# Technical Memorandum

**To: Columbia River CWR Project Team**

**From: Protect and Restore CWR Team (Keyyana Blount, Alex Clayton, Abigail Conner, David Gruen, Miranda Magdangal, Martin Merz, Jennifer Wu)**

**Date: August 6, 2020**

**Subject: Protect and Restore Snapshot Assumptions and Approaches**

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The EPA developed watershed summaries, or "snapshots," of 12 primary cold water refuge tributaries, and two additional tributaries. This memo describes the EPA's process to select which CWR tributaries to write snapshots for, and the assumptions and approaches to develop and review those snapshots.

Snapshots for the 12 primary cold water refuges focus on information on and actions to protect the cold water refuge. The snapshots for one of the additional tributaries focuses on a non-primary cold water refuge tributary targeted for restoration to improve its quality as a cold water refuge. The snapshot for the second additional tributary is not identified as a current cold water refuge, but is as an example of how an additional CWR could be provided, if restored.

Each snapshot provides detailed information about the quality and extent of the cold water refuge, factors in the watershed that affect cold water refuge quality, and actions in the watershed that can protect or restore the cold water refuge. The goal of the snapshots is to provide useful information to local stakeholders and regional planning groups for them to leverage resources for projects that protect and restore cold water refuges. In addition to benefiting cold water refuges, many of these projects have multiple benefits for watershed residents, salmon health and habitat for other wildlife. The snapshots highlight these other important benefits and how they align with actions to protect and restore CWR. The guiding principles in developing the snapshots were to provide concise and relevant information, and to ensure that the content was accurate by engaging local watershed experts to review our work.

<u>Selecting Tributaries to Protect and Restore</u>

As discussed in Chapter 2, EPA identified 23 CWR tributaries in the Lower Columbia River of which 12 were identified as primary CWR tributaries based on CWR volume, stream temperatures, and documented use by salmon and steelhead.

The process for determining the 23 CWR and the 12 primary CWR tributaries is described in the 3/29/18 EPA technical memo (Appendix 12.3), *Screening Approach to Identify the 23 Tributaries That Currently Provide CWR in the Lower Columbia River* and 07/22/20 EPA technical memo (Appendix 12.5), *Volume of Cold Water Refuge Associated with the 23 Tributaries Providing CWR in the Lower Columbia River and Selection of the 12 Primary CWR*.

The 07/22/20 memo shows the 12 primary CWR tributaries represent 98% of the total CWR volume in the Lower Columbia River. The EPA determined that these 12 primary tributaries are the most important to protect, and therefore, that snapshots would be written for these tributaries.

The EPA also evaluated the other 11 cold water refuges to determine whether snapshots should be developed. EPA screened the 11 non-primary CWR and other tributaries that could potentially provide CWR to identify a tributary that could potentially provide valuable CWR in the future if the tributary watershed was restored. The EPA used the following criteria:

1. Existing cold water refuge volume and use
2. Tributary flow
3. Availability of information on stream temperatures after restoration
4. Location of cold water refuge

Second, the EPA evaluated whether a TMDL had been completed that would include water temperatures that were modeled under restored conditions and specific recommendations for improving water temperatures. Based on this screening, of the 11 non-primary cold water refuges, the EPA selected the Umatilla River.

The Umatilla River ranked high due to its current flow, location within the Lower Columbia River, and existing information from the Umatilla River TMDL (ODEQ, 2001) and the Confederated Tribes of the Umatilla Indian Tribes (CTUIR) Umatilla River TMDL (EPA, 2005) suggesting that under restored conditions, August temperatures could be reduced and flow could be increased such that it could potentially provide important CWR in the Lower Columbia River in the future. The Umatilla River is a major tributary in this stretch of the Columbia River with a flow of 87 cfs. The Umatilla River currently has similar temperatures to the Columbia River in early August, but is generally cooler than the Columbia River in late August and September. The EPA Team observed major water quality issues in the Umatilla River during the fall of 2017, and the river is also on the Clean Water Act 303(d) impaired waters list for bacteria and nutrients. Therefore, significant restoration needs to be completed on the Umatilla before it becomes a dependable cold water refuge. The TMDL identifies improved water use efficiency and riparian vegetation to restore floodplain connectivity as well as improving water quality to cool water temperatures. The potential for good quality cold water coupled with the Umatilla River's location and flow make it a potentially important cold water refuge under restored conditions. Further, EPA has determined that augmented CWR from the Umatilla River is needed to attain Oregon's cold water narrative water quality criteria.

The Umatilla River, is located in a 125-mile stretch of the Columbia River where there are no other cold water refuges between the Deschutes River and the confluence of the Snake River. This area is east of the Cascade Mountain Range where hotter air temperatures heat the Columbia River and expose salmon to the highest water temperatures in the Columbia River, making it likely for salmon to seek refuge if it were available. Further, upon reaching the Umatilla River, salmon and steelhead will have been continuously exposed to warm Columbia River temperatures over the 84-mile stretch from the Deschutes River and will have expended significant energy traveling upstream 285 river miles past three dams from the ocean, so having access to CWR at this location may be highly beneficial to these migrating fish.

Table 1 below shows the list of the 11 non-primary CWR that EPA identified on its list of 23 cold water refuges in the Lower Columbia River.

**Table 1.** 11 Non-Primary CWR Tributaries Considered for Snapshot Development

| **Tributary Name** | **Considerations** | **Restoration Tributary Snapshot?** |
|---|---|---|
| Skamokawa Creek | Tributary flow >10 cfs (23 cfs); Located near the mouth of the Columbia River; fish use is unclear; no information on restored natural temperatures | No |
| Mill Creek | Tributary flow ≤ 10 cfs (10 cfs); located near the mouth of the Columbia River; fish use is unclear; no information on restored natural temperatures | No |
| Abernethy Creek | Tributary flow ≤ 10 cfs (10 cfs); located near the mouth of the Columbia River; fish use is unclear; no information on restored natural temperatures | No |
| Germany Creek | Tributary flow ≤ 10 cfs (8 cfs); located near the mouth of the Columbia River; fish use is unclear; no information on restored natural temperatures | No |
| Kalama River | High tributary flow (314 cfs); cold temperatures; tidal influences appear to make CWR use inaccessible at low tide | No |
| Washougal River | High tributary flow (107 cfs); no information on restored natural temperatures; lack of physical access to CWR | No |
| Bridal Veil Creek | Tributary flow ≤ 10 cfs (7 cfs); no information on restored natural temperatures; near other larger CWRs | No |
| Wahkeena Creek | Tributary flow > 10 cfs (15 cfs) ; no information on restored natural temperatures; near other larger CWRs | No |
| Oneonta Creek | Tributary flow >10 cfs (29 cfs); no information on restored natural temperatures; near other larger CWRs | No |
| Rock Creek | Tributary flow > 10 cfs; No information on restored natural temperatures; visual observations | No |
| Umatilla | High tributary flow (87 cfs); located in area with few CWR; TMDL; | Yes |

In addition, the EPA selected Fifteenmile Creek as an additional tributary to develop a snapshot primarily because of its importance to summer steelhead and the Middle Columbia-Hood (Miles Creek) TMDL (ODEQ, 2008), which models temperatures under fully restored conditions and describes actions needed to restore the watershed. The modeling analysis in the temperature TMDL for this creek indicates that if flow and shade were restored to near "natural" conditions, the summer river temperatures could be significantly reduced and flow restored to the point that a CWR could be formed at the creek's confluence with the Columbia River.

Figure 1 shows the 12 primary cold water refuges and the 2 additional tributaries that could serve as CWR under restored conditions.

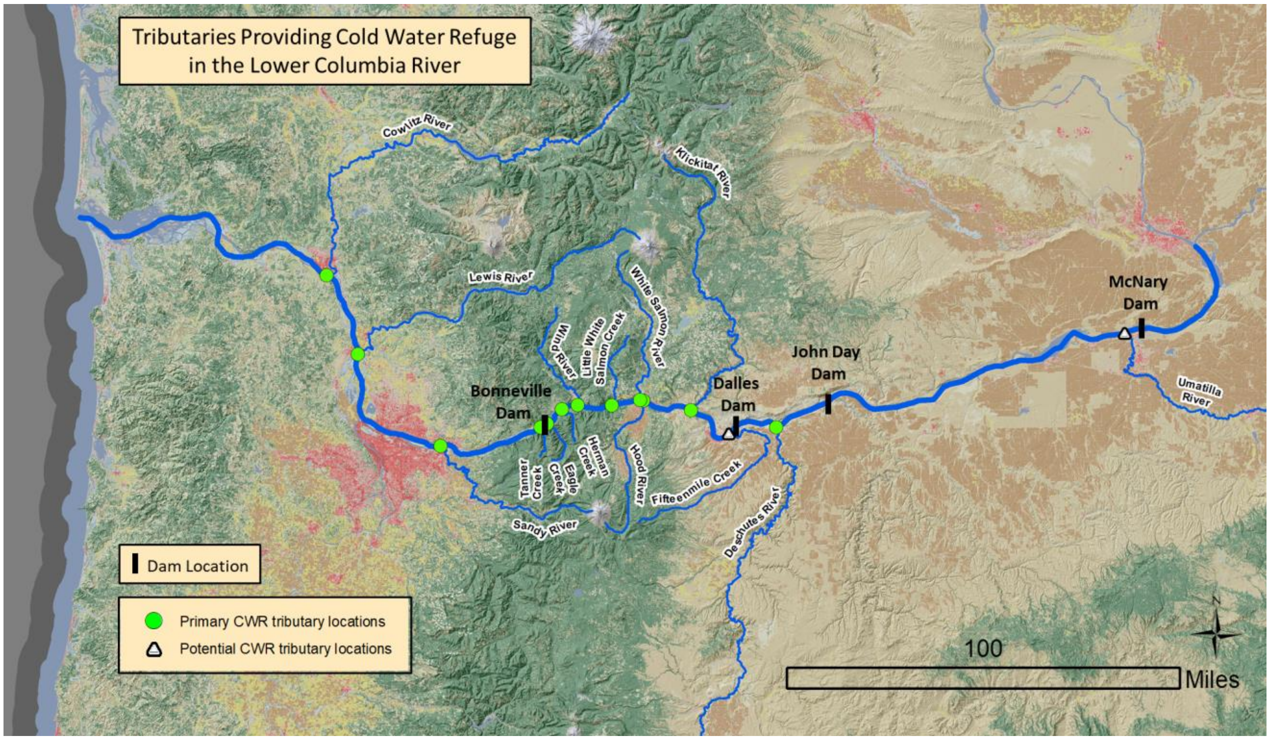


**Figure 1**. 12 Primary and 2 Restore CWR Tributaries

The EPA limited the additional snapshots to two streams due to resource and time constraints. It should be noted that the other 10 non-primary CWR tributaries and potentially other tributaries to the Lower Columbia River may have the potential to be restored to provide additional CWR. Restoration activities, such as riparian planting, bank stabilization, or water efficiency improvements in the other 10 non-primary CWR tributaries may increase the quality and quantity of their CWR. The EPA had limited information to quantify temperature improvements after restoration, so this Plan focused on areas with temperature TMDLs and other available information to select the two "restore" tributaries as described above. Information contained in the snapshots of the 12 primary CWR tributaries, Umatilla River, and Fifteenmile Creek can serve as examples for the types of actions which could benefit other tributaries to improve their viability as cold water refuges.

<u>Snapshot Development Approach and Assumptions</u>

To develop the protect and restore snapshots, we relied on work described in other technical memos in this report which describe cold water refuge plume volume, upstream extent of fish use, and documented fish use by migrating salmonids. The EPA also used LANDSAT to develop maps for the land cover and land ownership and conducted other analysis for riparian cover and water rights. For watershed background and context regarding different activities in the watershed, the EPA conducted a literature search relying heavily on Northwest Power and Conservation Council (NPCC) sub-basin plans, regional salmon recovery plans, local watershed priority plans, and information regarding individual projects within the basins. We then shared drafts of these documents with interested parties in the basins including Tribes, LCEP, counties, WDFW, ODFW, Washington Department of Ecology, Oregon Department of Environmental Quality, USFS, watershed councils and other groups who provided feedback.

The snapshots are not intended to go into the level of detail comparable to a subbasin plan but are intended to condense relevant CWR information and provide meaningful information to local stakeholders and regional planners. Table 2 is an overview of the snapshot elements and approaches. We chose these sections because they encompass CWR features, significant watershed factors affecting temperature, and recommendations to best protect or restore CWR tributaries.

**Table 2**. Summary of Snapshot Sections and General Approaches

| **Section** | **Description** | **General Approach/References** |
|---|---|---|
| Watershed at a glance | Watershed size, CWR information | Subbasin plans, regional planning documents, EPA analysis of plume volume |
| CWR features and description | CWR statistics, Relative location of CWRs in salmon's upstream migration, Tributary and Columbia River temperatures | EPA analysis of plume volume, NorWeST data and other temperature sources, Information from previous chapters, Oregon and Washington water quality standards; EPA site visits |
| Introduction to the watershed | Overview of watershed, significant land features and uses, land cover, ownership, | Subbasin plans, regional planning documents, EPA site visits, information from reviewers, LANDSAT images |
| Factors influencing temperature: riparian vegetation | Current and potential riparian vegetation in watershed, areas with the most potential for additional shading | EPA riparian analysis, information from USFS and other sources, regional planning documents, TMDLs, site visits |
| Factors influencing temperature: hydromodification | Dams, levees, irrigation canals, dikes, or other water diversions that could affect confluence temperatures | Subbasin plans, regional planning documents, TMDLs, EPA site visits, information from reviewers, Ecology, USFS, ODFW, and other sources |

| Section | Description | General Approach/References |
|---|---|---|
| Factors influencing temperature: water allocation | Water use and availability, especially at the mouth of the tributary | Oregon: Oregon Water Resources Division (OWRD) water availability statistics at mouth when available, information from ODFW on instream water rights, subbasin plans, regional planning documents<br><br>Washington: Washington Department of Ecology Water Resources Program Focus on Water Availability, information from Ecology on source water limited streams, instream water rights, and basin restrictions, subbasin plans, regional planning documents |
| Factors influencing temperature: climate change | Predicted rises in tributary and Columbia River temperatures and effects on the quality of the cold water refuge | EPA analysis of NorWeST predictions |
| Ongoing activities and actions to protect and protect/restore CWR | Current activities in the watershed that could benefit cold water refuges, recommendations to protect and enhance CWR, areas needing more research | Subbasin plans, salmon recovery plans, regional planning documents, EPA evaluation, information from reviewers |

Below is more detailed information on each section and the approaches and assumptions for each section

*Watershed at a Glance*

This section is intended to provide essential statistics on the temperature, location and plume size of the cold water tributary. Information from this section is from 07/22/20 EPA technical memo (Appendix 12.5), *Volume of Cold Water Refuge Associated with the 23 Tributaries Providing CWR in the Lower Columbia River and Selection of the 12 Primary CWR.*

This section also introduces the concept of marginal, good,, or excellent quality cold water refuges based on the tributary's temperature. The designation of the CWR quality is only based on temperature. The CWR quality does not consider the location of the CWR on a salmon's upstream migration, the volume of the cold water refuge, and physical access to the cold water refuge. However, temperature is a key factor for salmon to seek rest in a refuge when exposed to high temperatures in the mainstem Columbia River for extended time periods. Below are the definitions of cold water refuges, where August mean tributary temperatures were at least 2$^{o}$C cooler than August mean Columbia River temperatures:

- *“Excellent” cold water refuge* – Average August tributary temperatures are cooler than 16$^{\circ}$C.
- *“Good” cold water refuge* - Average August tributary temperatures 16-18$^{\circ}$C.
- *“Marginal” cold water refuge* - Average August tributary temperatures are greater than 18$^{o}$C

The EPA developed these guidelines based on EPA’s Region 10 Temperature Guidance and Oregon’s water quality standards defining CWR as tributary temperatures cooler than 2$^{o}$C compared to mainstem temperatures. However, the EPA recognizes that the actual tributary temperature is important for the health of salmon, not just its relative cooling effect on the mainstem.

*CWR Features and Description*

This section provides more detail on the temperature, location, plume size, fish use, and the significance of the cold water refuge in the context of these parameters. It also compares the tributary temperatures to the Columbia River temperatures and state water quality standards. Information from this section is from 07/22/20 EPA technical memo (Appendix 12.5),*Volume of Cold Water Refuge Associated with the 23 Tributaries Providing CWR in the Lower Columbia River and Selection of the 12 Primary CWR*; 11/1/2018 EPA technical memo (Appendix 12.4), *Location of Upstream Extent of 23 CWR Areas Used by Migrating Salmon and Steelhead;* Oregon and Washington state water quality standards, Oregon and Washington 303(d) Integrated Reports, and Total Maximum Daily Loads (TMDLs).

Columbia River and modeled tributary temperatures are average August temperatures described and referenced in EPA’s technical memos, *Screening Approach to Identify the 23 Tributaries That Currently Provide CWR in the Lower Columbia River and Selection of the 12 Primary CWR*, *July 22, 2020* (Appendix 12.5) *and Evaluation of the Potential Cold Water Refugia Created by Tributaries within the Lower/Middle Columbia River based on “NorWeST” Temperature Modeling Project, June 6, 2017* (Appendix 12.2). In contrast, when comparing tributary temperatures to state water quality standards, we used modeled maximum August temperatures, because water quality standards are expressed as 7-day average daily maximums, not average temperatures. Both pieces of information are important, since average temperatures are what a migrating fish would generally be exposed to. However, exceedances of the maximum temperatures show greater diurnal and/or seasonal fluctuations, such that while average temperatures are cold, maximum temperatures can violate standards and require TMDL plans and implementation. Therefore, we concluded that evaluating both average and maximum temperatures in these different contexts were important to include in the snapshot.

*Introduction to the Watershed*

This section gives an overview of the geography, geology, land use and ownership, and significant features and factors that affect temperature in the watershed. The EPA developed maps for land use and ownership in *Estimating land use and land ownership conditions within several priority Columbia River CWR tributaries, 5/6/19*. For other watershed information, we used available literature online and obtained additional information through comments and reports from our public review processes. The EPA documented the references we collected, including NPCC watershed reports, project planning and completion progress reports, local guidance documents, salmon recovery plans, and watershed council reports which can be found at the end of each snapshot. The EPA also visited each tributary at least once to observe the confluence and, in some tributaries, to collect temperature data.

*Factors Influencing Temperature: Riparian Vegetation*

This section focuses on the effects of riparian vegetation on shading, those impacts on temperature, and recommendations on locations to increase riparian shading that affect cold water refuges. Various reports, TMDLs, and literature have documented the importance of riparian vegetation on water temperatures from the amount of shading it provides to geomorphology related to erosion, incision, and subsequent effects on heating because of changes in channel size.

The EPA developed maps of the current riparian shade, potential riparian shade, and the difference between potential and current riparian shade conditions. This process is described in *Detailed Description of the Steps Used to Estimate Stream Shade for Tributaries that Drain into the Lower and Middle Columbia River, 5/3/19*.

To determine the areas we recommend for additional riparian vegetation, we evaluated the following: 1) areas where the difference between potential and current riparian shade were the greatest; 2) the proximity of those areas to the cold water refuge plume/mouth; 3) reports, TMDLs, or other literature that evaluated or recommended areas needing riparian vegetation; and 4) comments from peer reviewers who worked in or were familiar with the watershed. Based on this information, we developed recommendations for river reaches that, under restored vegetative conditions, would most benefit the cold water refuge temperature. We then shared drafts with reviewers who provided comments on our recommendations, which we then refined. Reviewers included Tribes, counties, USFS (including the Columbia River Gorge Commission), state agencies, and other watershed groups.

*Factors Influencing Temperature: Hydromodification*

This section focuses on dams, levees, and physical structures that could affect the quantity and movement of water in a stream or through a watershed. The amount of water in a stream greatly affects temperatures, since it takes much less energy to warm a small mass of water than a large one. Therefore, anything impeding or reducing flows has a direct effect on stream temperature and water quality. Low flows also indirectly affect water temperatures by affecting the movement and flushing of sediment which affects the geomorphology. The EPA used information from online references and information from reviewers to determine the presence of dams, levees, and water withdrawals.

The snapshots discuss impacts to flow and temperature from any hydromodification structures where information was available. The snapshots describe the impacts from dams, including selective withdrawal systems in dams, on the quality of cold water refuge. The Cowlitz River and Lewis River are significantly affected by dams where minimum instream flow releases are required through FERC licenses. We also obtained information from Portland General Electric on the Pelton Round Butte hydroelectric operations on the Deschutes River and modeling of downstream impacts. The Sandy River is also impacted heavily by water withdrawals in the Bull

Run Reservoir system, which serves as the drinking water source for the Portland metropolitan area. Because information was fairly limited on the impacts of dam on downstream temperatures in literature, in many cases we could only infer likely effects from dams, levees, and water withdrawals. In addition, to hydromodifications in the watershed, in some cases hydromodifications at the mouth of the tributary can play a large role in cold water refuge quality. This is the case for Drano Lake at Little White Salmon River and Herman Creek Cove, two primary cold water refuges that were artificially created berms and are widely used by migrating salmon. This illustrates the complexity of the impacts of hydromodification on the quality and use of cold water refuges. This area should be further studied.

This section does not evaluate the impacts of the dams on the lower Columbia River, which change the flow and sediment regime in the confluences area of the tributaries along with the geomorphology of the Columbia river. Though some watershed plans document the impacts from dams, data is limited on sedimentation at the mouths of tributary rivers and the effects of lower Columbia River dams on physical characteristics of tributary mouths. This is another area which warrants further study.

*Factors Influencing Temperature: Water Use*

This section focuses on water withdrawals, consumption and returns that affect the amount of water in the stream. As noted in the previous section, the amount of water in a stream directly and indirectly affects water temperature. Water withdrawals and consumption can harm the quality of a cold water refuge, particularly because heavy irrigation water use often coincides with warm summer Columbia River temperatures when cold water refuges are most important.

The EPA used information from Oregon and Washington water resource agencies, online literature, and information from peer reviewers in this section of the snapshots. For Oregon tributaries, the EPA used information from the Oregon Water Resources Department's (OWRD) Water Availability Reporting System (WARS) database (*http://apps.wrd.state.or.us/apps/wars/wars_display_wa_tables/search_for_WAB.aspx*). In this database, the EPA searched for water quantity information at the mouth of the tributary to view water availability information at that location. We selected 80% flow exceedance levels, which represent a low flow condition within the base period of years analyzed by OWRD from 1958 to 1987. This means that 80% of the time these flows are exceeded. We used an 80% flow exceedance based on conversations with ODFW and their thresholds to determine flow needs for aquatic life. We chose June through September, the four warmest months of the year during which cold water refuge use is important. The water allocated or reserved is the amount of water that is already being used or set aside for other uses. We then calculated the percent of water allocated by dividing the total water allocated or reserved by the natural streamflows from the WARS database. Table 3 illustrates water use in the Deschutes River included in the snapshot.

**Table 3.** Example of Water Use Table for Oregon CWR Tributaries

| DESCHUTES R > COLUMBIA R – AB MOUTH (@ 80% exceedance) | | | |
|---|---|---|---|
| Month | Monthly Streamflow (cfs) | | |
| | Natural Streamflow | Water Allocated or Reserved | % Allocated* |
| JUNE | 5,560 | 5,670 | 102% |
| JULY | 4,610 | 5,407 | 117% |
| AUGUST | 4,320 | 4,812 | 111% |
| SEPTEMBER | 4,410 | 4,997 | 113% |
| Top Users: Irrigation (87%), Municipal (8%) | | | |
| *% Allocated: [Water Allocated or Reserved]/[Natural Streamflow]. This is the percentage of water either allocated or reserved for in-stream or other uses compared with the natural streamflow. Percentages over 100% indicate the water is overallocated at the mouth of the river. | | | |
| Reference: https://apps.wrd.state.or.us/apps/wars/wars_display_wa_tables/display_wa_details.aspx?ws_id=70087&exlevel=80&scenario_id=1 | | | |

The accuracy of the "water allocated or reserved" information relies on allocated water rights, gauge data, correlations of this gauge data to the mouth of the tributary, consumptive use coefficients. Further, the "water allocated or reserved" may not reflect actual water diversions, since allocations held in 'reserve' may not always be used, in which case these numbers would be skewed upward relative to actual use. Conversely, it is unclear whether there may be other sources of water consumption not included in the WARS database, skewing these numbers downward. Still, this information provides a basic understanding of water use in the Oregon tributaries and the top users, which is useful to understand entities who may be affecting water flows.

We also received information from ODFW on instream water rights that the agency had applied for that help to protect aquatic life. ODFW also provided specific information for each of the primary tributaries, which were included in the snapshots.

In Washington, we used Washington Department of Ecology's website https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-rights and water availability reports for this section, which provided information on general water use and overallocation issues. We spoke to Washington Department of Ecology who provided us flow and water rights information on the primary CWR in Washington, including those with source water source limitations (SWSLs), basin restrictions, and instream flow rights. Washington Department of Ecology also provided minimum instream flows required under FERC relicensing on the Cowlitz and Lewis Rivers.

Additional information on water use and their impacts on stream temperature would be useful to understand.

*Factors Influencing Temperature: Climate Change*

This section discusses projections of temperature increases in the Columbia River and the tributaries to assess the quality of the cold water refuge in future scenarios with climate change. This information is useful to understand the urgency in preserving different streams and the viability and quality of these CWR tributaries in the future with higher temperatures from climate change.

To assess impacts from climate change, we used information from *Water temperature estimates of the Lower/Middle Columbia River and tributaries in 2040 and 2080 based on the NorWeST modeling effort, June 7, 2017* (Appendix 12.14). We then provided a qualitative assessment of the quality of the CWR tributary described in the *Watershed at a Glance* section.

Effects from climate change on CWR are complicated and unknown. We did not consider any changes to fish migration timing and patterns if Columbia River temperatures increase significantly. We did not estimate how predicted increases in temperatures can be offset by restoration or other management measures. This section instead makes some general conclusions to the effects of climate change from temperature. However, we included this section since climate change will likely affect the use of cold water refuges in the future.

*Ongoing Activities and Recommendations*

This section describes ongoing studies, plans and actions in the watershed and aligns those with recommended actions that would benefit cold water refuges. The purpose is to provide a targeted subset of tributary-specific restoration and protection measures, including any areas needing more research. We used information from online literature and relied heavily on watershed plans and comments from reviewers. Because of the complexity of watersheds, these recommendations are generally less specific than if there were a detailed watershed study on actions to protect and restore cold water refuge temperatures in the summer. It will be important to work closely with local practitioners moving forward to continue to align resources and assess actions that would have multiple benefits, including those that improve the quality and quantity of cold water refuges.

<u>Review Process</u>

To ensure relevance and consistency of the snapshots, the Cold Water Refuges Protect and Restore Team produced guidelines for the content and format of each snapshot. This process was iterative, and guidelines were adapted as issues arose on the best way to evaluate, display and /or include information. After each snapshot draft was completed, other team members reviewed the snapshots, and writers incorporated those comments. We then solicited comments from local stakeholders or people who were knowledgeable in the watershed and addressed those comments. During the public review of the CWR Plan in late 2019, we also received numerous comments on the snapshots, which we incorporated into the snapshots. We also responded to comments that recommendations should be more detailed by including in the recommended actions section, links between specific actions and existing plans, and agencies/organizations that would most likely be responsible for implementing or overseeing the implementation of actions .