UPPER GRANDE RONDE RIVER WATERSHED PARTNERSHIP
PLACE-BASED INTEGRATED WATER RESOURCES PLANNING

UNION COUNTY, OREGON

INTEGRATED STRATEGIES REPORT

December 2020

This project is funded through the Oregon Water Resources Department
Place-Based Integrated Water Resources Planning Grant

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Note: As with all interim documents produced by the Upper Grande Ronde River Watershed Partnership, this Step 4 Report is a living document and may be revised as more information is gathered through this planning process. All revisions will be confirmed by a Stakeholder consensus vote.

Acronyms and Definitions

This list includes acronyms and defined terms used in this report in alphabetical order. Definitions appear in parenthesis following the acronym. Acronyms are also defined in their first instance of use in each section of this report.

AF - Acre-feet.

ag ET - Agricultural Evapotranspiration.

Agricultural demand - Amount of water needed to meet irrigation requirements in the Upper Grande Ronde River Watershed.

BOR - U.S. Bureau of Reclamation.

BPA - Bonneville Power Administration.

CTUIR - Confederated Tribes of the Umatilla Indian Reservation.

Demand - This report does not distinguish between a "need" and a "demand" but refers to all uses of water as demands.

DEQ - Oregon Department of Environmental Quality.

DO - Dissolved oxygen.

ESA - Endangered Species Act.

FEMA - Federal Emergency Management Agency

FWT - The Freshwater Trust.

Groundwater - Alluvial and basalt aquifers in the Upper Grande Ronde River Watershed.

GRMW - Grande Ronde Model Watershed.

Instream Demand - Water quality and quantity needed to support instream functions including recreation and aquatic life. This is also defined as non-consumptive use.

Municipal demand - This is composed of three components municipal (city demand), unincorporated demand, and self-supplied industrial demand (self-supplied industrial use demand).

NMFS - National Marine Fisheries Service.

NRCS - Natural Resources Conservation Service.

ODA - Oregon Department of Agriculture.

ODFW - Oregon Department of Fish and Wildlife.

OSU - Oregon State University Extension Office.

OWEB - Oregon Water Enhancement Board.

OWRD - Oregon Water Resources Department.

SSIU - Self-supplied industrial user.

Stakeholder Committee - All members of the Upper Grande Ronde River Watershed Partnership that have signed on to the governance agreement.

Steering Committee - Smaller group with representatives from each demand group that conducts planning and administrative work that is approved and reviewed by the Stakeholder Committee.

Step 1 - Convene a group (outcome of this step was a signed governance agreement that described the way the group would work during this process).

Step 2 - Estimate water supply.

Step 3 - Estimate water demand.

Step 4 - Consider solutions to align the available resources with current and future demands.

Step 5 - Develop an action plan to implement solutions.

Subwatershed - The Upper Grande Ronde River Watershed is divided into eight subwatersheds that are assessed in this report.

UGRRW - Upper Grande Ronde River Watershed.

UGRRW Partnership - Upper Grande Ronde River Watershed Place-Based Planning Partnership.

Union SWCD - Union Soil and Water Conservation District.

Union County - Convener of the Place-Based Planning effort.

Union County Farm Bureau - Farming advocacy group.

USACE - U.S. Army Corps of Engineers.

USFS - U.S. Forest Service.

USGS - U.S. Geological Survey.

Water Rights - Rights granted by the state to beneficially use water without waste. According to Oregon Water Law (Oregon Revised Statutes 537.110), "all water within the state from all sources of water supply belongs to the public," meaning that all of Oregon's surface water and groundwater sources are owned by the public. Water rights are the legal right of a property owner to access and use Oregon's publicly owned water resources based on four legal provisions: 1) beneficial use without waste; 2) water right priority; 3) appurtenance (i.e., water right associated with legal description of the land); and 4) forfeiture (i.e., water right must be used at least once every five years).

Acknowledgements

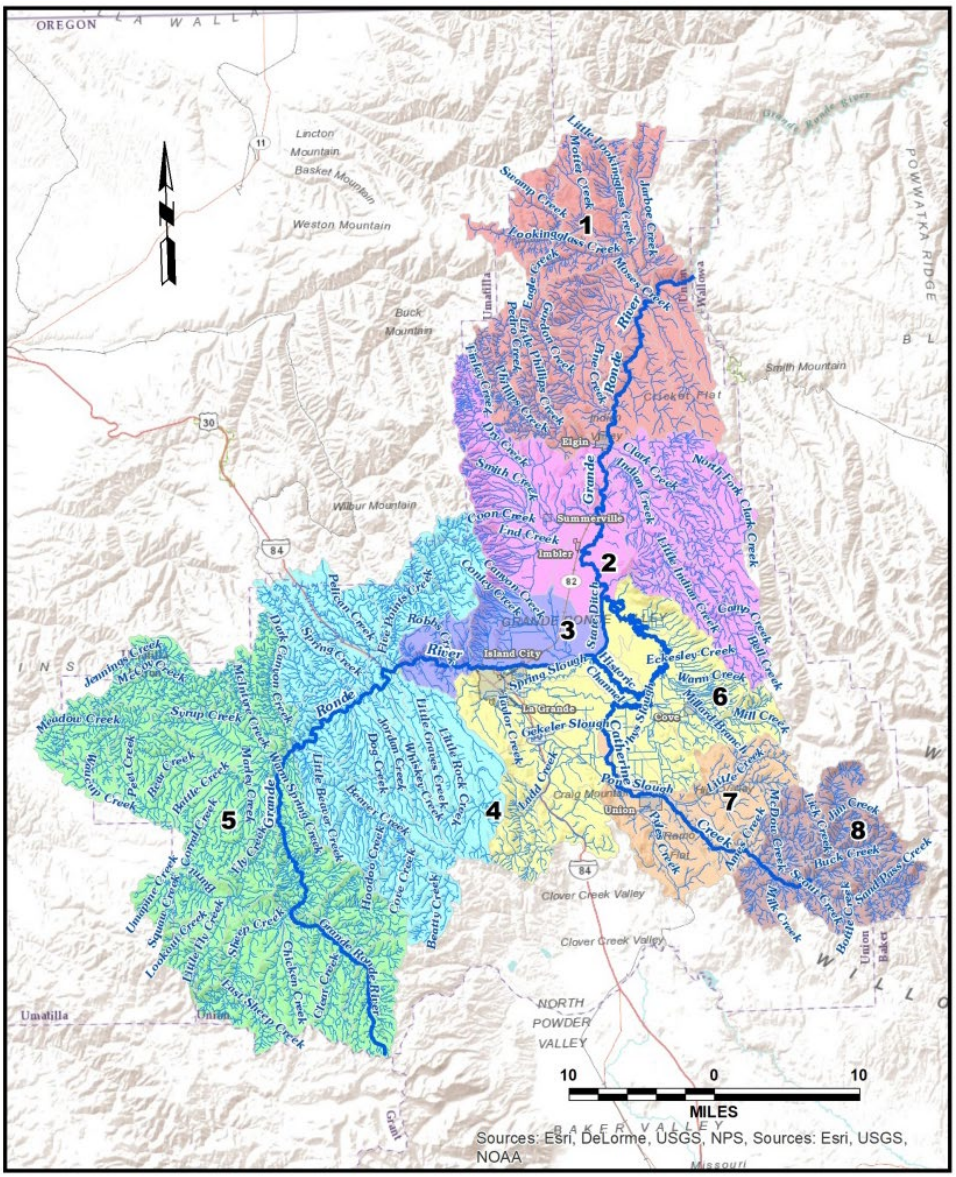
In a Stakeholder Committee meeting, including the entire Upper Grande Ronde River Watershed (UGRRW) Place-Based Planning Partnership (Partnership, Step 4 tasks were explained, and it was determined by the UGRRW Partnership that the entire membership would participate in brainstorming and evaluation of strategies. Separate committees were determined to be infeasible because of the importance of hearing everyone's viewpoint as each strategy was discussed. The UGRRW Partnership supports the conclusions and recommended strategies contained in this Integrated Strategies Report as determined by a vote of the Partnership on December 9, 2020.

Executive Summary

Section 1.0: Introduction

The Upper Grande Ronde River Watershed (UGRRW) Place-Based Planning Partnership (Partnership) brings together a variety of stakeholders to help plan for future water needs in the UGRRW (see Figure ES-1 below).

Figure ES-1*
Subwatersheds of the UGRRW



**This figure was reproduced from Figure 1-2 of the Step 3 report.*

The UGRRW Partnership includes a variety of stakeholders representing diverse water interests who are working collaboratively to develop a place-based integrated water resources plan for a better water future. This report represents the completion of Planning Step 4. The purpose of Planning Step 4 is to identify water issues facing the UGRRW, identify goals and objectives associated with each water issue, explore a wide range of strategies, and determine which strategies (and corresponding recommended actions) the UGRRW Partnership would like to pursue to address the identified water issues. This report represents the UGRRW Partnership's groundwork to create the Planning Step 5 Strategic Action Plan.

Section 2.0: Water Issues, Goals, Objectives, and Strategies

The purpose of this section is to describe the methods, data gaps, prioritization, goals, objectives, and strategies associated with water issues.

Water issues are identified as water-related problems or challenges that, if not resolved, will inhibit the ability to meet water demands. These issues can be viewed as outcomes of the Steps 2 and 3 reports, which were synthesized at the beginning of the Step 4 process.

The Step 2 report characterized the quantity and quality of water resources in the planning area. The Step 3 report characterized current and projected demand for water (subdivided by instream demand, agricultural demand, municipal demand, and the effects of climate change/natural hazards on demand). Critical concerns and uncertainties were identified in each report to reflect data gaps, unknown variables, and other issues that will require additional efforts to mitigate future work by the UGRRW Partnership. Critical opportunities were identified to present a path forward for this analysis. The reports included the following information:

- **Current and Future Annual Water Balance Summary by Subwatershed (Step 3 Report, Section 7.0):** Tables 7-1, 7-2, and 7-3

- **Agricultural (Step 3 Report, Section 4.0, and Appendix B):**

  Agricultural water demand was characterized using an evapotranspiration model, which has the advantage of providing temporal information about how crops use water throughout the growing season. The model also facilitates estimates for future climate and increased irrigation efficiency scenarios. Current (2018) agricultural water use was estimated to be 193,725 (surface water) and 77,973 (groundwater) acre-feet (AF) per year. A number of water use scenarios were considered given a 3 percent increase in mean annual temperature, representing a change due to drought or climate change. Future (2068) estimated gross irrigation water requirement is 284,532 AF per year (surface water) and 114,522 AF per year (groundwater) with existing irrigation efficiency and 214,169 AF per year (surface water) and 87,396 AF per year (groundwater) under the increased efficiency scenario (per page 4-31; Figure 4-1, Figure 4-5, Figure 4-15, Figure 4-17, and Appendix B, Agriculture Water Demand Summary Table [page 246]). Climate change parameters were generated using the Representative Climate Pathways 8.5 climate model.

Water rights were used to delineate irrigated lands and as a reference point for comparisons to modeled crop water use. Irrigation water rights represent an upper limit to current legal water use. Current (2018) estimated irrigation water rights total 211,134 AF per year (surface water) and 86,832 AF per year (groundwater). It is unknown what portion of groundwater is obtained from alluvial versus basalt aquifers.

- Critical concerns and/or uncertainties - Limited testing/surface water quality data gaps, long-term surface water quantity vulnerability, future increasing gap between water quantity/quality demands and low supplies in critical periods (late summer/early fall), and future groundwater demands and sustainable yields from groundwater aquifers.

- Critical opportunities - Increased stakeholder-agency partnerships to share data and coordinate monitoring activities, water storage infrastructure, and increased irrigation efficiency may reduce future irrigation demands by approximately 24 percent (range approximately 18 to 30 percent) (Step 3 Report, ES-2 and Section 4.0). Savings from increased efficiency was estimated using the Natural Resources Conservation Service water savings estimator.

- **Municipal (Step 3 Report, Section 3.0 and Appendix A):** Total municipal demand (including cities, self-supplied industrial users (SSIU), and unincorporated users was estimated to be 2,060 AF per year of surface water and 8,190 AF per year of groundwater. This water is primarily obtained from deep basalt aquifers. Total municipal demand is projected to increase from 10,300 to 22,300 AF per year from 2018 through 2068; with SSIU demand projected to increase by up to a factor of four (3,700 AF in 2018 to 15,000 AF in 2068). This increase in demand from current to future demand is large because the assumption was made that much of the unused portion of the SSIU permits/rights could possibly be used in the future and the UGRRW Partnership determined that this potential increase in demand should be incorporated into the planning document (when supported by growth projections as described in Step 3 Report, Section 3.0).

  - Critical concerns/uncertainties - Long-term stability/viability of groundwater aquifer system, SSIU water demand, unaccounted for water loss, aging infrastructure, lack of system redundancy, increasing water use, and drought impacts.

  - Critical opportunities - Increased cooperation between cities, additional conservation measures, voluntary rural well monitoring network, emergency inter-city mutual aid agreements, and coordinate with Oregon Water Resources Department (OWRD) to address groundwater supply data gaps and improve groundwater aquifer information.

- **Instream Water Quantity and Quality (Step 3 Report, Section 5.0 and Appendix C):** Current (2018) and future (2068) instream water demand is 173,750 AF per year based on existing water rights Water flows and temperatures are the primary components of instream demand for aquatic species and other water uses. Instream flow deficits are greatest in late summer/early fall. Water quality issues associated with low flows, elevated water temperatures, and high

bacteria and nutrients are a significant concern (Step 3 report; Figures 5-3, 5-4, and 5-5; Tables 5-8 and 5-9). These values are estimates (both water rights and water quality limits) and represent the best information available to the UGRRW Partnership at the time of the Step 3 report.

  - Critical concerns/uncertainties - Endangered Species Act (ESA)-listed summer steelhead, spring/summer Chinook, and bull trout survival are impacted by low water quantity and quality, by projected future climate change effects on water quantity and quality, and existing data gaps. Estimates of instream demand have significant uncertainty because they are based only on instream water rights.

  - Critical opportunities - Stream restoration actions to improve floodplain-riparian connectivity and function, forest management practices, water conservation to reduce out-of-stream use, short- and long-term voluntary cooperative agreements to increase instream flows, coordination with Oregon Department of Fish and Wildlife, Oregon Department of Environmental Quality (DEQ), and OWRD to improve data and characterize instream demand.

- Limited historic or observed regional monitoring and model data suggest declining trends in precipitation and snowpack, stream flow, and groundwater levels, and increasing trends in temperature. These future projections include increased air temperatures, reduced snowpack/shifted precipitation and hydrograph timing, and reduced summer base flows. As with all models, the limited data has accuracy concerns, which impact the future estimates. The UGRRW Partnership views these predictions as one of a number of potential scenarios and will work to manage water on that basis.

Overall, four primary water issues were identified:

- Surface water supply is limited in summer through late fall when demand is the highest for instream and agricultural needs (Step 3 report, Section 7.0, Table 7-3).
- There is significant uncertainty with groundwater supply. The UGRRW lacks sufficient groundwater monitoring wells, long-term trend data, pumping data, and an alluvial groundwater mitigation plan to evaluate groundwater supply sustainability and inform strategic groundwater resource planning (OWRD, 2019).
- Water quality is classified as degraded or impaired in all eight subwatersheds. The water quality issues are predominantly related to high temperatures, low dissolved oxygen (DO), and insufficient flows (DEQ, 2000; Step 2 report, Table 3-4 for Water Quality Impairments by Date and Beneficial Use [subwatersheds 1 through 8]).
- Natural hazards like flooding, fire, and drought impact the UGRRW frequently, and the UGRRW Partnership lacks an integrated plan to mitigate and respond to these events to protect water supply sources and enhance water source resiliency. A climate change scenario considered by the UGRRW Partnership suggests that the timing and occurrence (frequency, magnitude, duration) of these events could be altered within the UGRRW (see Step 2 report, Section 3.0, page 3-45, and Step 3 report, Section 6.0).

These four main water issues are generally prioritized as follows:

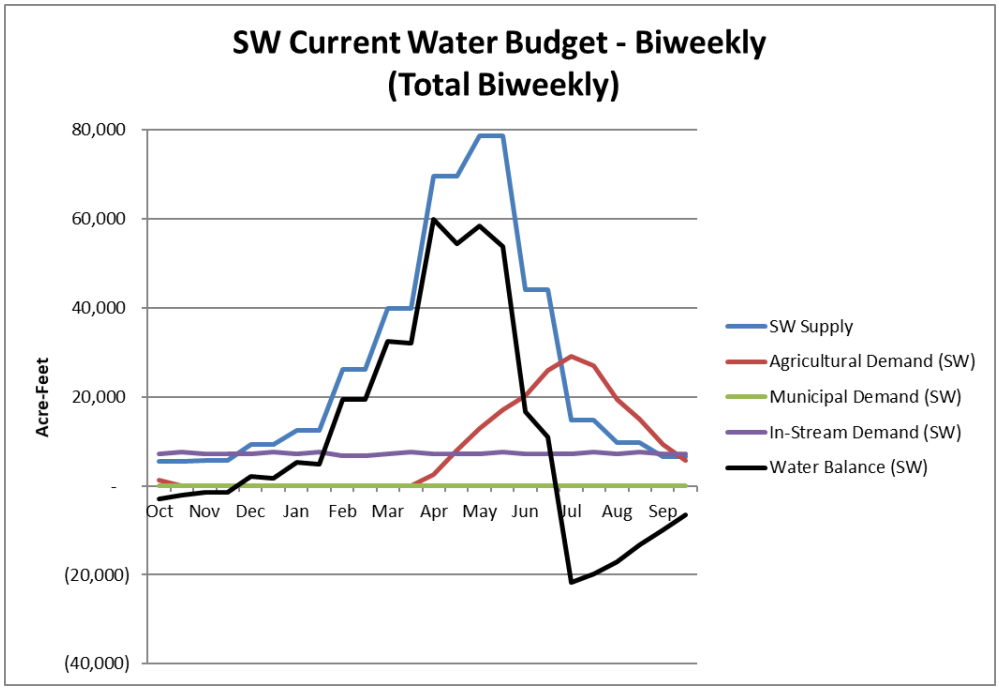
1. Surface water deficit because it affects most water user groups, including agricultural users and ecological users (specifically ESA-listed salmonid species).
2. Groundwater uncertainty because agricultural and municipal users currently rely on groundwater sources and these demands are projected to increase in the future.
3. Surface water quality because many of the quality issues are directly tied to flow, specifically surface water deficit.
4. Natural hazards and climate change issues are included in each of the three issues above and will be considered when addressing each of the above issues.

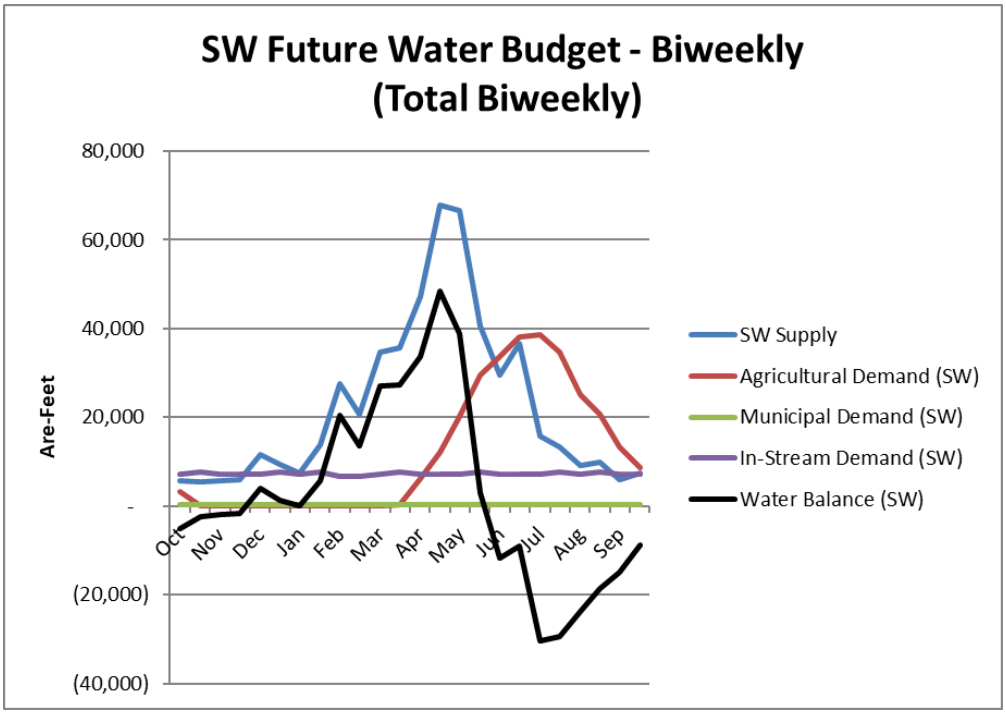
A goals/objectives/strategy document was developed and approved through consensus vote by the UGRRW Partnership. The specific issues, goals, and objectives are listed below. It is important to note that while certain objectives have a longer timeline attached to them, it is the intent of the UGRRW Partnership to try to move forward in an accelerated way and complete work as quickly and efficiently as possible. Benchmarks for interim steps in these longer timelines will be developed in Step 5.

Issue/Goal 1 Eliminate Surface Water Deficit

The largest issue facing the UGRRW is that surface water is limited in summer through late fall when demand is highest for instream and agricultural needs. A surplus of surface water occurs on an annual basis, with most of that surplus occurring in winter and spring. The goal is to eliminate 100 percent of the seasonal surface water deficits in each subwatershed through the UGRRW Partnership's work or support of other organizations. See Figure ES-2 below for the water availability hydrograph.

Figure ES-2*
Total Biweekly Surface Water (SW) Budget Summary





**This figure was reproduced from Figure 7-9 of the Step 3 report (the future demand graph was corrected, due to an error).*

Objective 1.1

By 2040, reduce current (2018) surface water deficit (Step 3 report, Table 7-3) as much as possible, per the outcomes of the feasibility studies and the total subwatershed deficits listed below. Initiate feasibility studies immediately to identify potential storage projects across the UGRRW. The total quantity achieved will be based on the outcome of the feasibility studies. Strategic and integrated actions will be implemented to verify and reduce this deficit according to data presented in the Step 2 and Step 3 reports, preferred alternatives identified in the feasibility studies, and the best available research and monitoring data. Projected water deficit may increase in magnitude, frequency, and duration by 2068 (Step 3 report, Table 7-3). The list below was generated in the Step 3 report. It is noted that these deficits are partially derived from water rights, are additive and carry over from upstream to downstream watersheds.

- Subwatershed 1: September through November - 7,940 AF deficit
- Subwatershed 2: July through November - 10,182 AF deficit
- Subwatershed 3: July through November - 10,129 AF deficit
- Subwatershed 4: July through November - 1,297 AF deficit
- Subwatershed 5: July through November - 13,098 AF deficit
- Subwatershed 6: June through October - 58,183 AF deficit
- Subwatershed 7: July through September - 7,843 AF deficit
- Subwatershed 8: July through November - 510 AF deficit

Agricultural shortages are located in the valley bottoms of subwatersheds 2, 3, 6, 7 in the late summer and early fall. Instream deficits occur both above and in the dominant agriculture elevation zone in subwatersheds 1 through 8 during the months of July through November. Municipal deficits are small in comparison to agricultural and instream deficits and occur primarily in summer months in subwatershed 6 (Island City and La Grande). Given that none of the watersheds contain impoundments specifically intended to manage seasonal flow, this objective will require an active flow management strategy to retain water during periods of excess flows with controlled release to mitigate periods of deficit. See Table ES-1 below (reproduced from the Step 3 report), summarizing water demand by subwatershed. Validation of instream rights above base flows is essential to the determination of the placement of impoundments and the timing of controlled water release.

TABLE ES-1*
WATER DEMAND
VULNERABILITIES BY SUBWATERSHED

Name	Agricultural+	Municipal^	Instream^	Water Quality^
1 Lookingglass Creek/Cabin Creek	Low	Low	High	High
2 Willow Creek/Indian Creek	High	Low	High	High
3 Lower Five Points Creek	High	Low	High	High
4 Beaver Creek, Upper Five Points Creek	Low	Low	High	Moderate
5 Meadow Creek Upper Grande Ronde River	Low	Low	High	Low
6 Ladd Creek Lower Catherine	High	Moderate	High	High
7 Upper Catherine Creek 1	High	Low	High	Moderate
8 Upper Catherine Creek 2	Low	Low	High	Low

**This table was reproduced from Figure ES-3 of the Step 3 report.*

+ Quantitative attribute assessments have measured attributes at their foundation but may include estimates to fill data gaps and/or some reliance on professional opinion.

^Qualitative attribute assessments are based on limited measured data and rely heavily on condition estimates, professional opinion, and agency policy.

Objective 1.2

By 2040, fill data gaps identified in the Steps 2 and 3 reports. Begin work immediately to fill data gaps identified in the Steps 2 and 3 reports, particularly with respect to instream demand and ecological flow needs. These studies are anticipated to investigate ecological flows needed year-round and the effectiveness of mitigation strategies to deliver the amount and timing of required flows. Municipal demand, agricultural demand, and supply (surface water and groundwater) data gaps will also be addressed.

Issue/Goal 2 Improve Water Quality

Water quality impairments are present in each of the eight subwatersheds. The water quality parameters of concern are predominantly high temperatures, low DO, and insufficient flow. The goal is to improve water quality with the tools available to the UGRRW Partnership, through our own work, support of other organizations, or a combination of the two.

Objective 2.1

By 2040, reduce each water quality issue as much as possible per the outcomes of feasibility studies addressing the parameters of concern as described below. Support the work of others in addressing additional water quality parameters beyond those identified by the DEQ. For instance, toxic chemicals, pharmaceuticals, heavy metals, etc., may also need to be addressed (Step 2 report, Section 7.0, Table 7-8).

- Subwatershed 1: Temperature, pH, DO, algae
- Subwatershed 2: Temperature, pH, DO, algae, *E. coli*
- Subwatershed 3: Temperature, pH, algae
- Subwatershed 4: Temperature, pH
- Subwatershed 5: Temperature, pH
- Subwatershed 6: Temperature, pH, algae, *E. coli*
- Subwatershed 7: Temperature, pH, DO, algae
- Subwatershed 8: Temperature

Numerous waterbodies in the UGRRW have been identified as water quality limited by the DEQ. The primary parameters of concern in the UGRRW are temperature, pH, DO, and *E. coli*. Temperature is a limiting factor for aquatic life for many of the summer months, especially in the lower and central part of the UGRRW. In most subwatersheds, temperature and pH are concerns for the summer months. Generally, subwatersheds in the northern and central portion of the UGRRW (subwatersheds 1 through 6) have more limiting factors than ones in the southern UGRRW (Catherine Creek area, subwatersheds 7 and 8). Given that there are no impoundments or intensive land management impacting the flow at the higher elevation subwatersheds these deficits may or may not reflect natural conditions in the watershed. Validation of water quality standards and the effectiveness of mitigating techniques are needed.

Objective 2.2

By 2040, fill data gaps identified in the Steps 2 and 3 reports with respect to water quality, including temperature and other parameters important for beneficial uses.

ES-Issue/Goal 3 Reduce Groundwater Supply Uncertainty

The UGRRW lacks sufficient groundwater monitoring wells, long-term trend data, and pumping data to evaluate groundwater supply sustainability and support strategic groundwater resource planning. Several specific questions that need to be answered include time required for replenishment, interdependence and volumes of underground sources, and surface water interaction. The goal is to improve understanding of groundwater supply and to develop and implement a plan to ensure that groundwater aquifer levels are sustained at acceptable levels.

Objective 3.1

Complete a groundwater study by 2035. Through data collection and analysis, understand the characteristics of the UGRRW aquifers and determine the rate of change in level, if any, for each aquifer.

Objective 3.2

Once the groundwater system is understood, convene a group of stakeholders to implement a plan to ensure sustainable use of groundwater. This plan (in the form of an update to the Step 5 Strategic Action Plan) will consider rates of aquifer recharge, withdrawals of groundwater and surface water, and the connection between groundwater and surface water. Short-term goals will be compiled to achieve sustainable groundwater levels in the meantime (also in the form of an update to the Step 5 Strategic Action Plan).

Issue/Goal 4 Natural Hazards/Climate Change

Natural hazards like flooding, fire, and drought impact water supply in the UGRRW frequently, and an integrated plan is needed to mitigate, respond, and adapt to the impact these hazardous events have on water supply. The goal is to develop an integrated plan to reduce or mitigate the impact of these events. Also, climate change models have projected temperature increases and stream flow changes by 2068. The goal is to create an adaptative management protocol that allows for all water uses (municipal, ecological, and agricultural water rights) without reducing water currently available to satisfy water rights.

Objective 4.1

By 2030, develop a Natural Hazards Mitigation Plan (set of projects and actions to be included in an update to the Step 5 Strategic Action Plan) to reduce or mitigate the impact of flooding, fire, and drought.

Objective 4.2

By 2040, implement mitigation measures identified in the Natural Hazards Mitigation Plan developed above.

Objective 4.3

By 2030, create an adaptive management protocol to apply new climate change data to goals. The protocol (in the form of an update to the Step 5 Strategic Action Plan) will document a method to modify goals based on new climate change data at regular intervals. This adaptive management protocol will evaluate the UGRRW Partnership's progress toward accomplishing the objectives and goals listed in this report. It will also provide a means for feedback to determine whether the approach needs to be changed. The UGRRW Partnership recognizes the

potential error and uncertainty inherent in models and will seek to avoid identifying numeric targets based on models that cannot be validated with empirical data.

Section 3.0: Evaluation of Potential Strategies

After water issues were determined, the Stakeholders identified and described potential strategies to meet specific goals and objectives. This section provides an overview of the evaluation and outcomes of the strategy development and review.

The following methods were used to evaluate and develop potential strategies: group brainstorming sessions, presentations, grouping ideas into major strategy categories, spreadsheet strategy development, individual preliminary rankings, development of strategy summaries, and a group prioritization.

Nine major strategy categories were identified. These included:

1) Built Storage - Aboveground Storage and Underground Storage
2) Land Management - Agricultural Land
3) Data Collection, Monitoring, and Research
4) Non-structural Water Storage and Habitat Management
5) Land Management - Public Land
6) Infrastructure/Land Modification
7) Administrative Actions
8) Land Management - Municipal Land
9) Outreach and Education

Strategy summaries were developed and prioritized in the order above based on group discussions and voting by UGRRW Partnership members. Action or implementation plans for each strategy will be developed in Planning Step 5 Strategic Action Plan. The top five strategies will be the focus of the Step 5 Strategic Action Plan. All strategies will be retained, and lower priority strategies will be opportunistically addressed.

Section 4.0: Public Participation and Outreach

Step 4 monthly meetings engaging all Stakeholders were held in Union County and conducted from January 2019 to December 2020. A comprehensive list of water planning meeting types and dates is included in this section.

Section 5.0: References

Documents referenced in this report are included in this section.

1.0 - Introduction

Background and Purpose

Helping communities plan for their water future through place-based integrated water resources planning is a recommended action in Oregon's 2012 Integrated Water Resources Strategy. In 2015, the Upper Grande Ronde River Watershed (UGRRW) Place-Based Planning Partnership (Partnership) was selected by the Oregon Water Resources Department as one of four funded pilot projects across the state to complete the five steps of place-based planning.

In late 2016, the UGRRW Partnership began meeting as a diverse stakeholder group. In early 2017, the UGRRW Partnership completed Step 1 (convene a group and complete a governance document). In early 2018, the UGRRW Partnership completed Step 2 (water supply availability analysis). In 2019, the UGRRW Partnership completed Step 3 (water demand analysis). All three completed documents can be viewed on the Union County website (UGRRW Partnership, 2017; 2018; and 2019).

The UGRRW Partnership includes a variety of stakeholders representing diverse water interests who are working collaboratively to develop a place-based integrated water resource plan for a better water future. This report represents the completion of Planning Step 4. The purpose of Planning Step 4 is to identify the water issues facing the UGRRW, document goals and objectives related to each water issue, explore a wide range of strategies, and determine which strategies (and corresponding recommended actions) the UGRRW Partnership would like to pursue to address the identified water issues. This report represents the UGRRW Partnership's groundwork to create an action plan in Planning Step 5 Strategic Action Plan.

This document is organized into five sections. Section 1.0 introduces the report. Section 2.0 describes identified water issues, goals, and objectives. Section 3.0 describes and evaluates potential strategies. Section 4.0 details public participation and outreach activities. Section 5 includes references.

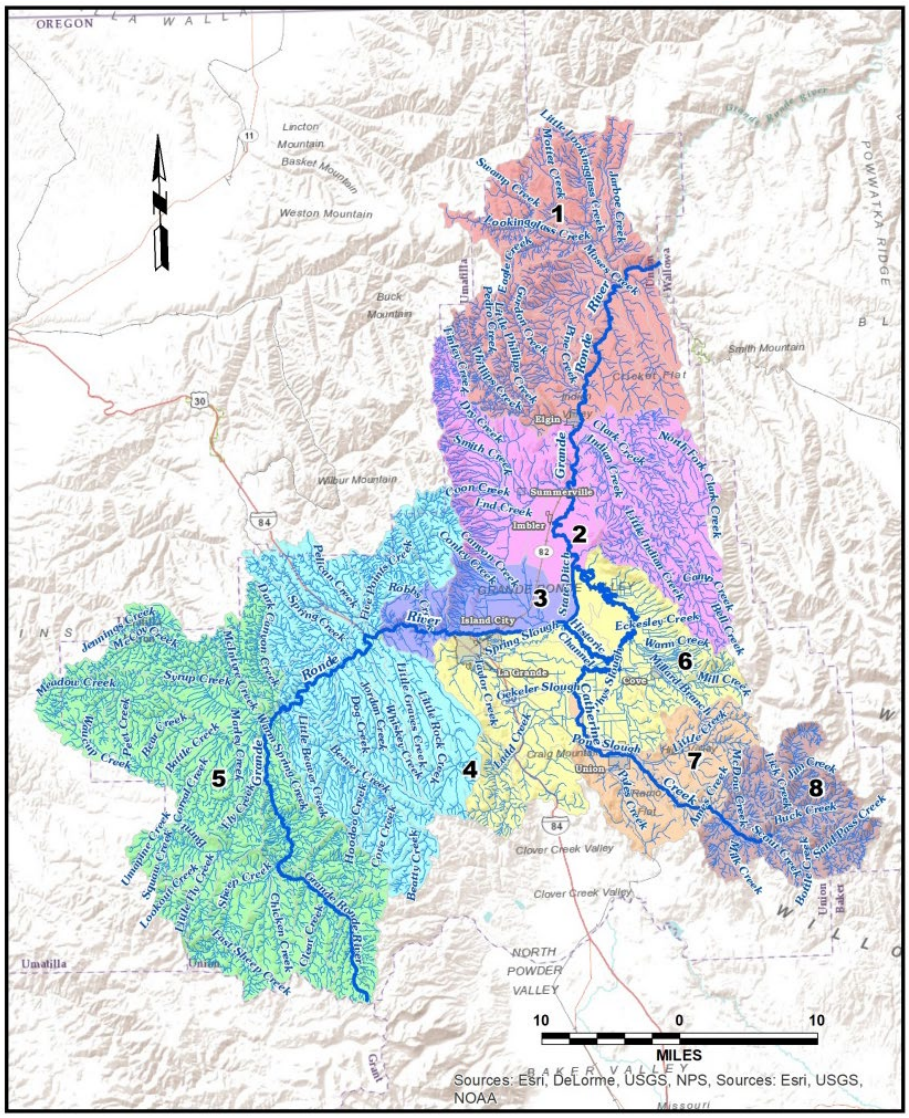
See Figure 1-1 for the planning area of the UGRRW Partnership.

Figure 1-1*
Planning Area

**This figure was reproduced from Figure 1-1 of the Step 2 report.*

The UGRRW is divided into eight subwatersheds, which were analyzed in Planning Steps 2 and 3 and are referenced in this report. For more information on the methodology to develop these subwatersheds, see the Place-based Integrated Water Resources Planning State of Water Resources Report (UGRRW Partnership, 2018). The subwatershed boundaries are shown below (see Figure 1-2).

Figure 1-2*
Subwatersheds of the UGRRW



**This figure was reproduced from Figure 1-2 of the Step 3 report.*

2.0 - Water Issues, Goals, Objectives, and Strategies

Introduction

The purpose of this section is to describe the methods, data gaps, prioritization, and overall problem statements and metrics associated with water issues.

Water issues are defined as water-related problems or challenges that, if not resolved, will impact the ability to meet current and projected water demands. These issues are the outcomes of Planning Steps 2 and 3 reports that were synthesized at the beginning of the Planning Step 4 process.

The following information summarizes the Upper Grande Ronde River Watershed (UGRRW) Place-Based Planning Partnership's (Partnership) current understanding of the issues facing the UGRRW, broad goals to address these issues, measurable objectives to meet our goals, and specific strategies that align with these objectives. Strategies are described in greater detail in strategy summaries included in this Step 4 report. These objectives are not presented in order of priority. These strategies should be considered potential strategies.

All goals are aspirational. The UGRRW Partnership recognizes that achieving each goal completely (i.e., eliminating 100 percent of water quantity deficits) may not be possible. The UGRRW Partnership intends to use monitoring and evaluation of actions to track progress toward achieving these goals and identify adaptive measures to advance goal achievement.

For the administrative actions strategy, please refer to the list and definitions in the Step 4 report strategy summary.

Please note that water issues were developed and then strategies were brainstormed to solve each water issue. Only after strategies were developed did the UGRRW Partnership determine that it was necessary to further clarify goals and objectives associated with each water issue, and match strategies to objectives. For the value of clarity and flow in this report, goals and objectives are described in this section, although it is not in the chronologically correct order.

Methods - Planning Steps 2 and 3 Summary

The following describes how water issues were determined through data collection (Step 2 report) and data analysis (Step 3 report).

The Step 2 report characterized the quantity and quality of water resources in the planning area. The Step 3 report characterized total current and projected demand for water (subdivided by instream demand, agricultural demand, municipal demand, and the effects of climate change/natural hazards on demand). Critical concerns and uncertainties were identified in each report to reflect data gaps, unknown variables, and other issues that will require additional efforts to mitigate in future work by the

UGRRW Partnership. Critical opportunities were identified to present a path forward for this analysis. The reports included the following information:

- **Current and Future Annual Water Balance Summary by Subwatershed (Step 3 Report, Section 7.0):** Tables 2-1, 2-2, and 2-3 were reproduced from Tables 7-1, 7-2, and 7-3 are included below for reference:

TABLE 2-1 *
ANNUAL WATER BALANCE (CURRENT DEMAND)

Subwatershed	Name	Surface Water Quantity (Natural Stream Flow) (from Step 2 Report) (AF per Year) (50th Percentile)	Groundwater Used (from Step 2 Report) (AF per Year)	Agricultural Demand Surface Water (AF per Year) (Water Rights Only)	Agricultural Demand Groundwater (AF per Year) (Water Rights Only)	Agricultural Demand Surface Water (AF per Year) (ET Estimate)	Agricultural Demand Groundwater (AF per Year) (ET Estimate)	Municipal Demand Surface Water (AF per Year)	Municipal Demand Ground Water (AF per Year)	Instream Demand (AF per Year) (Water Rights Only)	Surface Water Balance (ag ET)	Groundwater Balance (ag ET)
1	Lookingglass Creek/Cabin Creek	644,600	-	3,470	230	3,410	220	383	810	173,750	467,440	(1,030)
2	Willow Creek/Indian Creek	523,380	29,400	51,890	14,440	46,630	12,980	-	810	141,820	334,930	15,620
3	Lower Five Points Creek	234,120	25,720	23,780	23,490	20,770	20,520	1,393	500	85,610	127,740	4,700
4	Beaver Creek, Upper Five Points Creek	219,830	1,960	750	2,040	710	1,932	170	160	85,610	133,510	(120)
5	Meadow Creek Upper Grande Ronde River	127,840	190	520	-	510	-	-	50	46,840	80,490	140
6	Ladd Creek Lower Catherine	153,740	71,720	106,330	46,100	96,350	41,774	110	5,500	57,550	(160)	24,450
7	Upper Catherine Creek 1	116,240	9,280	24,030	530	24,870	550	-	370	57,550	33,820	8,360
8	Upper Catherine Creek 2	71,600	-	360	-	470	-	-	10	32,500	38,620	(10)
	Total	**644,600****	**138,270**	**211,130**	**86,830**	**193,730**	**77,973**	**2,060**	**8,190**	**173,750****	**277,130**	**52,110**

**This table was reproduced from Table 7-1 of the Step 3 report.*

***Total natural stream flow and instream demand are expressed as the total from subwatershed 1 (the most downstream section of the watershed) to prevent "double counting."*

AF = acre-feet
ag ET = agricultural evapotranspiration
ET = evapotranspiration

TABLE 2-2*
ANNUAL WATER BALANCE (FUTURE DEMAND)

Subwatershed	Name	2068 Temperature Change from Current (°F)	Surface Water Quantity (Natural Stream Flow) (from Step 2 Report) (AF per Year)	Groundwater Used (from Step 2 Report) (AF per Year)	Agricultural Demand Surface Water (AF per Year) (Water Rights Only)	Agricultural Demand Ground Water (AF per Year) (Water Rights Only)	Agricultural Demand Surface Water (AF per Year) (ET Estimate)	Agricultural Demand Groundwater (AF per Year) (ET Estimate)	Municipal Demand Surface Water (AF per Year)	Municipal Demand Groundwater (AF per Year)	Instream Demand (AF per Year) (Water Rights Only)	Surface Water Balance (ag ET)	Groundwater Balance (ag ET)
1	Lookingglass Creek/Cabin Creek	1.6	593,040	-	3,470	230	5,010	330	60	30	173,750	414,210	(2,090)
2	Willow Creek/Indian Creek	1.6	481,510	29,400	51,890	14,440	68,490	19,060	-	860	141,820	271,210	9,490
3	Lower Five Points Creek	1.6	215,390	25,720	23,780	23,490	30,510	30,140	5,570	1,240	85,610	93,700	(5,660)
4	Beaver Creek, Upper Five Points Creek	1.6	202,250	1,960	750	2,040	1,050	2,840	690	360	85,610	114,910	(1,230)
5	Meadow Creek Upper Grande Ronde River	1.6	117,610	71,720	520	-	750	0	-	50	46,840	70,020	140
6	Ladd Creek Lower Catherine	1.6	141,440	9,280	106,330	46,100	141,510	61,360	460	8,870	57,550	(58,070)	1,490
7	Upper Catherine Creek 1	1.6	106,940	-	24,030	530	36,530	810	-	390	57,550	12,870	8,080
8	Upper Catherine Creek 2	1.6	65,870	190	360	-	690	0	-	10	32,500	32,680	(10)
	Total	**1.6**	**593,040****	**138,270**	**211,130**	**86,830**	**284,530**	**114,520**	**6,780**	**11,810**	**173,570****	**126,510**	**10,200**

**This table was reproduced from Table 7-2 of the Step 3 report.*

***Total natural stream flow and instream demand are expressed as the total from subwatershed 1 (the most upstream section of the watershed) to prevent "double counting."*

F = Fahrenheit

TABLE 2-3*
SHADED BIWEEKLY WATER BALANCE

Biweekly surface water balance by subwatershed

	Oct		Nov		Dec		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep	
Subwater	1st to 15th	16th to 31st	1st to 15th	16th to 30th	1st to 15th	16th to 31st	1st to 15th	16th to 31st	1st to 15th	16th to 28th	1st to 15th	16th to 31st	1st to 15th	16th to 30th	1st to 15th	16th to 31st	1st to 15th	16th to 30th	1st to 15th	16th to 31st	1st to 15th	16th to 31st	1st to 15th	16th to 30th
1	-1607	-2059	-1393	-1393	2160	1684	5350	4874	19409	19409	32618	32142	62371	62276	71312	70762	36536	36436	7133	6697	2116	1716	-775	-712
2	-1007	-1029	-528	-528	2357	2010	4948	4601	16323	16323	27087	26740	46949	45651	51850	50243	25695	24336	-215	-19	-2064	-1377	-2134	-1282
3	345	431	-33	-33	1062	923	2504	2365	6960	6960	14425	14226	21029	20451	21306	20260	816	3185	-3345	-3302	-1715	-1314	-772	-392
4	449	395	-111	-111	918	779	2271	2132	6464	6464	13411	13212	19496	19476	20766	20156	2229	5183	-443	-633	262	218	172	185
5	842	-1534	-1110	-1110	658	579	1260	1181	3496	3219	7866	7767	13431	13417	15529	15370	4914	4900	-660	-803	-1547	-2478	-2353	-2343
6	-241	372	478	478	1325	1265	2086	2026	5384	5384	6506	6308	9370	6689	6365	3876	-5499	-6075	-13376	-12413	-8240	-6162	-3969	-2208
7	352	466	662	662	855	796	997	938	1320	1320	616	417	1725	1033	8971	8034	5495	7002	-2206	-2076	-1584	-1091	-670	-216
8	-8	-63	-54	-54	184	125	271	212	493	493	1319	308	3138	3125	8103	7954	6516	6502	262	129	-66	-130	-72	-63

2068 biweekly surface water balance by subwatershed

	Oct		Nov		Dec		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep	
Subwater	1st to 15th	16th to 31st	1st to 15th	16th to 30th	1st to 15th	16th to 31st	1st to 15th	16th to 31st	1st to 15th	16th to 28th	1st to 15th	16th to 31st	1st to 15th	16th to 30th	1st to 15th	16th to 31st	1st to 15th	16th to 30th	1st to 15th	16th to 31st	1st to 15th	16th to 31st	1st to 15th	16th to 30th
1	-1495	-2135	-1557	-1297	4301	1589	299	6076	20796	13882	27399	27911	39997	60417	58938	32329	21715	28686	7883	5032	1389	1906	-1386	39
2	-1322	-1051	-621	-411	4135	1972	886	5617	17489	11875	22889	23264	28016	43262	40190	16280	10655	15326	-1687	-3084	-3937	-2458	-3520	-1298
3	11	250	-249	-154	1641	733	472	2656	7279	4904	11981	12181	10782	19084	15439	3397	-4750	-328	-4340	-4588	-2594	-2046	-1474	-728
4	468	367	-172	-83	1604	743	505	2547	6905	4675	11258	11468	10361	18729	16107	5662	-1550	3207	-327	-948	145	219	53	297
5	867	-1538	-1133	-1082	1092	569	280	1426	3750	2251	6650	6784	8407	13014	12752	6707	2503	3644	-578	-988	-1607	-2467	-2412	-2267
6	-1187	351	436	498	1833	1240	878	2310	5712	4063	5259	5121	2276	4241	-187	-11382	-15670	-13929	-17816	-16628	-11293	-8895	-6141	-3481
7	149	459	631	701	1266	787	241	1127	1438	868	149	-5	-1293	312	5464	-1595	-865	3052	-3153	-3461	-2440	-1751	-1303	-409
8	18	-68	-73	-30	438	120	-194	328	566	214	1032	75	1552	2991	6501	2968	3630	5003	396	-132	-146	-105	-147	43

AF<-10000
-10000<AF<-5000
-5000<AF<-2000
-2000<AF<-1000
-1000<AF<-500
-500<AF<0
0<AF<500
500<AF<1000
1000<AF<2000
2000<AF<10000
10000<AF<20000
20000<AF<50000
AF>50000

**This table was reproduced from Table 7-3 of the Step 3 report.*

- **Agricultural (Step 3 Report, Section 4.0 and Appendix B):** Agricultural water demand was characterized using an ET model, which has the advantage of providing temporal information about how crops use water throughout the growing season. The model also facilitates estimates for future climate and increased irrigation efficiency scenarios. Current (2018) agricultural water use was estimated to be 193,725 (surface water) and 77,973 (groundwater) AF per year. A number of water use scenarios were considered given a 3 percent increase in mean annual temperature, representing a change due to drought or climate change. Future (2068) estimated gross irrigation water requirement is 284,532 AF per year (surface water) and 114,522 AF per year (groundwater) with existing irrigation efficiency and 214,169 AF per year (surface water) and 87,396 AF per year (groundwater) under the increased efficiency scenario (per page 4-31; Figure 4-1, Figure 4-5, Figure 4-15, Figure 4-17, Appendix B Agriculture Water Demand Summary Table [page 246]). Climate change parameters were generated using the Representative Climate Pathways 8.5 climate model.

  Water rights were used to delineate irrigated lands, and as a reference point for comparisons to modeled crop water use. Irrigation water rights represent an upper limit to current legal water use. Current (2018) estimated irrigation water rights total 211,134 AF per year (surface water) and 86,832 AF per year (groundwater). It is unknown what portion of groundwater is obtained from alluvial versus basalt aquifers.

  - Critical concerns and/or uncertainties - Limited testing/surface water quality data gaps, long-term surface water quantity vulnerability, future increasing gap between water quantity/quality demands and low supplies in critical periods (late summer/early fall), and future groundwater demands and sustainable yields from groundwater aquifers.

  - Critical opportunities - Increased stakeholder-agency partnerships to share data and coordinate monitoring activities, water storage infrastructure, and increased irrigation efficiency may reduce future irrigation demands by approximately 24 percent (range approximately 18 to 30 percent) (Step 3 Report, ES-2 and Section 4.0). Savings from increased efficiency was estimated using the Natural Resources Conservation Service water savings estimator, with inputs from a series of assumptions about reasonable improvements to infrastructure and irrigation management practices.

- **Municipal (Step 3 Report, Section 3.0 and Appendix A):** Total municipal demand (including cities, self-supplied industrial users (SSIU), and unincorporated users was estimated to be 2,060 AF per year of surface water and 8,190 AF per year of groundwater. This water is primarily obtained from deep basalt aquifers. Total municipal demand is projected to increase from 10,300 AF to 22,300 AF per year from 2018 to 2068; with SSIU demand projected to increase by up to a factor of four (3,700 AF in 2018 to 15,000 AF in 2068). This increase in demand from current to future demand is large because the assumption was made that much of the unused portion of the SSIU permits/right could possibly be used in the future and the UGRRW Partnership determined that this potential increase in demand should be incorporated into the

planning document (when supported by growth projections as described in Step 3 Report, Section 3.0).

  - Critical concerns/uncertainties - Long-term stability/viability of groundwater aquifer system, SSIU water demand, unaccounted for water loss, aging infrastructure, lack of system redundancy, increasing water use, and drought impacts.

  - Critical opportunities - Increased cooperation between cities, additional conservation measures (potentially through coordinated water management/conservation), voluntary rural well monitoring network, emergency inter-city mutual aid agreements, and coordinate with Oregon Water Resources Department (OWRD) to address groundwater supply data gaps and improve groundwater aquifer information.

- **Instream Water Quantity and Quality (Step 3 Report, Section 5.0 and Appendix C):** Current (2018) and future (2068) instream water demand is 173,750 AF per year based on existing water rights. Water flows and temperatures are the primary components of instream demand for aquatic species and other water uses. Instream flow deficits are greatest in late summer/early fall. Water quality issues associated with low flows, elevated water temperatures, and high bacteria and nutrients are a significant concern (Figure 5-3, Figure 5-4, Figure 5-5, Tables 5-8 and 5-9). These values are estimates (both water rights and water quality limits) and represent the best information available to the UGRRW Partnership at the time of the Step 3 report.

  - Critical concerns/uncertainties - Endangered Species Act (ESA)-listed summer steelhead, spring/summer Chinook, and bull trout survival are impacted by low water quantity and quality conditions, by projected future climate change effects on water quantity and quality and existing data gaps. Estimates of instream demand have significant uncertainty because they are based only on instream water rights.

  - Critical opportunities - Stream restoration actions to improve floodplain-riparian connectivity and function, forest management practices, water conservation to reduce out-of-stream use, short- and long-term voluntary cooperative agreements to increase instream flows, coordination with Oregon Department of Fish and Wildlife (ODFW), Oregon Department of Environmental Quality (DEQ), and OWRD to improve data and characterize instream demand.

- Limited historic or observed regional monitoring and model data suggest declining trends in precipitation and snowpack, stream flow, and groundwater levels, and increasing trends in temperature. These future projections include increased air temperatures, reduced snowpack/shifted precipitation and hydrograph timing, and reduced summer base flows. As with all models, the limited data has accuracy concerns, which impact the future estimates. The UGRRW Partnership views these predictions as one of a number of potential scenarios and will work to manage water on that basis.

The four primary water issues evident from the data and analysis described above in the Steps 2 and 3 reports are:

- Surface water supply is limited in summer through late fall when demand is the highest for instream and agricultural needs based partially on water rights (see Section 7, specifically Table 7-3, Shaded Bi-weekly Water Balance, from the Step 3 report).
- There is significant uncertainty with groundwater supply. The UGRRW lacks sufficient groundwater monitoring wells, long-term trend data, pumping data, and an alluvial groundwater mitigation plan to evaluate groundwater supply sustainability and inform strategic groundwater resource planning (OWRD, 2019).
- Impaired water quality is present in all eight subwatersheds based on limited baseline data. Water quality issues are related to high temperatures, low dissolved oxygen (DO), and insufficient flows (DEQ, 2000; see Step 2 report, Table 3-4 for Water Quality Impairments by Date and Beneficial Use [subwatersheds 1 through 8]).
- Natural hazards like flooding, fire, and drought impact the UGRRW frequently, and the UGRRW Partnership lacks an integrated plan to mitigate and respond to these events to protect water supply sources and enhance water source resiliency. Climate change may alter the timing and occurrence (frequency, magnitude, duration) of these events within the UGRRW (see Step 2 report, Section 3.0, Surface Water page, 3-45 and Step 3 report, Section 6.0, Climate Change and Natural Hazards).

Data Gaps

In addition to the critical concerns/uncertainties listed above, the following data gaps (identified in the Steps 2 and 3 reports) summarize the items that need to be addressed to better quantify identified water issues.

Step 3 Data Gaps include (Step 3 Report, page 2-10):

- Surface water volume (availability).
- Groundwater volume. Lack of information on whether groundwater pumping rates are sustainable and whether there are changes in groundwater storage.
- Uncertainty in the models used to estimate future temperatures, precipitation, and other climate variabilities.
- Uncertainty in estimated population growth.
- Uncertainty in quality of future water supply.
- Uncertainty in the UGRRW's available water supply response to changes in precipitation and temperature (timing, amount, intensity, and frequency).

- Uncertainty related to instream demand.

Step 2 Data Gaps include (Step 2 Report):

- Consistent methodologies for hydrologic and water resources. Leadership at the state and national levels is necessary to support development of policies to address new information in hydrology and climate research (Step 2 report, pages ES-7 and ES-8).

- One general information gap is that the UGRRW Partnership did not independently validate data discussed in the Step 2 report. Validation requires a comparison to independent data to get an estimation of the deviation between predicted and actual values. There was not a field validation/data verification component to this report and, as such, the information is only as reliable as the sources and studies from which it was obtained (Step 2 report, pages ES-7 and ES-8).

- The objective of the Step 2 report was to develop a report on existing water supply conditions. Attempts to gather information for the analysis established numerous information gaps that rendered the objective of a weekly water supply analysis unattainable. Surface water supply information is limited to eight gauging station locations within the entire watershed that are of varied accuracy and duration of data collection. Estimates of surface water usage reflect permitted use (maximum), not actual use. Groundwater supply also reflects permitted pumping levels, not actual pumping levels (meters are currently not required of all users so the actual amount withdrawn is unknown). Estimates of groundwater do not reflect the volume of water available, the depth at which it is being extracted, or the rate or source of recharge. Return flow to surface and groundwater after an initial use is unknown. As a result, report authors have relied heavily on previously prepared reports. Those reports, faced with the same information sources, contain assumptions designed to overcome information gaps and are typically not verified with data (Step 2 report, pages ES-7 and ES-8).

- Each agency and study uses different boundaries when mapping the UGRRW, so there is difficulty in interpreting results across agency databases (OWRD, DEQ, Grande Ronde Model Watershed ATLAS) (Step 2 report, page 2-41).

- Aquifer depth and interaction with surface water is not well understood (Step 2 report, page 2-41).

- Additional specific data will be needed to calculate and verify water quantity and quality questions. These data are not available and need to be collected (Step 2 report, page 2-41).

- There is a lack of timing information from DEQ data sets. The lack of standards for all but the most restrictive beneficial use makes data difficult to interpret for other uses (Step 2 report, page 3-44).

- Temperature data obtained from surface temperature measurements (such as thermal imaging measurements) may not all be representative of stream temperatures (Step 2 report, page 3-44).

- Existing total maximum daily load standards are referenced in the Step 2 report. The existence of these standards does not mean they are achievable for every area in the UGRRW (Step 2 report, page 3-44).

- Subwatersheds 7 and 8 have less temperature data than other subwatersheds described in this report; this data gap is to be evaluated as the ODFW and U.S. Forest Service may have additional data for Catherine Creek (Step 2 report, page 3-44).

- Some areas have diversions that export water from or import water to the UGRRW. These transbasin diversions are not accounted for in the Step 2 report (Step 2 report, page 3-44).

- Additional specific data are needed to calculate and verify water quantity and quality questions. These data are not available and need to be collected (Step 2 report, page 3-44).

- Additional groundwater quality data are needed, including groundwater temperature data and more information about nitrates and potential underground storage tank impacts to aquifers near La Grande and Union (Step 2 report, page 4-16).

- Additional information is needed to determine whether wells at risk from potential contaminant sources are meeting water quality standards for drinking water or agricultural usage, depending on the use (Step 2 report, page 4-16).

- More information is needed to determine overall groundwater level trends (Step 2 report, page 4-16).

- Development of confined volcanic aquifers is possible but at considerable expense and risk (Step 2 report, page 4-16).

- More information is needed to determine if legal water rights are an accurate representation of actual groundwater use (Step 2 report, page 4-16).

- Additional specific data are needed to calculate and verify water quantity and quality questions. These data are not available and need to be collected (Step 2 report, page 4-16).

- Scale is a limiting factor in each section of analysis. For each different component of analysis (i.e., groundwater, surface water, etc.), the scale of evaluation is stated. Information derived from different scales of analysis is not able to be used quantitatively; however, it is provided in this section to share what existing information is available (Step 2 report, page 5-6).

- Available data and analysis limits understanding of the accuracy and impact of a potential hydrograph shift (Step 2 report, page 6-8).

- A better description of rules on instream rights, transfers, storage, aquifer recharge, and aquifer storage and recovery could be provided (Step 2 report, page 6-8). It is noted that this item is not a data gap, but rather an area for additional work by the UGRRW Partnership.

Prioritization of Water Issues

The following describes the water issues in terms of priority given to them by the UGRRW Partnership.

Four main issues are generally prioritized in the following way:

- Surface water deficit because it affects most water user groups, including agricultural users and ecological users (specifically ESA-listed salmonid species).
- Uncertainty of groundwater resources (aquifer levels and extents) because agricultural and municipal users currently rely on groundwater sources and these demands are projected to increase in the future.
- Surface water quality because many of the quality issues are directly related to flow quantities (surface water deficit).
- Natural hazards/climate change can influence each of the three issues above and will be considered in assessment and solution development.

Water Issues, Goals, Objectives, and Strategies

Each of the four water issues are described below, along with a goal statement and measurable objectives for improvements. Potential strategies are identified for each objective. These strategies (including definitions and how they were developed) are detailed in Section 3.0 of this report.

It is important to note that while certain objectives have a longer timeline attached to them, it is the intent of the UGRRW Partnership to try to move forward in an accelerated way and complete work as strategically and effectively as possible. Benchmarks for interim steps in these longer timelines will be developed in Step 5.

Surface Water Deficit

Issue/Goal 1 - Eliminate Surface Water Deficit

The largest issue facing the UGRRW is that surface water is limited in summer through late fall when demand is highest for instream and agricultural needs. A surplus of surface water occurs on an annual basis, with most of that surplus occurring in winter and spring. The goal is to eliminate 100 percent of the seasonal surface water deficits in each subwatershed through our own work or support of other organizations. See Figure ES-2 Total Biweekly Surface Water (SW) Budget Summary for the water availability hydrograph.

Objective 1.1

By 2040, reduce current (2018) surface water deficit (Step 3 report, Table 7-3) as much as possible, per the outcomes of the feasibility studies and the total subwatershed deficits listed below. Initiate feasibility studies immediately to identify potential storage projects across the UGRRW. The total quantity achieved will be based on the outcome of the feasibility studies as well as specific deficits identified for individual tributaries. Strategic and integrated actions will be implemented to reduce this deficit according to data presented in the Step 2 and Step 3 reports, preferred alternatives identified in the feasibility studies, and the best available research and monitoring data. Projected water deficit is expected to increase in magnitude, frequency, and duration by 2068 (Step 3 report, Table 7-3). The values shown below are current water deficits (from the 2018 Water Year, Step 3 report, Table 7-1). It is noted that these deficits are additive, so a deficit in one watershed will carry over to the downstream watershed.

- Subwatershed 1: September through November - 7,940 AF deficit
- Subwatershed 2: July through November - 10,182 AF deficit
- Subwatershed 3: July through November - 10,129 AF deficit
- Subwatershed 4: July through November - 1,297 AF deficit
- Subwatershed 5: July through November - 13,098 AF deficit
- Subwatershed 6: June through October - 58,183 AF deficit
- Subwatershed 7: July through September - 7,843 AF deficit
- Subwatershed 8: July through November - 510 AF deficit

Overall, agricultural shortages are primarily located in the valley bottom of subwatersheds 2, 3, 6, 7 in the months of July through November. Instream deficits occur both above and in the dominant agriculture elevation zone in subwatersheds 1 through 8 during the months of July through November. Municipal deficits are small in comparison to agricultural and instream deficits and occur primarily in summer months in subwatershed 6 (Island City and La Grande). Addressing the sector deficits will require a diverse suite of integrated, passive, and active water strategies. See Table ES-1 (reproduced from the Step 3 report), summarizing water demand by subwatershed.

Potential Strategies

- Storage, Built Storage (Aboveground)
- Agricultural Practices
- Data Collection, Research, and Monitoring
- Non-structural Water Storage and Habitat Management
- Public Land Practices
- Outreach and Education

- Infrastructure/Land Modification
- Administrative Actions
- Municipal Practices

Objective 1.2

By 2040, fill data gaps identified in the Steps 2 and 3 reports. Begin work immediately to fill data gaps identified in the Steps 2 and 3 reports, particularly with respect to instream demand and ecological flow needs. These studies are anticipated to investigate ecological flows needed year-round. Municipal demand, agricultural demand, and supply (surface water and groundwater) data gaps will also be addressed.

Potential Strategies

- Data Collection, Research, and Monitoring

Surface Water Quality

Issue/Goal 2 - Improve Water Quality

Water quality impairments are present in each of the eight subwatersheds. The water quality parameters of concerns are predominantly high temperatures, low DO, and insufficient flow. The goal is to improve water quality with the tools available to the UGRRW Partnership, through our own work or support of other organizations.

Objective 2.1

By 2040, reduce each water quality issue as much as possible per the outcomes of feasibility studies addressing the parameters of concern as described below. Support the work of others in addressing additional water quality parameters beyond those identified by the DEQ. For instance, toxic chemicals, pharmaceuticals, heavy metals, etc., may also need to be addressed (Step 2 report, Section 7.0, Table 7-8).

- Subwatershed 1: Temperature, pH, DO, algae
- Subwatershed 2: Temperature, pH, DO, algae, *E. coli*
- Subwatershed 3: Temperature, pH, algae
- Subwatershed 4: Temperature, pH
- Subwatershed 5: Temperature, pH
- Subwatershed 6: Temperature, pH, algae, *E. coli*
- Subwatershed 7: Temperature, pH, DO, algae
- Subwatershed 8: Temperature

Numerous waterbodies in the UGRRW have been identified as water quality limited by the DEQ. The primary parameters of concern in the UGRRW are temperature, pH, DO, and *E. coli*. Temperature is a limiting factor for aquatic life for many of the summer months, especially in the lower and central part of the UGRRW. In most subwatersheds, temperature and pH are concerns for the summer months. Generally, subwatersheds in the northern and central portion of the UGRRW (subwatersheds 1 through 6) have more limiting factors than ones in the southern UGRRW (Catherine Creek area, subwatersheds 7 and 8). Given that there are no impoundments or intensive land management impacting the flow at the higher elevation subwatersheds these deficits may or may not reflect natural conditions in the watershed).

Potential Strategies

- Storage, Built Storage (Aboveground and Underground))
- Agricultural Practices
- Data Collection, Research, and Monitoring
- Non-structural Water Storage and Habitat Management
- Public Land Practices
- Outreach and Education
- Infrastructure/Land Modification
- Municipal Practices

Objective 2.2

By 2040, fill data gaps identified in the Steps 2 and 3 reports with respect to water quality including temperature and other parameters important for beneficial uses.

Potential Strategies

- Data Collection, Research, and Monitoring

Groundwater Sustainability

Issue/Goal 3 - Reduce Groundwater Supply Uncertainty

The UGRRW lacks long-term water level trend data and pumping volume data to evaluate groundwater supply sustainability and support strategic groundwater resource planning. Several specific questions that need to be answered include time required for replenishment, interdependence and volumes of underground sources, and surface water interaction. To address these data gaps and supply actionable data to inform future resource management questions, consistent measurement of a network of groundwater monitoring wells must be implemented and maintained for an extended period of time. It is important to increase not only the number of wells measured but also to ensure that observation points are both

geographically distributed and representative of a range of depths and subsurface conditions within the basin. In addition, refine estimates of unmetered groundwater use if it is not possible to meter each point of appropriation. The goal is to improve understanding of groundwater supply and to develop and implement a plan for sustainable use of groundwater.

Objective 3.1

Complete a groundwater study by 2035. Through data collection and analysis, understand the characteristics of the UGRRW aquifers and determine the rate of change in level, if any, for each aquifer.

Potential Strategies

- Data Collection, Research, and Monitoring

Objective 3.2

Once the groundwater system is understood, convene a group of stakeholders to implement a plan for sustainable use of groundwater. This plan (in the form of an update to the Step 5 Strategic Action Plan) will consider rates of aquifer recharge, withdrawals of groundwater and surface water and the connection between groundwater and surface water. Short-term goals will be compiled to achieve stable groundwater levels in the meantime (also in the form of an update to the Step 5 Strategic Action Plan).

Potential Strategies

- Storage, Built Storage (Aboveground)
- Agricultural Practices
- Non-structural Water Storage and Habitat Management
- Public Land Practices
- Outreach and Education
- Infrastructure/Land Modification
- Administrative Actions
- Municipal Practices

Natural Hazards and Climate Change Risks

Issue/Goal 4 Natural Hazards/Climate Change

Natural hazards like flooding, fire, and drought impact water supply in the UGRRW frequently, and an integrated plan is needed to mitigate, respond, and adapt to the impact these hazardous events have on water supply. The goal is to develop an integrated plan (composed of a set of

selected projects or actions) to reduce or mitigate the impact of these events. Also, climate change models have projected temperature increases and stream flow changes by 2068. The goal is to create an adaptative management protocol that allows for all water uses (municipal, ecological, and agricultural) to be whole (defined as not reducing water currently available to users).

Objective 4.1

By 2030, develop a Natural Hazards Mitigation Plan (set of projects and actions to be included in an update to the Step 5 Strategic Action Plan) to reduce or mitigate the impact of flooding, fire, and drought.

Potential Strategies

- Administrative Actions
- Public Land Practices

Objective 4.2

By 2040, implement mitigation measures identified in the Natural Hazards Mitigation Plan developed above.

Potential Strategies

- Storage, Built Storage (Aboveground)
- Agricultural Practices
- Data Collection, Research, and Monitoring
- Non-structural Water Storage and Habitat Management
- Public Land Practices
- Outreach and Education
- Infrastructure/Land Modification
- Administrative Actions
- Municipal Practices

Objective 4.3

By 2030, create an adaptive management protocol to apply new climate change data to goals. The protocol (in the form of an update to the Step 5 Strategic Action Plan) will document a method to modify goals based on new climate change data at regular intervals. This adaptive management protocol will also be used to evaluate progress in accomplishing our objectives. It will also provide a means for feedback to determine whether the approach needs to be changed. This objective will be applied to the goals listed in this document. The

UGRRW Partnership recognizes the potential error and uncertainty inherent in models and will seek to avoid identifying numeric targets based on models that cannot be validated with empirical data.

Strategies

- Administrative Actions

3.0 - Evaluation of Potential Strategies

Introduction

After water issues were determined, the Stakeholders identified potential strategies. Those strategies were later applied to the objectives and goals.

This section provides an overview of the evaluation and outcomes of the strategy development and review.

Methods

The following methods were used to evaluate and develop potential strategies:

- Group brainstorming sessions
- Grouping ideas into major strategy categories
- Spreadsheet strategy development
- Individual preliminary rankings
- Development of strategy summaries
- Group prioritization
- Presentations
- Development and approval of issues/goals/strategies document

These methods were selected to allow people to share feedback in a variety of ways (privately, through email, in person, and in a group context). This was done to maximize feedback. These methods were developed based on trial and error through discussion with the Upper Grande Ronde River Watershed (UGRRW) Place-Based Planning Partnership (Partnership). Originally, a benefits matrix was developed and then abandoned due to it being too detailed for this level of analysis. A draft of this matrix can be found on Union County's Place-Based Planning website with meeting minutes from the January 16, 2019, meeting (http://union-county.org/planning/place-based-integrated-water-resources-planning/). This draft was never completed, finalized, or approved by the Stakeholders and the method was terminated.

Each utilized method was applied in the following way:

1. **Group Brainstorming Sessions** - After identification of the four water issues, a series of four meetings was held with the entire UGRRW Partnership stakeholder group to brainstorm strategies. Each meeting was centered around a different UGRRW Partnership-identified water issue: natural hazards/climate change, surface water deficit, groundwater uncertainty, and water quality. Stakeholders (after being asked to individually review the Steps 1 through 3 reports) shared strategies to address these water issues. Strategies were written on a white

board and then captured in a Word document. The Word document was sent to the group after each meeting to ensure that all ideas were included.

2. **Grouping Ideas into Major Strategy Categories -** After the four brainstorming meetings were complete, more than 100 potential strategies had been generated. These individual strategies were combined into draft major strategy categories. These categories included subsets of similar individual strategies. The group reviewed these draft major strategy categories and after some revision, 12 major strategy categories were identified. These included:

    - Built Storage - Aboveground Off-channel
    - Built Storage - Aboveground On-channel
    - Land Management - Agricultural Land
    - Data Collection and Monitoring
    - Non-structural Water Storage and Habitat Management
    - Land Management - Public Land
    - Infrastructure/Land Modification
    - Administrative Actions
    - Land Management - Municipal Land
    - Outreach and Education
    - Underground Storage
    - Research - Review of Existing Information

3. **Spreadsheet Strategy Development -** Each major strategy category was listed in a spreadsheet with all associated individual strategies. Elements of each strategy were drafted, and Stakeholders reviewed and contributed to the spreadsheet. A draft of this spreadsheet can be found on Union County's Place-Based Planning website with meeting minutes from the December 11, 2019, meeting (http://union-county.org/planning/place-based-integrated-water-resources-planning/). This draft was never completed, finalized, or approved by the Stakeholders and the method was terminated. Elements described included:

    - Strategy Type
    - Description
    - Issues Targeted (and Metrics)
    - Potential Benefits
    - Potential Barriers/Negatives
    - Potential Magnitude (Low, Moderate, High)
    - Potential Costs (Low, Moderate, High)
    - Potential Environmental Impacts (Low, Moderate, High)

- Potential Human Impacts (Low, Moderate, High)
- Potential Feasibility (Recommended, Considered, Not Recommended)
    - Recommended (to be evaluated through feasibility study by the group)
    - Considered (missing information, or not enough impact to be recommended - if opportunities arise, the group would support working on this)
    - Not Recommended (strategy is not supported by the group and will not be evaluated further)
- Sites to Consider (for sub-strategies)
- Notes
- New Idea or Already Being Implemented
- Action Agency or Potential Action Agency
- What is Needed/Next Steps

4. **Individual Preliminary Rankings -** As identified in the spreadsheets, Stakeholders were asked (via email) to identify their preliminary rankings for each major strategy category whether it was:

    - Recommended (to be evaluated through feasibility study by the group)
    - Considered (missing information, or not enough impact to be recommended - if opportunities arise, the group would support working on this)
    - Not Recommended (strategy is not supported by the group and will not be evaluated further)

    The goal of this preliminary review was to identify the Stakeholders' preferences and concerns with various strategies. After discussion of the preliminary rankings, it was determined by the Stakeholders that all strategies should be retained and that strategy summaries should be developed to further explain what each major strategy category entailed.

5. **Development of Strategy Summaries -** These summaries were reviewed and refined by the group. Some components were similar to the original spreadsheets, but the goal was to simplify the plan to a one- to two-page summary of the anticipated action. The strategy summaries were originally called "draft action plans," but later changed to "strategy summaries" in recognition that the descriptions provided summarized work done to date, rather than provided a plan of action for implementation. This plan will be provided in Planning Step 5 Strategic Action Plan. Items included in each strategy summary are:

    - Recommended Action - Description of the initial action or set of potential actions to be taken to accomplish an objective during the initial phase of implementation (i.e., feasibility study or data collection).

- Water Issues to be Addressed - Narrative describing which of the four water issues the strategy will attempt to address (multiple issues are addressed by some strategies).
- Benefits - Potential positive effects of the ultimate result of a recommended action (i.e., benefits of potentially implementing a project).
- Concerns - Potential negative effects of the ultimate result of a recommended action (i.e., risks and problems associated with the implementation of a potential project).
- Methods to Address Concerns - A preliminary set of ideas on measures to take to reduce concerns and address potential problems associated with strategy implementation.
- Specific Subwatersheds - Which of the eight subwatersheds the recommended action would affect or focus on improving.
- Action Agency(ies) - Organizations to be involved with implementing the recommended action. This list includes potential funders, leaders, implementers, and technical resources in the Stakeholder group. Roles will be clarified in Step 5 Action Plan.
- Resources Needed - Description of assistance needed to begin work on the strategy (i.e., funding, information, staff).
- Research Needs/Data Needs - Description of known data and research gaps that need to be addressed before a strategy is implemented.
- Next Steps - Listing potential ordered tasks to be accomplished when beginning to implement the recommended action (i.e., obtain funding, conduct literature review, etc.). These next steps will be clarified in Step 5 Action Plan.

These strategy summaries are discussed below in the "Results of Evaluation" section.

6. **Group Prioritization** - The prioritization method used to review the strategies was an in-person vote where Stakeholders who were eligible to vote by Memorandum of Understanding requirements were asked to prioritize their top five major strategy categories. Each vote was assigned a point value of five points for a 1 rank, four points for a 2 rank, three points for a 3 rank, two points for a 4 rank, and one point for a 5 rank. The major strategy categories were prioritized from this ranking; however, some uncertainty remained about strategy types. See the original results from the group prioritization in the "Results of Evaluation" section below. It is noted that this voting did not embrace the consensus process; however, this method was used to achieve a draft order of strategies. Consensus was achieved on accepting the document with a strategy order presented in item 8 below.

7. **Presentations -** Four presentations were made, one on aboveground on-channel storage permitting and Endangered Species Act (ESA) consultation requirements, one on the logistics and types of underground storage, one on unappropriated water in the UGRRW, and one on water markets and water right transactions, which are administrative actions (National Marine Fisheries Service [NMFS], 2020; Confederated Tribes of the Umatilla Indian Reservation [CTUIR], 2020; Oregon Department of Agriculture [ODA], 2020; The Freshwater Trust [FWT], Oregon Water Resources Department [OWRD] and CTUIR, 2019). These presentations provided a better understanding of these strategy types. As a result, the UGRRW Partnership determined that it

would be beneficial to modify the original 12 major strategy categories (see item 2 above) so aboveground on-channel storage, aboveground off-channel storage, and underground storage could be combined into a single strategy. Given the challenges of siting on-channel storage facilities in a basin with ESA-listed species, sensitive cultural sites, and river recreation, the UGRRW Partnership further condensed the built storage category to "aboveground storage and underground storage." The UGRRW Partnership felt that this acknowledged these unavoidable siting challenges but still enabled an evaluation of potential aboveground storage sites in the future on a case-by-case basis. The UGRRW Partnership also determined that data collection, monitoring, and research should be combined into one strategy.

8. **Development and Approval of Issues/Goals/Strategies Document -** As described in item 2 above, an issues/goals/strategies document was created to summarize the four major water issues identified, clarify goals associated with those issues, and pair measurable objectives to those goals. The major strategy categories were linked with each objective and also listed in the following final prioritization:

    1) Built Storage - Aboveground Storage and Underground Storage
    2) Land Management - Agricultural Land
    3) Data Collection, Monitoring, and Research
    4) Non-structural Water Storage and Habitat Management
    5) Land Management - Public Land
    6) Infrastructure/Land Modification
    7) Administrative Actions
    8) Land Management - Municipal Land
    9) Outreach and Education

These strategies are listed in priority order with the first one listed as the highest priority strategy. It was determined that the top five strategies in the list would be the primary focus of the Step 5 Strategic Action Plan, and the remaining strategies would be retained. This was approved by a consensus vote of the UGRRW Partnership in April 2020.

Spectrum of Potential Strategies Explored

A full spectrum of potential strategies was explored through the Step 4 process. Strategies were explored in the following ways:

OWRD Step 4 Guidance Document - Each strategy category listed in this guidance document was discussed with the Stakeholders in a meeting, and they were asked to consider its applicability to the UGRRW. The strategies from the OWRD Step 4 Guidance are listed in bold below. The bracketed text cross references the UGRRW Partnership major strategy categories that incorporate the OWRD strategies. For additional details see the strategy summaries presented at the end of this section.

- **Efficiency and Conservation Measures** - Land Management - Agricultural Land; Land Management- Municipal Land
- **Built and Natural Storage** - Built Storage - Storage, and Underground Storage; Non-structural Water Storage and Habitat Management
- **Water Right Transfers and Management Agreements** - Administrative Actions
- **Water Reuse, Rainwater Harvesting, and Non-Traditional Methods -** Land Management - Municipal Land
- **Infrastructure Maintenance and Replacement -** Land Management- Municipal Land; Land Management - Agricultural Land; Infrastructure/Land Modification
- **Watershed and Habitat Restoration** - Non-structural Water Storage and Habitat Management; Land Management - Public Land
- **Instream Flow Protections** - Non-structural Water Storage and Habitat Management; Administrative Actions
- **Water Quality Protections** - Outreach and Education; Non-structural Water Storage and Habitat Management; Administrative Actions; Land Management-Public Land
- **Monitoring** - Data Collection, Monitoring, and Research
- **Water Markets and Mitigation** - Administrative Actions

From this list, Stakeholders were asked to identify any missing strategy ideas and also strategies that did not seem applicable. Strategies selected by the Stakeholders to be included are listed on Table 3-1, below.

1. **Group Discussions and Presentations** - Different strategies were explored via discussions in the group, with experts within the group sharing information on relevant programs and successful projects related to the different strategy types (NMFS, 2020; CTUIR, 2020; ODA, 2020; FWT, OWRD, and CTUIR, 2019).

2. **Resource Documents** - As Stakeholders found relevant research papers related to different strategies, these were shared with the group. These are included on a Microsoft OneDrive Account that can be accessed by the Stakeholders at [https://andersonperry-my.sharepoint.com/:f:/p/dkurtz/Ev_tkjjJI0REvFmhW55RATUBYM_p3bbw85NTsGxM3UAQhg?e=ov0SE0].

3. **Field Trip** - A field trip to identify successful projects in the areas of agricultural conservation, municipal efficiency, and instream benefits was conducted.

Results of Evaluation

As the strategies were evaluated, they were discussed and ranked by the Stakeholders. Table 3-1, below, shows the initial prioritization. In the December 11, 2019, Stakeholder meeting, each Stakeholder that was eligible to vote was given a list of strategies and asked to prioritize their top five. Their first priority strategy was given 5 points, their second priority strategy was given 4 points, their third priority strategy

was given 3 points, their fourth priority strategy was given 2 points, and their fifth priority strategy was given 1 point. These points were added to produce the weighted voting outcome presented in the ranking below on Table 3-1. The number of people who voted for each strategy is listed in parentheses next to each rank (i.e., the first strategy Built Storage- Aboveground Off-channel received 54 total points from 13 Stakeholders who voted for it).

TABLE 3-1
MAJOR STRATEGY CATEGORY PRIORITY

Strategy	Rank
Built Storage - Aboveground Off-channel	54 (13)
Built Storage - Aboveground On-channel	46 (11)
Land Management - Agricultural Land	28 (10)
Data Collection and Monitoring	28 (10)
Non-structural Water Storage and Habitat Management	26 (10)
Land Management - Public Land	23 (8)
Infrastructure/Land Modification	14 (6)
Administrative Actions	8 (2)
Land Management - Municipal Land	7 (4)
Outreach and Education	6 (4)
Underground Storage	5 (2)
Research - Review of existing information	4 (2)

After the prioritization on Table 3-1 was conducted, modifications were suggested by the Stakeholders. It was determined by the Stakeholders that all strategies should be retained and will be applied to different subwatersheds to solve different water issues, and the top five strategies will be the focus of the Step 5 Strategic Action Plan. The list below represents the final ranking of the strategies (as voted on in a July 2020 consensus vote of the UGRRW Partnership):

1. Built Storage (Aboveground Storage, Underground Storage)
2. Land Management - Agricultural Land
3. Data Collection, Monitoring, and Research
4. Non-Structural Water Storage and Habitat Management
5. Land Management - Public Land

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6. Infrastructure/Land Modification
7. Administrative Actions
8. Land Management - Municipal Land
9. Outreach and Education

The following section details these topics in the strategy summaries. A final Strategic Action Plan will be developed for the Step 5 report. The top five strategies will be the focus of the Strategic Action Plan; however, other lower priority strategies will be opportunistically addressed in ways that do not take resources from the higher priority strategies. The strategy summaries were originally called "draft action plans," but later changed to "strategy summaries" in recognition that the descriptions provided summarized work done to date, rather than provided a plan of action for implementation. This plan will be provided in Step 5 Strategic Action Plan.

Table 3-2 below shows which issue/goal and objective each strategy seeks to address.

TABLE 3-2
CROSSWALK OF OBJECTIVES AND POTENTIAL STRATEGIES

Issue, Goal, and Objective	Built Storage (Aboveground Storage, Underground Storage)	Land Management - Agricultural Practices	Data Collection, Monitoring and Research	Non-Structural Water Storage and Habitat Management	Land Management - Public Land	Infrastructure/Land Modification	Administrative Actions	Land Management - Municipal Land	Outreach and Education
Issue/Goal 1 - Eliminate surface water deficit									
Objective 1.1 - Reduce current deficit	X	X	X	X	X	X	X	X	X
Objective 1.2 - Fill data gaps			X						
Issue/Goal 2 - Improve water quality									
Objective 2.1 - Reduce each water quality issue	X	X	X	X	X				X
Objective 2.2 - Fill data gaps			X						
Issue/Goal 3 - Reduce groundwater declines and supply uncertainty									
Objective 3.1 - Complete a groundwater study			X						
Objective 3.2 - Implement plan based on study results	X	X		X	X	X	X	X	X
Issue/Goal 4 - Natural hazards/climate change									
Objective 4.1 - Develop natural hazards mitigation plan					X		X		
Objective 4.2 - Implement mitigation measures identified in plan	X	X	X	X	X	X	X	X	
Objective 4.3 - Create an adaptive management protocol to apply new climate change data to goals							X		

Strategy Summaries

1. Built Storage: (Aboveground Storage, Underground Storage)

Objectives this Strategy May Address:

- Objective 1.1 - Reduce current surface water deficit
- Objective 2.1 - Reduce each water quality issue
- Objective 3.2 - Implement plan for reducing groundwater declines and supply uncertainty
- Objective 4.2 - Implement natural hazards and climate change mitigation measures

Recommended Action: Study the feasibility of developing off-channel, on-channel, or underground multi-purpose storage projects with a favorable cost-to-benefit ratio. The following are specific tasks to be undertaken:

- Review existing information and studies (studies from the 1950s and 1981 and Union County's recently renewed Reservation for Multi-purpose Storage. Reservations are not County water rights, but an amount of water withdrawn from water availability and withheld or reserved (see Instream Flow Act) for future appropriation for agriculturally related economic development in Union County. To use the reservation, an application for a water right must be submitted and approved).
- Review list of criteria in OWRD guidance for consideration for built storage and determine how feasibility will be assessed by the UGRRW Partnership (i.e., location/physical feasibility or permitting/regulatory feasibility)
- Evaluate existing options: Change the intent and use of existing reservoirs by deepening, increasing storage levels, and/or enlarging or expanding storage capacity.
- Evaluate new reservoir options including legal requirements, geographic locations, and water availability
- Evaluate linear storage: Use existing empty old sloughs, enlarge/deepen ditches, create new linear storage (new ditches and side channels)
- Evaluate new underground storage options: Evaluate water source locations (and times of year that surface water sources can sustain a reduction in flow; examples include during floods or spring runoff). Evaluate underground storage locations. Evaluate storage type options (tank, confined alluvial aquifer, confined basalt aquifer, infiltration galleries, aquifer storage and recovery)

Water Issues to be Addressed: This strategy would seek suitable locations for water storage in aboveground off-channel, aboveground on-channel, or underground storage locations to provide water for use to support some or all of the following unmet demands:

- Municipal water redundancy

- Late season instream flows
- Late season irrigation
- Flood control
- Water quality

Benefits: Storage for multiple uses during periods of water deficit, flood mitigation, improvement in water quality, recreation, and hydroelectric uses.

Concerns: High costs, difficulty finding a location, geologic uncertainty, permitting issues, water quality issues, water rights, environmental impacts, social impacts, ESA species and instream impacts, impacts to channel-forming flows, funding availability, time frame for impact, legal obligations and requirements (i.e., treaty obligations with local tribes) and perception challenges (i.e., millions of dollars have been invested to help ESA species and it may be difficult to show that impounding an ESA waterway would not undermine this restoration work).

Methods to Address Concerns: A feasibility study could explore the concerns listed and answer questions about what options may be viable moving forward. Other methods to address concerns include continued UGRRW Partnership collaboration, early engagement with OWRD for water rights issues for each potential location, early engagement of local tribes, and early engagement with environmental agencies through the permitting process. Involvement of agencies at a local level will be essential to identify projects that can help ESA goals as well as water deficit goals.

Specific Subwatersheds: Off-channel storage would likely be located in central and upstream areas of the UGRRW, including subwatersheds 3, 4, 5, 6, 7, and 8. All subwatersheds could be impacted by on-channel storage; actual locations would likely be in high elevation subwatersheds, including 1, 2, and 8.

Action Agency(ies): U.S. Bureau of Reclamation (BOR); U.S. Army Corps. of Engineers (USACE); OWRD; Natural Resources Conservation Service [NRCS]; Oregon Department of Environmental Quality [DEQ]; U.S. Geological Survey [USGS]; Union County; individual landowners; tribes; Union County Farm Bureau; Union County Cattleman's; land trusts; Union Soil and Water Conservation District (SWCD), ODA; Oregon Department of Fish and Wildlife (ODFW); Oregon Department of State Lands (DSL); National Oceanic Atmospheric Administration; U.S. Fish and Wildlife Service; non-profits, or a newly formed irrigation district or special district to build and manage a multipurpose reservoir.

Resources Needed:

- Funding (potential funding sources include USACE, BOR, NRCS, Oregon Watershed Enhancement Board [OWEB], OWRD, Watershed Protection and Flood Prevention Act (PL-566) funding [which built Wolf Creek and Pilcher Creek Reservoirs], local funding for maintenance of infrastructure, water sales, development of non-irrigated land through an irrigation district [farmers might contribute in-kind things like land], Oregon Parks and Recreation Department [Wallowa Lake-type environment], Oregon Department of Energy,

Oregon Trail Electric Co-op, Energy Trust of Oregon, tribes such as CTUIR, and the Bonneville Power Administration [BPA])

- Land
- Strong local support and participation (including coordination with local tribes)
- Permits and other regulatory approvals
- Technical support

Research Needs/Data Needs: A feasibility study should review and investigate data and research needs (review research that has already been done), hydrogeologic research, hydrology and channel-forming flow research, permitting and regulatory requirements, water storage right requirements, and cost estimates.

Next Steps:

- Conduct a literature review of existing reports and feasibility studies on reservoirs and briefly summarize the feasibility conclusions from these reports. Use the information from these reports and the draft water plan to outline baseline information for the following criteria (per page 12, OWRD 2015 guidance document recommendations for planning groups considering new storage as a potential water source):
    - Purpose (e.g., type, location, and extent of use, instream and out of stream public benefits and beneficial uses);
    - Legal Requirements (e.g., state, federal, and local legal requirements);
    - Treaty Obligations (Nez Perce Tribe and CTUIR);
    - Social Considerations (e.g., recreational, public support, cultural, historic);
    - Technical Constraints (e.g., siting issues, public safety, structural integrity);
    - Financial Realities (e.g., project financing including site costs; cost sharing and repayment; and operating, maintenance, and rehabilitation costs);
    - Economic Analysis (e.g., project benefit/cost analysis);
    - Land Use (e.g., ownership, comprehensive plans, coordination);
    - Environmental Effects (e.g., impacts on stream flow, fisheries, wildlife, wetlands, habitat, biological diversity, water quality and opportunities for mitigation);
    - Other (e.g., direct and indirect impacts).
- Evaluate the efficiency of existing water supply infrastructure in the UGRRW (i.e., are existing systems managed as efficiently as possible? If not, an additional new supply volume can be reduced through improved management of existing supply to maximize beneficial use without waste).
- Identify optimal grants for this research and contact potential funding agencies about assisting the UGRRW Partnership with accomplishing project goals.

- Apply for OWRD, BOR, USGS, OWEB, and technical/feasibility study grants to:
    - Review existing studies
    - Evaluate water source locations and availability (and times of year that surface water sources can sustain a reduction in flow, examples include during floods or spring runoff. Due to Scenic Waterway provisions, water is only available for groundwater appropriation for December to February, and due to Division 33 rules surface water diversion is limited prior to April 15)
    - Evaluate underground storage locations
    - Evaluate groundwater storage options (tanks, confined alluvial aquifer, confined basalt aquifer, infiltration galleries, aquifer storage and recovery)
    - Evaluate aboveground options and expansion of existing options
- Complete Feasibility Study
- For permitting feasibility, the "Kaizen" process offered by the agencies involved with the Removal/Fill Permits (DEQ, USACE, DSL, NMFS) may be utilized. Applicants can request a meeting that brings all the agencies into the room at the same time to answer questions.

2. Agricultural Land - Land Management

Objectives this Strategy May Address:

- Objective 1.1 - Reduce current surface water deficit
- Objective 2.1 - Reduce each water quality issue
- Objective 3.2 - Implement plan for reducing groundwater declines and supply uncertainty
- Objective 4.2 - Implement natural hazards and climate change mitigation measures

Recommended Action: Determine the feasibility of improving management of agricultural land to improve water quality and quantity. Much of this work is already being done, so it is anticipated the role of the UGRRW Partnership would be to see where potential bottlenecks are occurring and if the UGRRW Partnership can assist in progress. Actions to be reviewed include:

- Identify where research in precision agriculture relevant to the UGRRW is needed.
- Identify whether conservation reserve enhancement program or conservation reserve programs would be beneficial
- Utilize incentive-based programs to:
    - Increase soil organic matter content (agricultural land)
    - Reduce nutrient (nitrogen and phosphorus) loading through irrigation efficiency and improved nutrient application methods
    - Increase irrigation efficiency, including improved irrigation water management

- Plant alternative crops to use less water
- Encourage high residue farming
- Improve farming practices (no till methods and more organics into the soil)
- Provide compensation for floodway easements
- Prevention of contamination when flooding occurs

Water Issues to be Addressed: This strategy would seek to address water quantity concerns through increasing agricultural efficiency and water quality concerns through reducing inputs to water systems. This strategy could also address flooding concerns.

Benefits: Programs on agricultural land are anticipated to benefit agricultural outputs, water conservation, instream flows, and flooding resiliency in a reasonably short time frame.

Concerns: Strategies and projects are dependent on the willingness of landowners to participate, many of whom are already implementing various irrigation efficiency methods. It is unknown if there are additional landowners who would be willing to participate in this work and whether the UGRRW Partnership will be able to assist with these existing efforts.

Methods to Address Concerns: Work collaboratively with partners who are already implementing this work to see where the UGRRW Partnership can be the most helpful. These may include NRCS, BOR, Oregon State University (OSU) Extension Office, private landowners, and others.

Specific Subwatersheds: Those utilized for agriculture - subwatersheds 3, 4, 5, 6, 7, and 8.

Action Agency(ies): Union County Farm Bureau, Union SWCD, NRCS, and ODA.

Resources Needed: Partner time, land, and funding.

Research Needs/Data Needs: Need to determine highest priority needs for UGRRW Partnership members and find landowners interested in projects.

Next Steps:

- Convene an *ad hoc* working group to determine where the UGRRW Partnership can assist in accomplishing agricultural land management goals.
- Determine a source and obtain funding if needed.
- Investigate the possibility of using existing irrigation ditches to reduce or ameliorate flooding impacts. Assess legal requirements and ditch capacity to receive and store flood flows. If this step yields positive results, convene a meeting with the OWRD Watermaster to explore the feasibility, regulatory, and legal requirements to create an operational method for utilizing ditches during flooding. It is noted that currently ditches are established in the UGRRW solely for irrigation and stock water and that opening ditches in attempts to relieve flooding could create liability for flood damage to those that would

not otherwise flood. If formal flood control is desired, then formation of a Chapter 553 Water Control District or Chapter 554 Corporation can be considered. Generally, the maximum capacity of diversion ditches would only account for a small percentage of flood flows and would not have a significant effect on reducing flood stage events.

3. Data Collection, Monitoring, and Research

Objectives this Strategy May Address:

- Objective 1.1 - Reduce current surface water deficit
- Objective 1.2 - Fill data gaps
- Objective 2.1 - Reduce each water quality issue
- Objective 2.2 - Fill data gaps
- Objective 3.1 - Complete a groundwater study
- Objective 4.2 - Implement mitigation measures identified in plan

Recommended Action 1: Develop and fund a plan (or set of plans) for monitoring and collecting data to fill data gaps identified in the Steps 2 and 3 reports as well as through Step 4 strategy development. Collect additional data to expand existing data sets, inform solution actions and designs, evaluate effectiveness of strategies, and improve forecasting (long-term).

- Surface Water Data Collection
    - Identify locations of all stream gages and determine additional beneficial locations
    - Install and operate additional stream flow gauging stations in strategic locations
    - Coordinate interagency data sharing (specifically of stream flow gauge data)
- Groundwater Data Collection and Monitoring
    - Improve our understanding of the data already collected through coordination with Oregon Health Authority and OWRD
    - Develop a network of observation wells to improve understanding of groundwater movement and variability throughout the basin by determining the geometry of the water table over time
    - Characterize the hydrogeologic framework of the basin, and how varying landforms and lithologies relate to groundwater movement and storage
    - Improve groundwater quality monitoring - (nitrates, arsenic, coliform). This could include increasing the quantity of wells sampled, increasing the frequency of wells sampled, increasing the number of sampled analytes or a combination of these methods

  - Characterize and understand the groundwater resource, including an estimation of the annual groundwater budget, total storage and aquifer extent, seasonal variability in response to drought and usage draw, rate of change in groundwater elevation and flow direction

- Instream Flow Study (CTUIR and ODFW)
  - Gather data to improve estimates of actual requirements for instream beneficial use versus water rights withdrawal demand
- Develop an Instrumented Watershed (ODA and U.S. Forest Service [USFS])
  - Initiate discussion with Pacific Northwest scientists to better understand the possibilities for this kind of research at Starkey.
  - Enable more accurate and empirical representative water balance computations
  - Build a system dynamic model to facilitate the water balance as well as, over time, simulate functional watershed processes to achieve water quality goals and ecological resilience; for use in planning, testing physical, operational and management alternatives, and other goals; and include monitoring
  - Study paired forest plots (30 percent canopy reduction to allow for water storage - Starkey) in coordination with the USFS
- Improve On-farm Efficiency Monitoring and Modeling
  - Locate pilot project site or landowners where there is interest in efficiency monitoring

Recommended Action 2: Complete research (identified as non-data collection activities) on identified data gaps from Steps 2 and 3 reports as well as outstanding questions identified during Step 4 strategy development. When possible, research topics will be linked to other strategies to improve results/support feasibility analysis. Research topics include:

- Historical Research
  - Reservoir research - begin by reviewing prior reservoir feasibility studies provided by Stakeholders
  - Flooding and fire histories (recorded and oral)
  - Collect anecdotal information from users to see what parts of the UGRRW have issues with flooding and drought
- Water Quality Research
  - Identify areas for improvement in data collection and analysis related to water temperature, dissolved oxygen, flow limitations, nutrients, and bacteria concerns
  - Investigate potential sources of pollutants and solutions to reduce input
  - Re-examine DEQ 303(d) standards to determine if the UGRRW Partnership should advocate for them to be changed

- Water Quantity Research
    - Use existing studies of area geology (i.e., Hampton and Brown; Ferns and McConnell) and pair this information with groundwater wells to verify accuracy. It is noted that there is limited information available from wells for this type of situation. Most wells are fairly shallow as compared to the overall depth of aquifers in the basin, though there are few that penetrate through the sedimentary sequence to the volcanic rock that composes the bottom of the hydraulic system.
    - Review demand and supply calculations (including instream water rights). Work to answer questions relating to summer instream flows necessary for a healthy fishery, as well as the discharge of channel-forming flows necessary during the winter for ecological function
- Nonstationarity Research (ODA and/or Climate Impacts Research Consortium)
    - Expand investigation into long-term data records for temperature, precipitation, and snow water equivalent to better understand basin hydrology and changes, including trends, that may be observed
    - Compare to results of model simulations of historical records
    - Review projections, including literature reviews
    - Organize periodic nonstationarity workshops (with specific and focused topics); cover approximately two to three related topics at each workshop every one to two years
    - Collaborate with researchers to conduct investigations into and develop new methods for conducting hydrologic analyses that incorporate nonstationarity of hydrology and climate.
- Identify all data gaps from the Steps 2 and 3 reports and categorize/associate them with strategies to ensure they are addressed

Water Issues to be Addressed: This set of data collection and monitoring strategies would support measurement of surface water flows (to enable better management for reducing the late season deficit) and improve groundwater information for better management. The research strategies would supplement other strategies by providing needed background information to inform these strategies. It is possible that these research topics would only be carried out on an as needed basis, by *ad hoc* groups. It is noted that the Grande Ronde River and Catherine Creek already have near real-time flow data stations to determine available water, and that the challenge in the management scheme is knowing water diversion quantities and locations.

Benefits: Improved flow data could enable real-time decision-making, instream flow information could inform restoration and conservation strategies and a watershed with a higher resolution of measurement instruments could provide new and improved information for decision-making. Focused research could benefit strategy development. A better understanding of non-structural storage and functional uplands can lead to better management of water resources.

Concerns: Cost, lack of agency resources for data collection, analysis, and distribution; concern about use of new data (especially groundwater information); and undefined outcomes from research.

Methods to Address Concerns: Identify and prioritize top research questions/data gaps and methods, obtain funding, create and prioritize the individual data collection strategies, research potential outcomes of groundwater monitoring to determine benefit to the UGRRW Partnership Stakeholders, tie research elements to specific projects, reach out to agencies to identify ways to support additional data collection/research.

Specific Subwatersheds: All.

Action Agency(ies): CTUIR, ODA, OWRD, NRCS, Eastern Oregon University, ODFW, OSU, DEQ, Columbia River Inter-Tribal Fish Commission, USFS Pacific Northwest Research lab (La Grande), and Grande Ronde Model Watershed (GRMW). Oregon agencies that are a member of the STREAM TEAM could be contacted to identify agencies/resources most pertinent to prioritized research questions.

Resources Needed: Funding, technical expertise, and partner capacity.

Research Needs/Data Needs: These data collection and monitoring ideas require planning and further vetting.

Next Steps:

- Revisit the Steps 2 and 3 reports and identify, categorize, and prioritize data gaps for implementation in the Step 5 Strategic Action Plan.
- Surface Water Flows - Obtain a technical assistance grant from OWEB (consider a partnership with GRMW)
- Groundwater Study - Based on available funding and resources determine the size and scope of the study
- Instream Flow Study - Coordinate with the CTUIR and ODFW to see what resources are needed
- Develop Instrumented Watershed - Seek funding (determine an appropriate grant for this work)
- On-farm Efficiency and Monitoring - Coordinate with NRCS to see what is needed
- Convene nonstationarity *ad hoc* working group to further develop a research plan for this topic
- Convene *ad hoc* working group to identify gauge needs

4. Non-Structural Water Storage and Habitat Management

Objectives this Strategy May Address:

- Objective 1.1 - Reduce current surface water deficit
- Objective 2.1 - Reduce each water quality issue
- Objective 3.2 - Implement plan based on study results
- Objective 4.2 - Implement mitigation measures identified in plan

Recommended Action: Study the best way to assist partners with increasing water storage capacity through natural processes using non-structural means. Actions to be reviewed include:

- Literature review (Use ATLAS and other tools [e.g., Beaver Restoration Assessment Tool, monitoring data] to identify priority project sites and determine how the UGRRW Partnership can assist)
- Learn from past and on-going restoration efforts and monitoring in the UGRRW
- Upland Management
    - Upland restoration to improve water storage and release during low flow periods
    - Improve forest canopy to capture snowpack (store and use) - highest elevations are on USFS land
- Floodplain Management
    - Reconnect and restore floodplains
    - Levee setbacks
    - Levee removal
    - Beaver reintroduction
    - Floodplain restoration to increase water storage and reduce flood risk
    - Improve floodplain function
    - Reactivate sloughs for water storage and flood management
- Riparian Habitat Management
    - Promote a healthy riparian vegetation community to provide stream shading and bank stability
- Instream Habitat Management
    - Restore functional and stable channel geomorphology
    - Reduce and restore channel downcutting and increase bank storage capacity

- Wetland Management
    - Create new wetlands and re-establish old wetlands
    - Improve ability to store and filter water
    - Restore functional wetlands within the UGRRW Basin and protect wetland processes to store water and enhance low flow discharge
    - Restore wet meadows to increase water storage and reduce flood risk

Water Issues to be Addressed: This strategy would seek to improve late season stream flows, decrease water temperatures, recharge aquifers, and improve flooding resiliency.

Benefits: Improved watershed processes and hydrologic function of instream, upland, riparian, wetland, and floodplain areas. Positive impacts anticipated to be seen in surface and groundwater quantity and quality. Healthy uplands, reconnecting rivers to floodplains, side channels with functional riparian areas, and sloughs grassed with sedges have the potential to store water, increase low flow discharge, improve water quality, and improve fish habitat.

Concerns: Costs, landowner permission, and uncertain metrics.

Methods to Address Concerns: Obtain funding, work with UGRRW Partnership Stakeholders who are already implementing these strategies to determine where the UGRRW Partnership could assist.

Specific Subwatersheds: All.

Action Agency(ies): CTUIR, GRMW, Union SWCD, Trout Unlimited, ODFW, FWT, USFS, BOR, BPA, OWEB, NRCS, individual landowners, Union County.

Resources Needed: Funding, partner capacity, and willing landowners.

Research Needs/Data Needs: Prioritization of actions and locations and site-specific data to characterize existing conditions and needed improvements.

Next Steps:

- Convene an *ad hoc* working group.
- Use ATLAS and other tools (e.g., Beaver Restoration Assessment Tool, monitoring data) to identify priority project sites and determine how the UGRRW Partnership can assist.

5. Land Management - Public Land

Objectives this Strategy May Address:

- Objective 1.1 - Reduce current surface water deficit
- Objective 3.2 - Implement plan based on study results

- Objective 4.1 - Develop Natural Hazards Mitigation Plan
- Objective 4.2 - Implement mitigation measures identified in plan

Recommended Action: Study the feasibility of assisting in public lands management to improve water quality and quantity. Potential efforts to explore include:

- Support Collaborative Forest Partnership Projects
    - Identify the best methods to support the Forest Collaborative and federal, state, and local forest managers
- Restoration Projects of Interest to the UGRRW Partnership (that will improve water quality and quantity)
    - Increase soil organic content
    - Identify and protect existing high-quality habitats that are important for water quality or quantity.
    - Restore floodplain-riparian-instream connectivity and complexity
    - Upland spring, wetland, and meadow protection
- Vegetation Management (to improve water quality and quantity available)
    - Grazing management on federal lands (range management of wild and domestic ungulates)
    - Timber management on federal lands (management of forest canopy)
    - Upland land management
    - Vegetation management - opportunity and costs for each type of project
    - Fire management
- Sediment and Erosion Management
    - Road management for allowing runoff to recharge groundwater locations, sizing culverts appropriately, and decreasing sediment yield
    - Monitor uplands for erosion (sediment)
    - Buffer zones (review all City and County riparian buffer zone requirements/standards and see how well they are being implemented)

Water Issues to be Addressed: This strategy could seek to increase storage capacity for surface water quantity and improve the quality as well. These activities could benefit summer through late fall instream flow, water quality, and provide mitigation for issues including flooding, fire, drought, and climate change (Halverson et al. 2018).

Benefits: Protection of high quality habitats and water resources in high elevation and water source portions of the watershed. Proper grazing and forestry management has the potential to build soil organic matter and build more resilient riparian areas in a relatively short time frame.

Concerns: Significant permitting requirements associated with work on federal lands and other public properties, challenge to find areas where support could be provided by the UGRRW Partnership.

Methods to Address Concerns: Work with federal, state, and local public land managers to determine permitting efficiencies and find where the UGRRW Partnership could best assist in ongoing or new work. It is noted that while USFS is one of the largest public land managers in the UGRRW, other state and local governments manage public lands that can be significant areas to focus actions and meet watershed goals.

Specific Subwatersheds: Primarily 4, 5, 7, and 8 (upstream of the valley).

Action Agency(ies): USFS, Bureau of Land Management, ODFW, Oregon Department of Forestry, NRCS, Union County, cities with land ownership.

Resources Needed: Partner time, funding, coordinated goals and objectives.

Research Needs/Data Needs: Greater understanding of current projects and gaps on public lands in the UGRRW Basin.

Next Steps: Convene *ad hoc* working group and meet with USFS and other public land agency staff to inventory all existing projects and identify areas to assist with actions to meet specific water resource goals. Utilize information from other groups including Northern Blues Forest Collaborative, My Blue Mountain Woodlands working group, and Northern Blues Cohesive Wildfire Strategy group.

6. Infrastructure/Land Modification

Objectives this Strategy May Address:

- Objective 1.1 - Reduce current surface water deficit
- Objective 3.2 - Implement plan based on study results
- Objective 4.2 - Implement mitigation measures identified in plan

Recommended Action: Study potential actions to increase flow through the Grande Ronde Valley to reduce flooding while protecting water quality and baseflows during summer through late fall. Potential actions include:

- Create a flow model to determine the benefit of maintenance (sediment removal) from Rhinehart Gap and other flow pathways through the valley
- Investigate and identify flow constriction points that create backwater and specific areas of flooding where floodplain modification may reduce impacts

- Evaluate options for development of a levee system for flood control (coordinate with the USACE)
- Evaluate the potential for constructing a parallel flood channel to alleviate flooding issues

Water Issues to be Addressed: This strategy would seek to mitigate flooding issues.

Benefits: Reduced impact on properties from flooding and less impeded stream flows.

Concerns: Potential impacts to stream channels and ability of the floodplain to absorb water and recharge groundwater aquifers. There is also the potential to negatively impact downstream landowners. Other concerns include landownership issues, permitting challenges, lack of support from land users, potential landscape scale changes with a new levee system, cost, flood control, aquatic and terrestrial habitat alteration and degradation, negative impacts of channelization that reduce floodplain-channel habitat connectivity and complexity, erosion, infrastructure ownership, and maintenance costs. The location of some existing infrastructure (roads, buildings, levees, etc.) in the active floodplain and on potential riparian areas and wetlands may inhibit hydraulic functions.

Methods to Address Concerns: Modeling and design-level evaluations should include studies about recharge and channel change impacts

Specific Subwatersheds: Low elevation subwatersheds 4, 5, 6, and 7.

Action Agency(ies): USACE, BOR, UGRRW Partnership.

Resources Needed: Funding, technical expertise, landowner coordination and willingness.

Research Needs/Data Needs: Hydraulic modeling outputs, inventory of physical form and surface elevation details. Need to determine if proposed actions would have a positive impact on flooding.

Next Steps:

- Set up a meeting with the USACE to determine federal options for flood management.
- Funding application for flood reduction study including:
  - Create a hydraulic model to determine the benefit of maintenance (sediment removal) from Rhinehart Gap and other flow pathways through the valley.
  - Evaluate options for developing a levee system for flood control.
  - Evaluate the potential for construction of a parallel flood channel to alleviate flooding issues.

7. Administrative Actions

Objectives this Strategy May Address:

- Objective 1.1 - Reduce current surface water deficit

- Objective 3.2 - Implement plan based on study results
- Objective 4.1 - Develop Natural Hazards Mitigation Plan
- Objective 4.2 - Implement mitigation measures identified in plan
- Objective 4.3 - Create an adaptive management protocol to apply new climate change data to goals

Recommended Action: Study the feasibility of developing a coordinated suite of publicly available actions to utilize existing laws to use water for different purposes in different times of the year (water market/management framework). Administrative actions would be voluntary and non-regulatory.

- Evaluate a water market/management framework with the following options included:
    - Outline methods to utilize water reservations (for storage strategies)
    - Cross basin transfers (currently prohibited in the Basin Program Rules)
    - Voluntary water right leases and transfers, including split-season instream leases
    - Method of allocation of conserved water
    - Method to obtain new instream water rights and instream flow protections
    - Minimum flow agreements
    - Source water exchanges
    - Wetland mitigation bank (or potentially a stream mitigation bank to incentivize wetland creation and restoration)
    - Water bank
    - Incentives to switch to crops that use less water
    - Explore feasibility of replacing surface water deficits with groundwater

Water Issues to be Addressed: This strategy would seek to move water through the watershed to be used in the most efficient way to optimize supply availability and water source resiliency for all beneficial uses in the UGRRW. Potential water issues to be addressed include surface water deficits, instream demands, and agricultural demands.

Benefits: Improved access to information and ability to use water for optimal outcomes. Currently, these agreements are completed on an individual "as-needed" basis, which is time consuming; a water market/management framework would be difficult to set up but more efficient in the long run. It is noted that these kinds of programs require a much higher level of measurement and water use accountability than is currently present in the UGRRW, and that there is currently a lack of support for additional diversion measurement. Many administrative actions are already available under current water law, for example reliable water rights can be leased or transferred from

upstream areas to meet downstream water demand. Water rights leasing and transfer could address water shortages as early as next season.

Concerns: Permitting, costs, and ability to find willing water rights holders.

Methods to Address Concerns: Create a framework for using administrative actions to find the most efficient way to optimize supply availability and water source resiliency for all beneficial uses in the UGRRW; determine landowner willingness to engage in these projects before significant resources are expended.

Specific Subwatersheds: Mainly agricultural-focused subwatersheds 4, 5, 6, 7, and 8.

Action Agency(ies): OWRD, BOR, NRCS, FWT, DSL, USACE, and ODFW.

Resources Needed: Funding and partner capacity.

Research Needs/Data Needs: Would need to determine which element would be important to include in the framework, and whether people would be likely to use these tools if they were developed.

Next Steps:

- Because many of these actions require the voluntary participation of water rights holders, they will be surveyed first to see if there is interest in some of these actions before allocating additional resources to developing water market frameworks
- Determine the best funding source for whatever work is needed as a result of the water rights holder survey
- Conduct a feasibility study/develop draft water market framework
- Obtain funding to conduct research on legal flood reduction measures for cities and landowners (i.e., County planning grant, Federal Emergency Management Agency [FEMA])

8. Land Management - Municipal Land

Objectives this Strategy May Address:

- Objective 1.1 - Reduce current surface water deficit
- Objective 3.2 - Implement plan based on study results
- Objective 4.2 - Implement mitigation measures identified in plan

Recommended Action: Coordinate with municipalities to determine how the UGRRW Partnership could best assist in providing support to multiple municipal systems and land to improve water quality and quantity. The UGRRW Partnership would first determine if such a plan would be

supported by municipalities. The plan could evaluate the potential to implement the following practices in municipalities. Ideally, actions will be taken in the seven cities, by self-supplied industrial users (SSIU), and unincorporated users, to increase efficiency of water use and distribution.

- Require bioswales (vegetation infiltration of stormwater) for new construction; add new bioswales to increase infiltration.
- Find additional locations that would benefit from filter strips.
- Review point source control technology and look for efficiencies.
- Improve municipal water efficiency and redundancy including needed infrastructure improvements.
- Improve existing stormwater facilities (pipes and ditches) to help channel and control water flow; look into the potential for stormwater collection for reuse.
- Nonpoint source control - Reduce impervious surfaces and direct runoff. Depave.org is a non-regulatory option that may be accessed.
- Review potential to develop or update Water System Master Plans, Water Management and Conservation Plans, or Water Curtailment Plans for each city and a coordinated approach to conservation, system testing, and maintenance, which could help smaller cities by producing conservation and long-term infrastructure planning to reduce the impact of potential demand increases.
- Look for opportunities for water reuse.
- Evaluate feasibility of non-traditional water supply techniques including rainwater, stormwater, greywater, and/or other novel and innovative technologies.

Water Issues to be Addressed: This strategy would seek to reduce water use for municipalities, SSIU, and unincorporated users, and, thus, decrease groundwater use.

Benefits: Reduced pressure on groundwater aquifers and improved sustainability of municipal infrastructure.

Concerns: Many cities are already doing this work; the difficulty is determining how to assist in this work, the Municipal Survey from the Step 3 report will be used as a starting point to determine municipal needs (see UGRRW Step 3 report, page 3-24 for details).

Methods to Address Concerns: Meet with UGRRW Partnership Stakeholders that are engaging in this work to determine needs, efficiencies, and how the UGRRW Partnership can best assist with new and ongoing work. This will be accomplished during the development of the Step 5 Strategic Action Plan.

Specific Subwatersheds: Watersheds where cities are located - subwatersheds 4, 5, 6, and 7.

Action Agency(ies): Cities' and the County's public works departments and OWRD.

Resources Needed: City plans and maps to determine locations for additional efforts.

Research Needs/Data Needs: Determine what efforts could be combined over multiple cities to benefit.

Next Steps:

- Convene a municipality *ad hoc* working group to prioritize actions to benefit multiple municipalities and obtain funding through coordinated efforts.

9. Outreach and Education

Objectives this Strategy May Address:

- Objective 1.1 - Reduce current surface water deficit
- Objective 2.1 - Reduce each water quality issue
- Objective 3.2 - Implement plan based on study results

Recommended Action: Update the UGRRW Partnership's outreach plan to include support or action on the following items:

- Promote awareness of local DEQ Environmental Cleanup Site Information Database-listed sites (potentially through posting a link on the County's website).
- Meet with the DEQ to discuss their pilot data sharing project.
- Promote the recycled chemical program (for pesticides from agricultural and municipal sources). This could potentially be done through fliers, supporting agencies working on this, or posting a link on the County's website.
- Inform the public about best practices for lawn care (i.e., inform the public about the risks of over-application of lawn care products and fertilizers flow to the creeks). This could potentially be done through new homebuyer packets, fliers, and links on County's website.
- When relevant, conduct public outreach related to local toxic algae blooms (potentially through newspaper articles, radio ads, or public postings).
- Distribute relevant information from city water reports and additional information such as how and where people can get well water tested to unincorporated users in the County (determine the best way to do this with the City of La Grande). Potentially contact the Portland Water Bureau for outreach material ideas.
- Support educational events promoting conservation farming practices (discuss the best method of support with OSU Extension Office of Union County).
- Develop outreach materials related to improving municipal water conservation and use efficiencies. Potentially contact the Portland Water Bureau for outreach material ideas.
- Determine interest in supporting landowner tours and hands-on workshops.

Water Issues to be Addressed: This strategy would seek to provide water quality and quantity-related information to the public. It could address water quality concerns and potentially late season water quantity concerns.

Benefits: Relatively low cost, good methods to inform end water users, impacts to individual decision-making.

Concerns: Relatively minimal concerns; however, this strategy will require coordination and willingness of organizations to take on additional work.

Methods to Address Concerns: Determine if a stakeholder has an interest in leading this work. Each *ad hoc* working group could identify education/outreach needs for their specific issue.

Specific Subwatersheds: All, primarily the places where people live.

Action Agency(ies): Cities, DEQ, Union County, and OSU. The Portland Water Bureau may also be contacted (via DEQ contacts) for resources and ideas.

Resources Needed: Time and funding.

Research needs/Data Needs: Need to understand whether tours and workshops would be beneficial, on what topics, and to what audience.

Next Steps:

- Convene an outreach *ad hoc* working group to revise the UGRRW outreach plan.

Flooding (Actions have been Integrated into Other Strategies)*

*This section summarizes the outcomes of an *ad hoc* Stakeholder meeting specifically on flooding. This meeting did not address other natural hazards such as drought, fire, or climate change, although these are likely to impact water supply sources (spatially and temporally) and are addressed in other strategy summaries discussed above (see Strategy Summaries 3 and 5). This summary is retained to document the specific issues discussed at the flooding meeting.

Recommended Action: Reduce catastrophic flooding impacts through preventative measures and store water for later use in the year. Specifically, through the following actions:

- Inventory and assess constriction points and specific areas of flooding within the valley. Complete a detailed hydraulic model for the Grande Ronde River and Catherine Creek in the valley to identify areas of concern.
- Conduct legal analysis and estimate of ditch capacity to affect flooding,
- Ditch Meeting: If the first step yields positive results, develop a process for opening ditches when flooding occurs. This would allow water to flow through the system, rather than flooding upland portions of the watershed. The first step would be convening a meeting of

the OWRD Watermaster and the president of each ditch company to explore the possibility of using this approach. It is noted that currently ditches are established in the UGRRW solely for irrigation and stock water and that opening ditches in attempts to relieve flooding could create liability for flood damage to those that would not otherwise flood. If formal flood control is desired, then formation of a Chapter 553 Water Control District or Chapter 554 Corporation can be considered. Generally, the maximum capacity of diversion ditches would only account for a small percentage of flood flows and would not have significant impact on reducing flood stage events.

- Feasibility Study: Apply for funding for a Feasibility Study to identify potential water storage locations, including underground storage and high elevation aboveground storage both on- and off-channel (OWRD and OWEB).
- Gauges and Data Sharing: Determine locations where new flow gauge installations would be beneficial. Potential ideas include Little Creek, Five-Points Creek, and Rhinehart Gap. Coordinate data sharing from agencies operating different gauges. This will allow for a better early warning system for flooding and other concerns. It is noted by OWRD that there is already a gauge station on Five-Points Creek at Hilgard. In the opinion of the OWRD Watermaster, there is adequate near real-time data on Grande Ronde River and Catherine Creek above the valley for flood warning. National Weather Service and local emergency management have been using these tools for more than 20 years, as well as some farmers. Rhinehart Gap is a poor location to maintain a gauging station for flow monitoring; the BOR may currently be operating one at the Rhinehart Bridge.
- Legal Research and Outreach: Address topics including, “What can we do to mitigate flooding risks when we see it? What can cities do for flood prevention? What are legal options for private landowners? Can old sloughs be cleaned out? Can we mitigate the risks of flooding quickly through opening ditch systems to allow water through when they are closed? Who has this authority?”
- Research non-structural storage options (see Strategy 4 above).

Water Issues to be Addressed: Strategies here will seek to address natural hazards concerns focused on spring flooding in the valley and surface water deficit that contributes to late season water shortages for instream and agricultural needs.

Benefits: Reduced flooding impacts on property and increased water stored for late season uses.

Concerns: Difficulty finding a suitable location to store water, difficulty coordinating multiple ditch companies, landowner willingness.

Methods to Address Concerns: Feasibility study, Stakeholder meetings, inventory of existing flooding locations and causes, development of a hydraulic model.

Specific Subwatersheds: Central parts of the UGRRW, including subwatersheds 3, 4, 5, and 6.

Action Agency(ies): OWRD, DSL, and UGRRW Partnership.

Resources Needed: Funding, technical expertise.

Research Needs/Data Needs: Legal research for landowner options, current gauge locations/ideal additional locations.

Next Steps:

- Conduct legal analysis and estimate of ditch capacity to affect flooding. If this step yields positive results, convene a ditch meeting with the OWRD Watermaster to explore the possibility of developing a system for ditch opening during flooding.
- Apply for funding for a Feasibility Study to identify potential water storage locations including underground storage and high elevation aboveground storage both on- and off-channel (OWRD and OWEB).
- Convene an *ad hoc* working group to identify gauge needs.
- Obtain funding to conduct research on legal flood reduction measures for cities and landowners (i.e., County planning grant, or FEMA grant)

Opportunities Identified for Integrating Strategies

As is evident by the commonality of seeking funding for a Feasibility Study and convening *ad hoc* working groups in many of the strategy summaries, it is anticipated that there will be many opportunities to integrate these strategies. These opportunities will be further refined in the Step 5 Strategic Action Plan, but preliminary integration ideas include:

- Working with the municipalities to apply for project funding together.
- Completing a Feasibility Study including aboveground on-channel, off-channel, and underground storage at the same time.
- Working with the USFS on a potential instrumented watershed project to include the UGRRW.
- Complete research and data collection tasks in conjunction with other strategies.

Prioritized/Tiered List of Strategies

The final list of prioritized strategies is as follows:

- Built Storage (Aboveground Storage, Underground Storage)
- Land Management - Agricultural Land
- Data Collection, Monitoring, and Research
- Non-Structural Water Storage and Habitat Management
- Land Management - Public Land
- Infrastructure/Land Modification
- Administrative Actions

- Land Management - Municipal Land
- Outreach and Education

The top five strategies above will be prioritized in the Step 5 Strategic Action Plan.

Recommended Actions

See individual strategy summaries for each major strategy category for the recommended actions (first item "recommended actions" and last section "next steps").

Next Steps

The next steps will be to refine these strategy summaries into a final Strategic Action Plan for funding and implementation (Step 5 report).

4.0 - Public Participation and Outreach

This section provides an overview of the total number of meetings held (broken down by work group/ committee), workshops/field trips held, associated conferences attended, and a web link to an archive of the meeting notes. It took hundreds of hours to develop this report, with representation and participation from more than 25 diverse water interests. Meetings were publicized through newspaper advertisements, radio interviews, and on the Union County website. Project progress was presented at several meetings throughout the area.

Step 1 Meetings

- March 22, 2016
- June 29, 2016
- June 30, 2016
- August 4, 2016
- August 30, 2016 - Steering Committee Kickoff
- September 6, 2016
- September 20, 2016 - Steering Committee Meeting
- October 6, 2016 - Stakeholder Committee Meeting
- October 18, 2016 - Steering Committee Meeting
- November 2, 2016 - Stakeholder Committee Meeting
- November 29, 2016 - Steering Committee Meeting

Step 2 Meetings

- January 10, 2017 - Water Supply Technical Committee No. 1
- January 11, 2017 - Steering Committee Meeting
- January 24, 2017 - Water Supply Technical Committee No. 2
- February 21, 2017 - Water Supply Technical Committee No. 3
- February 22, 2017 - Stakeholder Committee Meeting No. 4
- March 14, 2017 - Water Supply Technical Committee No. 4
- March 16, 2017 - Steering Committee Meeting
- April 3, 2017 - Water Supply Technical Meeting and Steering Committee Meeting
- April 12, 2017 - Stakeholder Committee Meeting No. 5
- May 24 through 25, 2017 - Bend Meeting
- June 6, 2017 - Water Supply Technical Committee Meeting No. 6
- June 21, 2017 - Stakeholder Committee Meeting No. 6

- July 28, 2017 - Field Trip
- August 8, 2017 - Technical Committee Meeting No. 7 and Steering Committee
- August 30, 2017 - Water Supply Technical Committee and Steering Committee Meeting
- September 6, 2017 - Stakeholder Committee Meeting

Step 3 Meetings

- September 19, 2017 - Technical and Steering Committee Meeting
- October 10, 2017 - Technical Committee Meeting
- October 25, 2017 - Technical and Steering Committee Meeting
- October 31, 2017 - Agricultural Work Group Meeting
- November 6, 2017 - Instream Work Group Meeting
- November 8, 2017 - Stakeholder Committee Meeting No. 9
- November 21, 2017 - Technical Committee Meeting
- December 13, 2017 - Natural Hazards Work Group Meeting
- December 14, 2017 - Agricultural Work Group Meeting
- January 8, 2018 - Agricultural Work Group Meeting
- January 16, 2018 - Stakeholder Committee Meeting No. 10
- January 23, 2018 - Technical Committee Meeting
- February 7, 2018 - Stakeholder Committee Meeting No. 11
- February 14, 2018 - Agricultural Work Group Meeting
- February 20, 2018 - Technical Committee Meeting
- March 13, 2018 - Stakeholder Committee Meeting No. 12
- April 18, 2018 - Stakeholder Committee Meeting No. 13
- August 15, 2018 - Stakeholder Committee Meeting No. 14
- September 17, 2018 - Technical Committee Meeting
- September 19, 2018 - Stakeholder Committee Meeting No. 15
- October 24, 2018 - Steering Committee Meeting
- October 25, 2018 - Technical Committee Meeting
- November 8, 2018 - Stakeholder Committee Meeting and Field Trip No. 16
- December 21, 2018 - Technical Committee Meeting
- January 16, 2019 - Stakeholder Committee Meeting No. 17 (combination meeting with Step 4 below)

- March 20, 2019 - Stakeholder Committee Meeting No. 18 (combination meeting with Step 4 below)

Step 4 Meetings

- January 16, 2019 - Stakeholder Committee Meeting No. 17
- January 25, 2019 - Steering Committee Meeting
- February 8, 2019 - Steering Committee Meeting
- March 20, 2019 - Stakeholder Committee Meeting No. 18
- April 17, 2019 - Stakeholder Committee Meeting No. 19
- May 1, 2019 - Stakeholder Committee Meeting No. 20
- May 15, 2019 - Stakeholder Committee Meeting No. 21
- June 12, 2019 - Stakeholder Committee Meeting No. 22
- July 17, 2019 - Stakeholder Committee Meeting No. 23
- September 25, 2019 - Stakeholder Committee Meeting No. 24
- November 13, 2019 - Stakeholder Committee Meeting No. 25
- December 11, 2019 - Stakeholder Committee Meeting No. 26
- January 8, 2020 - Stakeholder Committee Meeting No. 27
- February 26, 2020 - Stakeholder Committee Meeting No. 28
- April 15, 2020 - Stakeholder Committee Meeting No. 29
- May 20, 2020 - Stakeholder Committee Meeting No. 30
- June 24, 2020 - Stakeholder Committee Meeting No. 31
- July 15, 2020 - Stakeholder Committee Meeting No. 32
- September 16, 2020 - Stakeholder Committee Meeting No. 33
- October 14, 2020 - Stakeholder Committee Meeting No. 34
- November 18, 2020 - Stakeholder Committee Meeting No. 35
- December 9, 2020 - Stakeholder Committee Meeting No. 36

Meeting materials and notes are available at: http://union-county.org/planning/place-based-integrated-water-resources-planning/

5.0 - References

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APPENDIX A
Complete Strategy List

Major Strategy Categories

(Organized from lists below: 13 Strategies (in red) to be ranked/reviewed by stakeholders, sub-strategies (in black) provided, but not ranked/reviewed separately)

- **Storage - Aboveground-Off Channel**
  - Existing sloughs
  - New dams/reservoirs
  - Deepen existing reservoirs
  - Raise the storage levels in existing reservoirs
  - Wet meadows
  - Wetlands
  - Enlarge/deepen existing ditches
  - Capture snowpack (store and use)
  - New linear storage
- **Storage - Aboveground-On-Channel**
  - New On Channel dam (storage)
  - Reroute stream flows during highwater for storage and recharge
- **Storage - Underground Storage**
  - Aquifer Storage and Recovery
  - New belowground reservoir
  - Aquifer storage and recovery in confined alluvial aquifers
  - Infiltration galleries (city areas and other areas)
  - Use floodwater, pump it into an aquifer and use it later
  - Recharge of basalt wells
  - Recharge of alluvial wells
- **Research**
  - Reservoir Research
  - Flooding and fire oral histories
  - Use Hampton and Brown study of area geology and pair it with groundwater wells to verify accuracy
  - Collect anecdotal information from users to see what parts of the watershed have issues
  - Are there high mercury levels?
  - Nitrate abatement needed?
  - Reexamine 303(d) standards to determine if we should advocate for them to be changed
  - Review demand and supply calculations (including instream water rights)
  - Fill data gaps identified in step 2 and 3 repots
- **Data Collection**
  - Install flow gages
  - Coordinate interagency data sharing
  - Gather data to improve estimates of actual use versus water rights
  - Improve on farm efficiency monitoring and modeling
  - Systematic sampling of groundwater wells
  - Characterize and Understand the Groundwater Resource (rate of change, flow direction)
  - Study paired forest plots (30% canopy reduction to allow for water storage – Starkey)

- **Monitoring**
  - Monitoring – groundwater quality (nitrates, arsenic, coliform) in addition to surface water quality
  - Toxic algae blooms (testing, nutrients, temperature)
  - Spatially distributed and long-term data collection (intensively monitored watershed)
- **Administrative Actions**
  - Meet with USACE (Levee Strategy) - invite to meetings
  - Utilize new water reservations
  - Utilize cross basin transfers
  - Split season leases
  - Develop a water market
  - Minimum flow agreements (ex: Lostine river, dixie creek - turn water off if below certain point)
  - Voluntary water lease transfers (ex: 15 mile "FAST" program, stop withdrawals when temperatures are predicted to be lethal for fish)
  - Source water exchanges – "bucket for bucket exchange"
  - Point source control
  - Develop a wetland mitigation bank
  - Review the economic sustainability of agriculture, consider advocating for government subsidies for crops that use less water
  - Support collaborative forest partnership projects
  - Replace surface water deficits with groundwater
- **Outreach and Education**
  - Awareness of ECSI listed sites
  - Promote recycle chemical program (for pesticides, ag and municipal)
  - Inform the public about best practices for lawn care (fertilizers flow to the creeks) outreach and education needed
  - Public outreach for toxic algae blooms
  - We get a city water quality report – maybe watershed wide
- **Land Management – Public Land**
  - Raise organic soil content (forest land)
  - grazing management on federal lands (range management of elk)
  - timber management on federal lands (manage forest canopy)
  - Upland land management
  - Road management for allowing runoff to recharge groundwater, locations, culvert sizing, surfaces (decrease sedimentation through management)
  - Monitor uplands for erosion (sediment)
  - Invasive species management
  - Buffer Zones
  - Vegetation management – opportunity and costs for each type of project
  - Fire management
- **Land Management – Agricultural Land**
  - Raise organic soil content (agricultural land)
  - Reduce nutrient (nitrogen and phosphorus) loading through irrigation efficiency
  - Improve irrigation efficiency for agriculture uses
  - Plant alternative crops to use less water
  - Floodway easements for farmers
  - High residue farming

    - Prevention of contamination when flooding occurs
    - Improve farming practices (no till methods, more organics into the soil)
- **Land Management – Municipal Land**
    - Bioswales (vegetation infiltration)
    - Filter strips
    - Improve municipal water efficiency (including needed infrastructural improvements)
- **Habitat Management**
    - Reconnect and restore floodplains
    - Enhance riparian vegetation and stream shading
    - Upland restoration
    - Stream restoration (restore channel morphology)
    - Beaver reintroduction and beaver dam analogues
    - Alpine meadow restoration
    - Create new wetlands and reestablish old wetlands
- **Infrastructure/Land Modification**
    - Open up the valley
    - Construct Levee System
    - Levee Setbacks
    - Pump flood water for storage
    - Construct a Parallel Flood Channel to alleviate flooding issues
    - Microhydroelectroc power
    - Control warm water (thermal refuge in winter, divert for later use)

Natural Hazards Strategies List

(Developed by Stakeholders on 4.17.2019)

STORAGE

Capture surface water during high flows for flood control and use later in the season. Ideas include:

- **Reservoir research** – talk to Baker County about flooding changes after reservoirs were built. Did Baker County experience flooding prior to creating reservoirs for flood control? How did it work in that basin? How did it work in the Burnt River, that reservoir is managed for flood control.
- **Aboveground reservoirs** for both flood control and storage
- **High elevation reservoirs**
- **Storage in old sloughs** on the valley floor
- **Wet meadow storage** (store water throughout the whole valley in multiple locations)
- Reservoir – **OSU Hall Ranch** (currently moving medical springs to the highway (Storage capacity)

RESEARCH/DATA COLLECTION

Collect additional data or conduct research on topics with potential to reduce flooding and fire risks. Ideas include:

- Install a **flow gage** at Rhinehart Gap
- Coordinate interagency **data sharing** – snow levels reported in towns versus in mountains
- **Ask people** who have lived here a long time about historical flooding/fire events and strategies
- **Meet with USACE** to levee strategies for the region

LAND MANAGEMENT

Practices to improve agricultural land, grazing land, and forest land. Ideas include:

- **Raise organic soil content** – every 2.5% increase per square foot is 1 gallon of storage, in each acre increasing soil organic matter by 1% is 16,000 gallons of storage
- **Floodway easements** for farmers
- Proper **grazing management** on federal lands (range management of elk)
- Proper **timber management** on federal lands (manage forest canopy)
- Improve **farming practices** (no till methods, more organics into the soil)

- **Upland land management**
- **Prevention of contamination** when flooding occurs
- **Fire management**

HABITAT RESTORATION

Restoration of historical floodplains, rivers, and upland areas to reduce flood risks. Ideas include:

- **Restore State Ditch** – restoration could provide ¼ million AF of storage
- **Reconnect floodplains**
- Upland and stream **restoration**

INFRASTRUCTURE/ LAND MODIFICATION

Construct systems to slow the flow of water through the valley. Ideas include:

- **Open up Rhinehart Gap** – Rhinehart gap is grade control for the valley. Opening up Rinehart gap would slow water through the valley.
- **Levee System** Catherine Creek to Rhinehart
- **Levee Setbacks** – require lots of land to have enough capacity (small levees everywhere)
- **Pump water into Connelly Lake**
- State Ditch – Construct a **Parallel Flood Channel** to alleviate flooding issues

Surface Water Deficit Strategies List

(Developed by Stakeholders on 5.1.2019)

STORAGE/RECHARGE

Capture surface water during high flows and use later in the season. Ideas include:

- New **on-channel storage**
- New **off-channel storage** sites like Wolf Creek (9,000 AF of storage), Pilcher Creek (11,000 AF of storage), Thief Valley Reservoir (3,000 AF of storage), Phillips Creek Reservoir (63,000 AF of storage)
- New **above ground reservoir**
- New **below ground reservoir**
- **Aquifer Storage and Recovery** (ASR) (previous study found Upper Grande Ronde is not suitable, but Catherine Creek may be suitable for up to 10 cfs in summer (example: taking water from birch creek into a pipe and deep well)
- Reservoir combined with **microhydroelectric** power generation
- **Low elevation reservoir**
- **Deepen existing reservoirs**
- **Deepen existing ditches** (ex: the Orodell Ditch)
- **Raise the storage levels in existing reservoirs** (ex: Thief Valley, see data from BOR study)
- **Linear storage** – build canals or use old sloughs to provide off channel storage (ex: Treasure Valley and Foley Slough in Harney County)

RESEARCH/DATA COLLECTION

Collect additional data or conduct research on topics with potential to reduce the surface water deficit. Ideas include:

- Gather data to **improve estimates of actual use versus water rights**
- **Review demand and supply calculations** at later dates (permits need forecasting, check future conditions estimates)

LAND MANAGEMENT

Practices to improve agricultural land, grazing land, and forest land. Ideas include:

- Improve **grazing management and forest management** in the upper subwatersheds (7,8,4,5). Forest management practices including thinning for ecosystem resiliency and fire protection

- **Increase soil content organic matter** in mountains and watershed as well as on farms (ex: biochar, no till, cover crops).
- Improve **irrigation efficiency** for agriculture uses
- Improve **municipal water efficiency** (natural landscaping, water reuse)
- Improve on **farm efficiency monitoring and modeling** (ie: weather stations)
- **Plant alternative crops** to use less water

HABITAT RESTORATION

Restoration of historical floodplains, rivers, and upland areas to reduce flood risks. Ideas include:

- **Beaver reintroduction and beaver dam analogues** to mimic the work of beavers (ie: floodplain connectivity, slowing water)
- **Alpine meadow restoration**
- **Floodplain and stream restoration** and connection
- **Creation of wetlands**

POLICY ACTIONS

Utilizing laws or policies that govern water management to reduce surface water deficit. Ideas include:

- **Utilize new water reservations** (three in reserve in the basin for approximately 40,000 AF)
- **Utilize cross basin transfers** (ex: thief valley cross basin transfer)
- **Split season leases**
- Trade senior water rights upstream and junior water rights downstream (**water market**)
- **Invite USACE to meetings**
- Develop a **wetland mitigation bank** to encourage and monetize the creation of wetlands
- Review the economic sustainability of agriculture, consider advocating for **government subsidies** for crops that use less water
- **Replace surface water deficits with groundwater**

Groundwater Sustainability Strategies List

(Developed by Stakeholders on 5.15.2019)

STORAGE/RECHARGE

- **Recharge of alluvial wells**
- **Recharge of basalt wells**
- Aquifer storage and recovery in **confined alluvial aquifers**
- **Capture snowpack** (store and use)
- **Ladd Marsh** storage opportunities
- **Infiltration galleries** (city areas and other areas)
- **Use floodwater**, pump it into an aquifer and use it later
- **Aboveground storage**
- **Reroute stream flows during highwater** for storage and recharge (linear storage, Connely lake)

RESEARCH/DATA COLLECTION

- **Spatially distributed and long-term** data collection (intensively monitored watershed)
- **Systematic sampling** of groundwater wells
- **Community involvement** (OWEB grant to pay for local well measurements)
- **Characterize and Understand the Groundwater Resource** (rate of change, flow direction)
- **Collect anecdotal information from users** to see what parts of the watershed have issues
- Use **Hampton and Brown study** of area geology and pair it with groundwater wells to verify accuracy
- **Study paired forest plots** (30% canopy reduction to allow for water storage – Starkey)

LAND MANAGEMENT

- Support **collaborative forest partnership projects** (Beaver Creek, Vey Meadows, USFS)
- **Road management** for allowing runoff to recharge groundwater
- **Modify forest canopy** (ie: sheep creek) for water storage (30% reduction key)
- **Fire management**

HABITAT RESTORATION

- **Restore watershed functions** via floodplain connectivity and stream restoration

INFRASTRUCTURE/ CONSERVATION

- **Capture water from rooftop drains** in municipal areas and pond it up and use it
- **Reroute stormwater for storage**
- **Municipal conservation efforts** – low flow shower heads, low flow toilets, building codes for low use water
- **Pubic Outreach for unincorporated users**
- **Evaluate effectiveness of WMCP** conservation efforts
- **Plan for industrial reuse** if a large industry relocated to the watershed
- **More efficient summer delivery system,** but run water through leaky ditches in the winter to recharge groundwater (water ditches and soughs in the winter)

POLICY ACTIONS

- **Groundwater mitigation approach** (like Deschutes)
- **Define confined versus unconfined aquifers**
- Work with OTEC to learn about programs that **offset conservation costs**
- **Incentivize conservation**

Water Quality Strategies List

(Developed by Stakeholders on 6.12.2019)

STORAGE/RECHARGE

- Increase water storage (release cold water, speed up instream flows)
- Protect and improve groundwater recharge areas

RESEARCH/DATA COLLECTION

- Reexamine 303(d) standards to determine if we should advocate for them to be changed
- Monitoring – groundwater quality (nitrates, arsenic, coliform) in addition to surface water quality
- Toxic algae blooms (testing, nutrients, temperature)
- Nitrate abatement needed?
- Are there high mercury levels?

LAND MANAGEMENT

- Monitor uplands for erosion (sediment)
- Vegetation management – opportunity and costs for each type of project
- Invasive species management
- Reduce nutrient (nitrogen and phosphorus) loading through irrigation efficiency
- Buffer Zones
- Filter strips
- High residue farming
- Bioswales (vegetation infiltration)
- Road management, locations, culvert sizing, surfaces (decrease sedimentation through good management strategies)

HABITAT RESTORATION

- Enhance riparian vegetation and stream shading
- Reestablish wetlands
- Restore channel morphology

INFRASTRUCTURE/ CONSERVATION

- Control warm water (thermal refuge in winter, divert for later use)

POLICY ACTIONS

- Minimum flow agreements (ex: Lostine river, dixie creek - turn water off if below certain point)
- Voluntary water lease transfers (ex: 15 mile “FAST” program, stop withdrawals when temperatures are predicted to be lethal for fish)
- Source water exchanges – “bucket for bucket exchange”
- Point source control

OUTREACH AND EDUCATION

- Awareness of ECSI listed sites
- Promote recycle chemical program (for pesticides, ag and municipal)
- Inform the public about best practices for lawn care (fertilizers flow to the creeks) outreach and education needed
- Public outreach for toxic algae blooms
- We get a city water quality report – maybe watershed wide

APPENDIX B
Strategy Spreadsheet

Strategy Type

Description/Examples

Target Issue: Natural Hazards

Target Issue: Surface Water

Target Issue: Groundwater

Target Issue: Water Quality

Potential Benefits

Potential Barriers/Negatives

Potential Magnitude (notes only)

Potential Costs (notes only)

Sustainability (notes only)

Potential Human Impacts

Sites to Consider

Notes

New idea or already being implemented

Action Agency or Potential Action Agency

If approved by the group: What is needed/Next Steps

Potential Feasibility
Recommended
Considered
Not Recommended

Built Storage: Aboveground-Off Channel Storage

Store water for later use and/or flood mitigation off-channel

*Utilize existing sloughs to hold excess winter/spring water

*New dams/reservoirs

*Deepen existing reservoirs (do we have any existing off channel storage?)

*Raise the storage levels in existing reservoirs (enlarge or expand)

*Enlarge/deepen existing ditches

*New linear storage (new ditches and side channels for storage)

*Hydroelectric power to offest project costs

x

x

x

x

*reduced flooding
*reduced seasonal surface water deficit (improve late season flows)
*improve stream flow for fish and wildlife downstream of reservoir during summer months and provide additional water further downstream for multiple benefits including municipalities, agriculture and recreation
*recharge of groundwater
*reservoir related habitat enhancements
*potential new recreation types (locals and tourism)
*potential hydropower
*potential improve water quality (reduce stream temperatures and turbidity)
*improve fire fighting abilities
*produce more food by utilizing the water for agricultural use

*storage right
*permitting process - long timeline - uncertain if this could be permitted
*feasible location: finding a site that meets hydrology and engineering requirements (enough storage capacity) can be difficult.
*fish screen/ESA species impacts
*environmental impacts
*land ownership
*cost and funding availability
*degrade water quality
*degrade types of habitat (habitat destruction)
*loss of recreation types/reduce recreational opportunities
*downstream flooding/dam failure/safety (dam failure due to human error in design and/or operations, and/or aging infrastructure)
*there can be very mixed public opinion about dams and reservoirs unless the benefits and costs are positive.
*cultural impacts/historical preservation
*long term management issues (ie: algal blooms)
*Could cover up private land, potentially high value farmland/timberland/culturally significant land
* Difficulty in quantifying available water and associated reliability
* Enhanced soil and subsurface soil moisture may attract invasive and/or noxious plant species/aquatic invasive species risk
*Instream flow impact at POD

*storage would only potentially be beneficial in some subwatersheds (how does it address the identified water quantity and quality limitations. Per OWRD 2015 (p.12, citing OAR 690-410-0080), high priority is given to storage that "optimizes instream and out-of-stream public benefits and beneficial uses. Multi-purpose storage is preferred over single-purpose storage".)
related to scale, location etc
*depends on size of project, but if all new water, impacts would depend on how it is distributed (fairness between user groups is key - everyone must benefit to gain approval)
*Magnitude may vary from small to large depending upon size and type of storage.

*New reservoirs would be very high cost, while smaller projects like utilizing existing sloughs could be less expensive
*cost-benefit, cost to build, return on investment?
*Incentivize management practices to encourage side channels
* Innovative, integrated designs that may have broad applicability may be more likely to receive
* Enhanced near- and sub-surface soil moisture has been demonstrated to help mitigate effects of hot, dry conditions (e.g., drought, prolonged hot, dry conditions; heat waves; peak heat of the day), thereby promoting resilence and sustainability
* Off-channel reservoirs can offer potential to promote promote resilience and sustainability, however, new hydrologic methods and approaches are needed to quantify available water and associated
*increased safety
*negatively impact neighbors
*create an increase in pests/bugs
*negatively impact existing recreational opportunities
*loss of land and/or habitats
*positively impact economic benefits/return on investment
* Enhanced sustainability & reliability
*location/land ownership
*increased property taxes/fees to Union County residents to cover the high project costs

*Higher elevation locations
*Upper Catherine Creek reservoir already designed in 1960's?

*The city of Cove is considering looking at restoring an existing storage pond for the hydro power facility. Would be tied to Mill Creek drainage. Looking to capture high flows in spring of Mill Creek and Bridge Creek to use later for hydro power production with controlled flow release.
*reservoir has already been designed for Catherine Creek.
*could use reserved water from ODA

*New idea
*Revisited idea as past studies have evaluated the feasibility of built storage in the Grande Ronde basin
BOR; Union County; Individual Landowner; Tribes; UCFB; UC Cattleman's; Land Trusts; UCSWCD, ODA; NOAA, USFWS if salmon, steelhead or bull trout occur (or is listed as critical habitat), non-profits; possibly an irrigation district or other special district could be formed to take on the building and magaing of a multipurpose reservoir. UCSWCD could oversee the new reservoir and create a Water District
*identify feasible and applicable locations
*Apply for OWRD feasibility study (if approved by group)
*literature review of old reports and feasibility studies on reservoirs:
Recommend as the 1st next step, reviewing these reports and briefly summarizing the feasibility conclusions from these reports in the current water planning document.
As the 2nd next step, use the information from these reports and the draft water plan to outline baseline information for the following criteria (per p. 12, OWRD 2015 guidance document recommendations for planning groups considering new storage as a potential water source):
*Purpose (e.g., type, location and extent of use, instream and out of stream public benefits and benefical uses);
*Legal Requirements (e.g., state, federal, and local legal requirements)
*Social Considerations (e.g., recreational, public support, cultural, historic)
*Technical Constraints (e.g., siting issues, public safety, structural integrity)
*Financial Realities (e.g., project financing including site costs, cost sharing and repayment, and operating, maintenance and rehabilitation costs);
*Economic Analysis (e.g., project benefit/cost analysis);
*Land Use (e.g., ownership, comprehensive plans, coordination);
*Environmental Effects (e.g., impacts on streamflows, fisheries, wildlife, wetlands, habitat, biological diversity, water quality and opportunities for mitigation);
*Other (e.g., direct and indirect impacts).
*Have group all go meet with Governor's office/Natural Resources Commission (even before site selection)
* Investigate non-profit support
* Literature review of and Investigations into new methods to quantify estimates of water available for storage, and the associated reliability that incorporate nonstationarity in hydrology and climate (e.g.,

Built Storage: Aboveground-On Channel Storage

Store water for later use and/or flood mitigation on channel

*New On Channel dam (storage)

*Reroute stream flows during highwater for storage and recharge

*Hydroelectric power to offset project costs

x

x

x

x

*reduced flooding
*reduced seasonal water deficit (storage for late season release)
*recharge of groundwater
*reservoir related habitat enhancements
*Recreation benefits
*hydropower
*improve water quality (reduce stream temperatures and turbidity)
*improve fire fighting abilities
*increased instream flow
*reduced water temperature

*storage right
*permitting process - uncertain if this could be permitted (lawsuits)
*fish passage
*temperature impacts
*environmental impacts
*loss of instream habitat
*disruption of natural hydrologic function/impact to instream flow during filling period
*Could cover up private land, potentially high value farmland/timberland/culturally significant land
*cost and available funding
*land ownership
*finding an area with enough storage capacity/dentifying an appropriate dam/reservoir site
*negative water quality impacts (pH, turbidity, dissolved oxygen, algal blooms, methyl mercury)
*impossible to build an in-channel dam due to ESA, unless there is an UGR stream that does include ESA-listed critical habitat.
* lack of representative estimates of available water for storage and associated reliability.
*sediment/bedload transport impacts
*potential dam failure/safety
*impact to channel forming/ecological flows
*Invasive species introductions
*habitat favors non-native fish species
*operations and maintenance costs

*storage would only be possible in some subwatersheds
*suitable on-channel sites might be more restricted to smaller tributaries that are technically on-channel with anadromous fish, but the impacted reach and population is relatively minor.
*All the subwatersheds contain either critical habitat for ESA-listed fish species (steelhead, Chinook, Bull trout), and/or vital habitat for state and/or federal species of conservation concern (Pacific Lamprey, redband trout, Columbia spotted frog, various bird species, etc.), and/or culturally important species (e.g., Mule Deer, Elk) (USFWS 2015, NMFS 2017, ODFW 2017).

*permitting requirements and mitigation would create high costs
*Incentivize management practices that encourage stream channel succession that develops lateral bank storage, and reconnecting the stream to the flood plain.
*Long-term operation and maintenance costs would be additive to initial construction costs

*reservoir subject to sedimentation, filling

*loss of land use
*potential flooding issues due to mismanagement/ageing infrastructure
*Loss of river-based recreation
*impact to existing infrastructure (homes, roads, utilities)
*location/land ownership
*increased property taxes/fees to Union county residents to cover the high cost

*Higher elevation locations
*Meadow Creek (near Mackentire Road) (Deep and lots of capacity) all new water
*Upper Catherine Creek (beneficial to relook there because there has been so much work done there already)

*New project
*Revisited idea as past studies have evaluated the feasibility of built storage in the Grande Ronde basin

BOR; Union County; Individual Landowner; Tribes; UCFB; UC Cattleman's; Land Trusts, UCSWCD, ODA

*identify feasible and applicable locations
*Apply for OWRD feasibility study; permitting and design (if approved by the group)
*See comments in cell B18 regarding summarizing information from prior reservoir scoping reports.
*Have group all go meet with Governor's office/Natural Resources Commission (even before site selection)

Underground Storage

Store water for later use in underground aquifers

*Aquifer Storage and Recovery in confined alluvial aquifers (develop a new below ground reservoir)
*Infiltration galleries (city areas and other areas)
*Use floodwater, pump it into an aquifer and use it later
*Recharge of basalt wells
*Recharge of alluvial wells
* Potential underground storage options may involve infil tration using: (a) areas, ponds; (b) through some options mentioned in the 1st proposed strategy, the "Aboveground-Off Channel Storage," such as wet meadows, wetlands, ditches, linear storage; and (c) the river channel (e.g., Santa Cruz River in AZ)
* Storing water underground in an underground tank

x

x

x

*reduced seasonal water deficit
*recharge of groundwater
*no impacts to land
* Reduced evaporation of stored water; more available for multiple beneficial uses.
* Potenitally an alternative that may address one of the primary concerns well, but may also facilitate resilience on larger scales
*reduced peakflows
*see comments below regarding lack of sufficient data to demonstrate benefits

*storage right
*permitting process - long timeline
*cost
*reduce surface water avaliable
*impacts to winter channel forming flows/impacts to habitat from reduced winter flows
*Getting through the red tape and unknowns could be too high to make this a viable option - you could pump it into the ground but the unknown is what you will get back out
*potential site may be in places where it is not reasonable to meet the things we would like to accomplish
*Diversion rate for storage is limited (not useful for flood mitigation)
* lack of representative estimates of available water for storage and associated reliability.
* Would need to determine feasibility; ASR requires a limited license (WR) to test the proposted operation to see if it works as planned
*difficulty finding feasible location
*impacts to groundwater quality
*lack of hydrogeologic data to adequately determine the ability of this strategy to effectively store and recover water for multiple benefits (e.g., aquifer capacity and negative boundarys, infrastructure costs, groundwater quality, etc.) (Snyder/USGS, 2014)
*increased stream temperatures due to discharge waters (Snyder 2014)
*feasibility of attaining the desired 1-10cfs streamflow augmentation (Snyder 2014)

*underground storage is only possible in limited areas
* Depending on how water is input to an aquifer, for example, infiltration at the surface, additional acreage may need to be acquired.
* Storing water underground in an underground tank may require may require additional permitting, such as for construction, etc
*Per Snyder/USGS 2014, further data/testing/feasibility work is need to evaluate this strategy, the hydrogeology of the area, aquifer storage/recovery potential, and its impacts (water temperature, surface water - instream, wetlands, springs, local and distant effects on the surface-groundwater environment and other water users).

*Cost benefit ratio
*infrasture for diversion, injection and withdraw

* Increased reliability of water supplies and healthier watersheds are likely to contribute to sustainability and resilience

*belowground locations may have low impacts to people
*Per Snyder (2014), "There is not sufficient information to determine the potential for local or distant effects on the environment or on other water users that may result from the operation of an MUS [managed underground storage] system in the Milk Creek sub-area... "Therefore the issue remains unresolved pending further definition of the hydrologic and water quality conditions present in the Milk Creek sub-area and the necessary aquifer storage requirements needed to meet the goals of the MUS system."..."If further work on feasibility is done, consideration should be given to installing continuous water-level recorders in the alluvial aquifer, basalt aquifer, and Catherine Creek that, if present could then be used to determine the possible magnitude of water-level changes and local environment effects."

*Some research has been done (two feasibility studies), but this would be a new project

NRCS, GRMW, individual landowner, USGS, ODEQ, OWRD

*Apply for OWRD implementation grant to build on the feasibility study information gathered that indicated that Catherine Creek area underground storage of 10 cfs was feasible
*address technical concerns/issues identified in Snyder 2014

Research

Research various subjects to assist with project development

*Reservoir Research

*Flooding and fire oral histories

*Use Hampton and Brown study of area geology and pair it with groundwater wells to verify accuracy

*Collect anecdotal information from users to see what parts of the watershed have issues

*Are there high mercury levels?

*Nitrate abatement needed?

*Reexamine 303(d) standards to determine if we should advocate for them to be changed

*Review demand and supply calculations (including instream water rights). Work to answer questions relating to summer instream flows necessary for a healthy fishery, as well as what channel-forming flows are necessary during the winter for ecological function (the latter will inform availability of winter flows for storage).

*Characterize and Understand the Groundwater Resource (rate of change, flow direction)

*Study paired forest plots (30% canopy reduction to allow for water storage – Starkey) in coordination with the USFS

*Fill data gaps identified in step 2 and 3 reports

* (a) Review nonstationarity; (b) expand investigation into long-term data records for temperature, precipitaiton and snow water equivalent (SWE) to better understand basin hydrology; changes, including trends, that may be observed; (c) compare to results of model simulations of historical records; (d) review projections, including literature reviews.

* Organize periodic non-stationarity workshops; cover about 2-3 related topics at each workshop; every 1-2 years

x

x

x

x

*increased information to develop better projects
*utilize existing research to reduce field data collection efforts
*Understand best management practices to improve stream width/depth and vegetation for lower temps
*Measure flow and flood reduction benefits from on-going Habitat Management actions
* Utilize existing data and research to build the foundation of the systems dynamic model;
* Ability to conduct more accurate water balance computations; enhance water management and efficient water use; improve and protect water quality and healthy watershed functions;
* Promotes sustainability and resilience in agriculture; watershed functioning and the economy.
*Address critical uncertainties, identified data gaps
*Address climate change impacts
*Improve groundwater certainty
*Determine channel forming flows/ecological flows
*Increased information to determine watershed water quantity and quality sustainability
*Increased information to establish metrics and benchmarks for evaluating the effectiveness of water planning actionable strategies

*unfocused topics - not linked to specific projects
* Will need to work to find collaborators and funding partners
*concern from residents about how data collected will be used
*cost versus benefit of additional data collected

*not directly linked to projects, but likely helpful to other work

*Incentivize management to encourage successional processes

*Any improvement in channel morphology and vegetation will be sustained with BMP's

*Good to have more research - Physical models

New projects

EOU; ODFW; CTUIR, OSU, DEQ, OWRD, CRITFC, USFS PNW Research lab (La Grande)

*Seek oral history/research funding and partners to complete this work
*Gather anecdotal evidence
*Identify specific questions for research related to water shortages or uses
*define specific research goals and objectives
* link to data collection needs
*Recommend categorizing the research and prioritizing based on urgent/important data needs for implementing the actionable strategies (e.g., surface water quantity, groundwater quantity, water quality, municipal systems, land management - habitat restoration, public lands, agricultural lands, monitoring, education/outreach, etc.).

Data Collection & Monitoring

Collect additional data to expand existing data sets, evaluate effectiveness of strategies, and improve forecasting (long-term)

*Install and operate additional stream flow gaging stations in strategic locations.
*Coordinate interagency data sharing
*Gather data to improve estimates of actual use versus water rights
*Improve on farm efficiency monitoring and modeling
*Systematic sampling of groundwater wells to create a better network to monitor the condition of the aquifers
*Characterize and Understand the Groundwater Resource (rate of change, flow direction)
*Monitoring – groundwater quality (nitrates, arsenic, coliform) in addition to surface water quality
*Toxic algae blooms (testing, nutrients, temperature)
*Spatially distributed and long-term data collection (intensively monitored watershed)
*Install flow gages
*Improve on farm efficiency monitoring and modeling
*Systematic sampling of groundwater wells
*Gather data to improve estimates of actual use versus water rights
*Coordinate interagency data sharing
* Develop an instrumented watershed to : (a) enable more accurate representative water balance computations; (b) build a system dynamaic model to facilitate the water balance as well as, over time, to simulate watershed process to help achieve water quality, restoration; for use in planning, testing physical, operational and management alternatives and other goals; and will include monitoring.
*Study paired forest plots (20% canopy reduction to allow for water storage – Starkey) in coordination

x

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x

*better quality data
*more accurate surface water flow information
*improve groundwater certainty
*data collection should be tied to a project to determine if a project improves our metrics (ie: water quality) Pre and post monitoring is critical
*Better understand cause and effect of management practices
*measure flow and flood reduction benefits from on-going Habitat Management actions.
*measure effectiveness of water management strategies/actions over time
*improve surface-groundwater/hydrogeology characterization
*forecasting power - increase ability to detect watershed issues/concerns and develop response strategies to buffer the impacts of those concerns
*holistic monitoring could improve decision making
*Better understand cause and effect
*measure flow and flood reduction benefits from on-going Habitat Management actions.
*inform solutions for surface and ground water use
*improve effectiveness/efficiency of water management
*more accurate surface water flow information
*improve groundwater certainty
*determine channel forming flows/ecological flows

*difficulty implementating (where to install gages, which groundwater wells to sample)
*concern from residents about how data collected will be used
*cost versus benefit of additional data collected
*benefits are unknown - data could be used against you in the end
*Data may ask people to change current practices
*large scale monitoring could be difficult to maintain and implement but could build on and complement existing network in a more coherent and useful way if done properly
*Design monitoring to measure what can be managed to reduce noise
*shortages in funding and resources
*difficulty implementating (where to install gages, which groundwater wells to sample)
*concern from residents about how data collected will be used
*cost versus benefit of additional data collected
*unsustainable water quality and water quantity resources due to lack of monitoring in the basin
*inability to detect and proactively respond to emerging issues or concerns

*not directly linked to projects, but groundwater information and surface water information could inform future work
*would depend on results

*installation and monitoring of new gages would be a relatively low cost, however would need to be included in future action agency budgets (may not be seen agencies as a low cost given budget constraints, but community support for expanded gaging would be critical)
*development of an instrumented watershed and long term maintenance could have moderate costs associated

*primary human impacts will be staffing to maintain new monitoring equipment

*Good to have more data

already being implemented, however opportunities exist for expansion

ODA, GRMW, Union SWCD; OWRD; ODFW (ODFW may lack of funding to adequately engage on the monitoring), USFS, TFT, DEQ, CTUIR, CRITFC, OSU, individual landowners

*Meet with action agencies and determine scale of project (instrumented watershed or just a few new gages?) and determine funding strategy OWEB/OWRD/ODFW etc
*Should meet with DEQ Volunteer Monitoring Program to see how data collection could fit into larger monitoring efforts, and ensure that data collected will meet quality assurances/standardized processes.
*define study objectives and develop study plan

Administrative Actions

Utilize existing laws to use water for different purposes in different times of year

*Utilize new water reservations (for storage strategies)
*Utilize cross basin transfers
*Split season leases
*leases and transfers
*allocation of conserved water
*new instream water rights
*Develop a water market
*Minimum flow agreements (ex: Lostine river, dixie creek - turn water off if below certain point)
*Voluntary water lease transfers (ex: 15 mile “FAST” program, stop withdrawals when temperatures are predicted to be lethal for fish)
*Source water exchanges – “bucket for bucket exchange”
*Develop a wetland mitigation bank
*Review the economic sustainability of agriculture, consider advocating for government subsidies for crops that use less water
*Replace surface water deficits with groundwater
*Instream flow protection
*Water banks

x

x

x

x

*flexibility in water use and timing
*increase amount of water avaliable at critical times
*economic benefits (wetland mitigation bank)
*these opportunities can benefit all users
*need to recognize the environmental impacts the leases are having on fish (existing leases are working - meeting goals, measurable)
* Better meet highest and best use parameters.
* greater economic efficiency by making water potentially available for highest value uses
*improve efficiency/effectiveness of water management without high captial cost of infrastructure projects
*administative actions establish the legal fate of water resources and support the function of infrastructure

*piecemeal process (unless a water market is devleoped) - lots of time required for each agreement
*legal/permitting challenges
*rely on multiple willing actors to work

*would depend on how large of a scale these agreements become

*Many of these agreements would only have permitting costs to implement

*A mitigtation bank could reduce land avaliable and leases could impact the amount of water avaliable for agriculture, but could offer mitigation credits and water to higher-value demands, thereby increasing returns to landowners who are voluntarily participating.

already being implemented, with potential for expansion (are there any legal/administrative barriers to

TFWT, GRMW, OWRD, SWCD, NRCS, ODFW, individual landowners

*Identify existing projects, create a framework for new ones (water market?) develop funding strategy
*identify incentive programs and link to specific actions

Outreach and Education

Educate the public to reduce water quality issues

*Awareness of ECSI listed sites

*Promote recycle chemical program (for pesticides, ag and municipal)

*Inform the public about best practices for lawn care (fertilizers flow to the creeks) outreach and education needed

*Public outreach for toxic algae blooms

*We get a city water quality report – maybe watershed wide

*promote conservation farming practices

*This could/should be expanded to include water quantity issues as well, specifically opportunities to improve water conservation and use efficiencies (address deficits identified in the Step 3 report)

x

*reduced pollution from municipal/residential sources
*increased awareness of groundwater quality
*increased water use efficiency
*reduced erosion and sedimentation
*reduced nutrient loading
*voluntary implementation of water conservation, which affects demand and supply
*increased awareness of surface water quality and quantity and sustainability
*Recommend expanding outreach to 2-way tools (rather than limiting to flyers/mailers) to increase personal communication and strategy adoption. For example, land owner tours and hands-on workshops on actionable strategies.

*limited barriers to implementation - most items would simply be outreach in the form of fliers/mailers
*resident/landowner concerns over adopting new strategies over the status quo

*Many of these items address water quality issues from small sources, unlikely to create a large scale change in water quality
*Cumulative actions that are coordinated in space & time would likely have measurable (reach and subwatershed scale) changes in water quantity and quality

*mailers/fliers are low cost to send and produce
*tours, trainings, workshops are more expensive to host but would increase community connections to resource issues and likely increase adoption of actionable strategies

*no forseeable negative impacts to people

*This is interesting and has lots of opportunities, but is also probably necessary- what would this look like? Who would the craft messages? How would landowners dispersed over large areas be engaged?
*DEQ is currently working on a pilot project where the OWRD Groundwater and DEQ Cleanup programs are going to coordinate on groundwater right reviews. This is hoping to ensure that wells are not being drilled in areas with contamination. However, domestic wells of a certain size do not require a water right and it is up to the landowner to do this research. I would be interested in learning if landowners would be interested in receiving technical assistance from DEQ in navigating ECSI and/or getting information about potential contamination in the areas where wells may be located.

already being implemented, with potential for expansion

Cities and County; academic institutions; extension services; GRMW, Union SWCD, NRCS, OWEB, DEQ, TFT

*Meet with representatives, determine needs, develop funding strategy
*Learn about DEQ pilot

Public Land - Land Management

Manage public lands to improve water quality and quantity

*Raise organic soil content (forest land)
*grazing management on federal lands (range management of wild and domestic ungulates)
*timber management on federal lands (manage forest canopy)
*Upland land management
*Road management for allowing runoff to recharge groundwater, locations, culvert sizing, surfaces (decrease sedimentation through management)
*Monitor uplands for erosion (sediment)
*Invasive species management
*Buffer Zones
*Vegetation management – opportunity and costs for each type of project
*Fire management
*Protect existing high quality habitats
*Fish passage and screening
*Restore floodplain-riparian-instream connectivity and complexity
*Upland spring and meadow protection
*Support collaborative forest partnership projects

x

x

x

x

*increased water holding capacity of soil
*reduced erosion
*improved rangeland and forest conditions
*reduced fire risk
*Increased flood attenuation
*focus on function of natural processes
*protection of high quality habitat for ESA-listed species, Oregon State Sensitive/Sensitive Critical species (ODFW 2017), and culturally important fish and wildlife species
*improved resiliency to buffer future conditions/events
*public lands management that complements neighboring private lands habitat conservation and restoration efforts

*significant permitting/NEPA requirements for work on federal lands
*multiple agency actors - work depends on outside priorities
*temporary disturbance to ESA listed species likely

*much of the land in the watershed is public lands (approximately 40%) work in this area could yield large impacts

*much of the work would extend existing projects
*infrastructure and organizations are already in place

*some public recreational use of public lands might be temporarily disrupted or altered based on land modifications

Already being implemented, with potential for expansion

USFS/BLM, CTUIR, ODFW (through GNA with USFS)

*Inventory of all projects, identify areas to assist
*Identify actions specific to meet water conservation goals

Agricultural Land - Land Management

Manage agricultural land to improve water quality and quantity

*Raise organic soil content (agricultural land)

*Reduce nutrient (nitrogen and phosphorus) loading through irrigation efficiency and improved nutrient application methods

*Improve irrigation efficiency for agriculture and other uses (Efficiency upgrades are a huge opportunity to create a "new" source of water for demands that currently are not being met, i.e., a way to keep ag whole while improving instream flows.)

*Plant alternative crops to use less water

*Floodway easements for farmers

*High residue farming

*Prevention of contamination when flooding occurs

*Improve farming practices (no till methods, more organics into the soil)

*Utilize incentive-based programs

x

x

x

x

*increased water holding capacity of soil
*reduced irrigation frequency
*improved water quality
*flooding resilliancy
*increase efficiency of nutrient applications
*improved fish and wildlife habitats

*depends on willingness of individual landowners
*costs may be high for individual landowners
*work would likely be opportunistic - challanging to find project sites
*small gains for inputs required (much of this work is already done)
*land modifications would occur that could result in reduced farm land avaliable or altered crops
*effect of increased soil organic matter content is very small on heavier soils
*some practices for increasing soil organic matter (e.g. cover crops) will likely result in a net increase in water use.

*Depends on scale of action, may locations already have conservation practices in place

*Depends on scale of action

*individual land owners would be impacted. *Public impacts are unlikely.

*A tour at 6 Ranch could be an example of actions already being implemented for the ag community to see a tangible project. Maybe there are other ranchers/land owners engaged in other land management practices that could also consult or provide tours?

Already being implemented

NCRS, Union SWCD

*Inventory of all projects, identify areas to assist
*There might be some data collection needed here (survey?) to find out who is doing what, the barriers to implementing WQ-friendly land management practices, resource needs.
*Identify actions specific to meet water conservation goals

Municipal Land - Land Management

Manage municipal systems and land to improve water quality and quantity

*Bioswales (vegetation infiltration)
*Filter strips
*Point source control
*Improve municipal water efficiency and redundancy (including needed infrastructural improvements)
*Improve existing stormwater facilities(pipes and ditches) to help channel & control water flow
*Stormwater collection
*Reduce impervious surfaces and direct runoff
*development of water system master plans, or water management and conservation plans, or at least water curtailment plans for each city and a coordinated approach to conservation, system testing and maintenance could help the smaller cities by producing conservation and long-term infrastructure planning. Water reuse also if there are opportubnities remaining.
*Non-traditional water supply techniques: Per OWRD 2015 (p. 13) "planning groups should consider alternative or non-traditional water supplies [NTWS], such as the use of rainwater, stormwater, greywater, or desalinated water as a management strategy". While desalination is not applicable to the planning area, the other NTWS warrant consideration.
*rainwater collection
*stormwater
*greywater

x

x

x

x

*improve surface water quality through filtration
*reduce groundwater use
*reduce unaccounted for water losses in systems (increased system efficiencies)
*increase system preparedness for future water needs/issues/concerns

*limited municipal improvements currently identified
*limited areas to create new bioswales
*Improve inadequate existing facilities to handle upstream improvements

*limited areas and limited water volume impacted
*municipal service areas/systems have potential to improve conservation measures for over the short- (e.g., drought response) and long-term (water efficiencies, adoption of new methods such as greywater, rainwater collection, etc.).

*municipal conservation improvements can be expensive to implement
*potential for federal or other grant sources to offset improvement costs (e.g., EPA/ODEQ, BOR WaterSmart, etc.)

Already being implemented, opportunities or needs for expansion?

Cities

*Inventory of all projects, identify areas to assist
*Identify actions specific to meet water conservation goals

Non-Structural Water Storage & Habitat Management

Increase "water storage capacity through natural processes using non-structural means" (OWRD 2015); Manage upland, riparian, and instream habitats to benefit water quality and quantity *Reconnect and restore floodplains *Enhance riparian vegetation and stream shading *Upland restoration *Levee Setbacks *Stream restoration (restore channel morphology)/Restore/improve stream channel dimension, pattern and profile *Beaver reintroduction and beaver dam analogues *Alpine meadow restoration *Create new wetlands and reestablish old wetlands *Address channel downcutting and increase bank storage capacity *Wetlands - Create new wetlands and reestablish old wetlands/Improve ability to hold and clean water *Wet meadow restoration/Improve function of wet meadows to capture and store water *Floodplain and wet meadow restoration to increase water storage and reduce flood risk *Levee removal *Fish screening and passage to increase connectivity to cold water refuge *Beavers/Beaver Dams *Introduce Beavers where they are not present, habitat is suitable, and not in conflict with current land use *Improve Forest Canopy to capture snowpack (store and use) - highest elevations USFS land *Sloughs	
x	
x	
x	
x	

*improve ESA species habitat (for fish and other species)
*improve habitat for species of cultural significance
*reduce water quality issues (temperature, nutrients, sedimentation, turbidity)
*improve natural water storage
*reduce flooding impacts/increase flood attenuation
*improve groundwater recharge
*improve habitat for terrestrial species
*restore natural stream flow patterns
*focus on function of natural process
*habitat enhancements
*reduced seasonal surface water deficit
*recreation benefits (locals and tourism)
*reduced water quantity deficit extremes
*increased habitat connectivity/complexity and reduced seasonal water quantity deficit for ESA-listed salmonids
*groundwater recharge (raising groundwater table and increasing hyporheic flow exchange)
*increased terrestrial habitat (riparian vegetation benefits, wildlife species benefits)
*protection of existing high quality natural storage resources
*increase resiliency to buffer future watershed uncertainties

*Landownership (gaining permission for projects likely to be opportunistic)
*permitting
*certainty of results/monitoring requirements
*Habitat restoration projects change landscapes, and can result in changing land uses/can take water away from food production
*could beaver dams create more severe flooding during high water events?
*reduced land use
*ecological and socio-cultural benefits would be maximized through strategic, rather than opportunistic, implementation (e.g., protecting existing high quality habitats, expanding restoration areas out from adjacent/proximate cold-water from habitat strongholds, implementing coordinated floodplain and riparian restoration actions, monitoring to assess effectiveness)
*Wetlands - needs to dry out completely for recharge to be effective and noxious weed control become a concern *increased pests in wetland environments (mosquitos)

*Depends on scale of implementation, reach to subwatershed scale magnitude
*Monitoring is a critical complementary strategy to evaluate implementation and ecological effectiveness outcomes at various scales

*restoration projects are less costly than infrastructure projects, but costs would depend on the scale and type of work. Passive projects (e.g: cooperative agreements, beaver reintroduction, fencing) are least expensive
*state and federal grant funding available to off-set project costs
*recreation benefits (locals and tourism)

*individual landowners where projects occur would be impacted
*increased safety
*negatively impact neighbors
*create an increase in pests/bugs
*negatively impact existing recreational opportunities
*loss of land
*positively impact economic benefits/return on investment
* Enhanced sustainability & reliability

Use existing tools (e.g., Atlas, BOR Tributary & Geomorphic Assessments, Beaver Restoration Assessment Tool) and monitoring data to identify opportunities/limitations to expanding this strategy on the landscape to address existing water quantity and quality concerns

Already being implemented intensively, with potential for expansion

CTUIR, GRMW, Union SWCD, Trout Unlimited, ODFW, TFWT, USFS, BOR, BPA, OWEB, NRCS, Individual Landowner, Union County, BOR

*Use Atlas and other tools (e.g., Beaver Restoration Assessment Tool, monitoring data) to identify priority project sites, and determine how the Partnership can assist

Infrastructure/Land Modification

Develop new infrastructure to control water

*physically open up the valley through large land modification project to allow for improved flows and reduction flooding

*Construct Levee System to keep farmland from flooding

*Pump flood water for storage

*Construct a Parallel Flood Channel to alleviate flooding issues

*Encourage and incentivize additional Microhydroelectroc power

*Control warm water (thermal refuge in winter, divert for later use)

*Pipe irrigation ditches to control use and efficiency.

*Meet with USACE (Levee Strategy) - invite to meetings

x

x

x

*flooding reduction (for levees, this may not be acheived because extra water is in the system, it gets "pinched" in the levee infrastructure, and ends up going somewhere else in the system)
*water flow improvements ? See comments above and below
*Improved water efficiency

*landownership issues
*permitting challenges
*may not be supported by existing land users
*significant landscape scale changes possible with a new levee system
*cost
*likely modifications to land use
*flood control stuctures (levees) often fail and exacerbate the effects of flooding.
*aquatic and terrestrial habitat alteration/degradation
*levees "channelize" the river and result in reduced channel-floodplain habitat connectivity/complexity, increased river speeds, higher river flows between and upstream of the levees, increased erosion, increased channel incision, reduced riparian vegetation, and increased flooding outside the levee infrastructure
*infrastructure ownership and maintenance costs

*this would impact the valley, but not other portions of the watershed
storage only for flooding, not for use later

*significant earth work associated with levees and Rhinehart gap modifications

*existing landowners likely to be displaced, or experience loss of land
*operation/maintenance costs would likely be the responsibility of the land owners/Union County residents (not USACE) - likely cheaper and more effective long-term to buy floodplain acreage where flooding risk and human safety risk is highest.

New project

USACE

*contact USACE for levee strategy

* Apply for feasibility study to look into opening up Rhinehart Gap to aleviate flow and flooding issues in the valley

General Comments (not incorporated in strategies, but r

*Outreach: all landowners in Union County should be invited to place-based planning via personal letters
*Lots of ideas here, many don't seem practical - flood reduction should be the priority and then water for late season use
*government agencies are different than other stakeholders
*these strategies lack meaning now because we need to spend more time developing our objectives and metrics (want a strategic plan coordinated among groups, not a hodge-podge of projects)
*There will be value in tying specific strategies to specific critical water issues in terms of geography, scale, etc. to the extent possible so it is more clear what problems are trying to be solved. The water issues currently seem fairly vague.
*there does still seem to be a bit of a mismatch as to the scale and categorization of some of the strategies included
*Perhaps sorting by the mechanism (e.g., “ecosystem restoration”) rather than the function (e.g., ”increasing above-ground storage”) would be an easier way to differentiate these things into a hierarchy that doesn’t have so many redundant components. See diagram in "notes" tab
*what to do when a strategy could result in a benefit or detriment is is included in both categories
*Some or many of the strategies could be better described so there is less confusion about the intended meaning.
*It will important to clarify when the partners vote on different categories/strategies are they voting in support of all the bullets? Some? Will each bullet be voted on?
*A lot of these issues are interconnected. Land management, riparian shade, fencing, etc., a lot of it ties together. I would encourage the group to try think more broadly about the linkages, and ask if

oted for next steps)