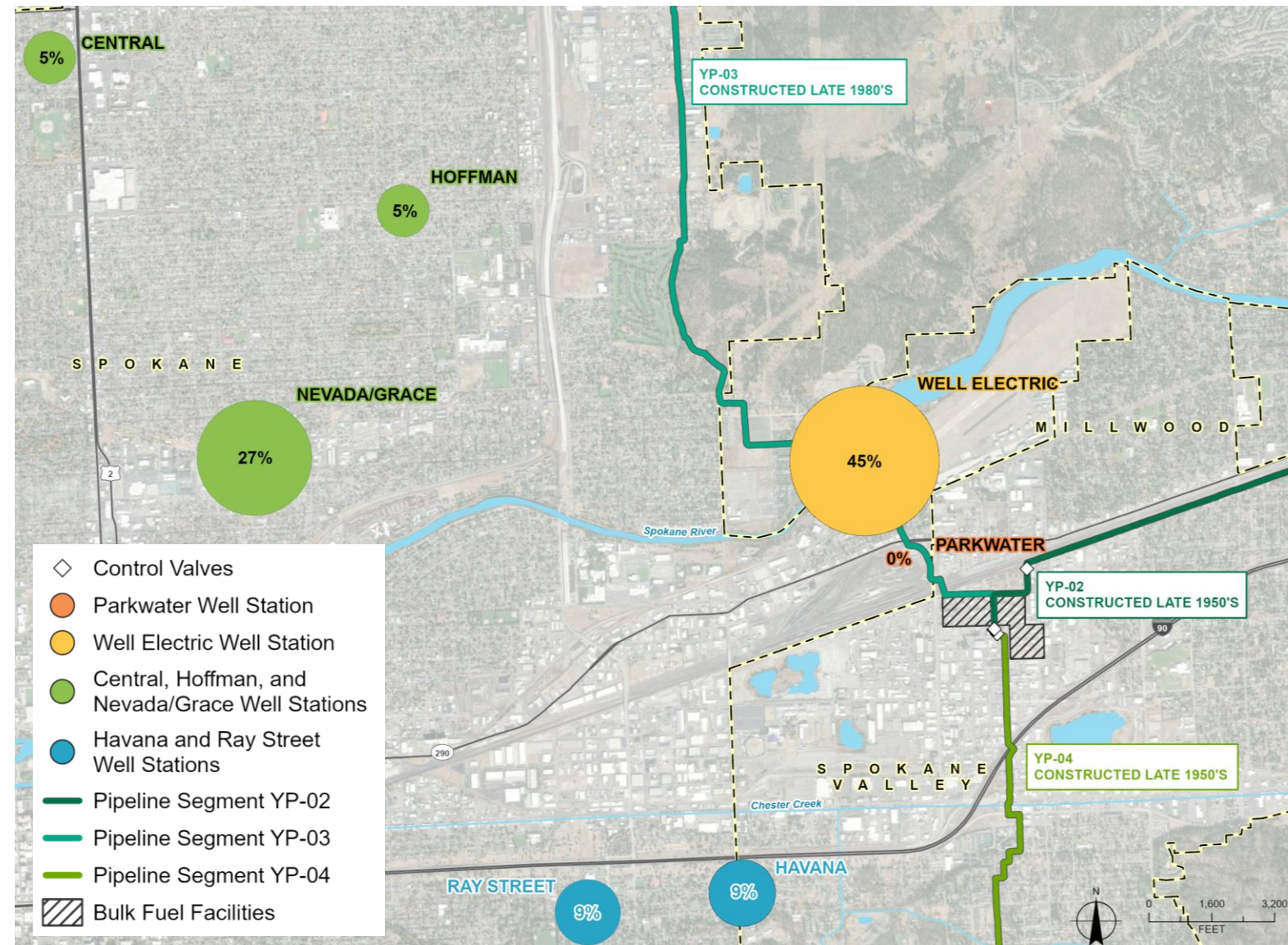




Pumping Analysis: Parkwater Offline

Distribution:

- 45% = Eastern Wells
- 18% = Southern Wells
- 37% = Western Wells

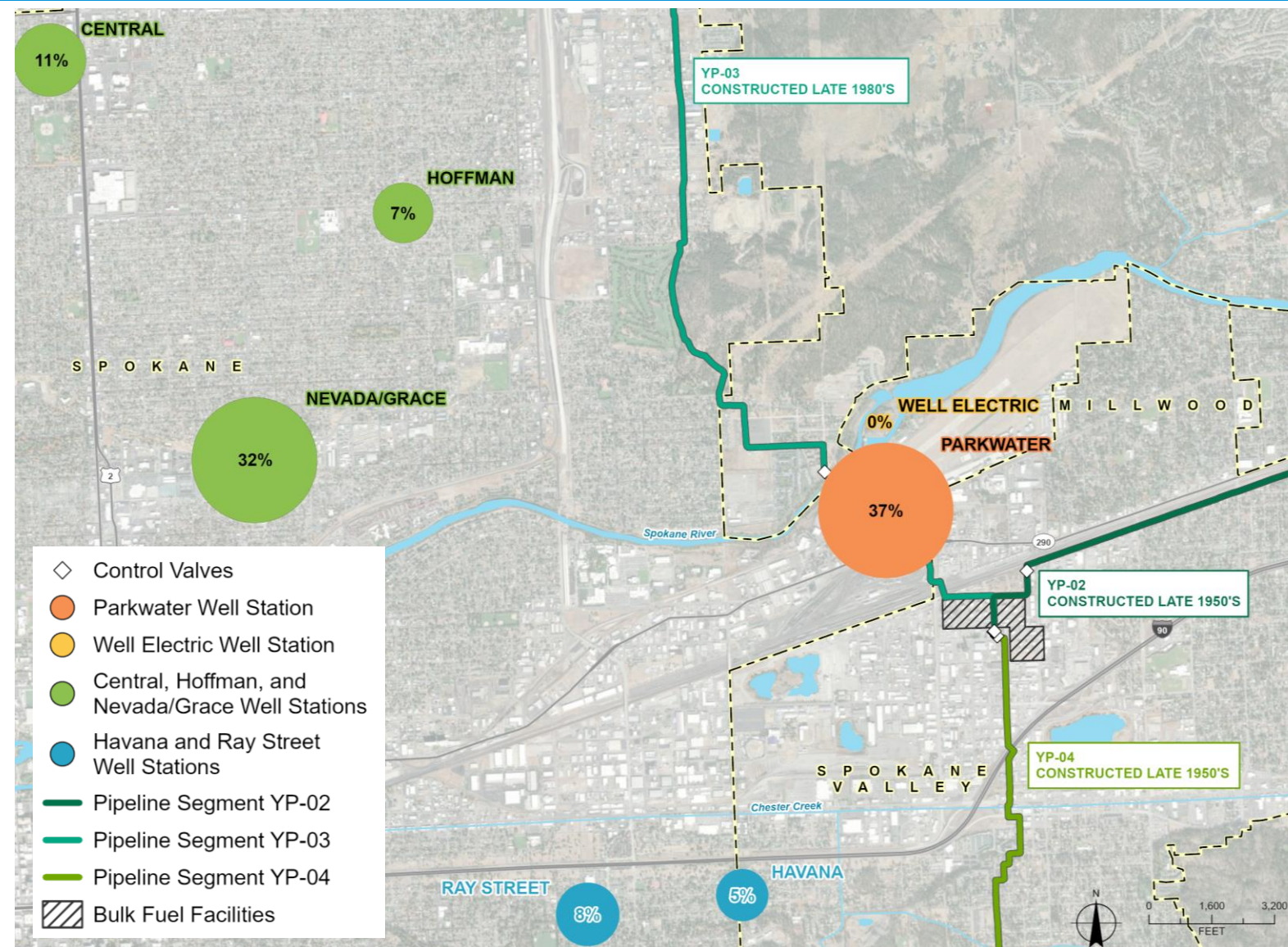




Pumping Analysis: Well Electric Offline

Distribution:

- 37% = Eastern Wells
- 13% = Southern Wells
- 50% = Western Wells

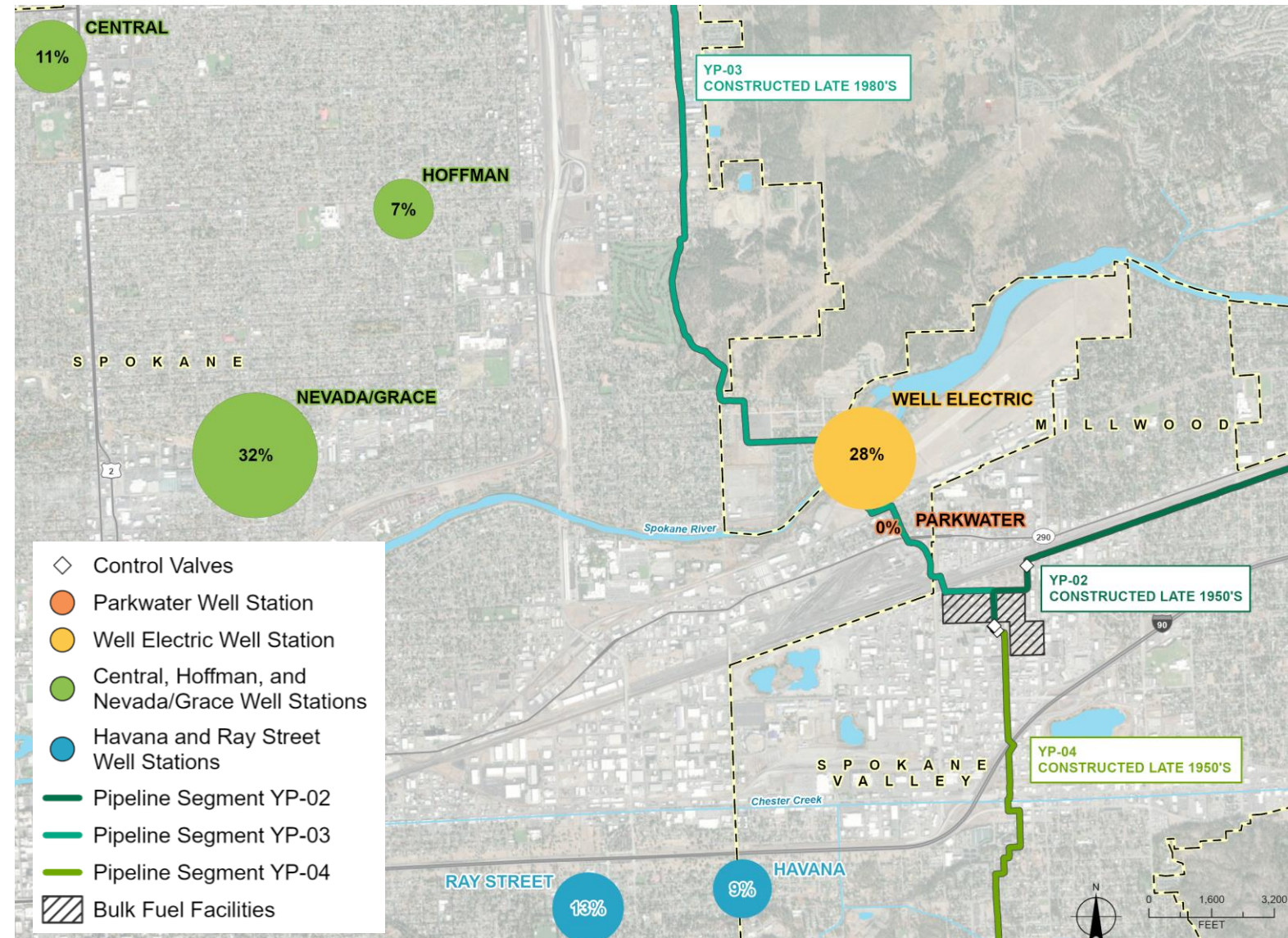




Pumping Analysis: Parkwater and Well Electric Offline

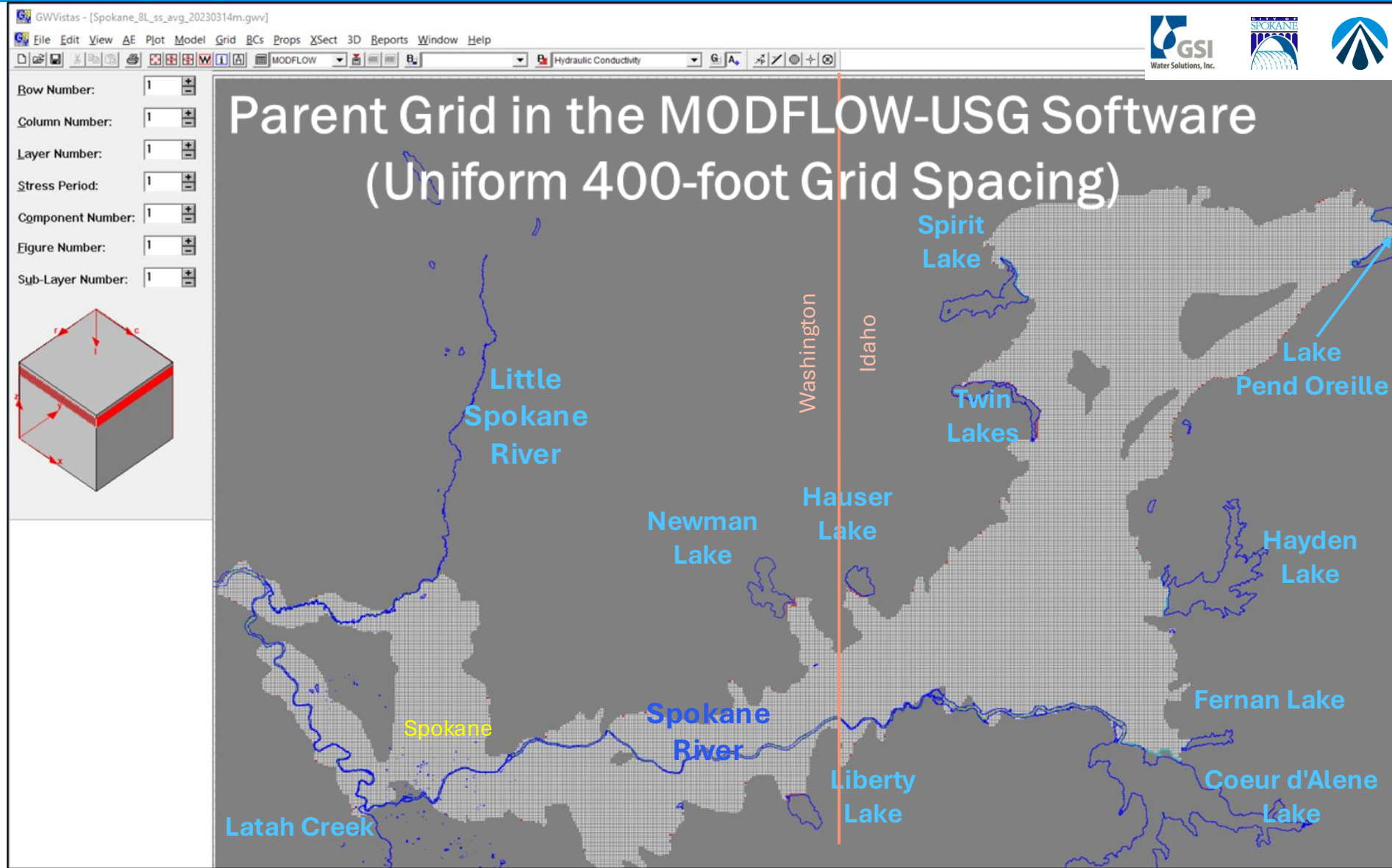
Distribution:

- 28% = Eastern Wells (Should Be Off!)
- 22% = Southern Wells
- 50% = Western Wells



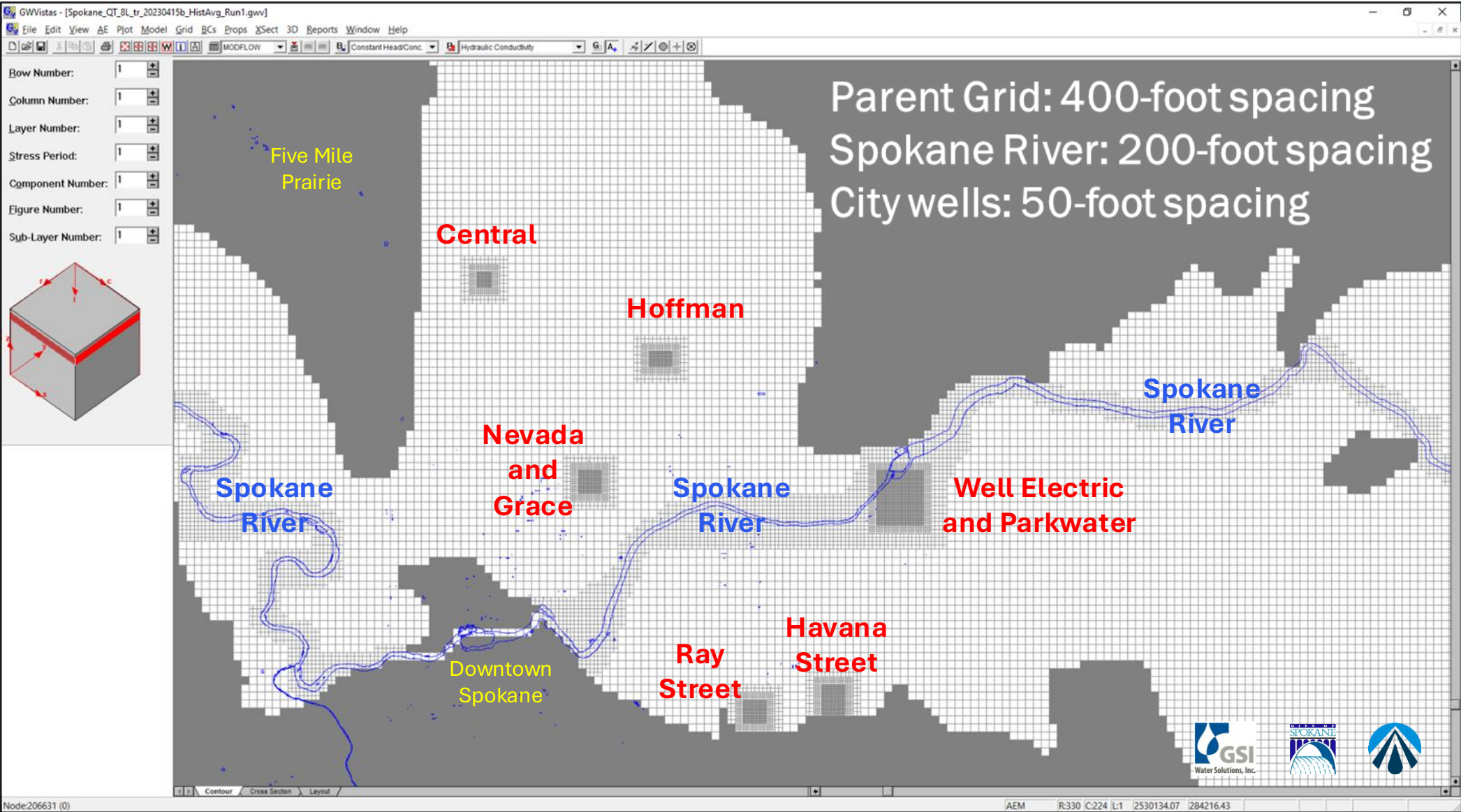


Regional Groundwater Model of the Spokane Valley-Rathdrum Prairie Aquifer System



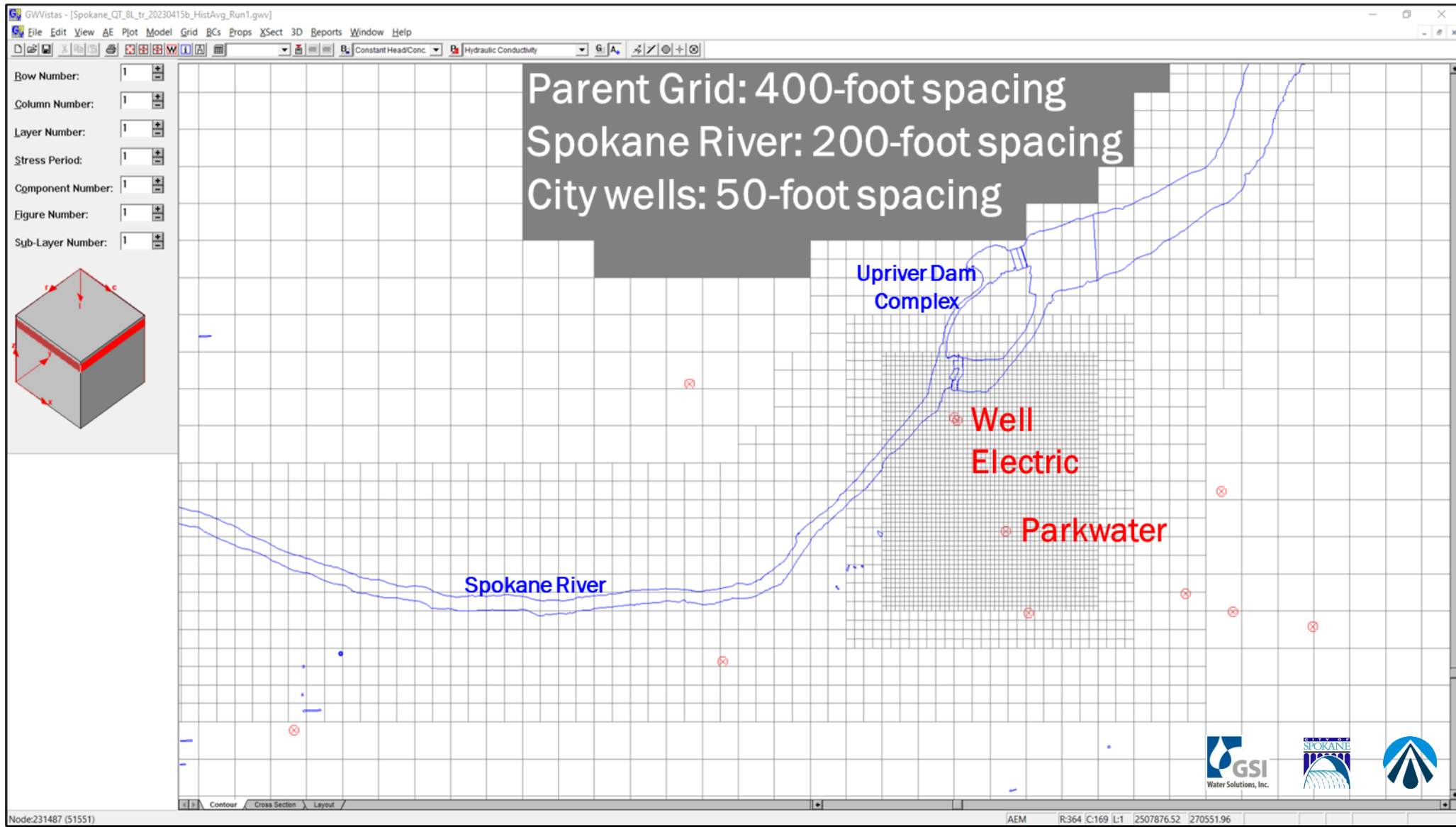


Groundwater Model Gridding for Enhanced Spatial Resolution



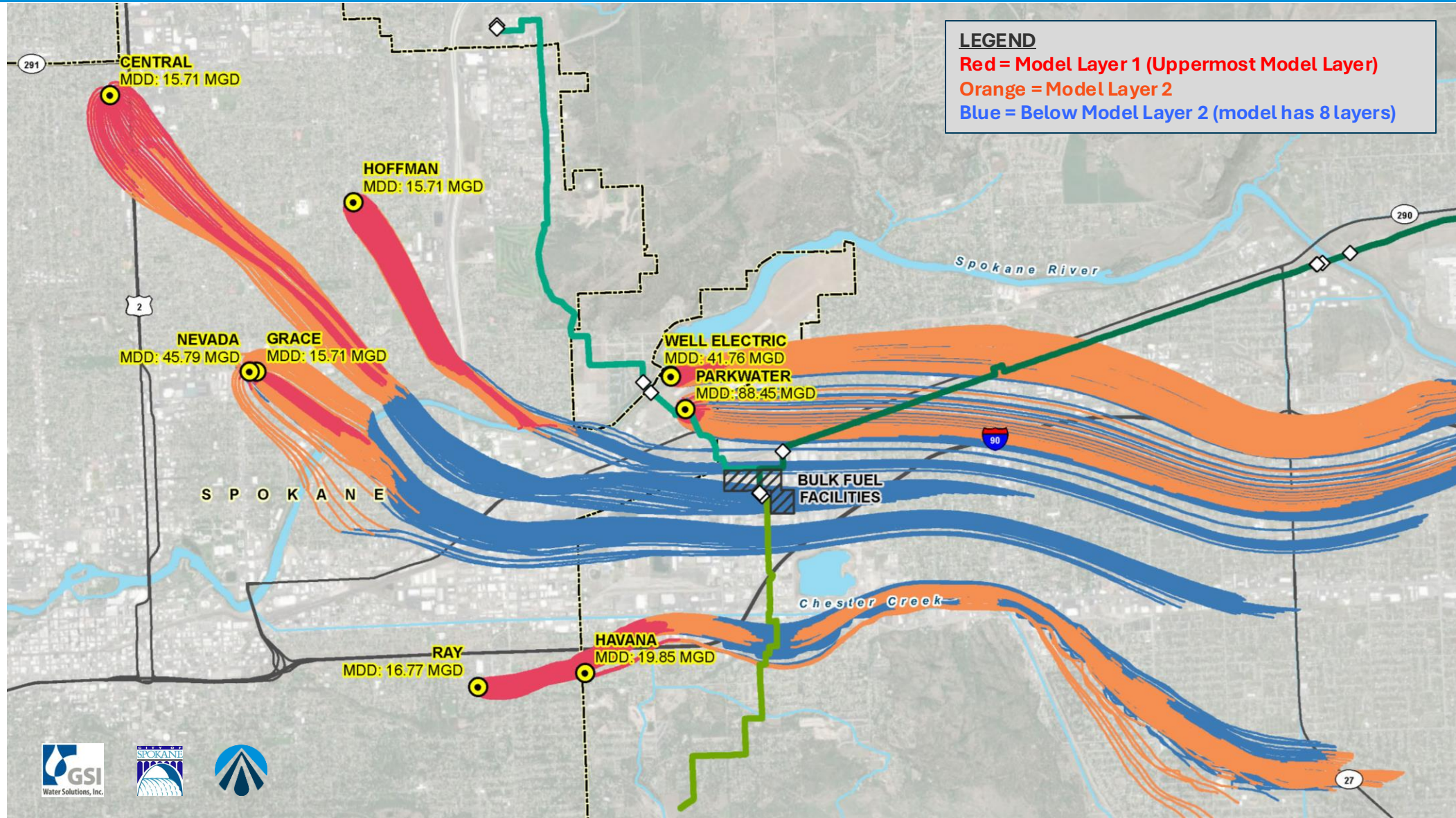


Groundwater Model Gridding for Enhanced Spatial Resolution



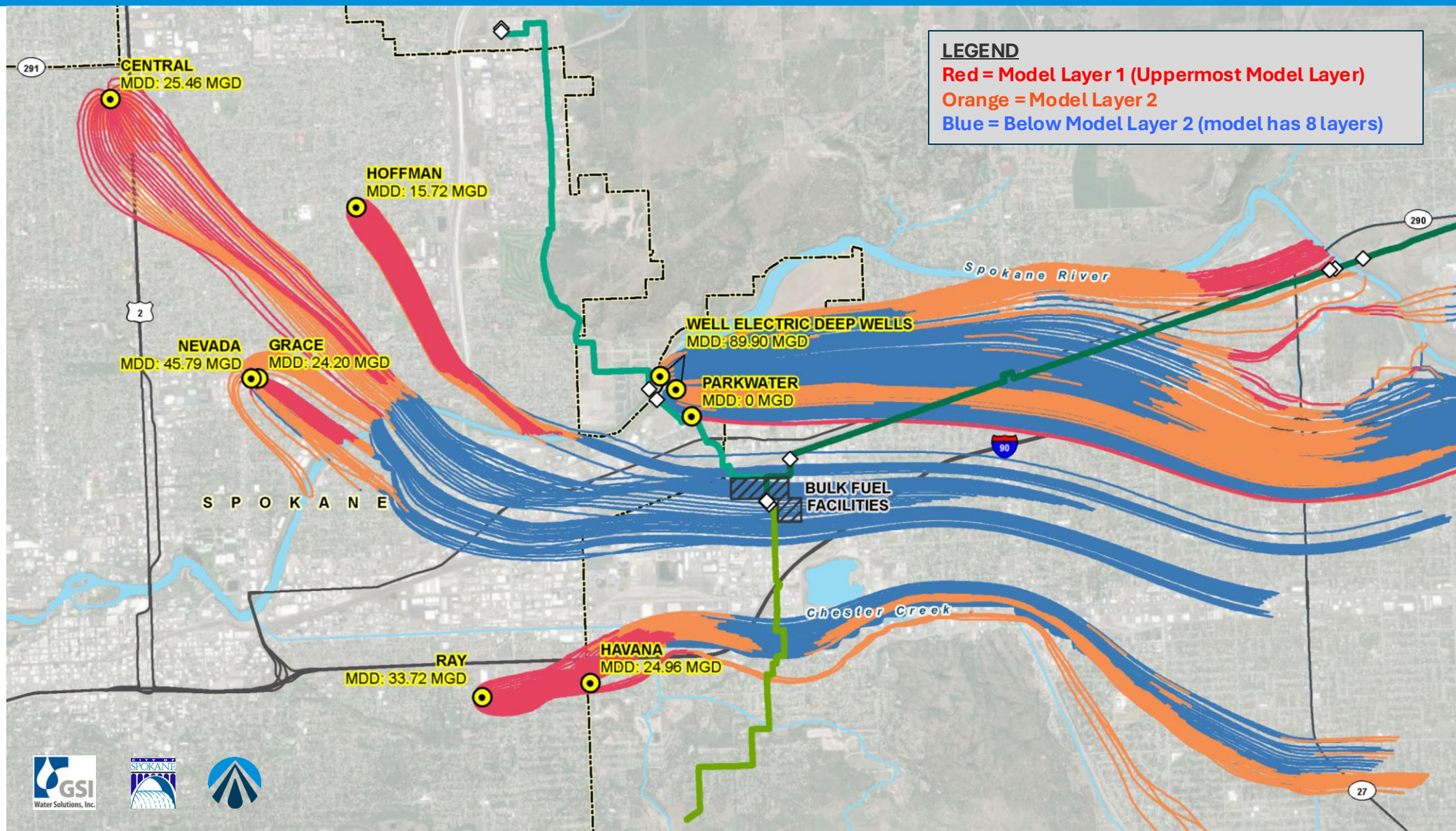


Capture Zones for City Wells Under Non-Emergency Conditions



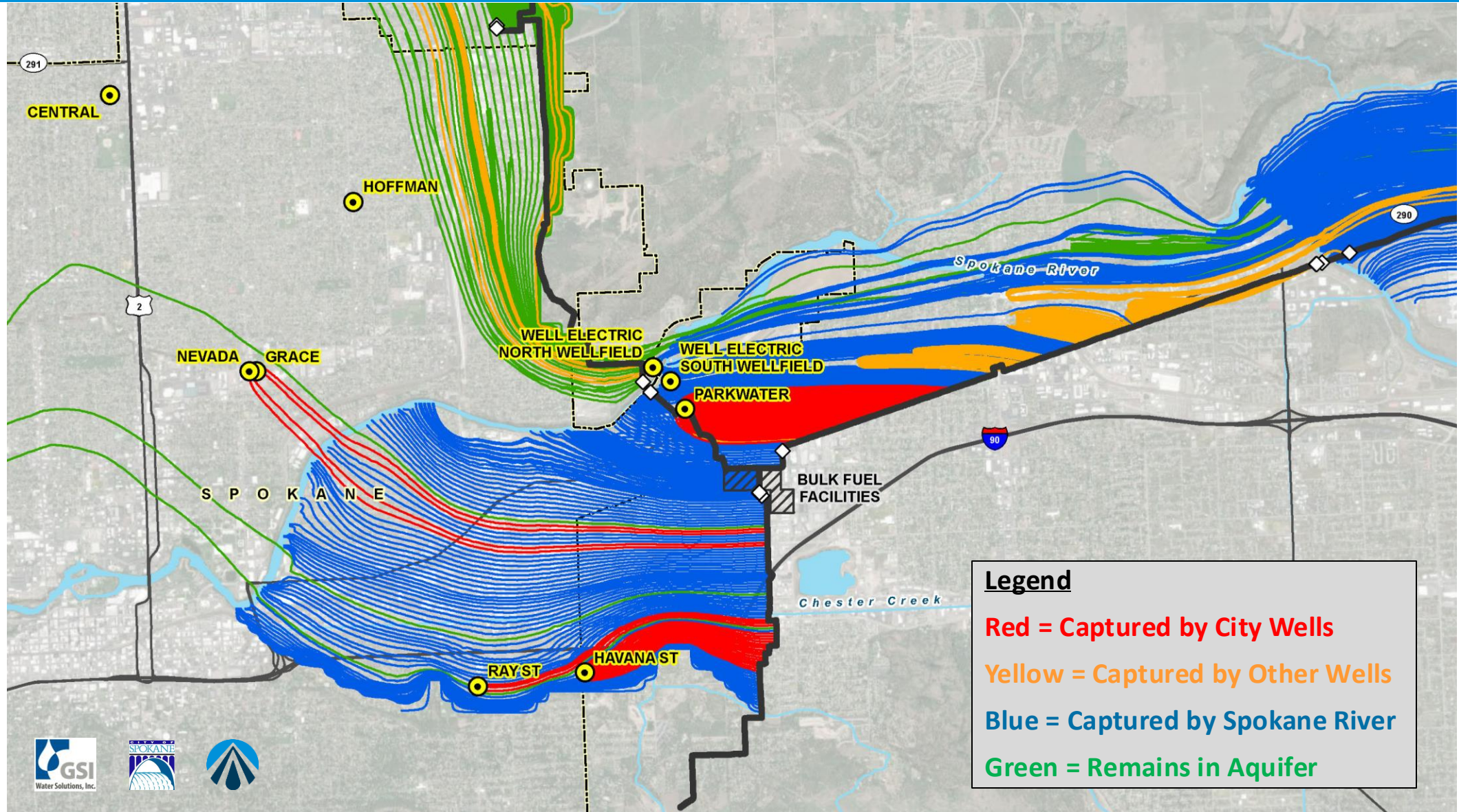


Capture Zones for City Wells (Parkwater and Well Electric Offline)





Modeled Flowpaths Emanating from Beneath the Pipeline





Model-Estimated Travel Times in Groundwater (From Pipeline to City Well Stations)

Parkwater
Critical Well

- **1 - 2 DAYS** (pipeline segment to south)
- 2.5 – 3 months (pipeline segment to east)

Well Electric
Critical Well

- 6 – 7 months

Havana St.

- 3 – 4 months

Ray St.

- 6 – 7 months

Nevada and
Grace

- 12 months

Central and
Hoffman

- 9 - 18 months



Distribution System Modeling

Analysis of impacts to City operations



Distribution System Contamination Response Plan

The City's plan to mitigate risk

Elisheva Walters, P.E.

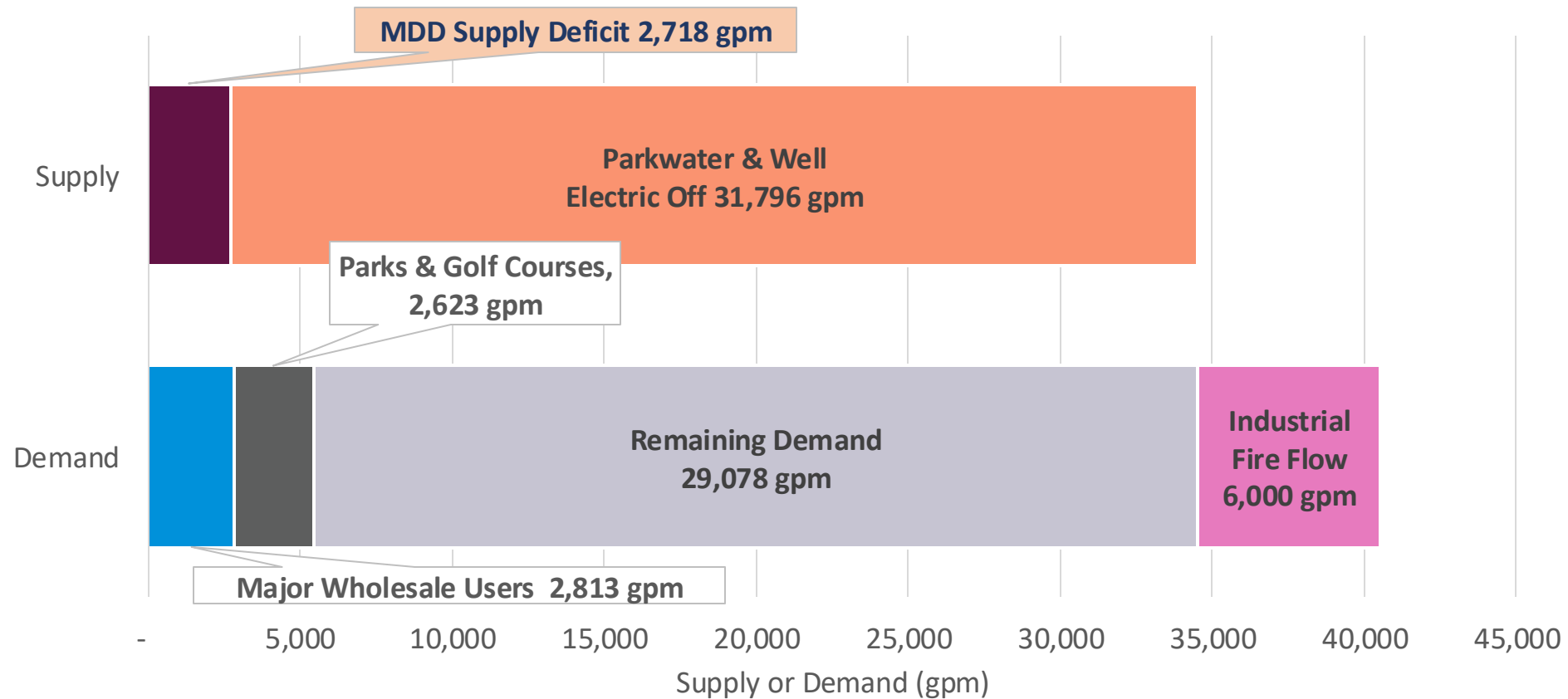
Conсор Distribution
System Modeler





Distribution Analysis: Mass Balance by Primary Pressure Zone

Low Primary Pressure Zone Mass Balance (Existing MDD)



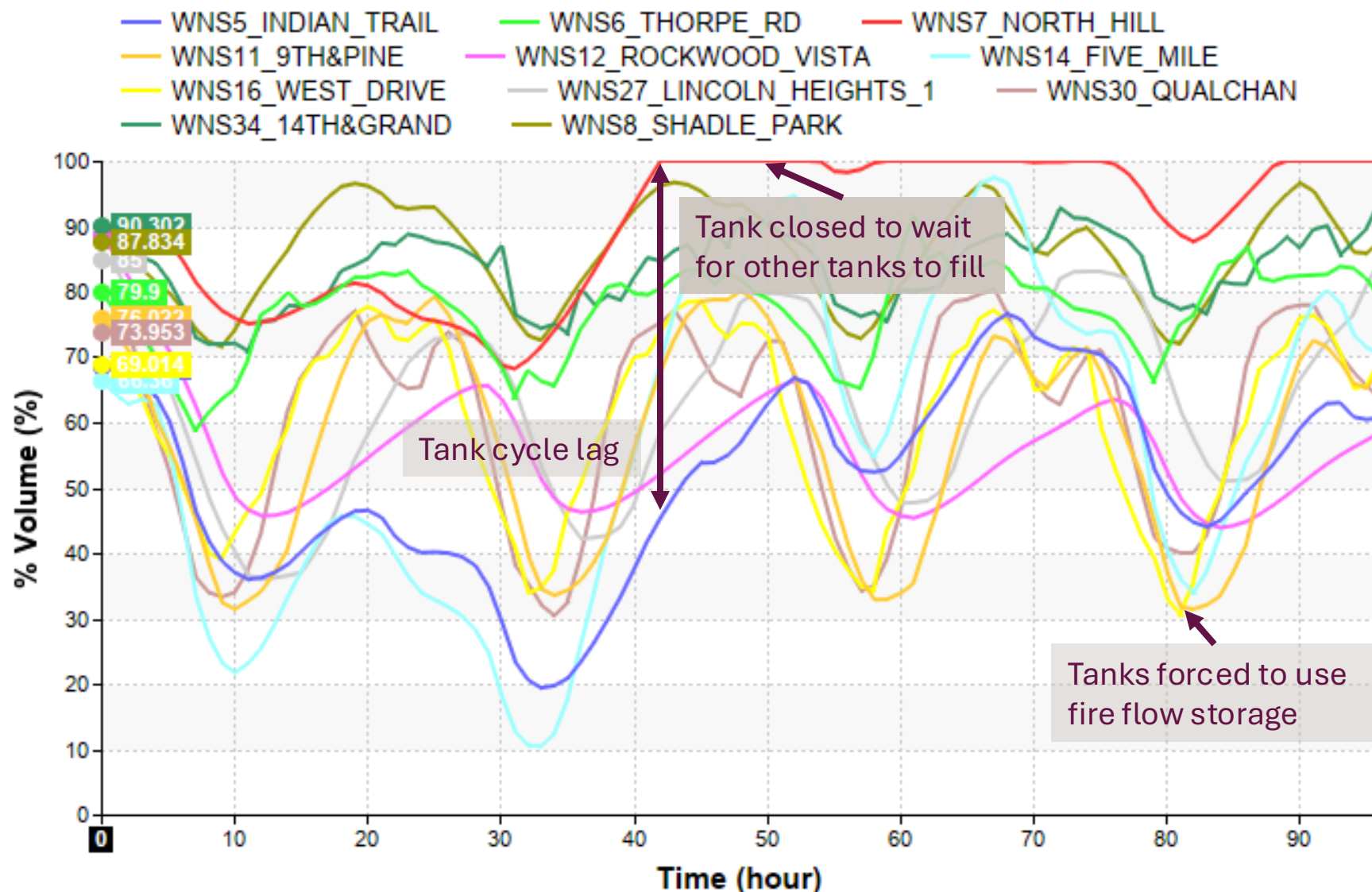


Distribution Analysis: Tank Vulnerability Assessment





Distribution Analysis: Tank Vulnerability Assessment



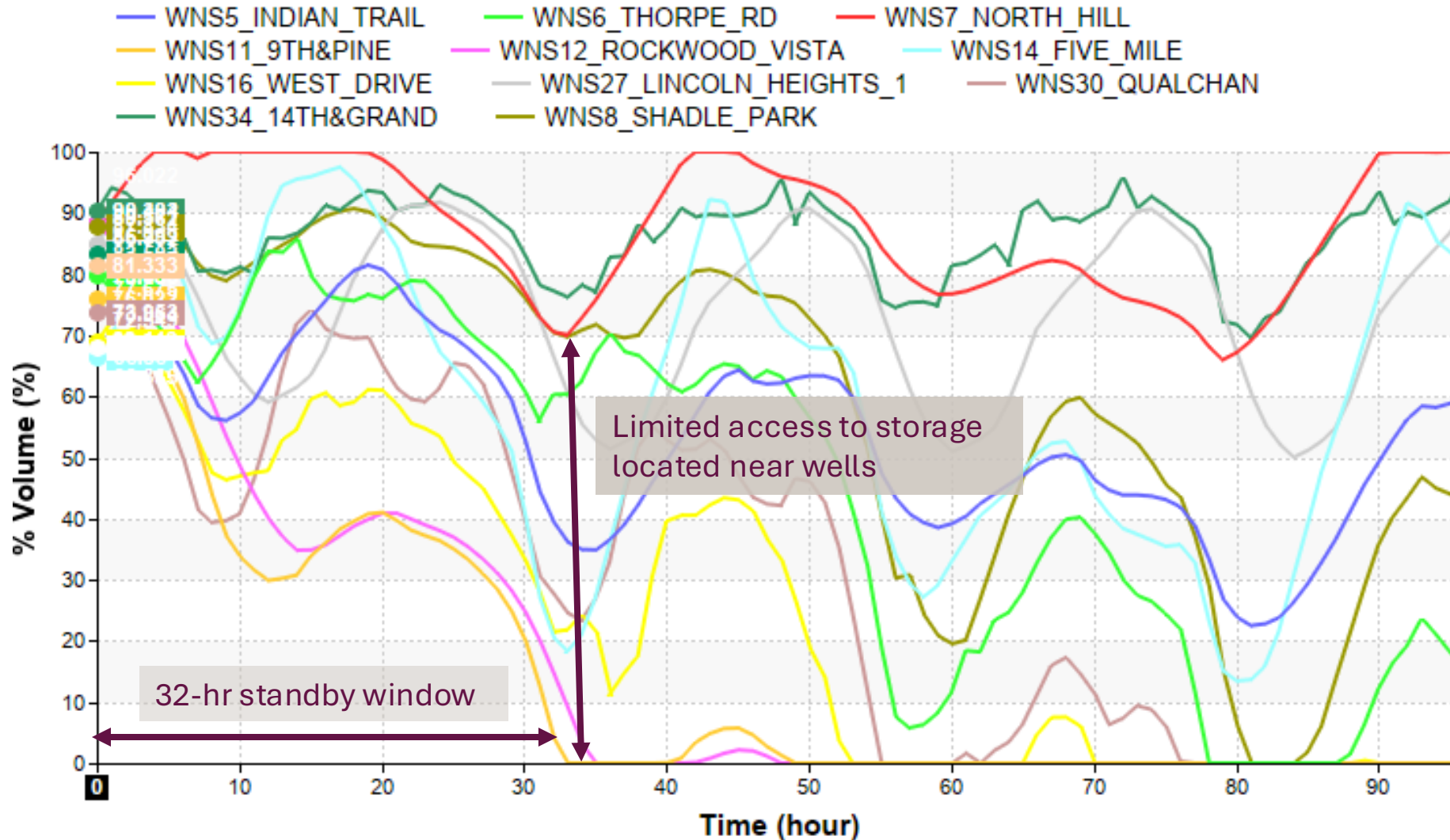
Existing MDD EPS

Well Electric Wells Offline:
Primary Zone Tanks

****Adequate Supply****



Distribution Analysis: Tank Vulnerability Assessment



Existing MDD EPS

Parkwater and Well
Electric Wells Offline:
Primary Zone Tanks

****Supply Deficiency****



EPA's Contamination Incident Response Guidance

Distribution System Contamination Response Plan:

Investigation Activities

Compiled Information

- Yellowstone Pipeline
- Communication information
- Health risks
- Pipeline products characterization
- High-risk wells



Response Activities

Evaluated Options

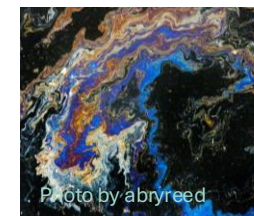
- Operational response
- Quantify demand curtailment
- Groundwater monitoring concept



Remediation and Recovery Activities

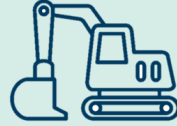
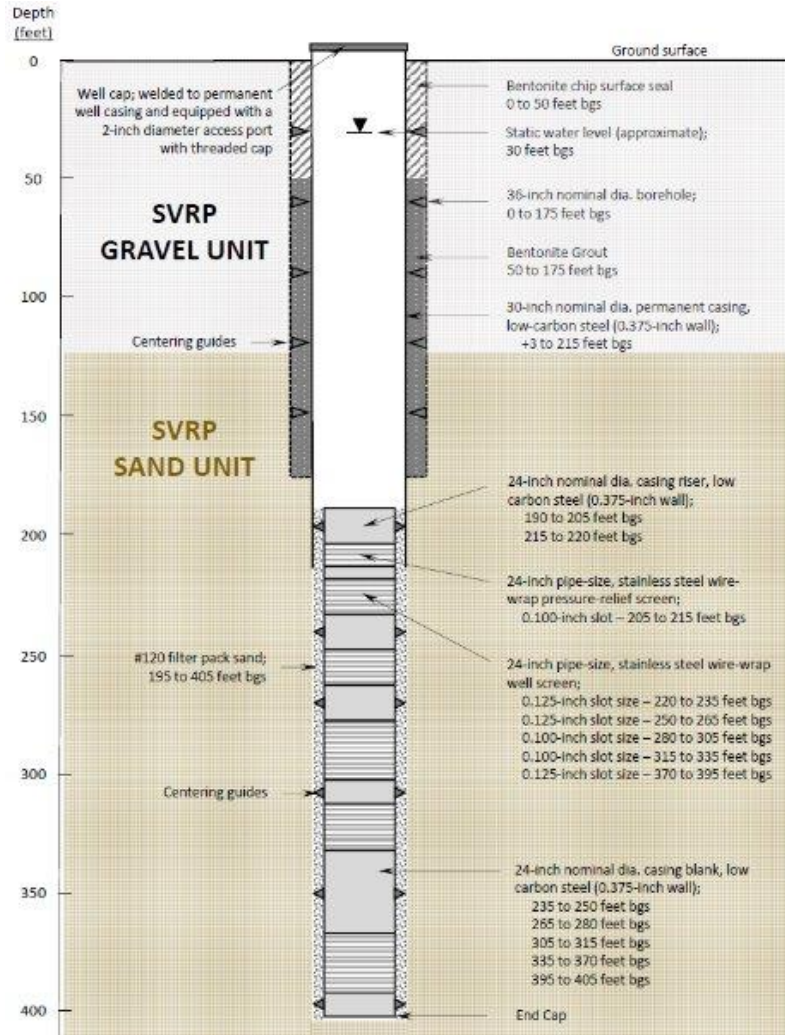
Engagement

- Coordination with Phillips 66 on risks to City/aquifer
- Summarize Phillips 66 standard responses





Project Conclusions and Next Steps



Infrastructure Improvements

- Deeper Well Electric boreholes
- Flexibility to direct supply between zones
- Transmission improvements
- Well station retrofits to leverage full capacities
- Buildout of designed Havana Well Station



Operations

- Estimated demand curtailment
- Basis for coordination with Parks irrigation
- Options for supply redistribution
- Understanding of reservoir empty vulnerability



Communication & Planning

- Coordination with Yellowstone Pipeline Co ERP
- Development of operational response decision tree

Thank You!

Link to Project Report:

“City of Spokane Well Station Vulnerability
to Potential Chemical Releases from the
Yellowstone Petroleum Pipeline”



Q&A

Additional questions for our presenters?

Elisheva Walters, Consor:
elisheva.walters@consoreng.com

Jim Sakamoto, City of Spokane:
jsakamoto@spokanecity.org

John Porcello, GSI Water Solutions:
jporcello@gsiws.com



Additional Info: Distribution Analysis Summary

 Parkwater Wells Offline	 Well Electric Havana Ray Nevada Grace Hoffman Central	19% Intermediate Zone Supply Lost 63% Low Zone Supply Lost	Tanks Affected: Qualchan	No MDD deficiency	-
 Well Electric Wells Offline	 Parkwater Havana Ray Nevada Grace Hoffman Central	19% Intermediate Zone Supply Lost 15% Low Zone Supply Lost 39% North Hill Zone Supply Lost	Tanks Affected: Qualchan 9th & Pine Thorpe Rd Five Mile Indian Trail	No MDD deficiency	Low primary zone further impacted via to booster stations and Northwest Terrace PRV
 Havana and Ray Wells Offline	 Well Electric Parkwater Nevada Grace Hoffman Central	63% Intermediate Zone Supply Lost	Tanks Affected: Qualchan 9th & Pine 14th & Grand Rockwood Vista Shadle Park West Drive Lincoln Heights	Intermediate MDD deficiency	Low primary zone impacted via booster stations and Northwest Terrace PRV
 Parkwater and Well Electric Wells Offline	 Havana Ray Nevada Grace Hoffman Central	38% Intermediate Zone Supply Lost 77% Low Zone Supply Lost 39% North Hill Zone Supply Lost	Low primary zone tanks begin to drain completely at 32 hours.	Low MDD deficiency	Low primary zone deficiency worsens due to booster stations and Northwest Terrace PRV