

DESCHUTES BASIN GROUNDWATER MITIGATION PROGRAM



OREGON



WATER RESOURCES
DEPARTMENT

DESCHUTES BASIN GROUNDWATER MITIGATION PROGRAM

2021 ANNUAL REVIEW

OREGON WATER RESOURCES DEPARTMENT



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Introduction

The attached report provides the 2021 Annual Evaluation of the Deschutes Basin Groundwater Mitigation Rules (Oregon Administrative Rules (OAR) Chapter 690, Division 505) and the Deschutes Basin Mitigation Bank and Mitigation Credit Rules (OAR Chapter 690, Division 521).

Background

A groundwater study of the Deschutes Basin above Lake Billy Chinook was conducted in the late 1990's by the U.S. Geological Survey (USGS) in cooperation with the Oregon Water Resources Department (OWRD); the City of Bend; City of Redmond; City of Sisters; Deschutes and Jefferson counties; the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS); and the U.S. Environmental Protection Agency and the Bureau of Reclamation.

The CTWS (Boundary shown in Appendix 1), along with the United States of America and the State of Oregon, is a party to the Confederated Tribes of the Warm Springs Reservation Water Rights Settlement Agreement, dated November 17, 1997 and amended effective May 16, 2002 (WRSA). The WRSA recognizes CTWS tribal reserved water right interests on the Deschutes River and tributaries for on and off Reservation uses. In addition, the parties to the WRSA have agreed to pursue long-term, cooperative management of the waters that affect their interests.

On September 13, 2002, the Commission adopted the Deschutes Basin Groundwater Mitigation Rules and the Deschutes Basin Mitigation Bank and Mitigation Credit Rules. The rules provide for mitigation of impacts to

scenic waterway flows and senior water rights including instream water rights, while allowing additional appropriations of groundwater in the Deschutes Basin Groundwater Study Area (Appendix 2). The mitigation program, by rule, allows an additional 200 cubic feet per second (CFS) of new groundwater use, referred to as the allocation cap.

Evaluation Requirements

Under OAR 690-505-0500(3) and OAR 690-521-0600 of the Deschutes Basin Groundwater Mitigation Rules, the Department is required to annually evaluate and report on the Deschutes Basin Groundwater Mitigation Program, including the implementation and management of mitigation credits allocated through existing mitigation banks. This annual evaluation report is to include information on new groundwater appropriations, streamflow impacts, and mitigation activity to determine whether scenic waterway flows and instream water right flows in the Deschutes Basin continue to be met on at least an equivalent or more frequent basis as compared to long-term, representative base-period flows (1966 to 1995).

The annual review must address the following topics:

- New groundwater appropriations
- Mitigation activity
- Mitigation bank activity
- Streamflow impacts
- Consultation with the Oregon Department of Fish and Wildlife (ODFW), Oregon Parks and Recreation Department, Oregon Department of Environmental Quality (ODEQ), and Oregon Department of State Lands

- Determination of whether the scenic waterway and instream water right flows in the Deschutes Basin continue to be met on at least an equivalent or more frequent basis

Report Contents

This report incorporates all the elements required for the annual report, as outlined in OAR 690-505-0500(3) and OAR 690-521-0600.

Agency Comments

The Department provided a draft of the report for review by the agencies listed above on November 28, 2022. Comments were provided by ODFW and ODEQ (see Appendix 3) and are summarized below.

Issues and concerns raised by ODFW include:

- Improvements to the Program must be made prior to the allocation cap being lifted.
- Water accounting and monitoring should be improved to ensure mitigation is providing a true offset for impacts and remains available as “wet water” in perpetuity. Such improvements may require additional gages, flow measurement, and modeling beyond what is currently in place.
- Mitigating permanent groundwater rights with temporary leased water does not provide certainty.
- Streamflow data should be presented in a form more biologically meaningful to fish and aquatic life instead of on a monthly and annual basis.
- Mitigation under the Program should directly offset the impact by being located upstream of the impacted reach, not within a larger “Zone of Impact.”

- Impacts of increased groundwater use under the Mitigation Program to local springs, which are an important source of cold-water inputs to streams by providing cold-water refugia and other habitat benefits for fish.
- Reduction of seepage and loss of cold-water recharge for springs resulting from conversion of area irrigation canals to piped delivery systems.
- The effect of the Mitigation Program on streamflows outside of the irrigation season.
- Potential impacts of the Mitigation Program on the ESA-listed Oregon Spotted Frog.
- Proposed winter reservoir releases with unclear mitigation intent.
- Continue working with other state agencies to seek funding for research, development and implementation of these concerns.
- Limited ability to shape the season of protection and releasing of higher amounts during shoulder months for mitigation projects because of rules and statutes within OWRD.

Questions raised by ODEQ include:

- When was the 200 CFS cap established and why was 200 CFS chosen?
- What is the mitigation obligation?
- Of the 284 GW applications, how many have been approved?
- Figure 1: Which number reflects the total CFS and the Number of applications?
- Needs a better explanation of credits and how credits are attained and at what percentage credits offset GW use.
- Is there an error in Figure 6? Allocated credits and reserved credits equal the same acre feet.
- Why are Deschutes Irrigation, LLC, and Arnold Irrigation District Mitigation Bank

not active? To date means since the last report or since 2002?

- In the model for mitigation impacts, was there consideration for population growth after 1995? Between 1990 and 2010 there was >100% growth in Deschutes County
- Instream flows seem to differ slightly but what about GW levels? Have there been any well depth/level analyses throughout the two-decade period?

Allocation Cap

To limit the amount of impact on surface water flows, the mitigation program established a 200 CFS cap on the amount of water that may be allocated to new groundwater use. At the end of 2021 the amount of water use approved under the cap was 164.19 CFS. The allocation cap restriction may only be lifted or modified by the Commission if the Department's evaluation determines that scenic waterway and instream water right flows are being met on at least an equivalent or more frequent basis as compared to long-term, representative base-period flows (1966 to 1995) and meets the Department's mission to sustainably protect and manage the resource.

The CFS amount deducted from the 200 CFS cap is the amount of water (in CFS) allowed in the Department's final order approving an application requesting the use of groundwater located within the Deschutes Groundwater Study Area (DGWSA). Final orders set a five-year limit for the applicant to provide the required mitigation (i.e., the mitigation obligation). Once the applicant meets their mitigation obligation, the Department issues the groundwater permit. If the mitigation is not provided by the deadline, the final order expires and the CFS is added back into the cap.

All actions that allow CFS to be added back into the cap are:

1. Rates associated with offsets pursuant to 690-505-0610(8);
2. Rates associated with applications withdrawn after final order issuance pursuant to 690-505-0620;
3. Portions of rates approved by a final order issued under 690-505-0620, but not included in a water right permit that is issued following satisfaction of the mitigation requirement;
4. Rates associated with expired final orders pursuant to 690-505-0620(2);
5. Portions of rates associated with permits issued pursuant to 690-505-0620 and subsequently cancelled;
6. Rates associated with certificates issued pursuant to 690-505-0620 and subsequently canceled; and
7. Rates associated with the portion of use originally authorized under a permit issued pursuant to 690-505-0620, but not included in a subsequent certificate.

Since the adoption of the rules in September 2002 through the end of 2021, approximately 284 groundwater applications have been submitted to the Department within the DGWSA totaling approximately 350.5 CFS; however, approximately 161.68 CFS has been added back to the cap for various reasons (outlined above). Therefore, as of the end of 2021, the total allocated CFS remains under the 200 CFS cap.

Figure 1 shows the status of all the applications received and the total amount of CFS associated with each action category. These action categories include the active and pending applications, as well as the cancelled, expired, withdrawn, rejected, misfiled, and denied applications.

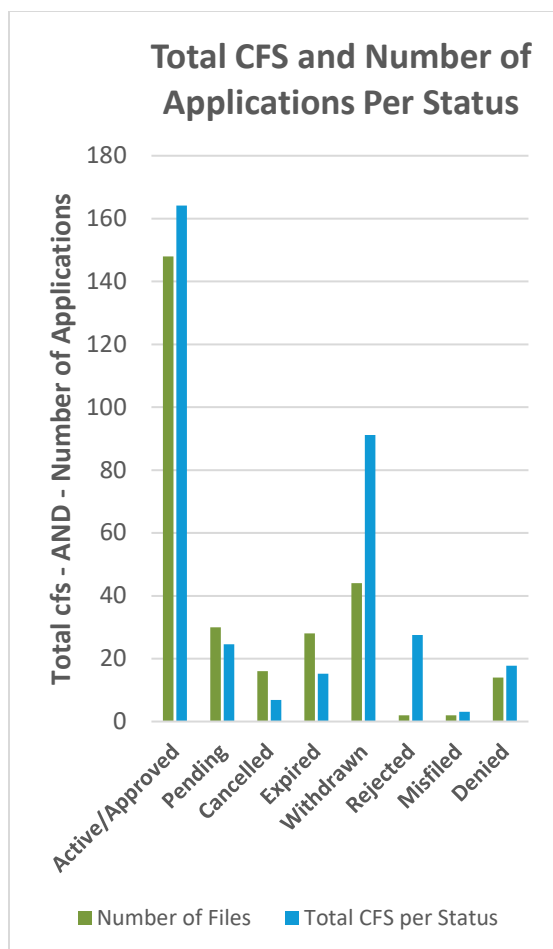


Figure 1: Total CFS & Number of Applications Submitted by end of 2021

2021 Mitigation Activity

For each groundwater permit application submitted, the Department reviews the application and notifies the applicant of their “mitigation obligation.” The “mitigation obligation” is expressed as a volume of water in acre feet and is equivalent to the consumptive portion of the use proposed in the permit application. Groundwater applicants mitigate for this consumptive portion of their proposed use. Consumptive use is calculated using average consumptive use data for different types of use (i.e., irrigation, municipal, etc.) obtained from the U.S. Geological Survey and OWRD’s own information on consumptive use.

Mitigation must be provided in the amount (mitigation water) and in the location (zone of impact) specified by the Department. Each applicant has five years from the date the final order is issued to provide the required mitigation. Applicants must provide mitigation before a new permit may be issued.

New Groundwater appropriations and Mitigation Activities as of end of 2021

A. Active Permits Issued:

- 135 permits issued
- 34 of which are certificated

B. Active Final Orders Issued:

- 15 final orders

C. Applications Pending with No Final Order:

- 30 applications

D. Allocation cap summary (Figure 2):

- 164.19 CFS – total CFS allocated under cap (permits and final orders)
- 24.40 CFS – pending applications not yet deducted from 200 CFS cap
- 11.41 CFS – remaining CFS if all pending applications were approved

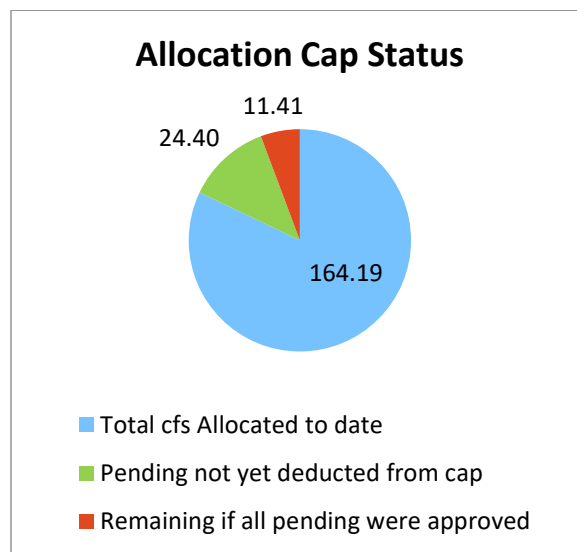


Figure 2: Allocation Cap Status

- E. **Incremental Development Plans:** By rule, the Department may allow a municipal or quasi-municipal applicant to satisfy their mitigation obligation incrementally as the water use is developed, rather than requiring mitigation to be provided before the permit is issued. These applicants must report annually to the Department on the volume of water used and the source of mitigation. There are 21 permits that have incremental development plans.

A summary of water use for municipal and quasi-municipal permit holders with incremental development plans is provided in Figure 3. This figure is a comparison between the amount that these water users are authorized to use at full development, the amount of water they could use based on how much mitigation they have provided through 2021, and the amount of water they actually used during 2021. Overall, in 2021, more mitigation was provided by entities with incremental development plans than was needed to mitigate for their actual use.

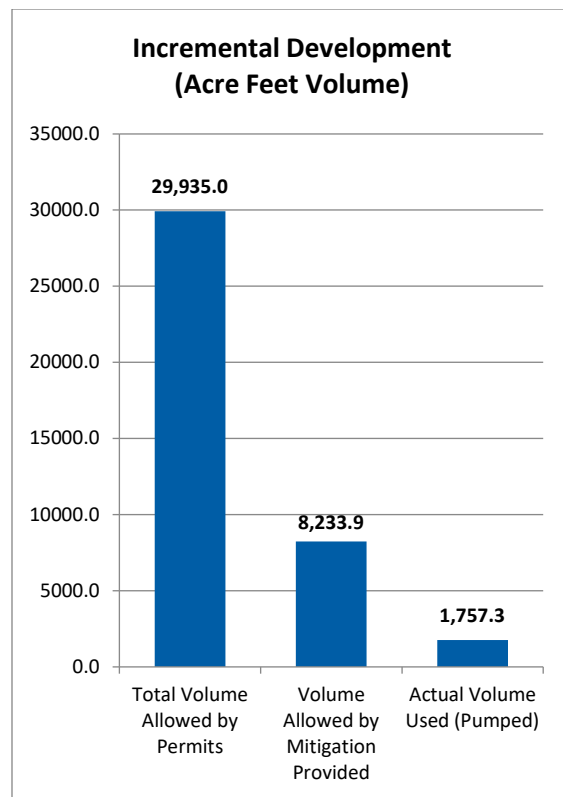


Figure 3: Incremental Development

- F. **Mitigation Activity:** For each mitigation project submitted, the Department identifies the amount of water resulting from the project that can be used for mitigation purposes. The resulting protectable water, expressed in acre feet, is also referred to as “mitigation water” or “mitigation credits.” One acre foot of mitigation water is equal to one mitigation credit. For each project submitted, the Department also identifies the zone or zones of impact in which the mitigation water provides instream benefits and may be used for mitigation purposes. Mitigation for active groundwater permits and certificates issued by the Department under the Mitigation Program is provided through permanent instream transfers and temporary instream leases (Figure 4). Mitigation credits established by a

Mitigation Project are considered used when assigned to a groundwater application or permit.

- As of the end of 2021 there are 67 total active mitigation projects, consisting of:
 - 50 permanent instream transfer projects;
 - 16 temporary instream lease projects; and
 - 1 permanent reservoir release for City of Prineville.

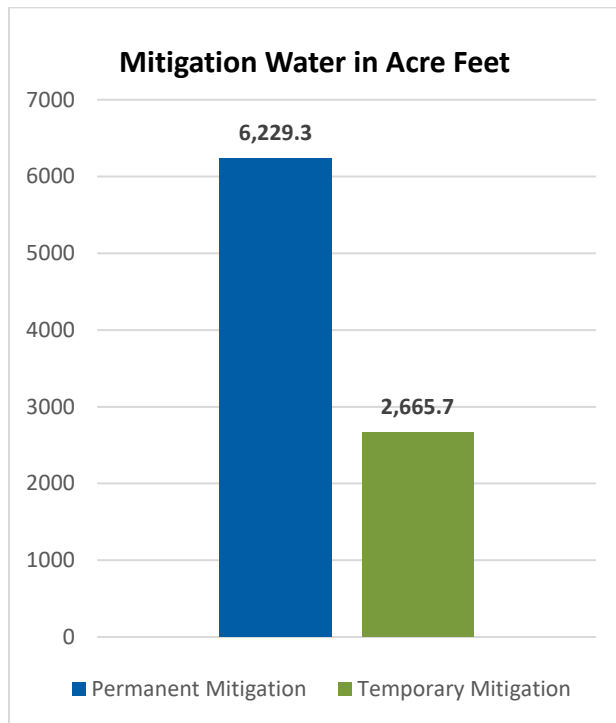


Figure 4: Mitigation Water

- Figure 5 shows the established mitigation broken out by zone of impact. The reason these amounts are more than the established amounts is because mitigation is sometimes established in multiple zones (i.e., 10 credits established in the middle and general zones, but only a maximum total of 10 credits can be used in either the middle or

general zones, or a combination thereof).

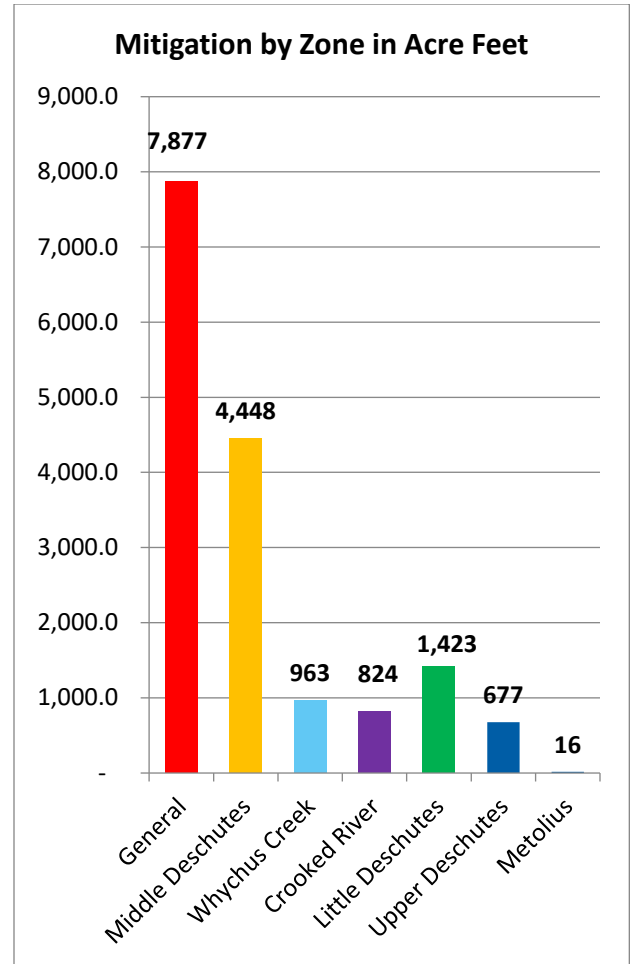


Figure 5: Mitigation by Zone

The above Figures 4 and 5 do not include the 5,100.0 AF of permanent mitigation credits issued to the City of Prineville as identified in Water Right Certificate 94149. These mitigation credits may be used to satisfy the mitigation obligation of a groundwater use found to impact surface water flows in the General and/or Crooked River Zones of Impact and are reported and managed on a water year schedule (Oct. 1 – Sept. 30). These mitigation credits may only be used by the City of Prineville and cannot be conveyed to any other person or mitigation bank. As of the writing of this report, 972.0 AF of these mitigation credits have been assigned to City

of Prineville incremental groundwater permits.

G. **Mitigation Banks:** Mitigation banks must submit an annual report detailing all credit transactions and activities for the preceding calendar year. As of the end of the 2021 year, there are three mitigation banks:

- Deschutes River Conservancy Mitigation Bank (DRC Mitigation Bank);
- Deschutes Irrigation, LLC; and
- Arnold Irrigation District Mitigation Bank.

H. **Mitigation Bank Activity:**

DRCMB

- Filed the required annual report
- Submitted 16 instream leases in 2021
- Maintained sufficient “reserve” credits to cover temporary mitigation credits used by groundwater permit holders in each zone of impact. (For each temporary mitigation credit used to satisfy all or part of the mitigation obligation of a groundwater permit, a mitigation bank is required to keep a matching credit in reserve.)
- Figure 6 shows the amount of temporary mitigation credits generated by the DRCMB, the credits allocated to a groundwater permit, and the reserve credits DRCMB is required to keep.

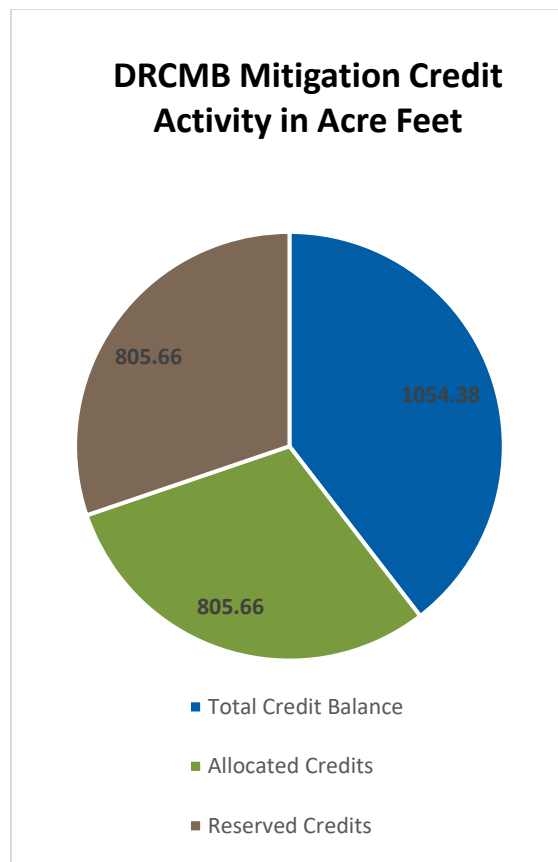


Figure 6: DRCMB Mitigation Credit Activity in Acre Feet

As of the end of the 2021 year, the following mitigation banks had not yet chosen to undertake in any mitigation activity. The mitigation program rules do not require a mitigation bank to be active to remain in place.

Deschutes Irrigation, LLC

Arnold Irrigation District Mitigation Bank

Delinquent Permits:

Instream leases are one of the identified sources of mitigation under OAR 690-521-0300(1)(b); however, this temporary mitigation (instream lease-based mitigation) may only be established through a Mitigation Bank chartered by the Oregon Water Resources Commission. To date, temporary mitigation has been available from the DRC

Mitigation Bank, which primarily brokers temporary mitigation credits available through final orders issued by OWRD approving instream lease applications. Some permit holders who have used temporary mitigation in the past failed to continue providing that mitigation. Every year, the Department and DRC Mitigation Bank each notify permit holders who have failed to provide mitigation. Written notifications from the Department identifies that unless mitigation is provided by a specified deadline, OWRD will initiate cancellation of the permit under ORS 537.720.

By rule and by permit condition, every groundwater user with a permit issued under the Deschutes Basin Groundwater Mitigation Program is required to maintain mitigation for the life of the groundwater use. Ultimately, the permit holder is responsible for maintaining any temporary mitigation being used annually with the DRC Mitigation Bank.

Since groundwater permit holders using temporary mitigation credits need to obtain mitigation credits on an annual basis, there is the risk of groundwater users failing to maintain the required mitigation. Under the Mitigation Program, when a permit holder fails to maintain their source of mitigation, OWRD is required, under OAR 690-505-0620, to regulate the use, propose denial of any permit extension request, and propose cancellation of the permit.

Figure 7 below shows the number of confirmed delinquent permits each year during a five-year period from 2017 through 2021. After being notified, several of the permit holders rectified the situation by providing the required annual mitigation. Others who failed to provide the required mitigation were cancelled or are in the

process of being cancelled by OWRD under ORS 537.720.

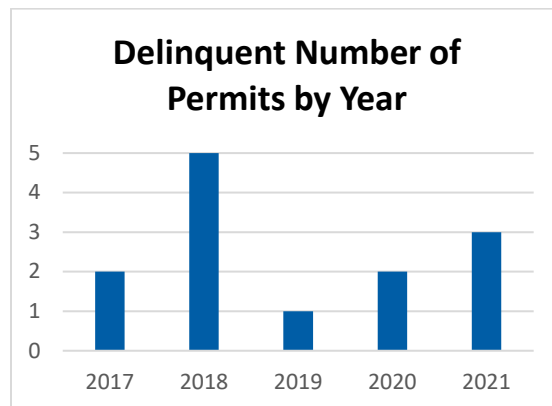


Figure 7: Delinquent Number of Permits by Year

Mitigation Effects on Streamflow

To evaluate the impact of the mitigation program on scenic waterway flows and instream water right flows, the Department developed a streamflow modeling program based on gaging records from the 1966-1995 base period, a pre-mitigation program time frame. The model simulates the long term (i.e., steady-state) estimated hydrologic effects of mitigation credits and debits on the historical records at the gaged locations across the basin, and then evaluates how often the instream flow requirements (ISFR) are met based on this adjusted streamflow data compared to the original flow records (Cooper, 2008). A modeling approach was used because the steady-state, long-term impact of streamflow to mitigation-related activities may take years or even decades to be reflected as actual changes in streamflow (Gannett and Lite, 2004), plus climate variability generally masks the streamflow response to mitigation activities at most locations (Cooper, 2008). The simulations do not reflect activities affecting streamflow

outside of the mitigation program, such as canal piping/lining.

Analysis of the 2021 data demonstrates that, on an annual basis, the simulated change in percent of time instream flow requirements (% ISFR) are met at the evaluation points ranges from -0.18% to +0.93%. Similarly, the overall annual change in mean streamflow ranges from -0.006 CFS to +23.2 CFS (Appendix 4).

Consistent with previous annual reports, the seasonal change in the quantity of streamflow (CFS) continues to be negative at all evaluation points during the non-irrigation season and positive at all evaluation points during the irrigation season, reflecting the general timing difference between the hydrologic impacts to streamflow of credits (irrigation season) and debits (year-around).

Similarly, the changes in % ISFR met generally follows this same seasonality as changes in streamflow quantity. The magnitude of change in % ISFR met varies by month and site, reflecting how close historical flows were to the ISFR prior to the mitigation program. If the historical flows were close to the ISFR for a given evaluation site, then a small change in flows can result in a large change in % ISFR is met, while the opposite is true if the historical flows differed greatly from the ISFR.

Again, this difference in seasonal results is expected due to the inherent timing difference between when the hydrologic effects of debits and credits reach the stream network. Debits (new groundwater withdrawals) produce a decrease in streamflow year-round due to the pumping effects on groundwater being attenuated in time (Gannett and Lite, 2004). Credit (instream leases and instream transfers of surface water rights) effects are immediate

and occur primarily during the irrigation season.

Summary

The Department continues working to effectively implement the Deschutes Basin Groundwater Mitigation Program. Groundwater permit applications and mitigation projects are moving through the required processes. Overall, the program continues to produce positive benefits as more mitigation water has been approved and protected instream than is required for active groundwater permits and certificates.

In response to comments and questions received from sister agencies (as outlined in “Agency Comments” above and provided in Appendix 3 attached to this report), the Department understands the concerns brought forth regarding impacts to cold-water springs, the zonal mitigation impacts, model accounting and climate change, and impacts during the non-irrigation season. From the beginning of the Deschutes Mitigation Program, however, it was determined that the program should be structured in such a way so that it was a manageable system for OWRD to track and maintain long-term. OWRD considered the goals of the Mitigation Program, the Deschutes Groundwater Mitigation Flow Model, and the base period flows (1996-1995) and created sub-zones and consumptive use coefficients to keep the Deschutes Mitigation Program manageable. Seasonal uses were allowed to generate credits that could then be purchased to mitigate for year-round uses. OWRD will need to work with ODFW, ODEQ, and stakeholders to address these challenging issues. Other concerns may need to be addressed through other venues and initiatives to develop and

implement a basin-wide water management plan.

The Deschutes Groundwater Mitigation Program is a performance based, adaptive approach to managing new groundwater permits in the Deschutes Groundwater Study Area. As part of this adaptive approach, the program included a cap on how much new groundwater use could be approved. The Department may issue final orders approving groundwater permit applications for a cumulative total of up to 200 CFS. This limitation is one of the elements of the program that is to be reviewed as part of the program evaluation. The 200 CFS cap represents the rate up to which water may be withdrawn from the groundwater resource. It is important to note that this rate-based limitation is different from the consumptive use portion (in acre feet) for which groundwater permit applicants must provide mitigation.

As discussed in the “Allocation Cap” section of this report, the quantity of water (CFS) allocated under the cap fluctuates up and down from year to year as a result of various administrative actions (i.e., denial, cancellation, expiration, withdrawal, etc.) which add back previously deducted CFS to the cap. As of the end of 2021, 164.19 CFS was allocated under the cap.

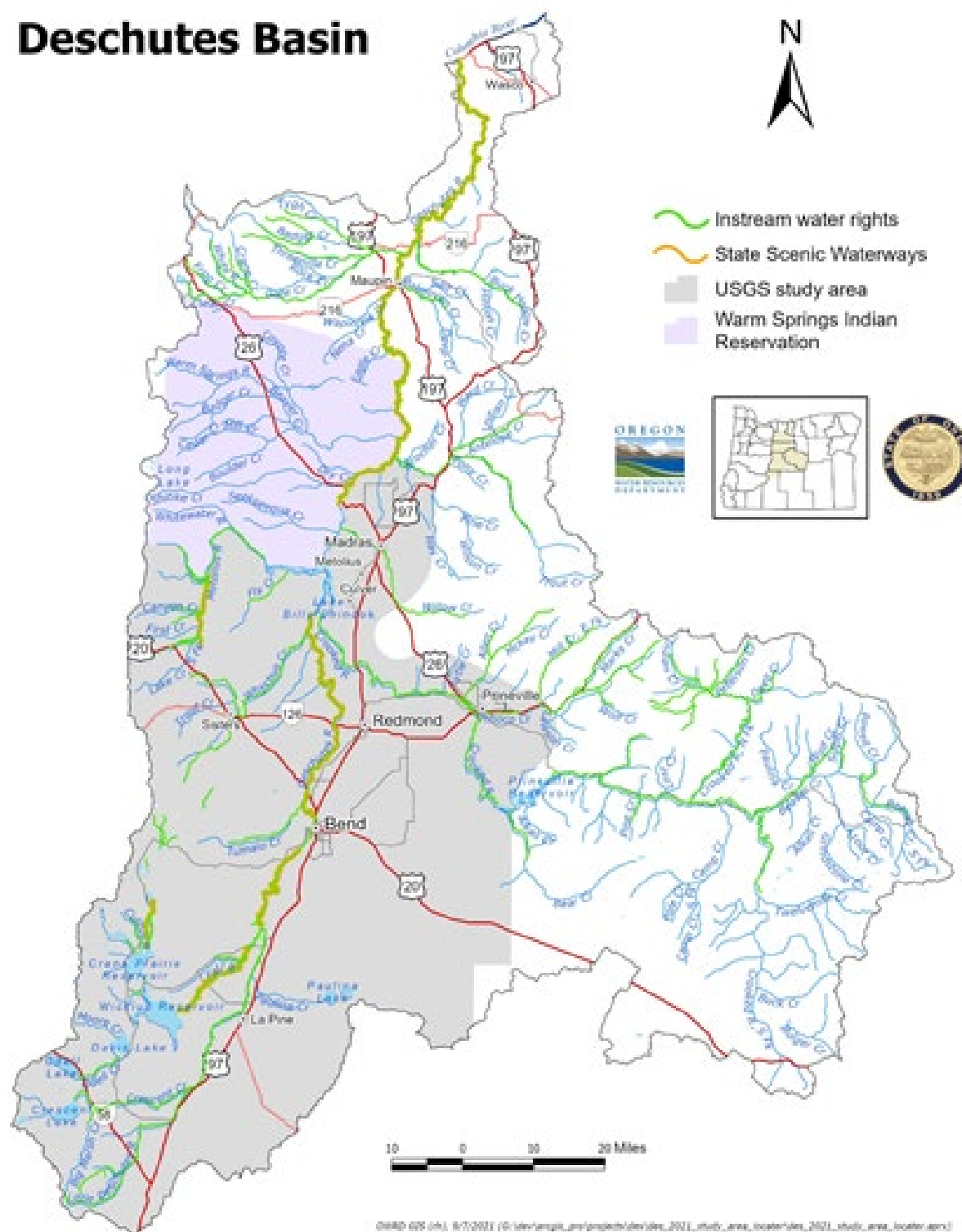
Given the status of the 200 CFS allocation cap, the Department understands there is much interest and diverse opinion in how the future of the Deschutes Basin Groundwater Mitigation Program should unfold. While ODFW and ODEQ detail several improvements that should be made to the Program before evaluating the potential for the 200 CFS allocation to be modified, there are several stakeholders in the basin who

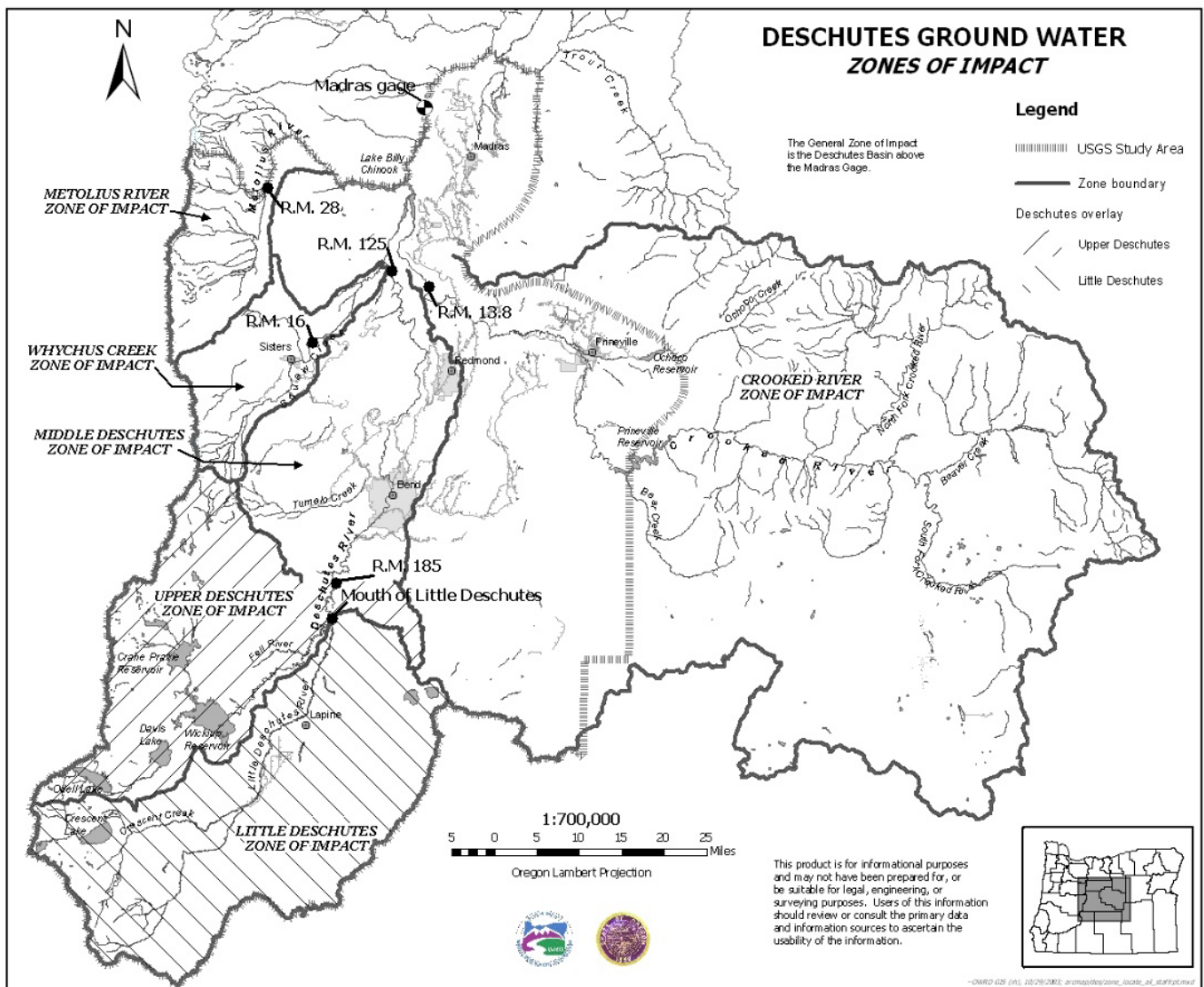
would like the Department to begin work immediately to explore feasibility of modifying the cap. The Department has prioritized working through the many complex issues related to the Program. Both sister-agencies and stakeholders will be invited to engage in the OWRD process to evaluate modifications to the existing Deschutes Basin Groundwater Mitigation Program.

Appendices

1. Deschutes Basin Groundwater Study Area Map
2. Deschutes Basin Groundwater Study Area Zone of Impact Map
3. Comments from ODFW and ODEQ
4. Summary of Modeled Streamflow for Water Year Ending September 2021

Deschutes Basin





Oregon

Kate Brown, Governor



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January 6, 2023

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**RE: ODFW Comments on the DRAFT 2021 Annual Review of the Deschutes Basin
Groundwater Mitigation Program**

Dear Ms. Henderson,

The Oregon Department of Fish and Wildlife (ODFW) appreciates the opportunity to provide comments on the DRAFT 2021 Annual Review of the Deschutes Basin Groundwater Mitigation Program (Program). Overall, ODFW agrees that the Program has been successful in maintaining and improving flows in the middle and lower Deschutes River during the irrigation season. Increases in stream flow during the irrigation season in the Middle Deschutes has provided an added benefit to the overall objective of the rules, which are to provide for mitigation of impacts to scenic waterway flows and senior water rights while allowing additional qualifying appropriations of ground water in the Deschutes Basin. However, as we acquire more information about the additional detrimental impacts to fish and wildlife expected in the future from a changing climate, we continue to have increasing concerns about water accounting, the impacts to springs, and decreases in flow during the non-irrigation season. These issues are also of immediate concern, as water users are currently moving ahead with innovative means to secure future mitigation credits that may not fully meet the needs of fish and wildlife in the basin (e.g., proposed winter reservoir releases with unclear mitigation intent).

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Since inception of the Program, ODFW has annually submitted comments that address our ongoing concerns and have discussed potential solutions with the Oregon Water Resources Department (OWRD) many times. We were pleased to see that OWRD included several actions to improve the Program in the 2021 5-year Program review and that OWRD is currently proposing a funding package to better understand potential impacts to springs from groundwater extraction. ODFW looks forward to continuing conversations and advising the agency on ways to strengthen the efficacy of the Program to improve and protect instream flow for fish, wildlife, and their habitats.

As in the past, ODFW will review our primary concerns here for the record. Specifically, ODFW recommends these tangible improvements to the Program be addressed before the 200 cfs cap on the Program is lifted:

Water Accounting and Impacts of Climate Change

- A. To offset potential impacts from new uses, water rights proposed for mitigation must represent valid and reliable replacement sources of water. Basin-specific hydrologic conditions, any history of regulation, and past use determine the reliability of a water right. ODFW recommends surface water rights used for mitigation demonstrate 100% reliability at the full rate for the past 8 out of 10 years and groundwater rights demonstrate use for the past 8 out of 10 years. This means that any water right that is regulated off on a frequent basis or cannot be/has not been reliably used will not be sufficient mitigation. As such, suitable mitigation will generally need to be in the form of a senior water right that has historically proven reliable as “wet water” for the permitted use.
- B. ODFW recommends the Program include a protocol for monitoring, accounting (measuring), and reporting the volume of water transferred instream from annual mitigation credits in each zone of influence. Currently, the Deschutes River Conservancy (the only active mitigation bank) tracks and accounts for the administrative transfer of water instream, but the verification and measurement of actual “wet water” used as mitigation in each zone is limited. A monitoring program to ensure mitigation is providing a true offset for impacts as initially intended and remains available as “wet water” in perpetuity (or for the life of the project) is necessary for assessing effectiveness of the Program. This may require additional gauges and flow measurement beyond what is currently in place.

We know that climate change will exacerbate existing issues and alter streamflow, temperatures, and adjacent landscape characteristics necessary to support fish and wildlife populations. As we acquire more information about the detrimental impacts to fish and wildlife expected from a changing climate, closely monitoring groundwater use and associated mitigation is a necessity for the Program. In fact, Gannett and Lite, in their 2013 report “Analysis of 1997–2008 Groundwater Level Changes in the Upper Deschutes Basin, Central Oregon,” found that groundwater flow model simulations indicated that climate

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variations have the largest influence on groundwater levels throughout the upper Deschutes Basin.

- C. A portion of the water supporting the Mitigation Program is leased instream. ODFW is concerned with mitigating permanent groundwater rights with temporary leased water. This could set up the potential in the future to not have enough mitigation water to cover all the permanent groundwater rights that need mitigated. In cases where permanent groundwater pumping certificates have been granted, temporary instream leasing provides no certainty that the mitigation will remain in place for the life of the permit and/or certificate. Past Program reports have identified permit holders that have allowed temporary credits to expire while continuing to irrigate. It is not clear if this issue has been addressed. Therefore, we recommend that OWRD increase compliance monitoring and immediate regulation of non-compliant participants. ODFW proposes that OWRD and Program partners work more proactively to provide permanent mitigation water (permanent instream transfers) to offset groundwater pumping.
- D. ODFW recommends modifying the presentation of flow data. The annual reports for the Program consistently present flow data on a monthly and annual basis, which demonstrate minor changes in flow. Because fish and other aquatic organisms are very susceptible to acute and chronic events (e.g., dewatered reaches or lower flow rates for extended periods), annual and even seasonal changes do not necessarily reflect true impacts to aquatic life. ODFW recommends presenting flow data in a form that is more relevant to fish needs, such as improvements in low flows, variability in flows throughout the year, and flows during critical time periods for fish.

Zonal Mitigation

Allowing mitigation for groundwater impacts to occur away from the point of impact but within a larger “Zone of Impact” results in localized impacts to streams and the fish and wildlife they support. This is particularly true for the General Zone, which according to Figure 5 in the Draft Review, is where most of the current mitigation occurs. Mitigation under the Program should directly offset the impact by being located upstream of the impacted reach consistent with the Program goals to provide for new ground water uses while maintaining scenic waterway and instream water right flows in the Deschutes Basin.

Impacts to Springs

The Program was not intended to mitigate for the impacts of groundwater development on groundwater levels, and groundwater in the basin continues to decline (see Figure 1; Thoma et al. 2021). Groundwater levels in parts of the basin are quickly approaching the 50 ft total decline benchmark, being one of the thresholds of “excessively declined” (OAR 690-008). OWRD (Iverson and Scandella 2021) ranked 15 townships in the Middle/Upper Deschutes State Scenic

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Waterway Restriction Area as “significant concern” for groundwater resources. As a result and given the close hydraulic connection between ground and surface water in the basin, ODFW continues to express concerns with the localized impacts of groundwater pumping on springs.

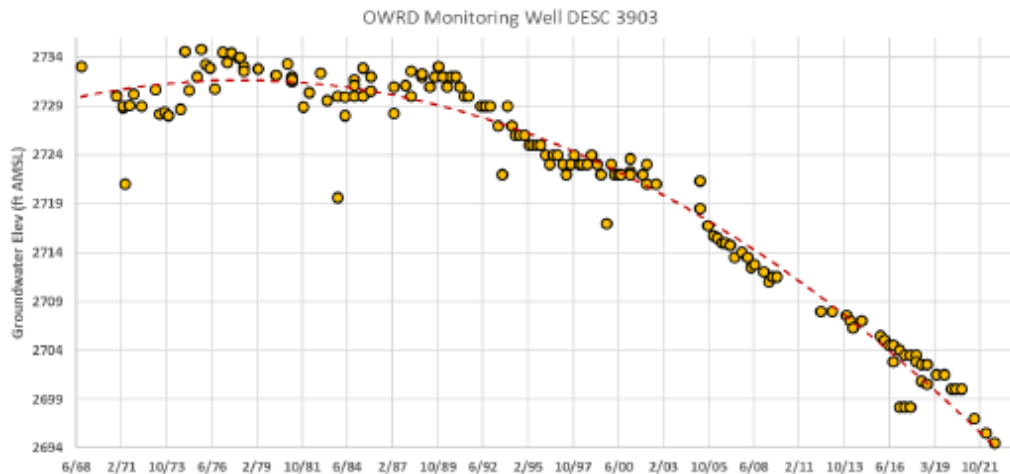


Figure 1. Oregon Water Resources Department groundwater elevation measurements at monitoring well DESC 3903 west of Redmond, Oregon 1968-2022.

Springs and seeps provide very important cold-water inputs to streams by providing cold water refugia and other habitat benefits for fish and by helping to cool stream temperatures during the summer in streams with depleted flows. The native trout, salmon and whitefish in the Deschutes basin require consistent sources of cold, clear water to complete their life histories and zones of groundwater discharge provide critically important habitat.

Monitoring of local springs needs to be improved to better understand how trends in regional groundwater supply and use are expressed as surface water flows and to assess the efficacy of the Program. One of the few springs with consistent monitoring is the main head springs on the Metolius River where groundwater discharge has declined over 50% between the spring of 2018 and fall of 2021 (OWRD 2022). Over time, continued and increased groundwater withdrawal for agricultural, residential, and municipal needs will further affect springs when there is a surface/groundwater connection.

Impacts to springs from current and future groundwater withdrawals are exacerbated by the increasing trend to convert area irrigation canals to piped delivery systems. While this is positive in that it generates conserved water that currently results in improved instream flows in the middle Deschutes River, it also eliminates seepage which recharges the aquifer and contributes to spring recharge of cold water. The result is an exchange (loss) of cold spring water for warmer water upstream. Further, any future shift for conserved water projects that return flow to

ODFW Comments

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the upper Deschutes River to benefit the Oregon Spotted Frog (*see Impacts During the Non-Irrigation Season*), particularly during the winter months, will add additional stress on the middle Deschutes and lower Crooked rivers in the valuable spring recharge areas. The impacts to fish and aquatic resources from these inconsistencies are likely to become more pronounced in future years as climate change continues to be increasingly more influential. Cold water refugia could likely become critical to long-term persistence of many fish species and populations and should be considered in water management decisions and when assessing effectiveness of the Program.

For many years, ODFW has requested that OWRD consider implementing a program to monitor key springs/spring complexes in the basin to determine ecological impacts to spring flow, including temperature and nutrient changes resulting from groundwater pumping. Monitoring impacts of groundwater pumping on springs and spring complexes is important in respect to their aquatic habitat, botanical, wildlife, water quality, water quantity, and societal values. In the past, this issue was recognized by state and federal agencies but work to address the concerns faded due to other priorities.

ODFW is pleased that OWRD has recently engaged in the spring flow concerns by moving forward to seek funding, coordinate efforts for research, and develop and implement a strategy to address these concerns.

As stated in the 2021 5-Year Review of the Deschutes Basin Groundwater Mitigation Program, WRD proposed the following specific action to improve the Mitigation Program: “The Department is working towards a more complete understanding of how the mitigation program has been implemented and whether changes to the program are necessary to improve protection of local water resources, or if those protections are outside the scope of the mitigation program. The Department should be partnering with ODFW and DEQ to jointly secure funding for a study aimed at these issues. OWRD staff intend to continue conversations with ODFW, DEQ, CTWS, and stakeholders on issues outlined above as well as other issues raised in the report as part of this evaluation to identify opportunities for improving the Mitigation Program.”

As a result, OWRD currently has a proposed Policy Option Package (POP) in the 2023-2025 Agency Requested Budget for spring monitoring.

Impacts During the Non-Irrigation Season

As currently designed, the Program mitigates year-round groundwater withdrawals with irrigation season water and reports changes to streamflow on an annual basis. This type of mitigation does provide for more instream water during the irrigation season, as is consistently reported, but is also reported to reduce flows in the lower river during the non-irrigation season. Critical fish life history components occur outside of the irrigation season, particularly during

ODFW Comments

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“shoulder months” at the beginning and end of the irrigation season (March/April and October/November) when reductions in streamflow are consistently reported.

In addition, current implementation of the Program poses potential impacts to the ESA-listed Oregon Spotted Frog (OSF) outside of the irrigation season. Improving winter flows on the upper Deschutes River below Wickiup Reservoir and on Crescent Creek is essential to the survival of the OSF, and freshwater spring habitats in the upper Deschutes Basin have been identified as critical to overwinter survival.

The continual detrimental impact to streamflow during the non-irrigation season is now a greater concern for more than just the “shoulder months.” Most stakeholders recognize that non-irrigation flow concerns still need to be addressed for the Deschutes basin as a whole. In the past, OWRD recognized this concern as well. One option, which is currently being implemented by Section 7 permittees under the Deschutes Basin Habitat Conservation Plan, is for water users in the basin to release stored water in Wickiup, Crane Prairie, Crescent and other reservoirs instream during the winter and shoulder months. ODFW recognizes the release of stored water during the non-irrigation season as a valuable tool for supplementing the existing mitigation credits that are currently limited to the irrigation season. Winter releases would aide in offsetting impacts of groundwater withdrawal on a true 1:1, year round basis, but only if utilized as mitigation for winter impacts and in partnership with other mitigation applied to the irrigation season. To fully mitigate impacts to fish and wildlife resulting from groundwater withdrawals, mitigation credits should apply the appropriate volume and quality of reliable, wet water to both the middle and upper Deschutes River on a year-round basis.

200 CFS Cap

Stream flows outside the irrigation season are important to fish for a number of reasons, including providing habitat for spawning, overwintering, rearing habitat throughout the year, and especially for juvenile salmon and steelhead during the spring smolt outmigration beginning in March and continuing through May. When the Program rules were developed, all parties recognized the Program would reduce flows in the lower river during the non-irrigation season. Because of this, the 200 cfs cap was put in place to limit flow reduction impacts in the lower river outside of the irrigation season and allow for an overall assessment of the Program. All stakeholders at the time recognized that non-irrigation flow concerns still needed to be addressed for the Deschutes basin as a whole.

As stated in the 2021 5-Year Review of the Deschutes Basin Groundwater Mitigation Program, OWRD proposed the following specific action to improve the Program:

- “OWRD to consider possibility of modifying allocation cap as part of work to be prioritized with Basin stakeholders.”

ODFW Comments

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ODFW looks forward to OWRD and Program partners working with us to seek clear options for year-round mitigation to offset year-round impacts. Therefore, ODFW recommends the 200 cfs allocation cap remain until such time as the winter flow and other issues can be resolved. Maintaining the cap will ensure that groundwater reductions due to unmitigated, non-irrigation season use is kept to a minimum (*see Impacts During the Non-Irrigation Season*).

Review of Mitigation Projects

OWRD works in cooperation with ODFW to enhance the resource benefits and make the most effective use of mitigation projects and mitigation water (OAR 690-505-0615(7)). Currently, ODFW's understanding is that in practice, OWRD is seeking input regarding shaping of mitigation flows for proposed mitigation projects. However, this shaping is limited to the season of the original water right and some certificates have protocols that preclude releasing higher amounts during shoulder months. In addition, reliability of the water rights to provide wet water are not fully assessed. As such, ODFW is limited in our ability to effectively comment on mitigation projects so that they maximize benefits to fish and wildlife. ODFW would like to provide more meaningful input that benefits fish and wildlife year-round in reach-specific locations, which may require updates to the existing rules. This will aide in ensuring that mitigation is offsetting the local impact and not resulting in impacts during the non-irrigation season.

Thank you for the chance to comment. We look forward to revisiting Program goals and rule language and pursuing solutions to our concerns in upcoming discussions as OWRD plans for Program updates. In the meantime, ODFW recommends the 200 cfs cap not be lifted until these issues are resolved, and the Commission can determine that scenic waterway flows and instream water right flows in the Deschutes Basin continue to be met year round on at least an equivalent or more frequent basis as compared to long-term, representative base period flows established by the Department per OAR 690-505-0500(4). If you have any questions, please contact me (503-947-6092) in Salem or Jerry George (541-388-6363) in Bend.

Sincerely,



Danette Faucera, Water Policy Coordinator



Jerry George, Deschutes District Fish Biologist

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References:

Gannett, M.W., and Lite, K.E., Jr., 2013, Analysis of 1997–2008 groundwater level changes in the upper Deschutes Basin, Central Oregon: U.S. Geological Survey Scientific Investigations Report 2013-5092, 34 p., <http://pubs.usgs.gov/sir/2013/5092>.

Oregon Water Resources Department. 2022. Metolius Springs Date Query. Available online at: https://apps.wrd.state.or.us/apps/sw/misc_measurements_view_only/

Iverson, J., and B. Scandella. 2021. Oregon Groundwater Resource Concerns Assessment – 2021. Memorandum to Water Resources Commission and Attached Assessment. Oregon Department of Water Resources.

Thoma, M, A. Bouchier, J. Iverson, and H. Burright. 2021. Response to Technical Assistance Request: Groundwater Mitigation Program purpose in relation to observed groundwater level trends. Memorandum from the Oregon Water Resources Department to the Deschutes Basin Water Collaborative Groundwater Mitigation Technical Committee.

HENDERSON Sarah A * WRD

From: HENDRICKSON Cole * DEQ
Sent: Thursday, January 5, 2023 12:04 PM
To: HENDERSON Sarah A * WRD
Subject: Comments for DRAFT 2021 Deschutes GW Mitigation Program

Good Morning Sarah,

Please find my comments on behalf of DEQ below for the Deschutes GW Mitigation Program Report.

Draft DB Groundwater Mitigation Program Comments

- When was the 200 CFS cap established and why was 200 CFS chosen?
 - September 2002?
- What is the mitigation obligation?
- Of the 284 GW applications, how many have been approved?
- Figure 1: Which number reflects the total CFS and the Number of applications?
- Needs a better explanation of credits and how credits are attained and at what percentage credits offset GW use.
- Is there an error in Figure 6? Allocated credits and reserved credits equal the same acre-feet.
- Why are Deschutes Irrigation, LLC, and Arnold Irrigation District Mitigation Bank not active? To date means since the last report or since 2002?
- In the model for mitigation impacts, was there consideration for population growth after 1995? Between 1990 and 2010 there was >100% growth in Deschutes County
- Instream flows seem to differ slightly but what about GW levels? Have there been any well depth/level analyses throughout the two-decade period?

Thank you,

Cole Hendrickson
he/him/his
Integrated Water Resources Specialist
Department of Environmental Quality
Eastern Region (Bend Office)
Cole.Hendrickson@DEQ.Oregon.Gov
Cell: 458-256-9155

Streamflow Model Data

The data presented in the following tables are from the Department's Deschutes Mitigation model. The "before mitigation" or baseline condition of streams in the Deschutes Basin has been determined from streamflows measured during water years 1966 to 1995. The model has been developed to mathematically estimate the change in streamflow expected due to mitigation (credits) and groundwater allocation (debits). The model is designed to reflect the theoretical, steady-state response of streamflow to mitigation-related activities only. In some cases, the actual hydrologic response to mitigation activities, such as new groundwater pumping, may take years or decades to be reflected as changes in streamflow.

CHANGE IN PERCENT OF TIME INSTREAM REQUIREMENTS ARE MET IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Deschutes River at Mouth

Time: 13:10

Date: 11/01/2022

Month	Base Line	Mitigated	Change in	Percent
	%	%	Percentage	Change
			%	%
JAN	93.20	92.90	-0.32	-0.35
FEB	90.80	90.20	-0.59	-0.65
MAR	95.30	95.10	-0.22	-0.23
APR	99.90	99.60	-0.33	-0.34
MAY	99.10	99.50	0.32	0.32
JUN	98.00	98.80	0.78	0.79
JUL	91.00	93.10	2.15	2.31
AUG	100.00	100.00	0.00	0.00
SEP	98.10	98.10	0.00	0.00
OCT	97.40	97.40	0.00	0.00
NOV	99.90	99.80	-0.11	-0.11
DEC	91.70	91.10	-0.64	-0.71
ANNUAL	96.20	96.30	0.09	0.09

Enter (1) to CONTINUE; (2) to WRITE the Table:

CHANGE IN MEAN STREAM FLOW (CFS) IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Deschutes River at Mouth

Time: 13:10

Date: 11/01/2022

Month	Base Line	Mitigated	Change	Percent
	cfs	cfs	in cfs	Change
			cfs	%
JAN	6910.0	6880.0	-29.8	-0.43
FEB	7080.0	7050.0	-29.8	-0.42
MAR	7250.0	7220.0	-29.6	-0.41
APR	6640.0	6630.0	-6.28	-0.09
MAY	5800.0	5820.0	16.3	0.28
JUN	5200.0	5230.0	33.5	0.64
JUL	4590.0	4630.0	39.5	0.85
AUG	4380.0	4420.0	38.2	0.87
SEP	4430.0	4460.0	25.8	0.58
OCT	4710.0	4710.0	-0.486	-0.01
NOV	5390.0	5360.0	-29.4	-0.55
DEC	6190.0	6160.0	-29.8	-0.48
ANNUAL	5710.0	5710.0	0.013	0.00

CHANGE IN PERCENT OF TIME INSTREAM REQUIREMENTS ARE MET
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Deschutes River below Pelton Dam

Time: 13:07

Date: 11/01/2022

Month	Base Line	Mitigated	Change in Percentage	Percent Change
	%	%	%	%
JAN	64.70	63.90	-0.86	-1.35
FEB	63.00	61.50	-1.53	-2.50
MAR	67.80	66.70	-1.18	-1.77
APR	71.40	70.70	-0.78	-1.10
MAY	58.80	63.00	4.19	6.66
JUN	55.60	60.20	4.67	7.75
JUL	41.00	45.20	4.19	9.29
AUG	98.20	99.40	1.18	1.19
SEP	66.80	68.80	2.00	2.91
OCT	81.10	81.10	0.00	0.00
NOV	97.20	97.10	-0.11	-0.11
DEC	66.10	65.40	-0.75	-1.15
ANNUAL	69.30	70.30	0.93	1.33

Enter (1) to CONTINUE; (2) to WRITE the Table:

CHANGE IN MEAN STREAM FLOW (CFS)
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Deschutes River below Pelton Dam

Time: 13:09

Date: 11/01/2022

Month	Base Line	Mitigated	Change in cfs	Percent Change
	cfs	cfs	cfs	%
JAN	5240.0	5210.0	-29.8	-0.57
FEB	5190.0	5160.0	-29.8	-0.58
MAR	5520.0	5490.0	-29.6	-0.54
APR	5130.0	5130.0	-6.28	-0.12
MAY	4420.0	4440.0	16.3	0.37
JUN	4230.0	4260.0	33.5	0.79
JUL	4020.0	4060.0	39.5	0.97
AUG	3940.0	3970.0	38.2	0.96
SEP	3980.0	4000.0	25.8	0.65
OCT	4190.0	4190.0	-0.487	-0.01
NOV	4680.0	4650.0	-29.4	-0.63
DEC	5030.0	5000.0	-29.8	-0.60
ANNUAL	4630.0	4630.0	0.013	0.00

CHANGE IN PERCENT OF TIME INSTREAM REQUIREMENTS ARE MET
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Metolius River at Lake Billy Chinook
Time: 13:10 Date: 11/01/2022

Month	Base Line	Mitigated	Change in Percentage	Percent Change
	%	%	%	%
JAN	97.70	97.70	0.00	0.00
FEB	99.20	99.20	0.00	0.00
MAR	99.80	99.80	0.00	0.00
APR	100.00	100.00	0.00	0.00
MAY	100.00	100.00	0.00	0.00
JUN	100.00	100.00	0.00	0.00
JUL	100.00	100.00	0.00	0.00
AUG	100.00	100.00	0.00	0.00
SEP	100.00	100.00	0.00	0.00
OCT	100.00	100.00	0.00	0.00
NOV	100.00	100.00	0.00	0.00
DEC	100.00	100.00	0.00	0.00
ANNUAL	99.70	99.70	0.00	0.00

Enter (1) to CONTINUE; (2) to WRITE the Table:

CHANGE IN MEAN STREAM FLOW (CFS)
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Metolius River at Lake Billy Chinook
Time: 13:11 Date: 11/01/2022

Month	Base Line	Mitigated	Change in cfs	Percent Change
	cfs	cfs	cfs	%
JAN	1510.0	1510.0	-0.044	0.00
FEB	1560.0	1560.0	-0.044	0.00
MAR	1560.0	1560.0	-0.044	0.00
APR	1520.0	1520.0	-0.044	0.00
MAY	1560.0	1560.0	0.056	0.00
JUN	1590.0	1590.0	0.056	0.00
JUL	1490.0	1490.0	0.056	0.00
AUG	1400.0	1400.0	0.056	0.00
SEP	1350.0	1350.0	0.006	0.00
OCT	1330.0	1330.0	-0.044	0.00
NOV	1370.0	1370.0	-0.044	0.00
DEC	1450.0	1450.0	-0.044	0.00
ANNUAL	1470.0	1470.0	-0.006	0.00

CHANGE IN PERCENT OF TIME INSTREAM REQUIREMENTS ARE MET
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Deschutes River at Lake Billy Chinook
Time: 13:11 Date: 11/01/2022

Month	Base Line	Mitigated	Change in	Percent
	%	%	Percentage	Change
JAN	100.00	100.00	0.00	0.00
FEB	100.00	100.00	0.00	0.00
MAR	100.00	100.00	0.00	0.00
APR	97.10	99.90	2.78	2.78
MAY	100.00	100.00	0.00	0.00
JUN	100.00	100.00	0.00	0.00
JUL	100.00	100.00	0.00	0.00
AUG	100.00	100.00	0.00	0.00
SEP	100.00	100.00	0.00	0.00
OCT	94.40	99.60	5.16	5.18
NOV	100.00	100.00	0.00	0.00
DEC	100.00	100.00	0.00	0.00
ANNUAL	99.30	100.00	0.67	0.67

Enter (1) to CONTINUE; (2) to WRITE the Table:

CHANGE IN MEAN STREAM FLOW (CFS)
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Deschutes River at Lake Billy Chinook
Time: 13:11 Date: 11/01/2022

Month	Base Line	Mitigated	Change	Percent
	cfs	cfs	in cfs	Change
JAN	1300.0	1290.0	-10.1	-0.78
FEB	1320.0	1310.0	-10.1	-0.77
MAR	1300.0	1290.0	-9.96	-0.77
APR	843.0	856.0	13.4	1.56
MAY	552.0	587.0	34.5	5.88
JUN	606.0	656.0	49.1	7.49
JUL	550.0	605.0	55.0	9.09
AUG	519.0	573.0	53.7	9.38
SEP	537.0	579.0	41.4	7.16
OCT	725.0	741.0	15.6	2.11
NOV	1130.0	1120.0	-10.1	-0.90
DEC	1220.0	1210.0	-10.1	-0.83
ANNUAL	881.0	899.0	17.8	1.99

CHANGE IN PERCENT OF TIME INSTREAM REQUIREMENTS ARE MET
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Deschutes River at Lower Bridge
Time: 13:12 Date: 11/01/2022

Month	Base Line	Mitigated	Change in Percentage	Percent Change
	%	%	%	%
JAN	60.50	59.00	-1.51	-2.55
FEB	63.80	62.50	-1.30	-2.08
MAR	68.30	67.70	-0.54	-0.79
APR	23.60	25.10	1.56	6.19
MAY	1.29	1.51	0.22	14.30
JUN	2.11	3.44	1.33	38.70
JUL	0.11	0.86	0.75	87.50
AUG	0.86	1.61	0.75	46.70
SEP	3.67	4.67	1.00	21.40
OCT	13.00	14.10	1.08	7.63
NOV	52.20	50.90	-1.33	-2.62
DEC	56.30	55.60	-0.75	-1.35
ANNUAL	28.60	28.70	0.11	0.38

Enter (1) to CONTINUE; (2) to WRITE the Table:

CHANGE IN MEAN STREAM FLOW (CFS)
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Deschutes River at Lower Bridge
Time: 13:12 Date: 11/01/2022

Month	Base Line	Mitigated	Change in cfs	Percent Change
	cfs	cfs	cfs	%
JAN	683.0	681.0	-2.01	-0.29
FEB	705.0	703.0	-2.01	-0.29
MAR	714.0	712.0	-2.01	-0.28
APR	299.0	319.0	20.6	6.46
MAY	51.2	91.8	40.7	44.30
JUN	50.5	103.0	52.7	51.10
JUL	42.6	97.6	55.0	56.40
AUG	46.2	100.0	54.2	54.00
SEP	61.0	103.0	42.1	40.90
OCT	222.0	244.0	21.8	8.97
NOV	551.0	549.0	-2.01	-0.37
DEC	614.0	612.0	-2.01	-0.33
ANNUAL	335.0	358.0	23.2	6.49

CHANGE IN PERCENT OF TIME INSTREAM REQUIREMENTS ARE MET
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Deschutes River above Diversion Dam at Bend
Time: 13:13 Date: 11/01/2022

Month	Base Line	Mitigated	Change in Percentage	Percent Change
	%	%	%	%
JAN	37.30	37.20	-0.11	-0.29
FEB	40.00	39.30	-0.71	-1.80
MAR	42.90	42.20	-0.75	-1.79
APR	73.20	73.30	0.11	0.15
MAY	97.00	97.00	0.00	0.00
JUN	100.00	100.00	0.00	0.00
JUL	100.00	100.00	0.00	0.00
AUG	100.00	100.00	0.00	0.00
SEP	97.00	97.60	0.56	0.57
OCT	54.60	55.30	0.64	1.17
NOV	29.00	28.70	-0.33	-1.16
DEC	35.70	35.50	-0.22	-0.61
ANNUAL	67.40	67.30	-0.06	-0.09

Enter (1) to CONTINUE; (2) to WRITE the Table:

CHANGE IN MEAN STREAM FLOW (CFS)
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Deschutes River above Diversion Dam at Bend
Time: 13:13 Date: 11/01/2022

Month	Base Line	Mitigated	Change in cfs	Percent Change
	cfs	cfs	cfs	%
JAN	712.0	710.0	-1.98	-0.28
FEB	738.0	736.0	-1.98	-0.27
MAR	781.0	779.0	-1.98	-0.25
APR	877.0	878.0	0.948	0.11
MAY	1180.0	1180.0	3.15	0.27
JUN	1360.0	1360.0	4.66	0.34
JUL	1440.0	1440.0	7.61	0.53
AUG	1290.0	1300.0	7.11	0.55
SEP	1090.0	1100.0	5.76	0.53
OCT	721.0	725.0	4.09	0.56
NOV	590.0	588.0	-1.98	-0.34
DEC	650.0	648.0	-1.98	-0.31
ANNUAL	953.0	955.0	1.98	0.21

CHANGE IN PERCENT OF TIME INSTREAM REQUIREMENTS ARE MET
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Deschutes River at Benham Falls

Time: 13:13

Date: 11/01/2022

Month	Base Line	Mitigated	Change in	Percent
	%	%	Percentage	Change
			%	%
JAN	43.40	43.20	-0.22	-0.50
FEB	54.50	54.40	-0.12	-0.22
MAR	32.50	31.40	-1.08	-3.42
APR	69.60	69.60	0.00	0.00
MAY	78.10	78.10	0.00	0.00
JUN	92.60	92.60	0.00	0.00
JUL	96.80	96.80	0.00	0.00
AUG	94.50	94.60	0.11	0.11
SEP	67.80	67.90	0.11	0.16
OCT	54.00	54.00	0.00	0.00
NOV	35.90	35.70	-0.22	-0.62
DEC	44.60	44.60	0.00	0.00
ANNUAL	63.70	63.60	-0.12	-0.19

Enter (1) to CONTINUE; (2) to WRITE the Table:

CHANGE IN MEAN STREAM FLOW (CFS)
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Deschutes River at Benham Falls

Time: 13:14

Date: 11/01/2022

Month	Base Line	Mitigated	Change	Percent
	cfs	cfs	in cfs	Change
			cfs	%
JAN	814.0	812.0	-1.96	-0.24
FEB	845.0	844.0	-1.96	-0.23
MAR	901.0	899.0	-1.96	-0.22
APR	1240.0	1240.0	-0.885	-0.07
MAY	1850.0	1850.0	-0.064	0.00
JUN	2100.0	2100.0	0.616	0.03
JUL	2200.0	2200.0	3.57	0.16
AUG	2040.0	2040.0	3.07	0.15
SEP	1730.0	1740.0	2.58	0.15
OCT	1000.0	1010.0	2.41	0.24
NOV	685.0	683.0	-1.96	-0.29
DEC	752.0	750.0	-1.96	-0.26
ANNUAL	1350.0	1350.0	0.141	0.01

CHANGE IN PERCENT OF TIME INSTREAM REQUIREMENTS ARE MET
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Little Deschutes River at mouth

Time: 13:14

Date: 11/01/2022

Month	Base Line	Mitigated	Change in	Percent
	%	%	Percentage	Change
			%	%
JAN	22.90	20.80	-2.15	-10.40
FEB	37.30	34.60	-2.72	-7.85
MAR	27.40	27.10	-0.32	-1.19
APR	45.20	45.00	-0.22	-0.49
MAY	55.90	55.80	-0.11	-0.19
JUN	56.60	56.60	0.00	0.00
JUL	85.10	86.80	1.72	1.98
AUG	93.90	94.30	0.43	0.46
SEP	72.00	73.10	1.11	1.52
OCT	11.60	12.80	1.18	9.24
NOV	14.70	14.00	-0.67	-4.76
DEC	20.30	19.70	-0.64	-3.28
ANNUAL	45.30	45.10	-0.18	-0.41

Enter (1) to CONTINUE; (2) to WRITE the Table:

CHANGE IN MEAN STREAM FLOW (CFS)
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Little Deschutes River at mouth

Time: 13:14

Date: 11/01/2022

Month	Base Line	Mitigated	Change	Percent
	cfs	cfs	in cfs	Change
			cfs	%
JAN	162.0	160.0	-1.93	-1.20
FEB	183.0	181.0	-1.93	-1.06
MAR	219.0	217.0	-1.93	-0.89
APR	262.0	261.0	-0.855	-0.33
MAY	329.0	329.0	-0.033	-0.01
JUN	298.0	299.0	0.647	0.22
JUL	230.0	234.0	3.60	1.54
AUG	200.0	203.0	3.11	1.53
SEP	144.0	146.0	2.61	1.79
OCT	76.7	79.1	2.44	3.09
NOV	108.0	106.0	-1.93	-1.82
DEC	142.0	140.0	-1.93	-1.37
ANNUAL	196.0	196.0	0.172	0.09

CHANGE IN PERCENT OF TIME INSTREAM REQUIREMENTS ARE MET
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Deschutes River above Little Deschutes River
Time: 13:19 Date: 11/01/2022

Month	Base Line	Mitigated	Change in Percentage	Percent Change
	%	%	%	%
JAN	29.70	29.70	0.00	0.00
FEB	30.10	30.10	0.00	0.00
MAR	33.50	33.50	0.00	0.00
APR	68.40	68.40	0.00	0.00
MAY	97.80	97.80	0.00	0.00
JUN	98.80	98.80	0.00	0.00
JUL	100.00	100.00	0.00	0.00
AUG	100.00	100.00	0.00	0.00
SEP	99.80	99.80	0.00	0.00
OCT	56.80	56.80	0.00	0.00
NOV	20.90	20.90	0.00	0.00
DEC	24.70	24.70	0.00	0.00
ANNUAL	63.50	63.50	0.00	0.00

Enter (1) to CONTINUE; (2) to WRITE the Table:

CHANGE IN MEAN STREAM FLOW (CFS)NTS ARE MET
IN THE DESCHUTES BASIN AS A RESULT OF MITIGATED GROUNDWATER USE

Effective Date: 9/30/2021

Deschutes River above Little Deschutes River
Time: 13:19 Date: 11/01/2022

Month	Base Line	Mitigated	Change in cfs	Percent Change
	cfs	cfs	cfs	%
JAN	329.0	329.0	0.000	0.00
FEB	331.0	331.0	0.000	0.00
MAR	319.0	319.0	0.000	0.00
APR	654.0	654.0	0.000	0.00
MAY	1220.0	1220.0	0.000	0.00
JUN	1500.0	1500.0	0.000	0.00
JUL	1690.0	1690.0	0.000	0.00
AUG	1530.0	1530.0	0.000	0.00
SEP	1260.0	1260.0	0.000	0.00
OCT	561.0	561.0	0.000	0.00
NOV	246.0	246.0	0.000	0.00
DEC	280.0	280.0	0.000	0.00
ANNUAL	829.0	829.0	0.000	0.00