



Photo source: Annie Dufficy

Scatter Creek Local Strategy Plan

A Subbasin Implementation Plan for the Chehalis Basin Aquatic Species Restoration Program

Prepared by:

Northwest Hydraulic Consultants Inc.

12787 Gateway Drive S.

Seattle, WA 98168

Tel: 206.241.6000

www.nhcwater.com

Prepared for:

The Chehalis Basin Partnership

100 W. Broadway, Suite 100

Montesano, WA 98563

June 30, 2025

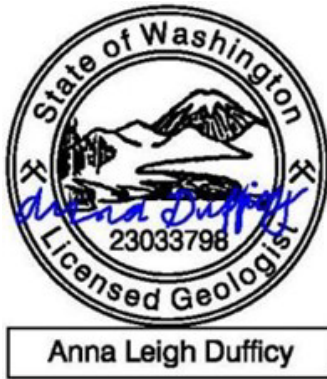
Final Report

NHC Reference No. 2009024

DOCUMENT TRACKING

Date	Revision No.	Reviewer	Issued For
6/16/2025	1	Subcommittee	Initial Review

Report prepared by:



Annie Dufficy, LG
Water Resource Geoscientist
Lead Author

Cynthia Carlstad, LHG
Principal Hydrogeologist
Author & Lead Facilitator

NHC File Path: Q:\2009024.01_Scatter_Creek_Local_Restoration_Strategy_Development\Local Strategy Plan\ScatterCreekLocalStrategyPlan_R2_trackedChanges.docx

DISCLAIMER

This document has been prepared by **Northwest Hydraulic Consultants Inc.** in accordance with generally accepted engineering practices and is intended for the exclusive use and benefit of The Chehalis Basin Partnership and their authorized representatives for specific application to the Scatter Creek Local Strategy Plan in Washington State. The contents of this document are not to be relied upon or used, in whole or in part, by or for the benefit of others without specific written authorization from **Northwest Hydraulic Consultants Inc.**. No other warranty, expressed or implied, is made.

Northwest Hydraulic Consultants Inc. and its officers, directors, employees, and agents assume no responsibility for the reliance upon this document or any of its contents by any parties other than The Chehalis Basin Partnership.

CREDITS AND ACKNOWLEDGEMENTS

The authors would like to thank the State of Washington Office of the Chehalis Basin for funding through the Office of Chehalis Basin in partnership with local, Tribal, and state partners to reduce flood damage and restore aquatic life in the Chehalis River Basin. The authors would like to also thank The Chehalis Basin Partnership for initiating this plan and for the support provided during the project. The Scatter Creek Subcommittee of the Chehalis Basin Partnership guided development of the Local Strategy Plan; work efforts by Subcommittee members form substantive content which creates a solid foundation for restoration and protection efforts that will achieve the Subcommittee's vision for Scatter Creek. Kirsten Harma (Chehalis Basin Partnership and Chehalis Basin Collaborative for Salmon Habitat), Drew Mealor and Victoria Knorr (WDFW ASRP), Kevin Hansen (Thurston County), and Jennie Lewis (Ecology OCB) were especially instrumental in shaping this work.

The following NHC personnel participated in the study:

- Annie Dufficy Project Manager, Lead Geomorphologist
- Cynthia Carlstad Principal in Charge, Facilitator

EXECUTIVE SUMMARY

The Scatter Creek Local Strategy Plan provides a comprehensive roadmap for restoring and protecting aquatic species and ecosystem functions in the Scatter Creek watershed—a critical subbasin of the Chehalis River located entirely in Thurston County. This plan is part of the Chehalis Basin Aquatic Species Restoration Program (ASRP) and was developed in partnership with the Chehalis Basin Partnership (CBP) Streamflow Restoration Program. Scatter Creek has been identified as a near-term priority due to its remaining high-value habitats, risk of degradation from ongoing development, and opportunities for meaningful restoration. The plan integrates historical context, hydrologic and ecological data, community knowledge, and a locally developed vision to guide targeted restoration investments.

The watershed has undergone substantial land use change over the past century, transitioning from prairie and forest to agricultural lands to predominantly rural residential development. These shifts, combined with its associated increase in groundwater extraction, riparian degradation, and changes in flow management, have led to reduced streamflow continuity, elevated summer water temperatures, and compromised aquatic habitat conditions. To address these challenges, the plan outlines a suite of strategies including riparian restoration, floodplain reconnection, flow augmentation, groundwater conservation, invasive species management, and beaver-based restoration. These actions are guided by a shared vision to restore and protect healthy streamflow and aquifers, reduce summer stream temperatures, create a resilient ecosystem, and safeguard unique aquatic habitats—supported by an engaged and informed community.

A detailed reach assessment investigated existing ecological and hydrologic conditions, identified major risks from development and habitat degradation, and highlighted key data gaps—particularly in groundwater-surface water interactions, species presence and range as they relate to seasonal trends in flow, tributary flow contributions, and species assessments for non-salmonids, such as lamprey and freshwater mussels. Addressing these data needs is essential to inform adaptive management and define a desired flow regime for Scatter Creek. The plan underscores that restoration strategies must be implemented in a coordinated, system-wide manner; the success of any one action is closely tied to the success of others. By integrating scientific investigations, local knowledge, and collaborative governance, the Scatter Creek Local Strategy Plan provides a robust framework to restore ecological function, support native species, and build long-term watershed resilience in the face of development and climate pressures.

Please read and understand the entire report before acting on the results.

TABLE OF CONTENTS

Executive Summary	vi
TABLE OF CONTENTS	vii
1 Introduction	11
1.1 Context for the Local Strategy Plan	11
1.2 Planning Process	12
1.3 Vision for Scatter Creek	13
2 Project Area Description	13
2.1 Watershed Characterization	13
Historical Setting	16
2.2 Geology and Soils	18
2.3 Surface Water and Groundwater Conditions	22
Scatter Creek Aquifer	22
Water Use	23
Scatter Creek Streamflow	24
Groundwater – Surface Water Investigations	27
2.4 Water Quality	31
2.4.1 Aquifer Water Quality	31
2.4.2 Stream Water Quality	32
Water Temperature	33
2.5 Aquatic and Semi Aquatic Habitat	36
2.5.1 Aquatic Species Existing Conditions	36
2.5.2 Semi-Aquatic Species Existing Conditions	40
2.5.3 Habitat limiting factors	41
3 Reach Assessment	42
3.1 Reach Assessment Approach	42
3.2 Reach Assessment Findings	50
Impaired Streamflow: Reaches 1 to 4, 9	50
Spawning Habitat is Limited: Reach 1	50
Habitat Connectivity and Intactness: Reaches 2(lower), 3, 6, and 8b	50
Water and Land Use Changes: Reaches 2 to 4, Reach 8b	51
3.3 Data Gaps	51
4 Prior and Ongoing Restoration Activities	52
5 Future Projected Conditions	54
5.1 Land and Water Use	54
5.2 Climate Change Impacts and Vulnerabilities	55
Climate Resilience	57
6 Outreach Strategy	58

	6.1 Outreach Audiences and Topics	59
	6.2 Outreach Actions and Outcomes	60
7	Protection and Restoration Strategy	62
	7.1 Protection and Restoration Goals	62
	7.2 Restoration Goals and Strategies	63
	7.3 Reach-Specific Protection / Restoration Strategies and Project Opportunities	65
	1. Restore Flow	65
	2. Outreach	65
	3. Reed Canary Grass	65
	4. Built Environment Improvements	65
	5. Climate Resiliency	66
8	Monitoring and Adaptive Management	67
9	Conclusion	68
10	References	68

TABLES, FIGURES, AND PHOTOS IN TEXT

TABLES

Table 2-1	Breakdown of land cover types in Scatter Creek basin from NLCD (2019)	16
Table 2-2	Scatter Creek aquifer characteristics from groundwater modeling	22
Table 2-3	Aquatic Life Temperature Criteria in Washington Fresh Water [Table 200 (1)(c) in Chapter 173-201A WAC]	35
Table 2-4	Summary of known aquatic species presence in Scatter Creek	37
Table 3-1	Data sources for Scatter Creek reach assessment	42
Table 3-2	Reach Assessment Summary Table for Scatter Creek	44
Table 3-3	Data gaps in Scatter Creek	51
Table 5-1	Projected future conditions flow in the Scatter Creek watershed by 2080.	
	Data from Coast Salmon Partnership web map	55
Table 5-2	Historic and Projected Climatic Conditions in Tenino, WA (from Climate Toolbox)	56
Table 5-3	Climate stressors (exposure) in the Scatter Creek and recommended actions to increase resilience in the face of those (Adams and Zimmerman 2023).	57
Table 6-1	Outreach Goals and Objectives	58
Table 6-2	Outreach Audiences and Topics	59
Table 6-3	Recommended Outreach Strategies and Actions	60
Table 7-1	Scatter Creek Goals and Restoration/Protection Strategies	63
Table 7-2	Summary of Reach-Specific Strategies, Actions, and Project Opportunities	66

FIGURES

Figure 1	Basin area land use zoning and recent residential building permits for single and multifamily housing (from TRPC)	15
Figure 2	GLO Cadastral Survey map of the area near Tenino, Cozy Valley, and McIntosh Lake from 1855 (Township 16N, Range 1W)	17
Figure 3	1910 photograph of high school students at the James Road bridge, from David James (1980) written family history	18
Figure 4	Glacial outwash drainage channels through Violet Prairie (Image from the Washington Geological Survey, Washington State DNR)	Error! Bookmark not defined.
Figure 5	Basin Area Geology and Critical Aquifer Recharge Areas	Error! Bookmark not defined.
Figure 6	Cumulative well completion ¹ and residential building permits ² by year in Scatter Creek basin	Error! Bookmark not defined.
Figure 7	Water use in Scatter Creek basin by allocated annual pumping yields (apy)	Error! Bookmark not defined.
Figure 8	Average daily streamflow from Thurston County monitoring station #55a at James Road for periods during flow augmentation (1993 to 2011, *note:	

	data gap between 1999 and 2007), after flow augmentation (2013 to 2024), with the most recent annual flows for comparison (2024)	25
Figure 9	Comparison of transpiration rates for various riparian plants from Gebauer et al. (2016)	Error! Bookmark not defined.
Figure 10	Comparison of seepage run data from 2010 (Gendaszek, 2011) and 2024-2025 (Thurston County ongoing study), plot modified from Thurston County (2025)	Error! Bookmark not defined.
Figure 11	TOP: Plot of seepage run gains/losses on May 31, 2024 (blue/yellow lines, TC data) and flow observations (circles, WDFW-USGS & CBP Citizen Science); BOTTOM: Discharge at James Rd and Precipitation at Grand Mound	Error! Bookmark not defined.
Figure 12	Plot of average and maximum July water temperatures in Scatter Creek, measured by Thurston Conservation District in 2002 (No data for RM 0 to RM 2)	34
Figure 13	Plot of daily mean water and air temperatures in Scatter Creek between RM 8.5 and RM 2.3, measured by Thurston County in 2024 (adapted from Thurston County, 2025)	34
Figure 14	Computed 7-DADMax for water temperatures measured in Scatter Creek in 2024 by Thurston County between RM 8.5 and RM 2.3 (lines indicate temperature criteria from Table 2-3)	36
Figure 15	Estimated coho escapement from Scatter Creek from 1984 to 2023 calculated by WDFW from spawning surveys conducted by WDFW (1984 to 2023), Quinault Indian Nation (1984 to 2023), and the Chehalis Tribe (1984 to 2000)	39
Figure 16	Beaver dam in Scatter Creek in the WDFW Wildlife Area	41

APPENDICES

Appendix A	Reach Assessment Mapbook
Appendix B	Scatter Creek Restoration Strategies by Reach

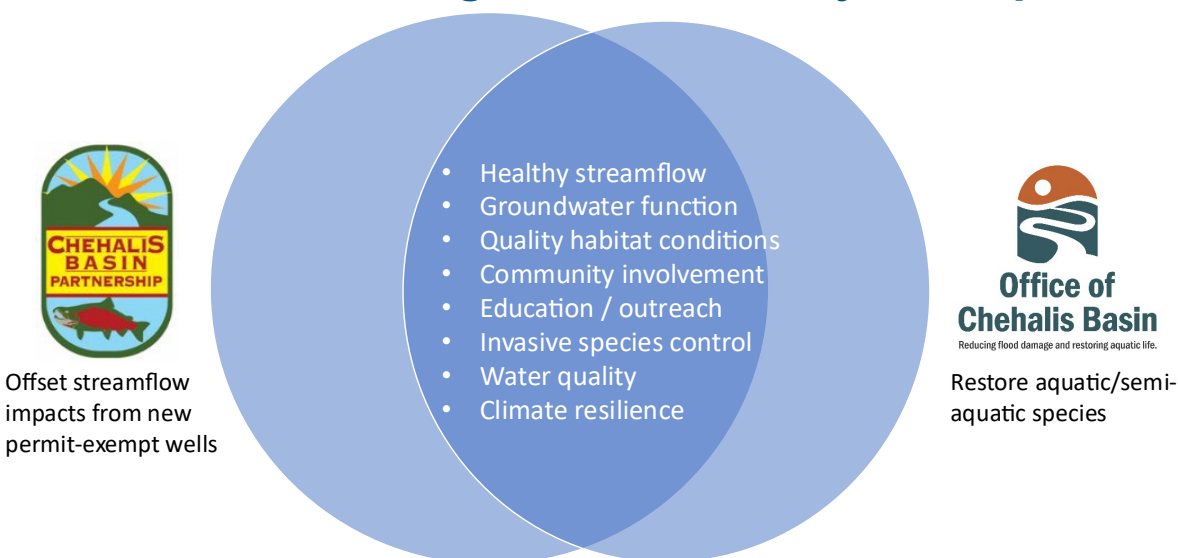
1 INTRODUCTION

This plan was developed through the Chehalis Basin Strategy Aquatic Species Restoration Program (ASRP) Local Strategy Planning process. It pertains to the Scatter Creek watershed, a tributary to the Chehalis River. The Local Strategy Plan's purpose is to communicate a more detailed implementation strategy for the Scatter Creek watershed than was described in the ASRP. The intention is to provide information to enable project sponsors to develop and implement projects that support the protection/restoration goals for Scatter Creek and the ASRP.

1.1 Context for the Local Strategy Plan

Scatter Creek is a priority watershed for two Chehalis Basin programs- the ASRP and the Streamflow Restoration Program, which is overseen by the Chehalis Basin Partnership (CBP). The CBP's Streamflow Restoration Program is largely focused on flow – protecting and offsetting streamflow impacts from residential wells. ASRP focuses on aquatic and semi-aquatic species and seeks to restore habitats through process-based restoration approaches. As shown below, the goals for these two programs largely overlap because streamflow is fundamental to most aquatic species needs.

CBP and Chehalis Basin Strategy Aquatic Species Restoration Plan Program Goals Mostly Overlap



The ASRP identified Scatter Creek as a near-term priority for several reasons. Based on two different habitat models and limited field and data analysis, Scatter Creek was identified as

containing high priority core habitats for coho and chum salmon. It was also understood to be at-risk to degradation associated with urbanization as it is located within the rapidly developing Interstate-5 corridor south of Olympia/Tumwater. In addition, the ASRP highlighted that riparian restoration should begin in the near-term ASRP phase to accrue the benefits needed for temperature amelioration.

The CBP's Streamflow Restoration Program identified Scatter Creek as a high priority for two major reasons. The first is that development projections suggest a high concentration of new domestic wells will come online over the next few decades. These wells will draw water supply from the shallow aquifer that is directly connected to Scatter Creek, and an impact to streamflow is expected. Secondly, there are good opportunities to restore, augment, and conserve water to aid streamflow in Scatter Creek.

1.2 Planning Process

The Scatter Creek Local Strategy Plan was funded by the ASRP and overseen by the CBP, working in close coordination with ASRP staff. The plan was guided by the Scatter Creek Subcommittee of the CBP, whose member organizations include the following (listed in alphabetical order):

- Chehalis Basin Collaborative for Salmon Habitat
- Chehalis Tribe
- Creekside Conservancy (a division of Heernett Environmental Foundation)
- Local Landowners
- Quinault Indian Nation
- Thurston County
- Thurston Conservation District
- United States Geological Survey
- Washington Department of Ecology
- Washington Department of Fish and Wildlife
- Washington Water Trust

Subcommittee members include current and potential project sponsors, researchers, subject matter experts, long-time residents, conservation landowners, and program staff.

The subcommittee met six times over the year-long planning process, guiding the NHC consultant team in plan development. With several active assessment and data collection project ongoing, NHC compiled and synthesized as much data as possible to include in this plan. However, as key studies are completed over the next year, it is advisable to update these findings, especially related to groundwater-surface water interactions and how those inform streamflow restoration efforts.

1.3 Vision for Scatter Creek

The Scatter Creek Subcommittee held a workshop in October 2024 to develop its vision statement for Scatter Creek. The resulting vision statement contains three components:

1. Physical:
 - a. Restore and protect healthy streamflows and aquifers
 - b. Reduce summer stream temperatures
 - c. Create a resilient ecosystem by restoring aquatic habitat and protecting unique aquatic habitats
 - d. Prevent future contamination from nitrogen, sediment, and other sources
2. Community and Governance: Central to achieving this vision is an active resident, tribal, and stakeholder community that understands the cultural significance and unique needs and vulnerabilities of the Scatter Creek watershed and actively participates in collaborative governance and decision-making.
3. Context: This vision is grounded in recognition that freshwater ecosystems have intrinsic value that provides a myriad of services to human and natural systems. The strategy considers economic conditions that influence land use management and details funding opportunities for the restoration and conservation work critical to protecting and enhancing life in and around Scatter Creek.

Goals for Scatter Creek restoration and protection are described in Section 7.

2 PROJECT AREA DESCRIPTION

2.1 Watershed Characterization

Scatter Creek is located within the ASRP Black River Ecological Region, which represents approximately 7% of the overall Chehalis Basin. Scatter Creek has a drainage area of approximately 45 square miles, with a maximum elevation of 1,480 feet and total basin relief of 1,360 feet (USGS, 2019). It is important to note that the contributing groundwater basin area is different than the topographic basin area calculated from purely runoff and overlaps with the Black River and Skookumchuck River aquifers (Mead et al., 1996). Scatter Creek has a temperate maritime climate, with wet winters and dry summers. Given the low relief and relatively low elevation of the basin, precipitation is dominated by rainfall. The mean annual precipitation of the basin from 1981 to 2010 was 49.2 inches (USGS, 2019).

The basin area has a relatively flat topography, which has led to distributed development, with historic agricultural fields slowly transitioning into rural residential uses. The entire basin resides within Thurston County and includes Urban Growth Areas (UGAs) of Tenino and Grand Mound, as well as the unincorporated subarea of Rochester. UGAs designate areas of future urban

growth and are intended to manage growth and concentrate development in areas where environmental impact can be minimized. According to most recent zoning information from the 2019 Thurston County Comprehensive Plan, most of the Scatter Creek basin is zoned as rural residential (RR) with a density of 1 home per 5 acres (75% of basin), while 5% is zoned as RR with a density of 1 home per 20 acres (Figure 1). Only 2% of the basin is zoned as long-term agriculture and 5% is zoned as long-term forestry. Public parks and other publicly zoned land accounts for 4% of the basin.

Most of the recent growth from the 1970s until the present have occurred within and in-between the Rochester subarea and Tenino UGA (Figure 1). Therefore, most of the development has occurred within the historic prairie range of the basin and along Scatter Creek itself. Development is slowly increasing into the forested uplands, although logging remains the primary land use in these areas. There are very few undeveloped parcels remaining along Scatter Creek; the largest of these parcels are owned by WDFW and Colvin Ranch (Figure 1).

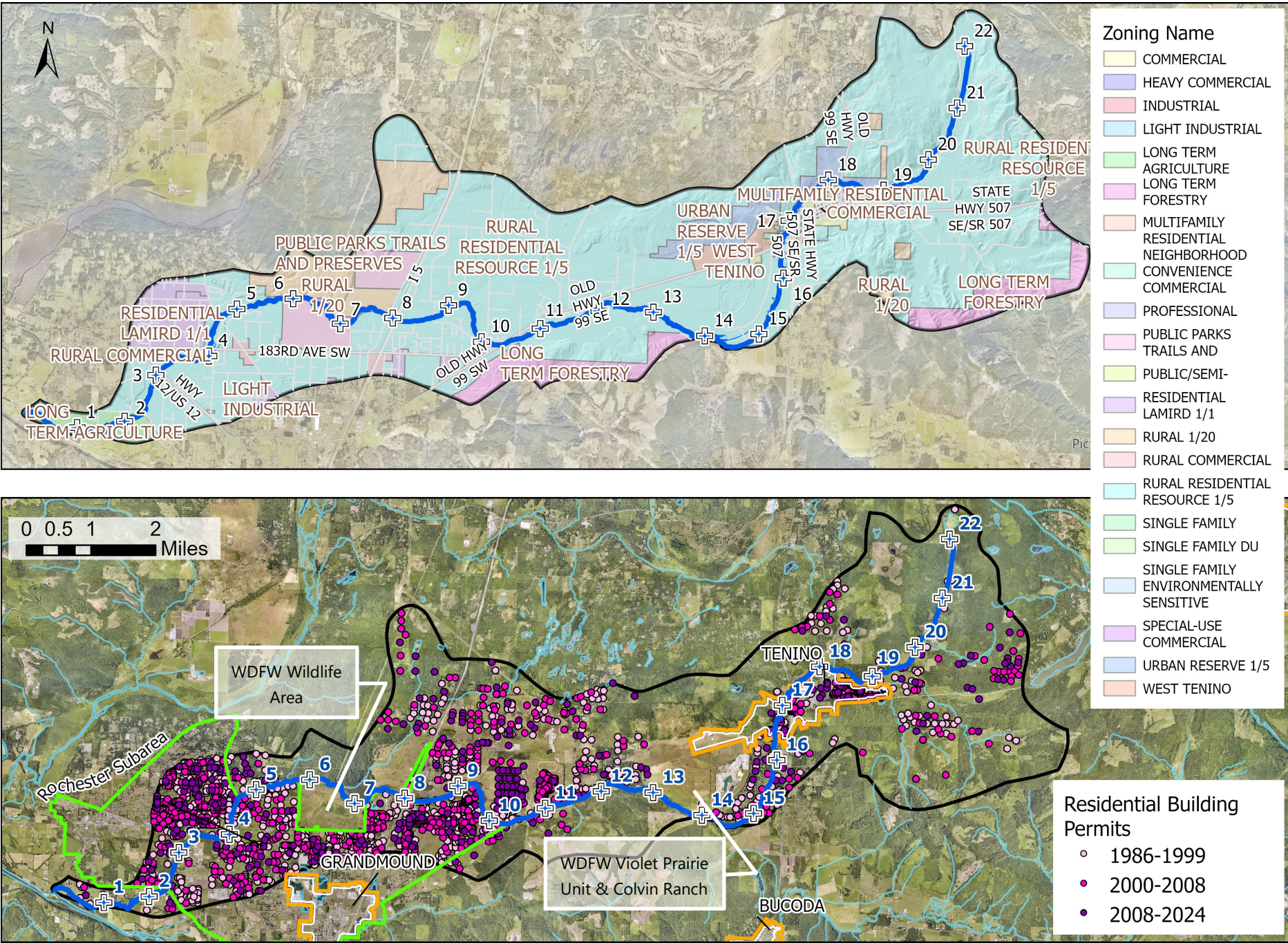


Figure 1 Basin area land use zoning and recent residential building permits for single and multifamily housing (from TRPC)

According to the 2019 National Land Cover Database (NLCD) primary land cover types include forest (41%: evergreen, deciduous, mixed, and shrub), pasture and agricultural land (33%), developed residential (16%: primarily low intensity and open space), with less than 7% of the basin area consisting of wetlands (Dewitz, 2021; Table 2-1). While forested lands account for more than 40% of the land cover, long-term forestry zoned land uses only account for 5% of the basin area due to rural residential zoning designations. Therefore, much of the forested uplands that are currently logged are zoned as rural residential and could be developed in the future. The primary forestry parcel landowners include: PB Lumber, Port Blakely, Green Diamond Resource Company, Ring Family Limited, CGVI LLC, Riffe Lake Timberlands, Taylor Timber, Violet Prairie Plantation, Weyerhaeuser, and the Department of Natural Resources. See Appendix A for mapped forestry parcels and their owners.

Table 2-1 Breakdown of land cover types in Scatter Creek basin from NLCD (2019)

NLCD Land	Relative
Developed,	5.5%
Developed,	7.6%
Developed,	2.6%
Deciduous	2.7%
Evergreen	27.5%
Mixed	6.3%
Shrub/Scrub	5.1%
Herbaceous	2.6%
Hay/Pasture	32.7%
Woody	4.4%
Emergent	2.2%

Historical Setting

For many centuries the Salish-speaking people of the Upper and Lower Chehalis lived along the Chehalis River and its tributaries. The Upper Chehalis fished for lamprey and salmon in Scatter Creek, once abundant in species richness and stock. The prairies surrounding Scatter Creek were cultivated for camas, berries, and other important medicinal and nutritional foods, using controlled burns to sustain the plant diversity that the prairies provide (Storm, 2004; GLO, 1855). The remaining native prairie is a highly threatened ecosystem in the Scatter Creek basin. Most of this land was converted to dairy farms, then most recently dairy farms were replaced by residential land uses. Several large prairie grassland parcels are protected by either WDFW or private land stewards. Protected parcels often use practices such as controlled burns and sustainable grazing to maintain biodiversity.

The first settlers arrived in Scatter Creek in the middle of the 19th century, increasing in number after the 1850 Donation Land Claim Act. The Chehalis Tribe did not sign a treaty with the federal

government and therefore did not officially cede their lands. Written historical accounts and mapping of basin conditions at this time are limited. The first written records of the basin are from nineteenth century General Land Office (GLO) survey field notes, which describe Scatter Creek as a “brushy scattering creek” that varied in width from 20 feet wide to more than 130 feet wide (GLO, 1854). The name “Scatter” could be in reference to the braided flow paths that are common along its 22-mile length, while some attribute the name to its intermittent pools and seasonal nature. It should be noted that none of the GLO records noted dry sections of the creek, despite surveys in summer months (GLO, 1854-1856). GLO surveys mapped much of the land surrounding the present-day alignment of southern headwater tributary (entering Scatter Creek around RM 19 near Tenino, Figure 2), noting it was a “brushy swamp.” Most of the flat land in the upper watershed was mapped as either “marshy creek bottom” or prairie with large oak trees. The notes provide limited details in the valley bottom prairies because the gravelly soil was deemed “second rate” for cultivation.

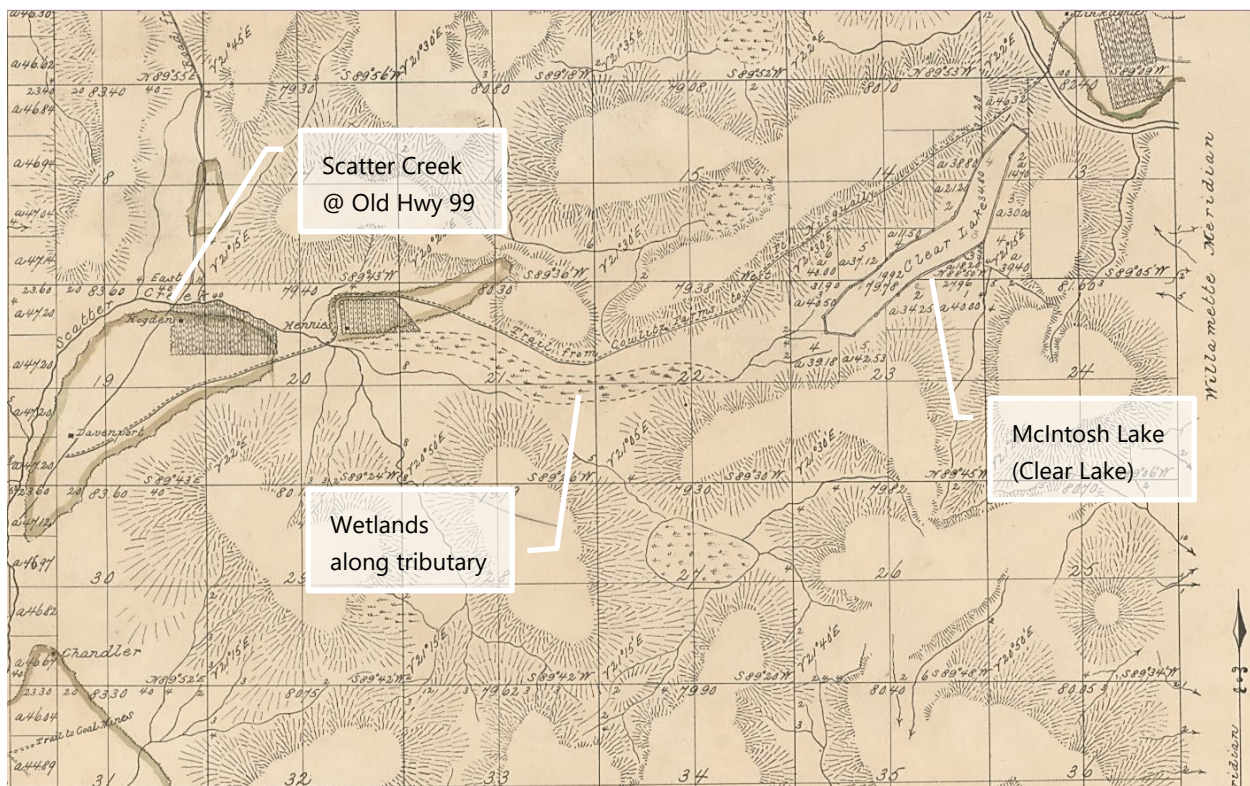


Figure 2 GLO Cadastral Survey map of the area near Tenino, Cozy Valley, and McIntosh Lake from 1855 (Township 16N, Range 1W)

Written records from the James family, the original settlers of Grand Mound, provide additional insight into the historical conditions of Scatter Creek. Letters from Anna Maria James in the 1860s note that Scatter Creek used to be “so full of salmon that [sons] Tom and Johnny could with ease catch a barrel in an hour. They are from 20 to 30 lb. in a fish, besides which we have a small fish very much resembling a pilchard. We are blessed with the most beautiful springs of

water I ever saw" (from David James, 1980). Her husband Samuel reiterates the note of spring water, saying "the waters which issue from innumerable springs are as soft as rainwater, and as clear and cool and delicious as can possibly be imagined" (from David James, 1980). There are no known written records from the James family of the creek going dry. A photograph from 1910 shows high school students in a wet but shallow and likely discontinuous section of Scatter Creek under present day James Road (Figure 3). The caption, written in 1980, says, "once it ran the year round, squirming with salmon in the Autumn runs, but now it is dry months at a time." It is evident from the photograph that some alterations to the streamflow had already begun.

These few historical records suggest the valley and creek were formerly wetter than today, presumably with year-round flows and abundant salmon runs.



Figure 3 1910 photograph of high school students at the James Road bridge, from David James (1980) written family history

2.2 Geology and Soils

The Scatter Creek watershed is located along the southern boundary of the Puget Lowland in an area affected by repeat glacial advances. The basin acted as one of the primary glacial outburst meltwater pathways formed by the rapid release of ice-dammed glacial meltwater during the most recent Vashon continental glacial advance (Olympia and Yelm) (Polenz et al., 2018). These shallowest valley-fill deposits overly very coarse outwash from prior glacial events. Meltwaters and outburst flooding deposited tens to more than 100 feet of very coarse and permeable sand, gravel and cobbles along the valley bottom and left the scars of abandoned channels through

which Scatter Creek flows today (Figure 4). These newer glacial sediments locally overly or juxtapose older glacial drift deposits from the Penultimate advance (over 125,000 years ago), which is the only glacial advance known to extend into the basin (Parametrix, 2003). Highlands forming the drainage boundaries are composed of Tertiary bedrock features overlain by thin, poorly-sorted glacial drift units or mass wasting deposits (Polenz et al., 2018) - generally of low permeability and low water-yielding capacity.

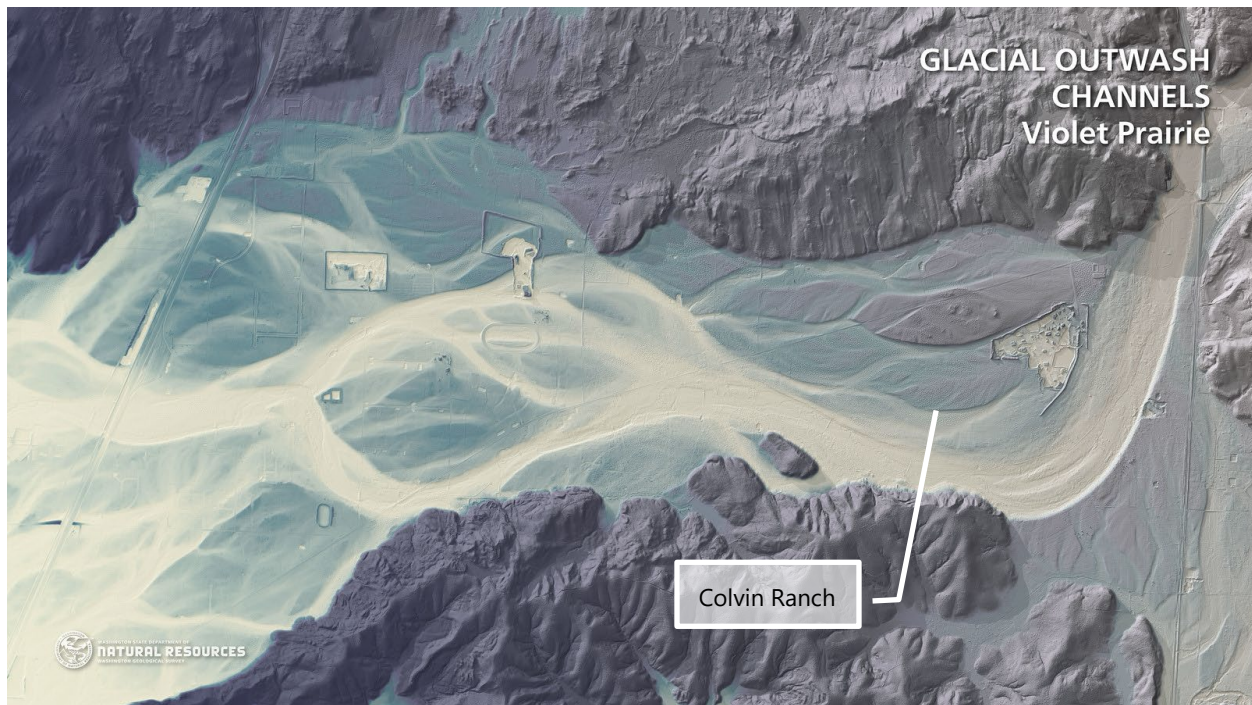


Figure 4 Glacial outwash drainage channels through Violet Prairie (Image from the Washington Geological Survey, Washington State DNR)

Glacial deposits have major effects on the surface water and groundwater of the valley. Thick coarse aquifer(s) provide extraordinarily large amounts of water – but also drain quickly in the dry season, leaving the channel of Scatter Creek predominantly dry for 3-6 months annually, in most years. The gravelly soils of the valley are very well-drained, favoring prairie and oak habitat.

The majority of oils within the basin are classified as a Critical Aquifer Recharge Areas (CARA) according to Thurston County Critical Areas Ordinance (Thurston County Code Chapter 24.10 – Critical Aquifer Recharge Areas¹, Figure 5). The term “aquifer recharge area” refers to places where water infiltrates into the ground and replenishes the aquifers. Most of the soils in the basin are considered Category I CARAs, defined generally as the most sensitive to

¹ [Thurston County Code of Ordinances - Chapter 24.10: Critical Aquifer Recharge Areas](#)

contamination. The Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) reports approximately 57% of soils represent are moderate to high drainage and infiltration potential, consisting of sandy loams and gravelly sandy loams, such as the Spanaway and Everett units. In contrast, the hills surrounding the valley are 43% are of low to very low infiltration potential. Some low-infiltration soils are coincident with visible wetlands from aerial imagery.

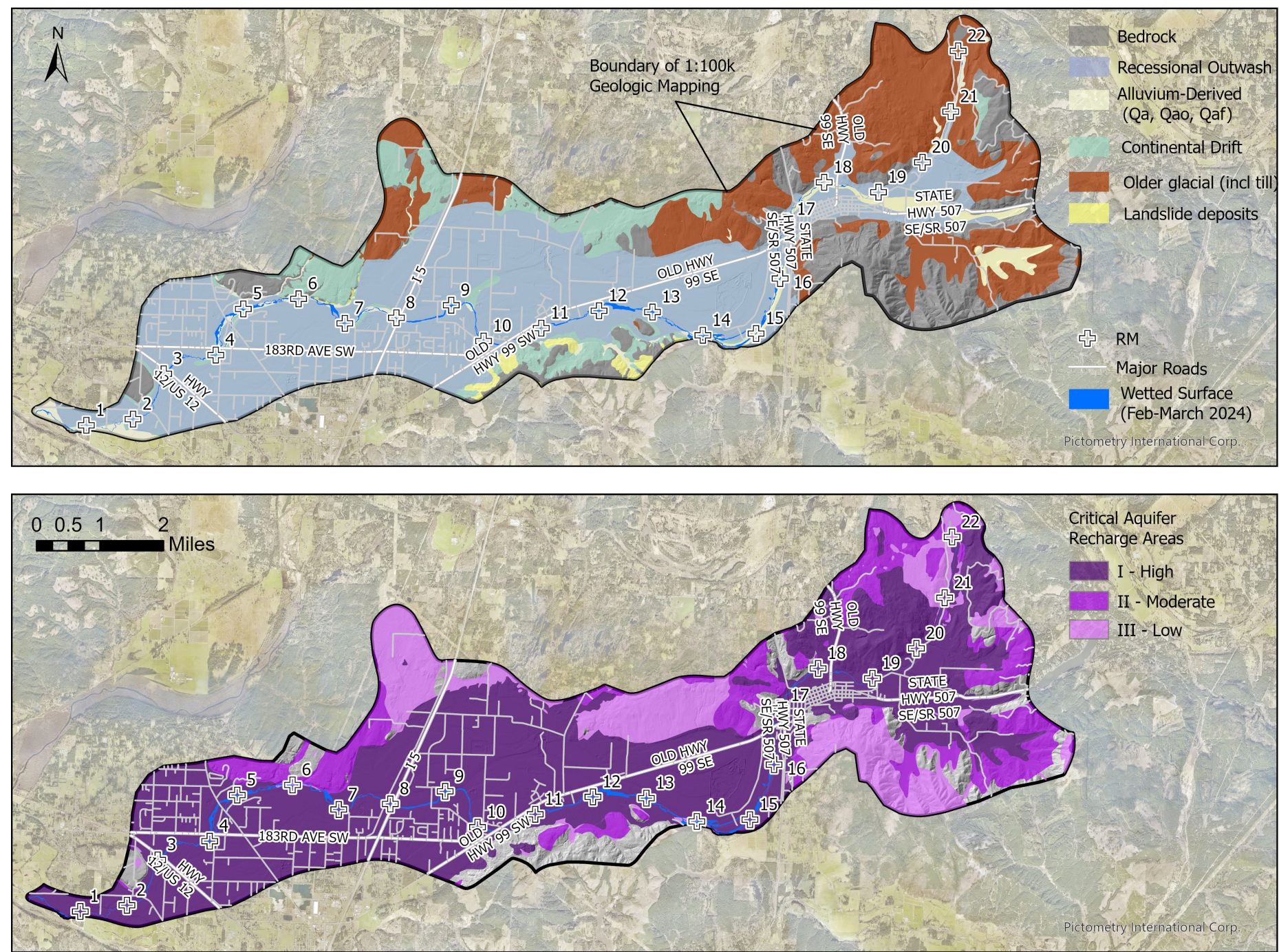


Figure 5 Basin Area Geology and Critical Aquifer Recharge Areas

2.3 Surface Water and Groundwater Conditions

Scatter Creek Aquifer

The Scatter Creek aquifer has been the subject of many studies over decades. We present herein just a few highlights from these.

The Scatter Creek aquifer is a shallow, unconfined to partially-confined aquifer that is the sole source of drinking water for more than 18,000 Thurston County residents. The number of residents is growing rapidly. The aquifer varies in width from less than one mile in the bedrock uplands near Tenino, to several miles wide and more than 100-ft thick as it flows west closer to Grand Mound (Mead et al., 1996). Saturated aquifer thickness varies between 60 and 100 feet depending on location and time of year (Mead et al., 1996). It is not uncommon for wells to observe groundwater elevations change by over 20 feet seasonally/annually, peaking in late spring and reaching their lowest levels in early fall (Thurston County, 2024b).

Table 2-2 Scatter Creek aquifer characteristics from groundwater modeling

Aquifer Characteristics				
Hydraulic Conductivity (ft/day)	Transmissivity (ft ² /day)	Saturated Thickness (ft)	Specific Yield	Recharge (in/yr)
100-5000	4000 to 400,000	40-80 ¹	0.03-0.30	12-18

Values provided from Thurston County (2025) and Sinclair and Hirschey (1992)

¹ Thickness representative of shallow, unconfined deposits within outwash terraces

Runoff to Scatter Creek is limited to the hillslopes, tributaries, and alluvial fans along the base of the uplands. Extremely high infiltration capacity of the overlying recessional outwash in the lowland prairies results in very little runoff potential in the valley bottom (Drost et al., 1999; personal communication with Kevin Hansen, LHg., Thurston County Hydrogeologist). While annual groundwater recharge is typically high for outwash soils, water losses from evapotranspiration (ET) must also be considered. Ongoing studies suggest that ET may be about 42% of annual precipitation (Hansen, pers. communication).

The Scatter Creek aquifer probably receives some groundwater flow from the Skookumchuck River valley near Frost Prairie (approximately RM 14-15) (Mead et al., 1996). These contributions, while the subject of ongoing research, likely contribute some streamflow to Scatter Creek. The Scatter Creek Aquifer also overlaps with the Black River aquifer. The Scatter Creek aquifer is an important contributor to the baseflow of the Chehalis River. In a 2007 seepage investigation of the Chehalis River, the Chehalis reach between Grand Mound and Rochester observed the highest streamflow gains than any other reach, about 77 cfs (Ely et al., 2008), probably due to the input from the Scatter Creek aquifer. Scatter Creek is the only tributary to the Chehalis River in

the reach that had measurable flow at that time, around 18 cfs, suggesting that Scatter Creek flow also contributes to the Chehalis River flows in this area. In 2010, 2024, and 2025, additional seepage run data are helping quantify gains and losses to Scatter Creek.

Water Use

In the Scatter Creek basin, over 2,500 water wells were completed between 1880 and 2020 (well data provided by Thurston County). These numbers are only for the contributing runoff basin, so they underestimate the total number of wells drawing from the Scatter Creek aquifer, which also underlies the Black River Basin. Figure 6 shows the cumulative increase in both rural residential building permits and well construction in Scatter Creek over time (note that the completion date data for 625 wells is unknown and at least 25 are now recorded as defunct). Of these wells, 2,178 are recorded as “domestic general.” Periods of intense rural residential growth can be inferred from the plot in Figure 5, including rapid growth from 1970 to 1980 and again between 1995 and 2008. A slower but steady rate of growth has continued since the 2008 recession.

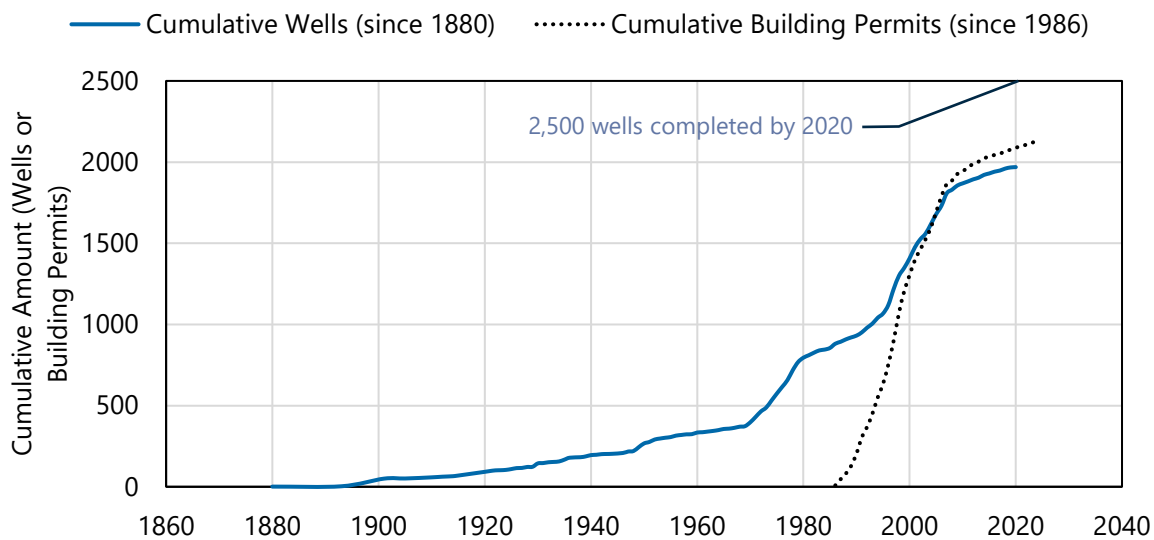


Figure 6 Cumulative well completion¹ and residential building permits² by year in Scatter Creek basin

1. Cumulative well data from Thurston County includes all well types, with 625 wells not plotted due to unknown completion dates (see note on plot)
2. Building permits from Thurston Regional Planning Council database for 1986 to 2024 for single-family, multifamily, and manufactured homes (removing demolitions) located in unincorporated Thurston County

Thurston County investigated the estimated pumping rates for wells in the County for use in their groundwater models, assuming a minimum usage of 226.6 gallons per day for the average residential use (Thurston County, 2017; Figure 7). Most of the water use from groundwater wells is allocated for irrigation (35%), followed by fish production (20%), most of which is allocated for

Cooke Aquaculture (currently not pumping) and is currently being assessed by Washington Water Trust and Thurston County for either retirement or Scatter Creek flow augmentation feasibility. Commercial uses account for about 14% of allocated groundwater withdrawals in the basin, followed by domestic general wells, including permit exempt wells, which account for about 13% of the total groundwater use. There are two public water supply systems in use in the Scatter Creek basin in and around Tenino and Ground Mound.

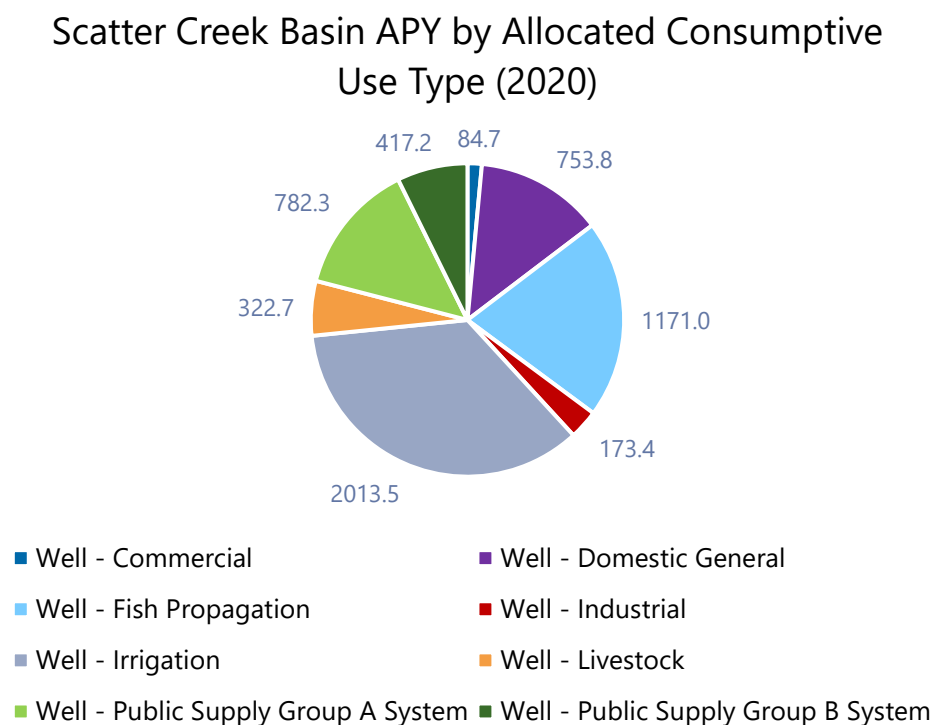


Figure 7 Water use in Scatter Creek basin by allocated annual pumping yields (apy)

Scatter Creek Streamflow

Scatter Creek is characterized as an intermittent/seasonal stream, with continuous flow over the winter and spring, becoming dry by early June, leaving long reaches of dry streambed in the summer. Re-wetting usually occurs by November. However, flow continuity is disjointed throughout the basin, varying both seasonally and spatially. Before 2012, flows in Scatter Creek were supplemented by discharge from an aquaculture facility located just east of the WDFW Scatter Creek Wildlife Management Area. This supplemental flow—from a facility now owned by Cooke Aquaculture—was sufficient to keep the lower reach of Scatter Creek flowing year-round. This conclusion is supported by continuous streamflow monitoring data collected by Thurston County at James Road before and after streamflow augmentation ended (Figure 8) and supported by accounts from local residents. Flow alterations were already apparent in the first half of the twentieth century, prior to flow augmentation efforts and rapid rural development,

with discontinuous flow observations at James Road occurring as early as 1910 (Figure 3) and was reporting of dry reaches in mid-September of 1942 (Williams and Riis, 1985).

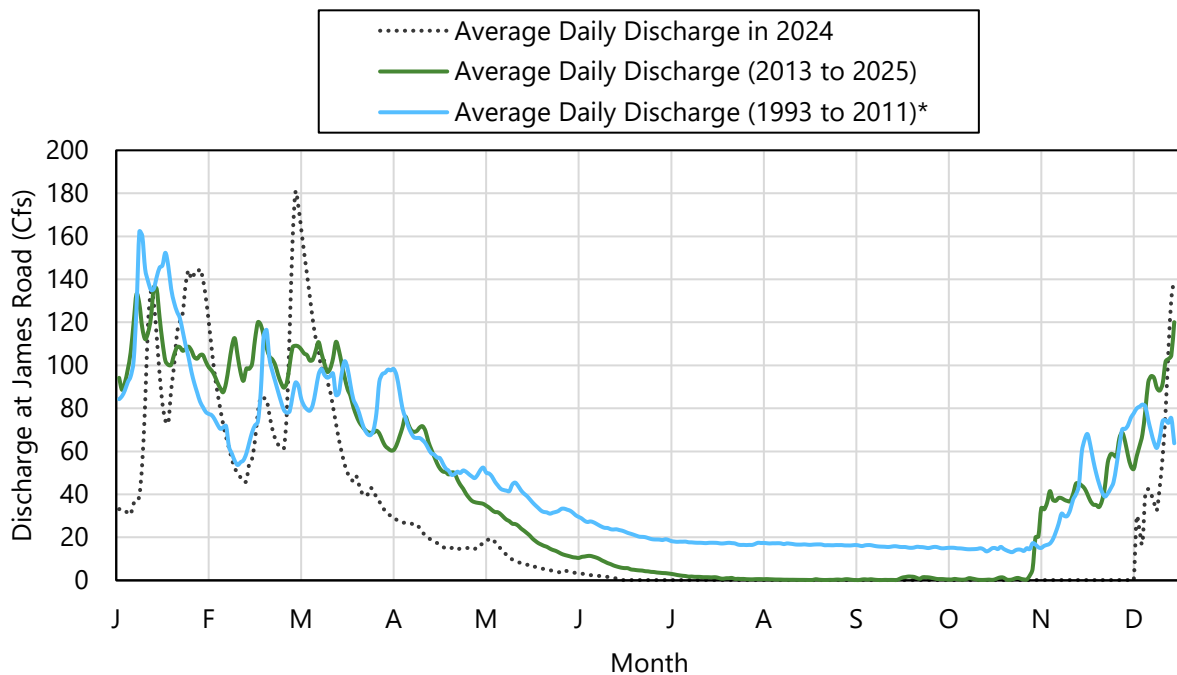


Figure 8 Average daily streamflow from Thurston County monitoring station #55a at James Road for periods during flow augmentation (1993 to 2011, *note: data gap between 1999 and 2007), after flow augmentation (2013 to 2024), with the most recent annual flows for comparison (2024)

Significant changes have occurred to Scatter Creek hydrology in the past 40 years. Two fish farms formerly pumped large amounts of water, discharging to Scatter Creek. In the 1990s, a fish operation upstream of Leitner Road closed (Sea Farm), that had formerly contributed to streamflow from groundwater pumping (Sinclair and Herschey, 1992). Flow from a second facility just downstream of Case Road halted in 2012. Now owned by Cooke Aquaculture (Icicle Acquisitions subsidiary), this facility reduced discharges to the Creek when it converted to a closed-loop water recycling system. As a result, sections of Scatter Creek downstream of these facilities resumed the prior condition of dry conditions by early summer, typically remaining dry until late fall (Figure 8). The exact streamflow contributions from the Cooke Aquaculture are presently unknown, but average flows from a period of flow augmentation sustained mean summer flows of 17 to 19 cfs compared to recent dry summer conditions (Figure 8). It is not clear whether these dry periods were the historical condition of the stream, as stated above. These dry periods may reduce wetted channel length in the dry season and may disrupt the early summer outmigration of juvenile salmonids, increasing the risk of fish kills in isolated pools with little cool water input. This was observed in the summer of 2024 at the WDFW Scatter Creek Wildlife Area. Additionally, the delay in rewetting can impede the upstream migration of adult

salmonids during fall spawning runs within the Scatter Creek watershed. Continuous flows did not return to the James Road monitoring station until as late as December/January in some very dry years (including 2022, 2023, and 2024 - Figure 8).

Two very small tributary streams enter Scatter Creek from Port Blakely lands at the WDFW Refuge, each measured at less than 0.2 cfs in April/May 2025 by Thurston County (Hansen, pers. comm). Another (north) branch of Scatter Creek with a confluence in Tenino that is also seasonally dry. Scatter Creek formerly received outflows from McIntosh Lake near the Deschutes River, but this connection was dammed and is now a smaller seasonal tributary flow. Regarding other tributary streams, there is very limited quantified information on tributary streamflow contributions and seasonality. Citizen Science accounts from landowners report that the headwaters of Scatter Creek east of Tenino flow continuously in Northcraft Creek, feeding Scatter Creek. This is an area for further assessment.

Groundwater pumping is presumed to have a direct connection to streamflow losses along Scatter Creek. There are multiple other factors affecting Scatter Creek streamflows currently being investigated. For example, one outstanding question is the streamflow losses caused by invasives like reed canary grass (RCG), potentially causing stress to the stream's water budget. Reed canary grass has a high specific leaf area and ability to produce dense stands of biomass, resulting in more photosynthetic surface through which to transpire water. A 2015 study in Eastern Washington found strong evidence that reed canary grass is altering the patterns of water availability and use in stream systems (Gebauer et al., 2016). RCG stands transpired more water than any other species tested, and substantially higher estimates of transpiration per ground surface area, especially in the active wetted channel area (Figure 9). This additional water demand should be studied in greater detail given the pervasiveness of RCG in Scatter Creek.

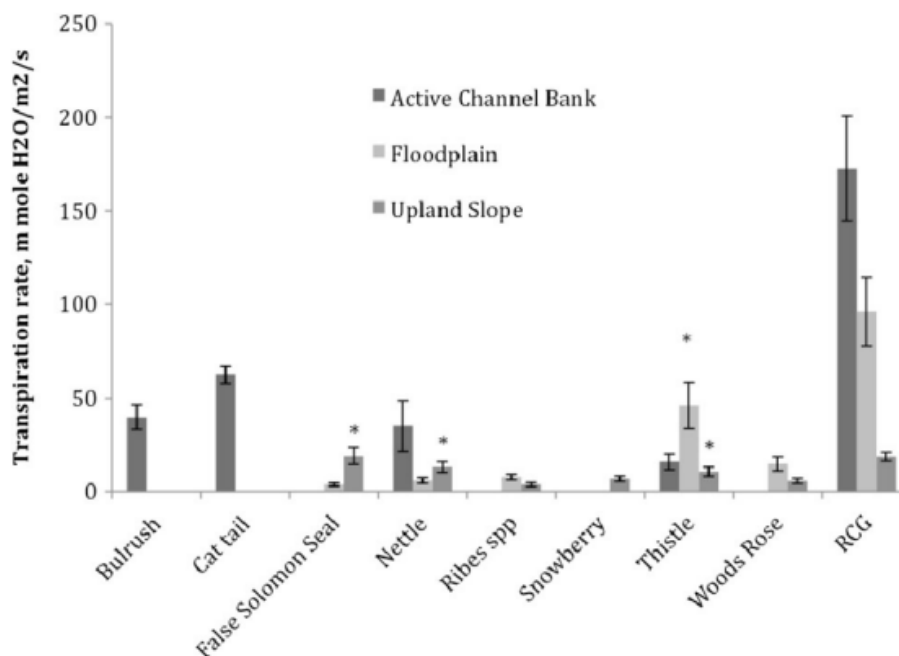


Figure 9 Comparison of transpiration rates for various riparian plants from Gebauer et al. (2016)

Groundwater – Surface Water Investigations

Scatter Creek is highly dependent on groundwater infiltration from the surrounding aquifer to enable continuous flows in late fall. These stream-groundwater interactions vary along the course of Scatter Creek, with some portions of the creek sustaining longer periods of flow and others running dry for months on end. Two primary datasets help shed light on these differences: seepage run flow investigations and spatiotemporal observations of wet and dry channel reaches.

Seepage runs have occurred on Scatter Creek in three main studies: Sinclair and Hirschey (1992), Gendaszek (2011), and the ongoing seepage run investigations of Thurston County (2024 to 2025). Thurston County's 2024 and 2025 seepage run study was designed to assess the present-day conditions of Scatter Creek to better understand where and why discharge is gained or lost within the lower reach, and specifically how Cooke Aquaculture's water rights may bolster flows in the dry season.

Gendaszek (2011) conducted a seepage run in mid-August 2010 during Cooke Aquifer flow augmentation, targeting 7 sites or 6 reaches, ranging from Case Road to the confluence with the Chehalis River. Thurston County's post-Cooke 2024 seepage run measured additional discharge measurements between Case Road and Sargent Road (see Figure 10 for comparison of data).

These additional datapoints show a very clear discharge decline and rebound in an area not recently measured, which better identifies areas of loss and gain in the absence of Cooke flow augmentation. While there is disparity in the season of measurement and magnitude of the flows, the overall trend of discharge follows the same trend as Thurston County's efforts, with a loss downstream of Sargent Road but a minor gain downstream of James Road. Water temperature data from the May 2024 seepage run recorded relatively cool temperatures at the WDFW Scatter Creek Wildlife Preserve, where 5 cfs was gained over less than a mile, highlighting an increase in cold water contributions with this gain, likely from groundwater.

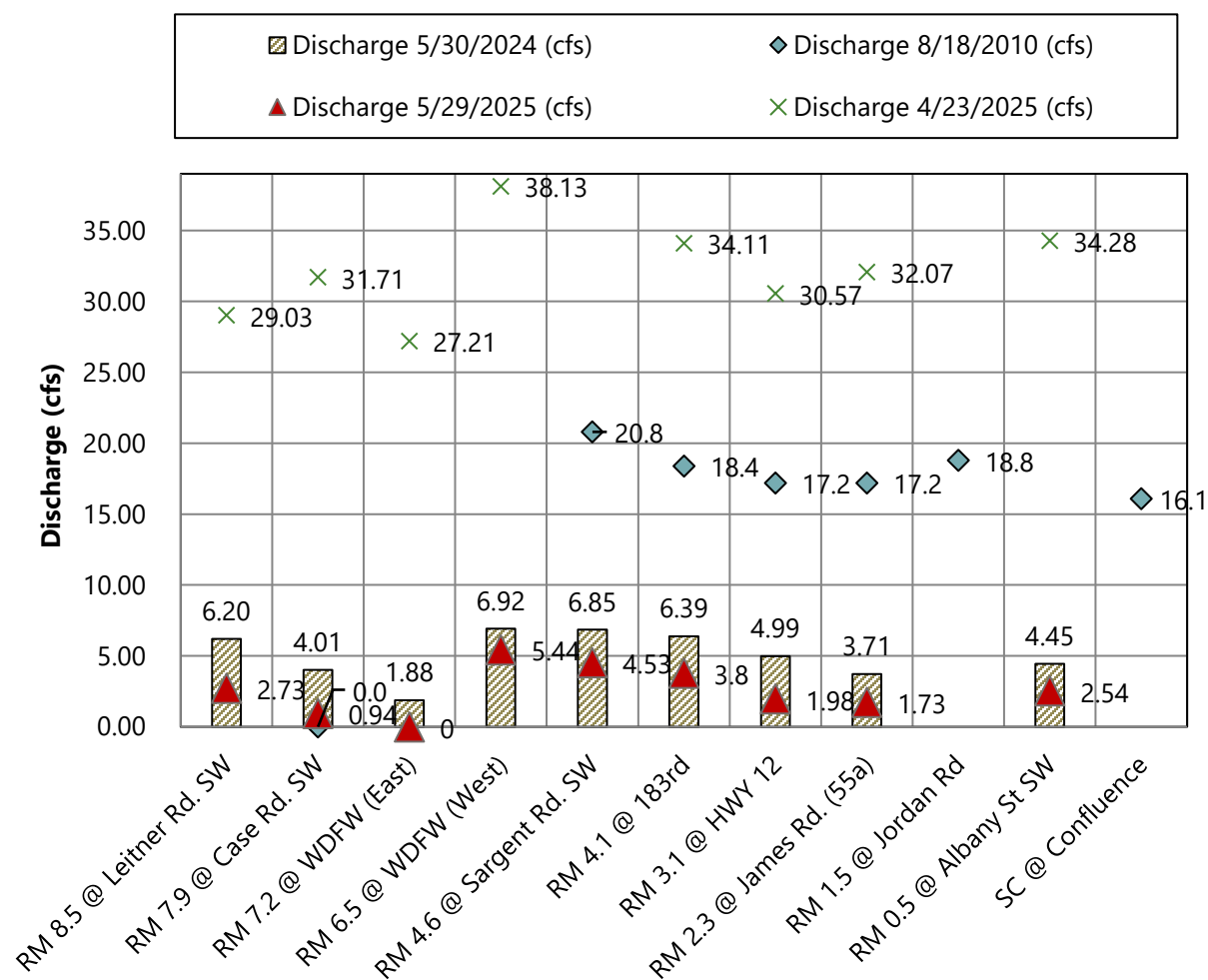


Figure 10 Comparison of seepage run data from 2010 (Gendaszek, 2011) and 2024-2025 (Thurston County ongoing study), plot modified from Thurston County (2025)

Additional data come from the CBP Citizen Science voluntary reporting of wet and dry observations and the joint USGS-WDFW groundwater-surface water exchange study (which uses the USGS FLOWPER data collection platform). Citizen Science data collection is ongoing, with discrete records along Scatter Creek since 2021.

Figure 11 summarizes the information collected during the 2024 monitoring period. These provide valuable insight into the seasonality of wetted channel segments in the recent past and in areas of private landownership where FLOWPER observations are absent. Similar to the Citizen Science records, the USGS and WDFW flow permanence observations (FLOWPER) collects measurements of dry segments and further classifies wet channel beds as continuously flowing or discontinuous (isolated pools) in order to differentiate where flow is connected from upstream to downstream. Locations are visited at least once a month, starting in July 2024 and will continue until 2026.

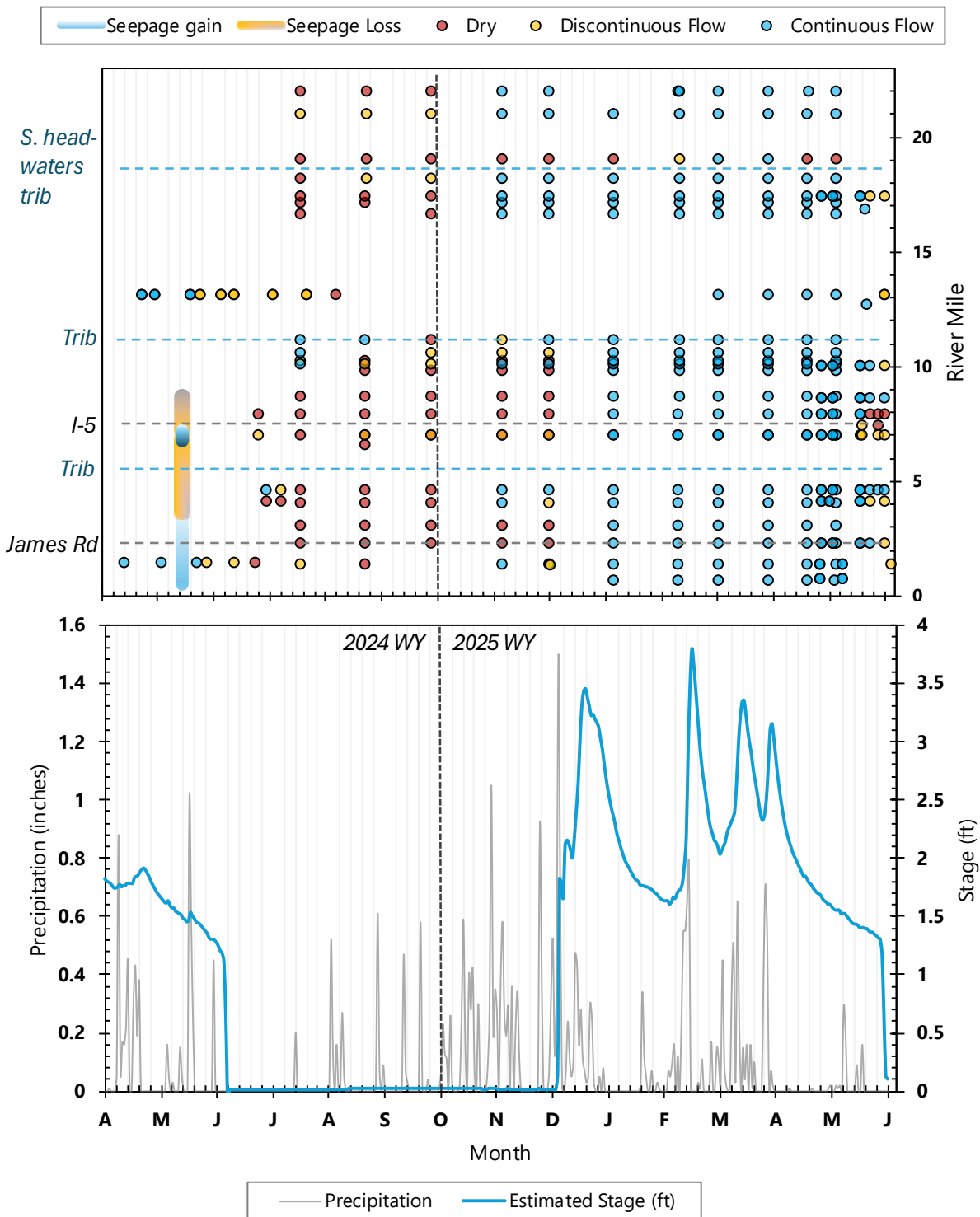


Figure 11 TOP: Plot of seepage run gains/losses on May 31, 2024 (blue/yellow lines, TC data) and flow observations (circles, WDFW-USGS & CBP Citizen Science); BOTTOM: Discharge at James Rd and Precipitation at Grand Mound

Several trends stand out from the comparison of the seepage run and flow permanence data with the precipitation and discharge records, presented in Figure 10. One of the most striking observations is the asynchronous and spatially varying relationship between precipitation and the onset of fall streamflow. Observable streamflow was not recorded at James Road until December 18, 2024, despite multiple rain events in the basin during the months preceding that date. The earliest onset of fall flows was observed on November 11, 2024 at 10 of the 19 FLOWPER stations. The latest summer continuous flow observation was recorded on September 6, 2024 at RM 11.2. The locations of these early onset flows correlate to the station's proximity to known tributary inflows and proximity to groundwater seepage from hillslopes and suspected contributions from nearby Skookumchuck aquifer.

The seepage run data appears to mostly align with the FLOWPER observations, apart from early onset of fall streamflow between RM 4 and RM 5 occurring within a reach that was losing streamflow in the spring. This is likely a result of localized groundwater or tributary inflows recharged from precipitation that were not present at the end of May. Further assessment of tributary contributions should be assessed in the future as they correspond to important salmonid life cycles, including spawning (fall) and migration and rearing (spring-summer). Additionally, increasing water demands from nearby wells in the irrigating window during May relative to November may also explain the relative change in stream character.

All monitoring and modeling studies are ongoing. Therefore, these plots only represent preliminary data results and trends will be more thoroughly investigated in the following years. Understanding longitudinal trends in streamflow losses and gains will be critical to successfully target restoration efforts along Scatter Creek, perhaps most importantly is the need to agree upon an informed desired and realistic flow regime for restoration.

2.4 Water Quality

2.4.1 Aquifer Water Quality

The Scatter Creek aquifer has historically been vulnerable to contamination from land use practices. Elevated nitrogen levels were observed in the 1970s at a time when residential growth accelerated in the Scatter Creek area (The Evergreen State College, 1978). Nitrate contributions from manure applications and commercial livestock operations resulted in the highest contamination, but since the mid 1990's, the Scatter Creek Basin has experienced significant transition to residential development. Residential septic systems have now replaced agricultural operations as the major nitrate source in the aquifer.

In response, Thurston County initiated several monitoring efforts. A 2009 report documented monitoring wells for water levels, nitrates, and coliform bacteria (TCPHSSD, 2009). While nitrate levels remained high compared to county-wide averages, improvements such as the construction of lined lagoons and more appropriate manure management reduced nitrate loading from agricultural practices. Additionally, four dairies ceased operation, further lessening

impacts. Coliform contamination was low, with only 9% of samples unsatisfactory and no detections of *E. coli*.

By 2015, the monitoring network expanded to 38 wells (TCPHSSD, 2015). Data from these wells, collected semi-annually, informed updates to the groundwater model. Findings indicated that nitrate concentrations have declined over time and are projected to remain below half the federal maximum contaminant level of 10 mg/L in the most vulnerable areas under full build-out conditions. Effective zoning, land use controls, and health regulations have collectively contributed to improved protection of the aquifer.

Some significant declines in nitrate concentrations occurred after about 2012, potentially related to the relocation of some dairy operations. Low-levels of nitrates remain persistent as Onsite Sewage Systems (OSS or septic-based wastewater technologies) expand with residential development outside the Grand Mound sewer service area. The aquifer remains highly vulnerable to contamination.

2.4.2 Stream Water Quality

There are limited historic water quality observations in Scatter Creek. In a 2006 to 2009 water quality study of the Chehalis River basin, water temperature, dissolved oxygen, fecal coliform, pH and turbidity were measured and assessed according to Washington State standards (173-201A WAC) (Green et al., 2009). The study monitored several locations along Scatter Creek, with a few exceedances observed at select monitoring stations. Dissolved oxygen observations were below the standard 8 mg/L for at least one sample for five locations between James Road and Tenino, with repeated low Dissolved Oxygen (DO) concentrations at the Case Road crossing.

It is important to note that this data was collected during a period of flow augmentation from Cooke Aquaculture. Cooke experienced multiple excursions of water quality as it discharged to Scatter Creek, documented in the Ecology PARIS system Discharge Monitoring Reports (DMRs). Note that these excursions were for predecessor companies to the current owners, Cooke. Water quality standards are suspected to have declined in recent years downstream of Cooke Aquaculture, and the Creek reach downstream of the Cooke outfall now runs mostly dry in the summer and fall. Case Road is located within a verified losing reach of Scatter Creek upstream of Cooke Aquaculture, which could help describe the low DO conditions as water levels drop. It is suspected that low DO conditions are now common downstream of Cooke Aquaculture.

Several other water quality flags were recorded – either in samples or DMRs. In addition to DO, one record at both James Road and at Tenino exceeded the fecal coliform level of 50 colonies/100 ml. The average turbidity expressed in Nephelometric Turbidity Units (NTUs) at Case Road was 8.5, which is higher than the 5 NTU standard for salmon spawning. Anecdotal accounts from landowners in the basin describe turbid streamflow in areas downstream of forest clear cutting, such as at the northern headwater reach Scatter Creek (confluence in Tenino). Furthermore, the James Road station exceeded temperature standards more than any other

monitoring station along Scatter Creek, when compared with criteria for salmonid and char summer core habitat, rearing, and spawning.

Water Temperature

Water temperature was listed as the near-term ASRP top priority for limiting factors in the Scatter Creek GSU. The main predictors of water temperature are air temperature and radiation, with the primary cooling factors being shade and groundwater inputs. Scatter Creek is at risk for high summer water temperatures due to flow conditions (extreme low flows or stagnant disconnected pools), inconsistent riparian shading, lack of groundwater inputs, and projected increase in air temperatures with climate change (See Section 5.2 for more details on climate projections). Water temperature was recorded by Thurston Conservation District in the summer of 2002 (during Cooke Aquaculture flow augmentation) and by Thurston County in the summer of 2024 (no flow augmentation).

Thurston Conservation District monitored water temperature throughout the Scatter Creek watershed in the summer of 2002 to document potential locations of groundwater contributions. Only two locations observed markedly cool water temperatures throughout the study, at RM 7 (just downstream of the Cooke Aquaculture flow augmentation) and RM 11.2 (at Outback Lane bridge) (Figure 12). Flow augmentation from Cooke Aquaculture was believed to be the primary cooling mechanism at RM 7. Additional data collected by Thurston County in July of 2024 suggests that groundwater seepage within the WDFW Wildlife Area provides cooling downstream of RM 7 even in the absence of Cooke Aquaculture flow releases. However, the downstream influence of this cooling appears to be limited, with much warmer water temperatures observed at Sargent Road (about 2 miles downstream), followed by the warmest water temperatures near James Road (another 2 miles downstream) (Figure 13). The relative contributions of both shade and tributary cooling is unknown at RM 11.2 because the sensor was located under the Outback Lane bridge, which could have provided beneficial cool shade, but is also located within a denser riparian corridor within range of several small tributary streams. Average daily stream temperatures exceeded 18 degrees Celsius at multiple downstream locations in 2024, coinciding with an increase in mean air temperature above this amount. The highest temperatures would be expected in locations that lack sufficient shade and advective cooling from groundwater.

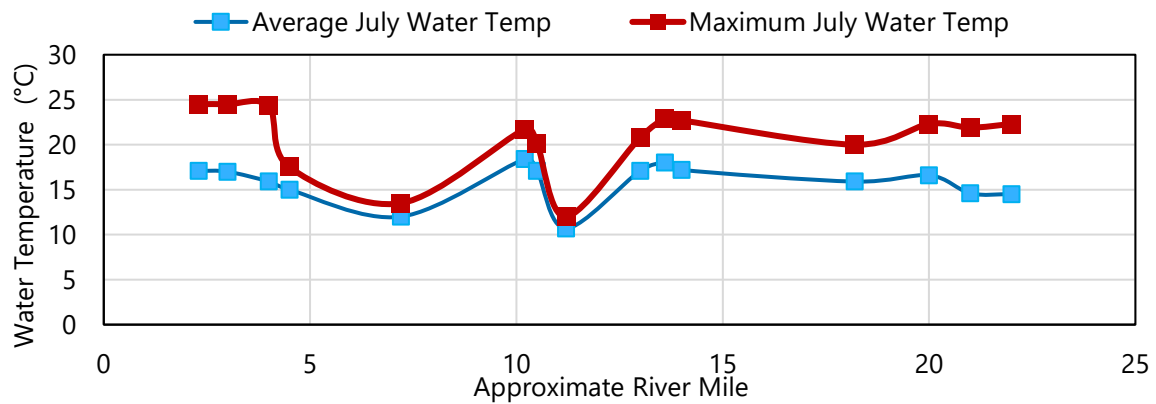


Figure 12 Plot of average and maximum July water temperatures in Scatter Creek, measured by Thurston Conservation District in 2002 (No data for RM 0 to RM 2)

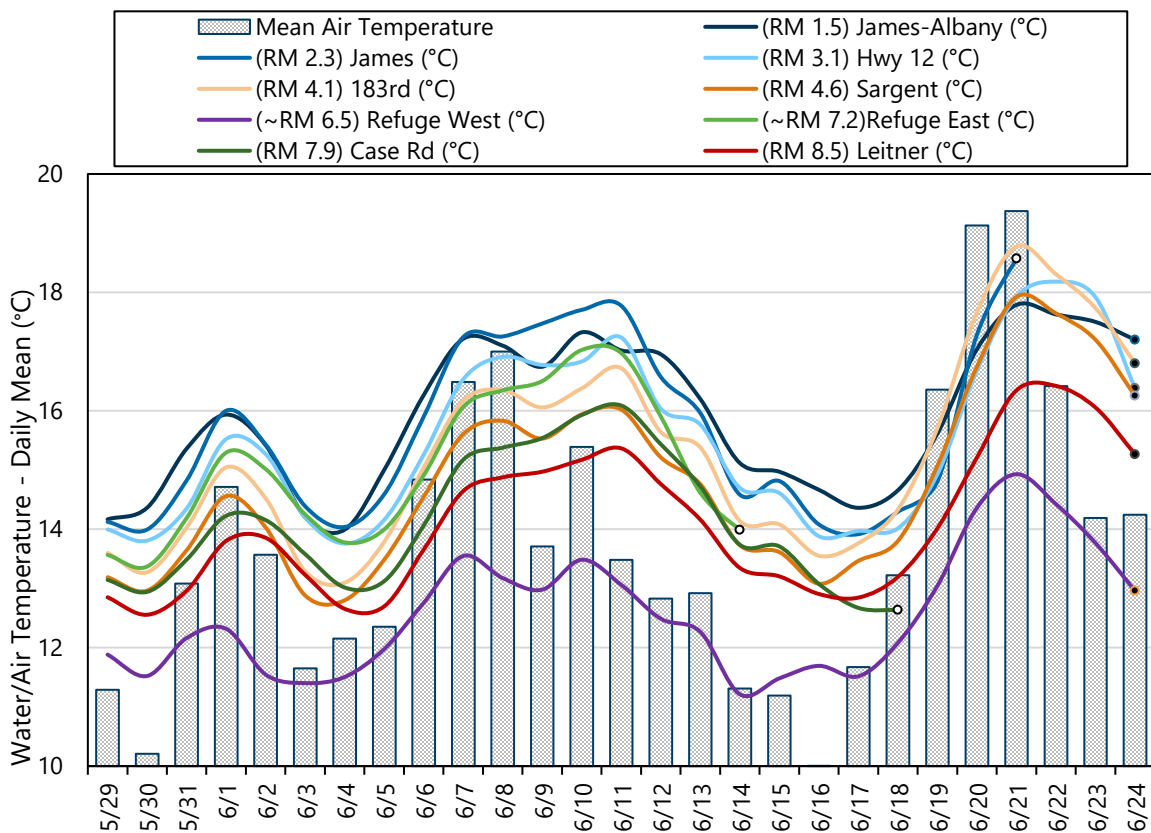


Figure 13 Plot of daily mean water and air temperatures in Scatter Creek between RM 8.5 and RM 2.3, measured by Thurston County in 2024 (adapted from Thurston County, 2025)

The Washington Department of Ecology provides temperature criteria for protection of some freshwater aquatic species (Ch 173-201A WAC). Temperature standards are reported by 7-day average of the daily maximum temperatures (7-DADMax), calculated by averaging a day's daily maximum temperature with the three days prior and after (Table 2-3). Richter and Kolmes (2005) summarizes the thermal ranges for a variety of salmonid life stages in the pacific northwest; While studies vary on the range for the lethal limit of Coho, water temperatures of 20 to 21°C provide a safety factor to avoid direct lethality.

Table 2-3 Aquatic Life Temperature Criteria in Washington Fresh Water [Table 200 (1)(c) in Chapter 173-201A WAC]

Category	Highest 7-DADMax
Char Spawning and Rearing	12°C (53.6°F)
Core Summer Salmonid Habitat ^A	16°C (60.8°F)
Salmonid Spawning, Rearing, and Migration	17.5°C (63.5°F)
Salmonid Rearing and Migration Only ^B	17.5°C (63.5°F)
Nonanadromous Interior Redband Trout	18°C (64.4°F)
Indigenous Warm Water Species	20°C (68°F)

The June 2024 water temperature data collected by Thurston County can be used to assess the existing adherence with state standards in the absence of long-term longitudinal water temperature datasets (Figure 14). Of the nine stations, seven exceeded the 16°C standard for core summer salmonid habitat and six stations exceeded the 17.5°C standard for salmonid rearing and migration. The temperature sensor at James Road was close to but did not exceed the 20°C conservative lethal limit for Coho. It can be assumed that temperatures exceed the lethal limit once continuous flows ceases and discontinuous pools form, where water temperature is expected to more closely mimic air temperature especially if shade is not present. Cooler 7DAD-Max temperatures downstream at RM 1.5 indicates that cooling may occur downstream of James Road. An extended water temperature record is expected to be available from Thurston County for the summer of 2025.

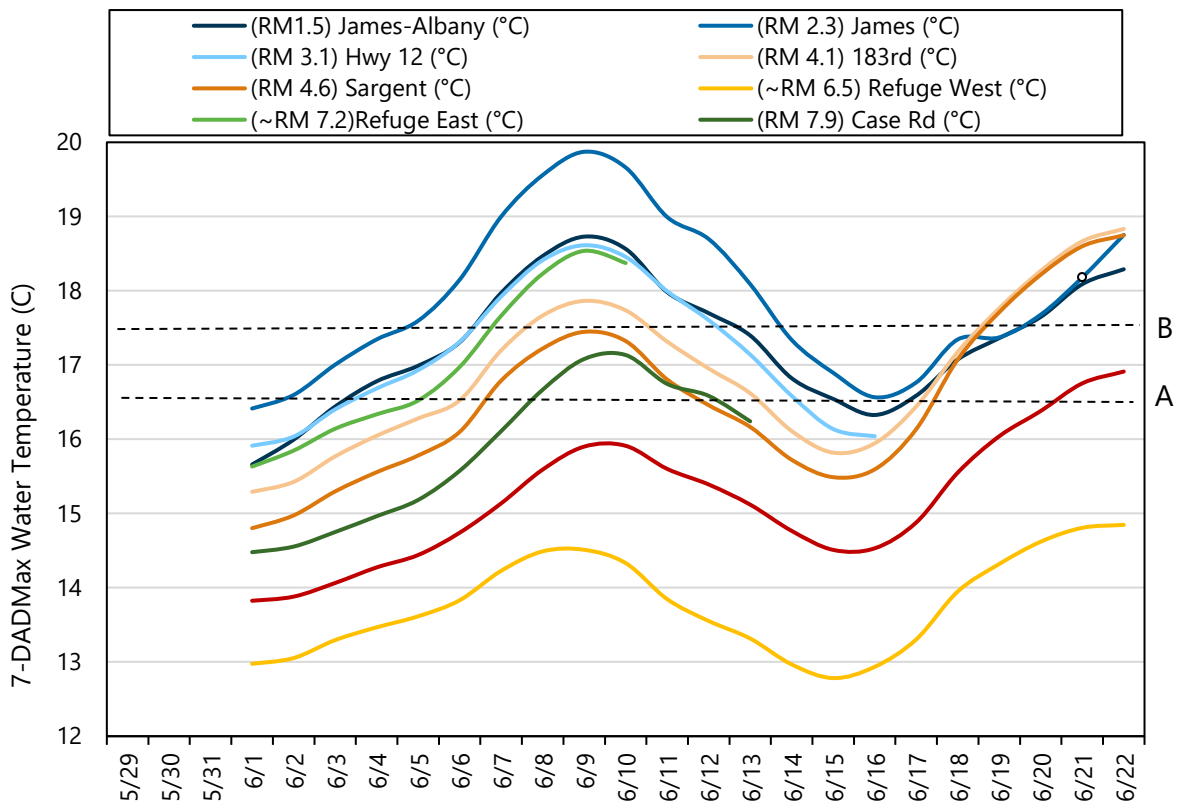


Figure 14 Computed 7-DADMax for water temperatures measured in Scatter Creek in 2024 by Thurston County between RM 8.5 and RM 2.3 (lines indicate temperature criteria from Table 2-3)

2.5 Aquatic and Semi Aquatic Habitat

2.5.1 Aquatic Species Existing Conditions

Scatter Creek has historically supported a variety of native fish species. Historically, Scatter Creek was home to several salmonid species, including coho, chinook, chum salmon, coastal cutthroat trout, and winter steelhead trout. Currently, coho salmon and cutthroat trout are known to spawn there, while other species like chinook and chum may no longer have spawning populations (Parametrix, 2003). The lower reaches of Scatter Creek serve as important rearing habitat for juveniles from the broader Chehalis River basin, especially during high winter flows. Other fish species in Scatter Creek include lamprey, Olympic mudminnow, sculpin, shiners, suckers, stickleback, sunfish, and whitefish (Parametrix, 2003). Several of these, like Pacific and river lamprey, reticulate sculpin, and Olympic mudminnow, are listed as Species of Greatest Conservation Need in the Washington State Wildlife Action Plan, although little is known about

their exact populations in the creek. Table 2-4 provides a summary of known species uses and ranges given available sources, including surveys from WDFW, Chehalis Tribe, and Quinault Indian Nation, the WDFW Statewide Washington Integrated Fish Distribution (SWIFD) database, and known citizen accounts.

Table 2-4 Summary of known aquatic species presence in Scatter Creek

Species	Present today (Documented [D] or Anecdotal [A])	Current Use	Current Range	Sources
Coho	Yes – D	Spawning & rearing	<u>Spawning</u> : RM 0 to 2, historically up to RM 4 and in headwaters, SWIFD: spawning to RM 14 <u>Rearing</u> : Up to southern headwaters	WDFW surveys, Chehalis Tribe surveys, Quinault Indian Nation surveys, citizen observations
Winter steelhead	Yes – D	Spawning & rearing	<u>Spawning</u> : RM 0 to 2 <u>Rearing</u> : Up to southern headwaters	WDFW surveys, Chehalis Tribe surveys, citizen observations
Chinook	Yes – D	Rearing (spawning assumed historically)	RM 0 to RM 8	WDFW SWIFD
Chum	No – D	None (Presumed historically)		
Coastal cutthroat	Yes – D	Spawning & rearing	Full basin	WDFW SWIFD
Rainbow trout	Yes – D	Spawning & rearing	Full basin	WDFW SWIFD
Pacific & river lamprey	Yes – A	Spawning (1990, currently unknown) & rearing	Only recent observation at RM 15 (post 1990)	Quinault Indian Nation 1990 survey, citizen observations
Olympic mudminnow	Yes – A	Present	Unknown	Parametrix (2003)
Sculpin	Yes– A	Present	Observed up to Cozy Valley (at least)	Thurston Conservation District, Citizen observations
Fresh water mussels	Yes– D	Present	Scattered up to RM 15 (at least)	CBS (2023b) survey, citizen observations

Species	Present today (Documented [D] or Anecdotal [A])	Current Use	Current Range	Sources
Bass (Smallmouth, Largemouth, and Rock)	Yes-A	Present (Invasive)	Unknown	Chehalis Tribe

Coho are the most widely distributed and documented salmonid species in Scatter Creek. Historic numbers and distributions are not available but have been surveyed in Scatter Creek since at least 1931 (Parametrix, 2003; Royal, 1931). Between 1984 and 2023, the number of coho salmon adults returning to Scatter Creek ranged from 178 to 3,700 individuals (an estimate of escapement, or returning spawners, from WDFW; Figure 15). The range in numbers could be due to a number of factors, including low spawning flows and habitat degradation. WDFW spawning records did on occasion note impassable flows. Of all the WDFW spawning records from 1988 to 2023, 30% of records reported dry to medium-low flow conditions. While historic spawning data recorded spawning up to RM 4, more recent spawning surveys by WDFW since 1988 have only recorded redds up to RM 1.5 (Parametrix, 2003). There are citizen accounts of spawning in the southern headwater streams of Scatter Creek historically, but there are no records to document trends over time. Spawning typically occurs between November and January, with emergence in spring. Rearing habitat is concentrated in areas of dense riparian zones and in-stream wood, which typically overlap with prime beaver habitat (Parametrix, 2003). Historically, lower Scatter Creek served as year-round rearing habitat when Cooke Aquaculture augmented flows near RM 8 but is now limited by water availability.

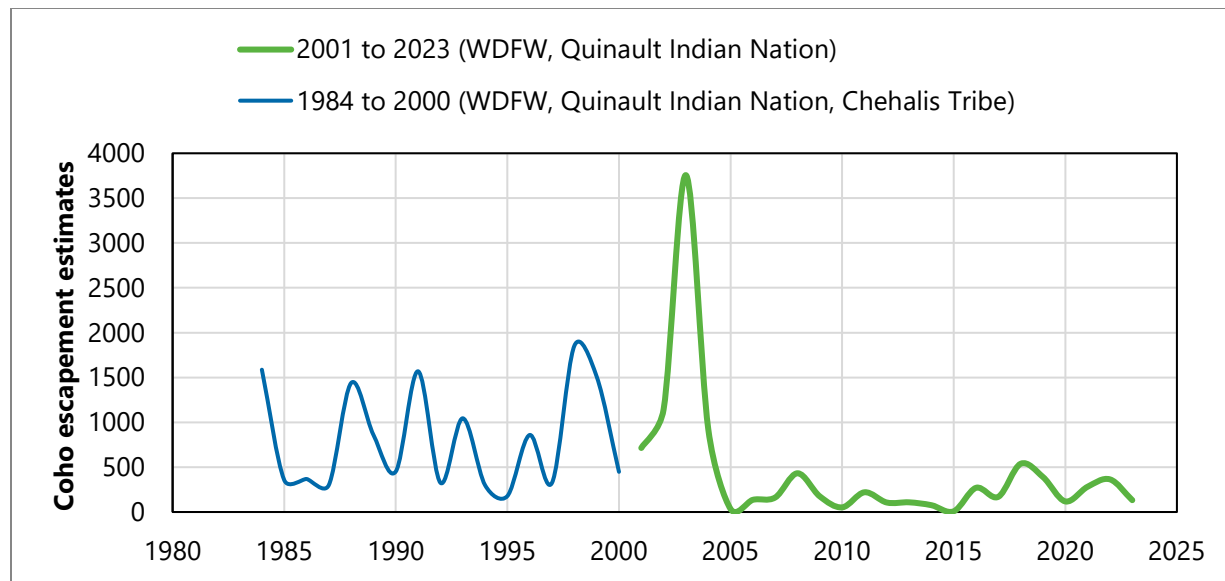


Figure 15 Estimated coho escapement from Scatter Creek from 1984 to 2023 calculated by WDFW from spawning surveys conducted by WDFW (1984 to 2023), Quinault Indian Nation (1984 to 2023), and the Chehalis Tribe (1984 to 2000)

There is no historical data that records Chinook salmon spawning numbers or distribution in Scatter Creek, although oral histories of the Upper Chehalis and early fish surveys reference historic runs (Royal, 1931; Parametrix, 2003). The most recent data suggests that Scatter Creek does not support a spawning population but does support juvenile Chinook rearing, as demonstrated by smolt traps surveys at RM 0.5 (Parametrix, 2003). In particular, rearing has been documented in the WDFW Wildlife Area (WDFW SWIFD).

There are documented accounts of winter steelhead spawning in the lower reach of Scatter Creek near the confluence with the Chehalis River. Fry typically emerge in late spring and early summer. Winter steelhead use Scatter Creek primarily for rearing, including those spawning in other areas of the Chehalis Basin. Unlike coho, which can migrate with their bodies partially exposed to air, steelhead prefer to be fully submerged. Therefore, their presence and survival in Scatter Creek is highly dependent on flow continuity, which begins to decline in late spring or early summer when fry migrate upstream (Figure 10).

Pacific lamprey and river lamprey are listed as a Species of Greatest Conservation Need in the Washington State Wildlife Action Plan. Historic and current numbers and in Scatter Creek are unknown apart from a few accounts. Approximately 30 lamprey redds were observed in a survey conducted by the Quinault Indian Nation in 1990, although it is not known if the redds belonged to Pacific or river lamprey (Parametrix, 2003). Pacific lamprey have also been collected in smolt trap surveys. Citizens in the basin have observed lamprey up to at least RM 15 (Chanele Holbrook, pers. communication). Similar to coho, spawning areas for Pacific lamprey would be limited to clean gravel reaches of Scatter Creek and rearing in low velocity areas and off-channel habitat that remain wet.

In western Washington, three native freshwater mussel species are found: Western Pearlshells, Oregon Floater Mussels, and Western Ridged Mussels (WRMs). Western Pearlshells and WRM prefer cool, flowing waters, while Oregon floaters are found in slower-moving water and are more tolerant of warm water and fine sediment. In 2022 the Chehalis Basin Strategy surveyed the lower 8 miles of Scatter Creek for freshwater mussels (CBS, 2023b). Western Pearlshells were observed in the lower 2 miles of Scatter Creek while Floater Mussels were found in clusters between the RM 8 and the Chehalis River confluence. Floater Mussel natural history suggests they tend to be found in softer sediment reaches, whereas Pearlshells can embed into harder substrate without causing damage to their shells. There are anecdotal accounts of freshwater mussels near RM 15 (Chanele Holbrook, pers. communication), but extensive surveys have not occurred upstream of RM 8 and is a knowledge gap in the basin.

Not all aquatic species have documented survey records to support their existing conditions knowledge in Scatter Creek. To support future restoration efforts for all fish, the Office of the Chehalis Basin conducted a survey of native freshwater non-salmonid fishes and shellfish within the Chehalis Basin and paired those results with a desktop GIS analysis to predict occupancy patterns outside of the surveyed locations (CBS, 2023a). The result was a multispecies occupancy model (MSOM) to predict occurrence throughout the Chehalis basin. The Black River was the closest stream surveyed to Scatter Creek. Estimated native fish predicted occupancy varies in Scatter Creek from more than 10 species in the lower 8 miles and decreasing upstream. Highest probability species occurrence (greater than 75%) for species with limited documented use in Scatter creek include Pacific lamprey, Speckled dace, Northern pikeminnow, Threespine stickleback, Torrent and Prickly sculpin, Signal crayfish, and Rainbow and Cutthroat trout.

2.5.2 Semi-Aquatic Species Existing Conditions

Scatter Creek is also home to several semi-aquatic species, including beaver, river otter, various amphibians, and numerous waterfowl. There is limited survey data to inform population estimates for semi-aquatic species in Scatter Creek, however, several reports and historic accounts provide perspective on their status.

It is believed that beavers once maintained a widespread range within Scatter Creek from the confluence with the Chehalis River to its upper tributaries prior to trapping practices (Parametrix, 2003; Williams et al., 1975). Beavers now have a more limited range in Scatter Creek, with the highest concentrations of sightings and dam observations in areas with dense riparian forests, such as the WDFW Scatter Creek Wildlife Area (Figure 15), the forested reach between Colvin Ranch and the Nature Conservancy, and the headwater stream systems. While less frequent than pre-settler conditions, beaver dams have still been observed throughout most of the watershed within the past 30 years, suggesting that population numbers could be improving overtime (Wampler et al., 1993). However, continued education outreach is needed to secure future coexistence throughout the basin, especially given the overwhelming private ownership of Scatter Creek riparian areas. Beaver trapping is still common practice throughout the basin. Beavers play an integral role in shaping channel morphology and localized hydrology in their

areas of influence. Where observed, beaver dams form pools to facilitate water storage and initiate localized scour that introduced channel-form complexity.



Figure 16 Beaver dam in Scatter Creek in the WDFW Wildlife Area

Holgerson et al. (2019) surveyed off channel habitat for amphibians along the Chehalis River at the confluence with Scatter Creek between 2015 and 2017. During these site visits, they observed northwestern salamander, northern red-legged frog, rough-skinned newt, and pacific tree frog. All of these species are presumed to be present in Scatter Creek, although their frequency and distribution is currently unknown.

2.5.3 Habitat limiting factors

The highest priority near-term ASRP limiting factors for the Scatter Creek basin include: Water Temperature, Key Habitat (physical features used in different life stages – spawning to rearing), and Habitat Diversity (presence of large wood and riparian conditions). Moderate to low near-term limiting factor priorities include: Predation, Channel Stability, Sediment Load, Flow, Obstructions/Barriers, and Channel Length (change in habitat quantity/capacity). These habitat limiting factors overlap in many ways, where any one success is dependent upon addressing many. For example, a lack of continuous flow increases water temperature, limits access to key habitat, and reduces the overall habitat length.

The primary habitat limiting factors from the analysis include the following:

- Dry stream conditions or discontinuous low flows results in entrapment and stranding, resulting in fish kills
- Inadequate supply of cool rearing habitat where juveniles can seek refuge to wait out the warm summer water temperatures (or they may become stranded before seeking such habitat)
- Large scale reduction in oak riparian forests that provide both woody material and shade
- Expanding range of invasive predatory bass with warming waters
- Extended periods of low, discontinuous, or dry flow alters or inhibits migration and spawning upstream
- Reduced range of beaver and a general lack of practice of or educational awareness on beaver coexistence strategies among private landowners

3 REACH ASSESSMENT

3.1 Reach Assessment Approach

A reach assessment was conducted to identify the main limiting factors and help identify potential restoration needs at a smaller scale. Scatter Creek was broken up into 9 major reaches defined by known shifts in dominant geomorphic, hydrologic, and land use characteristics. Table 3-1 summarizes the data sources used to support the Mapbook in Appendix A and accompanying reach assessment summary (Table 3-2). The reach assessment summary in Table 3-2 also highlights existing data gaps in the reach. These gaps can be seen as proposed research initiatives that will help inform restoration decisions.

Table 3-1 Data sources for Scatter Creek reach assessment

Data Type	Source
Land Use and Land Cover	
Thurston County Zoning & Land Use	Thurston GeoData Center (2025)
Thurston County Parcels	Thurston GeoData Center (2025)
National Land Cover Dataset (2019)	Dewitz (2021)
Historical Land Use Accounts	David James (1980)
Regulatory and Planning	
FEMA Flood Insurance Rate Map Mapping Products	FIS Study: FEMA (2024; initial FIS Effective Date: 2012)
Residential Building Permits	TRPC (2025)
Critical Aquifer Recharge Areas	Thurston GeoData Center (2025)
Thurston County Urban Growth Areas (UGAs)	Thurston GeoData Center (2025)
Population Growth Projections (2045)	TRPC (2022)

Data Type	Source
Geomorphology	
Channel slope (2021 LiDAR)	NHC (2025)
2024 Wetted Channel and Floodplain Delineation (NHC)	NHC (2025)
Surficial Geologic Mapping	DNR (1:24k to 1:100k scale mapping from various studies)
2025 UAV Imagery	NHC (2025)
Groundwater-Surface Water Interactions	
Streamflow Records	Thurston County Station 55a (real-time monitoring at James Road, 1993-present)
Seepage Run Datasets	• Sinclair and Hirschey (1992) • Gendaszek (2011) • Thurston County (2024 to 2025, ongoing)
Citizen Science Flow Observations	CBP (2021 to present)
FLOWPER Flow Observations	USGS & WDFW (2024 to present)
Groundwater Modeling Results	Thurston County (2024b) Primary contact: Kevin Hansen, LHG
Thurston County Wells & Pumping Rates	Thurston County (2022, 2017) (not for public distribution, contact: Kevin Hansen, LHG)
Habitat	
Beaver observations	From Thurston County and Wampler et al. (1993)
Species Distribution	• Statewide Washington Integrated Fish Distribution (SWIFD) (WDFW, 2024) • Personal Communications with Jesse McMahan (Chehalis Tribe), Karin Strelloff (Thurston Conservation District) and Chanele Holbrook (WA Dept of Ecology) • Multispecies occupancy model (MSOM) by CBS (2023a) • Freshwater mussels survey (CBS, 2023b) • Chehalis Amphibian Study by Holgerson et al. (2019)
Coho and Steelhead Spawning Records	• WDFW Spawning Ground Survey database • WDFW coho escapement calculations (Kim Figlar-Barnes, pers. communication)
WDFW Fish Passage and Diversion Screening	WDFW (2025) Inventory
Water Temperature	• Thurston Conservation District (2002) • Thurston County ongoing monitoring
Wetland Delineations (desktop)	Thurston GeoData Center (2025)
Habitat Assessment Reports	• Parametrix (2003) • Thurston Conservation District (1999)

Table 3-2 Reach Assessment Summary Table for Scatter Creek

Reach	River Miles	Land Use	Geomorphology	Groundwater-Surface Water Interactions	Documented Species Use <i>(From SWIFD, survey data, and/or anecdotal accounts)</i>	Habitat Conditions	Data Gaps
1	0 to 2.3	Agriculture and low density private residential	Morphology: Low gradient single thread channel, flowing through historic Chehalis River channel migration area. Confined by agricultural fields on both banks (relatively small accessible floodplain area) Geology: Scatter Creek flows through primarily Chehalis alluvium and floodplain deposits Average slope: 0.08% (RM 1) to 0.4% (RM 2) (from LiDAR water surface).	Gaining streamflow between RM 2.3 (James Rd) and RM 1.5 (Jordan St) observed in seepage run and FLOWPER data¹. RM 1.5 wet until July-August. Losing conditions observed in one seepage run from RM 1.5 to RM 0 (Chehalis River confluence) and in the FLOWPER data. High density of wells with large GW withdrawals (irrigation). August 2024 imagery: • RM 0 to 1: Wet • RM 1 to 2: Mostly dry	Aquatic Species: <u>Spawning:</u> Coho (RM 0.5 to 1.5², decreasing redds), Lamprey (Parametrix, 2003), winter steelhead (fry emerge in May-June) <u>Rearing, migration, and/or present:</u> Coho(emerge in spring), winter steelhead (emerge spring to early summer), Chinook, lamprey, cutthroat, rainbow trout, live Jack observations almost exclusive to this reach. <u>Other:</u> Western pearlshell mussels, floater mussels, presumed MSOM species³ Semi-Aquatic Species: Beaver, river otter, northern red-legged frog, rough-skinned newt, northwestern salamander, various waterfowl	Veg: Extremely limited riparian canopy (discontinuous buffer along agriculture land) and RCG present throughout. Aquatic Hab: Pool depth and frequency unknown, but upstream reach becomes discontinuous by May-July (when steelhead emerge). Beaver dams are important for maintaining water levels. Reach 1 is the only documented coho & steelhead spawning reach remaining in mainstem.	• General information gaps⁵
2	2.3 to 4.6	Mostly private residential with some agricultural land, Creekside Conservancy (Mill Property)	Morphology: Transitions from single-thread to multi-thread flow paths from downstream to upstream. Several small beaver dams are visible in reach. Some local wood recruitment from banks results in partial spanning log jams (wood length < bankfull width). Accessible forested floodplain area in some locations, floodplain area increases upstream. Geology: Primarily outwash deposits	Mostly losing streamflow throughout the reach. Downstream FLOWPER stations dry from 8/2/24 to 12/13/24. More continuous and discontinuous flow upstream observed on 11/18/24 near upstream reach boundary. Citizen observations at 183rd Street show discontinuous flow as early as April (2021) or as late as August (2022 – high water year). High density of wells with low to high GW withdrawals.	Aquatic Species: <u>Spawning:</u> Coho* (Historically spawned in this reach, in SWIFD database but no recent records) <u>Rearing, migration, and/or present:</u> Coho (migrate spring-summer), winter steelhead (migrate late spring – early summer), Chinook, cutthroat, rainbow trout <u>Other:</u> Floater mussels, presumed MSOM species³	Veg: Discontinuous buffer (best between James Rd and Hwy 12), extensive RCG in wider floodplain areas. Aquatic Hab: Pool depth and frequency unknown – discontinuous by May-July (when steelhead emerge and migrate upstream, potential barrier to migration). Stranding risk and limited cold water refugia available (water temperatures lethal for most salmonids in summer). Creekside	• General information gaps⁵



Reach	River Miles	Land Use	Geomorphology	Groundwater-Surface Water Interactions	Documented Species Use <i>(From SWIFD, survey data, and/or anecdotal accounts)</i>	Habitat Conditions	Data Gaps
			Average slope: 0.3% (from LiDAR water surface).	August 2024 imagery: - RM 2 to 3: Mostly dry - RM 3 to 4: Mostly dry	Semi-Aquatic Species: Beaver, presumed SA species ⁴	property has very good rearing habitat with potential spring inputs.	
3	4.6 to 7.5	WDFW Wildlife Area, Port Blakely timber lands, private residential, Cooke Aquaculture	Morphology: Multi-thread flow paths with major bifurcation near Sargent Rd. Higher density and frequency of beaver dams, especially in WDFW Wildlife Area, where wood recruitment occurs locally from banks (wood length < Bankfull width). Relatively wide accessible floodplain area, including off-channel flooding/ponding observed along private parcels that are hydrologically connected during wet season. Geology: Primarily glacial outwash Average slope: 0.15% (from LiDAR water surface).	Gaining streamflow from seepage along the northern uplands, disconnected pools retain water in summer, historic flow augmentation at upstream reach boundary (Cooke Aquifer). Tributary inflows at RM 5.6. FLOWPER data gap between RM 4.65 to 7.0. Minimal groundwater pumping in reach, increasing downstream. August 2024 imagery: - RM 4 to 5: Mostly Wet - RM 5 to 6: Mixed wet/dry - RM 6 to 7: Mixed wet/dry	Aquatic Species: <u>Spawning:</u> Coho* (Historically spawned in this reach, in SWIFD database but no recent records) <u>Rearing, migration, and/or present:</u> Coho, winter steelhead, Chinook, cutthroat, rainbow trout, sticklebacks, sculpin <u>Other:</u> Floater mussels, presumed MSOM species ³ Semi-Aquatic Species: Beaver, presumed SA species ⁴	Veg: Increasing buffer width upstream near wildlife area, but extensive reed canary grass throughout entire reach. Aquatic Hab: Pool depth and frequency unknown, but beaver dams and wood-forced pools visible in aerial photographs. Pools are discontinuous – stranding observed at WDFW Scatter Creek Wildlife Area in summer 2024 resulting in high water temps and mass die-offs (coho, sticklebacks, sculpin). Springs observed in WDFW Wildlife Area with flowing water through August 2024. Decay-free wood present at stream bottom within deep pools on western-side of Wildlife Area, indicating permanent water presence.	- General information gaps⁵ - Tributary inflows (flow volume, temperature) - Seeps and springs inflows (identify)
4	7.5 to 10.0	Agriculture and private residential	Morphology: Transitions from multi-thread planform upstream to predominantly single-thread through reach, accessible floodplain area is confined by private lands. The broader historic floodplain is relatively flat and vast through the large outwash plains. Limited local wood recruitment possible.	Losing streamflow through reach. FLOWPER stations observed dry conditions from 8/2/24 to 12/13/24. This reach flows across broad outwash plains and does not interact with hillslopes (no groundwater seepage gains). High density of wells with low to high GW withdrawals, increasing impervious area. August 2024 imagery:	Aquatic Species: <u>Spawning:</u> Coho* (Historically spawned in this reach, in SWIFD database but no recent records) <u>Rearing, migration, and/or present:</u> Coho, winter steelhead, cutthroat, rainbow trout	Veg: Narrow riparian buffer from residential parcels through prairie ecosystem (mostly oak). Extensive RCG throughout reach. Aquatic Hab: Pool depth and frequency unknown. This is a strong losing reach, with dry conditions at the downstream boundary by May 2025. Pools are discontinuous and pose risk for stranding and high	- General information gaps⁵ - Seepage run data (gaining/losing streamflow observations)

Reach	River Miles	Land Use	Geomorphology	Groundwater-Surface Water Interactions	Documented Species Use <i>(From SWIFD, survey data, and/or anecdotal accounts)</i>	Habitat Conditions	Data Gaps
			Geology: Glacial outwash Average slope: 0.15% (from LiDAR water surface).	- RM 7 to 8: Mostly dry - RM 8 to 9: Mixed wet/dry - RM 9 to 10: Mostly dry	<u>Other:</u> Floater mussels, presumed MSOM species ³ Semi-Aquatic Species: Beaver (few), presumed SA species ⁴	temperatures. No cold water refugia.	
5	10.0 to 12	Private residential, timber lands (Violet Prairie Plantation, Port Blakely, Ring Family Limited)	Morphology: Transitions from single thread downstream to multithread upstream, with increasing relative floodplain area. Beaver dams have been observed in the reach. Left bank proximal to valley walls. Some channel migration visible in historical imagery. Geology: Glacial outwash and alluvium, with Tertiary bedrock and Quaternary mass wasting deposits along valley wall. Average slope: 0.19% (from LiDAR water surface).	Relatively wet reach, with continuous or discontinuous streamflow observed at almost all FLOWPER stations from 8/2/24 to 12/13/24. Gibson Rd observations wet all 2022 (discont. flow by Aug 23). Groundwater seepage from forested uplands and small tributary inflows adding streamflow to reach until mid-summer, with adequate storage in pools to hold water through late summer months. August 2024 imagery: - RM 10 to 11: Mixed wet/dry - RM 11 to 12: Mostly wet	Aquatic Species: <u>Spawning:</u> Coho* (Historically spawned in this reach, in SWIFD database but no recent records) <u>Rearing, migration, and/or present:</u> Coho, winter steelhead, cutthroat, rainbow trout <u>Other:</u> presumed MSOM species ³ Semi-Aquatic Species: Beaver, presumed SA species ⁴	Veg: Narrow buffer (residential land) unless stream is flowing along timberlands, extensive reed canary grass throughout Aquatic Hab: Pool depth and frequency unknown, but beavers active in reach. Only reach with areas of reported continuous flow in summer – likely sourced from upland tributaries and seepage (mostly timberlands of various owners). Potential cold water refuge from tributaries and springs. Discontinuous pools likely.	- General information gaps⁵ - Seepage run data (gaining/losing streamflow observations) - Tributary inflows(flow volume, temperature) - Seeps and springs inflows (identify)
6	12.0 to 14.5	Colvin Ranch, The Nature Conservancy, timber lands (Ring Family Limited, CGVI LLC, Riffe Lake Timberlands, Taylor Timber), WDFW	Morphology: Multithread anastomosing channels flowing through a wider active floodplain area through Colvin Ranch with frequent beaver dams. Isolated bedrock knob between left bank valley margin and current channel position shows evidence of historic flow distribution through confined pathway. Geology: Glacial outwash and alluvium, Tertiary bedrock and landslide deposits along valley wall,	Wet conditions until late summer (mid-Aug 2024, citizen science). Thurston County CD conducted a habitat survey in the summer of 1999 and all segments were wet in this reach (does not specify continuous vs discontinuous flow). Increasing GW withdrawals near downstream reach boundary. August 2024 imagery: - RM 12 to 13: Mixed wet/dry - RM 13 to 14: Mixed wet/dry	Aquatic Species: <u>Spawning:</u> Coho* (Historically spawned in this reach, in SWIFD database but no recent records) <u>Rearing, migration, and/or present:</u> Coho, winter steelhead, cutthroat, rainbow trout <u>Other:</u> presumed MSOM species ³ Semi-Aquatic Species: Beaver, presumed SA species ⁴	Veg: Mostly continuous buffer, especially through Nature Conservancy lands (mature functioning oak stands), but extensive reed canary grass throughout. Connected wetlands and off-channel flow area but mostly privately owned. Extensive logging in uplands south of creek. Aquatic Hab: Pool depth and frequency unknown, but beavers active in reach. Discontinuous pools	- General information gaps⁵ - Seepage run data (gaining/losing streamflow observations) - Tributary inflows(flow volume, temperature) - Seeps and springs inflows (identify)



Reach	River Miles	Land Use	Geomorphology	Groundwater-Surface Water Interactions	Documented Species Use <i>(From SWIFD, survey data, and/or anecdotal accounts)</i>	Habitat Conditions	Data Gaps
			cutbank in contact with extensive landslide complex near RM 14 Average slope: 0.17% (from LiDAR water surface).			but stays wet longer than most of the reach (until late summer).	
7	14.5 to 16	Tenino urban growth corridor, Miles Sand & Gravel Mine, The Nature Conservancy, Timber lands (WDFW parcels)	Morphology: Single-thread and multi-thread flow paths, forested accessible floodplain area through Nature Conservancy land, with connected off-channel wetlands. Accessible floodplain width greatly exceeds observed (Feb-March 2024) wetted channel width from RM 15.4 upstream through private lands. Diffuse watershed and valley boundary along abutting prairieland that divides Skookumchuck drainage. Geology: Glacial outwash and alluvium Average slope: 0.13% (from LiDAR water surface).	Very little observational flow data available in downstream reach between Colvin Ranch (RM 14.5) and Tenino city center (RM 16.5) in area that is presumably connected to Skookumchuck River aquifer. Reservoir storage in Skookumchuck could affect gains/losses in Scatter Creek in this reach compared to historical conditions – affects need to be studied, but could enhance streamflow in summer due to releases. Early onset continuous flows observed in Tenino city center (starting 11/18/24 in RM 16.6 to 18.2), which is likely due to tributary inputs in the reach. August 2024 imagery: • RM 14 to 15: Mixed wet/dry • RM 15 to 16: Mostly dry	Aquatic Species: <u>Spawning:</u> NA <u>Rearing, migration, and/or present:</u> Coho, winter steelhead, lamprey (landowner obs), cutthroat, rainbow trout <u>Other:</u> Fresh water mussels (landowner obs), presumed MSOM species ³ Semi-Aquatic Species: Beaver, presumed SA species ⁴	Veg: Mature functioning oak stands transition to narrow riparian buffer through private residential properties upstream. Increasing impervious surfaces in the Tenino growth corridor and a gravel quarry in the nearby floodplain. Aquatic Hab: Pool depth and frequency unknown, with limited beaver observation in the reach. Gaining/losing conditions through end of reach are unknown but discontinuous pools likely.	• General information gaps⁵ • Seepage run data (gaining/losing streamflow observations) • Effects of Skookumchuck Reservoir on groundwater
8a	16-19.2	Tenino urban growth corridor, private residential and agriculture	Morphology: Single-thread channel with abrupt up-valley confinement from previous reach. Accessible floodplain area is confined by infrastructure in some places (BNSF railroad, Fenton Ave W bridge, Greene St bridge). Floodplain area increases upstream through grazing and pastureland (no riparian)	Southern headwaters (Cozy Valley area) tributary stream enters Scatter Creek at RM 18.8 and is an important contribution to Scatter Creek streamflow. Reach upstream of tributary confluence remains dry for very long periods of time (dry until January 2025 during current water year). Abrupt increase in impervious surface area associated with Tenino, but groundwater well density	Aquatic Species: <u>Spawning:</u> NA <u>Rearing, migration, and/or present:</u> Coho, winter steelhead, cutthroat, rainbow trout <u>Other:</u> presumed MSOM species ³	Veg: Very limited and disconnected riparian buffer through core Tenino urban center – buffer is completely absent from RM 16.5-17.5, with some active grazing along banks. The left bank floodplain is mostly modified and impervious. Riparian buffer increases behind middle school at upstream reach extent.	• General information gaps⁵ • Seepage run data (gaining/losing streamflow observations) • Tributary inflows (flow

Reach	River Miles	Land Use	Geomorphology	Groundwater-Surface Water Interactions	Documented Species Use <i>(From SWIFD, survey data, and/or anecdotal accounts)</i>	Habitat Conditions	Data Gaps
			followed by partial forest, where local wood recruitment is possible. Geology: Glacial outwash and alluvium Average slope: 0.14% (from LiDAR water surface).	decreases (public water supply) apart from some large agricultural wells. August 2024 imagery: - RM 16 to 17: Mostly dry - RM 17 to 18: Mostly dry - RM 18 to 19: Mostly dry	Semi-Aquatic Species: Beaver, presumed SA species⁴	Aquatic Hab: Pool depth and frequency unknown, with limited beaver observation in the reach. Appears to be losing streamflow (more continuous flow observed upstream near tributary inputs than downstream). Very little shade available in the reach. BNSF Railroad crossing culvert categorized as 0% passage culvert (complete fish passage barrier, WDFW ID 604153).	volume, temperature) Seeps and springs inflows (identify)
8b southern head-waters		Creekside Conservancy, Timberlands (Weyerhaeuser, Green Diamond Resource Company, WA Department of Natural Resources)	Southern headwaters in Cozy Valley enters mainstem Scatter Creek at RM 18.8. Many forested tributaries and upland wetlands contribute to this headwater basin of Scatter Creek.	Year-long continuous flow observed at Churchill Road crossing of Cozy Valley tributary to Scatter Creek. This reach may have been connected to McIntosh Lake, although the frequency and magnitude of the flow contributions is still unknown. August 2024 imagery: Mostly dry in exposed valley near Scatter Creek confluence but known flow in forested tributaries	Aquatic Species: <u>Spawning:</u> Coho (historically, currently unknown/presumed no), cutthroat <u>Rearing, migration, and/or present:</u> Cozy Valley Creek surveys found coho (2022) and steelhead (2025) fry, cutthroat, rainbow trout <u>Other:</u> presumed MSOM species³ Semi-Aquatic Species: Beaver, river otter, presumed SA species⁴	Veg: Riparian forest mostly intact in Cozy Valley tributary (with ongoing restoration efforts in creek) and partially developed and logged in Northcraft Creek tributary. Very little riparian shading in valley bottom (mostly cattle farm and residential) Aquatic Habitat: Year-round streamflow and active beavers (although landowner coexistence outreach needed to prevent future trapping)	- General information gaps⁵ - Seepage run data (gaining/losing streamflow observations) - Streamflow assessment (relative contributions to Scatter Creek)
9	19.2 to 22	Most of the upland timber lands are owned by PB Lumber, pastureland and low density	Morphology: Headwater reach flowing from wetland complex, transitions to a steeper mostly straight single-thread channel downstream. Some beavers observed in the reach.	FLOWPER observations at the upstream and downstream reach boundaries suggest that streamflow is losing to groundwater in this reach. The downstream reach is only wet for a few months out of the year (was dry from July 2024 until late February 2025 and remained wet until May 1 st 2025, dry	Aquatic Species: <u>Spawning:</u> NA <u>Rearing, migration, and/or present:</u> cutthroat, rainbow trout <u>Other:</u> Presumed MSOM species³	Veg: Transitions between narrow riparian buffer in pasturelands to fully forested buffer (but forested buffers are in timber lands). Uplands are mostly owned by logging companies. Limited impervious floodplain area.	- General information gaps⁵ - Assess extreme streamflow losses in downstream extent



Reach	River Miles	Land Use	Geomorphology	Groundwater-Surface Water Interactions	Documented Species Use <i>(From SWIFD, survey data, and/or anecdotal accounts)</i>	Habitat Conditions	Data Gaps
		residential in valley bottom	Geology: Adjacent high relief composed of Tertiary bedrock and glacial till Average slope: 0.5% (RM 20) to 0.05% (RM 22)	after). Contributions from headwater wetlands and forested hillslopes are unknown. August 2024 imagery: RM 19 to 22: Unknown (obscured by canopy)	Semi-Aquatic Species: Beaver, presumed SA species ⁴	Aquatic Hab: Pool depth and frequency unknown, with limited beaver observation in the reach. Appears to be losing streamflow (more continuous flow observed upstream). Fish passage migration barrier when dry (until mid-winter)	Tributary inflows

¹ Joint USGS + WDFW study assessing flow permanence in Scatter Creek (<https://pubs.usgs.gov/publication/ofr20201075>)

² River Miles documented in spawning survey reports may vary from river miles in map document

³ Multispecies occupancy model (MSOM) predicted aquatic species occurrence from Chehalis Basin Strategy [currently The Office of the Chehalis Basin] (2023a): Highest probability species occurrence (greater than 75%) for non-salmonids species with limited documented use in Scatter creek include Pacific lamprey, Speckled dace, Northern pikeminnow, Threespine stickleback, Torrent and Prickly sculpin, Signal crayfish

⁴ For undocumented reaches, presumed semi-aquatic species include beaver, river otter, northern red-legged frog, rough-skinned newt, pacific tree frog, and various waterfowl

⁵ General data gaps in each reach include: general species assessments (for non-salmonids), substrate data, bathymetry (pool depth & frequency), large wood surveys, invasive species surveys and impact assessment, and stream seal assessments

3.2 Reach Assessment Findings

The mapbook in Appendix A and Reach Assessment Summary Table (Table 3-2) provide detailed information on the geomorphic, hydrologic and biological characteristics of each reach according to the existing information currently available and include knowledge gaps to be filled with future assessments. Summaries of some of the main points include the following:

Impaired Streamflow: Reaches 1 to 4, 9

Scatter Creek flow continuity is highly variable, both spatially and temporally. Reach 4 (RM 10 to 7.5) is an extreme losing reach, which disconnects flow from the wetter reaches upstream to the gains seen in the WDFW Wildlife Area just downstream. This reach goes subsurface earlier than the lower 8 miles, but most of the lower 8 miles of Scatter Creek are dry between June to November/December, with the exception of several year-round pools, including the WDFW Wildlife Area and in the lower mile of Scatter Creek near the Chehalis River confluence. Further assessment of the lower 8 miles is needed, and partially underway through various studies by Thurston County, USGS, WDFW, and the Chehalis Tribe. These intermittent and disconnected reaches strand fish and prevent upstream and downstream migration during critical times, limiting fish use in the basin and access to the headwaters. The lower portion of Reach 9 (The northern headwaters reach) is the driest section of Scatter Creek. It is the last to achieve continuous flow in the winter wet season and first to go dry.

Spawning Habitat is Limited: Reach 1

Historically, coho spawning was recorded up to RM 4 (WDFW records since 1931), although WDFW SWIFD identifies coho spawning occurring up until RM 14. Currently, Reach 1 includes the only documented spawning records for coho and steelhead in Scatter Creek (WDFW SGS Database). The upstream extent of Reach 1 is dry from June to November-December, which restricts upstream access for spawning salmonids during this time. Historically, adult coho and winter steelhead spawned in Northcraft and Cozy Valley tributaries.

Habitat Connectivity and Intactness: Reaches 2(lower), 3, 6, and 8b

These reaches have large parcels with high quality instream and riparian habitat, including mature riparian areas (including oak stands), pools, as well as known springs and year-round flow sources that are in need of enhancement or protections. Most of these parcels also coincide with committed landowners, including the WDFW Wildlife Area, Colvin Ranch, the Nature Conservancy, and Creekside Conservancy. Much of the headwaters is partially intact (forested but logged intermittently) and zoned for rural residential.

Water and Land Use Changes: Reaches 2 to 4, Reach 8b

Reaches 2 to 4 are experiencing the highest groundwater demands from permit exempt wells and continued rapid growth is anticipated in these areas. These reaches are also losing streamflow to groundwater, most severely in Reach 4. Reach 8b (southern headwaters reach) contains large parcels that are currently undeveloped but zoned for rural residential use. Projected 2040 growth highlights development in these areas, which will require permit-exempt wells and potentially threaten tributary streamflow to Scatter Creek.

3.3 Data Gaps

One of the major findings of the reach assessment is the need for additional data to help identify potential restoration opportunities so that areas of the stream can be prioritized for specific restoration strategies. Filling these data gaps can be prioritized in the near term to help inform restoration needs and build upon the list of strategies presented in Section 7.

Some of these data gaps are currently under investigation, such as the ongoing groundwater modeling and flow permanence studies by Thurston County, USGS, and WDFW, habitat assessments underway by the Chehalis Tribe, and ongoing landowner relationship building by Thurston Conservation District. Given that habitat restoration is dependent on the target species and requires a suitable but attainable flow regime, further coordination amongst these entities is imperative to help the subcommittee answer the question: **What is the desired flow regime of Scatter Creek?**

Table 3-3 Data gaps in Scatter Creek

Data Need	Description
Identify New Water Source(s)	Dry stream conditions are the key limiting factor in most scenarios. Identifying and acquiring new streamflow is critical to salmonid restoration. Cooke Aquaculture water rights is currently the only sizable candidate. Ongoing investigations will yield more insights.
Species Assessment	Fill in knowledge gaps to identify extent of non-salmonid aquatic species such as lamprey (extent currently unknown) and freshwater mussels (data limited to lower 8 miles), and understand fish use in the northern headwaters, which is disconnected from lower Scatter Creek for much of the year due to subsurface flows. Additional data gaps include invasive species surveys in Scatter Creek (extensive presence known in Black, Skookumchuck, and Chehalis Rivers, so presumed in Scatter Creek but extent and pervasiveness unknown).
Paired Species Use and Hydrology	At a reach level, identify the timing and location of important life cycles of native species in Scatter Creek in context with expected flows for a given reach and time of year. Example of life cycles include spawning, emergence, and out migration. Species that may be of note include coho, winter steelhead, Chinook, Pacific lamprey, and freshwater mussels. This is to help inform seasonal flow needs for each species for targeted restoration.

Data Need	Description
Cold Water Refugia Assessment (partially ongoing)	Identify areas of cold-water inputs (tributaries or springs) to target restoration actions, such as protecting land, restoring shade, and/or engineering storage of water for resting and holding areas in the form of targeted BDAs. Quantify flow inputs (streamflow or springs) to assess level of design effort. Work by WDFW and USGS will help fill in some of these gaps (anticipated by 2027).
Cooke Aquaculture Water Right Feasibility Study (ongoing)	Investigate feasibility of actions such as resuming streamflow augmentation to Scatter Creek or using water right to supplement water use in locations that that rely on permit-exempt wells. This will help inform prioritization of restoration activities in the downstream reaches, which are currently dry for most of the summer and fall months.
Flow Presence-Absence Model (ongoing)	Seepage-run data (gaining/losing streamflow) is limited to the lower 8.5 miles of Scatter Creek. Ongoing USGS study, including FLOWPER observations, will help inform areas of losing and gaining across the entire mainstem of Scatter Creek. Citizen Science observations are filling in gaps where FLOWPER data is absent. Study is estimated to be completed in 2027. This will help prioritize reaches and strategies based on gaining and losing characteristics.
Shallow groundwater effects on Scatter Creek	Investigate how and where shallow groundwater pumping is affecting flows along Scatter Creek to identify potential water rights holders for donation, acquisition, or educational outreach on water use improvements.
Reed canary grass water demands	Investigate how and where reed canary grass is affecting the water budget of Scatter Creek (high transpiration rates).
Channel bathymetry and hydrologic connectivity (pool habitat study)	There is very little information about pool depth, frequency, permanency, and connectivity in Scatter Creek.
County code updates (CARA)	Thurston County is in the process of amending its Critical Areas Ordinance, including Chapter 24.10 – Critical Aquifer Recharge Areas ² . The subcommittee should work with Thurston County in these efforts.
Landowner Commitment	Continuing to build landowner relationships and identify parcels where restoration and/or protection may occur, or educational outreach is needed (such as beaver coexistence) will help prioritize restoration areas.

4 PRIOR AND ONGOING RESTORATION ACTIVITIES

Several organizations and residents have been actively working on restoration for many years. A summary of completed and ongoing projects is described below; project locations are shown in the mapbook in Appendix A:

- Weins Farm Restoration (Reach 1) – Thurston CD has been working with landowners to develop a restoration project at this site in the most downstream Scatter Creek reach.

² [Thurston County Code of Ordinances - Chapter 24.10: Critical Aquifer Recharge Areas](#)

- Cooke Aquaculture Water Right (Reach 3) – Washington Water Trust is working with the landowner to gauge interest in selling all or a portion of existing groundwater rights for streamflow and/or consumptive water uses. Actions that could be considered include:
 - Pump groundwater directly to Scatter Creek. Cooke has 12,843 ac-ft of water rights in Ecology's trust program as a 'temporary donation.' Potential actions could include resuming streamflow augmentation using pumped groundwater.
 - Permanent retirement of part of water right to ensure water remains in the aquifer which feeds Scatter Creek and the Chehalis River
 - Create a Scatter Creek Water Bank to mitigate for individual permit-exempt wells (offsets impact of new wells)
 - Transfer some of the consumptive portion of the water right to Thurston County for water supply in the Grand Mound Urban Growth Area. This action would offset impacts to other water sources Thurston County would use to serve this area.
 - Project would benefit streamflow restoration which support most other habitat restoration objectives.
- Upper Scatter Creek Managed Aquifer Recharge (Reach 8b)– Thurston County initially identified this opportunity during development of the Streamflow Restoration Plan. Thurston CD oversaw preliminary assessment in 2022 and determined that the site is likely more suited for passive restoration that promotes infiltration than an engineered MAR project.
- Sampson Wetland Restoration (Reach 8b) – Creekside Conservancy (aka Heernett Foundation) began restoration efforts as its land holdings in Cozy Valley increased. Thurston CD took on the active role of overseeing feasibility assessment activities in 2022, and continued to maintain a monitoring network there. Initial restoration project concepts have been developed that would increase potential coho rearing habitat and support groundwater replenishment through floodplain wetlands.
- Water Rights Transactions (basinwide) – Washington Water Trust completed a water rights assessment and identified several candidates for water right transactions, totaling 1051.3 acre-feet per year and an estimated streamflow benefit potential of 14.78 cfs. They are currently conducting outreach to water right holders (workshop conducted in Feb 2025) in coordination with Washington Farmland Trust. This project would benefit streamflow restoration which supports most of the habitat restoration goals.
- Assessment of Groundwater-Surface Water Exchange (basinwide) – WDFW and USGS are working together on this project which will provide information to resource managers to help guide restoration of the basin to improve instream conditions for resident fish. The project's objectives are to:
 - Estimate minimum and maximum extents of intermittent reaches using aerial imagery analysis and field surveys.
 - Map the occurrence and magnitude of groundwater discharge zones during wet and dry seasons in Scatter Creek using vertical and longitudinal thermal profiling techniques.

- Scatter Creek Streamflow and Groundwater Modeling – Thurston County has developed a groundwater model for the Scatter Creek watershed, and continues to investigate and monitor streamflow and groundwater to inform streamflow restoration and land use management decisions.
- Citizen Science Observations – CBP has been partnering with various agencies and private landowners to compile data on flow observations throughout the watershed. Data compilation has been ongoing since 2001.
- Southern Headwaters Fish Use Survey – Thurston Conservation District is currently working with Wild Fish Conservancy to conduct a fish species assessment of Cozy Valley and Northcraft Creek, including electrofishing and eDNA sampling. Field assessment was completed in May of 2025 but results have not been processed.

5 FUTURE PROJECTED CONDITIONS

5.1 Land and Water Use

The Scatter Creek basin is projected to see significant rural development through 2040. This projection reflects the area's high development activity, particularly around the communities of Grand Mound, Rochester, and Tenino, which are experiencing ongoing residential growth. Most of this growth is anticipated to occur within unincorporated areas, such as the Rochester subarea and the currently undeveloped uplands that are zoned for rural residential, that rely on permit exempt wells (Figure 16). Based on 2017 population forecasts from the Thurston Regional Planning Council, CBP estimates that approximately 526 new permit-exempt domestic wells are expected to be installed by 2040 (NHC, 2020).

Water use from these new wells has been evaluated in terms of both indoor and outdoor consumption, with estimates designed to be conservative yet reflective of rural residential patterns. Each new household is assumed to use around 15 gallons per day for indoor purposes and approximately 93.9 gallons per day for outdoor irrigation, based on an average irrigated yard size of 0.074 acres. These estimates follow Washington State Department of Ecology guidance, which assumes that only 10% of indoor use is consumptive (due to septic return flows), while 80% of outdoor irrigation water is considered lost to evapotranspiration and plant uptake. The anticipated water demand from new development in the Scatter Creek subbasin is estimated at about 64.2 acre-feet per year of consumptive use.

Thurston County is currently updating their county Code of Ordinances with respect to Critical Aquifer Recharge Areas.

5.2 Climate Change Impacts and Vulnerabilities

Scatter Creek faces growing environmental challenges due to climate change, including reduced summer streamflow, higher summer temperatures, and the potential for more extreme precipitation anomalies. The Coast Salmon Partnership developed a webtool³ based on available information, providing information on change in flows, water temperature, and fish habitat suitability, showing which reaches of each river and stream would be Optimal, Suitable, or Too Warm for salmon species by 2080. Table 5-1 summarizes the predicted changes for Scatter Creek.

Table 5-1 Projected future conditions flow in the Scatter Creek watershed by 2080. Data from Coast Salmon Partnership web map

Subwatershed	Summer Flow Mean % Change	Summer Flow Min % Change	Winter Flow Max %
Reach 1 - 7	-15.9 to -16.3	-21.2 to -21.3	+11.4 to +13.3
North Tributaries	-18	-22.6	+35.5
South Tributaries	-15.6	-20.8	+9.3

The Coast Salmon Partnership webtool shows the impacts of a changing climate on baseflows to be a decrease of mean summer flows of about 16% and as high as a 22% decrease in September low flows. Thus, actions to fully counteract these effects alone would need to result in 16-22% higher baseflows, and would be needed in addition to action to offset the impacts of already low seasonal flows in the basin.

The webtool predicts that temperature will be suitable or optimal for all reaches in 2080, however, this contradicts available known water temperature data in Scatter Creek and was therefore excluded from Table 5-1. Summer water temperature currently exceeds habitable water temperature levels in nearly every reach and can therefore be presumed to increase to more lethal levels in the future (see Section 2.4.2 for more details).

Projected changes in temperatures, precipitation, and evapotranspiration were assessed for the City of Tenino during the mid-century period (2040-2069) and presented in Table 5-2. Projections were based on two scenarios, Representative Concentration Pathway (RCP) 4.5 (reduced emissions scenario) and RCP 8.5 (business-as-usual high emissions scenario), using the

³ [Link to Coast Salmon Partnership Webtool](#)

Coupled Model Intercomparison Project Phase 5 (CMIP5), which averages 20 global climate models.

Table 5-2 Historic and Projected Climatic Conditions in Tenino, WA (from Climate Toolbox)

Climactic Variable	Historical Averages	Projected Change RCP 4.5	Projected Change RCP 8.5
Average Temperature (°F)			
Annual	50.8 °F	+3.7 °F	+5 °F
Winter	39.9 °F	+3.7 °F	+4.7 °F
Summer	62.5 °F	+4.3 °F	+5.9 °F
Maximum Temperature (°F)			
Annual	60.3 °F	+3.9	+5.1
Winter	46.6 °F	+3.7	+4.6
Summer	74.6 °F	+4.7	+6.3
Precipitation¹ (in)			
Annual	49.9 in	+3.30%	+3.60%
Winter	20.1 in	+7.20%	+7.40%
Summer	3.7 in	-13.4	-15.30%
Actual Evapotranspiration (in)			
Annual	27.2	+1.8 in	+2.2 in

Air temperature, solar radiation, and shade are the most important factors in determining water temperature. Therefore, predicted increases in both average and maximum summer air temperatures will have a direct result on increasing stream temperatures. This is particularly true in summer months, which are predicted to have the greatest relative increase in temperature and greatest decrease in precipitation. These changes threaten the health of aquatic ecosystems and native species, particularly salmon, where existing temperatures already exceed habitable levels and force migration away from large reaches of the mainstem of Scatter Creek. The impacts of climate change are compounded by existing pressures such as riparian vegetation loss, consumptive water use, floodplain disconnection, and immature forest buffers in the watershed's headwaters.

The degradation of riparian zones, especially in the lower reaches, leads to even higher stream temperatures, while water withdrawals from permit-exempt wells reduce summer baseflows. These wells, which are hydrologically connected to surface water, contribute to the overall decline in water availability during critical low-flow periods. Additionally, land-use practices and infrastructure, such as undersized culverts and roads that contribute sediment, further impair watershed function.

Climate Resilience

Climate resilience is the ability of a species or habitat to recover from a disturbance without significant loss of function. Resilience to climate impacts is influenced by climate exposure, ecological sensitivity, and social adaptability (Gunderson, 2000; Glick et. al., 2000). Some of the actions needed to improve resilience to climate change will involve expanding efforts to reduce past and ongoing degradation (i.e. instream and riparian restoration). Additional actions will be needed to improve the watershed's resilience in the face of climate change.

To improve climate resilience of salmon habitat, actions should be taken to improve resilience to each exposure metric. Since summer temperatures are likely to have a strong influence, actions to maintain or reduce water temperature at the local and landscape scale are needed. Baseflow is difficult to increase, but actions can be taken to protect existing levels of baseflows, such as protecting wetlands and shallow aquifer recharge areas. Riparian intactness can be maintained through protecting areas already intact, or through enhancing already mostly intact areas.

Table 5-3 Climate stressors (exposure) in the Scatter Creek and recommended actions to increase resilience in the face of those (Adams and Zimmerman 2023).

Exposure	Actions to reduce sensitivity
Summer Low Flows	Protect wetlands and shallow aquifer recharge areas
	Improve water storage (alluvial and surface)

Exposure	Actions to reduce sensitivity
	Reduce rate of groundwater uptake from younger vegetation through promoting mature riparian buffers and managing upland habitat for mature forest function
	Protect current forest cover
	Reduce consumptive water use from surface water and shallow aquifers
	Address invasive plants
Summer Temperatures	Maintain riparian intactness through protecting intact riparian area and enhancing mostly intact areas
	Repair riparian buffers, including removing invasive species
	Increase hyporheic flow, groundwater storage and groundwater connection
	Improve access to cool water refugia

Climate resilience for these watersheds was evaluated through the lens of feasibility given the social context. Actions are needed to increase **voluntary receptivity** to actions in these watersheds in order to improve the likeliness of uptake of landscape scale changes. Since most of the watershed is in private ownership, actions to increase receptivity among private landowners will be especially important. Methods to improve receptivity are listed in the Outreach section (Section xx)

6 OUTREACH STRATEGY

The goals and objectives for outreach related to Scatter Creek protection/restoration are described in Table 6-1.

Table 6-1 Outreach Goals and Objectives

Objectives	Goals
- Residents, landowners, and visitors know about the oak prairie ecology and surface water-groundwater connection. - Residents, landowners, and visitors have access to knowledge about the human history and current activities within the watershed	Cultivate understanding and stewardship values around the unique ecological character of the Scatter Creek watershed

Objectives	Goals
1. Creekside landowners understand what degraded conditions look like, how they negatively impact the stream and aquatic life. 2. Creekside landowners understand how to improve riparian conditions to support stream health and aquatic life 3. Creekside landowners have access to technical and financial support for protection/restoration efforts 4. Community-building activities occur regularly to encourage participation and build social infrastructure	B. Cultivate understanding, interest, and capacity for streamside landowners to protect/restore riparian areas
1. Landowners not adjacent to the creek understand how their water use and land management choices can negatively impact the stream and aquatic life. 2. Landowners not adjacent to the creek understand how their water use and land management choices can support stream health and aquatic life 3. Landowners not adjacent to the creek have access to technical and financial support for protection/restoration efforts 4. Community-building activities occur regularly to encourage participation and build social infrastructure	C. Cultivate understanding, interest, and capacity for landowners not adjacent to Scatter Creek about their role in protecting/restoring streamflow and aquatic life

6.1 Outreach Audiences and Topics

The subcommittee identified outreach topics needed to help promote restoration goals, ideas, and implementation for each respective targeted audience in the Scatter Creek basin. Outreach audiences and topics are described in Table 6-2.

Table 6-2 Outreach Audiences and Topics

Audience	Outreach Topics
Forest landowners	• Role of mature forests in supporting stream base flows • Role of mature forest in ameliorating elevated water temperatures • Availability of forest protection mechanisms (conservation easements, acquisition, buffer management)
Agricultural producers	• Stewardship of the stream-land interface for streamflow/aquatic life benefit • Water use / irrigation efficiency • Water rights trust opportunities • Technical and financial assistance programs

Audience	Outreach Topics
Industrial landowners	- Stewardship of the stream-land interface for streamflow/aquatic life benefit - Water use / irrigation efficiency - Best practices for chemical storage and disposal, vehicle maintenance, etc. - Water rights trust opportunities - Technical and financial assistance programs
Rural residential landowners	- Stewardship of the stream-land interface for streamflow/aquatic life benefit - Water use / irrigation efficiency - Best practices for landscaping chemical use and hobby farm animal waste management - Water rights trust opportunities - Technical and financial assistance programs
Thurston County	- Critical Aquifer Recharge Area assistance and enforcement - Grand Mound subarea water supply and wastewater planning - Aquifer replenishment techniques - Technical and financial assistance programs
City of Tenino	- Key needs and strategies for the Scatter Creek Local Strategy Plan - Who is participating - How the City can contribute to restoring/protecting Scatter Creek
General public (residents and visitors)	- What makes Scatter Creek special - How the community, agencies, tribes and NGOs are working together to restore Scatter Creek - How they can contribute to restoring/protecting Scatter Creek

6.2 Outreach Actions and Outcomes

Recommended outreach strategies include targeted landowner outreach, focused engagement with jurisdictional governments, and general educational activities and events. Strategies and activities are described in Table 6-3.

Table 6-3 Recommended Outreach Strategies and Actions

Category	Target Audience	Lead/Activity/Strategy	Material Needs
Targeted landowner outreach	Forest landowners	- Lead: Thurston CD - Direct contacts	- Informational materials on Scatter Creek streamflow and temperature data showing apparent benefits from upland/adjacent forest. - Information about available funding mechanisms for forest conservation

Category	Target Audience	Lead/Activity/Strategy	Material Needs
	Agricultural producers	- Lead: Thurston CD - Direct contacts - Educational/community events at Tenino Food Hub	- Informational materials on riparian restoration, invasive plant species abatement, on-farm BMPs for water conservation, water rights trust opportunities, and technical/financial assistance programs - Display boards with maps
	Industrial landowners	- Lead: To be determined - Direct contacts	- Informational materials on connection between site management, water use and Scatter Creek. - Information on water rights trust opportunities
	Rural residential landowners	- Leads: Thurston CD, CBP - Direct outreach (Thurston CD lead) - Community events (Prairie Days, Colvin Ranch annual event, Tenino Food Hub) (Lead: CBP, Creekside Conservancy)	- Informational materials on riparian management, water conservation, landscaping chemical alternatives, invasive plant species abatement - Maps
Jurisdictional governments	Thurston County	- Lead: Thurston County - Direct contacts - Board of County Commissioners' briefings - Continued collaboration through Scatter Creek Subcommittee	- Informational materials on Scatter Creek protection/ restoration goals and recommended strategies as they relate to the Grand Mound subarea land use policies and enforcement programs. - Information on financial/technical assistance programs
	City of Tenino	- Lead: CBP - Direct contacts - City Council briefings	- Informational materials on Scatter Creek protection/ restoration goals and recommended strategies as they relate to the City activities and residents. - Information on financial/technical assistance programs
General Public	Residents	- Leads: CBP, Creekside Conservancy, Thurston CD - Community events - Citizen science opportunities	- General informational materials about Scatter Creek setting, threats, needs, and protection/restoration opportunities - Interactive exhibits - Coordination and data collection materials for streamflow observations

Category	Target Audience	Lead/Activity/Strategy	Material Needs
	Visitors	- Leads: Thurston County, CBP, Thurston CD, Creekside Conservancy - Targeted information/ events for bicyclists (e.g. Colvin Ranch Day)	Highlight local food producers supporting Scatter Creek restoration

7 PROTECTION AND RESTORATION STRATEGY

7.1 Protection and Restoration Goals

The protection and restoration goals for Scatter Creek center on water quantity, water quality, and habitat. These three elements are interconnected, with water quantity being the foundational block that must be addressed for water quality and habitat goals to be met.

Goals for protection and restoration are the following:

1. Restore, protect, and sustain a flow regime in Scatter Creek that supports aquatic species that historically inhabited the watershed.
2. Restore geomorphic processes in Scatter Creek, which will enable desired habitat formation.
3. Restore and protect shallow groundwater quantity and quality to support cool baseflow contribution from groundwater and support groundwater-connected wetlands.
4. Protect surface water and groundwater from contamination from land uses (e.g. landscaping/agricultural chemicals, stormwater runoff, sediment)
5. Restore and protect summer water temperatures that favor native species over non-native species.
6. Restore native plant ecology consistent with the prairie setting

These goals address the deficiencies and threats described in earlier sections of this plan. Strategies to achieve these goals must recognize the integration of water quantity, water quality, and habitat and address current problem areas while also proactively putting protections and land use management practices in place that prevent future degradation.

7.2 Restoration Goals and Strategies

Protection and restoration strategies have been organized within the framework described in Table 7-1. Each goal is listed with strategies and actions expected to support the goal. Some strategies and actions support multiple goals.

Table 7-1 Scatter Creek Goals and Restoration/Protection Strategies

Goal	Strategies and Actions to Address Goal
1. Restore, protect, and sustain a flow regime that supports historical aquatic species uses	- Define desired flow regime A. Actions/projects/strategies i. Streamflow supplementation ii. Aquifer replenishment iii. Add surface water storage in locations where this is possible and would improve flows - Stream seal repair in locations where this would be beneficial to streamflow⁴ iv. Minimize impervious surfaces through conservation lands and stormwater management v. Minimize use of shallow groundwater for consumptive water uses.
2. Restore geomorphic processes which will enable desired habitat formation	A. Manage/control invasive plant species that obstruct geomorphic processes such as sediment transport B. Add instream structure to increase channel complexity and activate geomorphic process. C. Implement restoration projects that create floodplain connection, floodplain wetlands, and beaver habitat consistent with historical watershed conditions and low-gradient prairie setting.
3. Restore and protect shallow groundwater quantity and quality to support cool baseflow contribution from groundwater and	A. Ensure that Thurston County updates to the CARA code of ordinances better protects shallow groundwater in Scatter Creek Aquifer and are enforced

⁴ Once the water table is lowered below the streambed, hydraulic connection is broken (losing streamflow to groundwater). If the streambed lacks a more impermeable layer of sediment, then streamflow will infiltrate into groundwater and not return until the water table is at the elevation of the streambed again.

Goal	Strategies and Actions to Address Goal
support groundwater-connected wetlands.	B. Shallow aquifer recharge projects to restore lost groundwater storage and offset current withdrawals C. Minimize impervious surfaces to enable as much natural aquifer recharge as possible D. Utilize stormwater management practices that encourage aquifer recharge (e.g. rain gardens, treated stormwater infiltration, pervious pavement)
4. Protect surface water and groundwater from contamination from land uses (e.g. landscaping/agricultural chemicals, stormwater runoff, sediment)	• Develop and implement an aquifer protection program (including any amendments to the Critical Aquifer Recharge Area County ordinances) to encourage residents, businesses, and industries to follow contamination prevention plans and best management practices to avoid groundwater contamination • Utilize stormwater management practices to ensure only clean and/or treated stormwater infiltrates into the aquifer. A. Protect existing and restore riparian buffers along Scatter Creek and tributaries. B. Work with agricultural producers to implement BMPs that help limit off-site transport of chemicals and sediment.
5. Restore and protect summer water temperatures that favor native species over non-native species.	A. Protect intact riparian areas and restore degraded riparian areas to provide shade. B. Restore/protect shallow groundwater that provides cool baseflows during the summer. C. Identify opportunities for providing cool water refuge within Scatter Creek and its tributaries D. Protect intact forestland that provides cool summer inflows to Scatter Creek and its tributaries.
6. Restore native plant ecology consistent with the prairie setting	A. Develop and implement a systematic management/control program for invasive vegetation impairing Scatter Creek hydrologic/geomorphic/habitat function B. Provide technical and financial assistance to streamside landowners for invasive plant control, including replanting native shade species.

7.3 Reach-Specific Protection / Restoration Strategies and Project Opportunities

This planning process identified reach-specific protection / restoration strategies and actions for Scatter Creek's nine reaches. Table B1 in Appendix B provides detailed strategies for each reach, including target properties known through the work and relationships of Subcommittee members. Strategies are organized by project type, including proposed assessments to fill data gaps and strategies for future restoration projects, management practices, conservation efforts and outreach needs.

A summary of the types of actions recommended in the reach-specific opportunities and priorities is described here.

1. **Restore Flow**

Restoring a sustainable flow regime, along with abating the serious reed canary grass infestation are essential to making other habitat restoration actions effective. Flow assessment studies are still underway as of this Local Strategy Plan publication; preliminary study results have been included but should be updated when studies are complete. Flow restoration actions will benefit from understanding where the best locations are for corrective work based on aquatic species habitat, and what actions are likely to have the most benefit.

2. **Outreach**

Outreach and education efforts are a key strategy to reaching restoration and protection goals in Scatter Creek. Several large landowners along the creek have already indicated interest in conservation and restoration activities; building on these relationships, engaging additional landowners, and demonstrating the benefits to their community will grow support for restoration and conservation efforts.

3. **Reed Canary Grass**

Working with willing public and private landowners to test strategies for abating reed canary grass could inform a basin-wide investment in further treatment, an action which will be necessary to achieve success of other restoration actions. The WDFW Wildlife Area, Colvin Ranch, and lands owned by the Center for Natural Lands Management, The Nature Conservancy, and Creekside Conservancy are five possible locations for such pilot testing.

4. **Built Environment Improvements**

The Scatter Creek watershed is especially vulnerable to degradation from land use and management practices. It is also a rapidly urbanizing region of Thurston County. Recommended actions for most of the watershed include management and enforcement measures related to water conservation, stormwater management, minimizing impervious surface, and potentially reducing contaminating materials practices (landscaping, agricultural, industrial chemicals and vehicle fluids).

5. **Climate Resiliency**

Resiliency in the face of a changing climate is strongly tied to restoring a sustainable hydrologic regime, establishing a plant community that is well-adapted to the oak prairie setting and can thrive in seasonal dry conditions that we are already experiencing and are likely to be more pronounced in the future. Community participation and ownership of the vision set forth in this plan is the third key to building climate resiliency in the Scatter Creek watershed, which is why outreach and community connections are prioritized.

The Subcommittee did not formally prioritize reaches, but did discuss priority actions within each reach and the best way to gain a toehold or grow ongoing restoration / protection efforts. Table 7-2 provides a summary of reach-specific strategies, actions, and project opportunities. Where a priority was identified by the Subcommittee, it is described there as well.

Table 7-2 Summary of Reach-Specific Strategies, Actions, and Project Opportunities

Reach	Priorities	Strategy/Action/Opportunity Highlights
Reach 1 - RM 0 to 2.3	High priority based on known coho and steelhead spawning and perennial flow	Floodplain reconnections, off-channel habitat, in-channel restoration, promote beaver activity, restore riparian where degraded.
Reach 2 - RM 2.3 to 4.6	Medium priority for restoration projects until perennial flow can be restored	Implement flow restoration strategies when assessment work is completed, promote beaver activity, consider BDAs to help retain flow longer.
Reach 3 - RM 4.6 to 7.5	High priority based on perennial pools, known flow inputs, and likely restoration willingness on large public/private parcels	Test and pilot abatement methods for reed canary grass, install BDAs to spur geomorphic process, consider augmenting streamflow with Cooke Aquaculture wells as interim measure.
Reach 4 - RM 7.2 to 10.0	High priority for streamflow restoration efforts given streamflow losses and degraded in-channel and riparian conditions	Streamflow restoration actions should be informed by results of flow-groundwater interaction studies currently underway.
Reach 5 - RM 10.0 to 12.0	High priority for flow protection based on cold water inputs and known late season and suspected year-round pools	Complete flow studies to understand cold water inputs, build landowner relationships, especially with large landowners in cold water input source areas, in-channel and riparian restoration projects especially to abate reed canary grass and restore geomorphic complexity will be helpful.
Reach 6 – RM 12.0 to 14.5	Priority in this reach is continued work with willing landowners	Habitat assessment, instream and riparian enhancement, invasive species management are priority project types.
Reach 7 – RM 14.5 to 16	High priority for landowner engagement around beaver conflict	Build on existing landowner relationships to socialize beaver coexistence, invasive plant species management

Reach	Priorities	Strategy/Action/Opportunity Highlights
Reach 8a – RM 15 to 19.2	Opportunistic actions in this reach	BNSF barrier correction, partnerships with public schools in Tenino
Reach 8b – Southern Headwaters	Priority to continue working with landowners on existing projects. Priority area given being a headwaters and current year-round flows.	Restoration actions in Cozy Valley where conservation landowner now owns most parcels; target additional forestland conservation
Reach 9 – RM 19.2 to 22	Assessment, outreach, and conservation are priorities.	Protection of headwater area is important, mechanisms to retain flow are not yet understood; additional assessment needed. Building landowner relationships will be important.

8 MONITORING AND ADAPTIVE MANAGEMENT

As restoration and protection activities progress in Scatter Creek, three major areas of monitoring and adaptive management will be important:

- Streamflow and groundwater – continued streamflow and groundwater level monitoring to enable eventual correlation with weather, climate, and restoration/protection actions. The existing citizen science monitoring program could be a significant component of this monitoring program.
- Reed canary grass abatement – The infestation of reed canary grass is so extensive that it is expected to take significant experimentation and investment to control it. Research, provide outreach and conduct demonstrations of different control methods, including mechanical and chemical control, as well as planting of shading trees, to determine viable approaches suitable to different landowners is recommended. Community engagement should be incorporated into these demonstrations as private landowners will be key to reducing the footprint and continued spread of reed canary grass in the basin and having community understanding and engagement will be necessary. This includes maintaining shaded canopy where present or encouraging planting of shade trees where absent.
- Outreach – The Local Strategy Plan placed a high priority on outreach, especially to large landowners in key locations. Monitoring and adapting the approach, messaging, and receptivity of landowners will help hone the outreach program to be most effective.
- Funding – Research private/public opportunities to control RCG in ecologically-sound, landowner-approved eradication efforts up to and across property line boundaries. Potential funding from Washington State Noxious Weed Control Board and wildland fire prevention.

As project work begins, the Scatter Creek subcommittee or similar implementing body should add detail for each of these categories.

9 CONCLUSION

The protection and restoration strategy for Scatter Creek focuses on six interconnected goals addressing flow regime, geomorphic processes, groundwater connection and use, water quality, and native plant ecology. Achieving these goals will restore critical hydrologic and ecological functions, ensuring that Scatter Creek can support native aquatic species, sustain cool groundwater-fed baseflows, and maintain resilient riparian and prairie ecosystems. Coordinated implementation of these strategies through landowner partnerships, targeted restoration actions, and continued habitat and hydrologic assessments will provide the foundation for long-term watershed health and ecological recovery. The success of individual restoration strategies relies on their integration with broader efforts; isolated implementation limits their potential impact, especially where streamflow restoration and aquatic habitat reconnection is concerned.

Effective implementation will require ongoing continued scientific assessment and adaptive management as new information becomes available. The Scatter Creek Local Strategy Plan is a working document and reflects the available information known to date. Ongoing assessments and outreach conducted by Thurston County, USGS, WDFW, The Chehalis Tribe, and Thurston Conservation District will continue to provide updated information to fill in some of the data gaps identified in this report. Given that habitat restoration is dependent on the target species and requires a suitable but attainable flow regime, further coordination amongst these entities is imperative to help the subcommittee agree on the desired flow regime for Scatter Creek. The reach assessment and proposed reach-scale strategies should therefore be updated as new information is learned from the ongoing studies in the basin.

The plan is to be adopted by the Chehalis Basin Partnership, who is committed to upholding its recommendations. It is strongly recommended that the Scatter Creek subcommittee continue to meet regularly to amend the plan as new information is gathered in the coming years. There is the potential for future adoption by Thurston County commissioners once critical data gaps are addressed and CBP is comfortable transitioning ownership of the recommendations.

10 REFERENCES

- Adams, G. and Zimmerman, M., 2023. Salmon Restoration and Resilience in a Changing Climate: A Guide to 'Future Proofing' Salmon Habitat in the Washington Coast Region. Coast Salmon Partnership Special Publication Series: 2023-01.
- Chehalis Basin Strategy [currently The Office of the Chehalis Basin] (CBS), 2023a. Native fish occupancy and density. Aquatic Species Restoration Plan Monitoring Study Report - June 2003. Available at: <https://officeofchehalisbasin.com/wp-content/uploads/2023/07/Native-Fish-Occupancy-and-Density.pdf> [Accessed 16 June 2025].

- Chehalis Basin Strategy [currently The Office of the Chehalis Basin] (CBS), 2023b. Freshwater Mussels. Aquatic Species Restoration Plan Monitoring Study Report - June 2003. Available at: <https://officeofchehalisbasin.com/wp-content/uploads/2023/07/Native-Fish-Occupancy-and-Density.pdf> [Accessed 16 June 2025].
- Dewitz, J., 2021. National Land Cover Database (NLCD) 2019 Land Cover Science Product (ver. 2.0, June 2021). U.S. Geological Survey data release. Available at: <https://doi.org/10.5066/P9KZCM54>.
- Drost, B.W., Ely, D.M. and Lum, W.E. Jr., 1999. Conceptual model and numerical simulation of the ground-water-flow system in the unconsolidated sediments of Thurston County, Washington. U.S. Geological Survey, Water-Resources Investigations Report 99-4165.
- Ely, D.M., Frasl, K.E., Marshall, C.A. and Reed, F., 2008. Seepage investigation for selected river reaches in the Chehalis River basin, Washington. U.S. Geological Survey Scientific Investigations Report 2008-5180, 12 p.
- Gebauer, A.D., Brown, R., Schwab, S., Nezat, C. and McNeely, C., 2016. Effects of an invasive grass (*Phalaris arundinacea*) on water availability in semi-arid riparian zones. *Wetlands*, 36, pp.59-72.
- Gendaszek, A.S., 2011. *Hydrogeologic framework and groundwater/surface-water interactions of the Chehalis River basin, Washington* (No. 2011-5160). US Geological Survey.
- General Land Office, 1854. Land Statis and Cadastral Survey Records, Survey notes for Township 16 N, Range 2W. Bureau of Land Management Oregon State Office. Available at: https://www.blm.gov/or/landrecords/landsurvey/gGrid_ORWA.php?state=WA.
- General Land Office, 1855. Land Statis and Cadastral Survey Records, Survey notes for Township 16 N, Range 1W. Bureau of Land Management Oregon State Office. Available at: https://www.blm.gov/or/landrecords/landsurvey/gGrid_ORWA.php?state=WA.
- General Land Office, 1856. Land Statis and Cadastral Survey Records, Survey notes for Township 15 N, Range 3W. Bureau of Land Management Oregon State Office. Available at: https://www.blm.gov/or/landrecords/landsurvey/gGrid_ORWA.php?state=WA.
- Glick, P., Stein, B.A. and Edelson, N.A., 2011. Scanning the conservation horizon: a guide to climate change vulnerability assessment. Washington, DC: National Wildlife Federation. 168 p.
- Green, J., Loft, D. and Lehr, R., 2009. State of the River Report for the Chehalis River Basin 2006–2009. A Water Quality Study. Available at: <https://chehalisbasinpartnership.org/wp-content/uploads/2015/12/State-of-the-River-JAG-10-11-09.pdf>.

- Gunderson, L.H., 2000. Ecological resilience—in theory and application. *Annual review of ecology and systematics*, 31(1), pp.425-439.
- Hirschey, S.J. and Sinclair, K.A., 1992. A hydrogeologic investigation of the Scatter Creek/Black River area, Southern Thurston County, Washington State. MS Thesis. The Evergreen State College, Dept. of Environmental Studies, Olympia, WA.
- Holgerson, M., Duarte, A., Hayes, M., Adams, M., Tyson, J., Douville, K. and Strecker, A., 2019. Floodplains provide important amphibian habitat despite multiple ecological threats. *Ecosphere*, 10(9), e02853. DOI: 10.1002/ecs2.2853.
- James, David (1980). *From Grand Mount to Scatter Creek The Homes of Jamestown*. Olympia, Washington: State Capitol Historical Association of Washington.
- Mead, R.D., Cramer, D. and Tayne, T., 1996. Southern Thurston County aquifer characterization study. Thurston County Environmental Health.
- Ministry of Forest Lands and Natural Resource Operations (MFLNRO), 2014. Guidelines for Amphibian and Reptile Conservation during Urban and Rural Developments in British Columbia.
- NHC. 2020. Appendix 1: Permit-Exempt Well and Consumptive Use Projections. Chehalis Watershed (WRIA 22/23) Response to 2018 Streamflow Restoration Law: Addendum to the Chehalis Watershed Management Plan. Northwest Hydraulic Consultants, Inc. <https://apps.wa.gov/docs/WaterRights/wrwebpdf/watershed/wria2223/WRIA22-23-Appendices.pdf>
- Parametrix, 2003. Scatter Creek Habitat Conservation Plan. Associated Reports. Prepared for Thurston Conservation District.
- Polenz, M., Gordon, H.O., Hubert, I.J., Contreras, T.A., Patton, A.I., Paulin, G.L. and Cakir, R., 2014. Geologic Map of the Center 7.5-Minute Quadrangle, Jefferson County, Washington.
- Polenz, M., Ostrom, B., Lau, T., Sadowski, A.J., Blanks-Bennett, A.L., Cakir, R., Tepper, J.H., Legorreta Paulin, G., Nesbitt, E.A. and DuFrane, S.A., 2019. Geologic Map of the Violet Prairie 7.5-Minute Quadrangle, Thurston and Lewis Counties, Washington.
- Richter, A. and Kolmes, S.A., 2005. Maximum Temperature Limits for Chinook, Coho, and Chum Salmon, and Steelhead Trout in the Pacific Northwest. *Reviews in Fisheries Science*, 13(1), pp.23–49. DOI: 10.1080/10641260590885861.
- Royal, L., 1931. Untitled report on conditions of Scatter Creek. Report provided to Parametrix (2003) by Washington Department of Fisheries and Wildlife.

- Storm, L., 2004. Prairie Fires & Earth Mounds: The Ethnoecology of Upper Chehalis Prairies. Douglasia: Washington Native Plant Society Journal, 28(3), p.69. Available at: <http://w.southsoundprairies.org/documents/PrairieFiresandEarthMounds-LindaStorm.pdf>.
- Thurston Conservation District (TCD), 1999. Scatter Creek habitat survey. Thurston Conservation District, Olympia, Washington.
- Thurston County, 2018. Groundwater Well Pumping Rate Estimation Methods. Water Resources Technical Memorandum #8.
- Thurston County. 2017. Water Resources Technical Memorandum #8: Methods Used to Calculate the Pumping Rates, Locations and Open Intervals of Active Groundwater Wells in Thurston County, Washington. Updated July, 2018.
- Thurston County. 2024b. Countywide Three-Dimensional Steady-State MODFLOW-NWT Groundwater Flow Model. Thurston County Water Resources Technical Memo #64. Prepared by Kevin Hansen, LHg., November 27th, 2024.
- Thurston County, 2024. Scatter Creek Seepage Run 05/30/2024. Water Resources Technical Memorandum #90.
- Thurston County Environmental Health Division (TCEHD), 1995. Violet Prairie Special Area Study. Available at: <https://www.thurstoncountywa.gov/media/15462>.
- Thurston County Environmental Health Division (TCEHD), 2006. Scatter Creek Aquifer Water Quality. White Paper Memo. Available at: <https://www.thurstoncountywa.gov/media/15456>.
- Thurston County Public Health and Social Services Department (TCPHSSD), 2009. Scatter Creek Monitoring Summary Report 2008-2009. Available at: <https://www.thurstoncountywa.gov/media/15452>.
- Thurston County Public Health and Social Services Department (TCPHSSD), 2015. On-Site Sewage Management in the Scatter Creek Aquifer. Final Project Report for G1200391. Available at: <https://www.thurstoncountywa.gov/media/15460>.
- U.S. Geological Survey, 2019. The StreamStats program. Available at: <https://streamstats.usgs.gov/ss/> [Accessed 10 January 2025].
- Wampler, P.L., Knusden, E.E., Hudson, M. and Young, T.A., 1993. Chehalis River Basin fishery resources: Salmon and steelhead stream habitat degradations. U.S. Fish and Wildlife Service and Washington Department of Fish and Wildlife, Olympia, Washington.

Washington State Department of Ecology, 2025. Water quality standards for surface waters of the State of Washington: Chapter 173-201A WAC. March. Available at: <https://apps.ecology.wa.gov/publications/documents/0610091.pdf>.

Williams, J.R. and Riis, S.A., 1985. Miscellaneous streamflow measurements in the state of Washington, January 1961 to September 1985. U.S. Geological Survey Open-File Report 89-380.

Williams, R.W., Laramie, R.M. and Ames, J.J., 1975. A catalog of Washington streams and salmon utilization: Volume 2 coastal. Washington Department of Fisheries.



APPENDIX A

REACH ASSESSMENT MAPBOOK



APPENDIX B

SCATTER CREEK RESTORATION STRATEGIES BY REACH

