Water Uses and Needs in the Mid-Coast

Note: This section is a summary from Step 3 of the planning process. Please refer to Appendix J for ODFW letter re: instream demand.

During Step 3 of the planning process, three working groups learned about current and future water needs and challenges of three categories of water users and uses: instream/ecological water needs, municipal and special district water providers, and self-supplied water users (self-supplied rural residents, agricultural producers, and industries). Agency partners provided presentations, technical memos, and other information to inform the Step 3 proceedings. This section of the document summarizes the information assembled to support Step 3. All materials developed in support of Step 3 can be accessed in an online folder.

Water Law and Water Rights

Under Oregon law, all water belongs to the public. With some exceptions, cities, irrigators, businesses, and other water users must obtain a permit or license from the Water Resources Department to use water from any source—whether it is underground, or from lakes or streams. Generally speaking, landowners with water flowing past, through, or under their property do not automatically have the right to use that water without authorization from the Department.

Oregon's water laws are based on the doctrine of prior appropriation—the first person to obtain a water right on a stream is the last to be shut off in times of low streamflows. In water-short times, the water right holder with the oldest date of priority can demand the water specified in their water right without regard for the needs of junior users. Generally, Oregon law does not provide a preference for one kind of use over another. If there is a conflict between users, the date of priority determines who may use the available water.

You can find more information on Oregon's water laws and water rights in a primer developed and maintained by the Oregon Water Resources Department.

Overview of Instream Water Uses and Needs

Instream water—water left in rivers and in the ground—provides immense value to the Mid-Coast region by supporting natural watershed processes, water quality, habitat and water needs of fish and wildlife, recreational opportunities, navigation, and aquaculture (e.g., oyster hatcheries). Instream water provides cultural, spiritual, and aesthetic values. Instream water is vital to maintaining healthy commercial, recreational, and tribal fisheries, which are socially, culturally, and economically important to the region. Instream resources are of significance to the Confederated Tribes of the Siletz Indians. A public survey conducted by Oregon's Kitchen Table also identified that residents and visitors place a high value on water needed to support Mid-Coast ecosystems.

The Partnership prioritizes the sustainability of healthy ecosystems that support the economy and cultural values of the Mid-Coast region. Supporting healthy freshwater ecosystems provides benefits beyond those important to fish and wildlife. Therefore, an integrated approach to managing water resources must include the flows necessary to protect all these benefits, and consider impaired flows, reduced water quality, and diminished fish and wildlife as early warning signs of potential impacts to public benefits.

Ecological Values and Instream Water Rights

Instream flows are critical for maintaining many ecological functions and supporting aquatic species. Aquatic species evolved in response to the natural variability in stream systems and rely on the full range of flows represented by a natural hydrograph to meet their needs. "Streamflow quantity and timing are critical components of water supply, water quality and the ecological integrity of river systems. Indeed, streamflow, which is strongly correlated with many critical physiochemical characteristics of rivers, such as water temperature, channel geomorphology, and habitat diversity, can be considered a 'master variable' that limits the distribution and abundance of riverine species and regulates the ecological integrity of flowing water systems" (Poff et al., 1997).

NOAA-NMFS's 2016 Final ESA Recovery Plan for Oregon Coast Coho identified reduced streamflows as one of many interrelated factors affecting the health and viability of Oregon Coast Coho, which will likely be exacerbated by climate change. Reduced streamflows also result in increased water temperature, which is a significant limiting factor for fish and wildlife. According to the Recovery Plan, "in freshwater habitats, lower summer flows, higher summer stream temperatures, and increased winter floods, would affect Coho salmon by reducing available summer rearing habitat, increasing potential scour and egg loss in spawning habitat, increasing thermal stress, and increasing predation risk (NMFS, 2016, 3-32)."

Under Oregon water law, rivers, streams, and springs do not have a legal right to their own water. Instream water rights are needed to protect instream values and are subject to the system of prior appropriation. This means that, similar to all water rights, they are subject to curtailment to meet senior out-of-stream water rights. Allocations for instream water cannot take away or impair any legally established water right having an earlier priority date.

In Oregon, three agencies (the Oregon Department of Fish and Wildlife, Department of Environmental Quality, and Oregon Parks and Recreation Department) are legally allowed to apply for instream water rights that are then held by the Oregon Water Resources Department in trust to support public uses such as recreation, pollution abatement, navigation, and maintenance and enhancement of fish and wildlife and their habitats.

There are 133 instream water rights in the Mid-Coast planning area covering 11% of river miles in the planning area, or about 450 of 4,070 total river miles. Fifty-one streams have existing instream water rights. There are 3,620 river miles without instream water rights, which includes

most-of the ocean tributaries. The instream water rights have priority dates in 1966, 1974, 1976, 1983, 1991, 1992, and 2018. Understanding instream needs for the full range of flows needed to support multiple instream needs and values is a significant data gap that should be prioritized to aid in future planning and project prioritization. Administrative actions, such as instream leases and instream flow transfers, are underutilized in the Mid-Coast and may present an opportunity for future streamflow restoration and protection activities. You can explore the instream water rights by sub-area in the Mid-Coast StoryMap (under "Is There Enough Water For All?").

The amount of water specified in instream water rights varies by month and by reach. Many of the earlier instream water rights were minimum perennial streamflows that were converted to instream rights by the Oregon Water Resources Department. All of the other instream water rights were filed by the Department of Fish and Wildlife to support fish and wildlife and their habitats. No instream rights have been filed to support pollution abatement, recreation, or navigation.

The natural flow of rivers has been altered through time through diversions for out-of-stream uses, climate, groundwater pumping, infrastructure, land development, and various management practices. Water diverted from streams for municipal, agricultural, industrial, and domestic uses reduces the water available instream for fish and wildlife and other instream values. This is most evident in areas with significant out-of-stream water use relative to natural streamflows. According to the 2001 Mid-Coast Watersheds Council Sixth Field Watershed Assessment (Garono and Brophy, 2001, 14), "stream flow restoration is a high priority for 6th field watersheds in the Schooner/Drift Creek sub basin, and in the lower Yachats basin."

In the Siletz River watershed, there are multiple out-of-basin diversions that divert water from the Siletz River to other basins. It is an increasingly common occurrence for Siletz River flows to dip below the instream water right, triggering curtailment of junior users. Some of the largest water users, including the City of Newport, City of Toledo, and Georgia Pacific have rights that are senior to the instream water right, which may limit the effectiveness of the instream water right.

The Partnership recognizes that current instream water rights neither fully represent nor protect ecological values or other instream values, and there is a need to develop a more comprehensive understanding and approach to protecting and restoring these values, especially in light of climate change impacts. When water is not legally protected instream in important reaches and flow targets are not established using ecologically based methods, there are many possible consequences to streams, including:

- Water may be allocated to out-of-stream uses, leaving limited water instream during times of water shortage.

- Flow targets established by instream water rights inadequately capture the full range of flows needed to protect current instream ecosystems, especially for flows during winter months.
- Without ecologically based flow targets, it is difficult for collaborative efforts to act in the interest of the stream.

Current and Future Instream Water Needs for Fish and Wildlife

All aquatic species have water needs related to the timing, amount, and quality of water that provide habitat and support different life stages. In the Step 3 discussions, the Partnership requested assistance from ODFW in performing a preliminary analysis of instream needs. The analysis included a summary of existing instream water rights in the Mid-Coast Planning Area, along with an analysis of how often existing instream water rights are likely to be met. However, additional data was needed for a more complete understanding of instream needs. Using instream water rights as a proxy for instream need has limitations because they do not represent the actual water needed by aquatic species, or the full range of ecological flows, and do not consider the important relationship between flows and water temperatures needed to sustain healthy fisheries.

The Partnership recognizes the value of instream flows and is committed to acquiring information to fill data gaps identified in Step 3, including a more comprehensive understanding or ecological water needs. That information can be used to plan, implement, and monitor projects in high-priority areas as advised by ODFW and other agencies with instream values. The Partnership is interested in taking an ecosystem-based approach to increasing water supply, meeting the needs of fish and wildlife, and improving water quality for all users.

Critical Issues

The working group that examined instream and ecological water needs identified the following key issues for strategy development:

- The need to develop a more comprehensive understanding of instream needs that considers the full range of ecological flows, with the intent of establishing more legal protections and developing flow targets to guide restoration efforts;
- The need to restore and protect riparian vegetation that shades streams and provides other ecological benefits;
- The need to restore and protect beavers and their habitat to support reestablishment of natural processes in watersheds;
- The need to address water quality impairments that negatively impact instream values, with a focus on addressing elevated water temperature and low dissolved oxygen levels associated with low flows and high turbidity associated with high flows;

- The need to promote and encourage management activities on public and private lands that provide multiple ecological benefits;
- The need to prepare for and mitigate the impacts of climate change on streamflows, water temperature, and other ecological functions;
- The need to improve streamflow monitoring efforts to track streamflow conditions and protect instream water rights and instream values.

The working group identified the need to limit future out-of-stream allocations on rivers and stream with high ecological values and where out-of-stream uses are significant, partner with those users to reduce out-of-stream uses and restore streamflows to protect aquatic species and ecological functions.

Overview Out-of-Stream Water Uses and Needs

Table 3 provides an overview of the out-of-stream water uses in the Mid-Coast planning area.

Table 3. Estimated quantity of use by type of use for Lincoln County based on the 2015 water use estimates produced by the US Geological Survey in gallons per day.

Type of Use	Estimated Amount Diverted (gpd)	Percent of Water Diverted
Self-Supplied Industrial	10,960,000	34%
Self-Supplied Aquaculture	9,390,000	29%
Public Supplied Domestic	6,010,000	19%
Public Supplied Industrial	2,640,000	8%
Self-Supplied Agriculture	2,010,000	6%
Self-Supplied Domestic	790,000	3%
Self-Supplied Golf Courses	200,000	<1%
Self-Supplied Mining	40,000	<1%
Self-Supplied Livestock	40,000	<1%
Total	**31,810,000**	

Self-supplied industrial water use represents 34% of water use in the planning area, which is the largest water use category. The Georgia Pacific pulp mill in Toledo represents the single largest water use in the planning area. During the winter, this water is provided from Olalla Creek and Olalla Reservoir. During the summer months when streamflow in Olalla Creek is low, water for the mill is provided from the Siletz River and Olalla Reservoir. In addition to providing water to the mill, Olalla Reservoir, which is managed and maintained by Georgia Pacific, is an important recreational site in the Mid-Coast. Water diverted from Olalla Creek and the Siletz River are discharged to the Pacific Ocean and are not returned to the system for instream or out-of-stream uses.

Water for hatcheries represents 29% of water use in the planning area, which is the second largest use category. Although hatcheries divert a significant amount of water, this water use is

considered to be non-consumptive because diverted water is assumed to be returned to the system without being depleted. The Oregon Department of Fish and Wildlife maintains two hatcheries, one in the Salmon River sub-area and one in the Alsea River sub-area. The Confederated Tribes of the Siletz maintains a hatchery on in the Siletz River sub-area.

Public supplied water represents 27% of water use in the planning area. A total of 19% of the water is used for domestic purposes and 8% is used for industrial purposes. The three largest municipal community water systems are the City of Newport, City of Toledo, and the City of Lincoln City. The City of Newport has the largest public supplied industrial water use, primarily for fish processing plants. The three largest non-municipal community water systems are Kernville-Gleneden-Lincoln Beach Water District, Seal Rock Water District, and Southwest Lincoln County PUD.

Self-supplied agricultural use represents a relatively small amount of water use in the Mid-Coast region (6%) as well as self-supplied domestic use (3%).

Water use for all water user groups increases during the summer months due to increased industrial production as well as increased demand from tourists.

The distribution of water uses varies considerably among sub-areas. You can explore the major water uses in each sub-area in the Mid-Coast Storymap (under "Is There Enough Water for All") or via an interactive online graphic.

All of the largest water users—Georgia Pacific, City of Newport, and City of Toledo—rely on water from the Siletz River during the summer months and discharge water to the ocean, thus the water is not available for other instream and out-of-stream users downstream. The water rights for each of these users is senior to the instream water right on the Siletz River, though Georgia Pacific agrees to cease pumping when flows reach 75 cfs at the above stream gage. The instream water right on the Siletz River at the gage is 100 cfs and flows are increasingly dipping below the instream water right. Each of these water users draws water from a different source during the winter months and has a reservoir to help meet its water needs. View this interactive online graphic to see the competing demands on the Siletz River.

Overview of Water Uses, Needs, and Challenges of Community Water Systems

There are seven municipal community water systems serving an estimated 16,188 connections and an estimated population of 40,313. There are 22 non-municipal community water systems serving 7,901 connections and an estimated population of 17,407.

Governmental organizations, including municipal water systems and public non-municipal water systems, are required to measure and report monthly water use to the Oregon Water Resources Department on an annual basis. The water use reported by these entities is represented in Figures 8 and 9. As shown in these graphics, water use generally increases in the summer months in response to increased industrial production as well as increased use by residents and

visitors. Private or cooperatively owned non-municipal community water systems are not required to measure and report their water use to the state, therefore their actual water use is not known for purposes of this planning effort.

Municipal and large non-municipal community water systems customarily develop estimates of current water use and projected future demands as a part of their water planning efforts. These estimates may be contained in Water Management Conservation Plans, Water System Master Plans, or other planning documents. Smaller non-municipal water systems (e.g., smaller water districts and water corporations) may not develop and maintain estimates of current water use or future demand projections.

The only water system currently reporting insufficient supply to meet demand is the City of Yachats. Most other water providers report having sufficient water rights to meet 20-year demands. Some community water systems indicate that demands beyond the 20-year planning

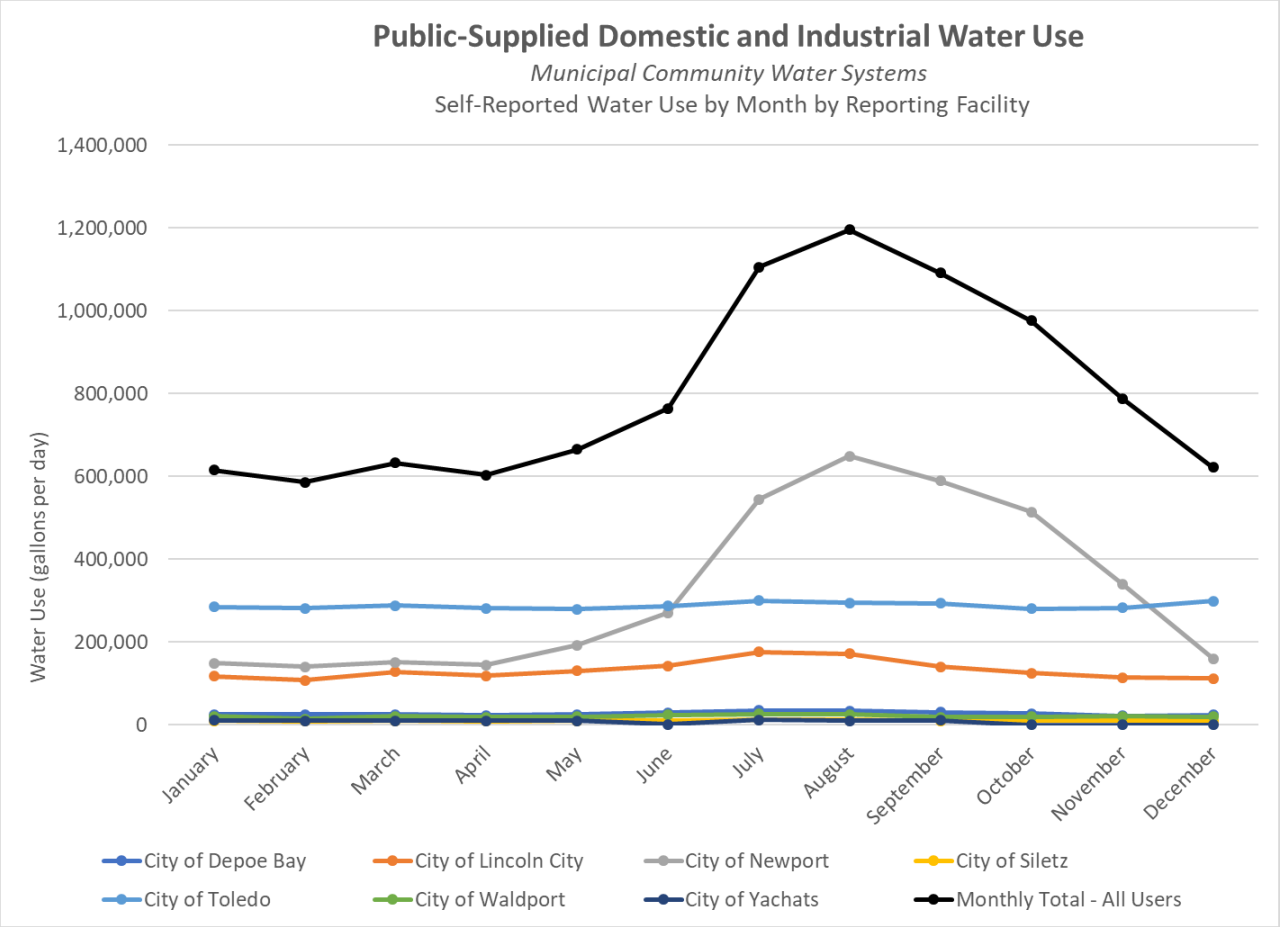

Figure 8. Monthly diverted water used by municipal community water systems in the Mid-Coast.

horizon may not be met with current water rights and there is a need to think about and plan for long-term water supply solutions beyond existing water rights and sources.

Two regional supply and demand projections have been completed, though the projections vary considerably from each other and differ from projected future use reported in Water Management Conservation Plans. The demands from these older reports are nearly two to four times what is reported in the Water Management Conservation Plans and may not represent accurate projections of future water needs in the region.

There is a need to develop an updated defensible projected future demand for community water systems in the region, along with an assessment of their ability to meet those demands with current sources and potential future deficits. The analysis should account for the potential for reductions in water supply resulting from climate change impacts. Understanding projected future supplies, demands, and deficits will help community water systems determine actions to meet water needs for their individual service areas as well as the region as a whole.

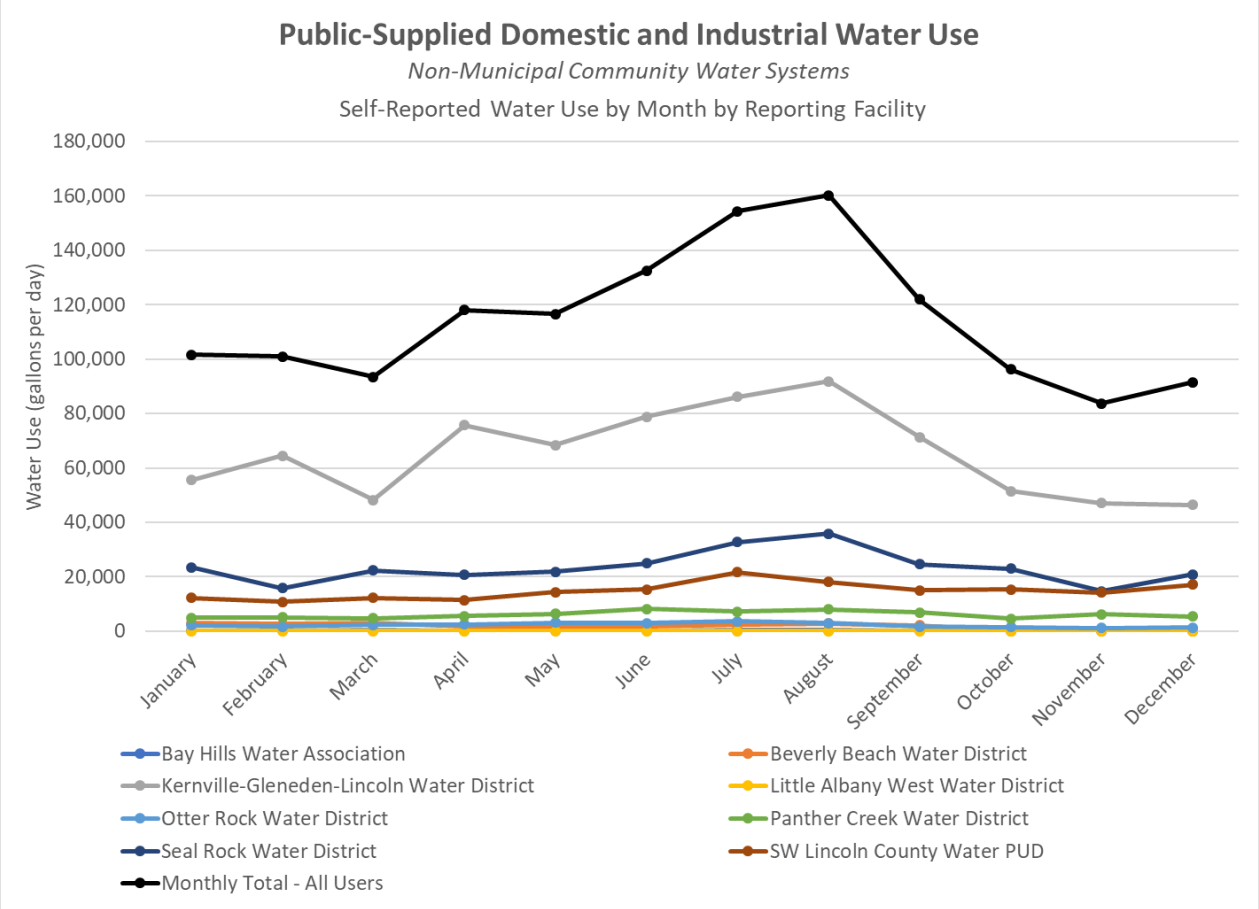

Figure 9. Monthly diverted water used by non-municipal community water systems in the Mid-Coast.

Small community water systems lack the capacity to engage in lengthy planning processes. As a result, the specific needs and challenges of these water users is not sufficiently captured in this plan. Lincoln County did an assessment of the water needs of small community water systems in 1997. It would be beneficial to update this assessment and identify the specific needs of these small, but important water users.

Critical Issues

The working group that examined the water needs and challenges of municipal and non-municipal community water systems identified the following key issues for strategy development:

- The need for increased access to funding to address current and legacy infrastructure issues and invest in resilient infrastructure that can withstand natural hazards and help communities adapt to climate change impacts;
- The need to coordinate conservation efforts between community water systems;
- The need to develop water supply redundancies and interconnections that would allow communities to access quality water in case of emergencies or shortages;
- The need to sustain efforts that increase coordination and collaboration between community water systems;
- The need to better understand and address the water needs and challenges of small community water systems that were not able to participate in planning;
- The need to address current and potential future water shortages by implementing water conservation measures and exploring future water supply options;
- The need to address water quality limitations posed by low streamflows in the summer and high turbidity in the winter;
- The need to improve coordination on shared water systems like the Siletz River in order to minimize ecological impacts.

Overview of Water Uses, Needs, and Challenges of Self-Supplied Water Uses

Rural Residents

A significant number of people in Lincoln County supply their own water for use in and around their home. It is estimated that 13,075 people, or about 30% of the population in Lincoln County, supply their own water from groundwater, springs, or streams. This is a very important water use for the region, even though the estimated water use is relatively small when compared to other uses.

It is difficult to estimate current water use and future water needs of rural residents. See Table 4 for a breakdown of wells and water rights by sub-area as well as estimated water use. Based on this information, rural domestic water users are distributed throughout Lincoln County. The majority of self-supplied domestic water users are in the Alsea and Yaquina River Basins.

Table 4. Estimated self-supplied rural domestic water users and demand by sub-area.					
Sub-Area	**Estimated Water Rights**	**Estimated Wells**	**Estimated Population Served**	**Estimated Use (gpd) based on 76-145 per capita per day**	**Estimated Consumptive Use (gpd)**
Salmon River	78	548	1,402	106,552–203,290	21,310–40,658
Siletz Bay – Ocean Tribs	46	511	1,248	94,848–180,960	18,970–36,192
Siletz River	129	532	1,480	112,480–214,600	22,496–42,920
Depoe Bay – Ocean Tribs	55	552	1,360	103,360–197,200	20,672–39,440
Yaquina River	143	1,754	4,249	322,924–616,105	64,585–123,221
Beaver Creek – Ocean Tribs	37	224	585	44,460–84,825	8,892–16,965
Alsea River	178	892	2,397	182,172–347,565	36,434–69,513
Yachats River – Ocean Tribs	37	121	354	26,904–51,330	5,380–10,266
Total	**703**	**5,134**	**13,075**	**993,700–1,895,875**	**198,740–379,175**

Rural residents that supply their own water for domestic use are responsible for testing their water to ensure it is safe for drinking. Anecdotal reports from residents and survey results from Oregon's Kitchen Table survey indicate that there is considerable concern about the drinking water quality for those who obtain their domestic water from streams, springs, and wells. There is generally insufficient data to determine the quality of source water for self-supplied users.

Water use of rural residents responsible for supplying their own water was estimated for this report, but is not well known. The current water use and water security of self-supplied rural residents is not well understood and should be further assessed. Anecdotal reports from pump installers, well drillers, the watermaster, and rural residents indicate that late in the dry season, rural residents experience declining water quantity from their springs or wells, especially during drought years. Water providers report increasing demands for bulk water from rural residents, and have begun to track demands.

As the population in Lincoln County increases, especially from people seeking refuge from hotter climates, there may be increased pressure on water resources in unincorporated areas.

The potential for increased development in unincorporated areas that are not served by community water systems is not well known. Proactively identifying the potential impact of increased development on localized streams, springs, and groundwater would be beneficial.

Irrigated Agriculture

The 2017 US Department of Agriculture estimates 2,818 actively harvested cropland acres, and 441 irrigated acres. The Oregon Water Resources Department reports that 6,141 acres have irrigation water rights. Estimates of water use for irrigated agriculture vary significantly, and there is not a standardized approach to estimate water use (Table 5).

It is expected that irrigators in the Mid-Coast region have had much of their crop needs met by precipitation. As the dry season extends in length and as temperatures increase, more landowners in the Mid-Coast may rely on irrigation to meet their crop water needs. Farmers who are junior to instream water rights may also have an increasingly difficult time meeting their water needs. The future needs and vulnerabilities of irrigators are not well understood in this region.

Current irrigation water use is not well understood in the Mid-Coast, and estimates vary greatly. Because of the limited data, it is difficult to know how water use trends are changing over time. Satellite-based monitoring of evapotranspiration using tools such as OpenET may be able to help fill this data gap, though data may be limited due to a limited number of clear, cloudless days on the coast.

Few farmers and landowners were involved in the planning effort. Effort should be made to better understand how the water needs of farmers are changing over time.

Table 5. Estimated irrigation water users and amount of water use by sub-area.

Sub-Area	Estimated Number of Water Rights (Irrigation/Livestock)	Estimated Irrigated Acres	Estimated Irrigation Diversions[15] (gpd)	Estimated Consumptive Use[16] (gpd)
Salmon River	45 (40/5)	156	348,170 gpd	174,085 gpd
Siletz Bay – Ocean Tribs	23 (18/5)	359	801,683 gpd	400,841 gpd
Siletz River	94 (76/18)	1,187	2,649,659 gpd	1,324,830 gpd
Depoe Bay – Ocean Tribs	11 (11/0)	52	116,057 gpd	58,028 gpd
Yaquina River	87 (77/10)	1,177	2,627,341 gpd	1,313,224 gpd
Beaver Creek – Ocean Tribs	14 (14/0)	82	183,012 gpd	91,953 gpd
Alsea River	176 (159/17)	2,964	6,615,221 gpd	3,307,610 gpd
Yachats River – Ocean Tribs	26 (24/2)	164	366,024 gpd	183,012 gpd
Total	**703**	**6,141**	**13,705,380 gpd**	**6,852,690 gpd**

[15] The per acre duty is derived from the OWRD WRIS database that shows the general maximum allowed duty for irrigation water rights is generally 2.5-acre feet per year per acre. Estimated diversions are derived by multiplying acres by a 2.5-acre foot per year per acre duty.

[16] The Oregon Water Resources Department Water Availability Reporting System estimates that 50% of irrigation water use is consumed.

Industry

There are very few self-supplied industrial water users throughout the planning area and self-supplied industrial water use generally accounts for a small amount of the authorized water use in most of the sub-areas. The major exception to this is Georgia Pacific's pulp mill in Toledo, which has the largest authorized withdrawals in the entire planning area (totaling 35 cfs).

The projected future needs or demands of self-supplied industrial users has not been estimated. The largest industrial water users (both self-supplied and public-supplied industrial water use) in the planning region represent a significant source of jobs and economic development. Most industrial water use in the region relies on flows in the Siletz River as well as storage (Olalla Reservoir and Big Creek Reservoirs). Drought conditions in 2015, 2018, and 2021 have likely revealed water insecurities for self-supplied industrial users. A 1997 study of Newport's water supply and the potential for future regionalization of water supplies noted that "Georgia Pacific's water supply is generally adequate to meet the needs of the mill at its present capacity to produce paper. However, to avoid shutting down in past water short years the mill had to practice water conservation measures that are detrimental to equipment and are economically acceptable for short period. A study was made in 1990 to investigate alternatives for increasing their water supply. The study concluded that a 10-foot, 420,000,000 gallon addition to Olalla Dam would be the preferred alternative to expand their supply" (Fuller and Morris, 1997).

Industrial water users did not participate in the planning effort and their specific needs and vulnerabilities are not known. Effort should be made to better understand their water use, their projected future needs, and vulnerabilities and find ways to support them in efforts to increase their water security and increase efficiency in their operations.

Critical Issues

The working group that examined the water needs and challenges of self-supplied water users identified the following critical issues for strategy development:

- The need to better understand the status of water infrastructure used by self-supplied water resources as well as provide resources to upgrade and maintain this infrastructure;
- The need to better understand water quality and ensure safe drinking water for self-supplied rural residents;
- The need to better track water shortages faced by all self-supplied water users and increase water security;
- The need to connect self-supplied water users with information to increase water conservation and efficiency in and around the home and on the farm;
- The need to assess opportunities for water conservation and efficiency and water security for self-supplied industrial water users.

Water Availability

The Water Availability Reporting System maintained by the Oregon Water Resources Department illustrates that there is limited water available for new out-of-stream appropriations, primarily in the summer months. Areas where some water may be available generally encompass ocean tributaries, or streams lower in river drainages. These systems generally have very limited summertime flows and may also be tidally influenced, which could prevent them from being used for most out-of-stream uses. Ocean tributaries also generally do not have instream water rights protecting instream values. The ecological value of ocean tributaries should be considered in any future allocation decisions.

Generally speaking, water is over appropriated, fully appropriated, or nearing full appropriation for instream and out-of-stream uses during the summer months, especially as conditions become drier and warmer during the late spring, summer, and early fall resulting in more limited supplies. The status of allocation can be viewed in the Mid-Coast Storymap (under "Is There Enough Water For All?"). Generally speaking, additional water is not available to meet new out-of-stream needs and new uses will need to be met via water rights transfers, water conservation, water reuse, storage, or other water supply strategies.

The Water Availability Reporting system is based on a period of record from 1958 to 1987.[17] Because three of the most significant drought years occurred in the past decade, the period of record for the Water Availability Reporting System may not accurately represent current streamflow conditions and may overestimate water supply and availability. There is a need to update the period of record to get a better understanding of water use and availability relative to available supply.

[17] For more information on how the Water Availability Reporting System was developed, see: https://www.oregon.gov/owrd/WRDPublications1/DeterminingSurfaceWaterAvailabilityInOregon.pdf.

Climate Vulnerability in the Mid-Coast

The Oregon Climate Change Research Institute (2019) produced a report describing future climate conditions for the Mid-Coast relative to temperature, precipitation, snowpack, floods, droughts, wildfire, sea level, and coastal ocean conditions. Future projected conditions were based on at least 10 global climate models and numerous scenarios of global greenhouse gas emissions, and were made locally relevant by combining the outputs from the global models to historical observations, achieving a resolution of 2.5 miles x 2.5 miles on the landscape. Projections were made for mid-21st century, the 2050s, late 21st century, and the 2080s.

The report authors considered both lower and higher emissions scenarios based on available data and published literature. Lower emissions scenarios represent modest efforts to reduce global greenhouse gas emissions by mid-21st century whereas the higher emissions scenarios represent "business-as-usual" practices, i.e., greenhouse gas emissions continuing to increase through the 21st century (Oregon Climate Change Research Institute 2019).

The following are a few highlights (Figure 10) from that report that describe the likelihood of projected changes in environmental parameters important to the Mid-Coast region.[18]

Climate change will exacerbate challenges that the Mid-Coast region already experiences. As a result of these changes, the Mid-Coast region needs to prepare for the following climate change impacts:

- Decreasing summertime streamflows and increased frequency of drought conditions will impact fish and wildlife, recreational opportunities, and the ability for cities and industry to meet their summertime water needs (which is generally when demand is highest).
- Increasing drinking water insecurity for community water systems and rural residents who draw water from streams, groundwater, and springs, as water supplies decrease with a hotter and longer dry season.
- Increasing stressors on fish and wildlife as they adapt to a changing hydrograph (more water in the winter and less water in the summer), elevated water temperatures and decreasing water quality conditions linked to low streamflows and elevated temperatures.
- Increasing impacts of extreme storms and flooding on community infrastructure.
- Increasing turbidity of drinking water during the winter months due to increased storms and erosion caused by higher precipitation events.
- Increasing potential for wildfire to affect water quality and water infrastructure.
- Increasing reliance on irrigation water to grow crops since crop water needs are less likely to be met by precipitation.

[18] Note: Not all model runs resulted in the projected changes shown in the graphic; there were differences in model outputs for these parameters. However, this graphic illustrates likely Mid-Coast trends.

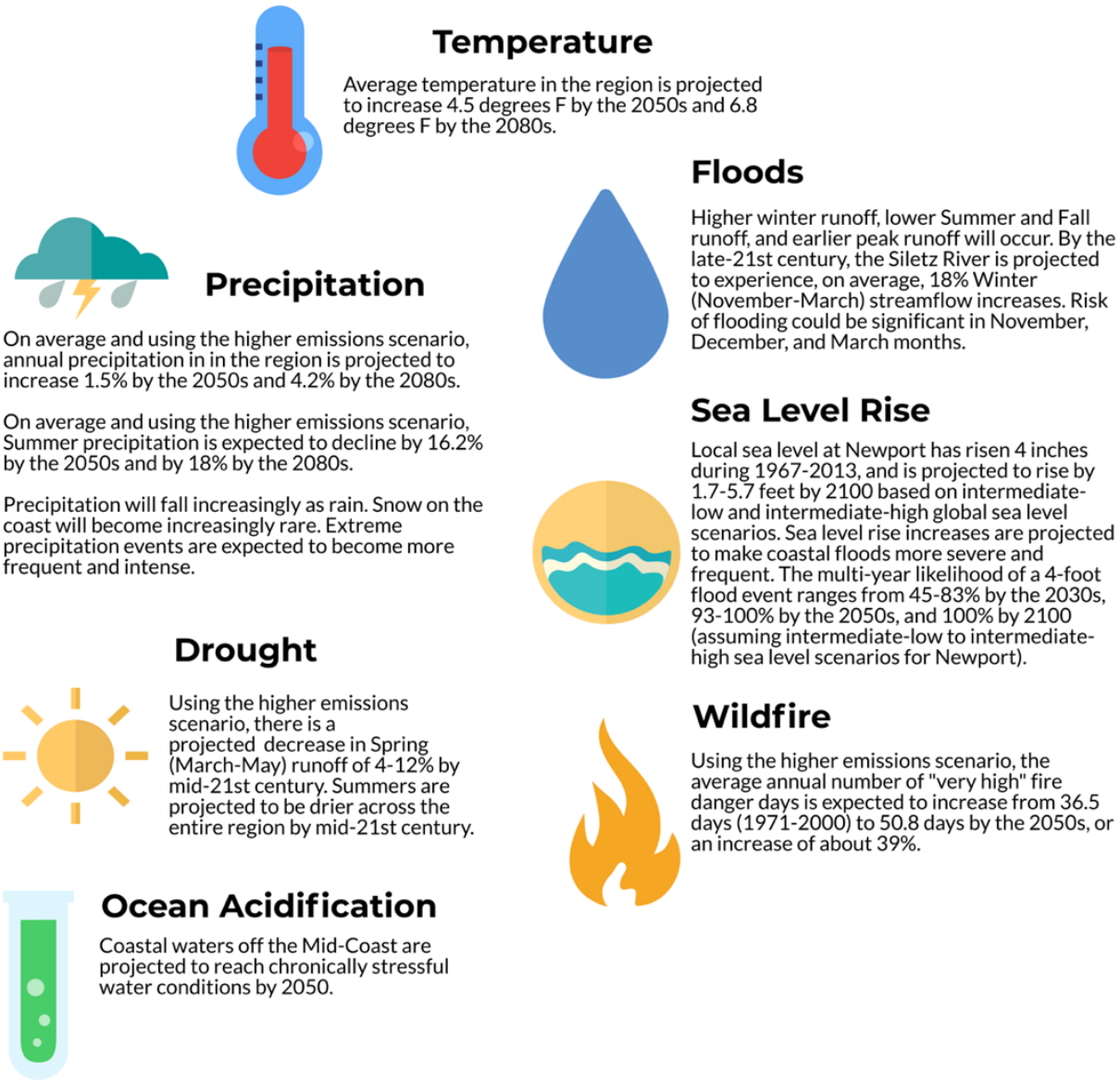

Figure 10. Projected changes in environmental parameters important to the Mid-Coast region.