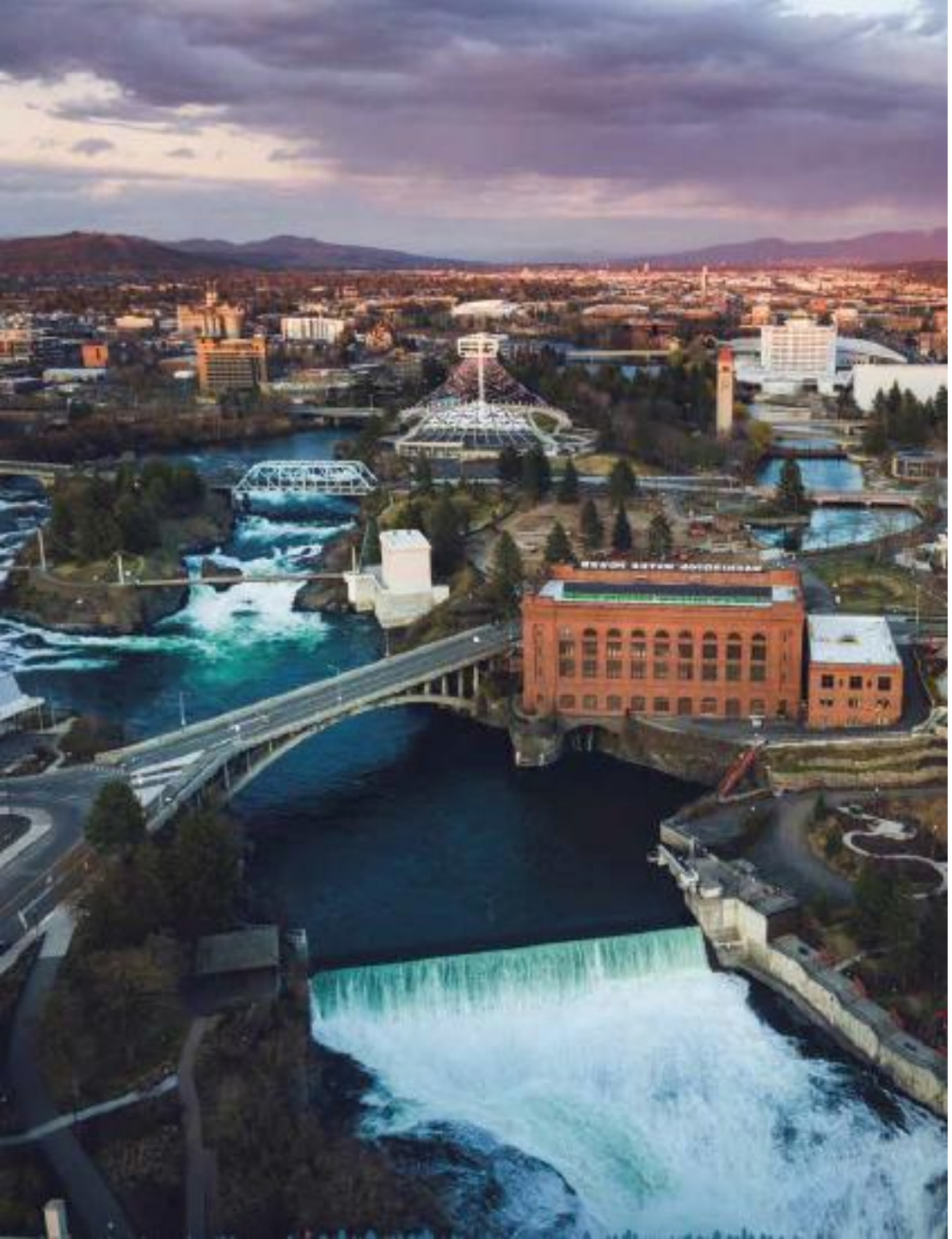


Climate-Based Modeling and Prioritization for Capital Planning:
A Spokane Case Study

Prepared by:

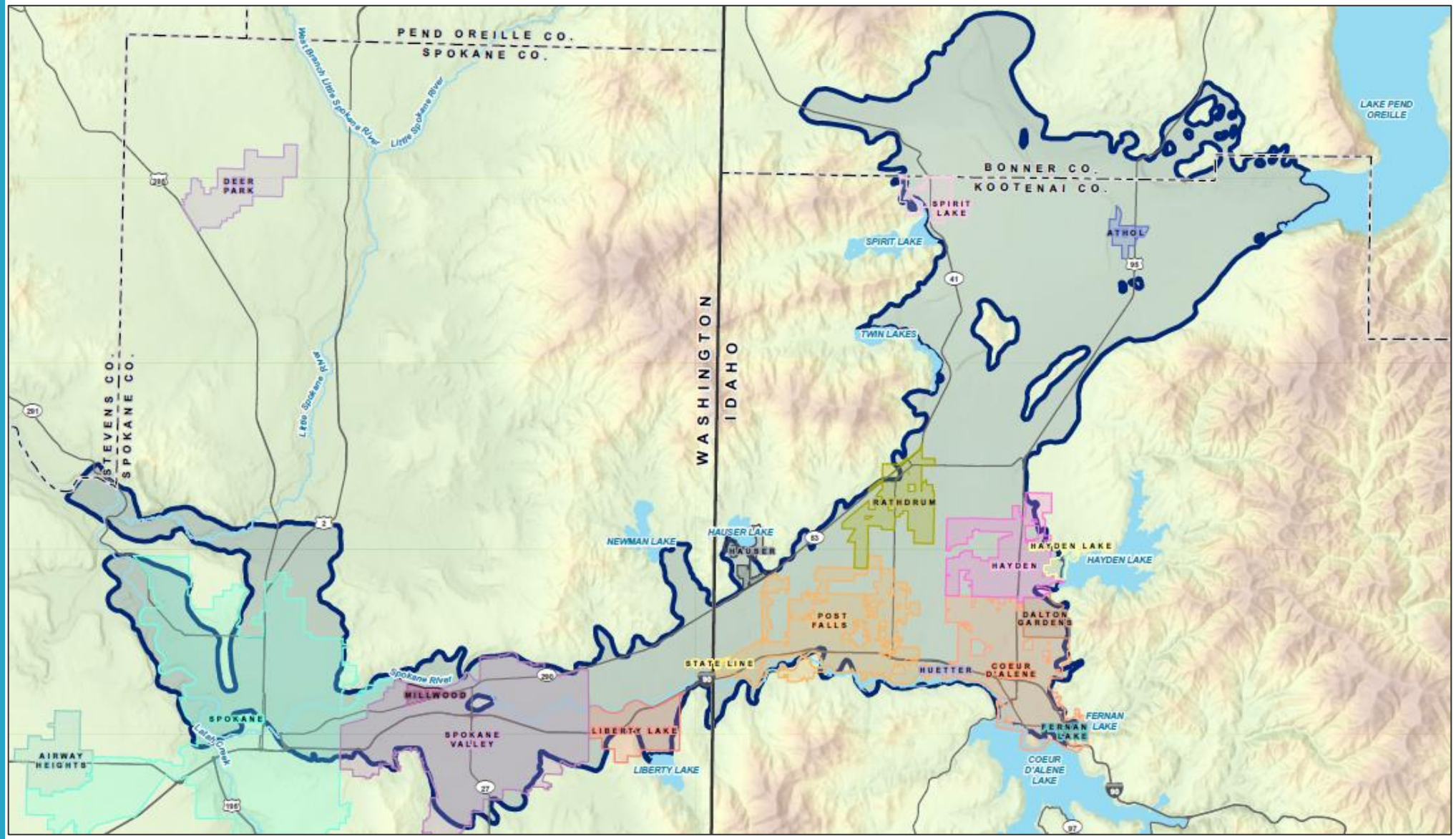
Beryl Fredrickson, PE (City of Spokane)
John Porcello, LHG (GSI Water Solutions)

Friday May 8, 2026

Prepared for the
American Water Works Association
Pacific Northwest Section Conference
Tacoma, Washington

The Spokane Valley – Rathdrum Prairie Aquifer System

An EPA-Designated Sole-Source Aquifer



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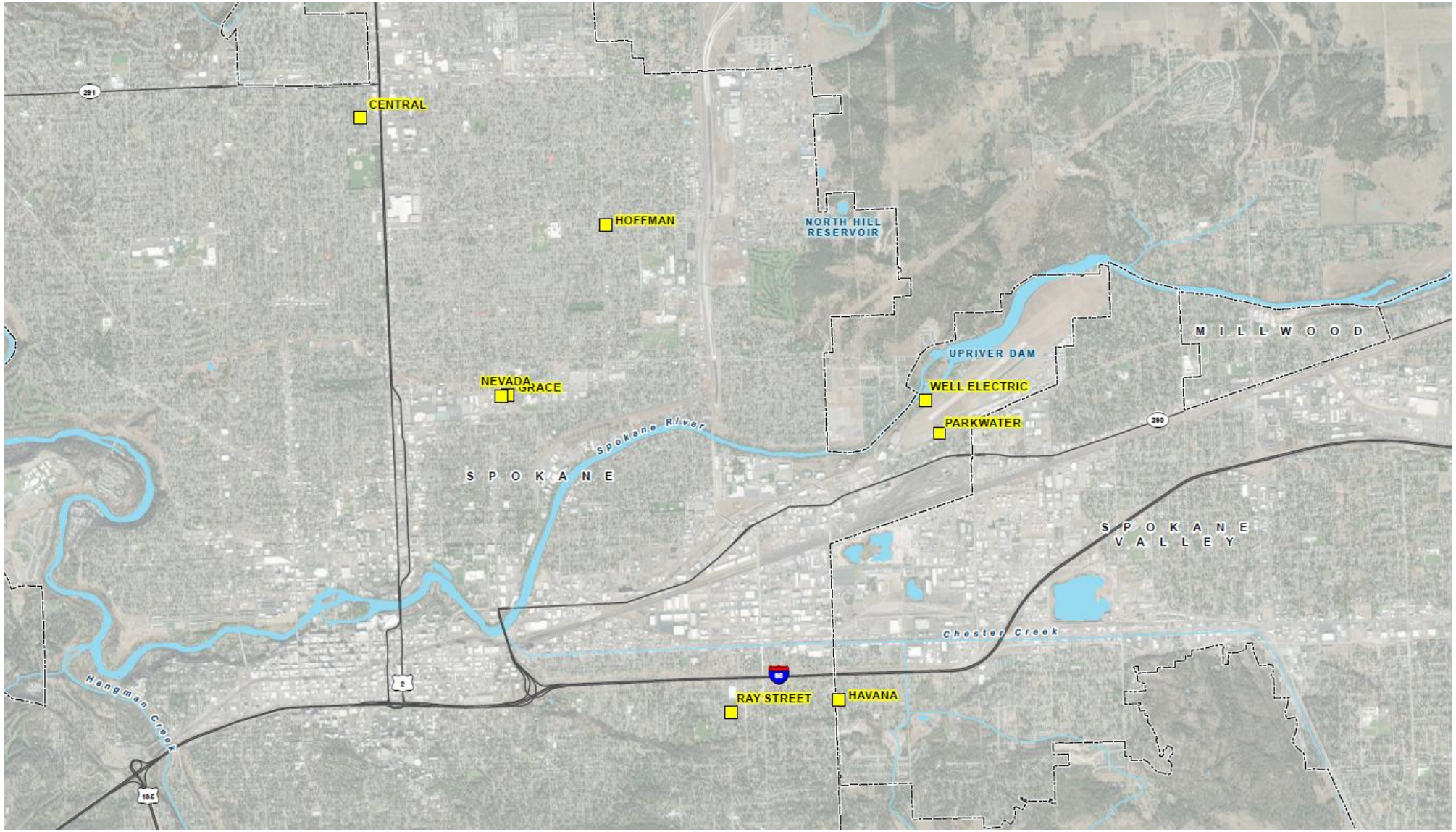
The City's 8 Well Stations

7 Have Large-Diameter Caisson Wells

1 is a Traditional Wellfield (Havana)

7 Well Stations Constructed 1910-1959

1 New Havana Well Station (2025)



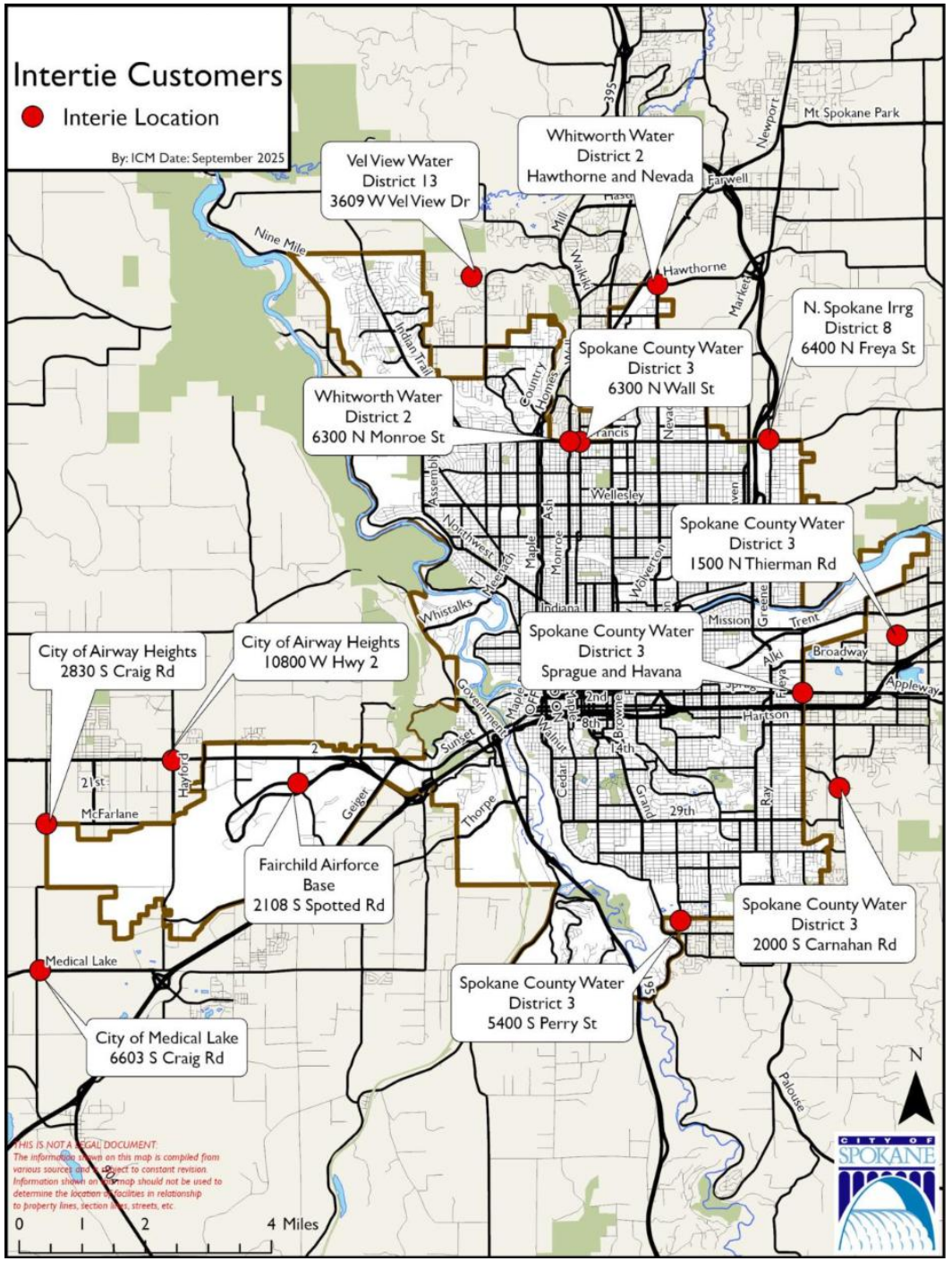
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Regional Water Purveyor

7 Intertie Customers

Adjacent Water System	Type of Service
City of Airway Heights	Wholesale supply
City of Medical Lake	Supplemental supply
Fairchild Air Force Base	Emergency
North Spokane District No. 8	Emergency
Spokane County Water 3	Supplemental supply and emergency
Vel View Water District #13	Supplemental supply
Whitworth Water Irrigation District 2	Emergency



Spokane's Planning History

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. Some of the cast iron water mains constructed for this system continue to be used today.

1884 — The pumping plant was relocated and a second pump was added to serve Spokane's growth.



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.

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.



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.



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.



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.



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.



1937 — Ray Street Well Station was 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.



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.

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.



1950 — Grace Well Station constructed. This well station houses one 18-foot diameter caisson well with two 900-horsepower pumps.



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.



1959 — Central Well Station constructed. This well station has two 7-foot diameter caisson wells with two 450-horsepower submersible pumps in each well.



1967 — The City's Water Department began serving water to customers outside city limits.



1971 — Water Resources Act – mandates sufficient clean water is provided for the residential population as well as commercial and industrial needs.



1972 — Clean Water Act – National Pollutant Discharge Elimination System(NPDES)-Permits required by water quality standards.



1974 — Safe Drinking Water Act – Authorizes the Environmental Protection Agency to establish minimum standards to protect tap water and requires all purveyors of public water systems to comply with these primary health standards.

1977 — Public Water System Coordination Act Creates water system performance standards and coordinated planning along with state financial assistance. Provides utilities with the assurance that planning, capital improvement programs, and financial commitments are consistent with State requirements.



1978 — EPA designates Spokane Valley-Rathdrum Prairie Aquifer a Sole Source Aquifer under the Safe Drinking water Act.



1979 — Spokane County's Water Quality Management Program – A Technical Advisory Committee and a Citizen Representatives Core Committee developed the Spokane-Rathdrum Aquifer Water Quality Management Plan to protect the sole source aquifer.



1990 — Growth Management Act – 36.70a RCW



2020 — The Water Conservation Master Plan provides a variety of water conservation activities to meet the goals, targets, strategies, and actions to conserve our water supply and to sustainably manage it for future generations.

2024 — Havana Well Station construction completed and begins to supply water. This well station will provide resiliency for the Intermediate Pressure Zone and to accommodate growth.



Drought Conditions Across Washington State

Dept of Ecology's Website

Prior to the current legislative framework:

1977 – Statewide (Governor convened "Ad Hoc Executive Water Emergency Committee" Feb. 16, 1977 -- pre current drought framework)

1988 – Statewide (Very dry 1987 resulted in legislation enacting current drought framework- RCW 43.83B)

Following years were based on current drought framework from 1989 (RCW 43.83B.405 and WAC 173-166-050):

1992 – Yakima Basin

1994 – Yakima Basin

2001 – Statewide

2005 – Statewide

2006 – Lyre-Hoko

2015 – Statewide

2019 – 27 Watersheds, including the Yakima, but excluding SE Washington and Puget Sound region

2021 – Statewide, except for central Puget Sound (Green, Cedar, Snohomish WRIAs)

2022 – Partial extension of 2021 declaration for a few watersheds in eastern WA, with the remainder of eastern Washington being put in Drought Advisory status. (Ecology pulled back the declaration in July after extending it in late May).

2023 – 12 watersheds/12 counties in the emergency drought declaration with a statewide advisory.

2024 – Statewide declaration, except for the areas served by the utilities of Everett, Seattle, and Tacoma.

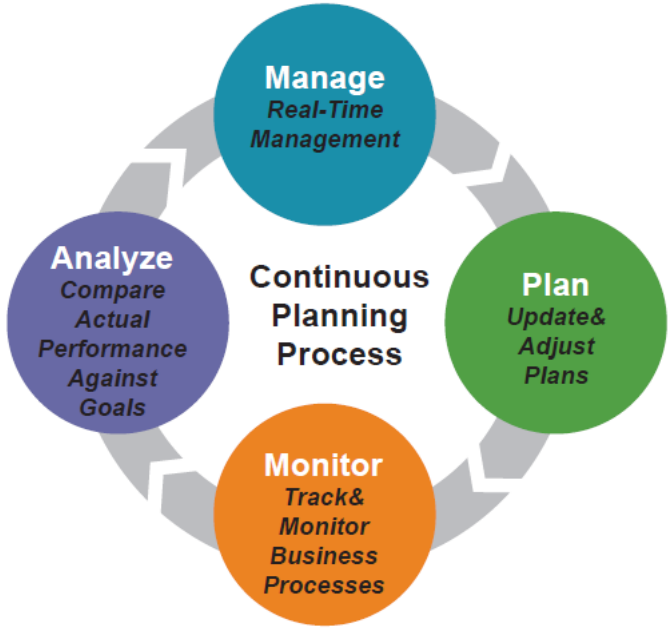
2025 – 22 watersheds, except for the areas served by the utilities of Everett, Seattle, and Tacoma.

2026 – 4th Statewide drought

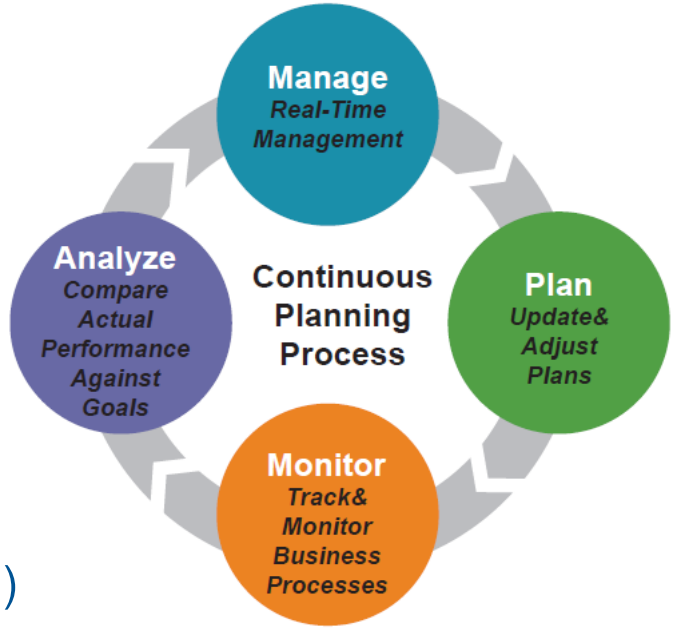
Recent Planning

Recently Completed

- 1999 Coordinated Water System Plan – County Delineated Service Areas
- 2014 Water Rights Change Application
- 2014 New Point of Use for Havana Well Station Water Rights Change Application
- 2015 Found Contamination at Cora New Well Site
- 2016 Water System Plan – 20 Year Infrastructure Requirements (Spokane)
- 2017 Comprehensive Plan – Future Vision
- 2017 Airway Heights Found Extreme PFAS Contamination in Drinking Water
- 2017 Havana Street Well Site Evaluation and Test Well Development (GSI, Landau Associates, and Consor)
- 2019 Ray Well Assessment (GSI)
- 2019 Well Electric Well Assessment (GSI)
- 2019 Hoffman Well Assessment (GSI)
- 2020 Groundwater Supply Evaluation (GSI & Consor)
- 2020-2025 Subarea Analysis in Northwest, Grandview/Thorpe Area, Supply for FAFB and Airway Heights (Spokane)
- 2021 Future Water Demand Projections (HDR)
- 2022-2025 Link Strategies – Multi-Objective Decision Analysis (GHD)
- 2023 Utility Rate Increase and General Facility Charge Rate Increase
- 2023 Fluoridization Implementation Study (Consor)
- 2023 Sodium Hypochlorite On-Site Generation Feasibility Technical Memorandum (Consor)
- 2023 Water System Plan – 20 Year Infrastructure Requirements (Spokane)
- 2024 Well Station Vulnerability to Potential Chemical Releases from the Yellowstone Petroleum Pipeline (GSI)
- 2024 Development of Monthly Distributions for Groundwater Pumping at City of Spokane Well Stations Under Future Water Demand Scenarios (GSI)
- *2024 Groundwater Modeling Study of Potential Changes to Water Levels in City of Spokane Well Stations Arising from Increased Water Demands and Climate Change Influences on the Regional Aquifer System (GSI)*
- 2024 Havana Well Construction Begins
- 2025 City of Spokane Water System Optimization and Water Conservation Analysis (GHD & Jacobs)



Recent Planning



In Progress

- Started in 2022 City Utility Rate/Financial Portfolio (FCS)
- Capital Facility Plan (Spokane)
- Nevada and Grace Well Concept Plans (GSI)
- Wellfield Feasibility Study for the Well Electric Well Station (GSI)
- Well Electric Well Concept Plans (GSI and Consor)
- Comprehensive Plan – PlanSpokane2046 (Spokane and Berk)

Future Study

- Parkwater Well Assessment
- Continuous questions around intertie supply capacity and required infrastructure
- Water Model Calibration
- Water Resource Planning
- Continue FCS updates to financial portfolios

Considerations for Providing Future Water Demands

The City's wells are aging and require replacement gradually over decades. Strategic investment along with future conditions should be considered.

Can the City meet its future pumping needs?

1. Future groundwater levels could be lower due to:
   - Increasing water demands inside and outside the City's service area
   - Regional-scale climate influences on the aquifer system
2. Limited well caisson penetration into the water table
3. Certain wells are critical to meet current and future forecasted demands in each pressure zone

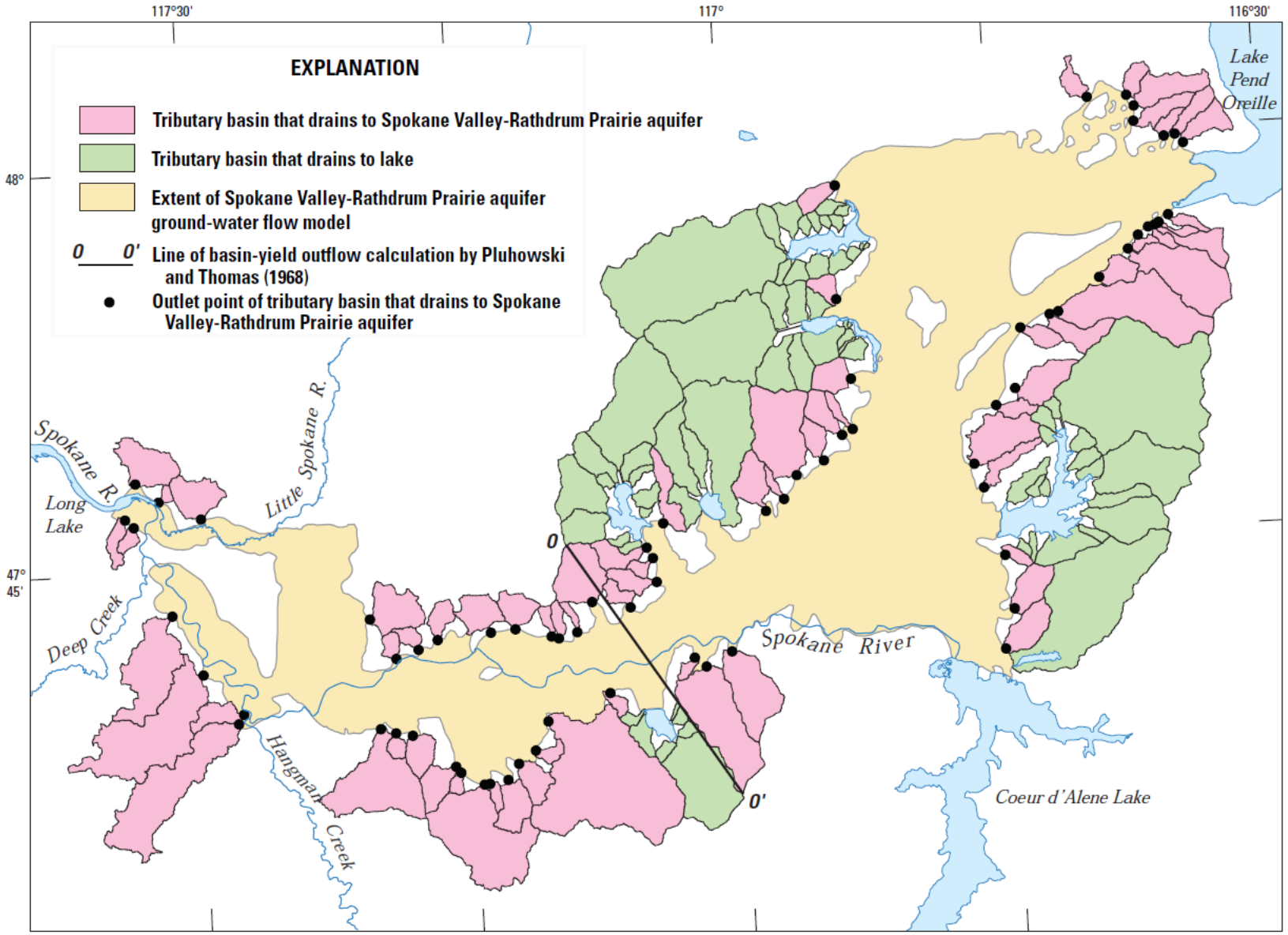
Approach and Methods for Climate-Change Evaluation

1. Obtain projections of future rainfall and streamflows
   - Public sources (https://climatetoolbox.org)
   - Focus on 2070s through 2090s (long-term resiliency)
2. Apply the projections to the groundwater model
   - Simulate 6 potential hydrologic futures
     - Optimistic and pessimistic scenarios for greenhouse gas emissions
     - Low, medium, and high degrees of change/outcomes
3. Run groundwater model and compile results
   - Late spring/early summer (most sensitive season)
   - Analyze changes at each of the City's 8 well stations

Groundwater levels could be affected by climate influences on aquifer recharge from tributary valleys

Climate Influences on Recharge to the Aquifer

From
(1) Rainfall over the Aquifer
and
(2) Inflows from Tributary Valleys

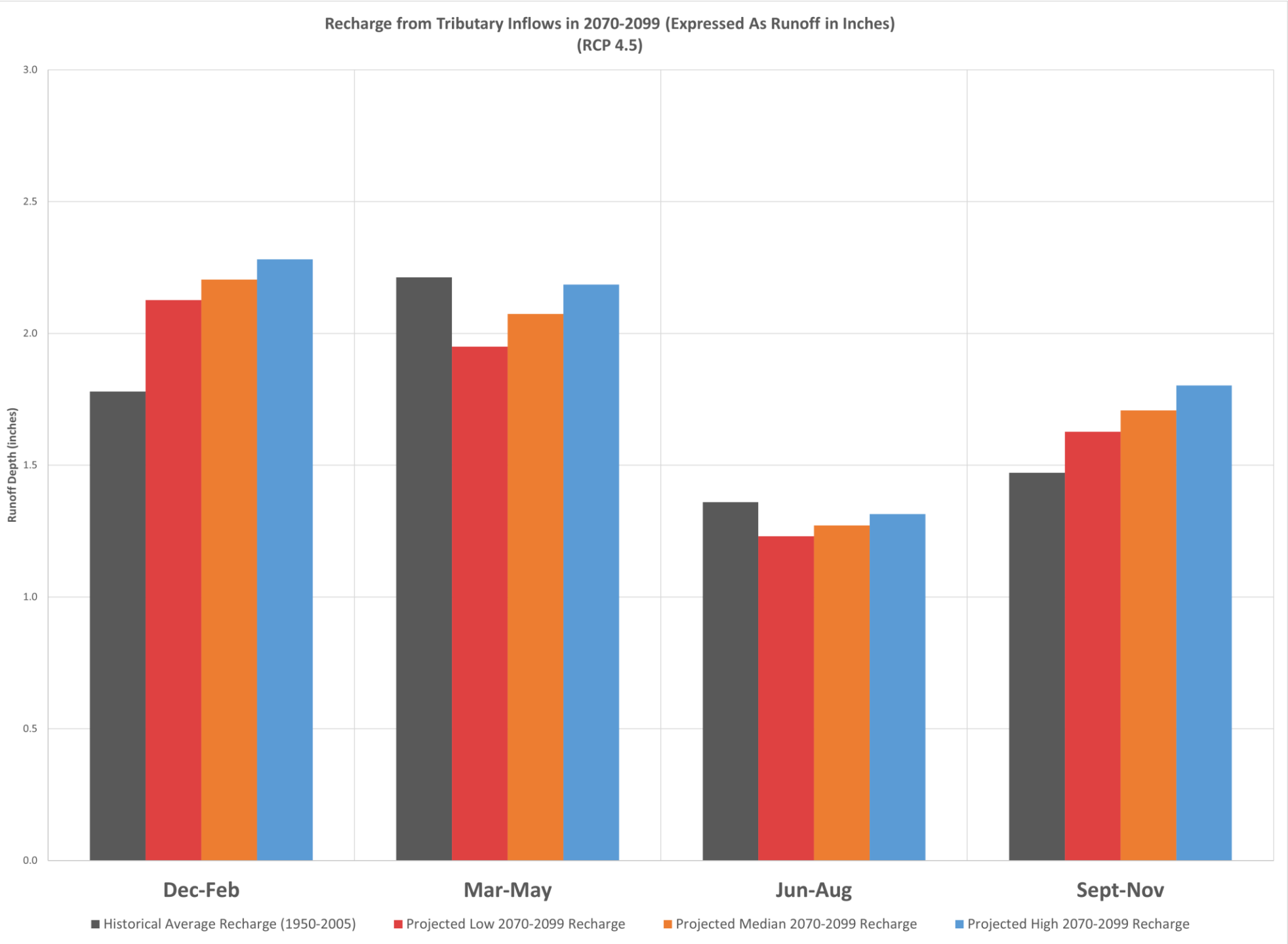


Source:
USGS BiState Model Report (Hsieh et al., 2007)

Climate Influences on Recharge to the Aquifer

From
(1) Rainfall over the Aquifer
and
(2) Inflows from Tributary Valleys

RCP 4.5



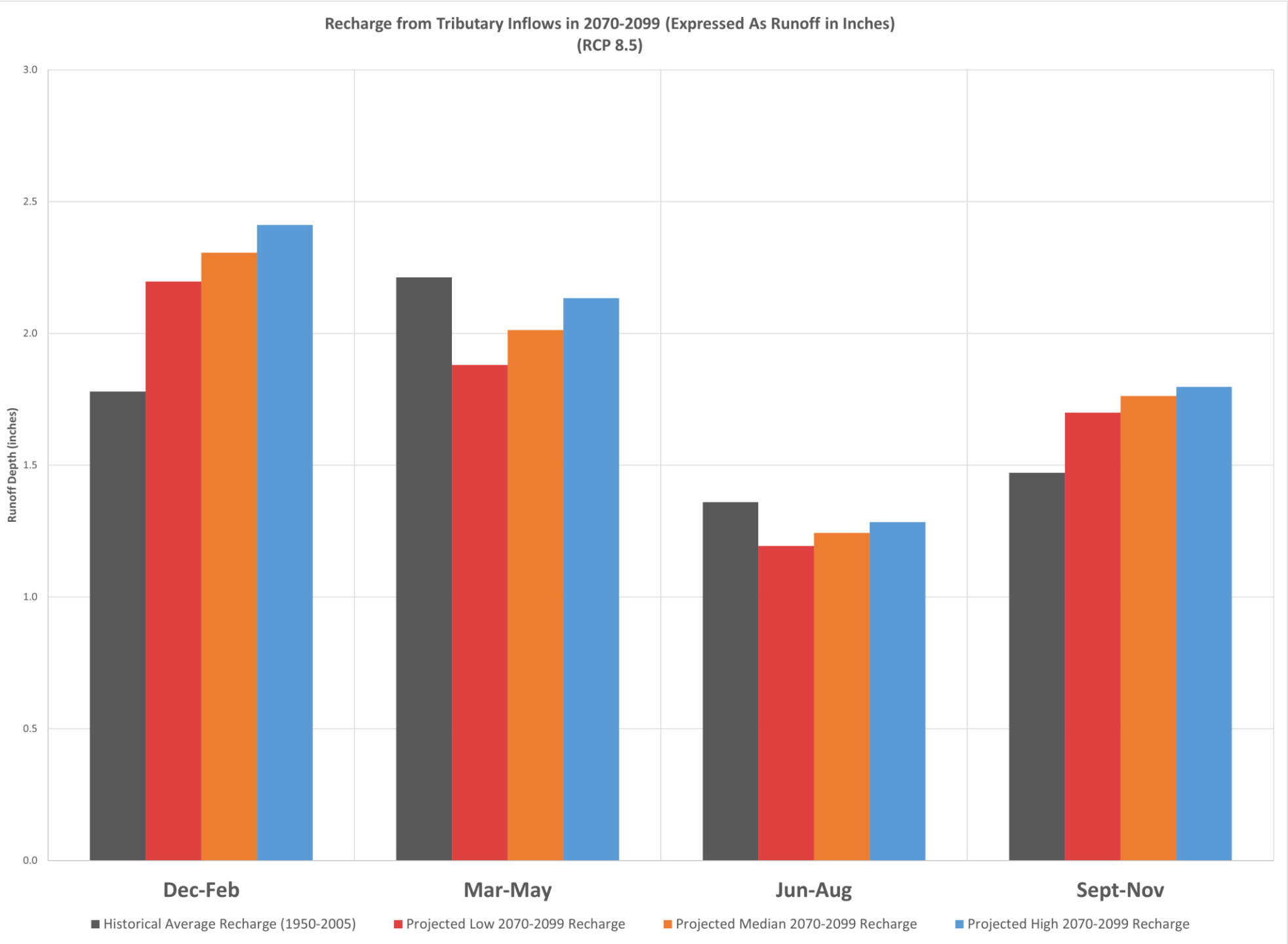
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Climate Influences on Recharge to the Aquifer

From
(1) Rainfall over the Aquifer
and
(2) Inflows from Tributary Valleys

RCP 8.5



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Spokane River Losing and Gaining Reaches

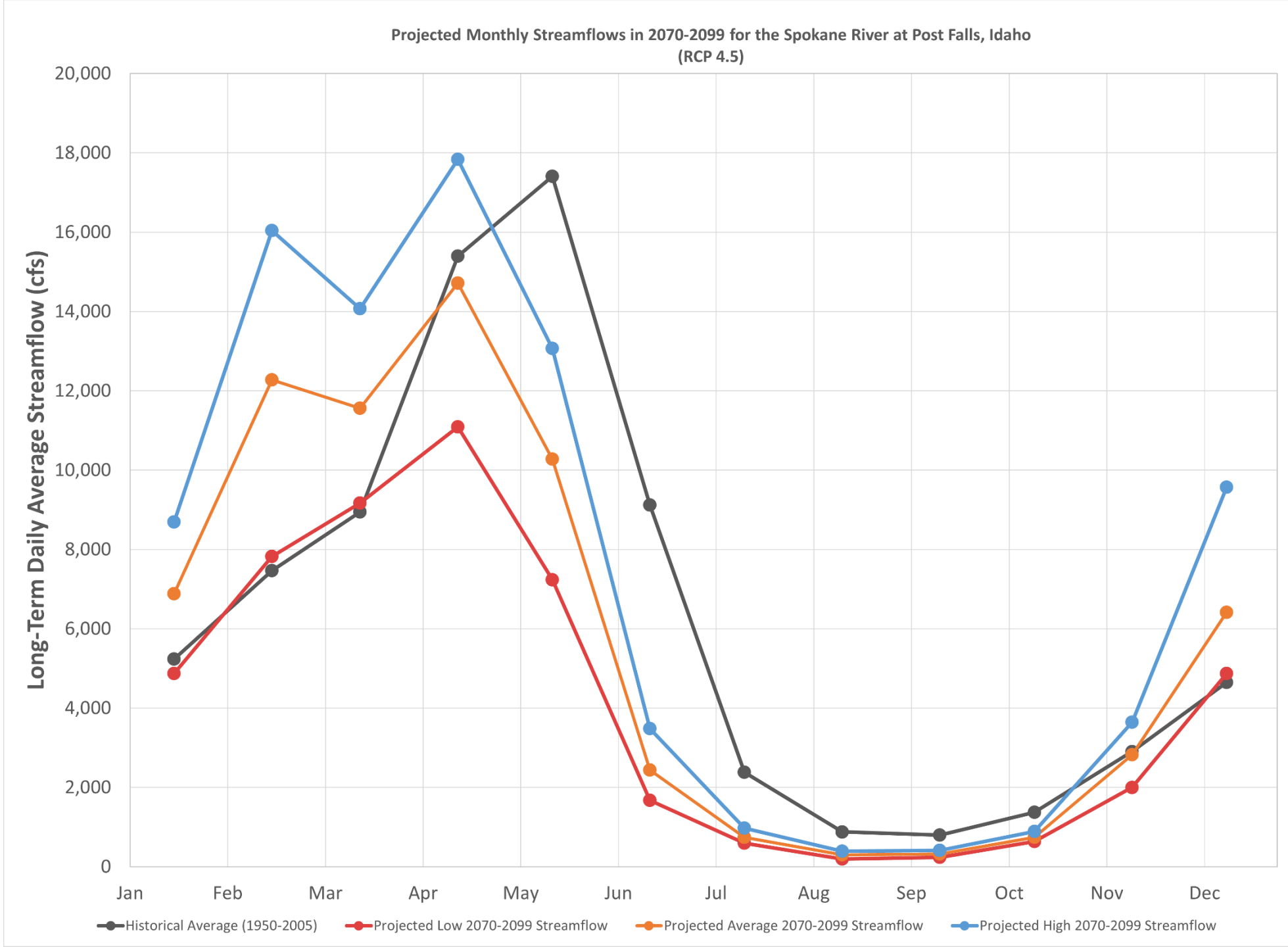


Source: The Spokane Valley-Rathdrum Prairie Aquifer Atlas, Fifth Edition (2023)

Climate Influences on Recharge to the Aquifer

From (3) Spokane River Streamflows at Headwaters (Outflows from Post Falls Dam)

RCP 4.5



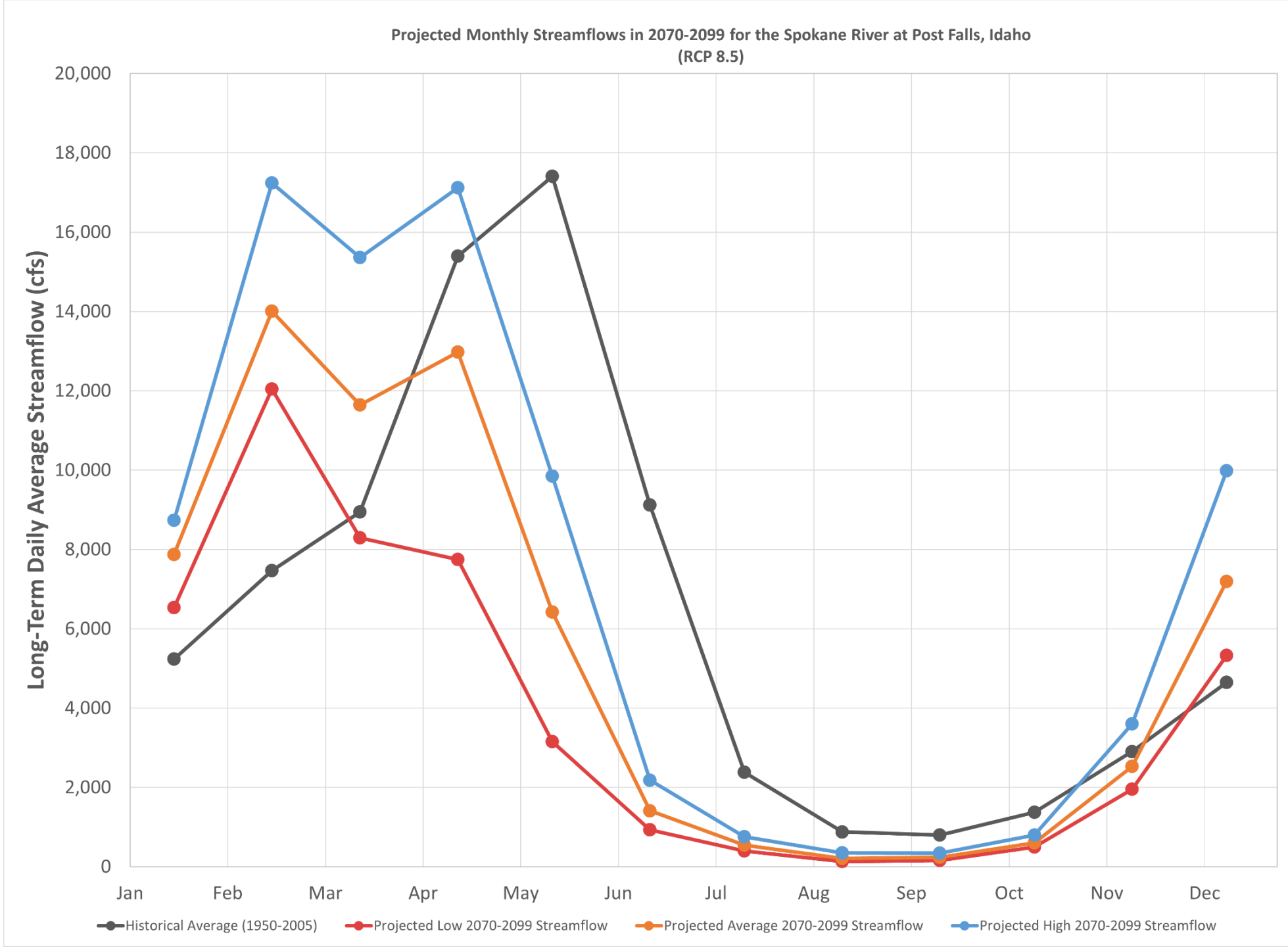
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Climate Influences on Recharge to the Aquifer

From (3) Spokane River Streamflows at Headwaters (Outflows from Post Falls Dam)

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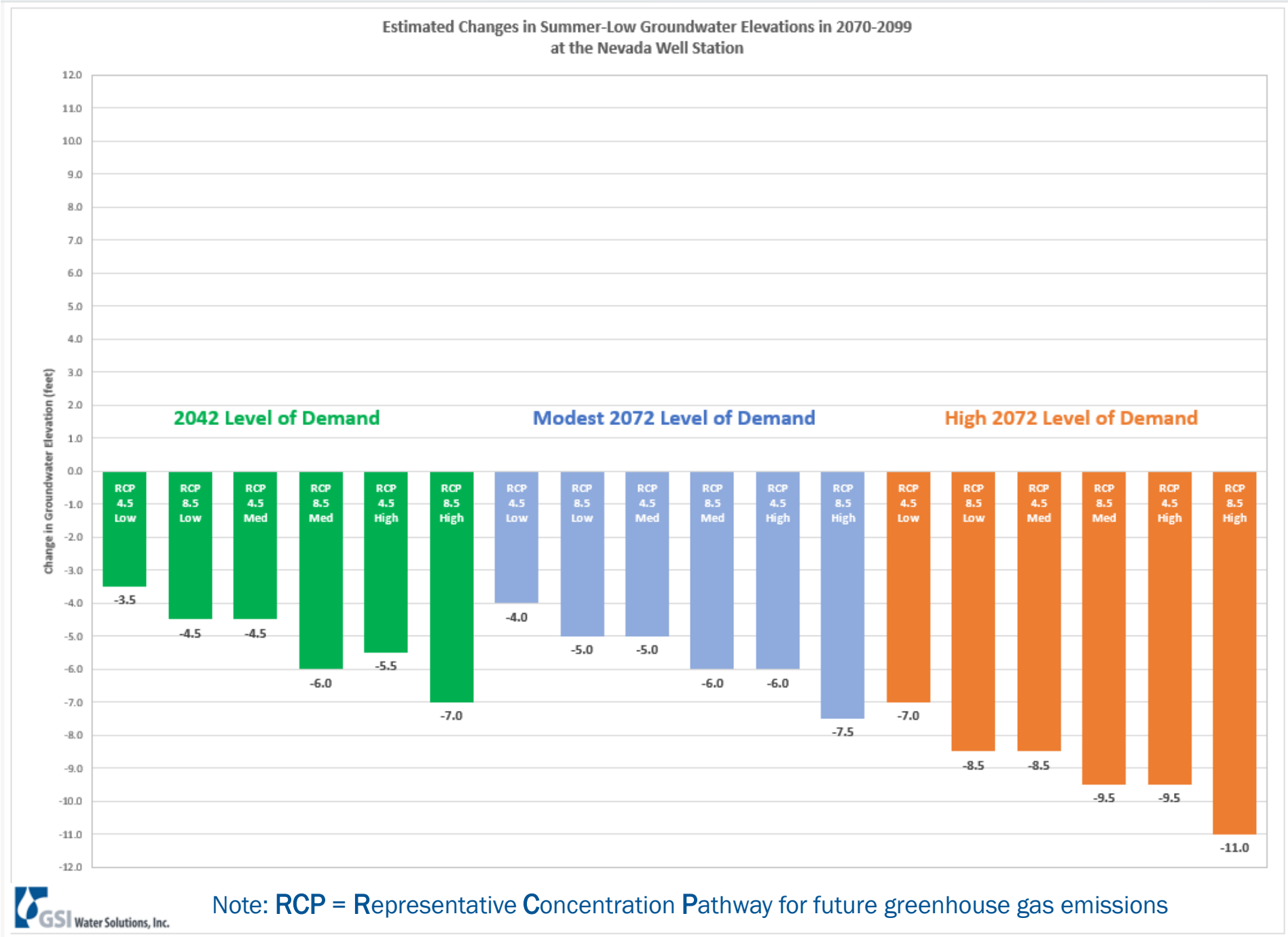


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Case Study:

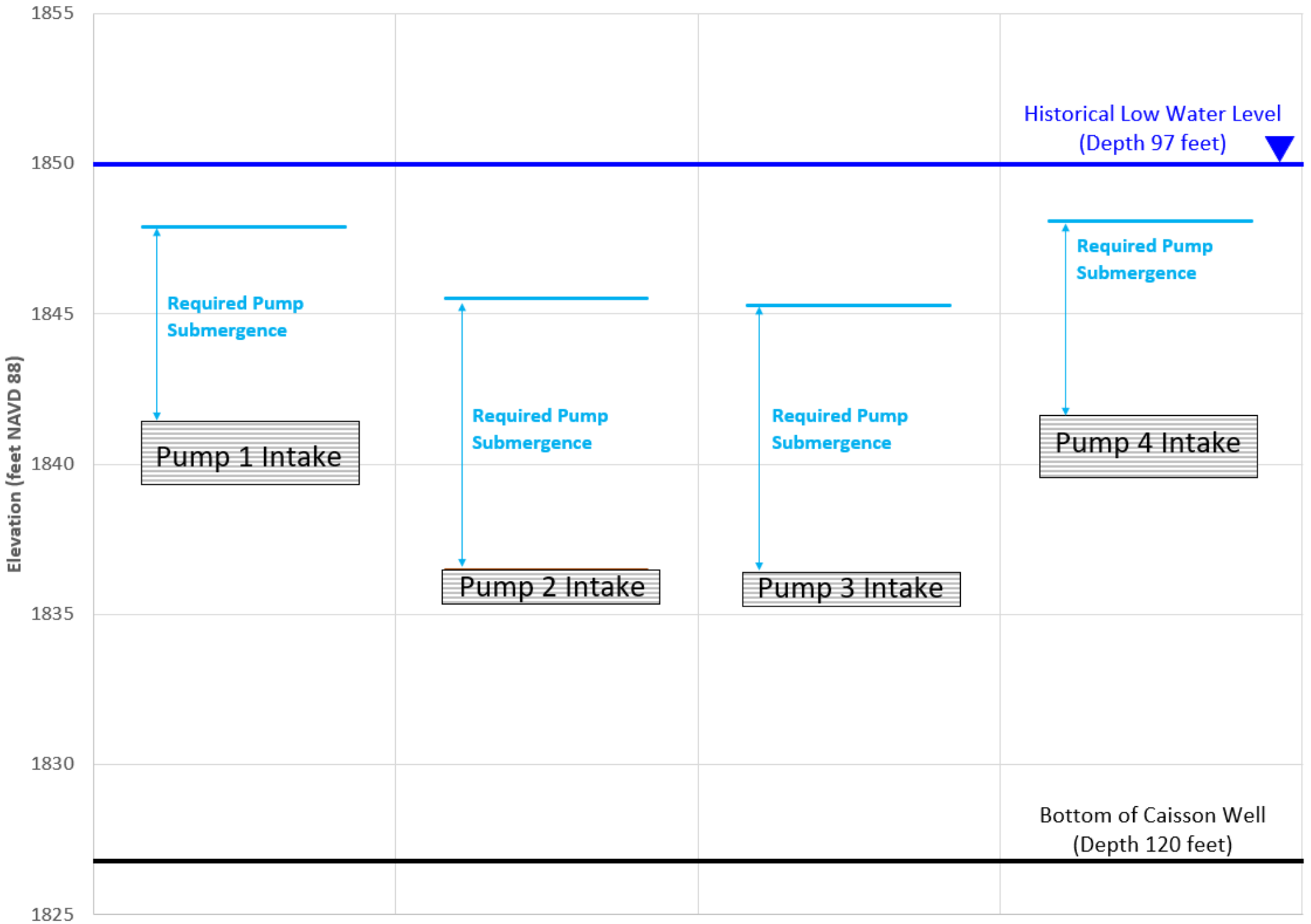
Assessment of Future Water Levels at the Nevada Well Station



Note: RCP = Representative Concentration Pathway for future greenhouse gas emissions

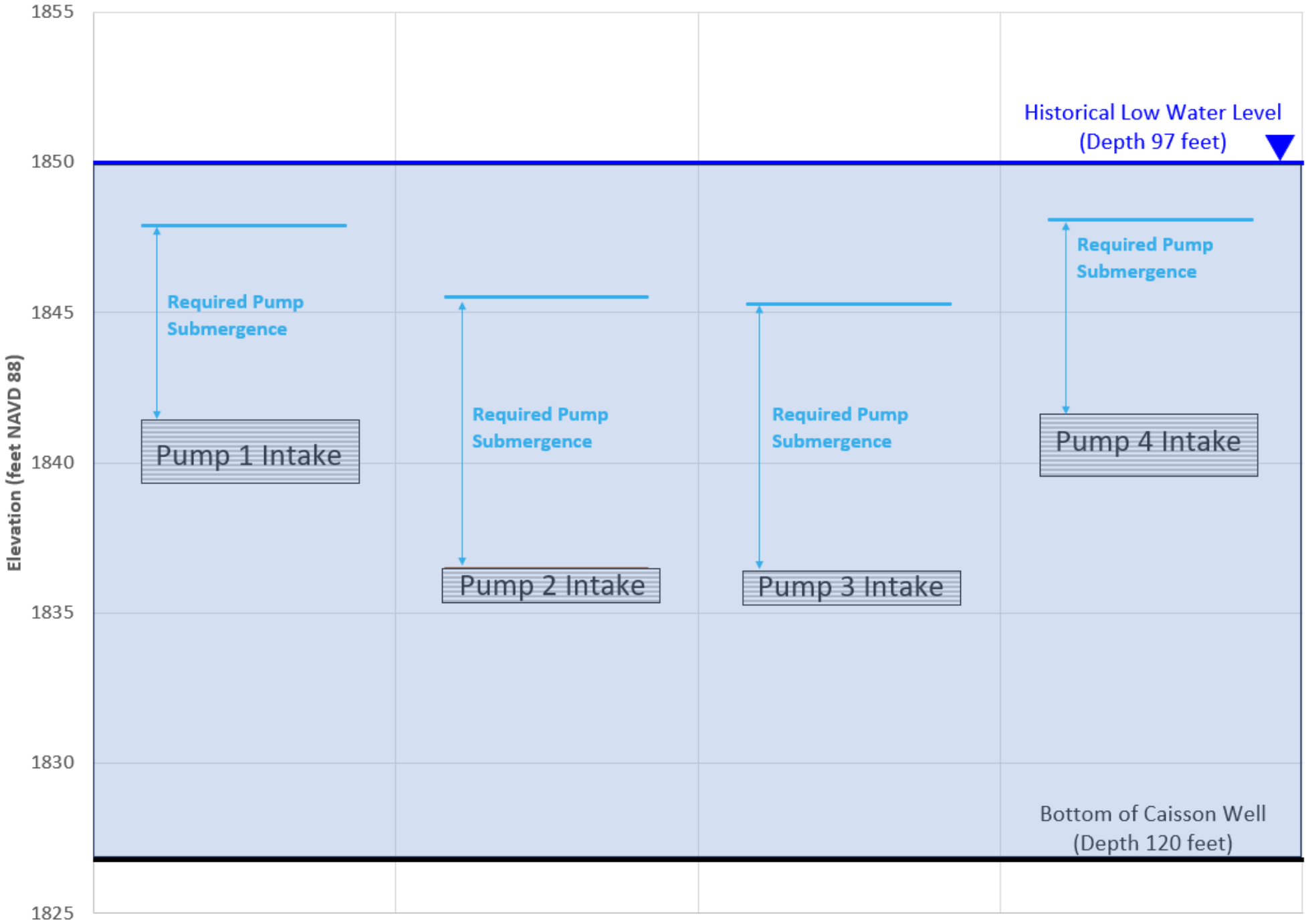
Case Study:

Assessment of the Nevada Well Station



Case Study:

Assessment of the Nevada Well Station

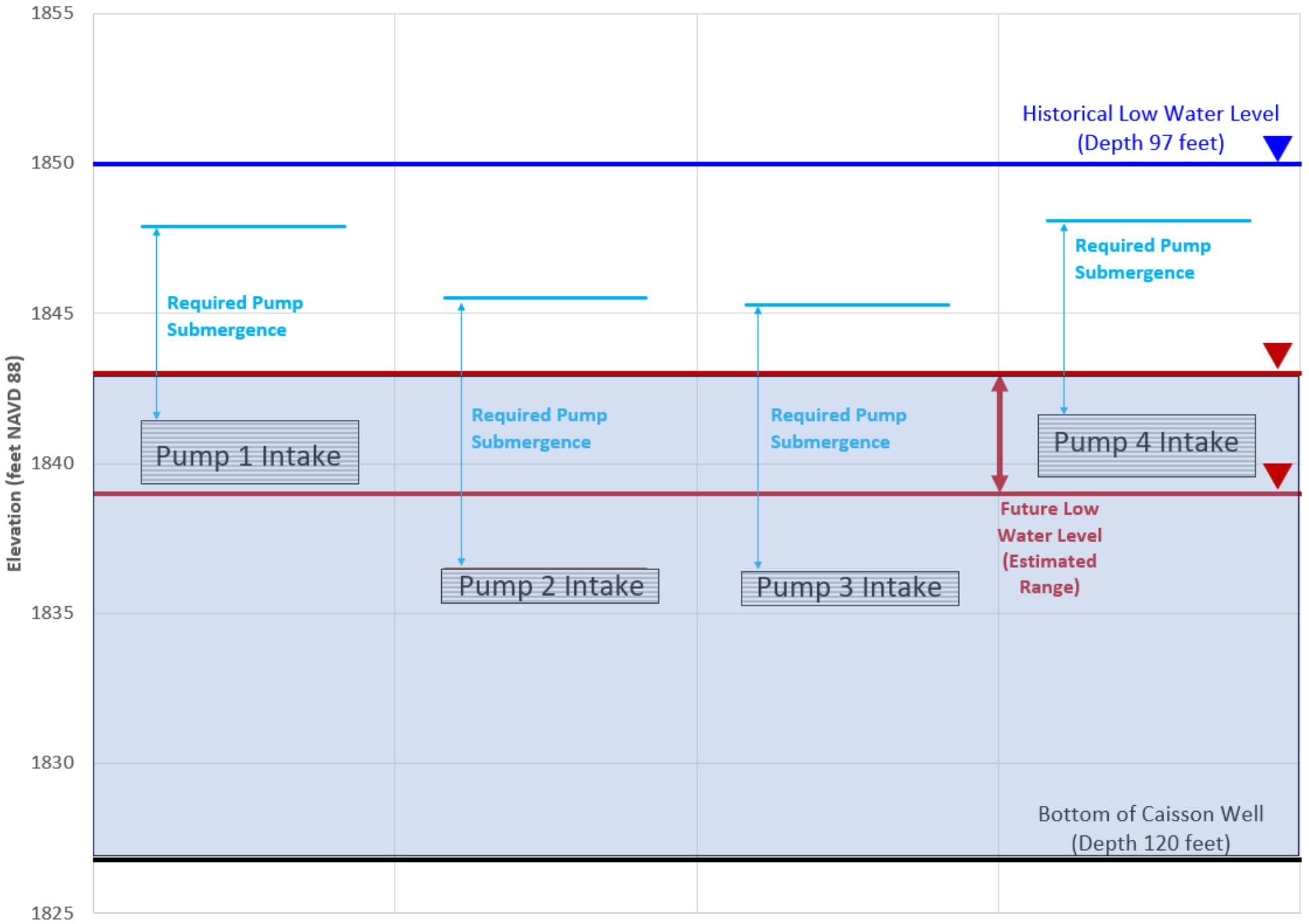


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Case Study:

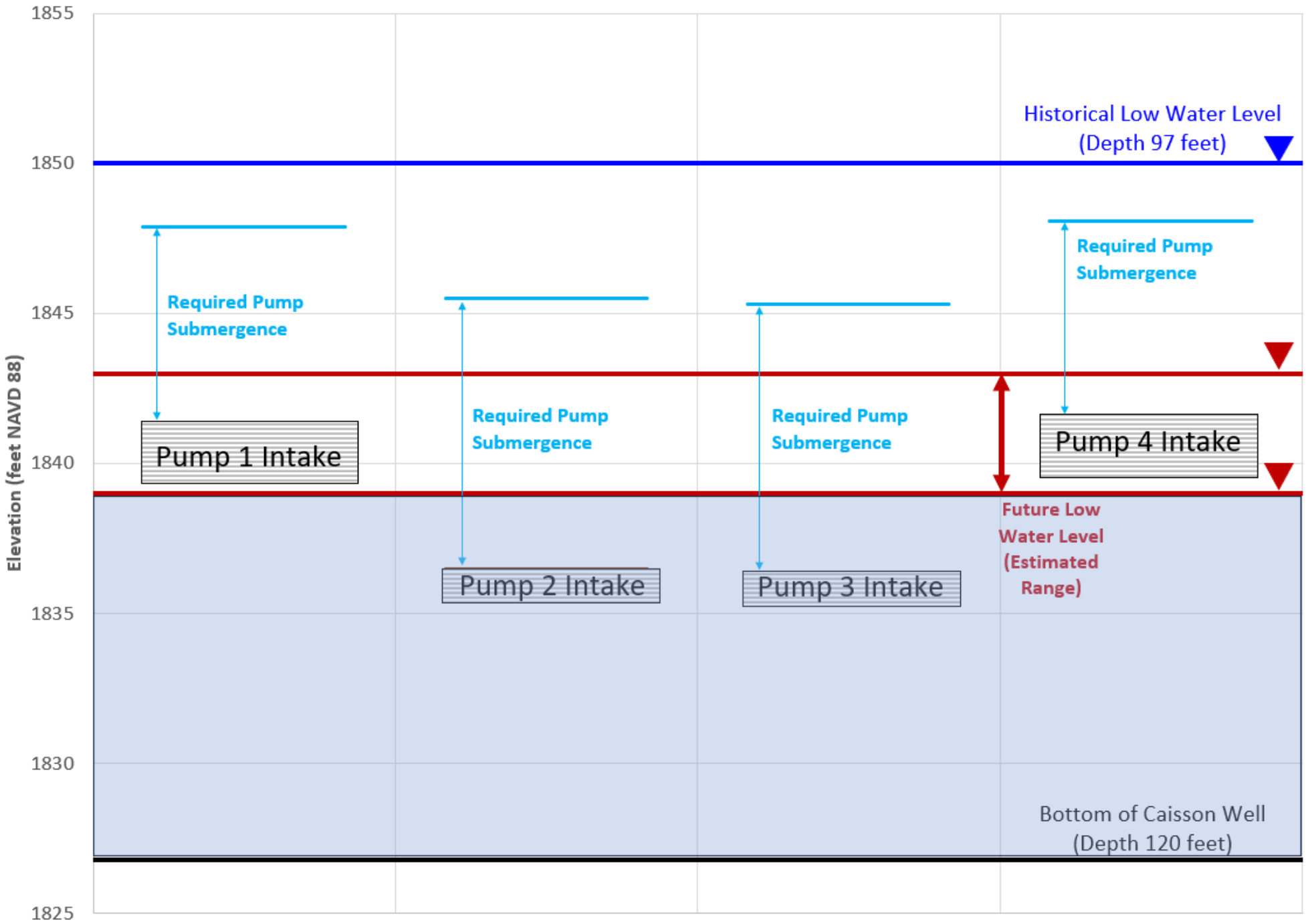
Assessment of the Nevada Well Station



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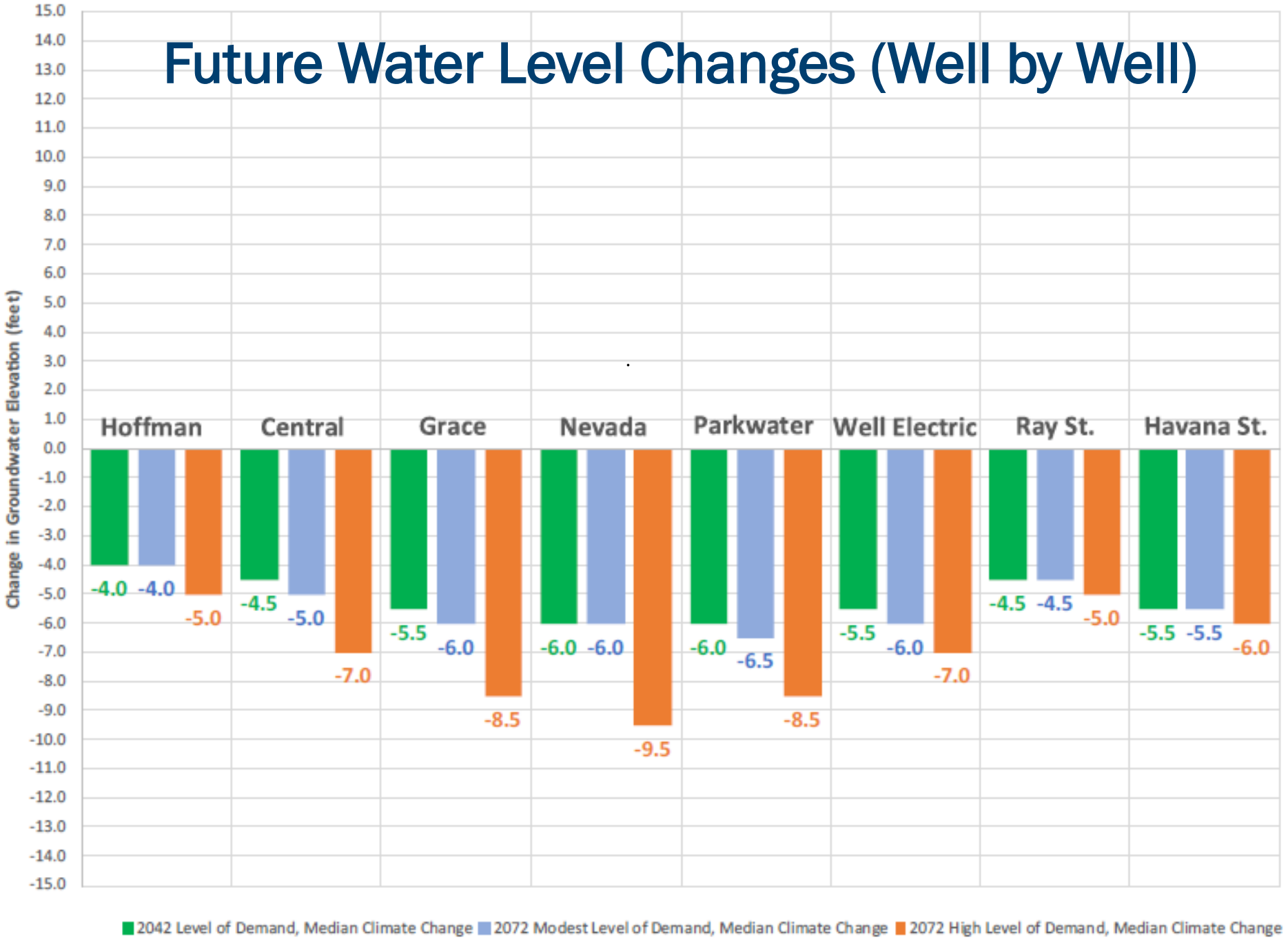
Case Study:

Assessment of the Nevada Well Station



GSI Water Solutions

Summary of Findings for Future Median Climate Conditions



Summary: Long-Term Sustainability Assessments

Future Pumping Assessments At All 8 City Well Stations

Well Station	Sustainable Without Further Modifications?	Types of Modifications Likely Needed
Havana Street	Yes	None
Central	Yes	None
Hoffman	No	Lower 1 of 2 pumps
Nevada and Grace	No	Modify caisson and pumps, or install new wellfield to provide supplemental or replacement supply
Well Electric	No	Install new wellfield to provide replacement supply
Ray Street	No	Lower pumps, and install new wellfield to provide supplemental supply
Parkwater	Unknown: Not yet studied	Unknown: Not yet studied

Capital Planning

Other Considerations

1. Available water rights
2. Age and condition of the existing wells
3. Available supply during the construction of other well sites
4. Available financial investment rates
   a. Each well per 5-10 years
   b. $2-7 Million/year
   c. Available Contractors
5. Consider emergency conditions and flexibility to serve
   a. Well Station Vulnerability (Yellowstone Oil Pipeline) Study Results
6. Consideration for emerging contaminants
7. The next regional need
8. Everything always changes

Capital Planning

Current Action Plan

1. Well Electric
   a. Finished the Feasibility Study
   b. Finished the Concept Plan
2. Nevada and Grace
   a. Finished the Feasibility Study
   b. Finished the Concept Plan
3. Continue well station condition assessments and provide maintenance to prolong the life of the stations
4. Start Parkwater Well Station Assessment
5. Finish the Utility Rate Study/Financial Portfolio (FCS)
6. Continue to review project and study priorities constantly

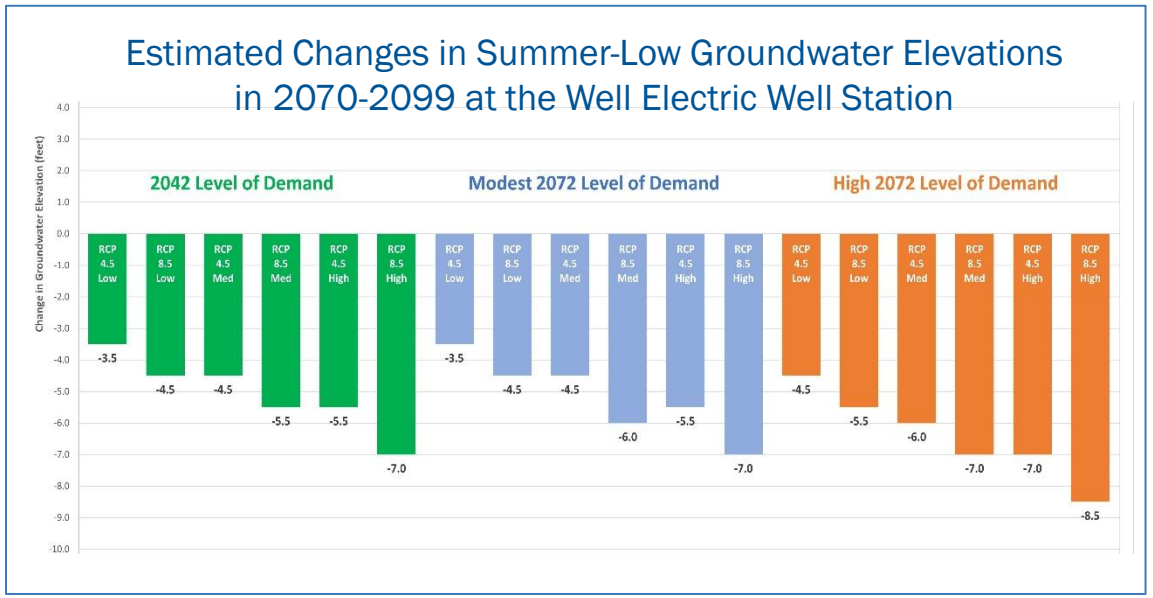
Well Priorities

Well Station	Sustainable Without Further Modifications?	Number of Primary PZ Supplied	Number of PZ's Supplied (Including Primary)	Annual Supply in 2025 (MG)
Havana Street	Yes	2	13	584
Central	Yes	1	6	1,426
Hoffman	No	1	6	1,006
Nevada	No	1	13	1,978
Grace	No	1	6	1,021
Well Electric	No	3	36	5,396
Ray Street	No	1	12	867
Parkwater	Unknown: Not yet studied	2	26	12,429
Total Pumping		3 Primary	36	24,707

Access the Study

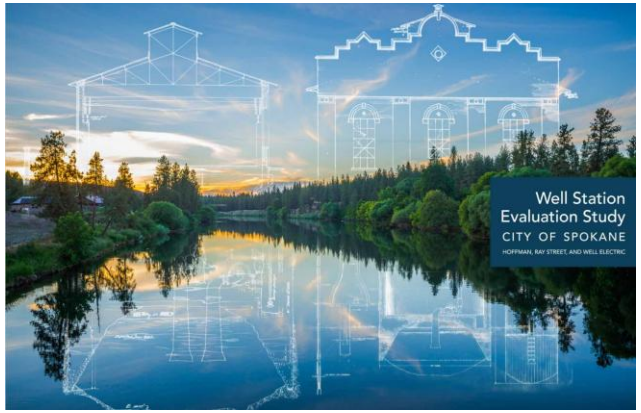
Scan the QR Code to view this presentation's report:

2024 Groundwater Modeling Study of Potential Changes to Water Levels in City of Spokane Well Stations Arising from Increased Water Demands and Climate Change Influences on the Regional Aquifer System (GSI & City of Spokane)



&

And for additional interesting information, scan this QR Code to view the *Well Electric, Hoffman and Ray Well Stations Evaluation Study Booklet (GSI & City of Spokane)*



THANK YOU



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