Integrating Residential Water Demand and Reuse Opportunities Into Puget Sound Resilience Planning Efforts

White Paper #4

Human Use of Water in Puget Sound: Managing Residential Water Demand for Resilient Communities and Healthy Ecosystems in a Changing Climate

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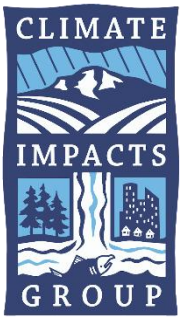

ABOUT THIS DOCUMENT

This document is the fourth in a series of white papers and resources associated with Puget Sound Partnership project '*Human Use of Water in Puget Sound: Managing Residential Water Demand for Resilient Communities and Healthy Ecosystems in a Changing Climate*.' This document connects key project findings with ongoing state, regional, and local resilience planning efforts. Other project documents and data sets produced in this analysis are available via the project webpage on the University of Washington, Climate Impacts Group's website.

Suggested Citation: Thebo, A. 2025. *Integrating Residential Water Demand and Reuse Opportunities Into Puget Sound Resilience Planning Efforts*. University of Washington Climate Impacts Group. Seattle, WA. pp.32.

Acknowledgments: Funding for this work was provided by the Puget Sound Partnership. We are grateful for the feedback provided by Laura Rivas and Katherine Wyatt at the Partnership, data shared by the Puget Sound Future Scenarios Project, and the many others who provided feedback and answered questions.

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OVERVIEW

The Puget Sound Region's population is projected to reach 10.5 million by 2080—an 84% increase. In the absence of mitigating measures such as increased water efficiency, this growth could drive a substantial rise in residential water demand, posing risks to both water supplies and ecosystems. The Puget Sound Partnership (Partnership) and UW Climate Impacts Group (CIG) project *Managing Residential Water Demand for Resilient Communities and Healthy Ecosystems in a Changing Climate* used scenario analysis to model future residential water demand under varying growth, efficiency, and climate scenarios. The project also assessed the potential for expanded use of reclaimed water across the region.

Key findings from this project include:

- Without efficiency improvements, residential water demand in the Puget Sound Region could nearly double by 2080;
- Modest efficiency improvements could nearly offset the residential water demand impacts of significant population growth;
- Reuse is underutilized but offers systemwide benefits;
- Land use patterns influence where—and how much—residential water is used;
- Hotter, drier summers may increase peak-season water demand; and
- Coordinated policies across land use, water, and climate planning are essential to managing future demand and building systemwide resilience.

These findings underscore both the potential risks of inaction and opportunities for integrating water efficiency and reuse strategies into broader resilience planning efforts. Climate change compounds these challenges by increasing peak-season demand and placing additional stress on water systems (Vano et al. 2010).

Acknowledging the risks to lives, livelihoods, and ecosystems posed by climate change and other stressors, Washington State and the Puget Sound Region have emerged as leaders in resilience planning. This white paper connects key project findings to several major planning frameworks—spanning state, regional, and local scales—to highlight opportunities for integrating water demand management and reuse strategies into ongoing resilience planning efforts.

The planning efforts included in this white paper include:

Part 1: State and Regional Resilience Planning

- Washington State Climate Resilience Strategy
- Puget Sound Partnership: Science Priorities, Action Agenda, and Salmon Addendum

Part 2: Local Resilience Planning

- Comprehensive Planning Requirements
- Water System Planning Requirements

PART 1: STATE AND REGIONAL RESILIENCE PLANNING

In this section, we link the findings from this project with two state/regional resilience planning efforts, the Washington State Climate Resilience Strategy and several interrelated Puget Sound Partnership plans. These efforts are similar in that both use an outcomes-based framework focused on identifying actions contributing to their respective goals—climate resilience and Puget Sound recovery—and measure progress across a range of time-based metrics.

WASHINGTON STATE CLIMATE RESILIENCE STRATEGY

Background

The Washington State Climate Resilience Strategy (State Climate Strategy) outlines a statewide framework for preparing for and responding to the impacts of climate change (Interagency Climate Resilience Team 2024). The State Climate Strategy identifies a series of strategies, actions, outcomes, and metrics to help guide, prioritize, and fund climate adaptation and resilience activities, with a focus on the activities of state agencies. In this section we discuss the findings of the project *Managing Residential Water Demand for Resilient Communities and Healthy Ecosystems in a Changing Climate* in the context of relevant strategies (and sub-strategies) within the State Climate Strategy. Relevant strategies cluster into two primary areas—resource management and supporting planning and decision making. Discussion below includes the relevant state strategy, relevant sub-strategies, and a brief summary of relevant project findings. Strategies are organized (roughly) by their degree of connection with the findings of this project.

Resource Management Strategies and Project Findings

Strategy 6: Implement innovative water conservation and management initiatives to ensure reliable and sufficient water for people, farms, ecosystems, wildlife, and fish.

Sub-Strategy: Prepare for water availability changes and implement projects in multi-benefit, large-scale water plans

Project Findings: The project's modeling of residential water demand under varying climate, growth, and efficiency scenarios provides insights into potential future changes in demand and sub-regional impacts of growth management and efficiency measures. It also identifies, at a high level, areas where there may be potential for reclaimed water use. These tools support the development of multi-benefit water plans that integrate demand reduction, reclaimed water use, streamflow restoration, and drought preparedness.

Sub-Strategy: Improve the resilience and efficiency of water use and infrastructure

Project Findings: Project findings show that modest improvements in indoor and outdoor efficiency can nearly offset residential demand associated with increasing population. Likewise, this study found substantial potential for additional reclaimed water use. These findings underscore the magnitude of potential resilience benefits associated with water efficiency and reuse. Strategic capital planning and investment decisions can help increase water system reliability and performance under future climate conditions.

Sub-Strategy: Improve water management by collecting, using, and standardizing shared water data across agencies

Project Findings: This project developed regionally consistent estimates of future residential water demand and the relative impacts of water use efficiency, growth management, and climate change. While local assessments are needed for detailed planning, these regionally consistent estimates can help unify regional planning efforts and provide insights into regions that may not have the capacity or budget for detailed local studies.

Strategy 5: Reduce existing sources of pollution that exacerbate climate impacts.

Sub-Strategy: Reduce water pollution

Project Findings: The project findings suggest significant opportunities for increasing outdoor water use efficiency and reclaimed water use. Improved outdoor efficiency can lower irrigation and dry-season runoff volumes, which in turn reduces pollutant loads entering waterways. Compact, water-smart land use patterns can be designed to limit impervious surfaces and associated nonpoint source pollution. Expanded use of reclaimed water can help reduce nutrient-rich effluent discharges to sensitive ecosystems. Together, these strategies offer climate-resilient pathways to simultaneously meet water supply needs and reduce pollution-related climate vulnerabilities.

Strategy 8: Improve land management and restoration practices to help ecosystems, habitats, and species adapt to changing conditions.

Sub-Strategies:

- *Prevent the worst effects of climate change on the Puget Sound ecosystem (including implementation of the regional chapter of the Puget Sound Salmon Recovery Plan)*
- *Watershed Resilience Program*

Project Findings: Modest, but widespread efficiency improvements and expanded reclaimed water use can help offset freshwater withdrawals, helping to maintain ecological flows and support salmon recovery objectives. By quantifying how land use patterns affect water demand, the research can help inform integrated planning under the Puget Sound Salmon Recovery Plan and aligns with the goals of the Watershed Resilience Program, which emphasizes multi-benefit restoration, flow protection, and coordinated land-water management.

Strategy 4: Support the vitality and viability of working lands through research, technical assistance, and incentives.

Sub-Strategies:

- *Promote agricultural viability*
- *Explore novel market opportunities to support climate risk reduction efforts*

Project Findings: The research highlights the potential for reclaimed water to offset agricultural irrigation needs, particularly in WRIAs that are facing increasing summer drought stress and/or closed to new water rights. Non-potable reuse for

farms, parks, and green infrastructure aligns with efforts to diversify water sources and reduce reliance on overdrawn aquifers or streams. These approaches can also create new market and infrastructure investment opportunities, helping producers manage risk, lower costs, and maintain productivity under climate stress. Coupled with technical assistance and incentives, these multi-benefit strategies can simultaneously contribute to both climate resilience and the economic vitality of the agricultural sector.

Planning/Decision Making Strategies and Project Findings

Strategy 3: Support Tribes, local governments, and communities with technical assistance, guidance, and best practices.

Sub-Strategies:

- *Support local planning and accelerate implementation of nature-based solutions for shorelines, floodplains, and coastal areas.*
- *Support local governments in assessing vulnerability and planning for resilience*
- *Build local-level resilience capacity in overburdened and underserved communities.*
- *Community resilience to a changing climate*

Project Findings: The project outputs directly support communities' consideration of the benefits and tradeoffs of three water and climate resilience strategies such as growth management, water efficiency, and reclaimed water. The findings include WRIA-level residential demand scenarios that can help inform local comprehensive plans, water system plans, and climate vulnerability assessments—helping communities anticipate future demand and climate-driven stress on water supplies. By demonstrating that modest efficiency measures can offset growth-driven residential demand and reduce peak summer usage, the project supports consideration of cost-effective, locally implementable solutions. As a regional-scale assessment, the study findings include assessments of potential in all communities, including those for whom studies of efficiency or reclaimed water potential may be out of reach. These findings do not replace local planning but may provide helpful insights into the relative impacts of different strategies.

Strategy 2: Plan for, respond to, and recover from climate-driven hazards and emergencies.

Provide communities with technical advice and guidance to support climate-driven hazard and emergency planning

Project Findings: Project outputs include projections of future residential demand, including climate-related impacts on outdoor demand. These findings can directly support hazard mitigation and emergency planning. The research suggests that hotter, drier summers and growing populations may increase peak-season water demand, potentially stressing water systems during droughts, wildfires, and heatwaves. By quantifying these risks and showing that modest efficiency improvements can significantly reduce seasonal and long-term demand, the findings inform preparedness strategies that enhance water supply reliability. Project resources may help utilities and emergency planners evaluate infrastructure vulnerability, prioritize high-risk service areas, and plan for equity-centered conservation and backup supply strategies—all essential components of community hazard resilience under a changing climate.

Strategy 7: Plan and invest in infrastructure and state assets to minimize vulnerability to climate impacts, maintain levels of service, improve performance and condition, increase equity, and promote nature-based solutions.

Sub-Strategy: Use climate projections to inform infrastructure funding and management

Project Findings: By evaluating the relative significance of different water and climate resilience strategies, the project findings can help state agencies and local governments plan and invest in climate-resilient water infrastructure. The project's models incorporate climate projections—such as hotter, drier summers—to forecast future residential water demand at sub-regional scales (e.g., WRIA). These projections can help guide investments to right-size water systems, reduce overbuilding, and identify where strategies such as water efficiency and reuse can help maintain service levels while increasing resilience. The findings suggest potential for modest, equity-centered efficiency measures to reduce capital costs, defer expansion, and ensure affordability—aligning directly with goals to use climate-informed data to improve infrastructure performance and equity statewide. To fully realize these benefits, planning and investment programs will need to center consideration of equity-related impacts.

Strategy 1: Coordinate how to best implement the strategy across state agencies.

Project Findings: The research highlights how water demand, land use, and climate planning are deeply interdependent, and that addressing future challenges will require collaboration across agencies responsible for water resources, infrastructure, public health, land use, and salmon recovery. The tools and data products developed—such as climate-adjusted demand scenarios and reclaimed water potential—can be integrated into programs led by Ecology, Health, Commerce, Fish and Wildlife, and others. Coordinated use of these tools could support consistent planning standards, improve alignment between Growth Management Act and water system planning, and help agencies prioritize investments in communities most at risk from climate-related water stress. This type of shared framework can strengthen the collective capacity of agencies to deliver resilient, equitable, and efficient water solutions across the state.

PUGET SOUND PARTNERSHIP: SCIENCE PLAN, ACTION AGENDA, AND SALMON ADDENDUM

Background

As the state agency tasked with leading the regional effort to restore and protect Puget Sound, the Partnership has developed a robust system for prioritizing and tracking progress toward these goals. In this section, we discuss project findings in the context of three interrelated sets of priorities and actions at the Partnership, including: Science Work Plan Priority Actions; Action Agenda; and Salmon Addendum.

Science Work Plan Priorities - Connections with Key Project Findings

This project was funded under the 2023-25 Puget Sound Scientific Research program and scoped to align with priorities identified in the 2020-24 Science Work Plan. Table 1 details the seven priority actions relevant to this project while Table 2 crosswalks key project findings with relevant science priorities and briefly discusses the connection between these two items.

Table 1. 2020-24 Priority Science Work Plan Actions relevant to project findings.

Priority Category	Relevant Science Work Plan Priority Action(s)
Human-biophysical Interactions	**1.** Evaluate how current and future social, economic, and political factors, such as population growth and urban development, will affect habitat quality and quantity, both negatively and positively as gauged by salmon viability.
Effectiveness of Recovery Interventions	**5.** Determine what incentives, human well-being factors, market drivers, tax systems, and characteristics influence residents', developers', and purchasers' choices that contribute to or prevent habitat conversion.
Ecological Conditions and Effects	**10.** Identify and address gaps in current efforts to assess water use in Puget Sound with a focus on groundwater quality and quantity discharged to Puget Sound.
Science-Based Decision Support	**12.** Refine risk assessment tools and scenario development and analyses to improve our understanding of highly uncertain, complex and inter-related challenges and solutions to provide information that can be used to identify actions to achieve a more resilient Puget Sound ecosystem.
	13. Develop a framework of recommended approaches for including risk analyses, including extreme events and uncertainty, into planning and decision making.
	15. Explore and advance the use of methods to integrate human dimensions with biophysical targets and goals by decision makers.
Recommendation	**G.** Develop and analyze alternative future scenarios to explore and express desired futures and evaluate trade-offs among possible approaches

Table 2. Connections between Science Priorities and project findings.

Key Project Finding	Relevant Science Priorities	How Findings Connect to Priority Science Work Actions
Without efficiency improvements, residential demand could nearly double by 2080.	10, 12, 13	• Highlight range of potential residential demand impacts on water systems and instream flows. • Groundwater contributes to baseflows and is a major source of supply for local water systems. • Support broader quantification of water use futures and sensitivity to management strategies.
Modest efficiency improvements could nearly offset the residential water demand impacts of significant population growth.	5, 12, 13, 15	Support understanding behavioral and policy levers for conservation success, particularly in residential and suburban water use patterns.
Reuse is underutilized but offers systemwide benefits.	10, 12	• Support incorporation of alternative supplies (reuse) into regional scenario planning and decision-making. • Add to adaptive infrastructure planning under uncertainty.
Land use patterns influence where—and how much—residential water is used.	1	Reinforce that development form directly shapes hydrologic impacts, and that integrated land-water planning is key to salmon and flow outcomes.
Hotter, drier summers may increase peak-season water demand.	13, 15	Help guide scenario-based planning for water system stress during droughts, aligning with climate-driven infrastructure and management preparedness.
Coordinated policies across land use, water, and climate planning are essential to managing future demand and building systemwide resilience.	12, 15, G	Support integrated socio-ecological research and scenario modeling, especially around land use, water availability, climate, and equity in planning.

Action Agenda Strategies – Connections with Key Project Findings

The Partnership's 2022-26 Action Agenda outlines plans for Puget Sound recovery, mapping a plan of vetted outcomes, strategies, and actions for Puget Sound recovery and resilience (Puget Sound Partnership 2022). In this section, we discuss key project findings in the context of Action agenda strategies and actions. In Table 3, we identify relevant strategies and actions from the Action Agenda then discuss how project findings support relevant strategies and actions (Table 4).

Table 3. Summary of Action Agenda strategies and actions relevant to project findings.

Theme	Strategy Name	Strategy Description	Relevant Action Agenda Actions		
Habitat	**1. Smart Growth**	Ensure smart development and protect intact habitats and processes by channeling population growth into attractive, transit-oriented urban growth areas (UGAs) with easy access to natural spaces.	Indirect (across several)		
Habitat	**2. Working Lands**	Reduce pressure for land conversion by supporting the long-term viability and sustainability of agricultural lands, including large and small parcel, hobby and working farms, and working forests through resilience and integrated management planning, improved incentives, and improved land use regulations.	Indirect (across several)		

Theme	Strategy Name	Strategy Description	Relevant Action Agenda Actions		
Habitat	**7. Freshwater Availability**	Understand and plan for future freshwater availability and implement regulations, projects, and voluntary approaches to reduce water demand and encourage conservation, as well as reclaimed wastewater.	Implement and improve technologies, voluntary programs, financial and technical assistance programs, and market-based approaches to reduce water demand and encourage conservation. (ID #27)	Implement watershed plans that offset impacts from new domestic permit-exempt wells and achieve a net ecological benefit within the watershed. (ID #28)	Understand and plan for future water needs and changing climate and ecosystem conditions by engaging all water users in a watershed to identify specific actions around water science, technology, management, and conservation. (ID #29)
Water Quality	**11. Wastewater Systems**	Reduce and prevent pollutants from wastewater systems (for example, treatment plants and large- and small-scale onsite septic) by improving regulatory controls and incentives and investing in new technology.	Promote appropriate reclaimed water projects to reduce pollutant loading to Puget Sound. (ID #211)		

Theme	Strategy Name	Strategy Description	Relevant Action Agenda Actions		
Climate Change	**20. Climate Adaptation and Resilience**	Integrate climate adaptation and resilience into all strategies to protect and restore ecosystems and human wellbeing.	Implement multi-benefit projects and programs that synergistically advance Puget Sound recovery goals and reduce greenhouse gas emissions, increase carbon sequestration in Puget Sound ecosystems, increase climate adaptation, and promote climate resilience. (ID #137)	Increase legislative support to accelerate funding and implementation of projects, programs, and initiatives that reduce emissions and decrease the vulnerability of Puget Sound to changing climate and ocean conditions. (ID #147)	Increase availability of data, tools, and training, and increase the technical capacity of partners in the recovery community, to reduce the magnitude of and vulnerability to climate change, and advance adaptation of the Puget Sound socio-ecological system. (ID #149)
Institutional	**C. Research and Monitoring**	Coordinate and invest in research and monitoring to support Puget Sound recovery.	Implement priority science work actions from the Science Work Plan for 2020-2024. (ID #182)	Develop and analyze alternative future scenarios to help leaders make decisions that will lead to system-level change under a range of projections for climate change, population growth, and other uncertainties. (ID #188)	

Theme	Strategy Name	Strategy Description	Relevant Action Agenda Actions		
Institutional	**E. Stewardship and Motivating Action**	Build issue awareness to increase public support for Puget Sound recovery and cultivate stewardship behaviors that benefit Puget Sound.	Cultivate broad-scale stewardship practices and behaviors among Puget Sound residents that benefit Puget Sound. (ID #125)	Build issue awareness and understanding to increase public support and engagement in recovery actions. (ID #126)	

Table 4. Connections between relevant Action Agenda Strategies and project findings.

Key Finding	Strategy Theme(s)	Strategy	Relevant Actions	Opportunities	How This Project Supports this Strategy
Without efficiency improvements, residential demand could nearly double by 2080.	**Habitat**	Strategy 7: Freshwater Availability	27, 28, 29	Improve regional water demand projections Integrate demand scenarios into WRIA and water system plans	Highlights the importance of anticipating future residential water pressures and planning for conservation-based offsets.
Modest efficiency improvements could nearly offset the residential water demand impacts of significant population growth.	**Habitat**	Strategy 7: Freshwater Availability	27, 28, 29	Expand efficiency rebate programs Adopt policies for indoor/outdoor water-saving standards	Supports investment in water conservation programs that cost-effectively reduce demand and defer infrastructure expansion. Quantifies potential water savings possible through investments in efficiency programs, differentiates indoor and outdoor use. Data on spatial distribution of future demand.
Reuse is underutilized but offers systemwide benefits.	**Water Quality**	Strategy 11: Wastewater Systems	11	Incentivize reclaimed water expansion Streamline permitting for beneficial reuse Consider opportunities for decentralized/ satellite reclaimed water projects in urban infill projects	Identifies opportunities to expand non-potable reuse for irrigation, cooling, and industrial uses, reducing demand on potable supply.

Key Finding	Strategy Theme(s)	Strategy	Relevant Actions	Opportunities	How This Project Supports this Strategy
Land use patterns influence where—and how much—residential water is used.	**Habitat**	Strategy 1: Smart Growth; Strategy 2: Working Lands	Indirect (across several)	Align development patterns with ecological goals Integrate water demand into comprehensive planning	Encourages compact development to reduce water use intensity, preserve headwaters, and minimize habitat disruption. Suggests value in incorporating water demand considerations into comprehensive planning efforts.
Hotter, drier summers may increase peak-season water demand.	**Climate Change**	Strategy 20: Climate Adaptation and Resilience	137, 147, 149	Integrate climate projections into water demand planning Support adaptive drought conservation strategies	Informs utilities and planners about climate-driven seasonal shifts in demand, supporting proactive infrastructure and outreach planning.
Coordinated policies across land use, water, and climate planning are essential to managing future demand and building system resilience.	**Habitat, Water Quality, Climate Change**	Strategies 1, 2, 7, 11, 20	See above	Foster multi-jurisdictional coordination Align GMA, water planning, and climate adaptation goals	Reinforces the need for cross-sector alignment to address regional water supply challenges and promote equitable, climate-smart growth that contributes to Puget Sound recovery.
Cross Cutting Findings/Strategies	**Institutional**	Strategy C: Research and Monitoring	182, 188	See above for Science Work Plan priorities Data and information to support Future Scenarios project and other efforts	Project conducted scenario analysis to inform decision making and understanding of the tradeoffs of different growth management, water use efficiency, and climate scenarios on future residential water demand

Key Finding	Strategy Theme(s)	Strategy	Relevant Actions	Opportunities	How This Project Supports this Strategy
	Institutional	Strategy E: Stewardship and motivating action	125, 126	Engage public and other stakeholders in water conservation behaviors	Developed series of fact sheets summarizing key findings of greatest relevance for six stakeholder groups (water utilities, ww agencies, policy makers, planners and land developers, salmon recovery and ecosystem management, Puget Sound residents); This document summarizes key findings relevant to major planning and policy efforts.

Salmon Recovery Plan Addendum Actions – Connections with Key Project Findings

The 2024 Puget Salmon Recovery Plan Addendum (Puget Sound Partnership 2024) updates the Regional Chapter of the 2007 Puget Sound Salmon Recovery Plan (Shared Strategy Development Committee 2007), adding a series of crosscutting regional actions that are needed to support salmon recovery efforts in the region. In 2025, the Partnership identified a list of 20 priority actions within the Salmon Addendum (Puget Sound Partnership 2025). In this section we focus primarily on the latter document, discussing the ways in which findings from this project can support relevant 2025-27 priorities.

Low Summer Flows (LSF)

Addendum Strategy

LSF Strategy 5: *Account for future water quantity demands due to a changing climate, ecosystem conditions, and increased population.*

Addendum Actions

- **LSF Action 5.3** Develop tools that project water carrying capacity with population growth and salmon needs to inform decision-making and policy development.
- **LSF Action 5.4** Develop and implement policies that consider growth management implications for projected future water use.

Relevant Project Findings

This project's research directly advances Low Summer Flows Strategy 5 of the Puget Sound Salmon Recovery Plan Addendum by providing a science-based foundation for understanding how residential water demand could change under future climate, growth, and land use scenarios. In particular, it contributes to Action 5.3 by delivering resources and projections quantifying potential increases in residential water demand through 2080. This is a necessary first step in assessing how those changes interact with watershed-scale carrying capacity for both human and salmon needs. Our modeling integrates factors such as population growth, irrigation demand under hotter, drier summers, and the spatial distribution of land use change—allowing decision-makers to identify areas where water use could conflict with instream flow needs or habitat restoration goals. This analysis supports cross-sector policy development by showing where demand

management, reuse, or growth strategies can help balance water availability for salmon and people under future conditions.

Other Relevant LSF Strategies and Actions

LSF Strategy 1: *Develop and expand efficiency and conservation programs.*

- **LSF Action 1.1** Incentivize municipal water purveyors to develop and share best practices for water reuse and recovery strategies.
- **LSF Action 1.2** Develop strategies for water conservation messaging and public education to be implemented as a shared service for municipal water systems.
- **LSF Action 1.3** Increase the use of irrigation efficiency programs through incentives.

LSF Strategy 4: Increase the pace and scale of local actions that address water quantity.

- **LSF Action 4.7** Improve local efficiency by supporting programs that work with landowners to reuse irrigation and agricultural drainage water, improve irrigation efficiency, plant drought-resistant and native plants, and promote indoor water conservation practices.

Population Growth and Infrastructure (PG&I)

Addendum Strategy

PG&I Strategy 1: *Protect critical salmon habitat and achieve a net gain in ecosystem function and habitat productivity by strengthening laws and regulations and improving their implementation to better channel growth and prevent habitat conversion.*

Addendum Action

- **PG&I Action 1.5** Identify and address factors that incentivize and enable continued conversion of lands—including both lands outside of urban growth areas (UGAs) and lands designated as critical areas—for low-density development and sprawl.

Relevant Project Findings

Project findings directly support PG&I Strategy 1 and Action 1.5 by demonstrating how low-density development patterns can increase residential water demand, potentially contributing to habitat degradation, especially in headwater and flow-limited basins. The analysis shows that dispersed growth drives higher outdoor irrigation demand and system expansion, intensifying withdrawals from ecologically sensitive areas and fragmenting salmon habitat. In contrast, compact

growth aligned with Urban Growth Areas (UGAs) reduces per-capita water use, limits infrastructure encroachment, and helps preserve critical areas. These insights highlight how current land use policies and infrastructure extension practices can inadvertently incentivize sprawl, especially in unincorporated or undeveloped lands. By integrating water demand modeling into growth management and capital planning, local and regional partners can more effectively identify and address the structural drivers of habitat conversion. This approach supports the net gain of ecosystem function while advancing socio-ecological climate resilience—ensuring development is both water-smart and habitat-sensitive.

Low Smolt Survival (LSS)

Addendum Strategy

LSS Strategy 4: *Reduce contaminant loads in juvenile salmon and in nearshore and marine habitats.*

Addendum Action

- **LSS Action 4.5** Reduce point and nonpoint source pollutant loads in Puget Sound watersheds.

Relevant Project Findings

Project findings provide initial insights into how different residential water use patterns and infrastructure decisions could affect certain pollutant loadings in salmon habitats, supporting Low Smolt Survival Strategy 4 of the Salmon Recovery Plan Addendum. Specifically, this analysis contributes to Action 4.5 by highlighting the potential role of water use efficiency and reclaimed water expansion in reducing both point source discharges and nonpoint source runoff. Inefficient outdoor water use contributes to excess irrigation and urban runoff, which carry nutrients, pesticides, and other contaminants into streams and nearshore areas. The project findings suggest that efficiency improvements and targeted landscape management could help reduce this runoff at scale. Additionally, increasing the use of reclaimed water can reduce nutrient loads and thermal impacts, improving water quality in critical rearing and migration corridors for juvenile salmon. These strategies offer practical, scalable tools to reduce pollutant inputs while also improving regional water resilience.

Climate Change (CC)

Addendum Strategy

CC Strategy 1: *Protect and restore critical habitats and ecosystem functions.*

Addendum Action

- **CC Action 1.5** Implement large-scale projects and programs that synergistically advance salmon recovery goals, reduce the magnitude of climate change (e.g., increase carbon sequestration in Puget Sound ecosystems), and promote socio-ecological climate resilience.

Relevant Project Findings

Project findings support CC Strategy 1 by illustrating how land use, water demand, and infrastructure planning intersect, pointing to the direct impacts of different choices on critical salmon habitats and ecosystem functions. In particular, the research contributes to Action 1.5 by identifying integrated strategies—such as efficiency improvements, compact land use, and reclaimed water expansion—that reduce pressure on aquatic ecosystems while supporting broader climate and community resilience goals. By showing that modest conservation measures can significantly reduce future withdrawals, especially during low-flow summer periods, the project helps protect headwaters, riparian areas, and instream flow conditions essential for salmon. Additionally, reducing the need for new, carbon-intensive infrastructure through conservation and reuse supports climate mitigation objectives. These approaches can be embedded in large-scale watershed programs that advance salmon recovery while promoting multi-benefit outcomes—including water security, habitat protection, and reduced emissions—consistent with a socio-ecological resilience framework.

Other Relevant CC Strategies and Actions

CC Strategy 6: *Build and maintain the capacity of practitioners and organizations working toward salmon recovery and climate change goals.*

- **CC Action 6.3** Invest in efficacy research on potential future management actions (e.g., protecting streams exposed by glacial retreat within and outside of Washington state; assisted translocation of species, using reclaimed water to supplement streams during critical low flow periods; buffering ocean acidification of Puget Sound marine waters with submerged aquatic vegetation or other means).

PART 2: LOCAL RESILIENCE PLANNING REQUIREMENTS

In this section we discuss Washington's Comprehensive Planning and Water System Planning requirements. In both cases, HB 1181 mandated the addition of a 'Climate Resilience Element' within existing planning requirements. These requirements are distinct in their applicability, scope, and requirements, but both follow a similar resilience planning framework (U.S. Climate Resilience Toolkit 2024).

The two local resilience planning efforts discussed are distinct from the state/regional resilience planning efforts in that they aim to support local communities/water systems in identifying the plans, actions, and strategies that are priorities for their community. In this section we discuss key project findings in the context of current planning requirements.

It is important to note that communities are not explicitly required to plan for water supply availability in their comprehensive plan, though some communities choose to do so. Water systems are required to evaluate water supply availability in their Water System Plan. In both cases, the planning horizon is 20 years, substantially less than the ~60-year projections in this project. Both planning processes have requirement for coordination with other planning efforts, but the plans do not speak directly to each other and are often on different update cycles. These observations are, in part, a driver behind an overarching key finding from this study,

Coordinated policies across land use, water, and climate planning are essential to managing future demand and building systemwide resilience.

COMPREHENSIVE PLANNING REQUIREMENTS

Background

Washington's Growth Management Act (GMA) (RCW 36.70A.070) requires counties and urban cities to include Utilities, Capital Facilities, Land Use, Climate & Resiliency, and Critical Areas elements in their comprehensive plans (Municipal Research and Services Center 2025). While some communities consider water availability in their comprehensive plans, it is not necessarily required by the GMA. Figure 1 connects key findings on residential water demand and reuse with required comprehensive plan elements and is followed by additional discussion of these connections.

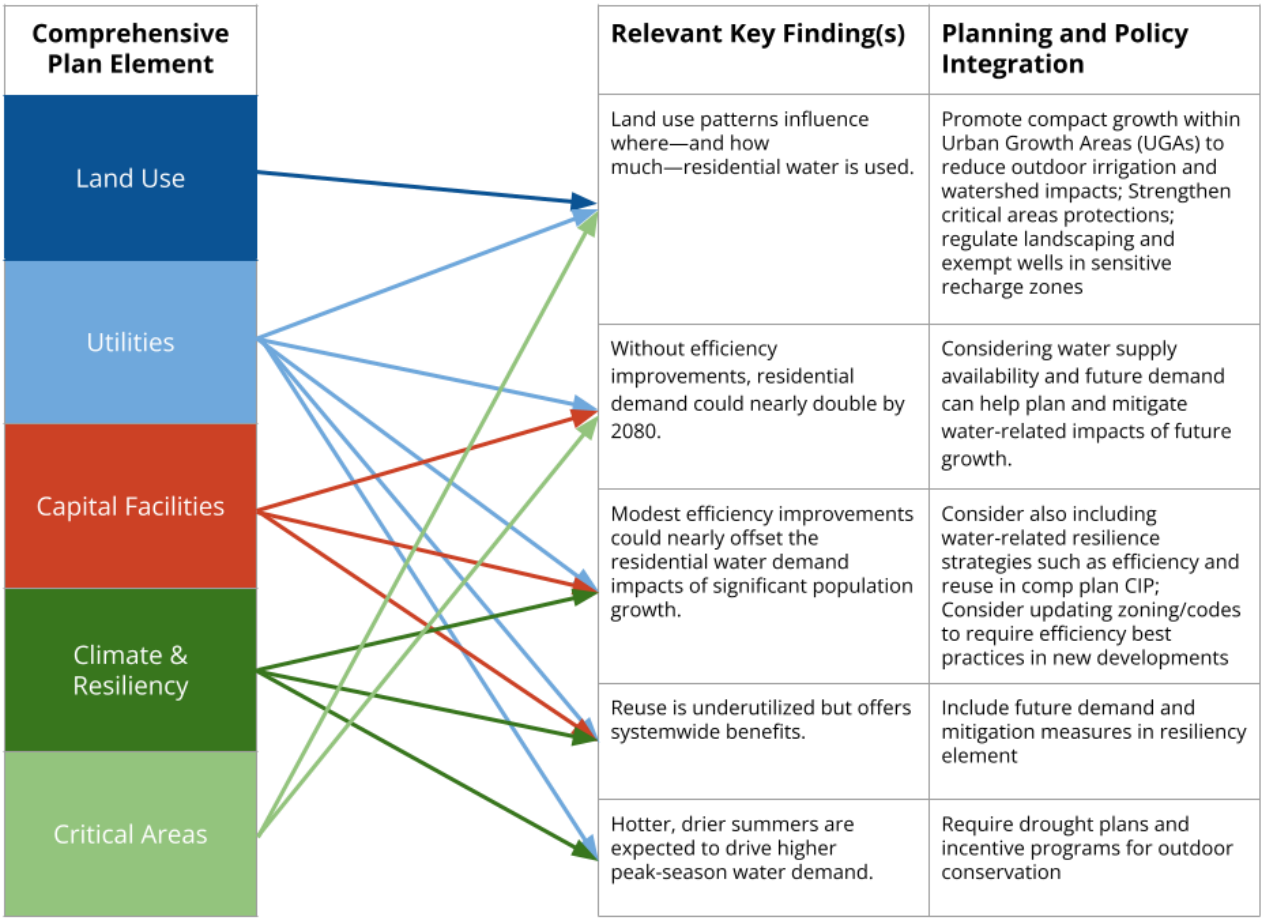

Figure 1. Connections between comprehensive planning requirements and key project findings.

Comprehensive Planning Requirements and Key Study Findings

Key Finding: Without efficiency improvements, residential demand could nearly double by 2080.

This finding raises important considerations for how jurisdictions meet comprehensive planning requirements under the GMA. This project highlights a need to integrate long-range water demand forecasting into land use, capital facilities, and utilities elements of local comprehensive plans, particularly in fast-growing areas. The GMA requires cities and counties to plan for urban growth in a way that ensures adequate public facilities (RCW 36.70A.070), and water supply is a fundamental part of that infrastructure. This finding supports more coordinated planning between land use and water utilities, as required by the Capital Facilities

and Utilities elements, and emphasizes the importance of aligning future growth with water system capacity and conservation goals. It also supports the integration of climate considerations into planning, as recommended under HB 1181 (2023), by showing how climate and efficiency variables can shape future demand trajectories and service reliability.

Key Finding: Modest efficiency improvements could nearly offset the residential water demand impacts of significant population growth.

Under the GMA, jurisdictions are required to ensure that public services and infrastructure, including potable water supply, are adequate to serve planned growth (RCW 36.70A.070). This research provides a strong technical basis for integrating consideration of water conservation strategies into the Utilities and Capital Facilities elements of comprehensive plans, supporting demand management as a viable alternative to costly system expansions. It also reinforces the importance of coordinating land use and water planning—a central tenet of the GMA—by showing that conservation can preserve capacity, improve service equity, and reduce the environmental footprint of new development. As jurisdictions update their plans under new climate planning requirements (e.g., HB 1181), this finding supports the case for embedding efficiency into growth and infrastructure scenarios as a key climate resilience strategy.

Key Finding: Reuse is underutilized but offers systemwide benefits.

As cities and counties plan for growth while ensuring the adequacy of public services and environmental protection, reclaimed water presents a strategic opportunity to enhance supply resilience, reduce pressure on potable sources, and support multi-benefit infrastructure investments. Jurisdictions can integrate reclaimed water opportunities into the Utilities element of their comprehensive plans, especially in areas with seasonal water shortages, growing demand, or instream flow closures. Reuse also supports goals in the Capital Facilities element by potentially deferring or downsizing future water and wastewater infrastructure projects. In light of climate change and new state requirements to incorporate climate resilience into planning (e.g., HB 1181), reclaimed water use represents a flexible adaptation strategy that supports both water reliability and ecosystem health — aligning with GMA goals to guide sustainable, coordinated development.

Key Finding: Land use patterns influence where—and how much—residential water is used.

Since the GMA requires the coordination of land use, infrastructure, and environmental planning, understanding how development form affects water demand is essential for creating sustainable, serviceable communities. Compact, higher-density growth tends to reduce per capita water use and irrigation needs, whereas dispersed or rural development increases demand and system extension costs. This has direct implications for the Land Use, Capital Facilities, and Utilities elements of local plans, which must address the timing, location, and financing of growth-related infrastructure. By integrating water-sensitive land use planning into comprehensive plan updates — especially in designated Urban Growth Areas (UGAs)— jurisdictions can better align future development with water system capacity, support streamflow protection goals, and reduce long-term service and environmental costs. This also strengthens climate resilience and supports compliance with new climate-related planning requirements.

Key Finding: Hotter, drier summers may increase peak-season water demand.

As local governments prepare for growth and infrastructure needs, this finding reinforces the importance of integrating climate projections into the Utilities and Capital Facilities elements of comprehensive plans, particularly in areas with known seasonal water stress. Increased summer demand also intersects with land use and environmental goals, as higher withdrawals during low-flow periods can impact stream health and salmon habitat. This underscores the need for coordinated land use, water supply, and climate planning, a priority elevated by recent updates to the GMA (e.g., HB 1181), which now requires jurisdictions to assess climate impacts and develop resilience strategies. Incorporating peak-season climate demand into local planning can help guide adaptive conservation programs, infrastructure design, and long-term service reliability.

Key Finding: Coordinated policies across land use, water, and climate planning are essential to managing future demand and building systemwide resilience.

The GMA requires local governments to develop comprehensive plans that integrate infrastructure and land use, while recent updates (e.g., HB 1181) now require jurisdictions to assess climate risks and incorporate resilience strategies.

This project underscores how fragmented planning across these domains can lead to inefficiencies, missed opportunities, and greater vulnerability—while coordinated approaches can stabilize demand, reduce infrastructure burdens, and enhance environmental outcomes. Aligning the Land Use, Utilities, Capital Facilities, and Climate elements of comprehensive plans allows jurisdictions to promote compact, water-smart growth; target conservation investments where they're most impactful; and design infrastructure systems that are more adaptable, equitable, and sustainable over time.

WATER SYSTEM PLANNING REQUIREMENTS

Background

In Washington State, Group A water systems serving more than 1000 connections must submit a Water System Plan (WSP) to Washington Department of Health (DOH) every ten years (or in response to other qualifying events) (WAC-246-290-100). Water System Planning requirements are outlined in the Water System Planning Guidebook (Washington State Department of Health 2025). The findings of this study span across multiple areas of water system operations and planning. In this section, we crosswalk project findings and DOH WSP requirements (Table 5) then discuss the relevance or project findings in the context of current WSP requirements.[1]

[1] It is important to note that findings are discussed based on potential relevance to WSP, generally, not necessarily because they are required to be part of a WSP (see discussion).

Table 5. Summarizing connections between project findings and DOH WSP Guidebook.

Key Findings	Water System Planning Guidebook Sections Relevant to Project Findings														
	Local Govt Consistency	Watershed Plan Consistency	Water Supply Characteristics	Water Supply Reliability	Future Population Projections and Land Use	Future Water Demand	Climate Resilience Element	Capacity Analysis	Water Use Efficiency Program	Water Use Efficiency Savings	Watershed Control Program	Emergency Preparedness and	CIP Prioritization	Financial Viability	Water Rate Evaluation
	1.7	1.8	2.4	2.5	2.6	2.7	2.8	3.4	4.3	4.4	5.3	6.4	8.1	9.1	9.2
Without efficiency improvements, residential demand could nearly double by 2080.			X	X	X	X	X	X	X	X	X	X	X	X	X
Modest efficiency improvements could nearly offset the residential water demand impacts of significant population growth.					X	X	X	X	X	X		X	X	X	X
Reuse is underutilized but offers systemwide benefits.						X	X	X					X	X	
Land use patterns influence where—and how much—residential water is used.				X	X	X	X	X	X	X	X	X	X	X	
Hotter, drier summers may increase peak-season water demand.				X		X	X	X	X	X	X	X			
Coordinated policies across land use, water, and climate planning are essential to managing future demand and building systemwide resilience.	X	X					X						X	X	

Water System Planning Requirements and Key Study Findings

Key Finding: Without efficiency improvements, residential demand could nearly double by 2080.

This finding has implications across multiple elements of water system planning, including water supply characteristics (Chapter 2.4), water supply reliability (Chapter 2.5), future demand (Chapter 2.7), capacity analysis (Chapter 3.4), and capital improvement planning (Chapter 8.1). While the project's modeling extends beyond the 20-year planning horizon required under WSP requirements, it provides valuable long-term insights into the scale and trajectory of potential residential demand pressures. Although regional estimates carry more uncertainty than utility-specific forecasts, they underscore the importance of integrated, climate-informed forecasting and coordinated conservation strategies, consistent with guidance in Chapters 4.3 and 4.4 on water use efficiency. They also inform long-term planning for infrastructure investment and financial viability (Chapter 9.1). Anticipating demand trajectories is essential to maintaining reliable, affordable, and climate-resilient service—particularly in the face of growing populations, evolving land use, and intensifying climate impacts.

Key Finding: Modest efficiency improvements could nearly offset the residential water demand impacts of significant population growth.

This finding directly supports the objectives of the WSP, particularly in the areas of demand forecasting (Chapter 2.7), water use efficiency planning (Chapters 4.3 and 4.4), and infrastructure investment (Chapters 8.1 and 9.1). By demonstrating that relatively modest indoor and outdoor efficiency measures can help stabilize demand—even amid substantial growth—this research provides a strong basis for cost-effective conservation strategies that can delay or avoid the need for major system expansions. It also reinforces the importance of embedding efficiency assumptions into future demand projections[2] and highlights opportunities for utilities to prioritize equity-focused retrofits, reduce operational risk, and align capital and financial planning with long-term sustainability.

[2] Water systems are required to consider the impacts of water use efficiency improvements on demand. However, water supply reliability and future water demand estimates, conservatively, do not incorporate projected savings via water use efficiency. The degree to which efficiency gains are considered by water systems in specific capital improvements will varies from system to system and project to project.

Key Finding: Reuse is underutilized but offers systemwide benefits.

Reclaimed water is currently underutilized in the region, yet it offers significant systemwide benefits that align with multiple WSP elements[3], including water supply reliability (Chapter 2.5), emergency preparedness (Chapter 6.4), capacity analysis (Chapter 3.4), and capital planning (Chapter 8.1). The project's findings highlight how expanded reuse—particularly in areas with seasonal water stress or marine effluent discharges—can supplement potable supplies, reduce demand on limited sources, reduce pollutant discharges, and provide climate-resilient alternatives for irrigation, cooling, or industrial uses. While potential varies across the region, incorporating reuse opportunities into water system planning could improve long-term service reliability, enhance system flexibility during drought or peak periods, and reduce capital costs by offsetting infrastructure expansion needs. Utilities can use this analysis to support feasibility assessments and regional coordination on non-potable reuse strategies, particularly in WRIAs with instream flow closures or projected supply-demand imbalances.

Key Finding: Land use patterns influence where—and how much—residential water is used.

This finding supports more integrated planning across WSP, GMA requirements, and WRIA-based watershed planning. Compact development within Urban Growth Areas (UGAs) tends to reduce per-capita demand and infrastructure strain, while dispersed growth increases seasonal outdoor use, creating potential challenges for long-term system sustainability. This has direct relevance for WSP sections on land use, population, and demand forecasting (Chapters 2.6 and 2.7) and planning consistency (Chapters 1.6 and 1.7). At the WRIA scale, the spatial distribution of future demand informs instream flow management, infrastructure siting, and habitat protection—particularly in headwater basins and flow-limited areas. By integrating land use-driven demand modeling into WSPs and regional watershed planning, utilities and local governments can better coordinate infrastructure investments, support salmon recovery goals, and plan for climate-resilient, water-smart growth.

[3] Reclaimed water is not required to be considered in WSP, but, for some systems, it may directly align with the overarching water system planning goal of system resilience.

Key Finding: Hotter, drier summers may increase peak-season water demand.

Higher peak season demand is a key climate-related risk that intersects with several WSP requirements, including water supply reliability (Chapter 2.5), future demand (Chapter 2.7), capacity analysis (Chapter 3.4), emergency preparedness (Chapter 6.4), and the climate resilience element (Chapter 2.8). The project's climate-adjusted demand modeling provides insights into the magnitude of potential future summer usage and system stress, especially from outdoor irrigation. This information can help shape future peak demand projections, inform drought response strategies, and help utilities evaluate whether their existing supply and infrastructure can maintain service under projected climate extremes. This finding also reinforces the importance of conservation, seasonal pricing, and adaptive water management strategies that enhance resilience to long, dry summers—now an increasingly likely planning scenario across much of the state.

Key Finding: Coordinated policies across land use, water, and climate planning are essential to managing future demand and building systemwide resilience.

This finding supports the intent of WSP Chapters 1.6 and 1.7 (planning consistency) and Chapter 2.8 (Climate Resilience Element), which emphasize alignment between WSP, comprehensive plans under the GMA, and broader climate preparedness efforts. The project highlights how fragmented planning can undermine conservation and infrastructure efficiency, while coordinated strategies—such as compact growth, integrated climate scenarios, and proactive water efficiency—can reduce demand, defer costly capital upgrades, and improve ecosystem outcomes. Incorporating this level of cross-sector coordination into WSP development strengthens both water supply planning and community resilience, and ensures that utilities, local governments, and watershed stakeholders are working from a shared foundation to address growth, climate impacts, and equity.

CONCLUSIONS

This project underscores a unifying message across Washington's climate, ecosystem, and infrastructure planning frameworks: residential water demand management is both a critical risk and a powerful opportunity for advancing resilience. Although each planning effort—state, regional, and local—has its own

mandates, timeframes, and scope, they share a growing recognition that integrated planning across water, land use, and climate domains is essential.

Within the *State Climate Resilience Strategy*, project findings speak to both water infrastructure and equity-centered adaptation goals, highlighting strategies that can help to plan for drought, reduce pollutant loads, and manage future demand under climate stress. Within the *Puget Sound Partnership's Science Plan, Action Agenda, and Salmon Recovery Addendum*, the findings support a wide array of ecological priorities, from protecting instream flows to preventing habitat conversion, reducing contaminants, and adapting to hotter, drier summers. At the local scale, these same findings provide a strong basis for meeting evolving requirements under *Comprehensive Plans* (RCW 36.70A.070) and *Water System Plans (*WAC 246-290-100), especially as communities incorporate climate resilience and interagency coordination into long-term infrastructure and growth strategies.

Ultimately, this research reinforces that small shifts in policy and planning—toward more efficient water use, compact growth, and expanded reuse—can yield significant systemwide benefits. Embedding these strategies into resilience planning across all levels of governance will be essential to sustaining both human communities and ecological systems in the decades ahead.

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