



Drought Resiliency for Jefferson County, Oregon Agriculture:

A Long-Range Plan to Thrive Despite Water Scarcity

December 2023

Produced by
Jefferson County
Agricultural Drought Resiliency Group

*Our Mission: to help agriculture create a sustainable, livable future
for Jefferson County by adapting successfully to drought with support
from Deschutes Basin stakeholders.*

*We promote innovative solutions to proactively improve watershed
health and increase the effective management of water.*

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Abbreviations & Acronyms

AF	acre-feet
AID	Arnold Irrigation District
BPA	Bonneville Power Administration
cfs	cubic feet per second
COAREC	Central Oregon Agricultural Research and Extension Center
COID	Central Oregon Irrigation District
COSI	Central Oregon Seeds, Inc.
DEQ	Oregon Department of Environmental Quality
DRC	Deschutes River Conservancy
HCP	Habitat Conservation Plan
JCSG	Jefferson County Seed Growers
JCSWCD	Jefferson County Soil and Water Conservation District
MDWC	Middle Deschutes Watershed Council
NRCS	Natural Resources Conservation Service
NUID	North Unit Irrigation District
ODA	Oregon Department of Agriculture
ODFW	Oregon Department of Fish and Wildlife
OSU	Oregon State University
OSU Ext	Oregon State University Extension Service
OWEB	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
PAE	Potential Application Efficiency
PGE	Portland General Electric
RC&D	Resource Conservation and Development Council
SWCD	Soil and Water Conservation District
USDA	United States Department of Agriculture
WC	Watershed Council



Winter wheat planted as a cover crop and sprayed out due to lack of irrigation water, May 2023.

Group Vision: “Jefferson County agriculture will thrive by adapting successfully to drought, and will support its people, animals, economy, environment, and culture.”

The following participated in the development of this Long-Range Plan at some level. Other invitees did not respond or were unable to participate despite interest. Anybody is welcome to participate.

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*producer = landowner and/or land manager raising crops and/or livestock commercially; includes both “ranchers” and “farmers”

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EXECUTIVE SUMMARY

Jefferson County consists of 1,800 square miles in Central Oregon. Half of the land is private, almost all in agricultural production (irrigated cropland, livestock grazing, or dryland farming). Most of the private land receives only 9-15" of rainfall per year. Agriculture drives Jefferson County's culture and economy and produces about \$70 million dollars annually. It is also important internationally: for over 20 years, as much as half the hybrid carrot seed planted worldwide was grown in Jefferson County.

Weather data for Jefferson County and Central Oregon show that temperatures increased while precipitation decreased in the last 30 years, resulting in drought. In addition, Jefferson County agriculture experiences water shortages due to Oregon water law (junior water right holder) and the Federal Endangered Species Act.

The combination of rising temperatures and inadequate water supply has resulted in an unprecedented crisis for Jefferson County agriculture, which will devastate the county if not successfully addressed. If the drought continues and the Oregon Spotted Frog Habitat Conservation Plan is implemented as agreed to, **Jefferson County irrigators may have insufficient water to operate in 10-15 years without increased efforts to conserve and redistribute water across the Deschutes Basin.**

The Jefferson County Agricultural Drought Resiliency Group, comprised of 60+ agricultural producers, conservation partners, and other interested parties, met monthly October 2022 through June 2023 to develop a long-range plan and continue to meet quarterly. Their concerns if the situation was not addressed include:

- The end of Jefferson County irrigated agriculture and, therefore, the loss of the main economic base for the area and community.
- Water issues become worse, with increasing conflict between various interests (not only humans, but also fish, wildlife, and the earth) competing for scarce water.
- The landscape deteriorates from increased desertification.
- Farmers/ranchers cannot sustain themselves and leave their land, by either selling it or abandoning it, leading to the loss of "institutional" knowledge of farming in this area.
- Land taken over by non-agricultural interests, e.g., housing developers and commercial.
- Businesses of all kinds (not just agriculture-related) fail during this transition.
- Madras/Jefferson County culture is completely changed. For example, it could become another tourist destination or a "bedroom community" for Redmond/Bend.
- The whole Deschutes River Basin would deteriorate environmentally, socio-culturally, and economically.

The Group identified over 40 tools to help agriculture thrive. These tools were prioritized based on current implementation status, benefit to the Group vision, and likelihood of implementation.

In July 2023, Workgroups (Water Availability/Access/Distribution, Irrigated Croplands, Ranchlands, and Agrivoltaics) formed to:

- Identify the goals, challenges, and opportunities for implementation for each tool.
- Develop an implementation plan that identifies needed resources (research, knowledge, outreach, funding, monitoring) and how to obtain them.

This Plan is the result of those efforts and will be updated annually as it is implemented.

Note: This document draws from both existing written sources and Group discussions.

I. BACKGROUND

A. NATURAL SETTING

Jefferson County is in Central Oregon (Map 1). It is centered on the city of Madras, encompasses 1,791 square miles (1,146,639 acres) and contains approximately 25,000 people. Approximately 55 percent of the land is privately owned; the remaining is split between federal lands and those managed by the Confederated Tribes of the Warm Springs Reservation of Oregon.

The elevation ranges from 1,562 feet at Warm Springs to 10,495 feet at the top of Mt. Jefferson.

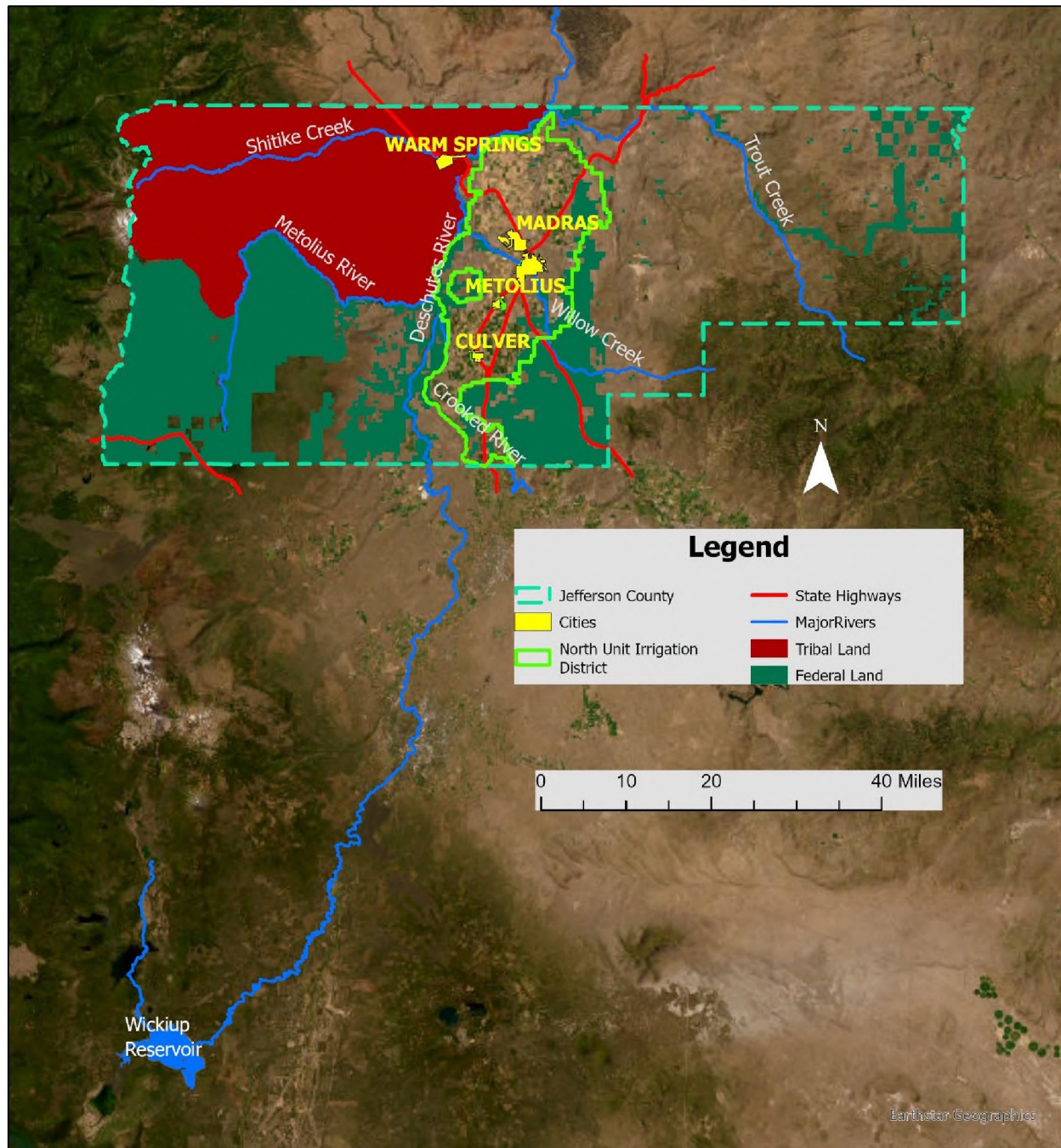
Rainfall averages 9-10 inches annually in Madras, 12-15 inches in much of the eastern part of the county, and 20-80 inches on the timbered slopes of the Cascades.¹ The growing season averages 90-110 days at Madras.² During the growing season (April through September), the amount of precipitation at Madras is less than 4 inches, making irrigation a necessity for most crop production;² irrigation water is generally delivered April 1 through October 15. The region averages nearly 300 days of sunshine with temperatures 45 to 85 degrees Fahrenheit in the summer and 20 to 40 degrees Fahrenheit during the winter.² During the growing season, it is not unusual for the nightly minimum temperature to drop below 40°F; this can happen even during the hotter months of July and August.² Cool evening temperatures are common during Central Oregon's growing season, which can result in slow plant growth/maturation, decreased pollination, and reduced yields, especially for heat-loving crops.² In contrast, the relatively cool, dry conditions with moderately warm days and cool nights is conducive to production of high quality seed of many cool-season crops. This climate makes Jefferson County one of the world's best seed-growing areas for several turfgrass and vegetable species.

The county is bisected by the Deschutes River, which originates in the Cascade Mountains south of Bend and has cut a steep canyon through Jefferson County lava flows. Other major drainages in Jefferson County include Trout and Willow Creeks and the Crooked River that flow into the Deschutes River from the east, and the Metolius River and Shitike Creek that flow in from the west. The Deschutes River, Crooked River, and their tributaries support a variety of sensitive species; steelhead, bull trout, and Oregon spotted frog are listed as threatened under the Endangered Species Act. Past and ongoing efforts support these species and their habitats; however, lawful irrigation-related activities continue to limit streamflow and negatively affect fish and aquatic habitat.³

Soils are generally shallow and naturally low in organic matter. Organic matter in row-cropped fields (mostly carrot seed) around Madras is 1-4%; it is hypothesized that irrigation has increased soil organic matter.⁴

The upper elevations consist of coniferous forest. Middle and lower elevations consisted historically of juniper savanna interspersed with shrub-steppe grassland. Many of the lower elevations have been converted to irrigated croplands.

Map 1. Jefferson County features, plus the source of irrigation water for North Unit Irrigation District (Wickup Reservoir).



City-Suburban Areas:

Madras, the County seat, is the center of the county and most landowners and residents conduct business there. Culver and Metolius are small, incorporated towns. Warm Springs is the center of business on the Warm Springs Reservation.

B. AGRICULTURE

1. Overview

Agriculture is vital to the economy and sociocultural fabric of Jefferson County. Farms are primarily multi-generational family operations; the oldest are operated by fifth or sixth generation farmers, and most have at least three generations dating back to the completion of the irrigation project in the early 1950s. Many Jefferson County farmers are innovators and early adopters of new technologies. The area is known for production of high value specialty and seed crops on irrigated cropland, and a high level of production expertise by growers and supporting industry.

Higher elevation timber and rangelands are grazed by cattle as part of large ranches and may include dryland crop fields.

Irrigated croplands cover much of the lower elevation areas. Ninety percent of irrigated land is dedicated to crop production with less than 10 percent reserved for pasture or grazing, as compared to the other irrigation districts in the Deschutes Basin which are mostly pasture or hay. Irrigated crops in Jefferson County include grass seed, alfalfa, seed potatoes, carrot seed, grains, reclamation native flower seed, hay, nursery crops, herbs, mint for oil and tea leaf, garlic, and some fresh vegetables. Specialty crops form the economic base of most farming operations, although broadacre crops and forages are grown in rotation to support the health and sustainability of specialty crop production. The number of irrigated farms has remained relatively unchanged over the recent past, with 298 farms in 1974, 311 in 2002, 304 in 2012, and 306 in 2017.⁵ Most of the irrigated acres are concentrated in the North Unit Irrigation District (NUID), along with hay meadows along Trout and Willow Creeks.

Soils within the most intensively farmed areas (Madras and Culver) are moderately deep to shallow loams and sandy loams on level to rolling slopes.¹ They are subject to wind erosion if left unprotected. They are very sensitive to overgrazing if not irrigated, and recovery rates can be slow. Soil erosion and leaching of nutrients is a concern due to permeability, shallow depth to bedrock, and risk of seepage. The high infiltration rate, low available water capacity, and rapid permeability are important considerations in irrigation management.

The small amount of non-irrigated cropland is devoted to a winter wheat/summer fallow rotation and is at best, very marginal wheat land. Most historically unirrigated cropland has been converted to dryland pasture or perennial vegetation planted under the Conservation Reserve Program (CRP).

The USDA provided the following statistics based on the 2017 Census of Agriculture;⁶ the Census of Agriculture is conducted every five years, and the 2022 results will be released in February 2024:

- Family farms = 94% of farms
- Farm acres = 792,920 (69% of Jefferson County)
- Cropland acres = 77,811 acres
- Agricultural commodity sales = \$67 million farmgate total (\$55 million in crop sales, \$12 million in livestock)
- Operating expense total = \$60 million
 - Cash rent/irrigated acre = \$140
- Net cash farm income per farm = \$31,281
- Cattle operations = 158 (17,000 head)
- Selected crops harvested

- Hay 23,775 acres (89,445 tons)
- Field/grass seed crops 11,150 acres (includes 12 million pounds of bluegrass seed)
- Vegetable seeds 4,637 acres
- Wheat 4,482 acres (429,834 bushels; half winter, half spring)
- Fresh vegetables 698 acres
- Mint 593 acres (54,006 pounds of oil)
- Workers hired = 972
- Irrigation
 - 53,928 acres irrigated at least once in last 5 years

Vegetable seeds, grass seeds, wheat, alfalfa, grass hay, oil crops, and flower seeds are the most common crops currently grown. Hybrid carrot seed is particularly important and lucrative in Jefferson County. While the numbers change 5-15% annually and no official statistics exist, in 2023, the industry estimates that approximately 60% of hybrid carrot seed planted in the United States and 45-50% worldwide was grown in Jefferson County.⁷

2. Socioeconomics

In 2022, the estimated population of Jefferson County was 25,330 (<https://www.census.gov/quickfacts/fact/table/jeffersoncountyoregon/PST045222>).

Jefferson County is one of the most ethnically diverse counties in Oregon; 18% of residents are American Indian and 20% are Hispanic or Latino.³ In 2019, it was also one of the poorest counties, with a 15% poverty rate, 6.1% unemployment rate (compared to Oregon's 3.4%), and a median household income \$15,000 less than the State of Oregon's (\$54,471 compared to \$70,116).³

USDA considers the City of Madras and the Warm Springs Reservation in Jefferson County as 'Distressed' or 'Disadvantaged' Communities.⁸

The following information is from Headwaters Economics (2017) unless otherwise noted.⁵ An updated economic report commissioned by NUID is expected by December 2023; information will be included in the next update of this Drought Plan.

Natural births account for most population growth since 2000, and employment is largely driven by jobs in manufacturing, agriculture, government, and service-related industries. Per capita income in Jefferson County has experienced relative stagnation during the past thirty years, averaging around \$30,000 per year, from 1974 to 2014.

Between 2001 to 2014, overall employment grew by only 2.95 percent (250 jobs). During the same time farming added 50 jobs, while Jefferson County's construction and manufacturing sectors declined by 28.8%.

Jefferson County owes much of its agricultural prosperity to the arrival of the railroad in 1911 and irrigation water in 1946, which created a land rush and a population boom in Madras and the surrounding area, and the farmland around the town eventually produced some of the world's finest mint and seed crops.

Agriculture continues to drive Jefferson County's economy. Gross income from agricultural commodity sales totaled \$74.4 million and contributed more than \$260 million to the Central Oregon economy in 2012. By comparison, agricultural commodity sales in Deschutes County averaged \$26.1 million and contributed \$91.3 million in total economic impacts.

In 2013, hybrid carrot seed production peaked at more than 4,700 acres in Jefferson County, grossing nearly \$15 million. In 2023, carrot seed from approximately 3000 acres was valued at \$20 million dollars; bluegrass seed added another \$8 million dollars.⁷

3. Agricultural Water

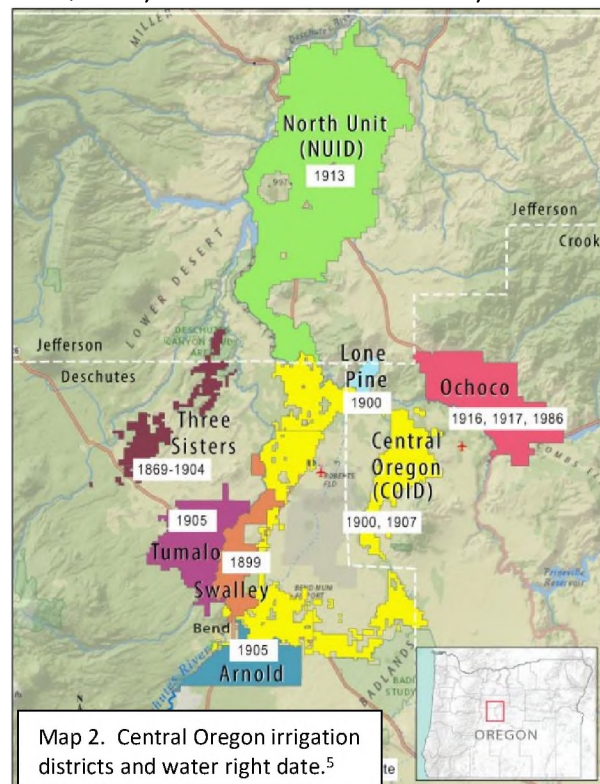
Jefferson County agriculture receives water from five sources:

- NUID deliveries
- water rights from local rivers (especially Willow and Trout Creeks)
- water for livestock from rivers and springs
- wells
- precipitation

a. NUID

NUID delivers water to approximately 58,990 acres. The Deschutes River supplies water for 82% of the acreage, using water stored over the winter in Wickiup Reservoir; the remaining acres are irrigated with water pumped from the Crooked River. Water is routed in the Deschutes River from Wickiup Reservoir to Bend and then diverted into 65 miles of main canal to and within Jefferson County. This water is in turn delivered to farms through 235 miles of lateral canals; the system has modern telemetry stations throughout to regulate water deliveries. When there is sufficient water, NUID can deliver 2 ¼ acre-feet (AF)* during an irrigation season, which is adequate to grow a Jefferson County crop with well-managed irrigation. Because NUID's delivery system is mostly open canal built in fractured basalt (like all irrigation delivery systems throughout Central Oregon originally were and mostly still are), water loss is great and delivery efficiency is approximately 64% at best (with reduced water delivery volumes, proportional delivery efficiency declines further). However, it is estimated to cost \$1.75 billion in today's funds to pipe all 300 miles of canals (Mike Britton, NUID).

The two largest irrigation districts are the Central Oregon Irrigation District (COID), located primarily in Deschutes County, and NUID in Jefferson County (Map 2). Together, the two irrigation districts account for nearly 84 percent of all water diverted from the Deschutes River and its tributaries.⁵ Yet



*One AF is the amount of water that cover one acre one foot deep; also equal to 325,851 gallons.

how this water is used and applied reflects significant strides towards efficient water use by NUID and its patrons.⁵ For instance, COID diverts 304,195 AF to irrigate approximately 45,000 acres (94% of which is relatively low value pasture),⁵ while NUID diverts 188,046 AF to irrigate nearly 60,000 acres, of which less than 8% is pasture.

In addition,⁵

- Between 2006 and 2013, farmers in Jefferson County harvested an average of nearly 13,000 acres per year of specialty crops, such as vegetable and grass seed, and diverted 60 percent less water from the Deschutes River compared to farmers in Deschutes County, who averaged just 239 acres of specialty crops per year. Despite the lower water use, the economic value of Jefferson County crop production was roughly three times that of Deschutes county crop production.
- As junior water rights holders facing regulatory water shortages, farmers in NUID apply water conservation strategies such as canal lining, pressurized pumps, drip irrigation systems, and lateral piping to achieve an average 94 percent water efficiency. In contrast, senior water rights holders in Deschutes County irrigation districts have negligible incentive to conserve abundant allotments and averaged as low as 42.9 percent water efficiency.
- In 2001, the United States Geological Survey found that the NUID was among the lowest of the seven irrigation districts for water lost to canal seepage, averaging around 2.1 AF of water loss per acre annually.

Currently, all Central Oregon irrigation districts are developing Watershed Plan-Environmental Assessments that support irrigation modernization and provide local environmental benefits.¹ This is part of the Public Law-566 modernization project to improve irrigation water conveyance system and improve stream flows. The project will also improve on-farm water delivery, supply pressurized water in some areas, enhance habitat for fish and aquatic species, and improve public safety by eliminating risks from open canals.

On-farm irrigation systems can be characterized by how effectively they deliver water to the plant's root zone, where it can be taken up by the plant. The less water lost to evaporation, runoff, or drainage below the root zone, the more efficient the irrigation system. This efficiency is generally expressed as a percentage of the water delivered by the system to the crop (Table 1). Actual application efficiencies depend on site specific factors like soil characteristics, field topography, and how well the system is managed.

Table 1. Irrigation systems classified by their minimum Potential Application Efficiency (PAE).⁹		
PAE	Irrigation Method	PAE Range (%)
High	Drip	85-95
	Micro spray, micro sprinklers	85-90
Medium	Center pivot/linear: LEPA, LESA	80-90
	Center pivot/linear	75-85
Low	Solid Set, K-lines	70-85
	Hand lines, wheel lines	65-85
	Big guns, travelers	65-75
	Flood, furrow	45-80
	Flood, wild	35-60

During the past several decades, irrigation in NUID has changed from primarily flood or furrow to approximately 90% sprinklers, half of which are some type of center pivot or linear,¹⁰ resulting in an estimated on-farm application efficiency rate of 87%.¹¹ In contrast, COID is still approximately 27% flood-irrigated.¹²

Further, many sprinkler irrigation systems in the NUID have recently been converted from traditional gravity application methods to pressurized pumps. Nearly 95 percent of the sprinkler-irrigated cropland in the district is pressurized by pumping.⁵ Low-pressure pumping and the use of center pivot systems are some of the most efficient application irrigation methods available.

Opportunities for the greatest improvement in water efficiency on Jefferson County farms include lining and piping ditches and laterals to reduce seepage and/or evaporative loss, using modern technology for irrigation scheduling, upgrading sprinkler systems, and repairing leaking irrigation systems.

The uncertainty of consistent water flow, especially during dry summer months, has compelled NUID irrigators to integrate water conservation efficiency measures such as drip irrigation, canal lining, and closed pressurized pipelines into their farming practices. According to Headwater Economics (2017),⁵

“In doing so, NUID irrigators are using less water to irrigate a greater amount of productive land. At the same time, there are no mechanisms in place to encourage improved water use by irrigators in Deschutes County who irrigate smaller, less productive land. Introducing incentives to support on-farm conservation measures and other water-saving activities in Deschutes County could help alleviate insecurities downstream for NUID irrigators.”

The water conservation strategies used by NUID farmers demonstrate practical on-the-ground solutions to reducing water loss from seepage, evaporation, and conveyance (Headwater Economics, 2017). Water use practices and conservation measures applied by NUID provide a useful example of potential water savings in the region. If adopted region-wide, these measures could maximize the benefits of irrigated water from the Deschutes River.”

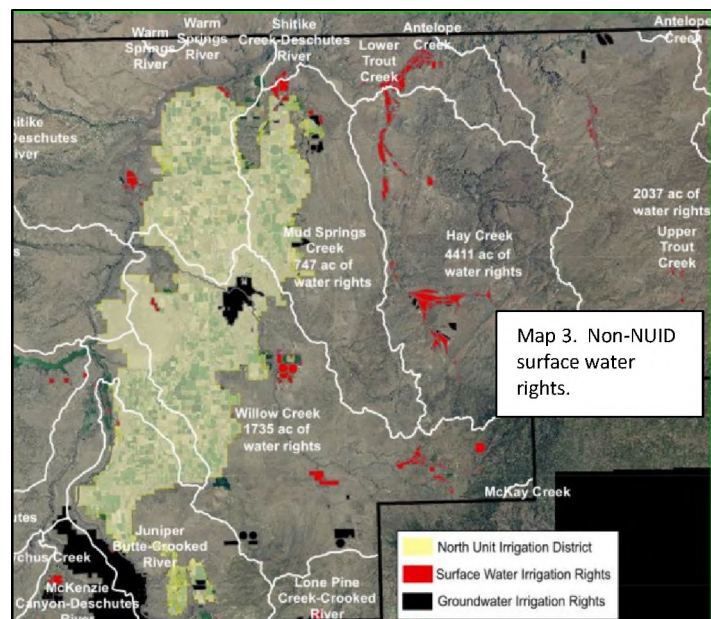
b. Surface water rights outside of NUID¹³

The rest of the irrigated land lies along smaller streams, and irrigation is limited to those stream flows. Some fields are also irrigated from private wells.

The main watersheds with irrigable lands are Trout Creek, Willow Creek, Hay Creek, and Mud Springs Creek (Map 3).

Trout Creek

It requires 48 cfs in Trout Creek to meet all water rights, which rarely happens. When irrigation begins in March/April, flows in Trout Creek are generally around 20 cfs, but it varies greatly year to year. However, with little exception, the entire creek goes dry between late May to early July. During this time flows often decrease from 5-10 cfs down to 0 cfs. Thus, only about 400 acres (~20%) can receive water at the beginning of the irrigation season.



Willow Creek

Water rights require 26 cfs to be met. Willow Creek behaves similarly to Trout Creek, being fed by runoff. About 350 acres of these lands can be irrigated into June/July.

Hay Creek

Water rights require 110 cfs to be met. Flow is driven by runoff. Approximately 900 acres of water rights can be served into early summer, comprising approximately three farms.

Mud Springs Creek

Water rights require 16 cfs to be met. This watershed is fed by surface runoff, springs, and NUID tailwater. The water rights are usually met for all the lands throughout irrigation season. However, a decrease in NUID tailwater in the last three years has meant that flows in Mud Springs Creek are less than they used to be, which affects these water right holders.

C. WATER SHORTAGES (“DROUGHT”)

Jefferson County is affected by two types of “drought”:

1. “Regulatory” drought = insufficient water due to regulations, primarily related to water rights and endangered species protections, but also to other requirements such as farm use tax exemptions.
2. “Hydrologic” drought = insufficient water due to the location, amount, timing, and ability to store precipitation.

1. Regulatory Drought

a. Water rights

Water rights in Oregon are mandated through 100-year-old prior appropriation laws, decreeing the “first in time, first in right” prioritization of water. The NUID water rights are the most junior of Central Oregon’s irrigation district water rights from the Deschutes River and its upper tributaries; when there is insufficient water, NUID is the first to get cut back.

For the irrigation districts, appropriation of water rights is significant to the management and economic sustainability of their patrons.

As downstream users with junior water rights who depend on the reservoir for water, irrigators within NUID are unfavorably positioned to receive adequate water supply.⁵ The uncertainties of a reliable water supply make it challenging for NUID irrigators to plan cropping operations and other farming activities.

b. Spotted Frog Habitat Conservation Plan (HCP) and its effect on Jefferson County agriculture

The HCP was approved by the US Fish and Wildlife Service in 2021. It includes a set of reservoir release and diversion restrictions to increase winter flow and decrease summer flows below Wickiup Reservoir to support the Oregon spotted frog (<https://www.fws.gov/project/deschutes-river-basin-habitat-conservation-plan>). If current drought conditions persist and the HCP is fully implemented as planned, the amount of water for Jefferson County irrigators could be severely diminished by 2029 without a major effort to conserve and redistribute water across the Deschutes Basin.

The following points are based on comments from Mike Britton, NUID (Group meeting minutes):¹⁴

- HCP signatories included all 8 Central Oregon irrigation districts and the City of Prineville
- HCP covers Oregon spotted frog, steelhead, and bull trout. Chinook and sockeye are not yet listed but would fall under this HCP. There is uncertainty about whether the western ridged mussel will be listed.
- HCP covers many activities, including storage and release in 9 reservoirs, pumps, and multiple locations of spills from irrigation districts.
- HCP requires winter flows, ramped up over 13 years. Currently it requires releases from Wickiup of 100 cfs, then increasing to 300 after September 2028 and then to 400-500 after September 2033. It is expected that the following types of activities will help make up the shortfall that is not stored for NUID in Wickiup:
 - Transfer or sale of summer flow water rights from COID and other irrigation districts to NUID (“water marketing”).
 - Piping canal infrastructure with conserved water coming to NUID as live summer flow.
 - On-farm efficiency in COID; this has been a challenge for years because the COID irrigators are often part of a rotation (multiple landowners that share water from one point of delivery) and generally have little incentive to become more efficient. However, now COID is piping laterals and pushing farmers to improve their IWM (irrigation water management).
- HCP is a 30-year plan; 2023 is the second year. Unfortunately, the first two years of the HCP coincided with severe drought. This has resulted in the erroneous conclusion by a meaningful number of NUID landowners that the HCP is responsible for their short water deliveries rather than the drought.
- **During the first phase of the HCP (when winter releases are 100 cfs), the HCP should not affect the amount of NUID water deliveries in years without significant drought.**
- Conservation projects are key to success moving forward. For example, when a Deschutes Basin irrigation district completes a “conserved water” project, the conserved water can be transferred to NUID as live summer flow withdrawal in exchange for winter Wickiup spotted frog releases.

2. Hydrologic Drought

Jefferson County has declared drought status for four consecutive years beginning in 2020. Its watersheds have always been susceptible to drought and lack of available water. But the last several years have had historically **lower snowpack** in the upper Deschutes Basin.¹⁵ Superimposed on this are the observations that groundwater flows in the region have been decreasing overall for the last 20 years even if periodically there have been above average snowpack years.¹³ This decrease in sub- surface flow has contributed to even lower year-to-year baseflows and stream discharge. Thus, the trend of less available water over time is beginning to further burden agriculture in Jefferson County.

From the Central Oregon Daily News (July 17, 2023): <https://wp.me/pdzeVF-22nK>

One decent winter does not break a multi-year drought. That’s becoming obvious as streamflows decline and irrigation districts reduce water deliveries to farms and ranches.

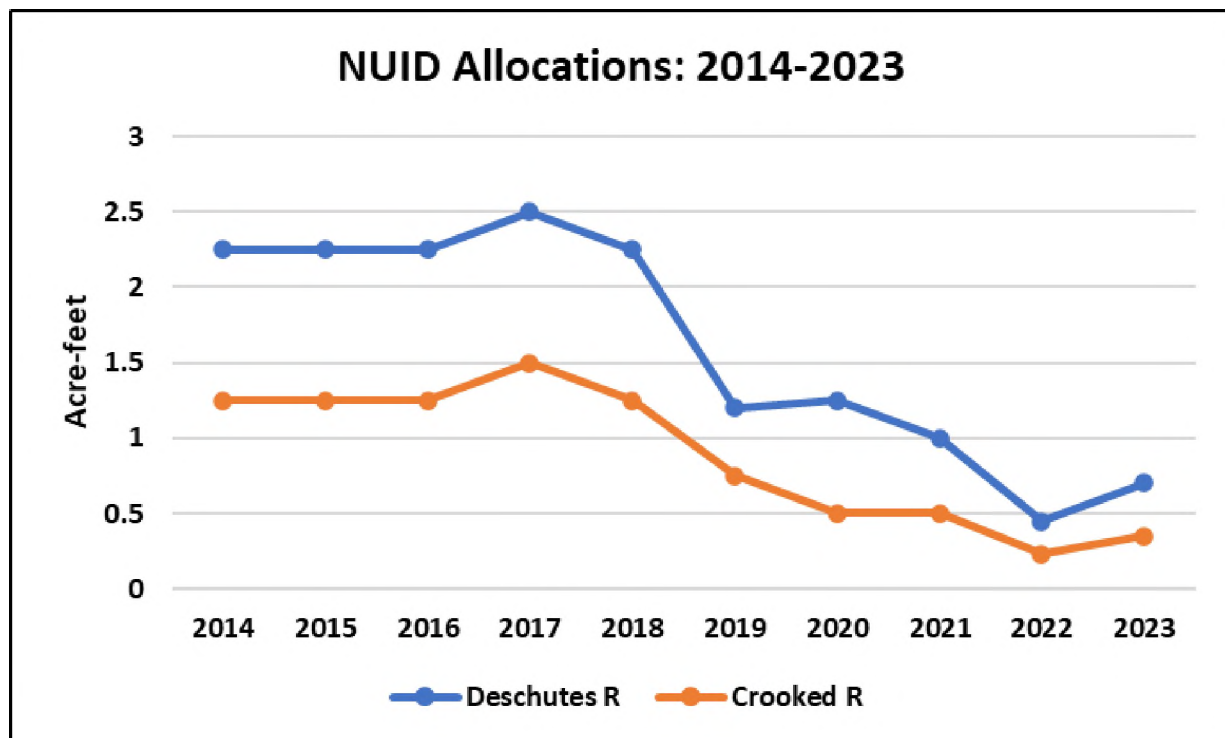
“We’ve been running a stream gauge on Fall River, which is a spring fed tributary of the Deschutes River for 85 years, since 1938,” said Jeremy Giffin, Deschutes Basin Watermaster with OWRD. “The flows that we are seeing coming out of those headwater springs today are the lowest on record.”

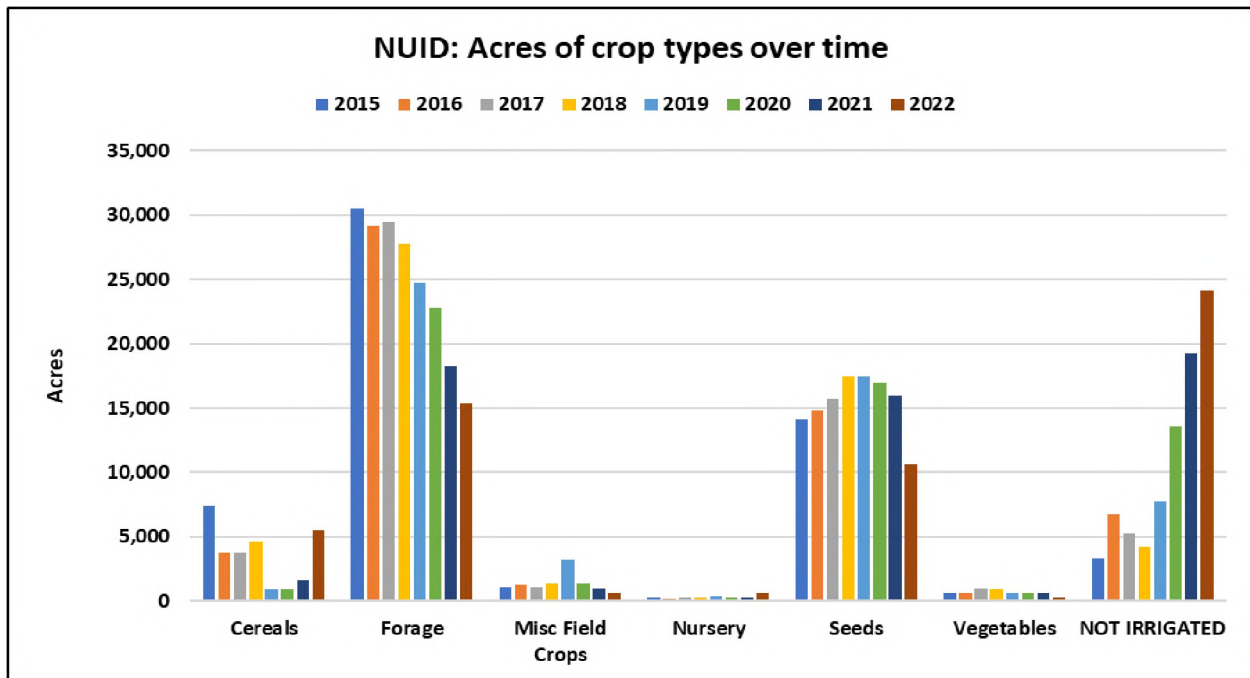
The Fall, Deschutes and Metolius rivers are mostly spring-fed. It takes years for the snow melt that percolates into the ground each winter to travel through miles of volcanic rock before it emerges from hundreds of springs.

Data show that Jefferson County **temperatures have been increasing** in the last 30 years, while total annual precipitation is cyclic and currently on a downward trend (Appendix A). Average annual temperatures have exceeded the long term-average (1895-2022) by 1.5°F in the last 20 years.¹⁵ The future is unknown, but it is expected that temperatures will continue to rise. Regardless of rainfall amounts, plant evapotranspiration rates will increase with higher temperatures, and thus plants will need more water (Appendix A, Figures 8-13).

D. EFFECT OF DROUGHT ON AGRICULTURE

It generally requires 2 ¼ AF of water to grow a crop in NUID. NUID has curtailed water deliveries since 2018, with a low of ¼ of the normal allocation in 2022. That year, 40 percent of NUID’s acreage was unirrigated.¹⁶ Many fields of cash crops went unharvested and were terminated with herbicide or failed for lack of water. Other landowners planted cover crops. A feedlot owner had to truck in millions of tons of feed for their cattle because they could not grow it on their own property as they do during normal years.





In 2022, the Oregon Legislature allocated \$3 million in emergency funding to help reimburse landowners who had planted cover crops and controlled weeds; 88 landowners received compensation for work on almost 25,000 acres. This support was desperately needed but was still a stop-gap measure for a long-term problem.

Landowners outside of NUID have experienced declining well levels and difficulty in diverting adequate water from local rivers and streams for irrigation and livestock water. Many dryland farmers enrolled their fields in the Conservation Reserve Program or converted to cattle grazing.

E. CHALLENGES

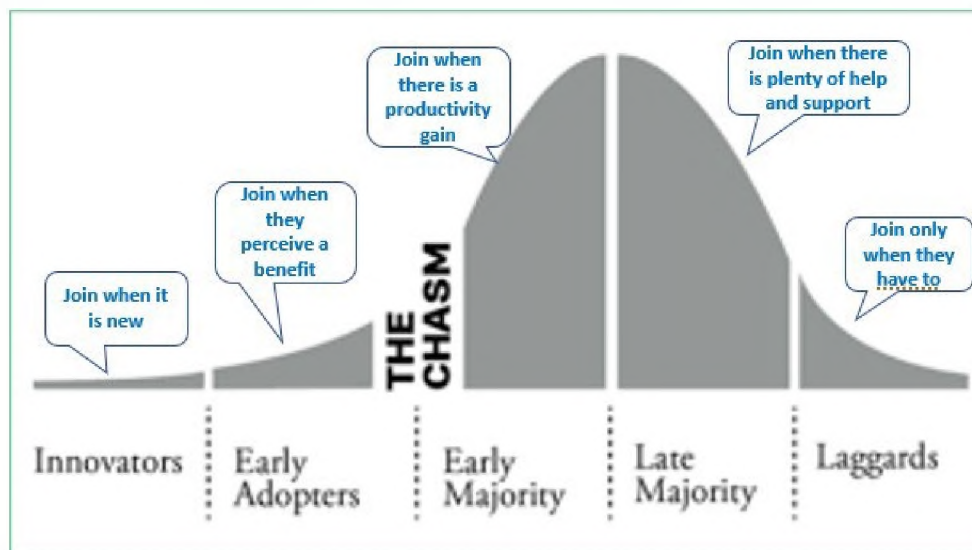
Jefferson County has had a vibrant farm economy and is a key producer of seed and specialty crops on the regional, national, and international stage. Why is it not prepared for drought?

Key issues are:

- Water laws, NUID as the junior water right holder on the Deschutes River system, and inadequate incentives for encouraging efficient on-farm use by senior water rights holders in the Upper Deschutes Basin.
- The recent requirements of the HCP have created an unprecedented financial and logistical challenge for NUID and Jefferson County irrigators.

“Without significant investments, NUID and their neighbors are unlikely to be able to implement water conservation projects at the scale needed to meet HCP requirements. If NUID fails to satisfy its requirements under the HCP, it may face additional involuntary curtailment leading to even more drastic reductions in agricultural production than the district faces today.”¹⁵

- Irrigation delivery systems throughout the Upper and Middle Deschutes Basins run through fractured basalt that experience huge water loss (up to 40%) and are extremely costly to pipe.
- Tensions exist among supporters of different water uses (e.g., fish, cities, farmers), such as beliefs that farmers take needed water from fish, or that urban desires for public trails along open, scenic canals clash with plans for water-efficient piping.
- Farmers and ranchers need to change what has worked for decades and try new ways.
- Farmers and ranchers struggle economically due to drought and cannot take on more risk than they are already experiencing; costs can be very high for new equipment or replacing a proven cash crop with an unknown.
- Local partners have not managed to successfully cross “The Chasm” with information and technical and financial help as evidenced by incomplete adoption of beneficial practices.



II. THE GROUP

In November 2022, OWEB provided funding to the JCSWCD to develop a long-range plan to help Jefferson County Agriculture thrive despite drought.

A. PARTICIPATION

In November 2022, JCSWCD staff convened the Jefferson County Agricultural Drought Resiliency Group to develop the plan. *The Group continues to grow and is open to any interested party that seeks to move forward in a collaborative manner to help both fish and farmers.* People can participate at any level they wish. Several participants are members of the Deschutes Basin Water Collaborative, and the Group seeks to stay aligned with the Collaborative's goals and messaging.

JCSWCD staff solicited participation and requested suggestions from:

- JCSWCD and Middle Deschutes WC Boards
- NUID
- Local agricultural groups, including Jefferson County Farm Bureau
- Jefferson County commodity groups
- Jefferson County agricultural businesses
- Oregon State University
- Conservation partners, such as energy efficiency entities
- Deschutes and Crook County SWCDs and Crooked River WC
- the mailing list of the now-defunct Irrigation Water Management Group led by ODA for over a decade, which had over 30 members from Deschutes, Crook, and Jefferson Counties representing diverse interests
- State and Federal natural resource agencies
- Confederated Tribes of the Warm Springs
- Latino Community Association of Central Oregon

Participants are listed on Page ii of this report.

B. GROUP PROCESS

The Group met monthly November 2022 through June 2023 and then changed to a quarterly meeting schedule. Meeting minutes are provided at <https://www.jeffswcd.org/drought-resiliency-group>.

First, they agreed that it was worth meeting and that not addressing drought would be calamitous. They also were committed to a respectful, collaborative process that did not rehash grievances but was forward thinking.

They developed a Vision that acknowledges the critical role that agriculture plays in the well-being of all of Jefferson County: *Jefferson County agriculture will thrive by adapting successfully to drought, and will support its people, animals, economy, environment, and culture.*

The Group decided their Mission is: *to help agriculture create a sustainable, livable future for Jefferson County by adapting successfully to drought with support from Deschutes Basin stakeholders.*

We promote innovative solutions to proactively improve watershed health and increase the effective management of water.

Group participants described best possible outcomes:

- We accomplish our vision, and all are thriving—not just the people, but the land, animals, plants, the whole environment—with a healthy economy and culture.
- Farmers/ranchers are doing things differently on the farm and land, e.g., planting different drought-tolerant crops, technology solutions, etc.
- Farmers/ranchers learn and start effectively using and embracing different ways of working with and stewarding the land in harmony with nature.
- There is greatly increased respect for and valuing of the role of farmers, ranchers, and land stewards by non-agricultural people, as well as by farmers and ranchers themselves.
- There is much better collaboration and cooperation among all stakeholders in the whole Deschutes Basin.
- Farmers/ranchers have plenty of water to grow crops successfully and at the same time there is plenty of water for all the different interests in the Deschutes Basin.
- The whole ecology (land, plants, and animals) is healthy and flourishing.
- Farmers/ranchers can sustain themselves and their families and create a healthy, thriving rural economy and culture.
- Jefferson County is a model for other areas dealing with similar challenges. We become a resource, sharing our experience and expertise to support others in this process.

The Group spent months brainstorming tools to help landowners. They named over 40 tools (actions that could be taken by landowners or their conservation partners) to help achieve the Group vision AND satisfy one or more of the following Goals:

1. Enough water to satisfy Jefferson County's agricultural needs
2. Consistent and predictable water supply for agricultural activities
3. Optimize agricultural profit with less available water
4. Benefit watershed health (including soil, fish, and wildlife)

The Group plans to meet quarterly to track long-term Plan implementation.

C. PUBLIC OUTREACH

Public outreach about the Plan development process was limited due to the unpredictable nature of the process.

- January 2023: announcement of the planning process at a meeting of the Deschutes Basin Water Collaborative
- May 2023: by invitation, presentation at the Northwest Energy Efficiency Exchange in Portland, Oregon, resulting in more experts in energy savings joining the Group.
- June 2023: presentation to the Jefferson County Board of Commissioners
- July 2023: article in the Madras Pioneer newspaper and website
- Upcoming February 2024: one hour roundtable at Madras' Farm Fair with local farmers and other attendees

III. THE PLAN

The Plan is a living document and will continue to be changed over time by the Group. It is expected that the Plan will be updated in December of later years.

A. THE TOOLS

Table 2 shows the Tools brainstormed by the Group in 2023, with varying degrees of Group-assessed usefulness. The Tools include both short and long-term solutions, some that can help many landowners, and some that are very site-specific.

Some of these Tools are related to soil health and ‘regenerative agriculture’. There was both enthusiasm and skepticism about the extent to which these Tools could increase soil organic matter and water retention. In fact, there is a lack of relevant research, especially for aridic soils. A 2021 report from The Nature Conservancy about the challenges of implementing ‘regenerative’ practices and the limited potential efficacy of such practices in the Upper Colorado Basin echoes much of the Group discussion regarding the efficacy of implementing similar regenerative practices in Jefferson County.¹⁷

Table 2. Tools brainstormed by the Group in 2023. They are grouped into the following categories that reflect the organization of the Workgroups. They are also listed in general order of highest to lowest ‘need’ for the Tool within each category based on Workgroup ratings.
1. WATER AVAILABILITY/ACCESS/DISTRIBUTION
NUID pumps from Lake Billy Chinook
Cloudseeding
NUID pipes canal infrastructure
Irrigation districts in Upper Deschutes Basin become more efficient (via piping), so water could get transferred to NUID
Change definition of beneficial use to allow landowners to fallow field without affecting 5-year use period
Allow seasonal water rights transfers between irrigation districts (“Water banking”)
Hydroelectric plants within NUID system
Allow permanent water rights transfers between irrigation districts
Allow split season and split duties in upper Deschutes Basin water rights w/saved water to go to NUID
Increase storage above (reservoirs) and below (aquifer) ground
Put water rights lost to development in upper Deschutes Basin instream
Irrigators in Upper Deschutes Basin become more efficient, so water could get transferred to NUID
Wells near main canals to catch seepage and repump into main canals
Change Deschutes Basin water rights so NUID is not the junior user*
Increase annual allocation for NUID water right*
Rescind or modify current HCP discharge requirements for Wickiup Reservoir*

* Not recommended; see below.

2. CROPLAND (on-farm efforts on lands in the irrigated area around Madras)
Diversify cash crops
Convert to more efficient irrigation, e.g., MDI, LESA/LEPA, variable frequency drives, subsurface drip
Maximize irrigation scheduling to plant needs and weather (soil moisture sensors, OpenET, NDVI, etc.)
Maintain irrigation equipment (fix leaks, etc.)
Use cover crops intentionally as part of a rotation for multiple benefits
Less tillage
Effective control of annual weeds
Graze cover crops/stubble to recycle nutrients
Apply soil health amendments (e.g., humic acid, enzymes, biochar, etc.)
Build more ponds to capture water for reuse
Maintain ponds: line and clean out
Diversify income-producing ag: (grass-fed meat, organic, CSA, farmstand)
Apply compost/manure to irrigated cropland
Agrivoltaics
Grow silage crops for livestock feed
Raise cash crops/livestock on part of the acreage; use rest of land for soil health/crop experiments/etc.
Soil surfactants to hold soil in place in furrows

3. RANGLANDS (on-ranch efforts on lands outside of the irrigated area around Madras)
Diversify income-producing management: (e.g., CRP, CREP, guided hunts, fee hunting, Country Natural Beef, grass-fed meat, CSA, agritourism)
Control junipers (includes periodic burning)
Targeted grazing to increase forage
Vegetated streambanks
Control annual weeds in rangelands
Raise water table in rangeland streams; reconnect creek to floodplain (channel modification, beavers, placing large wood, and BDAs) other than juniper control
Protect and capture seeps and springs to provide wildlife and livestock water (INCLUDES SOLAR)
Reseed uplands with non-native forbs and perennial grasses
Reseed uplands with native perennial grasses/forbs
Soil health amendments (e.g., humic acid, enzymes, biochar, etc.)
Agrivoltaics
Masticate trees and leave chips as mulch
Capture runoff in uplands w/ponds and checkdams
Drill into crop residue (low 'need' for this Group because only two ranchers still raise dryland crops and they are already drilling into crop residue)

B. WORKGROUPS

In July 2023, the Tools were assigned to one of four workgroups, which started meeting in November 2023 after the irrigation season. The Workgroups are charged with refining the characteristics of each Tool as captured in the Matrix (Appendix B), deciding which ones to focus on first, and how to move forward with each Tool. The Workgroups will develop implementation plans for each Tool, starting with the ‘focus’ ones. These implementation plans will become part of the Long-Range Plan; they will more clearly define the goals that the Tool will meet, challenges and opportunities for Tool implementation, specific resources needed for implementation (people, research, outreach, funding, etc.), and a timeline for moving forward.

The Workgroups are:

1. Water Availability/Access/Distribution (Chair: Josh Bailey, NUID)
2. Croplands (Chair: Gordon Jones, OSU Ext)
3. Ranchland: range/dryland grains/irrigated meadows (Chair: Ally Steinmetz, MDWC)
4. Agrivoltaics (solar panels on a farm/ranch in association with agricultural activities)
5. Public Outreach

C. “CURRENT FOCUS” TOOLS

The Workgroups used best professional judgement to identify challenges and opportunities for each Tool. They also rated each Tool for: current implementation status, benefit towards the Vision, and likelihood of full implementation. They rated each Tool for ‘need’ based on the 1) benefit towards the Vision, the 2) likelihood of full implementation, and 3) the gap between current implementation status and the benefit towards the vision. The larger the gap, the higher the potential need to focus on that Tool.

All this work is continually captured in the Matrix. The Matrix summarizes conversations and does not capture the context and nuances of the discussions. All ratings assigned by the Group or its Workgroups are subject to change as more becomes known and/or Tools are implemented. The Matrix is available from the JCSWCD.

As a result of working through the Matrix, the Workgroups decided which tools to focus on for now. Other Tools will be implemented as needed, but some may benefit only a few landowners, require more research before implementation, or were deemed unlikely to have meaningful benefits on further reflection by the Group. The Tools include both long-term (especially Water Availability/Access/Distribution) and shorter-term steps that landowners can take now. The Workgroups also identified research and assessment needs.

Three Tools are not recommended, all related to Water Availability/Access/Distribution. ‘Increasing NUID’s allotment’ and ‘changing NUID’s priority date’ would require massive changes in Oregon’s water law and are not needed if the Focus Tools can be successfully implemented. ‘Rescinding or renegotiating the HCP’ are not options for NUID or for most Group participants. Drought, not the HCP, is the biggest obstacle to providing adequate NUID deliveries. Plus, it would cost millions of dollars to alter the agreement, it provides protection to the HCP signatories (which includes NUID) against lawsuits for the next 30 years, and there is the possibility of *increasing* reservoir releases that would harm NUID

irrigators even more. However, while these three are not recommended per Group consensus, the Group recognizes that individual participants have every right to pursue them as they see fit.

1. Water Availability/Access/Distribution

The Focus Tools are long-term tools to help address both the demands of the HCP and changing climate. Implementation is complex and costs are high. NUID and the DRC are collaborating with other key players to implement the Focus Tools. The Group will support these projects as requested by both 1) writing letters of support and 2) creating and distributing videos to help explain the benefits of these projects to the public.

a. Change NUID Crooked River Point of Diversion to Lake Billy Chinook

- 1) Benefit: supply half of the water needed by NUID and would leave more water in the Crooked and Deschutes Rivers for aquatic life.
- 2) Challenges: Expensive and will need support from many major funders. Estimated to cost \$400+ million plus annual operating costs. Currently designed to divert Crooked River flows; if expanded to pump Deschutes River flows, there would need to be legal changes to the point of diversion and other issues. And NUID would still need to divert at Bend to supply water to landowners at Lower Bridge and near Juniper Butte “upper-canal” of its proposed pumping plant.
- 3) Status/Opportunities: Awaiting completion of appraisal study and feasibility study funding.
- 4) Timeframe: Appraisal study release Spring 2024. Feasibility study 3+ years.
- 5) Next Steps: Move to feasibility study If appraisal study recommends. Initial reports are that BOR can self-fund the study (\$5,000,000).
- 6) Comments: this is one of the long-term strategies that is of the greatest interest to NUID and would provide the greatest benefit for the environment, public, and farmers.

b. Pipe canal infrastructure in the Upper Deschutes Basin

- 1) Benefits: NUID would get most of the water they needed if COID and AID distribution systems were piped. It would also leave more water in the Deschutes River
- 2) Challenges: Piping is extremely expensive, and many landowners adjacent to canals in the Upper Basin are opposed because they do not want to lose the aesthetic value of open waterways adjacent to their properties. Several lawsuits to prevent piping have been filed; responding to lawsuits requires resources.
- 3) Status/Opportunities: This is a large and expensive project and requires support from landowners, irrigators, and irrigation districts. The DRC is supporting efforts by AID and COID to pipe their canals. The DRC is also working to develop an effective water bank that would allow conserved water from COID to be transferred to NUID (Pilz et al., 2023).
- 4) Timeframe: next 10 years
- 5) Next Steps:
 - 1) COID completes an Environmental Impact Statement that enables them to secure the federal funding to pipe their Pilot Butte Canal (1 year).
 - 2) COID completes piping of the Pilot Butte canal (5 year)

- 3) Continue to work to secure the federal funds and matching funds needed to pipe the districts.
- 4) AID completes their current piping project (3 year)
- 6) Comments: DBBC/DRC is taking the lead on working with the Upper Basin irrigation districts to implement water conservation projects. Completing the conservation projects means more water for aquatic life, recreation, and farmers.

c. Pipe canal infrastructure in NUID

- 1) Benefits: Piping all of NUID would increase water deliveries, but NUID estimates they would still be unable to meet patron demand. It would also leave more water in the Deschutes River below Wickiup Reservoir.
- 2) Challenges: Costs are enormous. It is estimated that piping all of NUID's 300 miles of canals would cost almost \$2 billion.
- 3) Status/Opportunities: NUID does not plan to pipe any of its main canals. However, NUID's Modernization Plan identified priority laterals to pipe. NUID recently received approval to convert 27.5 miles of open irrigation canal to gravity-pressurized, buried pipe, which will conserve 6,089 AF of water annually at a cost of \$37.5 million (Pilz et al., 2023).
- 4) Timeframe: NUID will pipe additional priority laterals as funding becomes available.
- 5) Next Steps: Complete current piping project. Continue to identify areas of conservation potential, seek funding, and implement the projects.
- 6) Comments: NUID continues to lead with on-farm efficiency and conservation projects and will strive to become increasingly efficient.

d. Change definition of Beneficial Use to allow for fallowing during drought

- 1) Benefits: Allows a landowner to withhold irrigation water from a field and not count against the 5-year 'use it or lose it' requirement if a drought is declared in that county. Currently NUID farmers can fallow fields and move water to other fields within the district. There are mechanisms in place for water to be transferred from one district farmer (COLD) to another (NUID) but state administrative processes get in the way and the "from" district needs to be a willing party which is not always the case due to board hesitancy, administrative and operational hurdles.
- 2) Challenges: Changing Oregon's definition of Beneficial Use
- 3) Status/Opportunities: SB718 was passed in the 2023 session. The new law, "[a] drought year does not count as a year for purposes of forfeiture under this section for a holder of a perfected and developed water right within the county for which the drought year was declared, if the holder has a facility capable of handling the entire rate and duty authorized under the water right and is otherwise ready, willing and able to make full use of the water right." A "drought year" is defined as "a calendar year in which the Governor declares ... that a severe, continuing drought exists, or is likely to exist, within a county."

The new law further states that "[a] year, during which nonuse occurs, that precedes or follows a drought year, counts as a year for purposes of forfeiture under this section for a holder of a perfected and developed water right within the county for which the drought

year was declared.” It also provides that the new exemption “may not have any effect on consideration of an application [to transfer a water right] under ORS 540.520.”

- 4) Timeframe: Legislation was passed in this Legislative session.
- 5) Next Steps: No additional work planned other than tracking whether the law is operating as intended.
- 6) Comments: Mike Britton (NUID Executive Manager) is taking the lead.

e. Cloudseeding

- 1) Benefits: Based on data from Idaho, cloudseeding could increase precipitation in areas like Central Oregon by up to 14%.
- 2) Challenges: legislative changes, lack of research or inconclusive research in Oregon (https://ir.library.oregonstate.edu/concern/parent/pk02cb67g/file_sets/w0892c181), opposition from some stakeholders concerned by the effect of cloud seeding on rainfall and the environment.
- 3) Status/Opportunities: A bill (SB58) was introduced in the 2023 Legislative session to have Oregon Water Resources Department study the concept. It did not pass. In addition, there is more education needed on the potential benefits of cloudseeding to agriculture.
- 4) Timeframe: Legislation may be re-introduced in the 2025 session.
- 5) Next Steps: NUID has submitted grant applications to the USBR and OWRD for funding to study cloud seeding in the Deschutes Basin.
- 6) Comments: Mike Britton (NUID Executive Manager) is taking the lead.

Additional Tools will be implemented as needed. For instance, the DRC is actively working with Upper Deschutes Basin irrigation districts on temporary transfers of water rights from individual irrigators to NUID through the ‘water banking’ project.

2. Croplands

This Workgroup is addressing the croplands around Madras (encompassing NUID and nearby croplands). It was originally named “Irrigated Croplands” until it was realized that growing dryland crops in fields with water rights could be a helpful Tool and is already being tried.

This Workgroup has the most complex agricultural practices and traditions to work with. Many farmers are innovative or ‘early adopters’ and have tried and are trying new things. However, a large number of farmers are waiting for proof of success or financial assistance before adopting new practices.

This Workgroup has met twice so far and agreed that diversifying cash crops was the highest priority, followed by irrigation efficiency/management. Additionally, there is interest in cover cropping and other soil health practices.

Tools to improve soil health suggested by the Workgroup would likely have received greater support and interest if more was known about what might work here in Jefferson County and how much benefit they would provide. Soil health is a priority for the NRCS and SWCD. The NRCS is starting a NUID Soil Health Conservation Implementation Strategy in 2024 that will encourage farmers to adopt various practices that improve soil health.

a. Diversify cash crops

- 1) Benefits: Greater variety of cash crops, especially anchor crops, would provide better economic sustainability for producers and limit the risk of fluctuating markets. Greater crop diversity would also spread demand for water across the season and could improve soil health.
- 2) Challenges:
 - a) There is an inherent financial risk for producers experimenting with new crops. New crops may take up acreage used for a proven cash crop and need specialized equipment. Crop insurance is generally not available to defray risk associated with new crop production.
 - b) If profitable new crops are identified, there is the risk of saturating the market and dropping the price for all growers.
 - c) Oregon has canola growing restriction zones, and Central Oregon is one control district. There may be other crop co-existence issues, although not of a statutory nature.
 - d) Need to find other crops that can be grown here profitably. This will require both agronomic and market research. Who will do the research? Who will pay for the research?
- 3) Status/Opportunities: Many crops have been grown in the past and were not viable either agronomically or economically. Research is needed to find out what can grow here, but more importantly markets will need to be developed so that new crops can be profitable.
- 4) Timeframe: The Workgroup will develop a Plan in 2024 for implementing this Tool.
- 5) Next Steps: Workgroup continues to meet every 1-2 months to develop and implement a Plan.
- 6) Comments: This Tool is critical for Jefferson County's success. It will also take much research and sharing of information.

b. Optimize crop water use efficiency

- 1) Benefits: Optimizing crop water use efficiency, or the "crop produced per drop" will reduce the amount of water needed to grow crops and/or will maximize profit on irrigated acreage. It may also reduce pumping costs and reduce runoff and leaching that can carry nutrients and other pollutants into sensitive sites.
- 2) Challenges:
 - a) Great improvements in irrigation application efficiency in NUID have already been made (50% of acreage under pivot/linear irrigation) and additional conversion will be costly and result in a moderate gain in water savings.
 - b) Converting to a center pivot can cost upwards of \$200,000. Plus, sprinklers need appropriate power supplies, which can add significantly to the cost of a project.
 - c) Many irrigation decision support tools such as websites, soil moisture monitoring probes, etc. are available but not widely used in Jefferson County for irrigation scheduling.
- 3) Status/Opportunities: Approximately 90% of NUID acreage is under sprinkler, half of that pivots, linear, or drip. Landowners, especially in the southern part of NUID are requesting

conversion from flood to wheel lines (wheel lines are cheaper than pivots and not as efficient). Many opportunities exist for providing landowners with more tools to help with irrigation scheduling and planning (e.g., Agrimet ([mrso - Madras, Oregon AgriMet Weather Station \(usbr.gov\)](#)) and Open ET (<https://openetdata.org/>)), and that outreach will be discussed in 2024. The Workgroup also needs to develop numeric goals and metrics to determine progress and success.

- 4) Timeframe: The Workgroup will develop a Plan in 2024 for implementing this Tool
- 5) Next Steps: Workgroup continues to meet every 1-2 months to develop and implement a Plan.
- 6) Comments: Many farmers have converted to pivots without financial assistance. These are primarily the innovators and early adopters, and generally also tend to be larger operations that have relatively higher degrees of capitalization and favorable equity positions to support such large investments. The JCSWCD routinely receives requests from other landowners for funding conversion from flood to wheel lines or pivots, or wheel lines to pivots. Improvement of physical irrigation systems (converting to pivots, LESA, LEPA, etc.) should not be conflated with the efficient operation of those irrigation systems, which still require soil moisture monitoring and use of evapotranspiration to track crop water use.

c. Increase use of cover cropping

- 1) Benefits: Cover crops can provide multiple on-farm and environmental benefits, but little research has been conducted on how to maximize benefits in Jefferson County farming systems. In other regions, cover crops have been shown to reduce wind and water erosion and improve soil health. Cover crops are a useful tactic in integrated control of weeds. Some cover crops have synergistic benefits for subsequently planted cash crops (e.g., legumes fixing nitrogen, and mustard suppressing pathogens before potatoes). Planting into cover crop residue may improve cash crop seed germination, plant establishment, and vigor for certain crops.
- 2) Challenges:
 - a) Cover crops can compete with cash crops for limited water.
 - b) Seed growers must provide seeds with a high level of purity. Cover crops may contaminate adjacent or subsequent seed crops.
 - c) Multi-species cover cropping may have more soil health benefits but doesn't qualify for crop insurance.
 - d) Some cover crops have been tried successfully here (e.g., winter wheat and mustard). It will require research and additional experimentation to identify additional crops that may help increase farm income and confer other potential agronomic and economic benefits.
 - e) Most cash crop seeds are small and can be challenging to plant into the standing residue left from a cover crop, increasing overall risk relative to traditional tillage-intensive practices.
 - f) The potential benefits of cover crops to increase water holding capacity is small relative to the amount of water normally applied to irrigated crops in the region.
- 3) Status/Opportunities: The last two years saw an increase in cover cropping, especially monoculture winter wheat in fallow fields and pivot corners. Landowners are

experimenting with Austrian peas, mustard, and other crops. Some cover crops could become cash crops if there was a way to cost-effectively process them. More information is needed for landowners on cover cropping. The Workgroup also needs to develop numeric goals and metrics to determine progress and success.

- 4) Timeframe: The Workgroup will develop a Plan in 2024 for implementing this Tool.
- 5) Next Steps: Workgroup continues to meet every 1-2 months to develop and implement a Plan.
 - Ray Archuleta (former NRCS Soil Scientist) will provide a workshop on Soil Health, including cover cropping, in June 2024 in Jefferson County
- 6) Comments: The innovative and early adopter farmers are already incorporating cover cropping. We need to characterize the benefits of cover cropping for those currently using them, conduct research on maximizing benefits, and share the resulting information with others.

3. Ranchlands

Part of the Blue Mountains ecoregion, the 'ranchlands' consist of the shrub/steppe landscape that is primarily grazed, and mixed conifer forest at higher elevations. The landscape includes irrigated hay meadows and a few remaining dryland wheat fields. Historically, juniper was confined to rocky outcrops and ridges and is now rapidly expanding into adjacent shrublands and grasslands where it competes aggressively with shrub-grassland communities and drives ecological transition to a degraded woodland state.^{18,19}

Restoration of the native shrub/steppe ecosystem is the priority of this group. This includes controlling juniper, managing grazing to increase desirable vegetative cover, and restoring stream ecohydrology (<https://ecohydrology.oregonstate.edu>).

a. Juniper control, followed by reseeding of perennials, control of annual weeds, and periodic burning

- 1) Benefits: Increased forage for livestock and wildlife, restoration of native shrub steppe ecology, restoration of hydrologic cycle, reduced fire danger, reduced erosion.
 - On average, 41% of total annual precipitation is intercepted by juniper canopy cover, and mature juniper trees use an average of 23 gallons per day of water during a wet year and 12 during a dry year ([Juniper Paired Watershed Study - Central Oregon | Ecohydrology | Oregon State University](#)).
- 2) Challenges:
 - a) Costs for labor, equipment, and herbicides.
 - b) Non-herbicide weed control is difficult at the large scale that is needed and may not be effective.
 - c) Some entities do not believe that juniper control improves watershed function.
 - d) Native perennial seed is much more expensive than a mix of natives and non-natives.
 - e) Juniper control has not traditionally always been 'bundled' with reseeding, weed control, and periodic burning. 'Bundling' can significantly increase the likelihood of success but also the cost and duration of projects.

- 3) Status/Opportunities: Juniper work has been done for decades in eastern Jefferson County. However, annual weeds have had limited control. The MDWC is mapping recent and planned projects to help the Workgroup develop a strategic plan. There has been discussion about mapping weeds, but Jefferson County is currently without weed control staff.
- 4) Timeframe: The MDWC and JCSWCD will provide a map of project areas by February 2024. The Workgroup will then develop a Plan in 2024 for implementing this Tool.
- 5) Next Steps: Workgroup continues to meet every 1-2 months to develop and implement a Plan.
- 6) Comments: The biggest challenge will be securing funding to fast-track juniper treatments at the watershed-scale and availability of skilled contractors to work across large, remote areas. Additionally, future grant proposals should be written to include the 'bundled' approach in project objectives.

b. Targeted grazing to increase forage

- 1) Benefits: Increased forage for livestock and wildlife, reduced erosion, improved soil health, increased water capture in soil
- 2) Challenges:
 - a) Most ranches are large with big, rocky pastures, and limited livestock drinking water.
 - b) Targeted grazing often requires smaller pastures and lots of fencing, which is expensive and challenging in rocky soils, or labor in the form of herders.
 - c) Need to provide livestock water for each pasture.
 - d) Costs for fencing, labor, and water developments.
- 3) Status/Opportunities: Landowners are interested in learning about more methods. The Workgroup needs to develop numeric objectives and metrics to determine progress and success.
- 4) Timeframe: The Workgroup will develop a Plan in 2024 for implementing this Tool.
- 5) Next Steps: Workgroup continues to meet every 1-2 months to develop and implement a Plan for this Tool.
 - Alejandro Carillo (rancher in the Mexican desert) will accompany Ray Archuleta at the Soil Health Workshop in June 2024 in Jefferson County
- 6) Comments: This Tool is not yet well defined or described. It will take work to figure out what it means and how to measure it.

c. Vegetated streambanks

- 1) Benefits: Store water in adjacent soils, later season flows, expanded riparian area for forage, improved fish and wildlife habitat.
- 2) Challenges: Costs of fencing, planting, and developing off-stream drinking water.
- 3) Status/Opportunities: Many streambanks have recovered from years of over-use and are providing water quality and quantity and habitat benefits. However, an unknown number of streambanks still need improvement. There has been interest but no mapping yet of 'streambank condition'. The MDWC and JCSWCD are working with ODA on metrics and

mapping tools to determine current status and guide the Workgroup on where to prioritize work.

- 4) Timeframe: The Workgroup will develop a Plan in 2024 for implementing this Tool.
- 5) Next Steps: Workgroup continues to meet every 1-2 months to develop and implement a Plan for this Tool.
- 6) Comments: Lots of interest in this tool.

4. Agrivoltaics

This Workgroup consists of experts in the field who are interested in increasing the use of agrivoltaics on both croplands and rangelands in Jefferson County.

There are multiple definitions of agrivoltaics, and the Workgroup adopted “Installation of solar panels on a farm/ranch in association with agricultural activities.” The generated power stays on the farm and offsets the existing power load. Locations include above crops or grazed land, unused land such as a pivot corner, on or over ponds or water conveyance systems, and pumping livestock water from ground or surface sources.

a. On-farm net meter solar agrivoltaics

- 1) Benefits: Retain water in shaded soils, increase soil health, reduce plant evapotranspiration rates, reduce evaporation when over water sources, and increase pollinator activity due to cooler air temperatures.
- 2) Challenges:
 - a) “Not in my backyard” due to concerns about the viewshed, property values, and losing farmland.
 - b) Not a lot of science about benefits and technology; few local examples.
 - c) Best practices for cropping and irrigating under panels are unknown.
 - d) Costs for installation, maintenance, and research.
 - e) Need to be near a meter.
- 3) Status/Opportunities: There is lots of potential for agrivoltaics in Jefferson County, but few installations. There is at least one in a pivot corner. Agrivoltaics could be used to power pivots, but we have no local examples. Lots more research is needed.
- 4) Timeframe: Increasing agrivoltaics in Jefferson County will take a long time.
- 5) Next Steps: The Workgroup is designing a flyer for Pacific Power customers to inform them of cost-share opportunities for using solar pumps for irrigation water, and at the same time soliciting participants in agrivoltaic research. The flyer will be ready for distribution in January 2024.
- 6) Comments: Multiple applications for agrivoltaics are possible in Jefferson County, and the Workgroup decided to start with on-farm net metering, while also being available to advise on panels over irrigation conveyance systems and pumping livestock water.

5. Public Outreach

Key Message: “Jefferson County agriculture is at risk, diverse, valuable, and worth supporting”

Support from Deschutes Basin stakeholders is key to the success of this Plan, because 1) the most likely source of additional irrigation water for NUID is from Deschutes County irrigation districts, 2) changes are expensive and need diverse support for funding, 3) some Tools may require legislative changes, and 4) a meaningful proportion of Central Oregonians perceives the use of water to irrigate crops as wasteful, destructive to environmental and other common good uses, or otherwise deserving of reduction or elimination.

A Public Outreach Workgroup developed an Outreach Plan with the goal of “informing the general public about Jefferson County’s unique role in regional and worldwide agriculture and landowner stewardship efforts so they support opportunities to help Jefferson County agriculture survive in spite of water shortages.”

The Workgroup will continue to refine and implement the outreach plan over time.

Key elements of the Outreach Plan

a. Desired results:

1. The public understands that Jefferson County farmers and ranchers are innovative land stewards and use their resources wisely.
2. The public understands that Jefferson County agriculture is a vital and unique part of regional and international food networks.
3. Jefferson County agriculture, streams, and cities/communities share the water so all have their needs met.

b. Desired actions:

1. Deschutes Basin stakeholders and the general public support improved water reliability for Jefferson County agriculture.
2. Deschutes Basin stakeholders and the general public support funding for irrigation districts, ranchers, and farmers.
3. Upstream irrigation districts endorse the sharing of irrigation water.
4. Upstream irrigators/irrigation districts share their irrigation water with NUID.
5. Deschutes Basin stakeholders and the general public support and take part in the Tools developed to solve water shortages in Jefferson County.

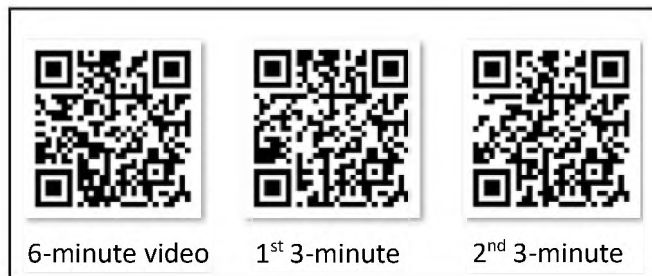
c. Key audiences and outreach methods

The Outreach Plan identifies key audiences and the most effective ways to reach them.

The Outreach Workgroup prioritized several tasks and started making them a reality.

Video

In December 2023, the Group released a draft 6-minute video (vimeo.com/back40media/jcswcd) and two 3-minute videos (vimeo.com/back40media/jcswcd2 and vimeo.com/back40media/jcswcd3) that highlight Jefferson County agriculture's diversity, value, and precarious position. The 6-minute video was first announced at a DRC Raising the Deschutes webinar at Worthy Brewery in Bend.



They will also release six one-minute videos in 2024 that highlight: food and food production, grass seed for sporting venues, wildflower and native land restoration, families and community, water losses in the canal system and how piping is needed, and river stewardship.

Logo

The Workgroup is working to develop a logo for Jefferson County agriculture that includes: a sense of location/place, water, agriculture (row cropping, range, and/or crops), and stewardship, with the words 'Jefferson County Agriculture'.

Presentations

JCSWCD staff and a local farmer participated in a panel discussion at Bend's Worthy Brewery after a showing of the "Kiss The Ground Movie" about regenerative agriculture.

Written information

The Workgroup is developing a brochure that describes Jefferson County agriculture and the work of the Group. Workgroup members are also developing a policy and process for responding to misinformation about Jefferson County agriculture in local media.

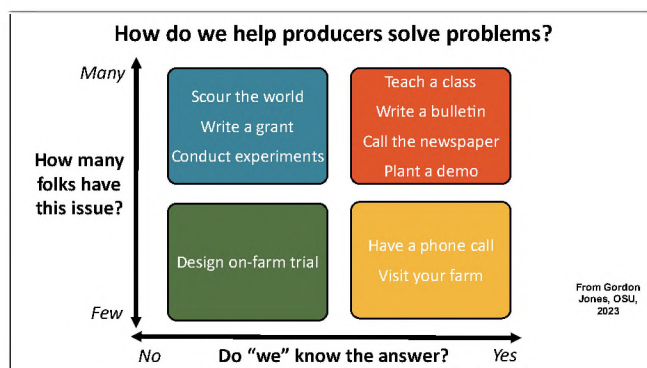
IV. FINAL WORDS

This first version of the Plan was intended to include implementation plans for Tools. However, it was impossible to predict how much the Group could achieve by December 2023, the due date for the Plan.

Given that the Group was formed only a year ago and that all landowners are taking time away from their income-producing activities to participate, the Group has managed to accomplish a great deal and is committed to filling in the missing pieces in the coming year. In 2024, each Workgroup will develop implementation plans that include timeframes and measures of success.

One of the largest challenges will be determining the most effective ways of providing information to the innovators and early adopters and bridging the Chasm to encourage the rest of the landowners to follow and successfully navigate drought in Jefferson County.

The Group expects to update this Plan annually.



The Group will be successful because its work is in line with this summary by Pilz et al. (2023).¹⁵

"Central Oregon is helping to pioneer a collaborative approach that takes these goals as compatible rather than in conflict."

These takeaways are important to highlight:

- **Investing in governance alongside infrastructure can be a powerful combination** when the paired efforts result in more than the sum of their parts. Without creative governance, investments in piping and modernization in NUID and COID could not be leveraged for instream flow to benefit the Oregon spotted frog.
- **Aridification may be the new normal** for much of Oregon east of the Cascades. While there will also continue to be years with high precipitation, the overall trend for the foreseeable future could be toward increased water supply scarcity. This underlines the importance of aggressive conservation and flexible innovations in governance to weather unpredictable future changes.
- **Collaboration is powerful.** As demonstrated by the Central Oregon irrigation districts, the DRC and other basin partners, collaboration opens the door for funding; trust built over time between collaborators increases resiliency by reducing conflict and providing a basis for the level of commitment that will be required to tackle the coming challenges.
- **Collaboration is the backbone of successful funding.** The costs of large irrigation modernization projects like piping 150 miles of COID's canals, are immense. Federal funders along with state and other sources are more likely to consider funding projects of this scale when they are supported by a broad coalition; in the case of the Central Oregon, long-term collaboration between the irrigation districts, the DRC and the CTWS, along with area cities and others, provide a compelling case for funding requests".

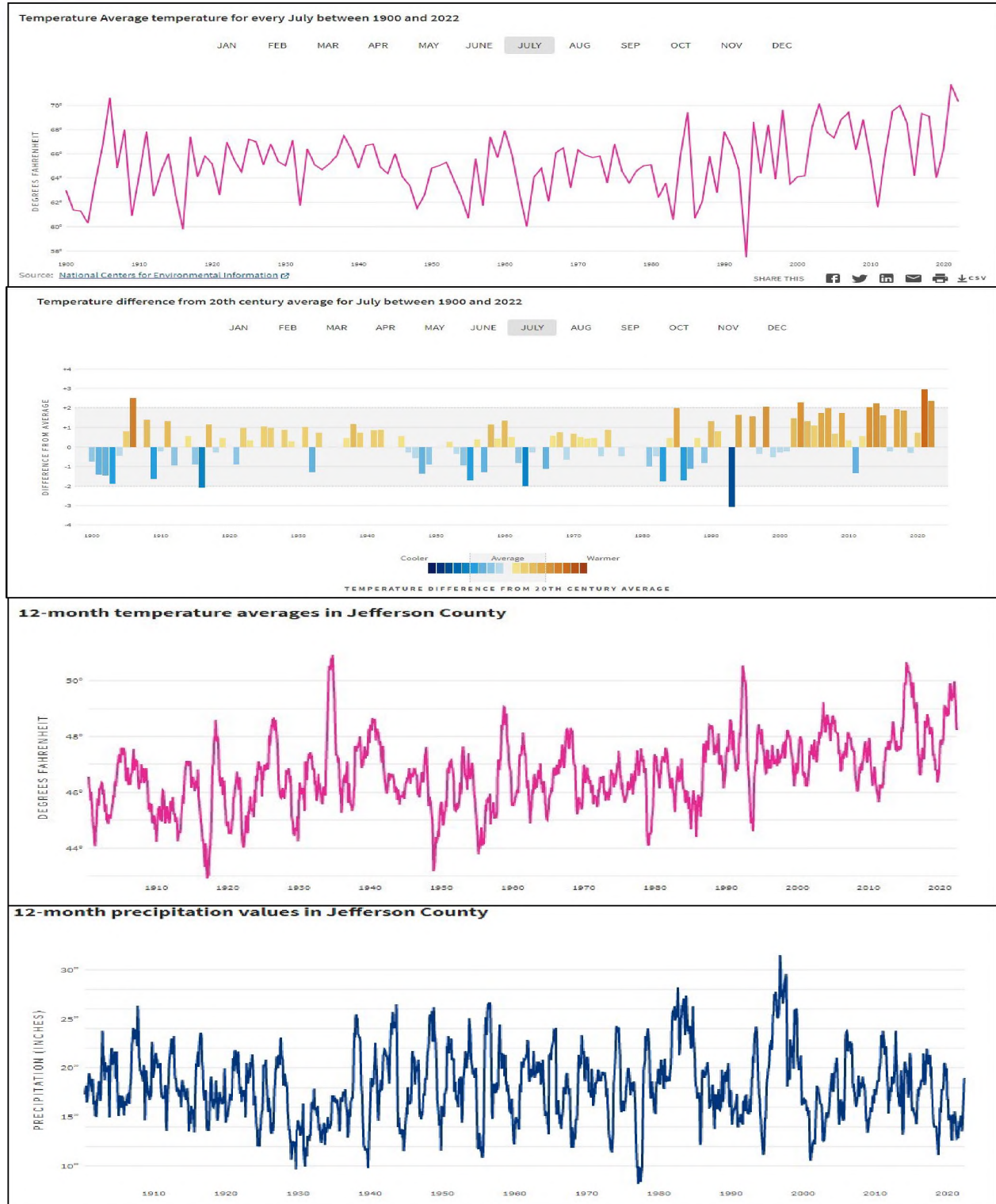
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APPENDIX A: CLIMATE DATA

Figures 1-4. Jefferson County, 1900-2022. Results are modelled from multiple data sources. Rainfall is calculated for all of Jefferson County, so values are higher than would be found around Madras. Note increasing temperatures since about 1995. Source: <https://usafacts.org/issues/climate/state/oregon/county/jefferson-county%20>.



Figures 5-6. Temperature and precipitation recorded at the Central Oregon Agricultural Research and Education Center (COAREC) northwest of Madras, 1983-2021. Note rising temperatures since the early 1990s and lower rainfall at Madras since around 2000. Source: <https://www.usbr.gov/pn/agrimet/wxdata.html>

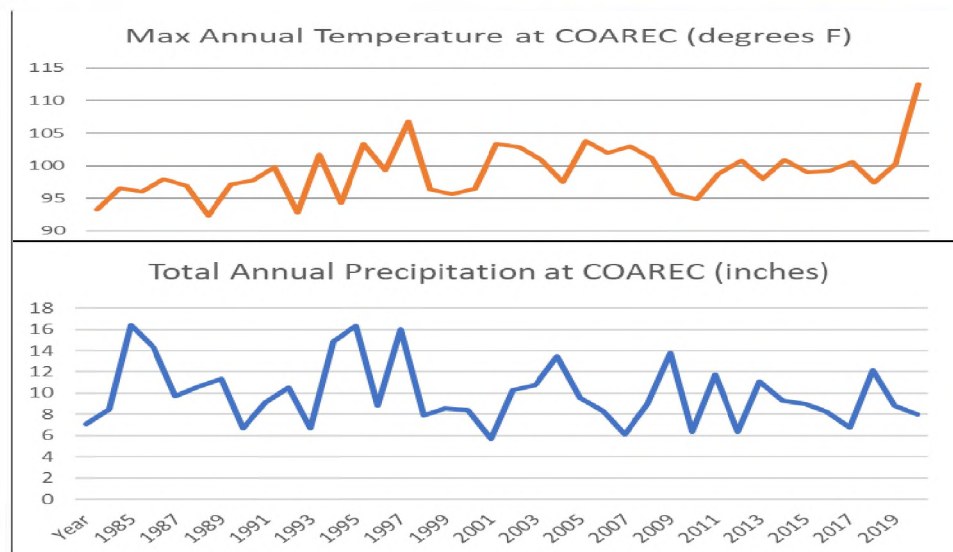
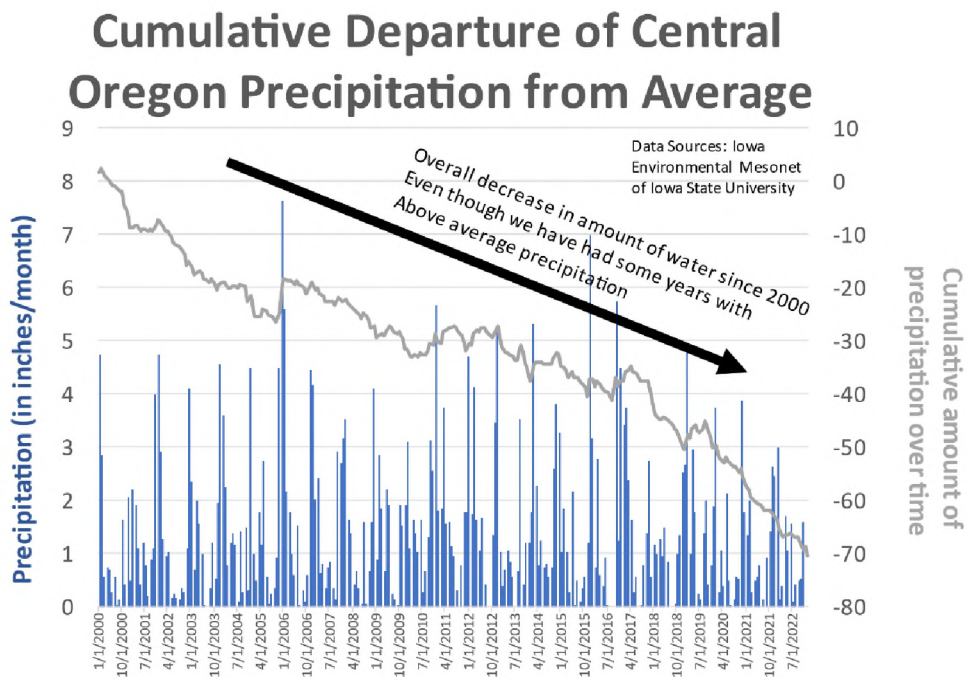
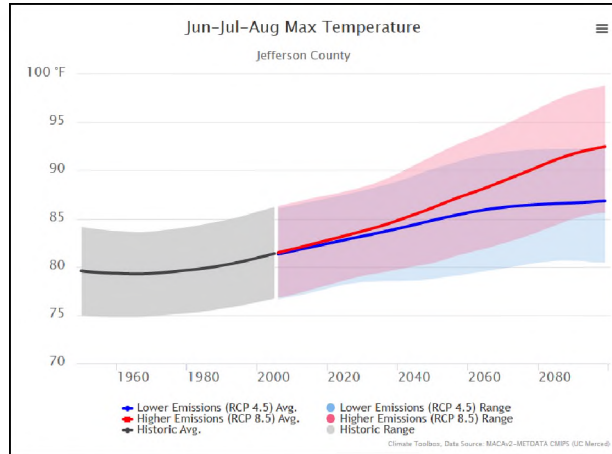


Figure 7. Precipitation at Wickiup Reservoir (where NUID stores its water for eventual delivery), 2000-2022. This graph was generated by comparing the monthly average against the actual precipitation each month, and then comparing a running total over time (22 years). Annual rainfall averages 22" per year at Wickiup Reservoir. In the last 22 years, Wickiup should have received 484" of rain (22" x 22 years). Instead, rainfall has steadily decreased and Wickiup has received 70" less over that time that would be expected. Source: Kyle Gorman, OWRD.

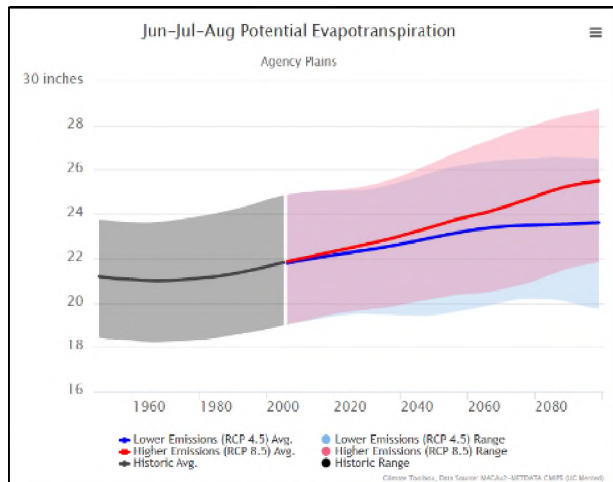
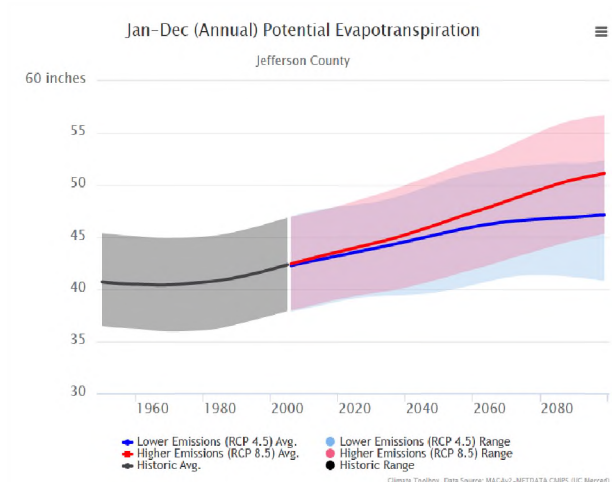
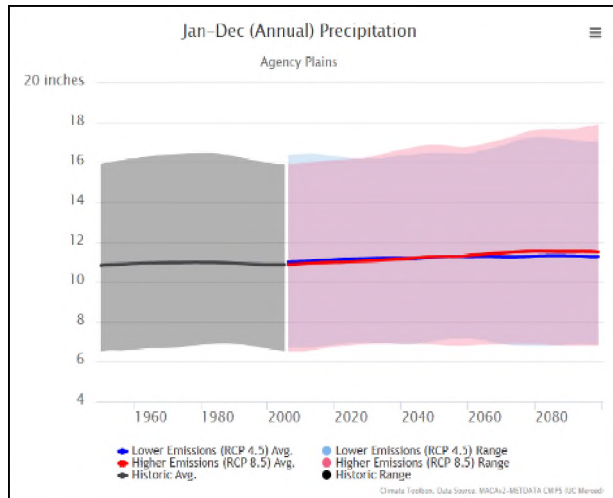
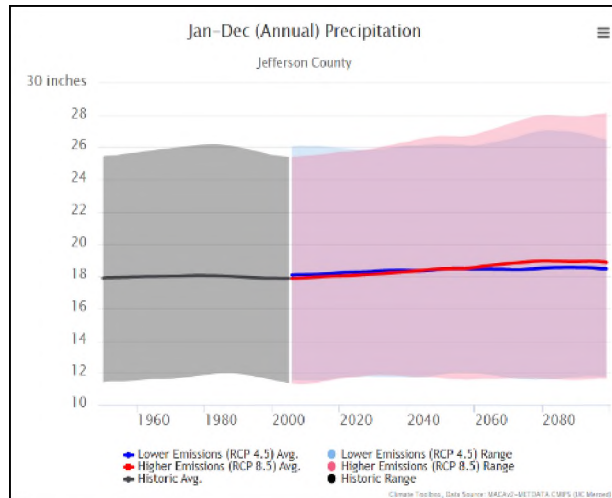
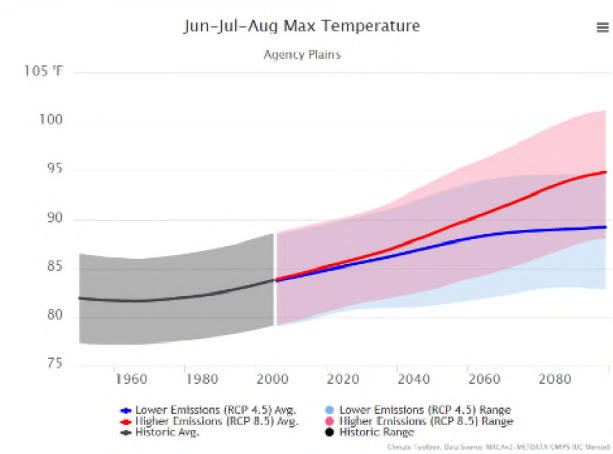


Figures 8-13. Temperature, precipitation, and evapotranspiration forecasting through 2090 for Jefferson County and for NUID, based on two levels of greenhouse gas emissions (black= historic average; red= high; blue=low). Note that annual rainfall is not expected to change much, but evapotranspiration rates are expected to increase with increasing temperature. Source: <https://climatemtoolbox.org/tool/Future-Time-Series>.

Jefferson County



NUID



APPENDIX B: THE MATRIX

The Matrix consists of an Excel spreadsheet that captures thoughts related to each of the Tools. Group participants use it to keep track of key concepts and to view the Tools in relation to each other.

The Matrix is constantly updated by ongoing discussions and is therefore not included in the Plan or on a website. However, an example for the Agrivoltaics Tool is shown below.

Tool: On-farm net meter solar agrivoltaics (as of December 2023)

Goal 1:	Goal 2:	Goal 3:	Goal 4:
Enough water to satisfy ag needs	Consistent and predictable water supply for ag activities	Optimize ag profit with less available water	Benefit watershed health (incl soil/fish/wildlife)
<ul style="list-style-type: none"> _Reduce evaporation when over water sources _Retain water in shaded soils 	N/A	<ul style="list-style-type: none"> _Increase soil health _Reduce plant ET _Electric farm equipment (less diesel) _Carbon offset 	<ul style="list-style-type: none"> _Increase available soil moisture _Floating panels reduce algae growth _Increase soil health _Reduce soil erosion _Improved pollination (cooler environments)

Challenges to successful implementation				
Legal	Opposition from some Deschutes Basin stakeholders	Unknowns	Costs for ag	Other
<ul style="list-style-type: none"> _Commissioner needs to exempt for irrigated farmland _Size restrictions of 12 acres for irrigated farmland? 	<ul style="list-style-type: none"> _NIMBY (visual, concern that losing farmland to PV, property value) 	<ul style="list-style-type: none"> _Not a lot of science about benefits and technology _What are best practices for not harming ag? _Few local examples 	<ul style="list-style-type: none"> _Installation and maintenance _Research 	<ul style="list-style-type: none"> _Overhead irrigation, planting, harvesting, spraying _how affect erosion of fallow fields _Meter location _Local utility substation need _Change farming system _What happens when you rotate a crop? _Sometime long time to wait for return

Opportunities					
Legal	Inform non- ag stakeholders	Info to landowners	Research	Funding	Other
Commissioners are supportive	Will figure out	<ul style="list-style-type: none"> _Gordon Jones _Ruralite _CO Extension newsletter _Farm Fair _CO Rancher 	Solicit local landowners for research	TBD	Try on smaller acreages

Ratings						
Current Implementation Status (0-5; 0=no, 5=all)	Benefit towards Vision if Fully Implemented (0-5; 0=none, 5=huge)	Gap between Benefit and Status)	Likelihood of Full Implementation (0-5, 0=none; 5=highest)	Benefit + Likelihood	Need for Tool (Benefit + Likelihood + Gap)	Lead?
1	3	2	3	6	8	OSU, Wy'East RC&D, BPA