

Agricultural Water Management and Conservation Planning

A Guidebook for Oregon Irrigation Districts and
Other Agricultural Water Suppliers



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Oregon Water Resources Congress



Participants & Acknowledgements

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Water Measurements & Conversions

Volume

1 inch runoff = 53.3 ac ft/sq mi
1 ac ft /sq mi = 0.01875 in runoff
1 cu ft = 7.48 gal
1 cu ft = 28.32 liters
1 cfs day = 0.0372 in runoff (1 sq mi)
1 ac ft = 325,851 gal = 1233.5 m³
1 gal = 3.785 liters
1 liter = 2.111 pints liquid
1 m gal = 3.07 ac ft

Weight

1 cu ft water = 62.4 lbs
1 cu ft concrete = 150 lbs
1 gal water = 8.34 lbs
1 kg = 2.2046 lbs
1 lbs = 0.4536 kg

Length

1 mi = 0.868 nautical mile
1 mi = 1.609 kilometers
1 in = 2.54 cm
1 ft = 30.48 cm
1 meter = 39.37 inches = 3.28 ft
1 km = 3280.8 ft = 0.6214 mi

Area

1 acre = 43,560 sq ft
1 sq mi = 640 acres = 2.59 sq km

Rate

1 mph = 1.467 fps
1 fps = 0.682 mph
1 cms = 35.3 cfs
1 cfs = 0.0283 cms
1 cfs = 448.8 gpm
1 cfs = 0.646 mgd
1 cfs = 1.983471 ac ft/day
1 cfs = 723.97 ac ft/ yr
1 mgd = 1.547 cfs = 695 gpm
1 gpm = 1,440 gpd
1,000 gpm = 2.23 cfs = 1613 ac ft / yr

Power

1 psi = 2.31 ft head
1 ft head = 0.433 psi
1 hp = 746 watts = 1 cfs falling 8.81 ft

Conversion Formulas

Multiply:

- cfs by 1.9835 to convert to acre feet per day
- acre-inches per hour by 453 to convert to gpm
- gpm by 0.002228 to convert to cubic feet per second
- psi by 2.3077 to convert to feet of head
- ac-inches by 27180 to convert to gallons
- gallons by 0.13368 to convert to cubic feet

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Acronyms

| |
|---|
| BOR: Bureau of Reclamation |
| OAR: Oregon Administrative Rules |
| ORS: Oregon Revised Statute |
| WMCP: Water Management and Conservation Plan |
| WRC: Water Resources Commission |
| WRD: Oregon Water Resources Department |

Chapter 1

Introduction

The purpose of this Guidebook is to assist irrigation districts and other agricultural water suppliers in preparing Agricultural Water Management and Conservation Plans (WMCPs). By closely following this guidance, districts and others will be better able to meet the State of Oregon requirements found in Oregon Administrative Rules (OAR) Chapter 690, Division 86 (hereafter referred to as “Division 86 rules”). This guidebook will also assist districts under federal contract that are mandated to meet requirements for water conservation and management under Section 210(b) of the Reclamation Reform Act.

Water Management and Conservation Plan Description

WMCPs are an important element in the state’s program to encourage water conservation and stewardship of Oregon’s water resources for both present and future needs.

A WMCP is a long-term water management and conservation tool that allows the District to “tell its story” by describing current conditions, analyzing opportunities, planning for shortages and anticipating the future.

If submitted to WRD for approval, a WMCP is a document prepared by or for your district (irrigation district, drainage, water improvement, or water control district) under OAR 690-086-0040. Through out this guide, entities submitting a WMCP are referred to generally as “district.”

A WMCP describes the water delivery system and its water demands, identifies the district’s sources of water, and explains how the district will manage and conserve those supplies to meet present and future needs. This plan must contain specific categories of information and meet standardized requirements in order to be approved by WRD. WMCPs are in some instances required by the Bureau of Reclamation (BOR) and in these cases the plan must pass WRD review. In addition to meeting state and federal requirements, there are several benefits to preparing a WMCP.

Benefits to Preparing a Water Management and Conservation Plan

One of the greatest benefits to preparing a WMCP is that it provides management tools to address the diverse set of existing and future demands and challenges that face agricultural water suppliers across Oregon.

The process of developing and submitting a WMCP may yield the following benefits for districts:

- Increases flexibility in managing existing supply and securing additional supplies (such as a water right transfer under OAR Chapter 690, Division 385)
- Prepares district to meet future challenges (such as population growth, urbanization, drought and other shortages)

- Provides a basis for capital improvement projects
- Provides a basis for grant applications
- Establishes a concise set of information for future managers to use

WMCPs are intended to produce and synthesize knowledge that is useful to the district while preparing the district for future pressures and uncertainties. Although there are state requirements that must be met when submitting a WMCP, it is most important that the plan is understood and easily used by district managers.

The following chapters provide a description of and guidelines for creating a water management and conservation plan. They outline the information requirements of a plan, why this information is important and ways to gather information and meet these requirements. The examples provided are to illustrate the complex and often changing environment in which districts manage limited water supplies.

Guidebook Overview

For district managers who have not previously developed and submitted a WMCP, a review of Chapter 2 “Overview of Plan Requirements,” will be helpful. This chapter explains more about what a WMCP is, who must prepare a WMCP, and what kind of information it contains. Chapter 2 also includes other useful information in a question and answer format, with references to subsequent sections of this guidebook and any applicable statute. The summary also provides a brief overview of how WRD evaluates a WMCP and how the typical review process works.

Chapter 3 “Initiating the Plan Process” provides some helpful hints on beginning the process and a checklist of the various components in a WMCP.

Chapter 4 “Guidance for Preparing Plan” provides step-by-step information on how to develop each of the required components:

- Water Supplier Description,
- Water Conservation Element,
- Water Curtailment Plan, and
- Water Supply Element.

Chapter 4 also includes a section on finalizing the WMCP, additional requirements, and an overview of the WRD review process. References to the specific part of Division 86 or other related rules that apply to each section are included.

Additionally, because there are often several meanings to terms used throughout this guidebook and in the rules relating to water conservation and management, there is a glossary of water terms and definitions provided in the Appendix A. This glossary contains general water terminology as well as specific definitions under Division 86 and other related rules. Definitions of frequently used acronyms are listed on page iv.

There are also appendices provided as resources that irrigation districts and other agricultural water suppliers may find useful in preparing a WMCP. The other appendices include:

- Sample District WMCP (Appendix B),
- WMCP Review Worksheet used by WRD (Appendix C),
- OAR Chapter 690 Division 86 rules (Appendix D),

- OAR Chapter 690 Division 85 Rules (Appendix E), and
- Other valuable resources.

District Managers may use this guidebook to prepare a plan, write a request for a proposal, review proposals, and/or review plans prepared for them by a contractor.

Chapter 2

Overview Of Plan Requirements

This chapter provides an overview of the state requirements related to Water Management and Conservation Plans (WMCPs) under Division 86. There are some related provisions applying to water right transfers and permit extensions that are under other rules, known as Divisions 385 and 315 respectively, which are referenced, but not included, in this guidebook. This overview is provided in a question and answer format so that readers can quickly and easily find topics of interest. The complete text of Division 86 is included in Appendix C and has specific sections and rules pertaining to WMCPs for agricultural water suppliers. Divisions 385 and 315 are available through WRD's website at: <http://egov.oregon.gov/OWRD/>

A detailed description of the process of preparing and submitting a WMCP, and guidance for meeting state requirements are provided in the following chapter of this Guidebook. There is significant overlap between this overview section and the following chapters to make it easier to find the information you need. Some topics are adequately described below and needed no further description, while other topics are discussed in depth in Chapter 4.

What is a Water Management and Conservation Plan?

A WMCP is a plan created by a district documenting the water rights, water use, management, water conservation, and future plans for water supplies

in the district. The Division 86 rules govern the state requirements for developing a WMCP. In 2002, changes were implemented that altered the scope of Division 86 for municipal water suppliers. No substantial changes were made relating to agricultural suppliers.

To create a WMCP, districts examine their supply, demand, future needs, and water conservation tools. By using this process, districts can create a "water budget" for their current and future needs. This water budget, along with projected future demands on the system, help to clarify how much water is required to meet current and future needs.

WRD is the state agency with the responsibility to make sure the requirements of the Division 86 rules are met and coordinates plan review to meet federal requirements under the Section 210(b) of the Reclamation Reform Act. WRD staff can be contacted for further information on preparing a WMCP.

Who must submit a WMCP?

Preparation of WMCPs by districts is largely voluntary; however, there are some instances when districts must submit WMCPs.

In most circumstances, a district must submit a WMCP if:

- The district needs to transfer water rights from a place within the district to prevent forfeiture, or

- The district contracts for water from federal water projects, such as the BOR. An approved state WMCP plan will meet federal requirements.

OAR 690-086-0220(5)
 OAR 690-385-5000 (2)
 ORS 540.572

What are the major elements of a WMCP?

A WMCP has the following major elements:

- Water Supplier Description,
- Water Conservation Element,
- Water Curtailment Plan, and
- Water Supply Element.

An overview of each of these required components and necessary elements is provided below.

What should the Water Supplier Description include?

The Water Supplier Description should include enough information to tell the story of the district and the district’s water system. Aside from the required elements, other information may be of benefit to your district or to the WRD reviewer in understanding your district’s system.

The eight necessary elements include the following:

- Water rights served by the district;
- Sources of water, including any transfer, rotation, exchange, or intergovernmental agreements;
- Map of the water delivery system, including storage, drainage, and major operational spills;
- Current water use, including peak and annual diversions;

- Major water uses, including beneficial use classifications, acreage, and number of accounts;
- Types of on-farm irrigation systems common in the district’s service area;
- Crops typically grown, with estimated average and peak water use; and
- Operations and maintenance plan.

Guidance Chapter 4, page 19
 OAR 690-086-0240

What should the Water Conservation Element include?

The Water Conservation Element should describe all water conservation measures undertaken or to be undertaken by the district, (including past, current, and future actions). Division 86 lists specific conservation measures the district should evaluate for this element.

In addressing required conservation measures, the district needs to evaluate the viability of each of the measures and implement any of the measures that are feasible. There are also conservation measures that are not required by WRD, but that may be useful to investigate as a water efficiency and management tool for your system. A description and schedule for implementation of conservation measures, as well as a monitoring plan, need to be included.

Guidance Chapter 4, page 31
 OAR 690-086-0250

What should the Water Curtailment Element include?

The Water Curtailment Element will help the district react quickly and effectively to meet their patrons needs in the event of a water supply emergency, such as supply shortage due to drought, contamination, or infrastructure failure. This element requires a district to

prepare a curtailment plan with stages of alert which will trigger increasingly restrictive water use requirements. The district must also review its ability to maintain water delivery during a long-term drought. The district should consider any past curtailment plans that may have been required under drought declarations that may still be in effect for district service areas.

Guidance Chapter 4, page 49
OAR 690-086-0260

What should the Water Supply Element include?

The Water Supply Element should include an estimate of the district's projected water demands for 20 years. Any expected district boundary expansion and anticipated crop or beneficial use changes should also be included. These demands should be based upon population projections and anticipated development as found in comprehensive land use plans or other similar planning documents relating to agricultural lands, water resources and supply, public facilities and services, or urbanization.

Urbanization and other land use trends are factors that must be considered when evaluating long-range water supply needs. The impact of changing land use patterns, whether as a result of urbanization or conversion from irrigated lands to a non-irrigated use of the land, can have major impacts on the district's long-range water needs. Impacts that should be considered include changes in place of use as a result of structures and roads replacing crops on the land, or changes affecting the type of use and distribution of water. Other aspects of urbanization such as annexation to cities and competition for water through the use of exempt wells may be elements

that are important depending on the situation.

In addition to projecting demand, the water supply element of a WMCP evaluates the adequacy of current water rights, contracts, and other water supply sources held by the district in meeting the projected demand. Based on this evaluation, the district creates a list of potential sources of water, including reuse and conservation opportunities, to meet the demand. The district is also required to compare the costs, availability, reliability, and likely environmental impacts among the potential supply source(s).

Guidance Chapter 4, page 52
OAR 690-086-0270

What additional information must be considered when creating a WMCP?

There are several additional items which must be considered when creating a WMCP.

- The district must include a list of affected local governments to whom a draft of the WMCP was made available for review and comment and any comments from those local governments. The affected governments must be notified of the draft plan by the district 30 days prior to submission to WRD. In all cases this includes any County or City Planning Department or Port Authority that the District physically touches or transmits water through. In some specific cases this notice may include other districts with water use agreements or any downstream district that may be affected by changes in discharge.
- The district must propose a date for submittal of an updated WMCP within 10 years. The proposed date

should be based on the timing that works best for the district considering community planning activities and other changes expected by the district.

- If the district believes future updated WMCPs are unnecessary, the district must explain why.
- If a district has requested additional time to implement metering or other measures established in a previously approved WMCP, the district must provide reasons why.

Guidance Chapter 4, page 56
OAR 690-086-0225

What criteria will WRD use to evaluate a WMCP?

WRD will review a WMCP and evaluate whether or not it meets the requirements of Division 86. After an initial review of a draft plan, WRD will provide the district with comments on each section. The worksheet of criteria used for this review is included in Appendix C. In particular, WRD will use the following criteria:

- The plan includes all of the information required under Division 86.
- Conservation measures have been evaluated by:
 - Ability for district to use conservation as tool(s) in increasing water use efficiency
 - Economic costs to district in implementing,
 - Time needed to implement, and
 - Environmental impacts of measures.

- Supply element includes:
 - Potential sources to meet projected demand, and
 - Development of conservation measures which are available at a lower cost than other options.

Guidance Chapter, page
OAR 690-086-0910

What process and timelines are involved in WRD's review of the WMCP?

After a district decides that a plan is ready for submission, the typical process is depicted in Figure 1 and is as follows:

- (1) The district prepares a draft WMCP,
- (2) The district provides 30-day notice to any local affected governments,
- (3) The district submits a draft WMCP to WRD,
- (4) WRD issues public notice of the receipt of the WMCP,
- (5) WRD prepares a preliminary review of the WMCP, considering any public comments, and provides the review to the district,
- (6) The district responds to WRD's review by revising the WMCP, as appropriate, and submits a final draft of plan,
- (7) WRD conducts final review of plan,
- (8) If the criteria are met, WRD issues a Proposed Final Order to approve the WMCP,
- (9) WRD notifies the district and any commenting parties,
- (10) The district and commenters have 30 days to appeal the proposed order, and
- (11) If no appeal is received, WRD issues final order approving the WMCP.

The preliminary review process can take as little as 90 days. However, review and approval of a WMCP that does not meet the criteria may take substantially longer than 90 days. The worksheet used by WRD for WMCP review is included as Appendix C. For deficient WMCPs a work plan may be proposed by WRD, in consultation with the district. A work plan provides strict direction for future activity, but allows approval of a WMCP. (See “What is a workplan?” in this chapter.) There are also resources available to the district when the plan does not meet the review criteria, such as requesting additional time from WRD, a review by a Director-appointed board, or a file review by the Water Resources Commission (WRC). Following the recommendations of this guidebook can assist districts in creating a WMCP that meets WRD criteria and serves as a valuable water management tool.

Guidance Chapter 4
OAR 690-086-0900 to 0920

What is a work plan?

A work plan may be required if, after submitting a WMCP and revising that plan based on comments from WRD, the plan still does not meet Division 86 requirements. In these cases, WRD may require the district to develop a work plan to meet the requirements.

The work plan will include a schedule for completion of any additional work necessary to comply with WMCP requirements. Districts who are required to submit a work plan generally will be given up to five years to meet this schedule.

OAR 690-315-0050 (6)

What will WRD’s order approving a WMCP include?

Once the WMCP meets the requirements for agricultural water suppliers, WRD will issue a final order and notify the district.

- The order will contain the date when the next update of the WMCP should be submitted to WRD (typically within 10 years, no earlier than 5 years), if required.
- WRD will also notify any person who submitted comments of the final order.

OAR 690-086-0915

How are progress reports used after issuance of an order approving the WMCP?

For most districts, progress reports do not have to be submitted to WRD. However, for districts operating under a BOR contract, progress reports may be required to be submitted to BOR under the contract. Also, for any district participating in the water transfer provisions under Division 385, annual reports of progress made towards implementing a WMCP must be submitted under those agreements.

OAR 690-086-0220(3)(5)

How does a WMCP relate to a Comprehensive Land Use Plan?

Since Division 86 requires that future water use estimates are consistent with land use and population projections, irrigation districts and other agricultural districts should use the information contained within comprehensive land use plans of each affected local government. This information is crucial in estimating demand and other impacts on long-

range water needs in the Water Supply Element of the WMCP. A draft WMCP must be submitted to each affected local government, which includes not only municipalities and counties, but also Ports and other local government entities.

 OAR 690-086-0220(6)
 OAR 690-086-0270(1)(5)

What is required in terms of public involvement?

Though the rules applying to WMCPs do not require direct public involvement, districts are encouraged to involve the public during the preparation of the plan. Division 86 suggests making the WMCP available for public inspection and conducting public meetings to provide information and gather input. After the plan is submitted, WRD issues public notice of the plan and uses comments from citizens and local governments in the review process.

Additionally, under the Water Conservation Element, there is a required information and education component for encouraging water efficiency. Early citizen involvement can add to the success of any educational program and to the WMCP as a whole.

 Guidance Chapter 4, page 47
 OAR 690-086-0905
 OAR 690-086-0250(7a)

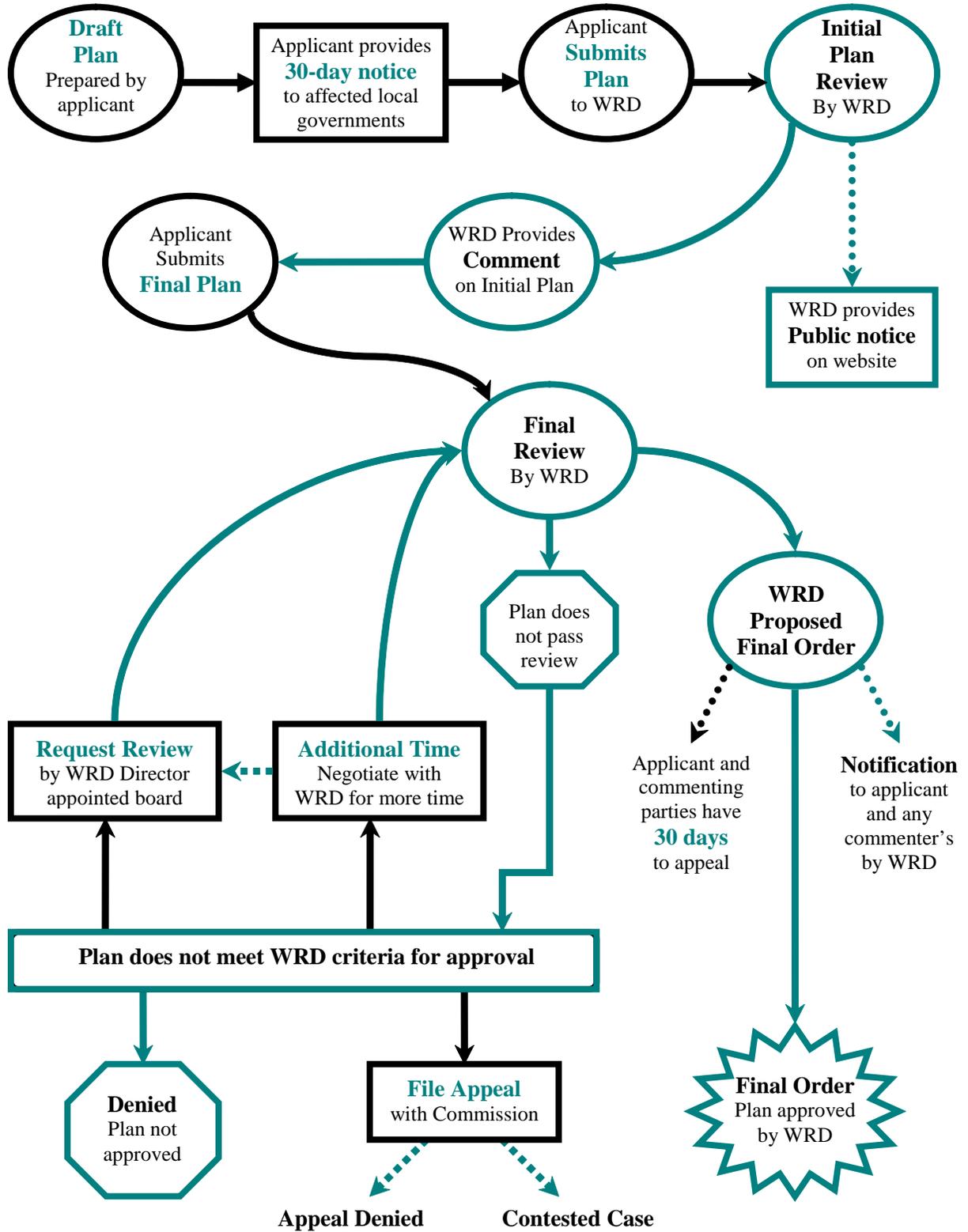
Will WRD recognize the benefits of conservation actions implemented prior to the WMCP?

The purpose of a WMCP is to document a sound and responsible approach to managing water resources. Where a district has already integrated conservation actions into its water supply management strategy, those actions should be described in the

WMCP. Depending upon the actions carried out and the particular circumstances facing each district, these past actions could potentially serve to meet some or all of the required conservation actions. Districts who have previously created and received approval for a WMCP are required to describe progress from previous plans.

 Guidance Chapter 4, page 31
 OAR 690-086-0250

**Figure 1:
Typical WMCP Process for Districts**



Chapter 3

Initiating the Plan Process

This chapter provides suggestions on how to initiate the WMCP process and how districts can write effective plans. Where the previous chapter provided an overview of the state requirements, this chapter provides some helpful preliminary steps designed to make the process of developing a WMCP easier. This chapter also explains the icons used throughout the guidebook and contains a checklist for keeping track of the various required and voluntary components of a WMCP (Figure 2 at the end of this chapter).

Getting Organized

As with any planning effort, organizing early will make the process smoother and more efficient. This section provides some ideas for organizing the planning process. This section is “optional” in that the suggestions contained here are not required by Division 86.

Establish Plan Objectives

It may be useful for the district to list some objectives of the planning process at the beginning of the process. This can help guide staff, policymakers, and consultants working on the plan.

Examples of potential objectives include:

- Conserve water through improving management of one or more of the district’s water sources;
- Control costs of operations, maintenance and capital investments, while maintaining level of service;

- Maintaining reliability of water supply at some pre-determined level defined by the district;
- Increase long-term water supply security and flexibility;
- Continue to work in support of fisheries and other natural resources;
- Maintaining customer satisfaction;
- Meeting State requirements for the WMCP;
- Meeting Federal requirements for the WMCP.

Each of these objectives can be tailored to meet the specific situation of the district, or can be replaced with other objectives as necessary.

Early Discussion with WRD Staff

Districts are encouraged to contact WRD early in the process to lay out a framework for the plan, identify any key issues, and discuss the methods that will be used to develop required information. There are a variety of WRD staff with expertise in areas related to WMCPs that can be contacted, such as the local Watermaster for your district, WMCP review staff, and district transfer staff in Salem. Early and diverse contact can save time later in the process. This can also help districts understand better the specific criteria that WRD will apply in evaluating their individual plan.

Establish a Planning Team

Depending on the size and complexity of the district’s water system, staff assigned to develop the plan may range

from one person to several. Some districts may choose to hire outside service providers to assist in developing the WMCP. It is important at the outset to identify what types of information and analysis will be needed. Staff can then be identified to meet these needs, and can participate in developing key objectives, methods and timelines.

In some cases, there may be opportunities for cost sharing with other irrigation districts and other agricultural suppliers that share interconnections or conjunctive uses of source. This would be particularly true where outside service providers are needed for services such as analyses of alternatives and cost-benefits of water conservation measures. In addition, as discussed elsewhere in this Guidebook, there may be cost sharing opportunities for carrying out actions in the WMCP, such as publications developed as part of a public outreach effort.

Assembling Information

The checklist provided in Figure 2 shows the type of information that may be needed to prepare a WMCP. Not every district will need all of the information listed. At the beginning of the planning process, the district may want to take stock of the specific information that will be needed. Sources of that information can then be determined. Much of the information needed for a WMCP will come from the district's own records. This includes information such as pumping or diversion records, billed sales, conservation program assessments, extent of the service area, number of connections, and experience with supply interruptions or other shortages.

Other types of information will be needed from local governments or state sources. These include, for example, land use plans, estimates of current

population, and projections of future population. This step may also be an opportunity for your district to transition from paper to electronic records or other updates to your record-keeping systems, as your district determines what information is needed and where it could be obtained.

Provide for Public Involvement, if Desired

The State of Oregon rules and statutes encourage districts to involve the public as they develop a WMCP. While public involvement is not required, notice is given by WRD when the plan is submitted and comments are used in the review process. Early public involvement can also aid in the implementation of water efficiency measures involved in the Water Conservation Element. Therefore, each district should determine the need and level of public involvement for their specific plan.

Public involvement techniques may include:

- Distributing information through articles in a district newsletter, posting on a Web site, or flyers inserted with annual bills;
- Issuance of a press release to local media to inform the public of planning issues and plan development;
- Holding public meetings on the WMCP;
- Formation of a public advisory committee, or use of an existing committee to provide input as the plan is developed;
- Giving presentations at regular board meetings as well as local community, environmental and business groups

(such as local watershed councils or Chamber of Commerce);

- Making the plan available for public comment at district offices or other locations.
- Sending a copy to state and federal water conservation coordinators.

Funding for Plan Preparation

There are no funding sources specifically earmarked for preparing WMCPs. Districts will need to either use their own staffing and funding resources, or seek funding related to other types of state and federal funding programs. For example, federal or state money for community and economic development and other sources may potentially be available. However, in many cases a district may need to link plan development to a proposed capital project that would receive funding. System improvements and operation and maintenance can be used as a basis to apply for grants. Other conservation measures, such as energy efficiency measures, also have funding opportunities available. A few examples of sources of funding are provided below to illustrate the breadth of possible projects. .

Examples of funding sources and successful agricultural projects

BOR 2025 Challenge Grants

www.doi.gov/water2025/grant.html

Through the Challenge Grant Program, BOR provides 50/50 cost share funding to irrigation and water districts and states for projects focused on water conservation, efficiency, and water marketing. Projects are selected through a competitive process, based on their ability to meet the goals identified in Water 2025: Preventing Crises and

Conflict in the West. As funding is allocated each year, districts should check for requirements and availability. The following examples are some of the district projects recently selected as part of this program:

- East Fork Irrigation District. The district will install 1.7 miles of pipeline and inverted siphon near Neal Creek. The project is estimated to save 1,745 acre-feet of water per year. The total project cost is \$4,327,674, including a Water 2025 contribution of \$300,000.
- Klamath Irrigation District. The district will replace the Miller Hill Pump station with electric variable speed pumps and install SCADA in a new pumping plant. The project is estimated to better manage 12,500 acre-feet of water per year. The total project cost is \$697,231, including a Water 2025 contribution of \$300,000.
- North Unit Irrigation District. The district will replace 0.5 mile of canal with HDPE pipe. The project is estimated to better manage 1,360 acre-feet of water per year. The total project cost is \$574,007, including a Water 2025 contribution of \$237,002.

NRCS Conservation Innovation Grants

www.or.nrcs.usda.gov

Natural Resource Concern Category – Water Resources examples:

- Aquifer recharge/maintenance of groundwater supplies;
- Increased water supplies/availability through alternative treatment; enhanced automation, monitoring or scheduling; reduced system losses; or reuse strategies; and
- Small Farm Scalable technologies.

Technology Category (such as on-farm efficiency) example:

- Farmers Irrigation District received funding in 2006

Columbia Basin Water Transactions Program

www.cbwtp.org

Using permanent acquisitions, leases, investments in efficiency and other incentive-based approaches, the CBWTP supports program partners in Oregon, Washington, Idaho and Montana to assist landowners who wish to restore flows to existing habitat. Participants in the program must partner with one of following:

- Deschutes River Conservancy (DRC)
- WRD
- Oregon Water Trust (OWT)
- Walla Walla Watershed Alliance (WWWA)

Through this program, Central Oregon Irrigation District partnered with the Deschutes River Conservancy to pipe canals and make other improvements.

State of Oregon Renewable Energy Feasibility Fund

<http://econ.oregon.gov/ECDD/REFFShtml>

Oregon Economic & Community Development Department and the Department of Energy established the Renewable Energy Feasibility Fund (REF Fund) to encourage renewable energy projects that reduce Oregon's dependence on fossil-based energy sources and promote sustainable economic development. An "REF" study is one that incorporates renewable energy source(s) for the purpose of generating electricity, heat and/or fuel and would qualify as a "renewable resource project" under Oregon's

Business Energy Tax Credit (BETC) program. The program is available to irrigation districts.

Helpful Tips and Other Icons

There are three icons used throughout the chapters of this guidebook. State of Oregon requirements under Division 86 include some items that must be addressed by each district preparing a WMCP. Other items, however, are voluntary or only apply in certain circumstances.

Throughout this guidebook, the following icons are used:



This icon indicates a requirement that every district preparing a plan should include in the WMCP.



This icon indicates a required analysis or evaluation of items that every district preparing a plan should include in the WMCP, but are not necessarily required to implement.



This icon indicates that the item is an optional element to include in a WMCP or only applies in certain circumstances. These items are provided to assist your district in conserving and managing the water in your system and are generally not required in most cases. Each district should review the information and determine whether the information applies to them, either as a management tool, or under Division 86.

This icon indicates a "HELPFUL TIP" box with information that may be useful in preparing a WMCP.



Figure 2: WMCP Guidance Checklist contains all the required items with checkbox icons in an easy to read list. To keep better organized, districts may wish to mark in the boxes provided those items that apply to them. Also, districts

may wish to check each item off after that item has been completed. For those wanting to double check or clear up any uncertainty, consult the Division 86 rules provided in Appendix D.

Figure 2 WMCP Guidance Checklist

This checklist is provided to assist you in preparing a Water Management and Conservation Plan. Check the first box as you complete each section. Refer to the corresponding Guidance Page No. for more information.

- Requirement for all districts
- Indicates the item must be evaluated
- Optional water management tool

| WMCP Item | | Guidance Page No. |
|---|---|-------------------|
| Water Supplier Description - OAR 690-086-0240 | | |
| <input checked="" type="checkbox"/> | Summary of Water Rights | 21 |
| <input checked="" type="checkbox"/> | Source(s) of water | 21 |
| <input checked="" type="checkbox"/> | Schematic or map of the system | 22 |
| <input checked="" type="checkbox"/> | Current water use, including peak and average annual diversions | 25 |
| <input checked="" type="checkbox"/> | Summary of major classifications of uses and users | 26 |
| <input checked="" type="checkbox"/> | Types of on-farm irrigation systems commonly used | 28 |
| <input checked="" type="checkbox"/> | Crops commonly grown, estimated average and peak consumptive use | 28 |
| <input checked="" type="checkbox"/> | Description of the operation and maintenance program | 30 |
| Water Conservation Element - OAR 690-086-0250 | | |
| <input checked="" type="checkbox"/> | Progress report on conservation measures from previously approved WMCP | 32 |
| <input checked="" type="checkbox"/> | Description of the water supplier's agricultural water measurement program | 33 |
| <input checked="" type="checkbox"/> | Description of other conservation measures currently implemented | 34 |
| <input checked="" type="checkbox"/> | Short and long-term goals of the water supplier to improve water management | 34 |
| Evaluation of the opportunities for improving water use efficiency | | |
| <input type="checkbox"/> | Description of losses of water from canals, pipelines, and laterals | 35 |
| <input type="checkbox"/> | Assessment of whether water deliveries are insufficient to meet crop needs | 42 |
| <input type="checkbox"/> | Assessment of whether water deliveries are insufficient to meet other needs | 42 |

| WMCP Item | | Guidance Page No. |
|---|---|-------------------|
| For each of the following conservation measures not currently implemented, an evaluation of whether implementation is feasible and appropriate | | |
| <input type="checkbox"/> | ➞ Promotion of energy audits for district water users | 44 |
| <input type="checkbox"/> | ➞ Conversion to metered, pressurized deliveries to all parcels of 1 acre or less | 44 |
| <input type="checkbox"/> | ➞ Piping or lining earthen canals to reduce losses | 45 |
| <input type="checkbox"/> | ➞ Modifying facilities and policies to increase the flexibility of deliveries | 45 |
| <input type="checkbox"/> | ➞ Provision of on-farm irrigation scheduling assistance | 45 |
| <input type="checkbox"/> | ➞ Construction of re-regulating reservoirs | 46 |
| <input type="checkbox"/> | ➞ Adoption of rate structures that support and encourage water conservation | 46 |
| <input type="checkbox"/> | ➞ Any other conservation measures identified by the water supplier that would improve water use efficiency | 46 |
| Description and estimated schedule for implementation of each of the following conservation measures | | |
| <input type="checkbox"/> | ☑ Information and education program addressing all types of uses served | 47 |
| <input type="checkbox"/> | ☑ Any other conservation measures identified as feasible and appropriate | 48 |
| <input type="checkbox"/> | ☑ A program to monitor and evaluate implemented conservation measures | 49 |
| Water Curtailment Element - OAR 690-086-0260 | | |
| <input type="checkbox"/> | ☑ Description of past supply deficiencies and current capacity limitations | 51 |
| <input type="checkbox"/> | ☑ Description of situation(s) that trigger implementation of water curtailment element | 51 |
| <input type="checkbox"/> | ☑ Description of the procedure used to allocate water during shortages | 51 |
| Water Supply Element - OAR 690-086-0270 | | |
| <input type="checkbox"/> | ☑ Estimate of long-range water demand projections for 20 years | 54 |
| <input type="checkbox"/> | ☑ Comparison of the projected water needs and available sources | 54 |
| <input type="checkbox"/> | ☑ List of potential sources of water to supply the long-range needs | 55 |
| <input type="checkbox"/> | ☑ Comparison of potential sources of additional water | 55 |
| Evaluation of the effects of the following factors on long-range water needs | | |
| <input type="checkbox"/> | ➞ Regional options for meeting future water needs | 56 |
| <input type="checkbox"/> | ➞ Urbanization and other land use trends | 56 |
| <input type="checkbox"/> | ➞ Local government related plans or ordinances | 56 |
| Additional Requirements - OAR 690-086-0225 | | |
| <input type="checkbox"/> | ☑ List of the affected local governments to whom the plan made water available and a copy of any comments on the plan provided by the local governments | 57 |
| <input type="checkbox"/> | ☑ Proposed date for submittal of an updated WMCP | 57 |

Chapter 4

Guidance for Preparing Plan

After reviewing the general requirements and tips for beginning the process of completing and submitting a WMCP, you have already taken the first steps toward preparing the plan for your district. The organization of this chapter follows the requirements under Division 86 and is written in a step-by-step format. This format should be useful for both the novice and more experienced manager in the development of a WMCP.

The following sections: Preparing the Water Supplier Description; Preparing the Water Conservation Element; Preparing a Water Curtailment Plan; and Preparing a Water Supply Element mirror the four major requirements of a WMCP as described in Division 86. Refer to each of these sections for detailed guidance on the specific parts of each requirement.

District managers will also find other useful sections in this guidance chapter. Finalizing the Plan Document and Additional Requirements discusses the final steps in preparing a WMCP and some additional requirements to consider before submission. The last section in this chapter, WRD Review Process, describes the process used by WRD staff in reviewing WMCPs.

Preparing the Water Supplier Description

After assembling the basic information for the plan, the next step is to prepare a description of the district water supply system, its current service territory, and a summary of available water rights.

The intention is to create an inventory of the district's sources of water and the facilities used to divert and deliver that water, as well as to assess the adequacy and reliability of supplies subject to potential future restrictions. The required elements for this section of the WMCP are outlined under OAR 690-086-240 and are listed in the previous chapter in a checklist format in Figure 2.

In the sections below, a check mark in the box next to each action indicates that all districts submitting a plan must consider that item. If there is no check mark, the element is optional to include in a WMCP or only some districts must consider the action.

Sources of Information

Information needed to prepare this section of the WMCP may be found in previous reports on the water supply system, including district facilities plans or a prior WMCP. The district will need to collect data on the district's water rights, and sources of water, including intergovernmental or exchange agreements for water supply or delivery contracts. Additionally, information on current water use, major types of water use classifications, types of irrigation systems, crops commonly grown, and operations and maintenance programs must be included.

The district will also need a schematic or map illustrating the district's boundaries, storage and distribution facilities, points of diversions, and major operational spills.

Because some of this information may be difficult to locate, or involve additional time for research, planning ahead is essential for the successful completion of a Water Supplier Description.

Specific Components of the Water Supplier Description

The first step in preparing a WMCP is to describe the district. Before looking at ways to conserve water, district managers, staff, district policymakers (such as board members), and WRD staff need to know what types and amounts of water are available and typically used in your system.

Examples of sources of information

- Prior WMCP or other district plans for facilities or water supply
- Water rights documents (Internal or from WRD)
- Internal documentation of agreements or contracts for water delivery or purchase
- District billing records or other sales data
- Drawings of the district's system, "as-builts," system plans, or "record drawings," or CAD drawings
- City or County information on growth and development
- Interviews with system operators
- Service boundary agreements and maps
- Capital improvement plans or infrastructure plans
- Fisheries management plan and other plans and agreements related to natural resources management (available from the Oregon Department of Fish and Wildlife, NOAA Fisheries, or U.S. Department of Fish and Wildlife)

The description of the water supplier system should include:

- Summary of water rights served by the district;
- Description of sources of water used by the district, including any transfer, rotation, exchange, or intergovernmental agreements;
- System schematic or map of the water delivery system, including the locations of storage, drainage, and major operational spills;
- Current water use, including peak and annual diversions,
- Major water classifications and uses, including beneficial use classifications, acreage, and number of accounts;
- Types of on-farm irrigation systems common in district service area;
- Crops typically grown, with estimated average and peak water use;
- Operations and maintenance plan.

These items are discussed in detail below.

• WRD's "Water Rights Information System" database can be used to assist managers in describing existing water rights. This database can be accessed online at: www.wrd.state.or.us.

• In addition, this information is available by contacting your local Watermaster through the Department or online at: www.wrd.state.or.us/OWRD/offices.shtml.





Summary of Water Rights Held

OAR 690-086-0240 (1)

The rule requires that the WMCP include a table listing all water rights held by the district. Note that there are a variety of water right types, such as permitted, certificated, decreed, statutory, limited licenses that should be included in the table. For some districts, such as those that share permitted rights with other suppliers, a brief description of the arrangements with these other suppliers should be included in addition to the table.

The water rights table (or tables) should include the following information:

- General location of water right acreage,

- Numbers of the associated water right certificates and permits, and
- Description of relevant conditions of the water rights including the seasons of use and the uses of any other permitted withdrawals by the supplier;



Description of Supplier's Source(s)

OAR 690-086-0240 (2)

Division 86 rules call for a description of each source of water for the district, including related diversion(s) and storage facilities. In addition, the rule requests descriptions for each exchange or intergovernmental cooperation agreement for the sale or purchase of water, and any other contracts for the supply or delivery of water.

| Example: Summary Of Water Rights | | | | |
|---|--|--|--|-----------------------|
| Water Right Certificates And Permits | Location of Water Right Acreage | Acreage (or Acre Feet of Storage) | Conditions of Water Rights | Seasons Of Use |
| Certificate 1235 (held by District) - a secondary right related to Cedar Creek Reservoir | Down stream of Cedar Creek Reservoir T1S R1W portions of Sec 2,3,4, 5 and 6 | 1000 acres | Standard conditions for irrigation and must have BOR contract | May - October |
| Permit S 5678 (held by District) - a secondary right related to Cedar Creek Reservoir | Feed Canal T1S R1W portions of Sec 5 and 6 | 500 acres | Standard conditions for irrigation and must have BOR contract | May - October |
| Certificate 1234 (held by BOR) - Cedar Creek Reservoir | Cedar Creek Reservoir T1S R1W Sec 2 | 30000 acre feet | Standard conditions for storage in impoundment over 10' in height and over 9.2 acre feet | November – April |
| Certificate 4321 (held by District) | Well numbers 1 & 3 (Cedar City Golf Course) T1S R2W portions of Sec 5 and 6 | 150 acres | Standard conditions for irrigation and report static water level annually | May - October |

The description of each source of water should include a general discussion of the type and location of the point of diversion for each right. In the case of a ground or surface water right, the description should include:

- Identification of the source of water, such as the stream or aquifer name, and
- Township, range, and quarter-quarter section location of the diversion, as specified under the existing water right permit or certificate.

This information can be found on the actual water right permit or certificate documentation which the district or local Watermaster office should have on file.

The description of the diversion should include a summary of the physical structure or equipment used to divert or withdrawal water. Examples include brief descriptions of the pipe or screen used at a river intake, including any fish screens that may be in place to limit impacts to protected aquatic species, as well as any pumps and their capacity used for water diversion. Similar descriptions would apply to a ground water right, including a summary of the well depth, diameter, and installed pumping capacity. For storage rights, held or operated by the district, the source description should include summaries of the name of the river or stream from which water is diverted or stored, the size of the reservoir(s), height and crest (width) of the dam, and normal operating pool level.

If the storage right is held by the federal government, the name of the facility, managing agency, and contract number with pertinent agencies should be listed. As part of this description, any additional sources of water, including interconnections with other

suppliers, exchange or intergovernmental agreements for water or supply, and delivery contracts with other suppliers must be included. The description of these agreements should identify the entity with which the agreement is made; its general terms and conditions; the quantities of water agreed upon for exchange, sale or purchase; and the period for which the agreement is in effect.

This description should also include existing and planned interconnections or transfer arrangements with other water suppliers, and details such as minimum purchase quantities, maximum limits, and delivery restrictions, and other details that pertain to the availability or reliability of that service. The listed agency is usually BOR; however, the US Army Corps of Engineers (USACE) or US Forest Service (USFS) may also have contracts, special use permits, or other relationships with storage rights that should be included in the description.



System Schematic

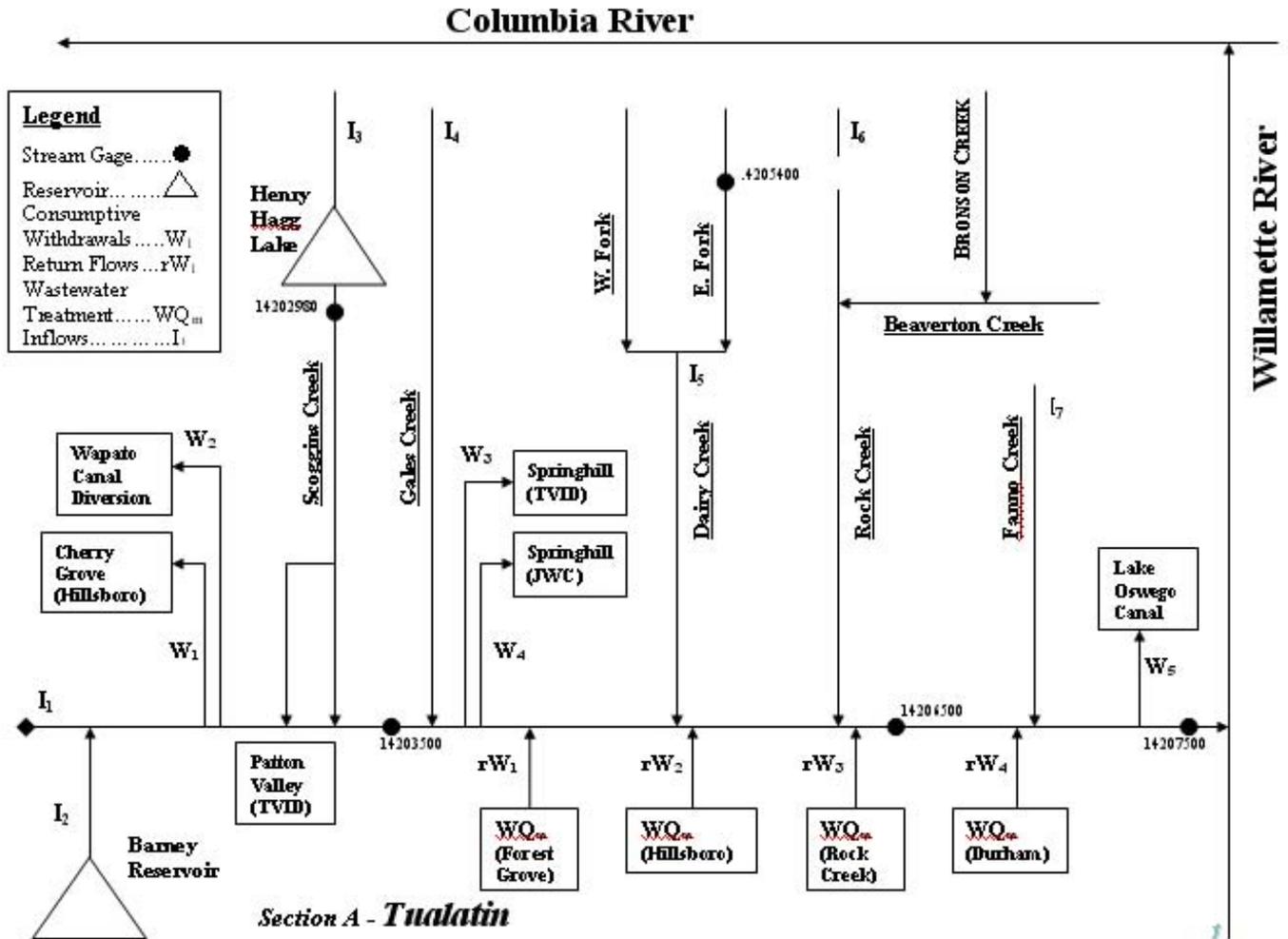
OAR 690-086-0240 (3)

The rule calls for a schematic (or map) of the district's operational system showing storage and distribution facilities, measurement stations, points of diversion, major operational spills, and other major infrastructure items. The following list indicates features that should be illustrated on the schematic, flow chart, or map of the district.

Major schematic features:

- Generalized district boundaries
- Storage facilities: dams, reservoirs, re-regulating structures
- Distribution systems: such as pipe lines, open channels

**Figure 3:
Sample Flowchart Schematic**



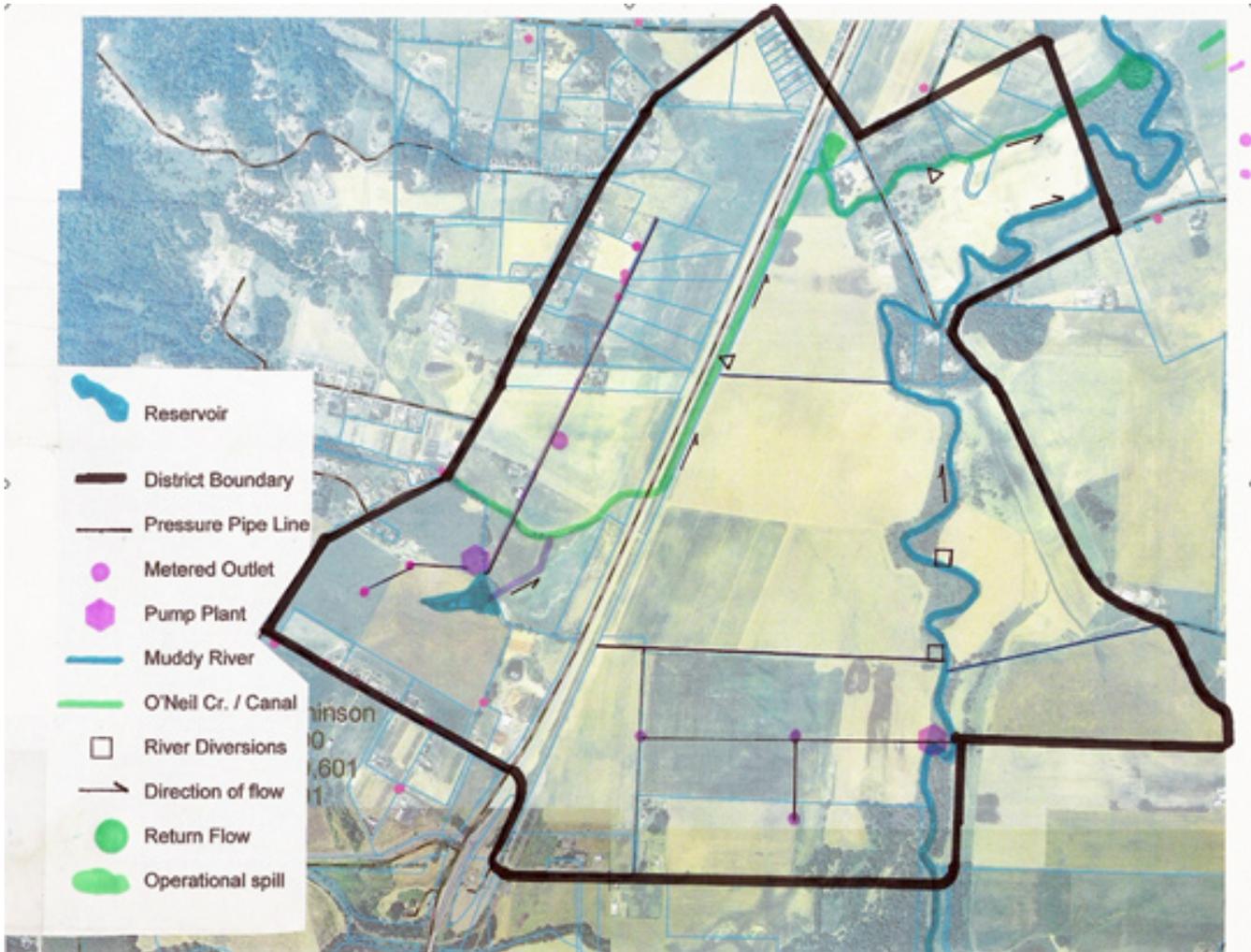
Tips on Schematics

Example schematics are provided in Figures 3 and 4. For more complex districts, or for a low-tech option, a flow chart schematic, like the example provided in Figure 3 can be submitted.



- USGS mapping programs can cost less than \$125 and can be used along with a hand-held GPS unit to make clear and easy to read maps. Good quality photos can be obtained from FCS, NRCS, or county planning departments.
- ARC-GIS programs can be used for professional looking maps and can be layered to avoid looking cluttered.
- Training in use of mapping software is available at colleges and universities. For example, OSU has a wide array of information and courses on mapping technologies at: www.geo.oregonstate.edu/ucgis.
- While WRD is making electronic submission of schematics available as an option, a paper version of some type still needs to be submitted with the plan.

**Figure 4:
Sample Schematic**



Example: The schematic shown above represents a hypothetical irrigation district. The schematic was drawn on an aerial photo obtained from a regional government planning department, Portland Metro. Photos may also be obtained from NRCS, ASCS, County or other free source such as Google Earth. Markings were made by Sharpie pen. Shapes were drawn using a template bought from an office supply store. Legend was typed on plain paper and symbols drawn in. The legend was taped to the aerial photo and copied and/or scanned into a computer and printed. (Total cost was about \$18.)

- Direction of flow should be shown on primary conveyance facilities
- Drainage systems
- Locations of district operated diversion points
- Measuring devices such as meters, weirs, gauging stations
- Locations of major operational spills and return flows
- Special water recovery/reuse infrastructure, such as Aquifer Storage and Recovery (ASR), or Artificial Recharge (AR) projects
- Interconnections with other supply systems
- Other infrastructure features, as applicable

The schematic may be taken directly from any District Water System Master Plan or other similar plans. District maps may also be available from BOR or a final proof survey conducted by a certified water rights examiner. The schematic need not be professionally done; it can be done by hand or generated by GIS/GPS or mapping programs as shown in Figure 4. Operational schematics can be multi-paged to accommodate complex or multi-layered maps. The schematic, flowchart, or map should be to a scale that can be easily read and on which the infrastructure items can be identified and be generally located on site. Note that discharge points of major operational spills and important channels of return flows should be indicated on the map even if they are beyond district boundaries. Major planned improvements should also be shown.



Current Water Use and Return Flows

OAR 690-086-0240 (4)

The description of the water system includes information on current water use, including peak and average annual diversions and, when available, water reuse and return flows.

Current Water Use

Current water use refers to the district water deliveries of recent years. Diversions during peak months and annual total diversions should be presented for seasons that are representative of a range of water supply conditions (e.g., a normal, low and high water supply year). A recent five to ten-year period might be used for this determination. For areas that rely on snow melt as the primary source of surface water, seasonal surface water supplies each year might be characterized as wet, dry, or normal based on the NRCS Surface Water Supply Index (SWSI).

Tabulated water use summaries should be presented for each major point of diversion for each year showing total annual diversions and peak month diversions. The peak month diversions for each permit and the highest monthly

The SWSI accounts for snowpack, mountain precipitation, streamflow, reservoir storage, and soil moisture conditions. It is available at: www.or.nrcs.usda.gov/snow/watersupply/swsi.html. A historical summary of SWSI for the principal river basins of Oregon can be downloaded at www.or.nrcs.usda.gov/snow/watersupply/SWSI_Summary.csv.



total diversions also need to be reported to WRD (in compliance with OAR 690-085).

Return Flows and Water Reuse

Recapture and reuse of irrigation return flows is often an important part of a district water supply and should be included when available. Water reuse and return flows can be measured or estimated to develop an accurate picture of the district’s water budget. Return flows may take the form of surface runoff, seepage into drains or streams and deep percolation to ground water. If surface runoff and seepage to drains is systematically collected and channeled back into a canal system or re-regulating reservoirs, it should be possible to measure those flows directly. However such surface flows may only be a fraction of total return flows.

Deep percolation is often the biggest component of return flows. While it

cannot be observed or measured directly, it is possible to estimate the potential deep percolation without detailing where and how it is distributed. One way to estimate the percolation from irrigated fields based on the irrigation systems employed and the intensity of irrigation.

Figure 5 provides rough estimates of potential percolation as a percentage of applied water for different irrigation system types.



Summary of Water User Classifications

OAR 690-086-0240 (5)

This component of the Water Supplier Description requires a summary of major water use classifications in the district.

This summary must include:

- Major classifications of water user accounts, including water right acreage;

Example: Annual and Peak Diversions by Month

| Year | Diversion | Permit # | Time of use | Annual diversion (AF/year) | Peak diversion (AF/month) | Peak diversion (cfs) |
|------|-----------------|----------|-------------|----------------------------|---------------------------|----------------------|
| 1998 | Alpha creek | S-0001 | Seasonal | 3800 | 650 | 10.6 |
| | Beta River | S-0002 | Seasonal | 21244 | 8404 | 136.9 |
| | Theta Reservoir | S-0003 | Full year | 80329 | 12069 | 196.6 |
| 1999 | Alpha creek | S-0001 | Seasonal | 3825 | 641 | 10.4 |
| | Beta River | S-0002 | Seasonal | 21055 | 7844 | 127.8 |
| | Theta Reservoir | S-0003 | Full year | 73456 | 11056 | 180.1 |
| 2000 | Alpha creek | S-0001 | Seasonal | 3657 | 590 | 9.6 |
| | Beta River | S-0002 | Seasonal | 19912 | 7904 | 128.8 |
| | Theta Reservoir | S-0003 | Full year | 76489 | 11156 | 181.8 |
| 2001 | Alpha creek | S-0001 | Seasonal | 3344 | 637 | 10.4 |
| | Beta River | S-0002 | Seasonal | 20278 | 8199 | 133.6 |
| | Theta Reservoir | S-0003 | Full year | 7799 | 10188 | 166.0 |
| 2002 | Alpha creek | S-0001 | Seasonal | 3694 | 610 | 9.9 |
| | Beta River | S-0002 | Seasonal | 21158 | 8288 | 135.0 |
| | Theta Reservoir | S-0003 | Full year | 79468 | 11789 | 192.1 |
| 2003 | Alpha creek | S-0001 | Seasonal | 3788 | 603 | 9.9 |
| | Beta River | S-0002 | Seasonal | 20344 | 8313 | 133.1 |
| | Theta Reservoir | S-0003 | Full year | 76631 | 11008 | 188.8 |

- Number of accounts for each classification;
- Beneficial uses

A summary of major water user classifications provides an overview of the district. The classifications should be grouped according to the beneficial uses served, such as:

- Irrigation
- Frost protection
- Livestock
- Fire protection

- Industrial uses
- Municipal deliveries
- Commercial
- Instream
- Power generation

The summary should show the number of accounts included in each classification and the associated water rights acreages. The data source and specific years represented should be noted. Non-irrigation classifications such as livestock, municipal, fire protection or industrial uses are generally tabulated

Figure 5: Estimating Return Flows from Irrigation Systems

| System Type | Percolation (%) |
|--------------------------------------|-----------------|
| Hand move, side move, side roll | 18 |
| Solid set (low wind design) | 30 |
| Solid set (high wind design) | 18 |
| Center pivot, linear move | 10 |
| Traveling big gun (low wind design) | 35 |
| Traveling big gun (high wind design) | 18 |
| Surface irrigation | 10-80 |
| Drip/trickle | 10 |

Example: The following table illustrates general classifications and water user descriptions for acreage in a hypothetical district. A sample text and summary table follow.



“This table was generated using information collected in a 2002 survey to which 90% of users responded. Those farms not responding are listed as ‘unknown’. The processing plant and livestock uses were tabulated using the average daily rate (cfs) of water delivery multiplied by the number of days during which the delivery took place then multiplied by 1.98 to calculate the volume of water delivered in acre-feet. The resulting volumes were converted to equivalent irrigated acres by dividing by 3.0 feet, the basic duty of water in the district.”

Water User Classifications

| Classification | Description | Acres | % of Total | # of Accounts |
|-----------------------------|------------------|-------------|------------|---------------|
| Irrigation | Cropping | 2700 | 81 | 100 |
| Irrigation/Frost Protection | Orchard | 420 | 13 | 1 |
| Industrial | Processing Plant | 180 | 5 | 1 |
| Livestock | Cattle/Sheep | 30 | 1 | 25 |
| Totals | | 4912 | 100 | 127 |

in terms of annual volumes (e.g. acre feet) or discharge rates (e.g. cfs). The following formulas can assist your district in conversions, as well as the Water Measurements and Conversions provided on page ii of this guidebook.

(a) Flow rates can be converted to equivalent acre feet (AF) using the following equivalents:

- 1.0 gallon of water is equivalent to 0.1337 cubic feet
- A flow of 1.0 cfs for 24 hours is equivalent to 1.98 acre feet

(b) Volume of water in acre feet can be converted to equivalent irrigated area by dividing by the duty of water in the district.

For the purposes of the water user summary, however, they can be displayed as equivalent acreages so that the various uses can be easily compared as shown in the example on page 27.

Possible sources of information:

- District records
- Survey of district customers

Example: A survey mailed to members of an irrigation district could be used to determine the amount of land irrigated by each of the different irrigation system types used in the district. The survey results are shown below.



Types of On-farm Irrigation Systems

| System Type | Acres |
|--------------------------|--------------|
| Center Pivot | 1489 |
| Fixed Interval Sprinkler | 13709 |
| Surface | 4664 |
| Total | 19862 |

- WRD Water Rights Information System



Types of On-farm Irrigation Systems

OAR 690-086-0240 (6)

This section of the Water Supplier Description must include a summary of irrigation systems commonly used within the district. Precise descriptions of each irrigation system is not necessary. It is only necessary to identify broad categories of irrigation system types, such as:

- Pivots and linear systems
- Wheel lines and hand lines
- Solid set
- Drip/trickle/microspray
- Flood/furrow

One way to obtain this key information is through a mailed survey. Since not all users will respond to a survey, the results of the survey should include a statement of what percent responded and whether the district manager considers the response representative of the entire district. Alternatively, the relative acreages irrigated with different system types might also be estimated by visual inspection and discussions with representative water users.



Crops Commonly Grown and Consumptive Use

OAR 690-086-240 (7)

As part of the Water Supplier Description, the district must provide a general characterization of commonly grown crops within the district. In addition to the crop summary, an estimate of average and peak consumptive use must also be included.

Characterization of commonly grown crops:

- Common crops might be based on a survey of district farmers.
- Crop acreages might be based on county averages that are routinely compiled by the OSU Extension Service.
- Some districts may have to submit annual crop reports to BOR, and this information can also be used.

Average and peak consumptive use can be estimated using:

- OSU Extension Bulletin 8530 (Figure 6).
- Agrimet, a web-based service of BOR, which provides crop water use estimates and weather data based on an extensive network of weather

stations around Oregon and the rest of the Pacific Northwest. Agrimet offers several advantages over Bulletin 8530: (i) the data are readily available on-line and are of better quality; (ii) the network of stations is more extensive and therefore more accurate for specific locations; and (iii) the data are more recent, and reflect changing weather patterns. An overview of the Agrimet program is included in Appendix F.

- NRCS Irrigation Water Requirements (IWR), a crop consumptive use program, is available at NRCS offices or can be downloaded online. The IWR program estimates monthly evapotranspiration (ET), effective rainfall and net irrigation requirement for 50% frequency (an average year) and 80% frequency (8 years out of 10) for most irrigated areas in the state.

Example: Crops Commonly Used and Consumptive Use

A mailed survey of client farms, determined the following mix of crops:

- Corn (1800 acres)
- Mint (2700 acres)
- Grapes (1400 acres)
- Other (200 acres)

Using the survey results and information from Bulletin 8530, the district was able to estimate peak water consumption for each crop. The acreage listed as ‘other’ accounts for land on which cropping is not known and small acreages of miscellaneous minor fields/crops.

Peak Crop Consumptive Use (inches per month)

| Crop | Acres | Apr | May | Jun | Jul | Aug | Sep | Oct | Totals |
|--------------|-------------|------|------|------|------|------|------|------|--------------|
| Corn | 1800 | 0.94 | 2.95 | 5.20 | 7.52 | 6.06 | 3.50 | 0.24 | 26.41 |
| Mint | 2700 | 0.12 | 2.95 | 4.92 | 4.82 | 0.00 | 0.00 | 0.00 | 12.81 |
| Grapes | 1400 | 0.08 | 0.98 | 2.60 | 4.13 | 3.31 | 1.73 | 0.12 | 12.95 |
| Other | 200 | 0.63 | 2.28 | 3.94 | 5.55 | 4.49 | 2.56 | 0.24 | 19.60 |
| Total | 6100 | | | | | | | | |



Additional Suggestions for Determining Crop Consumptive Use

- If the length of season, or type of crop listed in Bulletin 8530 needs adjustment to your situation consult with the local OSU extension service.
- The Oregon Irrigation Scheduling Online (OISO) is a web-based advisory program. This program can be accessed by contacting the Department of Biological and Ecological Engineering at Oregon State University.



Operation and Maintenance

OAR 690-086-0240 (8)

Operations

The district operations description includes the district's organization, its people and their duties. A brief description of tasks performed by administrators, contractors, ditch riders, and other staff. Other information that reflects the size of the organization and the annual procedures that are followed should be included. It is useful to describe equipment required for

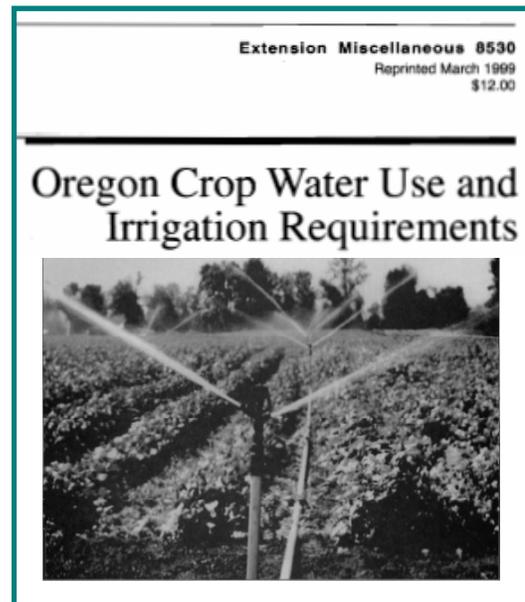
performing these normal tasks. It is also helpful to include a description of recurring operational problems, and any major past problems and how they were overcome, as this provides insight into how the district is managed.

Repair and maintenance

A brief description of the major repair and maintenance items and identification of the personnel resources (such as employees, vendors, or contractors) that perform these tasks is required. An approximate schedule and description of maintenance tasks or inspection is satisfactory. This item could be in a table or spreadsheet format. Ditch cleaning, moss control, diversion inspection, liner repair, and measurement apparatus maintenance are examples of maintenance tasks.

Figure 6: Sample Crop Water Requirements

Extension Bulletin 8530 can be used to estimate net irrigation requirements for your region, by crop type.



REGION: 5 Willamette Valley
CROP: Grapes

| MONTH | 5 out of 10 years | | 6 out of 10 years | | 7 out of 10 years | | 8 out of 10 years | | 9 out of 10 years | | 19 out of 20 years | |
|--------|-------------------|----------------|-------------------|----------------|-------------------|----------------|-------------------|----------------|-------------------|----------------|--------------------|----------------|
| | ET crop mm in. | Net IRR mm in. | ET crop mm in. | Net IRR mm in. | ET crop mm in. | Net IRR mm in. | ET crop mm in. | Net IRR mm in. | ET crop mm in. | Net IRR mm in. | ET crop mm in. | Net IRR mm in. |
| April | 37 (1.46) | 1 (0.04) | 38 (1.50) | 1 (0.04) | 39 (1.54) | 2 (0.08) | 40 (1.57) | 2 (0.08) | 41 (1.61) | 5 (0.20) | 42 (1.65) | 7 (0.28) |
| May | 62 (2.44) | 6 (0.24) | 63 (2.48) | 12 (0.47) | 64 (2.52) | 18 (0.71) | 65 (2.56) | 25 (0.98) | 67 (2.64) | 36 (1.42) | 69 (2.72) | 48 (1.89) |
| June | 84 (3.31) | 40 (1.57) | 86 (3.39) | 50 (1.97) | 87 (3.43) | 59 (2.32) | 88 (3.46) | 88 (2.60) | 89 (3.50) | 73 (2.87) | 90 (3.54) | 81 (3.19) |
| July | 103 (4.06) | 96 (3.78) | 104 (4.09) | 99 (3.90) | 105 (4.13) | 102 (4.02) | 107 (4.21) | 105 (4.13) | 108 (4.25) | 108 (4.25) | 111 (4.37) | 111 (4.37) |
| Aug | 86 (3.39) | 73 (2.87) | 87 (3.43) | 78 (3.07) | 88 (3.46) | 81 (3.19) | 89 (3.50) | 84 (2.81) | 91 (3.58) | 89 (3.50) | 92 (3.62) | 92 (3.62) |
| Sep | 64 (2.52) | 24 (0.94) | 64 (2.52) | 29 (1.14) | 65 (2.56) | 36 (1.42) | 67 (2.64) | 44 (1.73) | 69 (2.72) | 60 (2.36) | 69 (2.72) | 65 (2.56) |
| Oct | 32 (1.26) | 2 (0.08) | 33 (1.30) | 2 (0.08) | 33 (1.30) | 2 (0.08) | 34 (1.34) | 3 (0.12) | 35 (1.38) | 3 (0.12) | 35 (1.38) | 20 (0.79) |
| Nov | 7 (0.28) | 0 (0.00) | 8 (0.31) | 0 (0.00) | 8 (0.31) | 0 (0.00) | 8 (0.31) | 0 (0.00) | 9 (0.35) | 0 (0.00) | 10 (0.39) | 0 (0.00) |
| Season | 475 (18.72) | 242 (9.52) | 483 (19.02) | 271 (10.67) | 489 (19.25) | 300 (11.82) | 498 (19.59) | 329 (12.95) | 509 (20.03) | 374 (14.72) | 518 (20.39) | 424 (16.70) |

For scheduled maintenance, what is the inspection schedule and who performs the inspections? Are there exceptional and recurring maintenance problems in the district? Are there maintenance or repair items that effect the operation of the district, and if so, how are they being overcome? The discussion of these issues provides perspective on the challenges faced by your district, useful information for future managers, and could lead the district to embark upon a capital improvement project, if appropriate.

Example: Operation and Maintenance Issues

These are some examples of the operations and maintenance issues that districts are faced with and are provided to help managers think about possible problems before they arise.

- “Moss and aquatic weeds are a major problem during periods of warm summer weather, since excess moss causes canals to overflow if left uncontrolled. Maintenance costs to control moss in the canals is a major concern to the District. Chemicals have been applied in the past at a cost of \$20,000 per year. The District has recently purchased a mechanical device that will operate continuously in the summer to remove moss without chemicals.”
- “Canals and laterals that cross tributaries in many places are occasionally damaged by high runoff events, incurring significant expenses for clearing of trees, repair of rip-rap and repairing canals.”

Preparing the Water Conservation Element

OAR 690-086-0250

Water conservation provides an important management tool for districts to meet the present and future water supply needs of their constituents. This section explains how to prepare the water conservation element of the WMCP.

There are certain conservation activities that must be included by all districts submitting a WMCP under Division 86 requirements. The following information must be provided:

- Progress report on conservation measures from previous WMCP;
- Description of the district’s water measurement program;
- Description of other currently implemented conservation measures; and
- Short and long-term goals to improve water management in the district.

The other conservation measures must be evaluated by the district to determine whether it is feasible and appropriate for the district. When a district determines that a specific conservation activity is not suitable for its service area, the district must document the basis for their determination in the WMCP.

A checklist, shown in Figure 2, lists all of the items in Division 86, both required and optional. A check mark indicates a measure required of all districts whereas an open box indicates an optional requirement, and an arrow indicates an area that requires evaluation but not necessarily implementation.

Water conservation should not be confused with water curtailment. As used in the state requirements under Division 86, water conservation is the elimination of unreasonable losses or the implementation of other measures to more efficiently meet constituents' needs. Curtailment represents measures taken in response to a short-term supply emergency, such as a drought, when not all needs can be met. Water curtailment is discussed in the next section of this guidebook.

Sources of Information

There are many resources available to assist in the development of a water conservation program. These include books and other publications, as well as conferences and events sponsored by organizations like the Oregon Water Resources Congress (OWRC) and the OSU Extension Service. In addition, many water conservation plans have been developed by districts in Oregon and other western states, and can serve as useful examples. Contact with other districts and water suppliers to exchange

Example: Sources of Information

- Water Conservation Plan Guidelines (EPA 1998)
- Achieving Efficient Water Management: a Guidebook for Preparing Agricultural Water Conservation Plans (BOR, 1996)
- Irrigation Management Practices: Checklist for Oregon (Oregon State University Extension Service, 1996)
- American Water Works Association's Waterwiser Web Site: www.waterwiser.org
- Regional Water Providers Consortium: www.conserveh2o.org

ideas and information can be one of the best ways to get started in building an effective water conservation program that meets the needs of a particular district.

Specific Components of the Water Conservation Element

Now that you have described the district's water supply system, it is time to identify ways to conserve water. Division 86 identifies a variety of water conservation actions that should be considered in a WMCP. Examples include:

- Reducing identified losses through piping or lining,
- Promoting energy audits,
- Adopting rate structures,
- Public education programs,
- Technical assistance such as irrigation scheduling,
- Retrofits of inefficient water-using devices,
- Water reuse, and
- Other possible actions that would improve water use efficiency.

For these and other conservation activities, Division 86 requires that the district either describe how they will implement the action or document why implementation is not feasible.



Progress Report on Scheduled Conservation Measures and Previously Approved Conservation Plans

OAR 690-086-0250 (1)

If this is the first time that the district has submitted a WMCP, a progress report is not required. Progress reports and

plan updates are meant to assist districts in long-term planning. Conservation measures determined by the district to be reasonable, feasible and appropriate should be scheduled for implementation. Updates on previous plans must include any progress made toward conservation actions described in earlier plans. Short or long-term goals that did not have a specific accompanying schedule should, at the very least, be addressed. Any circumstances since the last plan submittal that delayed scheduled conservation activity must also be discussed.



Water Measurement Program Description

OAR 690-086-0250 (2)

A description of the district's water measurement program must be included in the WMCP. The rule requires an explicit statement that the district complies with OAR Chapter 690, Division 85 or has an acceptable reason not to be in compliance.

Diversion water must be measured and reported accurately. The many acceptable methods of measurement are explicitly described in Division 85, which is included as Appendix E.

The measurement program must include a description of the types of diversion measurement methods used by the district and an accounting of methods used at all diversion points operated by the district. In order to fulfill the requirements of Division 85, this description applies only to the initial points of diversion from the source. While information on measurement devices and practices on all diversions in the district may be useful in managing operations, it is not required by WRD, and depending on the size and

complexity of your district, it can be very time intensive.

A seasonal measurement schedule must also be included to verify compliance with Division 85. Photographs and descriptions of typical measurement devices used in the District are often included to support the measurement program, but are not required.

Guidance for Water Measurement and Accounting Systems

To comply with Division 85 rules, only the initial points of diversion from the source need to be measured. However, the "ideal" water measurement system has flow measurements at all points in the diversion, conveyance and delivery system where flow diversions takes place, including farm turnouts, and tail water, drainage, and system spill locations. The actual number of flow monitoring stations required would

Benefits of Better Water Measurement

At the district level, accurate water measurement and good accounting records will help the district in several ways:



- Facilitating accurate distribution of water within the district and allocating equitable shares of water among competing uses both on and off the farm.
- Reducing need for time-consuming current metering through installation canal flow measuring structures.
- Improving the evaluation of seepage losses in unlined channels and identification of areas where additional efficiency can be achieved.

depend on the size and complexity of the conveyance system.

Water use accounting systems will vary among districts depending on the complexity of the district's conveyance system and the amount of water measurement data available. For example, in some districts a simple ledger sheet might be used to track deliveries to a relatively small number of individual users or down a few canals or laterals. Other districts may use commercially available computer software or custom software to track deliveries through a complex system.



Description of Currently Implemented Conservation Measures

OAR 690-086-0250 (3)

The district should summarize previous conservation activities undertaken in the past and describe on-going activities that are specifically designed to aid delivery of water. Examples could be derived from the district maintenance program or include descriptions of educational materials provided by the district to irrigators. A description of any activities that are perceived to enhance the delivery and efficiency of water use will satisfy this requirement.

It is also important to note if the district does not have any conservation measures that are currently implemented.



Short and Long-Term Goals to Improve Water Management

OAR 690-086-0250 (4)

Districts are subject to occurrences in the natural environment that often need immediate action. These forces may place long-term planning for management and water conservation

at a lower priority to other district operation activities. The intention of this requirement of a WMCP is to encourage the district to identify areas needing attention and to consider ways to implement conservation activities that will eventually ensure all district water users are provided with their permitted water allotment. Districts should identify issues and priorities that are problems or may become problems in efficiently operating the district. The short and long-term goals to improve water management for each district will vary based on the needs and challenges of the area.

Example: Sample Measurement Programs

- “Currently, measuring devices are in use on about 10% of on-farm turnouts using standard weirs. An aggressive program is being pursued for installing about 10% of the required remaining measuring devices each year.
- The District measures its water at all known diversion points and reports the flow results in the monthly Water Use Report provided to the WRD in compliance with OAR 690-085.
- The following photo shows a typical measurement device installation.”



Goals and objectives describe what needs to be accomplished and when it needs to be done in order to resolve a specific issue or accomplish a priority. Goals should be set for each issue determined to be relevant to the district. Good goals are specific, measurable, achievable, and time based, and appropriate for the district. Ideas for short and long-term goals will emerge as the district evaluates various opportunities for improving water use efficiency.



Identifying Opportunities for Improving Water Use Efficiency

OAR 690-086-0250 (5a-d)

Improving water use efficiency can be done by several methods. In order to determine what methods are best for a particular water supplier, an evaluation of specific opportunities is needed. This evaluation should include the following:

- ➡ OAR 690-086-0250 (5a) - A description of losses from canals, pipelines, and laterals, and operational spills;
- ➡ OAR 690-086-0250 (5b) - An assessment of the extent to which water deliveries are inadequate for crop demands;
- ➡ OAR 690-086-0250 (5c) - Any alternative conservation measures

Examples of Goals

- Short-term Goal: Evaluate the district's distribution system and identify areas that can be altered to increase delivery efficiency during the next off-season.
- Long-term Goal: Improve distribution facilities through piping or lining canals in the next 3-5 years.

identified to reduce the losses and to address the insufficiencies in water deliveries identified in (b); and

- ➡ OAR 690-086-0250 (5d) - Assessment of existing and future alternatives to finance conservation measures, including analysis of applying for the allocation of conserved water.

Suggestions for assessing losses and the sufficiency of water deliveries to meet crop demands are provided in the following two sections. Each of the items discussed must be evaluated in your WMCP. Only those measures that the district finds to be feasible and appropriate must be implemented.



Assessment of Delivery System Losses

OAR 690-086-0250 (5a)

Under this section of the rule requirements, there are two major areas to evaluate: 1) loss from operational spills and 2) losses from canals, pipelines and laterals (system loss).

Determining Losses from Operational Spills

Operational spills generally take three forms:

- (1) Initial fill is the volume of water needed at the start of delivery operations to fill canals to the design depth. That depth must be maintained in order to transport water efficiently. Once the delivery operations end, that water will either be drained from the canals or lost as canal seepage. Initial fill is calculated from the geometry of the canal and the design operating depth.
- (2) Flushing flow is the volume of water used to flush debris from the

canals at the start of the season. Typically this is estimated as 50% of the nominal flow rate for 7 days.

- (3) Operating spills are the result of imperfect scheduling of deliveries. Typically a district will attempt to smooth out the flow of water in canals by anticipating demands and discharging water into the canals a few days ahead of expected use. Any of that water that is not used will be discharged at the end of the canal.

Spills can be captured in a regulating reservoir and directed back to the distribution system or a stream, but are commonly added to water loss in an overall district water budget. Developing ways to measure and quantify operational spills could be a goal of the district, if it is not already being done.

Estimating Canal Losses

This section deals with in-field determinations of distribution system losses from pipelines, canals and flow regulation facilities as a result of seepage, evaporation and unintended spillage. Estimates of distribution system losses are used to estimate district total water demands and to identify opportunities for conservation.

The general approach is to:

Step 1: Estimate the rate of water loss in cubic feet per second (cfs) from representative sections of the canal system (e.g. pipelines, canals of various configurations, or combination of canals and control structures). This can be derived experimentally or estimated from observed conditions.

Step 2: Multiply the loss rate by the distances traveled through the canal system to determine total canal loss rates in cfs and district total daily loss rates in acre feet per day.

Step 3: Multiply the daily loss rate by the number of days the canals are in use.

Two common ways of experimentally determining loss rates in a canal section are 1) the ponding method and 2) the inflow-outflow method. Rates of loss may need to be derived differently for different types of conveyance (e.g., large lined canals, smaller, lined secondary canals or closed pipelines, and unlined tertiary canals). Neither of these methods are required by WRD, but both are accepted methods for evaluating losses, which is required in this section of the Water Conservation Element.

(1) Ponding Method

With the ponding method the rate of seepage of standing water from a representative canal section is determined by damming both ends of the section, filling it with water, then observing the decrease in depth of water over a period of time.

The section chosen for the test should have a well-defined shape in order to accurately calculate the ponded surface area. The canal should have been filled or operating normally for several days to achieve a representative initial condition before starting the test. The required duration of the test depends on the loss rate. Depending on the soil type and other factors it might take days for the depth to change by a few inches or it might only take a few hours to see a significant change.

After the test is completed the measured change in depth (feet) is multiplied by the average surface area of the pond (square feet) to determine the total seepage losses (cubic feet). Total losses are then divided by the test duration (in days) to arrive at the rate of loss in cubic feet per day. Dividing the result by 43,560 converts the total losses to acre-feet per day. Finally, multiplying

by 0.5042 converts the loss rate to cubic feet per second.

(2) Inflow-Outflow Method

The inflow-outflow method involves measuring the quantity of water flowing into a selected reach of the canal, and the corresponding outflow from the same reach.

Prior to the test the canal should have been flowing at a representative rate for several days. Measurements may be made at only one input and one output point or at multiple inflow and outflow points. The method depends upon high accuracy measurements, such as weir measurements, at all major discharge points.

The total of all inflow rates minus the total outflow rate, averaged over a sufficiently long period of time, will equal the average rate of loss in the section. If flow rates are measured in cfs the total loss rate (cfs) can be converted to acre-feet per day by multiplying by 1.98.

Once the loss rate in acre feet per day has been determined by one of the methods outlined above, the seasonal total losses can be derived by extending the local measurements to the full extent of the canal system and multiplying the total loss rate by the length of time the canals were in use.

Estimating Transmission Losses

Transmission losses refer to seepage, evaporation, unintended spillage and any other losses from pipelines, canals and flow regulation facilities. This section discusses the adjustments for canal transmission losses and the final computation of gross water demand. Estimates of transmission losses are needed both for identifying opportunities for conservation.

The procedures outlined below can be used to estimate canal losses as a percent of the total water diverted into the canal. In the absence of such experimental determinations of loss rates, estimates of typical losses by canal type (Figure 7) may be useful for preliminary calculations of losses. Note that these generic estimates, derived from experience under a very wide range of circumstances, are not explicitly linked to canal length, soil types, general condition or operating practices. As such, they should be regarded as crude first estimates, not a substitute for in-field determinations.

Whether the actual efficiency of a canal is nearer the upper or lower end of the above ranges is affected by soil types, subsoil structure, farm size, canal length and the proportion of time the canal is in operation. Small farms served by rotational supply have a lower efficiency

Figure 7: Typical Losses by Canal Type

| Type of Canal | Seepage Losses (%) |
|---|--------------------|
| Unlined Canals | 20-30 |
| Lined Canals | 15-20 |
| Unlined Large Laterals | 15-20 |
| Lined Large Laterals and Unlined Small Laterals | 10-15 |
| Small Lined Laterals | 10 |
| Pipelines | 0 |

Source: Bos and Nugteren, 1990.

than larger ones as a result of the losses that occur at the beginning and end of each irrigation turn. Farms served by pipelines or situated on less permeable soils will have a higher efficiency. Where there are long intervals between canal deliveries, canal losses will be higher because of increased losses during the initial wetting of the canals. Most of these losses do not occur if farms receive a continuous water supply.

Additionally, the efficiency is linked to canal maintenance to reduce such things as leakage, vegetative growth, sedimentation, bank stability and pest damage. In general, seepage in excess of the above figures may be high and warrants further investigation.

District wide seepage losses are an aggregate of the losses in individual canals.

A district wide average loss rate can be derived by calculating the volume of losses estimated for each canal, totaling the seasonal losses in all canals and dividing by total deliveries to arrive at an average percent loss. In order to compute total water demand at the district level, the spills and seepage losses may be combined to arrive at a delivery system efficiency.

Computing District Average Losses

Although computing district average losses is not directly called for in the Division 86 requirements, computing district average losses is an important

Example Calculations for Estimating Delivery System Losses

Example: Canal D, a primary canal, receives water at a rate of 12 cfs through a weir. There are three discharge points to secondary canals follows: (i) first turnout at 400 feet from the intake point, discharging 4.0 cfs; (ii) second discharge point at 900 feet, discharging 3.5 cfs; (iii) third discharge at a distance of 1200 feet, discharging 3.3 cfs. The difference between the input rate and total of all discharge rates is then 1.2 cfs. Multiplying by 1.98, the loss rate is then 2.4 acre-ft/day. To convert these figures to a loss rate per mile of canal, divide by the length of the canal (1200 feet, or 0.23 miles) to arrive at a seepage loss rate of 5.28 cfs per mile.

Example: An estimate of water seepage loss from Canal A was performed by the inflow-outflow method. Canal A had not been maintained during the year and had extensive moss infestation and weed growth on the banks. Water loss was calculated by the difference between the flow into and out of a 2600 ft length of the canal. The canal weir was set at the normal rate during full flow conditions and allowed to run for four days prior to the downstream measurements being recorded. Upstream and downstream weir measurements were taken three times during the day. The upstream flow averaged 16 cfs while the downstream weir averaged 11.7 cfs. This corresponds to a water loss of 8.73 cfs/mile along this length of the canal.

Example: Seepage loss was calculated by a static method over a 360 foot length of the canal. The drained canal operating volume was estimated by assuming a flat bottom width of 6 feet and wall height:width slope of 1:2. The canal was filled to an operating depth of 5 feet in 8 hours and the diversion gate was then closed and the canal was allowed to sit while depth measurements were taken for 8 hours. During that time the depth of water fell 2.625 feet (31.5 inches). Based on the 1:2 side slope, it was determined that the width of the channel when full was 26 feet. After the depth dropped by 2.625 feet the width would be reduced by 5.25 feet on each side, or a total of 10.5 feet. The ending width was therefore 15.5 feet and the average width was 20.75 feet.

The volume of water lost to seepage would be:

$$(20.75) \times (2.625) \times (360) = 19,609 \text{ cubic feet} = 0.45 \text{ ac-ft}$$
$$\text{seepage volume} - 20.75 \text{ ft} \times 2.625 \text{ ft} \times 360 \text{ ft} = 19,609 \text{ ft}^3 = 0.45 \text{ ac-ft}$$

Dividing by the test duration (0.333 days), the calculated time rate of seepage loss was:

$$\text{seepage loss rate} = \frac{0.45 \text{ ac-ft}}{0.333 \text{ days}} = 1.35 \text{ ac-ft/dy}$$

Multiplying by the conversion constant 0.5042 converts the time rate of seepage loss to cubic feet per second:

$$\text{seepage loss rate} = 1.35 \text{ ac-ft/dy} \times 0.5042 = 0.68 \text{ cfs}$$

Dividing by the section length (360 feet represents 0.0682 miles) we arrive at a rate of loss rate along the length of the canal of 9.98 cfs/mile.

The district has identified several canals with dimensions and soil characteristics similar to canal A. This water loss rate might therefore be used to estimate canal losses along these similar canals. For example, Canal C is similar to Canal B, but 2800 feet long (0.53 miles). Total seepage losses along Canal C would be estimated as:

$$\text{total canal losses} = (9.98 \text{ cfs/mile}) \times (0.53 \text{ miles}) = 5.29 \text{ cfs}$$

The water loss calculations are not considered definitive examples for all canals throughout the District. However the district has decided to make a short term goal of identifying which distribution canals may have the greatest potential for seepage loss.

Example: A distribution system is comprised of a main canal and 7 secondary canals. The main canal is 1.3 miles long with a peak inflow of 96.0 cfs and an observed loss rate of 8.7 cfs. The secondary canals have been grouped by district personnel into three categories. Type 1 are two unlined canals over a sandy loam soil with a combined length of 1.3 miles; the estimated loss rate is 18.0 cfs per mile. They are operated continuously. Type 2 are four lined canals with a combined length of 1.2 miles in an area of heavier soils, and have a loss rate of 11.1 cfs per mile. They are operated in rotation, two at a time, with three days off and three days on. There is one Type 3 canal, 0.4 miles long, with a loss rate of 27.7 cfs per mile. The high rate of loss is attributed to long intervals between use (one day out of four).

The data are tabulated in columns 1 through 3 of the following table. Column 4 is the total loss rate for all canals in each class, the product of columns 2 and 3. Column 5 represents the average ‘on’ time for each type of canal, expressed in hours per day. For example each of the Type 2 laterals are operated half time, which is equivalent to 12 hours per day. The last column, which shows time-averaged loss rates for each type of canal, is derived by multiplying the total loss rates (column 4) by the daily operating time (column 5) and dividing by 24 hours. The district average loss rate is the sum of the average rates for each type of canal; 44.1 cfs, which is 46% of the district inflow rate (96.0 cfs).

Tabulation of Canal Losses

| Canal Type | Number of Canals | Total length (miles) | Loss Rate (cfs/mi) | Total Losses (cfs) | Operating Time (hours) | Average Loss Rate per Day (cfs) | Average Flow (cfs) | Average Loss Rate (%) |
|---------------------------------|------------------|----------------------|--------------------|--------------------|------------------------|---------------------------------|--------------------|-----------------------|
| Main canals | 1 | 1.3 | 8.7 | 11.3 | 24.0 | 11.3 | 96.0 | 11.8 |
| Secondary canals | | | | | | | | |
| Type 1 laterals | 2 | 1.3 | 18.0 | 23.4 | 24.0 | 23.4 | 51.0 | 45.9 |
| Type 2 laterals | 4 | 1.2 | 11.1 | 13.3 | 12.0 | 6.7 | 40.1 | 16.7 |
| Type 3 laterals | 1 | 0.4 | 27.7 | 11.1 | 6.0 | 2.8 | 4.9 | 57.0 |
| District total loss rate (cfs) | | | | | | 44.1 | | |
| District peak inflow rate (cfs) | | | | | | 96.0 | | |
| District loss rate (%) | | | | | | 46 | | |

Example Calculations for Determining Losses

Example: Estimating initial fill volume

The BOR has estimated initial filling of a secondary canal based on a length of 12,500 feet, bottom width of 9.0 feet and side slope of 1:1. The nominal operating depth is 2.0 feet. The volume of water needed to fill this canal is then:

$$\text{canal volume} = 12500 \times 11.0 \times 2.0 = 275000 \text{ ft}^3$$

$$\text{initial fill} = \frac{275000}{43560} = 6.31 \text{ acre feet}$$

Example: Estimating flushing volume

The nominal carrying capacity of a canal in central Oregon is 40 cfs. If it is flushed at a rate of 50% of capacity for 7 days the spill will be:

$$\text{volume} = \frac{40 \text{ ft}^3/\text{sec}}{2} = 86400 \text{ sec/day} \times 7 \text{ days} = 12,096,000 \text{ ft}^3$$

$$\text{spill for flushing} = \frac{12096000}{43560} = 278 \text{ acre feet}$$

Example: Estimated Operational Spills and Related Conservation Activity

The BOR has estimated operational spills for a hypothetical district as:

| | |
|------------------|--------------------------|
| Initial filling | 240 acre feet per year |
| Flushing | 700 acre feet per year |
| Operating spills | 6,600 acre feet per year |

Conservation Activity: A collection (re-regulation) reservoir is currently being investigated for location at the end of the Main canal. Water will be pumped back into the Main Canal and excess water will be allowed to flow through a constructed wetland back into the river.

step in evaluating opportunities for improving the efficiency of distribution.

The procedure for estimating the average loss in a district delivery system is to calculate the average loss of water in each sector of the main canal(s) and the secondary canals.

Losses in the main canal are computed as the product of the loss rate per mile multiplied by the length of the main canal.

The total loss in all secondary canals is derived as follows:

- 1) enter the loss rate per mile for each type of secondary canal;
- 2) multiply the loss rate per mile by the total length of all secondary canals in a given class to determine the total losses (cfs) in each class of canal;
- 3) multiply the total loss rate in each class of secondary canal by the average

number of hours per day a canal in that class is operated;

4) sum the losses in each class of secondary canal and the main canal(s).

Improving the Accuracy of Estimates of Distribution System Losses

An analysis of distribution system losses will generally reveal the significance of field determinations of canal loss rates. For example, note in the above table that the loss rate from the distribution system may be excessive, and that more than half the estimated losses are associated with Type 1 laterals. That implies that one short term goal might be more extensive field measurements in those canals to determine whether canal improvements are needed. If a district lacks sufficient data for even rudimentary water loss calculations, collection of field data for that purpose can be addressed as a short term goal.

Example: Delivery Requirements

2700 acres of alfalfa in the northwestern sector of the district are supplied with water at an average diversion rate of 32.07 cfs during the peak demand month. Because of the length of travel through an unlined canal, it is believed that sector may suffer shortages during peak demand times. The distance from the point of diversion to the nearest alfalfa field is 1.2 miles, and to the farthest alfalfa field is 3.9 miles. The average delivery distance is therefore 2.55 miles. Using the average loss rate of 8.73 cfs per mile, the estimated canal losses are 22.26 cfs. The remaining available water, 9.81 cfs, is 31% of the original diversion.



Assessment of Extent to Which Water Deliveries are Insufficient for Crop Needs

OAR 690-086-0250 (5b)

This evaluation determines whether and to what extent the water supply system falls short of meeting crop water demands. Knowing the flow of water at the input point of the system and the losses in the distribution system makes it possible to compare final farm delivery rates to crop water needs (Figure 8). This evaluation can be presented in tables or text format using figures derived from earlier sections of this guidebook

An exhaustive analysis of potential shortages in the district is not necessary. It would be sufficient to focus on critical delivery points where water supplies are likely to be restricted for one reason or another.

An analysis of a representative situation for each of those points will serve two purposes: (1) to quantify potential shortages in those critical areas of the district, and (2) to identify where more detailed information about delivery system losses is needed.



Assessment of Extent to Which Water Deliveries are Insufficient for Other Needs

While this information is not required as part of the Water Conservation Element, there may be significant demands that are not accounted for by crop needs alone. These demands, such as municipal or industrial, should be assessed to determine whether current deliveries are being met. Estimating the total water requirement is one way to assess whether water deliveries are sufficient to meet water demands other than crop demands.

Total water requirement is the amount that must be diverted into the district distribution system to meet the total of all water demands outlined above, as well as operational spills. Information on the gross water demand of your district may be invaluable in evaluating the adequacy of available water sources to meet existing and future demands. This is particularly important for districts that have water demands that are not captured in the description of irrigation water requirements.

“Other water demands” refers to any non-agricultural demands that use district water supplies, facilities, or otherwise impact district operations. As with other current water uses, peak and average flows, and when available, water reuse and return flow information should be included for these other water demands.

Examples of such demands include:

- Municipal water,
- Deliveries to industrial users, e.g. food processing plants,
- Fire protection,
- Maintenance of in-stream flows,

- Pass through conveyance of water for other districts,
- Conveyance of flood runoff,
- Conjunctive use for power production,
- Minimum required stream flows (mandated by Dam Operations plan).

The water demands should also be adjusted to account for transmission losses in the distribution system.

Calculation of Gross Water Requirements at the District Level

District level gross water requirements are determined by dividing monthly total water demands (including water use for agricultural, municipal, industrial, and all other users) by the weighted average canal delivery efficiency.

Canal delivery efficiency (E_d) is the percentage of the water turned into a canal that is delivered to client water users, i.e. the percentage of water that remains after canal losses and operational spills.

$$E_d = (100 - \text{canal loss percentage})$$

The delivery efficiency is used to calculate district level gross water

Figure 8: Gross Irrigation Requirements for 2006 (inches per month)

| | Apr | May | Jun | Jul | Aug | Sep | Oct | Season |
|----------------|-----|-----|-----|------|------|-----|-----|--------|
| Grains | 0.0 | 2.8 | 9.8 | 15.2 | 0.9 | 0.0 | 0.0 | 28.7 |
| Alfalfa Hay | 3.8 | 7.1 | 8.4 | 14.1 | 11.7 | 8.1 | 1.2 | 54.4 |
| Other Hay | 3.8 | 7.1 | 8.4 | 14.1 | 11.7 | 8.1 | 1.2 | 54.4 |
| Grass/Pasture | 3.1 | 5.3 | 6.3 | 11.2 | 9.2 | 5.9 | 0.5 | 41.6 |
| Mint | 0.0 | 1.4 | 6.7 | 15.3 | 12.2 | 0.0 | 0.0 | 35.6 |
| Garbanzo Beans | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Garlic Seed | 1.8 | 4.1 | 9.3 | 16.6 | 6.7 | 0.0 | 0.0 | 38.5 |
| Other Seed | 0.0 | 0.8 | 4.5 | 7.9 | 1.7 | 0.0 | 0.0 | 14.9 |
| Urban | 3.9 | 6.5 | 7.8 | 13.2 | 10.9 | 7.0 | 1.1 | 50.5 |

requirements by dividing total water demand by delivery system efficiency.

$$\text{Gross district water requirement} = \frac{\text{Total water demand}}{E_d}$$



Evaluation of Specific Strategies for Improving Water Use Efficiency

ORAR 690-086-0250 (6)

The preceding parts of this guidebook have laid out a general procedure for developing a complete picture of district water use, and have quantified certain key information such as crop water use and canal loss rates. That information can now be used to evaluate specific options for improving water use efficiency.

This section of the guidebook deals with preliminary determination of whether particular options for increasing water use efficiency are in fact appropriate and feasible for your district. Any conclusions derived from these analyses must be adequately supported by a brief economic analysis. If the analysis is not complete enough to support the conclusion of whether a particular option is feasible or not, completion of a future

Example: On-farm Energy Audit

An Oregon State University study of actual efficiencies in 529 tests of pumps on working farms in Oregon found the following:

- Efficiencies ranged from 14% to 79%
- 77% of the pumping plants were operating at less than 67% efficiency (the lower limit of nominal efficiencies)
- 24% of the plants were operating at less than 50% efficiency

analysis of that option should be listed as a short term goal.

With respect to economic analyses, it is important to include any opportunity costs of water saved by a conservation measure. If conserved water can be sold to another user or to an outside interest, that potential sale can provide a basis for estimating opportunity costs.



Promoting Energy Audits

ORAR 690-086-0250 (6a)

The Energy Trust of Oregon and others offer energy audits for district water users (www.energytrust.com). The rationale for these programs is to reduce energy demands. Energy use can be related to water use so the net effect may include a reduction in water use. Energy audits offer an immediate benefit to many water users whose pumping plants may be operating at very low efficiencies.



Conversion to Metered, Pressurized Deliveries to All Parcels of One Acre or Less

ORAR 690-086-0250 (6b)

Another option for improved distribution systems is conversion to metered, pressurized deliveries to all parcels of one acre or less. This assessment should include the number of small parcels within district boundaries, potential for future division of larger parcels, and the type of beneficial use expected on these parcels. Local price estimates should be provided for construction of pump and meter systems to deliver pressurized water to small parcels. Metered delivery may also be considered under a different rate structure than that applied to gravity flow delivery systems.



Piping or Lining Canals

ORAR 690-086-0250 (6c)

Having already estimated loss rates for different classes of canals, one immediate option is to investigate piping or lining of earthen canals. The district can contact local contractors to obtain cost estimates of piping or lining canals suspected of having high seepage loss rates. The results might be summarized in terms of alternative methods of piping, lining, cost per foot of lining and estimated reductions in seepage rates. Additionally, the economic analysis should account for the value of water saved.



Modifying Distribution Facilities and District Policies

ORAR 690-086-0250 (6d)

Modifying the distribution systems and district policies to increase the flexibility of water deliveries may also lead to increased water use efficiency and must be evaluated. Operational spills or bypass losses may be reduced by better forecasting of water demands, revised procedures for district operations, and provision of re-regulating reservoirs or other in-line storage facilities for increased flexibility of water deliveries.

Some ideas a district might consider for this section include:

- Operation strategies to increase water delivery capability to specific areas,
- Structural modifications to improve delivery efficiency,
- A short-term goal to identify opportunities to improve delivery flexibility,
- A long-term goal to secure funding for infrastructure improvements.



Provision of On-farm Irrigation Scheduling Assistance

ORAR 690-086-0250 (6e)

The district can support a water user education program by distributing educational modules designed to raise awareness and provide more extensive information on on-farm irrigation scheduling and efficiencies. An educational module on irrigation scheduling and on-farm efficiency is provided with this guidebook in Appendix G.

Additionally, districts can alert patrons to informational web sites, dispense additional informational bulletins provided by the Extension Service, NRCS, energy utilities, BOR and other institutions, and host OSU Extension Service workshops.

Energy Audits

The district can contact local energy utilities to inquire about availability of energy audits by utility personnel or training of district personnel to perform distribution system energy audits (such as evaluating existing pump stations). In addition to a district level energy audit, there are resources available to district patrons through local utilities. For further information, visit the following websites:

- Oregon Dept. of Energy: <http://oregon.gov/energy/incentives.shtml>
- Energy Trust of Oregon: www.energytrust.org
- Northwest Energy Efficiency Alliance: www.nwalliance.org





Construction of Re-Regulating Reservoirs

OAR 690-086-0250 (6f)

Where operations spills are significant, construction and operational costs for re-regulating reservoirs should be evaluated. Funding and construction may be judged to be long term goals, but an evaluation of the benefits of reduced spillage should include an estimate of the potential water savings.



Rate Structures

OAR 690-086-0250 (6g)

While the rules require a district to evaluate the adoption of rate structures that encourage conservation, there may be statutory or contractual provisions that prescribe the district’s rate structure. You should check Oregon statutes and any contracts the district

has with individual water users, other districts, or government agencies for such provisions that might relate to your district. If you find such provisions, they should be acknowledged in this section of the WMCP.

Rate structures, such as volumetric pricing, have been successful in encouraging water conservation for many years. Additional fees for pressurized water delivered to small parcels may also be evaluated to account for greater energy input by the district.

A district may propose alternative rate structures, billing practices, and other programs as applicable to the district. If alternative approaches are proposed, the district should demonstrate in the WMCP that their proposed approach meets the requirement to support and encourage conservation.



Evaluation of Any Other Identified Conservation Measure

OAR 690-086-0250 (6h-i)

Any conservation measure identified in the previous sections that would improve water use efficiency, such as opportunities for decreasing losses and increasing delivery efficiency,

Helping Users Understand On-Farm Losses

Information from NRCS or OSU Extension often indicates that on-farm losses generally occur in three ways: (i) leaks, breaks or spills from on-farm distribution systems, (ii) surface runoff from irrigated fields, and (iii) deep percolation of applied water due to poor uniformity or errors in irrigation scheduling. The first two are visible problems, and most irrigators are sensitive to them. However, deep percolation, though not apparent, is often the greatest loss. Even in a well managed field under sprinkler irrigation, deep percolation can easily exceed thirty percent of applied water. If irrigation timing is off or the depth applied is greater than needed deep percolation losses may be much higher.



Example: Construction of Re-Regulating Reservoirs

A re-regulation reservoir has been installed at the end of the “A” Canal. This lower end reservoir collects operations spill from several piped laterals, from the west end of the “A” Canal and from runoff from surface irrigated lands in the lower west part of the district. Being at the lower end of the project, water must be pumped back uphill from the pond to provide delivery to two patrons and back into the “A” Canal.

also needs to be considered. Any other conservation measure that you have identified as having potential for increasing conservation in the district, even if it was not identified in previous sections, should also be evaluated in this section.



Schedule for Implementation of Proposed Conservation Measures

OAR 690-086-0250 (7)

Now that your district has identified conservation measures to increase water efficiency, you need to describe and estimate a schedule for implementation. The schedule should include all of the conservation measures identified in the preceding sections of the WMCP that were deemed feasible and appropriate.

The schedule is not meant to be a series of deadlines, but must identify the steps necessary to:

- 1) Implement each of the measures,
- 2) Show a time-progression that exhibits the district's earnest intent to implement the measures, and
- 3) Show anticipated times the district will evaluate the previous irrigation season's accomplishments and the effectiveness of water conservation and management activities.



Public Education Program

OAR 690-086-0250 (7a)

In order to implement conservation measures in your district, you will need an information and public education program to convey the information to your customers. Division 86 requires all districts submitting a WMCP to have a public education program to encourage efficient water use for all

types of uses served by the district and including voluntary water use audits. It is recommended that the program include regular communication with customers that includes information about the district's water conservation activities.

Some ideas you might consider are:

- Distribution of brochures providing tips for water savings via mailings or made available at locations such as the district office or other public places
- Development of a portable or fixed display and materials for county fairs and other community events, public libraries, schools, or other public buildings
- Providing speakers to give presentations at civic organizations, chambers of commerce, or other venues
- Newsletters or press releases to publicize key programs, unique customer achievements, or other information that promotes awareness of water conservation
- Internet technologies, such as electronic newsletters, information sent out to a group of customers on an e-mail listserve, and utilizing the district's website to promote conservation activities and web-based resources.

These ideas are only some of the possible methods for conveying information to the district's patrons, and some will be better suited for your district than others. The ideal educational program will depend on the size and financial resources of the district, the region of the state, limitations on the water source, and characteristics of the customer base in that community.



Other Conservation Measures Identified by the District

OAR 690-086-0250 (7b)

A schedule for implementing any other conservation measures identified by the District to improve water management and conservation should be also provided. This section should include a description of the activity and the steps necessary for implementation.



Program for Evaluating Effectiveness of Conservation Measures

OAR 690-086-0250 (8)

As part of planning for individual measure the method of evaluation of effectiveness should be established in advance. This rule is therefore best satisfied by outlining the plans for evaluating each measure.

Evaluating Measures to Include in WMCP

There are many different approaches to evaluating water conservation measures. However, the district must show they have systematically analyzed any activities they do not plan to implement. For any measures that are found not to be feasible or appropriate, the district must provide documentation of this finding. The district must also show that

Example: Other Conservation Measures

Nozzle Exchange Program

- The district will develop a program to allow district patrons to replace old and inefficient nozzles with new nozzles that better conserve water. The new nozzle will be free to customers, in exchange for turning in the old model to the district.

they have used a suitable methodology to evaluate these activities.

For example, considerations in this review may include:

- Types of customers in the district’s service area, and how the water conservation activity relates to those customers
- Cost of the measure, in comparison with costs of other water conservation activities, costs of other source alternatives, and overall costs of the district (e.g. annual operations and maintenance budget, per unit cost of other capital projects, etc.)
- Effectiveness of a given conservation action to meet a district’s needs, in comparison with the other conservation actions and water supply sources considered in the WMCP. The WMCP can compare measures and may demonstrate that some measures perform better than others.
- Impact on revenues. If a district believes that a given measure will reduce revenues and cause significant financial problems, this should be explained.
- Staff resources and operational capacity to provide the activity.
- Amount of water savings that could be expected from a specific activity. If the district determines that an activity will not produce significant water savings, this should be documented and explained. However, it is recognized that water savings may be difficult or impossible to estimate for some types of conservation activities (e.g., public education).
- Community acceptance. In some communities, customers may be reluctant or unwilling to undertake

some types of conservation activities. In these instances, the district should document and explain the situation as best as possible.

- Results of studies measuring the effectiveness and/or efficiency of a conservation measure. This might include comparison of effectiveness compared with other conservation measures to be implemented.

For any of the items listed above, or other obstacles that districts identify and document, the district should also look ahead and indicate whether these obstacles can be addressed and eliminated over time. This is where the benchmark concept can be especially useful. Districts should explain how progress could be made on these issues between submittal of the WMCP and submittal of the next WMCP update (within ten years). Providing this information will help WRD evaluate the district's overall water conservation program, including areas where the district is doing more than required under law. It is also important to take credit for what you are already doing to improve water conservation and management in your district.

Criteria for WRD Review of the Water Conservation Element

The WRD Review Worksheet, included as Appendix C, lists the criteria WRD will use in reviewing the Water Conservation Element of a WMCP. WRD will first determine whether all of the items required for that particular water supplier are included. WRD staff will also consider the schedule for implementation of conservation measures presented in the Water Conservation Element, to determine whether they are reasonable and appropriate.

Preparing a Water Curtailment Plan

OAR 690-086-0260

A water curtailment plan provides districts with a plan to address a short-term or emergency water shortage. For districts without such a plan or with an outdated plan, this section provides guidance in developing or revising an effective plan. The following section describes water curtailment plans, their role, and how districts can tailor a plan that meets their unique needs.

Water curtailment plans are designed to minimize the impacts of a short-term emergency water shortage by reducing demand and finding alternative supply. Generally, conservation measures, as well as the use of a backup or secondary supply if available, such as an intertie with an adjacent water supplier, or some combination of the two, are the most important tools district can use to immediately reduce and meet demand.

Curtailment plans usually contain voluntary and mandatory water use restrictions. The restrictions become progressively severe as the shortage becomes increasingly dire. So, in the early stages of a shortage, curtailment plans rely on customers taking voluntary curtailment actions. Curtailment plans require specific customer activities in the later, more severe stages of shortages.

Districts should have policies in place allowing for the district to declare an emergency, and authority for the district to enact the curtailment plan once an emergency has been decreed. Once the emergency is over, the district returns to normal service conditions. It is also important to consider that shortages are not always from drought, but also floods that can washout delivery systems. Your

curtailment policies should be flexible enough to address shortages, regardless of the cause.

Some of the conservation measures discussed in the previous section will also be used in a curtailment plan. The difference is that these measures, in the later stages of an emergency, are mandatory and enforceable. In addition, a curtailment plan may include further actions that are not part of routine conservation activities, and are needed to reduce demand to meet unusual circumstances. In addition to voluntary and required conservations measures, curtailment plans should also include methods to ration water amongst users based on essential or non-essential uses, and indicate at what point alternative sources, such as interties, are used.

Short-term emergency water supply shortages can come in the form of sudden interruptions, such as loss of power or mechanical problems that result in distribution equipment failure,

contamination of water supply, and natural and man-made disasters. Or, supply shortages may be more gradual, and offer some lead-time to prepare. This would be the case during a drought. In the case of an immediate shortage, more severe restrictions on water usage may be used right from the start. Water shortages that allow time to prepare may provide an opportunity to gradually ramp up restrictions.

If a severe, continuing drought results in a lack of water resources and threatens the availability of essential services, the state may declare an emergency and require districts within the drought area to adopt and implement a water conservation or curtailment plan. Districts should consider any past curtailment plans that may have been required under drought declarations that may still be in effect for the district service areas, but note that these plans may not satisfy all the requirements within Division 86 described in this Guidebook.

Useful bulletins on drought forecasting and current water supply conditions are available on-line:



- WRD Drought Watch website:
www.oregon.gov
- The NRCS web site for drought management provides drought forecasts, updated weekly, for different parts of the country at the following web site:
www.cpc.ncep.noaa.gov/products/expert_assessment/season_drought.gif
- BOR provides information on reservoir levels, expressed as a percentage of normal, at: www.usbr.gov/pn/hydromet/select.html

Sources of Information

As a preliminary step, it may be helpful to gather a few curtailment plans of other districts or other agricultural water suppliers to use as samples. Also, many districts have used a public input process to help develop curtailment plans.

WRD has several tools that might may be applicable to your district to help you copy with drought:



- Emergency change in point of diversion
- Emergency Water Use Permits
- Temporary Transfers of Water Rights
- Use of Existing Right Option/ Agreement

Public input is most useful for the creation of a list of curtailment actions for each stage of alert (this option is described in more detail below). As a second preliminary step, districts are encouraged to build additional time into the curtailment plan process to allow for public input.

Other sources of information include:

- The National Drought Mitigation Center (University of Nebraska)
- The USDA/NRCS National Water Management Center
- Manual M-50 Water Resources Planning (AWWA, 2001). See Chapter 4 for sections on conservation in relation to other sources of water and on drought management and water resources planning.
- Drought Management Handbook (AWWA 2002)

Specific Components of a Curtailment Plan

Division 86 requires that water curtailment plans have at least the following information:

- An analysis and description of past water supply deficiencies, delivery and capacity limitations
- Description of situations which trigger the curtailment plan and each stage of alert
- A list of curtailment actions for each stage of alert to allocate limited supplies during shortages

Each of these requirements are described below in more detail. Districts are encouraged to develop a comprehensive curtailment plan to ensure maximum protection from a short-term emergency water supply shortage. As such,

additional information is provided and noted by a “Tip” icon next to the text. Also, a check mark in the box next to each action indicates that all water suppliers submitting a plan must consider that item. If there is no check mark, only some water suppliers must consider the action.



Past Supply Deficiencies and Current Capacity Limitations

OAR 690-086-0260 (1)

The requirement is for a description of the frequency and magnitude of past supply deficiencies and current capacity limitations. The description shall include an assessment of the ability of the water supplier to maintain delivery during drought or other source shortages. This element can be satisfied with a brief historical discussion of actions taken in the past, during times of environmental or man-made shortages.



Situations Which Will Trigger Curtailment Plans

OAR 690-086-0260 (2)

This element involves a description of the water supply situations that cause water allocation curtailment plan to be implemented. The supply situations which trigger warnings to users or public notice of impending shortage should be described. The trigger for curtailments should be linked to basin weather data, flow disruption, water contamination or pre-season assessments of supply.



Procedures to Allocate Water During Shortages

OAR 690-086-0260 (3)

This element must include a specific statement describing the method of water allocation during periods of low

flow or other emergency. Methods used by various districts around Oregon include uniform reduction, priority date, voluntary cut-backs, buy back of water, and retiring of land.

A curtailment plan should include the specific title or position of who will decide when the plan should be enacted, a list of officials (state or regional authorities, law enforcement, legal authorities, etc.) to contact in the event of a short term water supply shortage, the process and method to communicate restrictions to water users at each stage of alert, the process of enforcement of any water restrictions, and other actions specific to the curtailment plan. This element should list the steps taken during a reduced flow situation, such as who is notified and when, which diversions are restricted, what operational changes are instituted and under what authority or agreement allocation or curtailment actions are taken.

Some allocation strategies that might be considered, such as allowing users to shift water to others in exchange for reduced district charges, may require extensive analysis of legal, economic, administrative and operational implications. Short-term district goals might therefore include evaluating new or alternative allocation procedures for drought conditions.

Preparing the Water Supply Element

OAR 690-086-0270

The water supply element provides a long-range water supply plan in which the district prepares a demand forecast and compares the projected demand with available supplies. When additional sources of water supply is needed, the district should explain what sources it plans to use. The district should also show how management of the resource

Example: Curtailment Triggers

The District monitors the NRCS and Hydromet web sites for current climate information and snowpack data. When the indices of precipitation and snow depth are more than 20% below average, water users are notified of potential drought during the irrigation season. If the indices are 30% below average and the depth of Theta Reservoir is 30% below average by April 1, allocation of water will be reduced uniformly to all water users. Delivery reductions will also be instituted if the Governor declares a basin-wide drought emergency.

The following indices, trends, reports, etc. are used to evaluate pending drought conditions:

- BOR Hydromet System data
- NRCS Sno-tel System data and runoff projection
- District self-evaluation of snow survey data and forecast runoff

Key triggers for initiation of curtailment are:

- Lack of low elevation winter precipitation becomes critical at 50% of long term average by March 1;
- The March 1 reservoir storage is at 75% of long term average; and
- The projected runoff for April-June reaches 75%.

through activities such as water conservation, can contribute to meeting individual customers' needs. Because there are many variances between districts, a broad range of options should be considered, as appropriate for your district.

The required elements for this section of the WMCP are outlined under OAR 690-086-270. For a summarized list of these items, see Figure 2. Further guidance on each of these items is provided below. It should be noted that many of the items required are closely related to items in the earlier Water Supplier Description.

Sources of Information

Various sources of information may be useful in preparing the water supply plan. In general, these include information obtained from the district's records; information related to local land use planning; crop patterns and changes; and more detailed sources of information on methods and techniques related to demand forecasting, source analysis, and related topics. The following is a list of possible sources of information:

- District billing records
- Prior WMCP
- Oregon Department of Agriculture studies
- City or County land use plans
- Local or regional population forecasts and demographic data
- Interviews with local or county planning staff
- Local weather information regarding historic rainfall and temperature (optional)

- Water rights information from WRD database or request from your local Watermaster
- Summaries of operational constraints related to water availability from each source.

Specifics Components of the Water Supply Element

This section provides detailed guidance on preparing each component that is required for the Water Supply Element. The Water Supply Element section must include:

- Estimated demand projection for 20 years;
- Comparison of projected needs with size and reliability of current supply sources;
- List of potential sources to meet future demand, including conservation and reuse;
- Comparison of sources, considering costs, availability, reliability, and any likely environmental impacts; and
- Evaluation of:
 - Regional options for meeting future needs;
 - Urbanization and other land use trends;
 - Provisions in local government's plans relating to uses or lands served by district.

As in previous sections, a check mark in the box next to each component indicates that all districts submitting a plan must address the item in the final plan. If there is no check mark, the component is not required but may be of benefit to your district.



Prepare Demand Forecast

OAR 690-086-0270 (1)

A demand forecast for a 20-year time frame for the district’s service area is required. A longer time period may also be included, but is not required. A few districts with very stable cropping patterns and no urbanization may have a fairly static demand. In most cases there will be changes.

District controlled factors

Any lining or piping projects, expected district boundary expansion, or application for allocation of conserved water should be addressed.

Outside factors to consider

Agricultural and industry trends, such as conversion to nursery use from traditional crops, and other changes can impact the district’s water supply demands. Urbanization trends should also be considered, including potential impacts from conversion of agricultural to residential use, as well as other demand changes.

Climate Trends

Long-term trends in winter discharge to streams may lead to greater demands for earlier water delivery that traditionally experienced. The district might consider these climate trends in preparing their demand forecast.



Comparison of Projected Need and Available Sources

OAR 690-086-0270 (2)

Districts should compare the projected demand with the existing sources of water identified in the Water Supplier Description. Will projected demand exceed the current permitted diversions from these sources?

Districts should consider and discuss the adequacy and reliability of their water sources to meet projected demand. One way to compare needs and sources is to prepare a table or graph that identifies source capacity at 20 years with the projected demand.

In conducting an assessment of the adequacy and reliability of existing water supplies, the district should first examine a summary of the water rights held by the district and then address the reliability of each of those source(s).

Often, physical restrictions exist that limit the actual capacity of a source, such as natural limits on the diversion from a well or intake. There are often seasonal limits on the quantity of available water, especially during late summer and early fall.

Examples include:

- Periodic reduced flow from a spring or well
- Reduced flow in a river or stream that limit access to the full amount designated in a water right permit or certificate
- Interties, even those reserved for emergency purposes only, are also considered sources of supply and the adequacy and reliability of these sources should be addressed.

In addition, the district should assess the reliability of those source(s) with regard to existing or future restrictions, such as those that may be imposed through protection of threatened or endangered species, instream flow requirements, or ground water limits established by the state (e.g. ground water limited or critical areas).

Using this information, an assessment should be made to quantify the actual amount of potential water available

under each water right permit or certificate or other sources. A summary can be constructed of the actual water available to the district, subject to any noted conditions of reliability with regard to continued or expanded use under each water right. District needs may include needs for redundancy, or emergency backup.



List of Potential Sources to Meet Long-Range Needs

OAR 690-086-0270 (3)

All potential sources of water to meet projected needs should be considered, including both conserved water and new sources. Information relating to water conservation within the district can be derived from the previous conservation evaluations, including feasible conservation alternatives and estimates of the water that could be conserved. Water reuse, from municipal and industrial effluents, and new sources, including Aquifer Storage and Recovery, should be considered as potential sources to meet long-range needs.



Comparison of Potential Water Sources

OAR 690-086-0270 (4)

A comparison of the above listed potential sources should provide a general benefit/cost analysis to compare the financial feasibility of the options for meeting increased water demands for the projected 20 year future. To the extent that availability, reliability and potential environmental impacts may affect the feasibility of the various options these should also be discussed. Certification of current water permits should also be discussed.



Impacts of Various Factors on Long-Range Water Needs

OAR 690-086-0270 (5)

After projecting long-range water supply demand, it is important to evaluate the effects of various factors on the identified water needs. This evaluation must include regional options for meeting future supply needs, urbanization and other land-use trends, and any provisions in local government plans relating to agricultural lands, water resources or supply, public facilities and services, or any other area concerning the uses or lands served under the long-term water supply plan. Other factors effecting long-range water needs can be included but are not required in the WMCP. All of the factors should be evaluated by the district and discussed in the WMCP, but are not required to be addressed through implementation. The effects of these factors on the long-range water needs of your district may vary in frequency, severity, and likelihood.

Factors that may affect long-term water supplies include:

- Setting - including elevation; geological and physical features
- Relationship to federal lands
- Seasonal trends
- Permit conditions; rate and duty; priority dates
- Adjudication process (if any)
- History of regulation
- Listed or sensitive species
- Cultural or historic features
- Shared facilities
- Urban growth





Regional Options for Meeting Future Water Needs

OAR 690-086-0270 (5a)

An evaluation of regional options that may affect long-term water supply could include the potential for sharing operations personnel between districts, combined district opportunities for reservoir and storage sharing, or shared expense and responsibility for BOR conservation projects within a defined region shared by more than one district.



Urbanization and Other Land-Use Trends

OAR 690-086-0270 (5b)

An analysis of long term water demand should include an evaluation of land use trends, including potential urbanization of portions of the district service area and any potential changes of the beneficial use of water within district boundaries.



Local Government Related Provisions and Plans

OAR 690-086-0270 (5c)

The district should review local long-term planning activities performed by governments or entities within and adjacent to district boundaries. Any relevant provisions in local governments' comprehensive plans related to agricultural lands, urbanization, water resources, water supply, public facilities and services, and any other plan or ordinance related to the lands served by your district, or propose to be served under the long-term water supply plan should be noted and evaluated. Districts should summarize any planning activities that may affect the District's efforts to manage available water resources.

Additional Requirements and WRD Review Process

Finalizing the Plan

When the district has completed the various elements described in previous sections, they can be assembled into a complete WMCP. The state requirements under Division 86 do not prescribe an exact format of the WMCP, apart from the requirement that it contain the four main elements discussed previously (the Water Supplier Description, and the Water Conservation, Curtailment and Supply Elements).

A sample plan has been provided in Appendix B as an example of a district WMCP. The format and types of information for your district may be different, and will have to be tailored to meet your unique needs, while meeting the state requirements for submission.

Additional Requirements

Division 86 recognizes that in some cases a district may be unable to provide

Districts may wish to show graphically how water conservation savings, interconnections, and cooperative regional management efforts can impact demand projections. This can be done by creating a chart with two lines: one will represent projected demand and the other line will represent projected demand reduced as a result of conservation, interconnections, and regional management efforts. The demands listed in a table format also works well.



all required elements of a WMCP. In this case, a district may develop a “work plan” with WRD to complete the missing elements over some period of time. In general, a work plan will outline the steps necessary to satisfy the requirements of Division 86.

considering the proposed schedule for implementing conservation measures, and growth or other changes anticipated. If a district determines that submittal of an updated plan should not be required, they should explain why.

The completed WMCP must also include:

- A list of the affected local governments to whom the plan was made available and a copy of any comments received from them;
- A proposed date for submittal of an updated plan, within no more than 10 years (BOR districts required every 5 years). The district must explain why this date is appropriate,

It is anticipated that most district boards will want to formally adopt the plan after it has been approved by WRD. There is no requirement for adoption in Division 86, but adoption will formalize the plan as the district’s policy. It is suggested that adoption occur after approval by WRD, to allow for any changes that occur through the WRD review process.

Example: Effects of Urbanization

“The projected population growth of 225,000 in the Bear Creek Basin urbanized area would require over 80 square miles or 51,200 acres of new urban land if current housing density levels are maintained. These urban lands will likely come from existing irrigated lands and adjacent dry foothills.

The total irrigated land in the district is 8663 acres. The estimated net irrigation requirement is 15,853 acre feet per year, or approximately 1.8 acre feet per year.

Assuming an overall irrigation efficiency of 50%, the resulting gross irrigation requirement would be 3.6 feet per year, which corresponds closely to the water duty of 3.5 feet per year.

It is difficult to predict what fraction of this acreage might be consumed by increased urbanization, but the effect that converting irrigated farm land to urban use would have on district demand can be estimated as follows:

- Current water duty for irrigated land = 3.5 acre feet/acre
- Per capita land use for increased urban housing = 0.228 acres per capita
- Number of new residents per acre = 4.4
- Water demand for new residents = (0.1282 acre feet/year/capita)x(4.4 people/acre)

$$= 0.56 \text{ acre feet per acre converted}$$

It is therefore estimated that agricultural land converted to urban land will reduce demand for water by **2.94 acre feet/year** (3.5 – 0.56 acre feet/year).

WRD Review Process

Districts should anticipate that WRD may request changes in the WMCP once initially submitted, and should plan and budget accordingly. Early contact with WRD can help to minimize changes later in the process.

The specific criteria used by WRD in the WMCP review process is provided in a table format in Appendix C: WRD WMCP Review Worksheet. Also in Chapter 2, there is an illustration of the typical review process provided as Figure 1.

WRD will issue a final order of approval if the WMCP meets the review criteria. For WMCPs that do not meet the criteria, WRD will comment on any deficiencies and request that the district make changes to their WMCP.

After the district makes changes, the WMCP needs to be resubmitted to WRD so that the changes are reviewed. At that point, WRD has the option to either issue a final order approving the plan or denying the WMCP, or may choose to work with the district, if the district is making a good faith effort to meet the requirements.

Generally, the review process will take up to 90 days from initial submittal to WRD. For those WMCPs that do not meet the criteria, the review process may take longer.

WRD reviews and comments on each WMCP submitted. If a WMCP does not meet Division 86 requirements, the district has a minimum of 60 days to make changes to its WMCP based on comments they receive from WRD.

Chapter 5

Conclusion

Water Management and Conservation Plans are one of several important management tools for protecting Oregon's water supply and all the diverse interests that depend on it. While there are state and federal requirements to satisfy when preparing these plans, it is most important to develop a document that is useful for your district. With a fully developed WMCP, your district will be prepared to face existing and future challenges with a set of diverse management tools.

Through preparing the various components of a WMCP, you have also created a document for current and future managers to use in making

decisions. The process of successfully creating and submitting a WMCP is more than simply fulfilling state and federal requirements. Your district can take pride in the work that goes into developing a plan and the final product you create.

The plan should be regularly updated (internally or for WRD submission) to keep it current in relation to how the district operates and any applicable changes that have occurred. Through water management and conservation planning, your district will be better prepared to meet the current needs of your customers as well as the anticipated demands of the future.

Glossary of Terms

GENERAL WATER TERMS

100-year flood - A 100-year flood does not refer to a flood that occurs once every 100 years, but to a flood so severe it has a 1% chance of occurring in any given year.

Acre-foot (ac-ft) - The volume of water required to cover 1 acre of land to a depth of 1 foot. Equal to 325,851 gallons.

Aquifer - A geological formation that stores and/or transmits water to wells and springs. Use of the term is normally restricted to formations capable of yielding water in sufficient quantity and pressure to constitute a significant supply.

Cubic feet per second (cfs) - A measure of flow rate, equal to a volume of water 1-foot high and 1-foot wide, flowing a distance of 1 foot in 1 second. One "cfs" is equal to 7.48 gallons of water flowing each second.

Discharge - The volume of water that passes a given location within a given period of time. Usually expressed in cubic feet per second.

Drought - A shortage of moisture severe enough to have a negative effect on vegetation, animals and humans over a large geographic area.

Groundwater - 1. Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper surface of the saturated zone is called the water table. 2. Water stored underground in rock crevices and in the pores of geologic materials that make up the Earth's crust.

Kilowatt-hour (kwh) - A unit of energy equivalent to 1,000 watt-hours; a power demand of 1,000 watts for one hour. Power company utility rates are typically expressed in cents per kilowatt-hour. Watt-hour (wh) is a measure of electrical energy equal to one watt of power supplied to, or taken from, an electrical circuit steadily for one hour.

Million gallons per day (mg) - A rate of flow of water equal to 133,680.56 cubic feet per day, or 1.5472 cubic feet per second, or 3.0689 acre-feet per day. A flow of one million gallons per day for one year equals 1,120 acre-feet (365 million gallons).

Prior appropriation - The system for allocating water to private individuals used in most Western states. Prior appropriation is based on the concept of "First in Time, First in Right." The first person to take a quantity of water and put it to beneficial use has a higher priority of right than a subsequent user. Under drought conditions, higher-priority users are satisfied before junior users receive water. These rights can be lost if not used.

Return flow - 1. That part of a diverted flow that is returned to its original source or another body of water. 2. (Irrigation) Drainage water from irrigated farmlands that re-enters the water system to be used further downstream.

Surface water - Water that is on the Earth's surface, such as in a stream, river, lake or reservoir.

Water cycle - The circuit of water movement from the oceans to the atmosphere, to the Earth and back to the sea. Water moves through the cycle via processes such as precipitation, interception, runoff, infiltration, percolation, storage, evaporation and transportation.

Water table - The of the water surface in the saturated part of an aquifer.

Watershed - The land area that drains water to a particular stream, river, or lake. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. Large watersheds, like the Columbia River Basin, contain hundreds of smaller watersheds.

Withdrawal - Water removed from the ground or diverted from a surface-water source for use.



For more information on terms, a comprehensive glossary of hydrology and water terms is available through the USGS Water Resources of the United States website: <http://water.usgs.gov/>

DEFINITIONS FROM OREGON STATUTES

As used in OAR 690-086-0010 to 690-086-0920, OAR 690-085-0010, OAR 690-085-0015, 690-086-0040, OAR 690-300-0010:

Affected local governments - any local government as defined in OAR 690-005-0015, within whose jurisdiction the diversion, conveyance, or use of water is established or proposed within the context of the water management and conservation plan.

Agricultural water measurement - using measuring devices, including but not limited to weirs, flumes, submerged orifices, gaging stations, and meters, to quantify the rate of flow and the volume of water in a water delivery system.

Agricultural water supplier - any public or private organization, including but not limited to an irrigation district formed under ORS Chapter 545, a drainage district formed under ORS Chapter 547, a water improvement district formed under ORS Chapter 552, a water control district formed under ORS Chapter 553, a corporation organized under ORS Chapter 554, an unincorporated private association or a ditch company, the primary purpose of which is to supply water to others for agricultural uses.

Agricultural Water Use - the use of water related to the production of agricultural products. These uses include, but are not limited to, construction, operation and maintenance of agricultural facilities and livestock sanitation at farms, ranches, dairies and nurseries. Examples of these uses include, but are not limited to, dust control, temperature control, animal waste management, barn or farm sanitation, dairy operation, and fire control. Such use shall not include irrigation.

Aquatic Life Water Use - the use of water to support natural or artificial propagation and sustenance of fish and other aquatic life.

Artificial Groundwater Recharge - the intentional addition of water to a groundwater reservoir by diversion from another source.

Beneficial Use - the reasonably efficient use of water without waste for a purpose consistent with the laws, rules and the best interests of the people of the state.

Change in channel conditions - includes but is not limited to scour, siltation, accumulation of debris, accumulation of aquatic growth, and the removal of aquatic growth.

Comment - a written statement concerning a particular proposed water use. The comment may identify elements of the application which, in the opinion of the commenter, would conflict with an existing water right or would impair or be detrimental to the public interest.

Commercial Water Use - use of water related to the production, sale or delivery of goods, services or commodities by a public or private entity. These uses include, but are not limited to, construction, operation and maintenance of commercial facilities. Examples of commercial facilities include, but are not limited to, an office, resort,

recreational facility, motel, hotel, gas station, kennel, store, medical facility, and veterinary hospital. Examples of water uses in such facilities include, but are not limited to, human consumption, sanitation, food processing, and fire protection. Such uses shall not include the irrigation or landscape maintenance of more than 1/2 acre.

Commission - the Water Resources Commission.

Conservation - eliminating waste or otherwise improving efficiency in the use of water while satisfying beneficial uses by modifying the technology or method for diverting, transporting, applying or recovering the water; by changing management of water use; or by implementing other measures. (OAR 690-400-0010(5))

Contested Case - a hearing before the Department or Commission as defined in ORS 183.310(2) and conducted according to the procedures described in ORS Chapter 53, ORS 183.413 - 183.497 and OAR Chapter 690, Division 2.

Continuous stage recorder - any device that accurately and continuously records the rise and fall of a water surface with respect to time.

Control - a natural constriction of the channel, a long reach of the channel, a stretch of rapids, or an artificial structure downstream from the gage that determines the stage-discharge relation at the gage.

Cranberry Use - all necessary beneficial uses of water for growing, protecting and harvesting cranberries. Examples of these uses include, but are not limited to, irrigation of cranberries or other crops in rotation, chemical application, flooding for harvesting or pest control, and temperature control.

Department - the Water Resources Department.

Director - the Director of the Water Resources Department or designee.

Domestic Use Expanded - the use of water, in addition to that allowed for domestic use, for watering up to 1/2-acre of lawn or noncommercial garden.

Domestic Water Use - the use of water for human consumption, household purposes, domestic animal consumption that is ancillary to residential use of the property or related accessory uses.

Economic hardship - a financial burden of an extraordinary nature. Examples of situations causing such a burden include, but are not limited to, the following: the entity is required to report on an unusually large number of diversions or locations, the costs of measuring and reporting for a diversion or location greatly exceed the normal costs associated with a similar volume of water, or the costs of measuring and reporting threaten the entity's fiscal ability to continue operating.

Fish Bypass Structure - as used in OAR 690-340-0010, means any pipe, flume, open channel or other means of conveyance that transports fish that have entered a water diversion structure back to the body of water from which the fish were diverted.

Fire Protection Water Use - the use and storage of water for the purpose of extinguishing fires or reducing the potential outbreak of fires.

Fish Screen - as used in OAR 690-340-0010, means a screen, bar, rack trap or other barrier at a water diversion to entrap or provide adequate protection for fish populations, including related improvements necessary to insure its effective operation.

Fishway - as used in OAR 690-340-0010, means any structure, facility or device used to facilitate upstream or downstream passage of fish through, over or around any man-made or natural barrier to free movement.

Flume - a specially shaped open channel flow section which may be installed in a canal, lateral, or ditch to form a control.

Groundwater Reservoir - a designated body of standing or moving groundwater as defined in ORS 537.515(5).

Group Domestic Water Use - the use of water for domestic water use by more than one residence or dwelling unit.

Human Consumption - the use of water for the purposes of drinking, cooking, and sanitation.

Industrial Water Use - the use of water associated with the processing or manufacture of a product. These uses include, but are not limited to, construction, operation and maintenance of an industrial site, facilities and buildings and related uses. Examples of these uses include, but are not limited to, general construction; road construction; non-hydroelectric power production, including down-hole heat exchange and geothermal; agricultural or forest product processing; and fire protection. Such use shall not include irrigation or landscape maintenance of more than 1/2 acre.

Irrigation - the artificial application of water to crops or plants by controlled means to promote growth or nourish crops or plants. Examples of these uses include, but are not limited to, watering of an agricultural crop, commercial garden, tree farm, orchard, park, golf course, play field or vineyard and alkali abatement.

Mining Water Use - the use of water for extraction, preliminary grading, or processing of minerals or aggregate at a mining site or construction, operation and maintenance of a mining site. These uses include, but are not limited to, general construction, road construction, and dust control. Examples of mining include, but are not limited to, aggregate, hard rock, heap leach and placer mining.

Municipal Water Use - the delivery and use of water through the water service system of a municipal corporation for all water uses usual and ordinary to such systems. Examples of these water uses shall include but are not limited to domestic water use, irrigation of lawns and gardens, commercial water use, industrial water use, fire protection, irrigation and other water uses in park and recreation facilities, and street washing. Such uses shall not include generation of hydroelectric power.

Nursery Operations Use -the use of water for operation of a commercial nursery which may include temperature control, watering of containerized stock, soil preparation, application of chemicals or fertilizers, watering within greenhouses and uses to construct, operate and maintain nursery facilities. The use of water within plant nursery operations constitutes a different use from field irrigation, although that may be a part of nursery use. If used for field irrigation for nursery stock, such use is not restricted to the defined agricultural irrigation season.

Off-Channel - outside a natural waterway of perceptible extent which, during average water years, seasonally or continuously contains moving water that flows off the property owned by the applicant and has a definite bed and banks which serve to confine the water. "Off-channel" may include the collection of storm water run-off, snow melt or seepage which, during average water years, does not flow through a defined channel and does not flow off the property owned by the applicant.

Open channel flow measurement - a series of velocity, depth, and width measurements taken across an open channel using a velocity meter and a calibrated tape measure as described in references listed in OAR 690-085-0015(4)(f).

Point of diversion - the point at which water is appropriated from its source.

Pollution Abatement or Pollution Prevention Water Use - the use of water to dilute, transport or prevent pollution.

Primary Right - the right to store water in a reservoir or the water right designated by the commission as the principle water supply for the authorized use, or if no designation has been made, the first in time or initial appropriation.

Protest - a written statement expressing disagreement with a proposed final order that is filed in the manner and has the content described in ORS 537.145 to 537.240.

Quasi-Municipal Water Use - the delivery and use of water through the water service system of a corporation other than a public corporation created for the purpose of operating a water supply system, for those uses usual and ordinary to municipal water use, or a federally recognized Indian tribe that operates a water supply system for uses usual and ordinary to a municipal water use. A quasi-municipal water right shall not be granted the statutory municipal preferences given to a municipality under [ORS 537.190\(2\)](#), [537.230\(1\)](#), [537.352](#), [537.410\(2\)](#), [540.510\(3\)](#), [540.610\(2\)](#), (3), or those preferences over minimum streamflows designated in a basin program.

Rate and Duty of Water for Irrigation - the maximum flow of water in cubic feet per second or gallons per minute (rate) and the total volume of water in acre-feet per acre per year that may be diverted for irrigation (duty).

Recharge Permit - a permit for the appropriation of water for the purpose of artificial groundwater recharge.

Recreation Water Use - the use of water for play, relaxation or amusement. Examples of these uses include, but are not limited to boating, fishing, wading, swimming, and scenic values.

Secondary Groundwater Permit - a permit for the appropriation of groundwater which was stored through the exercise of a recharge permit or certificate.

Stockwater Use - the use of water for consumption by domesticated animals and wild animals held in captivity as pets or for profit.

Storage - the retention or impoundment of surface or groundwater by artificial means for public or private uses and benefits.

Storage Account - a net volume of artificially recharged groundwater which is calculated for a single recharge activity from a formula specified in a single recharge permit which records additions to a groundwater reservoir by artificial recharge and depletions from a groundwater reservoir by pumping and natural losses.

Stored Recharge Water - groundwater which results from artificial groundwater recharge.

Storm Water Management Water Use - the use or storage of water in any structure or drainage way that is designed, constructed and maintained to collect and filter, retain or detain surface water runoff during and after a storm event for the purpose of water quality improvement, flood control or property protection. It may also include, but is not limited to, existing features such as wetlands, water quality swales, and ponds which are maintained as storm water quality facilities.

Stream or Riparian Area Enhancement Water Use - the use of water to restore or enhance a stream or riparian area.

Supplemental Water Right or Supplemental Water Use Permit - an additional appropriation of water to make up a deficiency in supply from an existing water right. A supplemental water right is used in conjunction with a primary water right.

Temperature Control - the use of water to protect a growing crop from damage from extreme temperatures.

Transfer - a change of use or place of use or point of diversion of a water right.

Velocity meter - a device designed and constructed to the specifications cited in the reference listed in OAR 690-085-0015(4)(f)(C) for measuring stream velocity in open channels.

Waste - the continued use of more water than is needed to satisfy the specific beneficial uses for which a right was granted. The need for water shall be based on using the technology and management practices that provide for the efficient use of water considering:

- a. The economic feasibility of use of the technology and management practices by the water user;
- b. The environmental impacts of making modifications;
- c. The available proven technology;
- d. The time needed to make modifications;
- e. Local variations in soil type and weather; and
- f. Relevant water management plans and subbasin conservation plans.
(OAR 690-400-0010.)

Wastewater - water that has been diverted under an authorized water right after it is beyond the control of the owner or that right but has not yet returned to the channel of a natural stream. In an irrigation district, the wastewater of an individual user is not subject to appropriation until it leaves the boundaries of the district. Wastewater abandoned to the channel of a natural stream becomes a part of that stream and is subject to appropriation.

Water Availability Analysis - the investigation of stream flow or groundwater measurement records, watermaster distribution records, flow requirements of existing water rights, stream flow modeling in ungauged basins, minimum perennial streamflows, or scenic waterway flow requirements to determine if water is available to support the proposed water use.

Water Right Subject to a Transfer - a right established by a court decree or evidenced by a valid water right certificate, or a right for which proof of beneficial use of water under a water right permit or transfer has been submitted to and approved by the Director but for which a certificate has not yet been issued.

Water use - water diverted or pumped from the source, or in the case of non-diverted water, the water available to satisfy the right.

Weir - an overflow structure built across an open channel to form a control.

Sample Water Management and Conservation Plan

Note to the reader: This sample plan has been developed solely for the purposes of the Guidebook on WMCPs. It offers an example of a WMCP based on a cooperative effort with the Ochoco Irrigation District (OID). The overall organization and approach to planning can serve as an example to other districts preparing their own plans. Special thanks to Ochoco Irrigation District for their work on this sample plan. When preparing a WMCP it is normally suggested to include a copy of all active permits (certificates or decrees). These documents were not provided in the sample plan to save paper.

OCHOCO IRRIGATION DISTRICT PRINEVILLE, OR

Executive Summary

The Ochoco Irrigation District (OID) is submitting this Water Management and Conservation Plan (WMCP) in accordance with OAR Chapter 690 Division 86. This plan is divided into six sections that cover the OID Water Management and Conservation Plan. The order of the first five sections within the plan follows the rule requirements in OAR 690 Division 86. Section Six of the plan also provides a brief history of the district and description of the climate and soils.

The purpose of the WMCP is to update the plan as required by the final order from the Water Resources Department approving the first OID WMCP.

| WMCP Item | Section |
|---|---------|
| Section 1 Water Supplier Description - OAR 690-086-0240 | |
| Summary of water rights | 1.1 |
| Source(s) of water | 1.2 |
| Schematic of the system | 1.3 |
| Current water use, including peak and average annual diversions | 1.4 |
| Summary of major classifications of uses and users | 1.5 |
| Types of on-farm irrigation systems commonly used | 1.6 |
| Crops commonly grown, estimated average and peak consumptive use | 1.7 |
| Description of the operation and maintenance program. | 1.8 |
| Section 2 Water Conservation Element - OAR 690-086-0250 | |
| Progress report on conservation measures from previously approved WMCP | 2.1 |
| Description of the water supplier's agricultural water measurement program | 2.2 |
| Description of other conservation measures currently implemented | 2.3 |
| Short and long-term goals of the water supplier to improve water management | 2.4 |

| | | |
|---|--|-----|
| Evaluation of the opportunities for improving water use efficiency: | | |
| Description of losses of water from canals, pipelines, and laterals | | 2.5 |
| Assessment of whether water deliveries are insufficient to meet crop needs | | 2.5 |
| List of alternative conservation measures to reduce the losses of water identified in (a) and address insufficiencies of water deliveries identified in (b) | | 2.5 |
| Assessment of alternatives to finance conservation measures | | |
| For each of the following conservation measures not currently implemented, an evaluation of whether implementation is feasible and appropriate: | | |
| Promotion of energy audits for district water users | | 2.6 |
| Conversion to metered, pressurized deliveries to all parcels of 1 acre or less | | 2.6 |
| Piping or lining earthen canals to reduce losses | | 2.6 |
| Modifying facilities and policies to increase the flexibility of deliveries | | 2.6 |
| Provision of on-farm irrigation scheduling assistance | | 2.6 |
| Construction of re-regulating reservoirs | | 2.6 |
| Adoption of rate structures that support and encourage water conservation | | 2.6 |
| Any other conservation measures identified by the water supplier that would improve water use efficiency. | | 2.6 |
| Description and estimated schedule for implementation of each of the following conservation measures: | | |
| Information and education program addressing all types of uses served | | 2.7 |
| Any other conservation measures identified as feasible and appropriate | | 2.7 |
| A program to monitor and evaluate implemented conservation measures | | 2.8 |
| Section 3 Water Curtailment Element - OAR 690-086-0260 | | |
| Description of past supply deficiencies and current capacity limitations | | 3.1 |
| Description of situation(s) that trigger implementation of water curtailment element | | 3.2 |
| Description of the procedure used to allocate water during shortages | | 3.3 |
| Section 4 Water Supply Element - OAR 690-086-0270 | | |
| Estimate of long-range water demand projections for 20 years | | 4.1 |
| Comparison of the projected water needs and available sources | | 4.2 |
| List of potential sources of water to supply the long-range needs | | 4.3 |
| Comparison of potential sources of additional water | | 4.4 |
| Evaluation of the effects of the following factors on long-range water needs: | | |
| Regional options for meeting future water needs | | 4.5 |
| Urbanization and other land use trends | | 4.5 |
| Local government related plans or ordinances | | 4.5 |
| Section 5 Additional Requirements - OAR 690-086-0225 | | |
| List of the affected local governments to whom the plan water made available and a copy of any comments on the plan provided by the local governments | | 5.1 |
| Proposed date for submittal of an updated WMCP | | 5.2 |

SECTION 1: SYSTEM DESCRIPTION

OAR 690-086-0240

LOCATION

Ochoco Irrigation District is located in Central Oregon, in Crook County. The irrigated lands are situated in a valley extending from Ochoco Dam, 5.5 miles east of the City of Prineville to a point on Crooked River 12 miles west of Prineville. The lands are enclosed by foothills and lava escarpments on the north and south. The land slopes south and west from Ochoco Dam. Elevations in this document are in feet above sea level. The outlet works at Ochoco Dam is at an elevation of 3050 feet. Typically, canals flow on a grade of 1 foot fall per 1,000 foot of length. Elevation of irrigated lands within the District is 2800 to 3120 feet above sea level.

SECTION 1.1: Water Rights - OAR 690-086-0240(1)

The irrigation season is April 1 to October 15. All users in the District share water rights on all irrigated lands. Water rights provided to Ochoco ID are specifically stated on the certificates as follows:

Certificate 82246

| | |
|----------------------|---|
| Permit | 5426 |
| Source | Ochoco, McKay, Dry, Lytle and Johnson Creeks, and all waste and return water flowing in all unnamed waterways, and Ochoco Reservoir |
| Priority | March 13, 1916, from McKay Creek, and August 10, 1917, from all other sources named herein |
| Use | Primary irrigation of 16614.3 acres and industrial use of 160.2 acres/equivalent |
| Rate | 209.7 cfs |
| Duty | 4 ac-ft/acre |
| Legal Season | Feb.- Dec. |
| Actual Season | April - Oct. |
| Remarks | This is the primary right for most of the District. |

Certificate 82247

| | |
|----------------------|---|
| Permit | 25991 |
| Source | Crooked River and Prineville Reservoir |
| Priority | April 8, 1914 |
| Use | Primary irrigation of 3087.3 acres and supplemental irrigation of 12011.9 acres |
| Rate | 190 cfs |
| Duty | 4 ac-ft/acre |
| Legal Season | Feb.- Dec. |
| Actual Season | April - Oct. |
| Remarks | This is the supplemental right for most of the District. |

Certificate 82248

| | |
|---------------------|--|
| Permit | 49824 |
| Source | Ochoco Creek and Reservoir |
| Priority | September 2, 1986 |
| Use | Industrial use for the equivalent of 200 irrigated acres |
| Rate | 2.75 cfs |
| Duty | 4 ac-ft/acre |
| Legal Season | Year round |

Actual Season Year round
Remarks This right makes use of 600 ac-ft of the water stored in Ochoco Reservoir.

Certificate 82249

Permit N/A
Source Crooked River, Ochoco Creek and Springs, and McKay Creek
Priority Varies from 1869 to 1916
Use Supplemental irrigation of 4601.87 acres
Rate 59.93 cfs
Duty 4 ac-ft/acre
Legal Season Year round
Actual Season Year round
Remarks This certificate combined many prior rights with varying priority dates into one supplemental certificate.

Certificate 55973

Permit R-528
Source Ochoco Creek
Priority April 8, 1914
Use Storage of 46,400 ac-ft for irrigation and 600 ac-ft for industrial use
Rate N/A
Duty N/A
Legal Season Year round
Actual Season Year round
Remarks The reservoir lands and this water right are owned by OID.

Certificate 57612

Permit R-2223
Source Crooked River
Priority April 8, 1914
Use Storage of 155,000 ac-ft for irrigation
Rate N/A
Duty N/A
Legal Season Year round
Actual Season Year round
Remarks The reservoir lands and water right are owned by the United States. OID operates the reservoir under contract with USBR. OID has contracted for 57,899 ac-ft of the storage space. The right to storage for the United States is secondary to the OID natural flow right.

The primary sources of water are Ochoco Reservoir and Prineville Reservoir. However, OID has water rights on Johnson Creek, Dry Creek, McKay Creek, and Lytle Creek, and if water is available in the spring, it is diverted from these streams where OID canals cross these creeks. It is not enough to supply the district but augments the flow from the two main reservoirs. In addition to the OID canal system, segments of Crooked River, Ochoco Creek, Johnson Creek, Dry Creek, McKay Creek, and Lytle Creek are used as conveyances for district irrigation water.

SECTION 1.2: Sources of Water; Storage and Regulation Facilities; and Summary of Transfer, Rotation, Exchange, or Intergovernmental Agreements - OAR 690-086-0240(2)

OID has two principal sources of stored water, Ochoco Reservoir, formed by Ochoco Dam constructed on Ochoco Creek, and Prineville Reservoir, created by Bowman Dam constructed on Crooked River.

Storage Facilities

| | |
|--------------------------|---------------------------|
| Ochoco Dam | |
| Capacity | 39,600 ac-ft |
| Crest Elevation | 3130.7 ft |
| Dam height | 125 ft |
| Crest Length | 1350 ft |
| Use | Irrigation, flood control |
| Construction Date | 1918-20 |

| | |
|--------------------------|---|
| Bowman Dam | |
| Capacity | 154,690 ac-ft |
| Crest Elevation | 3264.0 ft |
| Crest height | 245 ft |
| Crest Length | 800 ft |
| Use | Irrigation, flood control and fish life |
| Construction Date | 1958-61 |

Ochoco Dam and Reservoir

Ochoco Dam is a hydraulic-fill structure on Ochoco Creek about 6 miles east of Prineville. The dam was rehabilitated by BOR in 1949 and the reservoir capacity was increased at that time. The dam provides flood control of Ochoco Creek in addition to storing water for irrigation. In 1989, the dam was deemed unsafe due to excessive leakage from the north abutment and storage was limited to 25,000 ac-ft. The dam was repaired in the 1990s under the Safety of Dams Program. Presently Ochoco Dam has a storage capacity of 39,600 ac-ft with 16,000 ac-ft required for flood control from November 15 through February 15 each year. 600 ac-ft is for municipal and industrial (M&I) use.

Title to Ochoco Dam remains with the District.

Bowman (Prineville) Dam and Prineville Reservoir

Bowman Dam is an earthen-filled structure on the Crooked River about 20 miles upstream from Prineville. OID contracted with the Bureau of Reclamation (BOR) for the irrigation use of percentages of the storage space in Prineville Reservoir in contracts executed in 1958, 1966, and 1968, pursuant to the Crooked River Project Act and the Crooked River Project Extension Act. The total percentage of storage space contracted for was originally equivalent to 59,600 ac-ft, however this was reduced to 57,899 ac-ft as a result of a reservoir sedimentation survey.

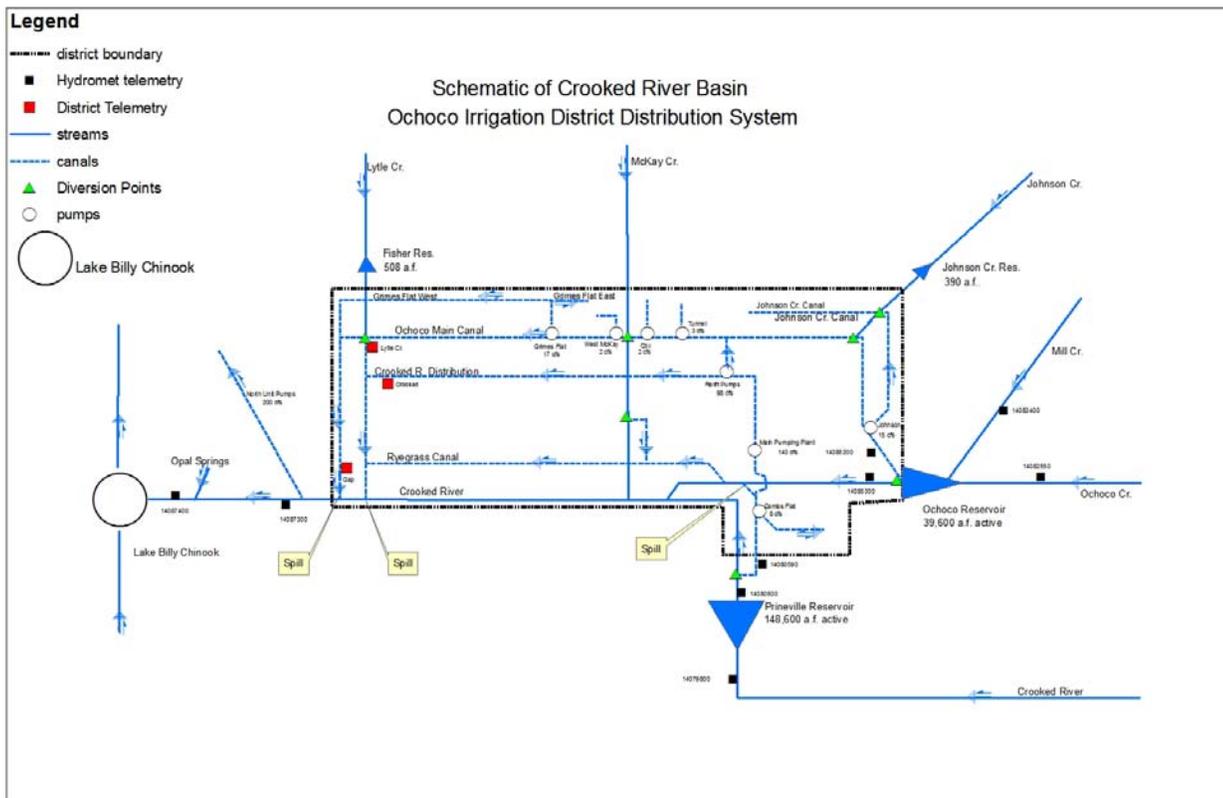
The total capacity of Prineville Reservoir at closure was 154,690 ac-ft (active 152,800 ac-ft). A reservoir sedimentation survey completed in 1998 estimates the total capacity at 150,200 ac-ft (active 148,600 ac-ft). 60,000 ac-ft of vacant space is required from November 15 through February 1 each year for flood control. After February, water can be stored following the fill rule curve in accordance with forecasted inflow. The fill rule-curve was developed by the BOR and the US Army Corps of Engineers.

The title to the dam and reservoir is with the BOR.

District Water Delivery Contracts, Agreements, and Interconnections.

OID operates and maintains Bowman Dam and Prineville Reservoir under contracts with the BOR. OID releases irrigation water into the Crooked River for 15 contractors who are outside of the OID boundaries and have contracted with Reclamation for the irrigation use of Prineville Reservoir storage space. The largest non-OID contractor is the Peoples Irrigation Company, which has a contract with BOR for the use of a percentage of storage space in Prineville Reservoir that is equivalent to 3,497 ac-ft, with stored water released into the Crooked River.

SECTION 1.3: Schematic of the Irrigation System - OAR 690-086-0240(3)



As shown in the schematic above, the major diversion structures include the following:

- Downstream of Prineville Reservoir, from Crooked River at the Diversion Dam, into the Crooked River Diversion Canal.
- From the outlet facilities of Ochocho Reservoir, into the Ochocho (Main) Feed Canal.
- From Ochocho Creek downstream from Ochocho Dam, into the Rye Grass Canal.
- Other points of diversion are where the main canal crosses Johnson, McKay, Lytle and Dry Creeks.

SECTION 1.4: Current Water Use and Return Flows - OAR 069-086-0240(4)

Current Water Use – Peak Diversions, Average Annual Diversions, and Peak Monthly Diversions

| Year | Diversion Name | Gauge Number | Time of Use | Total Annual Diversion (ac-ft/mo) | Peak Monthly Diversion | Peak Diversion (cfs) |
|---------|-------------------------|--------------|-------------|-----------------------------------|------------------------|----------------------|
| 2006 | Ochoco Creek | 14085300 | Year Round | 61088 | 19710 | 326.32 |
| | Ochoco Feed Canal | 14085200 | Seasonal | 26580 | 5980 | 99.01 |
| | Crooked Diversion Canal | 14080590 | Seasonal | 47700 | 9940 | 164.57 |
| 2005 | Ochoco Creek | 14085300 | Year Round | 6885 | 1100 | 18.21 |
| | Ochoco Feed Canal | 14085200 | Seasonal | 18125 | 5650 | 93.54 |
| | Crooked Diversion Canal | 14080590 | Seasonal | 50340 | 9860 | 163.25 |
| 2004 | Ochoco Creek | 14085300 | Year Round | 14757 | 3500 | 57.95 |
| | Ochoco Feed Canal | 14085200 | Seasonal | 25350 | 5130 | 84.93 |
| | Crooked Diversion Canal | 14080590 | Seasonal | 51030 | 9010 | 149.17 |
| 2003 | Ochoco Creek | 14085300 | Year Round | 5720 | 958 | 15.86 |
| | Ochoco Feed Canal | 14085200 | Seasonal | 18322 | 5180 | 85.76 |
| | Crooked Diversion Canal | 14080590 | Seasonal | 49300 | 9710 | 160.76 |
| 2002 | Ochoco Creek | 14085300 | Year Round | 5385 | 1180 | 19.54 |
| | Ochoco Feed Canal | 14085200 | Seasonal | 17675 | 4840 | 80.13 |
| | Crooked Diversion Canal | 14080590 | Seasonal | 55690 | 9990 | 165.40 |
| Average | | | | | | |
| | Ochoco Creek | 14085300 | Year Round | 18767 | 5290 | 88 |
| | Ochoco Feed Canal | 14085200 | Seasonal | 21210 | 5356 | 897 |
| | Crooked Diversion Canal | 14080590 | Seasonal | 50812 | 9702 | 161 |

Reservoir storage, Peak Monthly Releases, and Daily Average Peak Releases

| Year | Reservoir Name | Certificate Number | Time of Use | Annual Releases (ac-ft/yr) | Peak Monthly Releases (ac-ft/mo) | Daily Peak Releases (cfs) |
|------|----------------------|--------------------|-------------|----------------------------|----------------------------------|---------------------------|
| 2006 | Ochoco Reservoir | 55973 | Year Round | 87668 | 22840 | 378.15 |
| | Prineville Reservoir | 57612 | Year Round | | | |
| 2005 | Ochoco Reservoir | 55973 | Year Round | 25010 | 6750 | 111.75 |
| | Prineville Reservoir | 57612 | Year Round | | | |
| 2004 | Ochoco Reservoir | 55973 | Year Round | 40107 | 7350 | 121.69 |
| | Prineville Reservoir | 57612 | Year Round | | | |
| 2003 | Ochoco Reservoir | 55973 | Year Round | 24042 | 6112 | 101.19 |
| | Prineville Reservoir | 57612 | Year Round | | | |
| 2002 | Ochoco Reservoir | 55973 | Year Round | 23060 | 6020 | 99.67 |
| | Prineville Reservoir | 57612 | Year Round | | | |

District Return Flows

The district calculated or measured return flows with standard USGS measurement procedures in flumes, weirs or with fixed flow measurement devices. The Gap Canal data for example are

gathered with a fixed flow measurement device and telemetered (please refer to the district schematic).

**Average Return Flows in Acre-Feet by Location
2002 to 2006**

| Month | Reynolds Canal | Lytel Creek | Ochoco Creek | Gap Canal | Totals |
|--------|----------------|-------------|--------------|-----------|--------|
| April | 183 | 244 | 219 | 56 | 702 |
| May | 367 | 624 | 460 | 183 | 1633 |
| June | 222 | 538 | 320 | 122 | 1201 |
| July | 89 | 413 | 328 | 129 | 959 |
| August | 119 | 577 | 358 | 143 | 1197 |
| Sept | 172 | 677 | 400 | 155 | 1403 |
| Oct | 114 | 261 | 182 | 66 | 622 |
| Totals | 1547 | 3557 | 2988 | 1130 | 9222 |

SECTION 1.5: Classification of User Accounts - OAR 690-086-0240(5)

User accounts are described in the following table. This summary is based on district records for 2007.

| User Classification | Amount in acres or acres-equivalent | Number of Accounts |
|----------------------------|-------------------------------------|--------------------|
| Irrigation | 19,000 acres | 749 Irrigation |
| Manufacturing & Industrial | (600 ac-ft)= 303 acre equivalent | One saw mill |

SECTION 1.6: Types of Irrigation Systems - OAR 690-086-0240(6)

The percentages of irrigated cropland associated with these irrigation methods and systems in OID are estimated at:

| Type of Irrigation System | Percent of Irrigated Acreage |
|---|------------------------------|
| Flood, furrow, corrugation, border, etc | 23.5 |
| Set-move and solid set sprinklers | 69.0 |
| Center Pivot | 7.5 |

SECTION 1.7: Crops Commonly Grown, Average and Peak Use - OAR 690-086-0240(7)

For the ease of estimating gross irrigation water requirements, information on types of irrigation systems, crops commonly grown, and the estimated average and peak consumptive use of the crops are combined into this section on irrigation water requirements for the district.

Commonly Grown Crops

The district maintains a data base containing ownership, crop and assessment (fees charged) information for each acre served by the district. Many patrons change crop type in their fields annually. Annual crop reports are prepared and submitted to BOR and OWRD. All crops grown in the district are included in the analysis; however some were grouped together to determine crop ET (evapotranspiration or consumptive use) and IR (irrigation requirement). Major crops represent nearly 60 % of the total irrigated crops in OID, i.e. grain, alfalfa hay, grass hay, and pasture. There are a total of 750 patrons with many times that number of combinations of crops and specific fields. Therefore, many crops are changed annually specific crops by field by account is not reasonable to display (i.e. garlic, seed crops, potatoes, and sugar beets are typically grown in a new field each year). Mint is rotated every few years depending on disease. Many of the fields on the small farms remain long term in pasture, grass hay and alfalfa hay.

The general mix of crops within the district is shown in the following table. The acreages for 1997 were chosen to represent an average distribution of crops in the district. Urban area represents farms in the district of less than 25 acres, and turf on county, city, schools, cemetery, etc. for which there are water rights.

If reservoirs fill, water is sufficient for crop needs. The district will continue to further quantify the reservoir levels at which reduction of water deliveries become necessary.

| Crop | Acres | Percent of Total Area |
|------------------|---------------|-----------------------|
| Grain | 449 | 2.6 |
| Alfalfa hay | 4244 | 24.5 |
| Grass Hay | 5949 | 34.4 |
| Pasture grass | 2718 | 15.7 |
| Mint | 675 | 3.9 |
| Garbanzo beans | 87 | 0.5 |
| Garlic seed | 344 | 2.0 |
| Other seed crops | 45 | 0.3 |
| Urban | 2794 | 16.1 |
| TOTAL | 17,305 | 100.0 |

Estimates of Crop Consumptive Use

Two methods of estimating crop water requirements were considered; (i) using estimates from OSU Extension Bulletin 8530 Bulletin 8530 for the Redmond-Madras area, or; (ii) deriving AgriMet on-line data from the Madras station. Bulletin 8530 does not provide data for mint, garlic and other seed crops, garbanzo beans or urban water use (lawns), which together account for about one quarter of the total acreage. It was therefore necessary to determine ET and IR

using AgriMet data from the Madras station. Data collected from the “Grimed” weather station located at the OSU Experiment Station at Powell Butte is transmitted to the GOES satellite system and downloaded at the regional BOR office in Boise, ID, where the raw data is converted to crop ET using a modified Penman equation. Crop ET information for most crops in the Prineville area are available on the BOR web site, as the AWARDS program. The one exception is garbanzo beans. Since that crop only accounts for half of one percent of irrigated land, and is often grown without irrigation, it was not included in the analysis.

This analysis involved first choosing a ‘design’ year with crop water demands greater than 8 of 10 years, then determining the ET and monthly precipitation for that year, and finally, calculating the net irrigation requirement (ET minus precipitation) for the various crops in that year. The Madras AgriMet station data spans 18 years (1988-2006). These years were ranked according to annual total ET for alfalfa

The 2006 season was chosen for analysis of crop water requirements because it was the fifth ranked year out of 19 years, implying that the ET for alfalfa that year was greater than or equal to approximately 80% of the seasons. AgriMet estimates of ET during 2007 for the various crops were downloaded from the *Crop Water Use Information/Historical Crop ET* web page. Corresponding monthly rainfall data for 2007 were downloaded from the *AgriMet Weather Data/Historical Archive Data Access* web page. The monthly irrigation requirements, calculated as the difference between ET and precipitation, are shown in the table below. The seasonal ET demand is typically offset by about 3 inches from the carryover of winter storage in the soil that can be utilized by the crop during the following season.

| Net Irrigation requirements (2006) | | | | | | | | | | |
|---|--------------|------------|------------|------------|------------|------------|------------|------------|------------|---------------|
| (inches) | | | | | | | | | | |
| | Acres | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Season |
| Grains | 449 | 0.0 | 0.0 | 1.8 | 6.3 | 9.7 | 0.6 | 0.0 | 0.0 | 18.4 |
| Alfalfa Hay | 4244 | 0.0 | 2.5 | 4.5 | 5.4 | 9.0 | 7.5 | 5.2 | 0.8 | 34.8 |
| Other hay | 5949 | 0.0 | 2.5 | 4.5 | 5.4 | 9.0 | 7.5 | 5.2 | 0.8 | 34.8 |
| Grass | | | | | | | | | | |
| Pasture | 2718 | 0.0 | 2.0 | 3.4 | 4.0 | 7.2 | 5.9 | 3.8 | 0.4 | 26.6 |
| Mint | 675 | 0.0 | 0.0 | 0.9 | 4.3 | 9.8 | 7.8 | 0.0 | 0.0 | 22.8 |
| Garbanzo beans | 87 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Garlic seed | 344 | 0.0 | 1.1 | 2.6 | 6.0 | 10.6 | 4.3 | 0.0 | 0.0 | 24.7 |
| Other seed | 45 | 0.0 | 0.0 | 0.5 | 2.9 | 5.1 | 1.1 | 0.0 | 0.0 | 9.6 |
| Urban | 2794 | 0.0 | 2.5 | 4.2 | 5.0 | 8.5 | 7.0 | 4.5 | 0.7 | 32.3 |

The maximum crop ET and IR typically occurs in July when the temperature is the highest, crop growth (foliage) and soil surface evaporation is the greatest and precipitation is the least.

The following net irrigation requirements, expressed as irrigation depths in inches, was converted to ac-ft by multiplying the above monthly ET values by the acreages shown in the first column. The results are shown in the following table. During 2006 the district net irrigation requirement peaked in July at 14,824 ac-ft. The annual total consumptive use in 2006 was 48,549 ac-ft. However the annual total would be offset by 3.0 inches carryover soil moisture from winter and spring precipitation, equivalent to 5040 ac-ft of antecedent moisture, which brings the resulting annual gross demand down to 43,509 ac-ft.

| Net Irrigation requirements (2006) | | | | | | | | |
|------------------------------------|------|------|------|-------|------|------|-----|---------------------------|
| Monthly (ac-ft) | | | | | | | | |
| | Apr | May | Jun | Jul | Aug | Sep | Oct | Season |
| Grains | 0 | 67 | 236 | 363 | 21 | 0 | 0 | 687 |
| Alfalfa hay | 866 | 1602 | 1906 | 3194 | 2642 | 1825 | 269 | 12304 |
| Other hay | 1215 | 2246 | 2672 | 4477 | 3703 | 2558 | 377 | 17247 |
| Grass | | | | | | | | |
| Pasture | 451 | 772 | 915 | 1626 | 1339 | 852 | 79 | 6034 |
| Mint | 0 | 49 | 240 | 552 | 440 | 0 | 0 | 1281 |
| Garbanzo beans | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Garlic seed | 32 | 75 | 171 | 304 | 123 | 0 | 0 | 707 |
| Other seed | 0 | 2 | 11 | 19 | 4 | 0 | 0 | 36 |
| Urban | 584 | 971 | 1160 | 1972 | 1621 | 1048 | 170 | 7525 |
| Monthly totals | 3149 | 5784 | 7310 | 12507 | 9893 | 6282 | 895 | |
| Antecedent moisture | | | | | | | | 4326 |
| | | | | | | | | Annual total 41494 |

Gross irrigation requirements at the farm level

Dividing net irrigation requirements by application efficiency gives the gross water requirement at the field level. District average application efficiency was based on the irrigation systems used. Two principal methods of irrigation water application exist in OID, that being surface (flood) or sprinkler. Of surface irrigation method, flood systems are most prevalent. Common crops irrigated by flood systems include mostly pasture with some hay. Common sprinkler systems include: periodic move (hand move lines, and solid sets), many center pivots, and a few big guns. Common crops irrigated by sprinkler systems include hay, grain, pasture, mint, garlic seed, carrot seed, etc.

Specific on-farm evaluations to determine actual application efficiencies are not available at this time, district wide estimates are provided based on observations by district personnel and published industry values.

- Surface Irrigated lands - Seasonal irrigation efficiency of 55 % is used as the district wide seasonal on-farm efficiency for all of the surface irrigated lands (23.5% of irrigated land). It is estimated that 25% goes to deep percolation (DP), and 20 % goes to runoff (RO).
- Sprinkler Irrigated Lands - An overall application efficiency of 75 % is used as the district wide seasonal on-farm efficiency for all sprinkler irrigated lands (76.5% of irrigated land). It is estimated 70 % is used to meet crop IR, 10 % goes to evaporation and 20 % goes to deep percolation. Of the sprinkler irrigated lands in the district, nearly 100 % are pressurized by pumping at the point of delivery (practically all using electric motors).

- District Wide Weighted Average - Based on average delivery needs and weighted crop IR (and accounting for 3.0 inches of carry-over soil moisture), the weighted average (for both surface and sprinkler irrigated lands) for the seasonal overall district wide on-farm efficiency then becomes 70%.

The weighted average represents an ‘attainable’ efficiency. However, there will be inevitable losses to deep percolation due to occasional over irrigation and longer set times than needed, inadequate pattern distribution uniformity due to worn nozzles or inadequate operating pressure, wind drift losses, direct evaporation from plant and soil surface surfaces, joint leaks etc. Consequently the above attainable efficiency is unlikely to be achieved as a district average. On the other hand, with the many center pivot systems now in use and the diligent operation and water management of many irrigators, it is felt the value is a reasonable goal.

Gross water demand for full irrigation in 8 out of 10 years in OID was calculated using the estimated attainable efficiency of 70% and the peak and annual net water requirements listed earlier (12,507 ac-ft in July and 41,494 ac-ft for the year). Peak delivery rates (averaged for the peak month of July) were calculated by dividing the monthly demand by the number of day in the month (31), then dividing again by 1.9835 to convert acre feet per day to cfs. Summarizing the results:

- **Peak monthly demand (July):** **17,867 ac-ft**
- **The peak delivery rate during July:** **291 cfs**
- **Annual total demand:** **59,277 ac-ft**

SECTION 1.8: Operation & Maintenance - OAR 690-086-0240(8)

Operation

The governing body is a Board of Directors comprised of three directors elected at large by direct vote of the landowners. Each Director serves 3 years. The Board of Directors set the policy for the district. They meet monthly, and more often as necessary. The annual budget, prepared by the manager and staff, non-budgeted construction, inclusion and exclusion of irrigation land, etc. must be approved by the Directors. The Directors select a Secretary/Manager who has full charge of all departments of the district for the day-to-day operations. The district has 8 full time employees who are primarily responsible for the operation of the district. The district has a full time manager who is responsible to the board of directors and oversees all of the operations of the district and is the secretary to the board. The administrative staff is comprised of an office manager and an office assistant. Their function is billing, taking water orders, completing government forms and reports and other administrative duties required by the manager.

The field operation of the district is divided into two sections (divisions), irrigation operation and repair and maintenance. The field operation section has three ditch riders who control the distribution of water to the various water users. The ditch riders are also damn tenders. Their duties include releasing water from the dams, setting diversions and monitoring canal operation. The three “ditch riders” provide control of deliveries for 6,000 – 7,000 acres each. They keep daily records of delivery at each diversion and turnout, which is then totaled weekly. They also clean the various trash screens during their rides. There is a maintenance foreman and a maintenance technician; they are responsible for repair and maintenance during the irrigation

season and maintenance and construction during the non Irrigation season. There are also several part time employees that allow the district to operate continuously during the irrigation season.

Ditch riders and maintenance personnel keep track of problems that do not need immediate attention and are evaluated and prioritized at the end of the irrigation season.

Off-Season Maintenance and Repair

Most maintenance is preformed on the distribution system during non-irrigation season, i.e. fall, winter and early spring months. Any new construction must be done between when the irrigation season ends to the end of December. Maintenance consists of removing excess vegetation and moss, and removal of accumulated sediment from canals, repair or replacement of water control structures, maintenance & repair on diversion structures, repair of concrete canal lining, and installation of new flow measuring devices. Maintenance and repair on pumps and electrical motors and their related controls is preformed at this time also. Maintenance must also be performed on the telemetry facilities the district owns and operates.

Inspections

The district performs inspections for safety and to prevent down time during the irrigation season. Key inspections include:

- BOR and OID provide periodic inspections of Ochoco and Bowman Dams (for structural integrity and flood flow passage). Dam tenders provide weekly inspections and there are annual inspections by BOR and OID on dam facilities. The control gates on the outlets of Ochoco and Prineville Reservoirs have regular inspections to assure adequate operation. BOR provides inspections of all facilities in the district on a regular schedule. Repairs are made as necessary.
- OID has a large number of pumps and electrical controls that are critical to the district operation. The district contracts to have all pumps and electrical switch gear inspected and serviced before the beginning of the irrigation season. The pumps are also inspected during the irrigation season for excessive heat and vibration.

Distribution System

Ochoco Irrigation District is an on-order type delivery system whereby the patron orders water turned “on” or “off” as needed. Discharge gates at Ochoco Dam are regulated twice daily during irrigation season as demand dictates. Crooked River water from Prineville Reservoir is regulated with gates at Bowman Dam. The conveyance and distribution system consists of many miles of open canal and open and closed lateral. The system is generally open canals from the main distribution. Laterals are a combination of open canals or ditches, gravity pipes and tight pipe.

There are 50 miles of open delivery canal. A section 1.75 miles long, referred to as the Ochoco Feed Canal, beginning at Ochoco Dam is concrete lined, with another approximately 5.5 miles clay or bentonite lined.

The district has canals at several different elevations with the most upper canal starting at elevation 3120 feet. The distribution system consists of 24 miles of open laterals, 36 miles of

pipelines and concrete-lined canals/laterals. There are also 16 miles of drains of which 12 miles are piped.

Where the main canals cross creeks, siphons have been constructed to pass natural stream flood flows and reduce spills or leaks into the creeks. Where there are creek crossings and siphons have not been installed standard stop log structures have installed. There are also many bridges and culverts where the canals and laterals are crossed by state, county and private roads.

There are five tributaries of the Crooked River within the bounds of the district. None of the tributaries have year long natural flow within the district. Irrigation water is delivered into the tributaries at various points as the district uses all five as part of their conveyance system, and for operational spills. Four of the tributaries totally dry up after the end of the irrigation season when irrigation delivery water is shut off. Ochoco Creek has flow after the close of the season due to seepage from Ochoco Dam. This flow is also supplemented with releases from Ochoco Reservoir for fish and wildlife purposes and to maintain stream riparian growth.

Rye Grass Canal was the original diversion canal from Ochoco Creek to provide water to the irrigated lands in the Ochoco Creek valley before construction of Ochoco Reservoir. Capacity is limited to 7 – 8 cfs due to very flat grade and size of canal through Prineville.

Functional Operation

Releases from Ochoco Reservoir are diverted into the Ochoco Canal and Ochoco Creek. The first 1.5 miles of the Ochoco main canal is concrete lined, water travels down canal and is removed at the Johnson Creek pumping plant to supply water to the Johnson Creek Canal. Water continues down Ochoco main canal to the intersection with Johnson Creek. When there is water available Johnson Creek water can be diverted into the Ochoco Main Canal. Water continues down Ochoco Main Canal until it reaches the point where the Relift Pumps lift the water from the Crooked River Distribution Canal to the Ochoco main canal. At this point Ochoco Reservoir water and Crooked River water can be co-mingled. Water continues down the canal with pumping plants to divert water into the Tunnel Canal and Cox Canal. The canal then passes under McKay Creek via a siphon. Water can be diverted from McKay Creek when water is available or spilled into McKay Creek as needed. Water is diverted by pump into the west McKay Canal. Further down the Ochoco Main Canal, the Grime Flat pumping plant diverts water into the Grimes Flat East and West Canal. Water continues down the Canal to Lytle Creek, water can be diverted if water is available or spilled to Lytle Creek. The district operates a telemetry station to monitor flow which is used to regulate the release from Ochoco Reservoir and the Relift pumps. The Grimes Flat west canal spills into the Ochoco Main Canal west of this point. The Ochoco main canal continues through the gap and spills into the Crooked River. There is also district telemetry at this point. Water also flows down Ochoco Creek to the Rye Grass Canal diversion. After the diversion Ochoco Creek flows into the Crooked River. The Rye grass canal spills into Lytle Creek to the Crooked River.

Prineville Reservoir releases flow down river and is diverted about river mile 10. The releases from the reservoir are measured by gauging station 140.80.500 and the water that is diverted is measured by gauging station 140 80 540. The Prineville Reservoir water is diverted to the Crooked River diversion canal. Water is diverted by pump for the Combs Flat canal. Water can be spilled into Ochoco Creek above the Rye grass canal diversion. Water crosses Ochoco Creek via an aqua duct and continues to the Barnes Butte pumping plant where the water is lifted to the Crooked River distribution canal. Crooked River distribution canal crosses McKay Creek and

continues to Lytle Creek. There are several lateral canals that feed off of the Crooked River Distribution Canal. Where CRDC spills or enters Lytle Creek there is district telemetry station. Lytle Creek eventually spills into the Crooked River.

Pump Plants

OID relies heavily on pumps to move water to canals and pipe lines in the district. A summary of the main pump plants is listed below.

| Name | Number of Units | Capacity (cfs) | Dynamic Head (ft) | Total Horsepower |
|----------------------|-----------------|----------------|-------------------|------------------|
| Barnes Butte (Main) | 5 | 147 | 82 | 1,800 |
| Ochoco Relift | 6 | 98 | 99 | 1,300 |
| Combs flat | 2 | 8 | 140 | 135 |
| Cox | 1 | 2 | 59 | 20 |
| Johnson Creek | 2 | 14.2 | 125 | 250 |
| Tunnel | 2 | 7.8 | 92 | 120 |
| Mckay Creek | 1 | 3 | 49 | 25 |
| Grimes Flat | 3 | 21 | 78 | 260 |
| Houston | 2 | 4 | 4 | 3 |
| Stahancyk No. 1 | 2 | 4 | 4 | 3 |
| Stahancyk No. 2 | 2 | 4 | 4 | 3 |

Operation and Maintenance Concerns

Aquatic weeds and moss become a big problem in the main canals during mid and late summer as water temperature increases. Moss and water weeds drastically reduce canal capacity and cause plugging of screens and trash racks and inlets to pumps. Maintenance time and materials cost to the district to control moss in the canals is a major concern. Moss must be controlled and/or removed, as it can cause canal to overflow if left uncontrolled. Both mechanical and chemical control methods are used. All chemical applications are in strict accordance with EPA requirements.

SECTION 2: WATER CONSERVATION ELEMENT

OAR 690-086-0250

SECTION 2.1: Progress Report on Previous Measures – OAR 690-086-0250(1)

The following table provides a list of water management or conservation projects that have been completed since the last WMCP was filed. The list is complete, but lacks quantitative descriptors of the projects such as cost, complete physical description (i.e. 600 feet of class 160 PVC pipe), reason for the project, and methods of evaluation. Over the next year OID will develop a format for this information and where practical will collect information about these completed projects. The same format will be used to describe future projects.

Removal of Check Board Diversion Dams and Installation of Fish Friendly Diversion Structures and Associated Water Conservation Structures on Ochoco and McKay Creeks

| Diversion Projects | Description |
|---------------------|---|
| Jones Dam | Installed siphon and automated fish screen. |
| Reynolds Dam | Installed siphon and automated regulating gate. |
| Battles Dam | Abandoned Dam, Installed pipeline from main canal. |
| Pine Products Dam | Installed siphon. |
| Smith Dam | Installed inverted weir and pump boxes. |
| Rye Grass Dam | Installed inverted weir and piping. |
| Slaughter House Dam | Abandoned dam infiltration gallery, installed piping. |
| Schnoor Dam | Abandoned dam infiltration gallery installed piping. |
| Breese Dam | Installed inverted weir, 2 pumps, and pump boxes. |
| Cook Dam | Installed inverted weir, piping, delivery boxes. |
| Red Granary Dam | Built new automated dam complete with fish ladder and screen. |

Open Canals and Laterals Converted to Pipe

| Piping Projects | Description |
|-------------------------------|---|
| Lanius Pipeline | Installed resulting in large water savings, reduced amount of ground in flood irrigation. |
| 301 Pipeline | Concrete changed to PCV, tight lined. |
| Breese Pipeline | Piped open lateral, added delivery box. |
| Battles Pipeline | Replaced Battles Dam. |
| Various Pipeline Replacements | Concrete to PVC, tight lined. |

Telemetry

| Location | Description |
|--|---|
| The Gap Telemetry | Real time flow measurement, sent directly to OID. |
| Lytle Creek Telemetry | Real time flow measurement, sent directly to OID. |
| Crooked River Telemetry-End of Crooked River Canal | Real time flow measurement, sent directly to OID. |
| Relift Alarm System | Alarm alerts OID Office of system failure. |
| Main Plant Alarm System | Alarm alerts OID Office of system failure. |

Canal Check Dams

| Location | Description |
|----------------------|-------------------|
| Ochoco Main Canal #3 | Rebuilt Check Dam |

Pumps

| Location | Description |
|-----------------------------|------------------------------------|
| Johnson Creek Pumping Plant | Installed variable frequency drive |

SECTION 2.2: District's Water Measurement Program - OAR 690-086-0250(2)

OID has a comprehensive flow measurement system. Diversion flow measurement and annual reporting to OWRD and BOR meet OAR 690 Division 85 requirements. All on-farm delivery points are also measured. Major flow measurement points are included on the district schematic. Location of these sites and the continuous recording devices used meets OAR 690 Division 85 requirements. The district has many other flow measurement sites at key locations within the district that are used for day to day operation and management purposes.

Reservoirs and Major Diversions

Stream flow is measured into Ochoco Reservoir on Mill Creek and Ochoco Creek and into the Prineville Reservoir on Crooked River. The elevation of the water in the reservoirs is measured and the capacity can then be computed. Output from the Prineville Reservoir is measured just below the Bowman Dam. The OID diversion on Crooked River is measured in the Crooked River Diversion Canal, down canal from the diversion site.

Releases from the Ochoco Reservoir are measured by summing the measurement of the flow of Ochoco Creek and Ochoco Feed Canal. Diversion flow measurements and annual reporting to WRD and BOR meet OAR 690, Division 85 requirements.

When available, water can be diverted from Johnson Creek, McKay Creek, Dry Creek, and Lytle Creek. These diversions flow into the Ochoco Main Canal, they are manually measured and smaller than the diversions on the Crooked River and Ochoco Creek. Inlets to Ochoco Feed and Crooked River Feed Canals are equipped with continuous recording data loggers and data is transmitted by telemetry facilities. The telemetry is transmitted through the BOR Hydromet System. OWRD Deschutes River basin watermaster monitors the same system as well as the information being recorded at each station. Where the schematic shows diversion sites, spills or

diversion into canals or laterals, these spots can also be measured. In addition there are many measure points throughout the distribution system.

OWRD Flow Measurement Sites Within the Crooked River Basin

| Location | Gage Number | Data Date |
|--------------------------------|-------------|-----------------------------|
| Crooked River near Post | 14079800 | 1961 – 1968, 1993 - present |
| Prineville Reservoir | 14080400 | 1961 - present |
| Crooked River below Bowman Dam | 14080500 | 1961 - present |
| Crooked River Diversion Canal | 14080590 | 1981 - present |
| Crooked River below OID | 14087300 | 1967 - 2004 |
| Mill Creek above Ochoco Dam | 14083400 | 1961 - present |
| Ochoco Reservoir | 14085100 | 1953 - present |
| Location | Gage Number | Data Date |
| Ochoco Main (Feed) Canal | 14085200 | 1953 - present |
| Ochoco Creek below Ochoco Dam | 14085300 | 1953 - present |
| Ochoco Creek above Ochoco Dam | 14082550 | 2000 - present |

Conveyance and Distribution Canals and Return Flows

The OID has automated gauging stations at critical points throughout the district. The readings from these gauging stations are available real time at the district office and to the ditch riders by cell phone. The district also has manual gauging stations throughout the district. These stations are located where water is diverted into lesser canals or laterals. Measurement is generally by flow meter or weir.

Return flows to the Crooked River are measured at the Gap and Lytle Creek. These measurements are made by the district’s telemetry stations. These flows are subtracted from the diversions and not counted against the district’s stored water allocation.

District Operated Measuring Sites

| Location | Description | System Type |
|---|---|-------------|
| The Gap | Main canal return flows | Telemetry |
| Lytle Creek | Main canal return flow into Lytle Creek | Telemetry |
| Crooked River Distribution Canal | Distribution canal return flow into Lytle Creek | Telemetry |
| McKay Creek Siphon/main canal | Main canal flow measurement | Telemetry |
| McKay Creek Siphon/Distribution canal | Distribution canal flow measurement | Telemetry |
| Main Canal and Tunnel Lateral | Diversion to Tunnel Canal | Manual |
| Main Canal Johnson Creek | Diversion to Johnson Creek lateral | Manual |
| Main Canal and Cox | Diversion to Cox Canal | Manual |
| Main Canal and West McKay | Diversion to West McKay Creek Canal | Manual |
| Main Canal and Grimes Flat | Diversion to Grimes Flat Canal | Manual |
| Diversion Canal at Relift Pump | Output of Relift Pump | Manual |
| Diversion Canal at Main Plant | Output of Main Plant | Manual |
| Ochoco Creek Rye Grass Canal | Diversion to Rye Grass Canal | Manual |
| Crooked River Diversion Canal to Ochoco Creek | Spill to Ochoco Creek | Manual |

Delivery for Farm Use

The ditch rider then adjusts the user's delivery outlet gate to meet the amount ordered. 90% of all deliveries are measured or estimated with standard devices. These include weirs, standard type flow meters, manufacturers' standard operating curve for center pivots, counting sprinkler heads, or calculating pump discharge knowing power usage. Totalizing flow meters are required to be installed by a user when a free flowing sharp crested weir cannot be used, i.e. delivery to areas upslope of the canal. The amount of water delivered to the users is recorded by the ditch rider each day. At the end of the week the ditch rider's daily water reports are turned into the office. A tabulation of the weekly usage for each irrigator is recorded and the amount subtracted from their seasonal allocation, thus determining the amount of water remaining for their use.

SECTION 2.3: Other Conservation Measures Currently Implemented - OAR 690-086-0250(3)

The district has a number of conservation measures that were identified and have been implemented under previous WMCPs. No additional conservation measures are being implemented at this time.

SECTION 2.4: District Goals for Improving Water Conservation and Management - OAR 690-086-0250(4)

It is recognized the pursuit of all of the following goals will be expensive and time consuming; however the district will pursue what they can physically and financially. The cumulative effect of all of these goals would improve district operations, water accountability, increase water conservation, and improve watershed enhancement in Ochoco Creek, Crooked River, and adjoining basins.

Overall goals include:

- To improve system water losses, improve water control, decrease seepage losses of canals, decrease O & M costs, and continue to improve water accountability.
- Implement technology to improve data collection and retrieval that will improve and reduce costs of district operations.

These following actions will be taken to fulfill these goals:

Immediate - Less than one year

- Continue with work to improve district maps and records. This includes water rights maps and data.
- Investigate and implement methods of keeping current paper records on computer spread sheets.

Short Term - 1-2 years

- Investigate and install additional telemetry that will improve water management.
- Continue to improve distribution system, based on district priority, by tight lining smaller open laterals and ditches.

Long Term - 2 – 10 years

- Continue support of the OSU soils moisture monitoring and irrigation scheduling program.
- Investigate and plan larger projects to main canals and implement if funding becomes available.
- Provide evaluation of potential pressurized and metered flow into subdivisions within the district.

SECTION 2.5: Improving Water Use Efficiency - OAR 690-086-0250(5)

Based on previous BOR studies on canal losses and seepage, OID has identified that the greatest opportunities to increase water use and efficiency is through reduction in operational spills and return spills. The following table provides a list of potential projects and cost estimates as provided by BOR in the April 1997 Report “Deschutes River Basin Project, Ochoco Division”. Projects will be reevaluated based on present day costs.

| | Estimated Total Costs (\$) | Annual Costs (\$) | Annual O & M Costs (\$) | Annual Water Savings (ac-ft) | Annual Cost per Ac-Ft Water Savings (\$ per ac-ft) |
|---|----------------------------|-------------------|-------------------------|------------------------------|--|
| Replace lateral N with pipe (also replace pump, at \$26,000 annual power savings) | 426,000 | 42,600 | 1,615 | 650 | 68 |
| Line lateral S | 15,930 | 1,590 | 640 | 50 | 45 |
| Line lateral R | 39,100 | 3,910 | 1,565 | 120 | 46 |
| Line lateral Z | 43,460 | 4,346 | 1,738 | 130 | 47 |
| Line lateral W | 268,560 | 26,850 | 10,740 | 730 | 51 |
| Line lateral Y | 146,300 | 14,630 | 5,850 | 360 | 57 |
| Line lateral L | 72,400 | 7,200 | 2,900 | 70 | 144 |
| Line Rye Grass Canal | 978,300 | 97,800 | 39,130 | 890 | 154 |
| Line lateral J | 653,100 | 65,300 | 26,100 | 590 | 155 |
| Line Highline Canal | 274,800 | 27,500 | 11,000 | 240 | 160 |
| Line Main Canal | 3,048,000 | 305,000 | 121,000 | 2,450 | 174 |
| Line lateral K | 29,000 | 2,900 | 1,200 | 20 | 205 |

Water deliveries at this time are sufficient to meet historic crop needs on average or better water years. The projects identified above will help increase efficiencies and address shortfalls in low water years.

SECTION 2.6: Evaluation of Water Conservation Projects - OAR 690-086-0250(6)

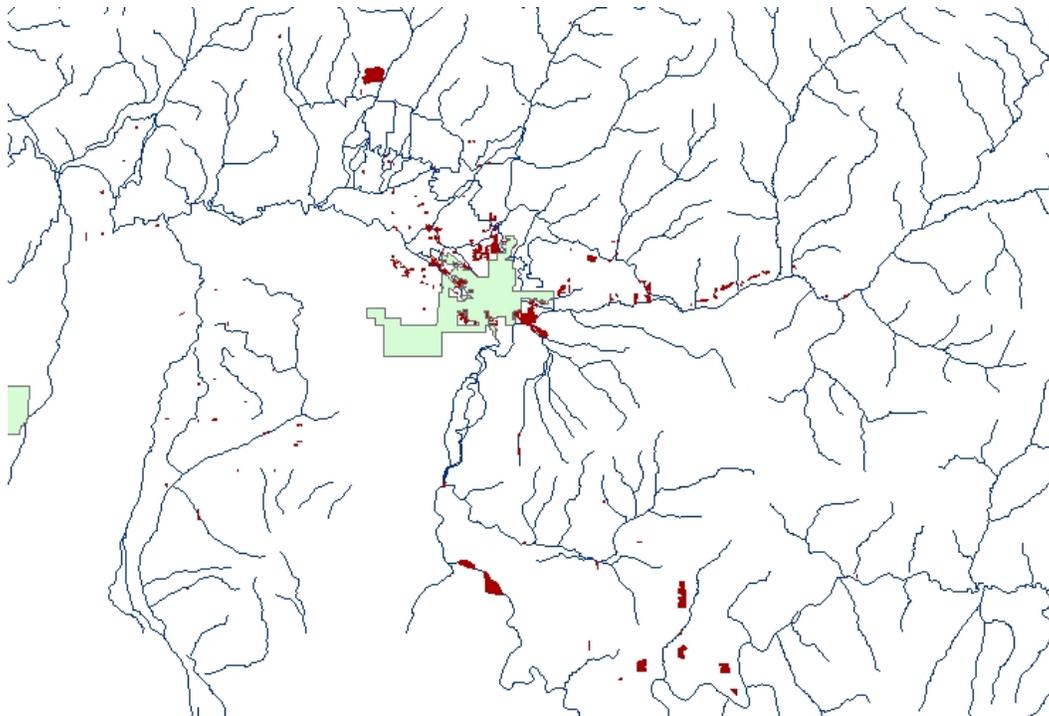
Promotion of energy audits

OID supports energy audits for water users. At this time there is not a formal energy audit program offered by Pacific Power and Light. These programs are administered through the Energy Trust of Oregon. The Energy Trust of Oregon has an ongoing program available. Energy Trust offers incentives for energy efficiency measures. The custom incentives reimburse a business for up to 15¢/annual kWh (or up to 26¢/annual kWh for municipal water/wastewater projects) or 50% of total project costs, whichever is less. The Energy Trust of Oregon also provides incentives throughout its service territory for cost-effective agricultural measures through the Production Efficiency Program. A description of these programs and the contact information will be supplied in an article in the district's annual newsletter.

Conversion to metered, pressured deliveries parcels one acre or less

OID will further study the option of metered, pressurized deliveries of parcels of one acre or less (see goals above). The district has already implemented grouped deliveries to subdivisions of any size. These deliveries are monitored for quantity at this time and most of them are pressurized from the point of delivery by the subdivision. There are 166 users with 1 acre or less. Half of these users are within subdivisions and delivered water at one point. Distribution of water is in pipe and in ditch. Where land is subdivided, the district secures a water delivery agreement. This insures a primary and secondary contact, single point delivery, pressurized systems within the subdivision, and provides the end user with an understanding of the quantity and timing of the delivery.

Tax lots one acre or less



Piping or lining earthen canals

Through the 1997 BOR study OID has identified and implemented lining and piping laterals. Section 2.1 describes projects completed to date. Section 2.5 identifies additional projects. The district will update cost estimates and pursue projects that are feasible and reasonable, as funding is available.

Modifying distribution facilities and district policies to increase the flexibility of water deliveries

OID has already implemented modification to distribution facilities as described elsewhere in this WMCP. District policies have also been modified to increase flexibility and efficiency of water deliveries. For example, the district has consolidated the delivery of subdivision water to a single point and will continue to do so with new subdivisions in the future.

Provision of on farm irrigation scheduling assistance

The district monitors patron water use. The amount of water delivered to the users is recorded by the ditch rider each day. At the end of the week the ditch rider's daily water reports are turned into the office. A tabulation of the weekly usage for each irrigator is recorded, and the amount subtracted from their seasonal allocation, thus determining the amount of water remaining for their use.

In addition to monitoring patron water use, the district will cooperate with OSU extension on an on-going basis to promote on farm irrigation scheduling through the district's newsletter and will make appropriate publications available at the district office.

Construction of re regulating reservoirs

OID has evaluated the potential for constructing re-regulating reservoirs in past studies. At that time the district found the costs of the projects too high compared to water savings benefits.

Adoption of rate structures that support and encourage water conservation

The district rate structure is already based on a cost per unit of delivered water. The district will continue review their O & M costs, rate structures and revenues as part of the annual budget process.

Each of the conservation measures listed in Section 2.5 above according to OAR 690-86-0240 (5)(c)

Projects to reduce losses from canals, pipelines, and laterals that were identified in Section 2.5 are being reviewed for current cost estimates. The district will be pursuing as funding is available those projects that are deemed appropriate and feasible.

Any other conservation measures identified by the water supplier that would improve water use efficiency

The district may explore a program the Energy Trust on the opportunity to exchange old, worn irrigation nozzles for new replacement nozzles free of charge. Worn nozzles may cause an irrigation system to deliver more water than necessary and consequently use more energy. The district will evaluate on an annual basis the feasibility of participation in Energy Trust custom incentives to upgrade some portion of the district's pumps. The maximum incentive is \$500,000 per site.

SECTION 2.7: Schedule for Implementation of the Projects - OAR 690-086-0250(7)

Information and outreach program

The district has been supplied examples of conservation materials by OWRD. OID will review these materials prior to the publication of the next district newsletter for inclusion of a list of appropriate materials available to patrons at low or no cost. The district will also review the concept of having these materials on hand at the district Office for staff and patrons.

Other conservation measures identified as feasible and appropriate

The district will evaluate on an annual basis the feasibility of participation in the programs listed in section 2.6.

SECTION 2.8: Program for Evaluations of Projects - OAR 690-086-0250(8)

Capitol improvement projects are likely to be done with cooperative funding partnerships from state and or federal agency programs. At the time of project funding the method of evaluation will be consistent with the funding agency's criteria.

SECTION 3: WATER ALLOCATION AND CURTAILMENT ELEMENT OAR 690-086-0260

SECTION 3.1: Frequency and Magnitude of Past Supply Deficiencies - OAR 690-086-0260(1)

The drought of 2001 was the most recent water supply deficiency. Others occurred in 1991, 1992 and 1994. In the early 1990s, single patron deliveries to subdivisions were discontinued. During these low water conditions, the district grouped the delivery of water to subdivisions. The practice of grouping these deliveries proved to be a cost effective conservation program that also eliminated distribution workload for non-drought circumstances and has been continued.

Past experience has shown that if the reservoirs do not have 50 % of capacity by the beginning of the irrigation season there is a high potential for supply deficiency during the irrigation season.

SECTION 3.2: Criteria for Implementation of Water Allocation/Curtailment Element - OAR 690-086-0260(2)

The three primary criteria that OID will use for triggering actions under its curtailment plan are:

1. Drought which would result in less than 50% of the reservoir capacity, particularly in Ochoco Reservoir.
2. Catastrophic damage to the reservoirs or main canals flood or seismic events.
3. Spills from truck or rail that would include chemicals that would damage crops.

SECTION 3.3: Procedure for Allocating Water During Shortages - OAR 690-086-0260(3)

The following priorities are applied by OID when allocating water during shortages:

1. Share in shortage equally if possible.
2. Work with patrons to group irrigators to make the most of each run on laterals.

The District uses the following procedures when allocating water:

Drought: Rotations may be based on patron cropping. The district will consult with OSU Extension Services to see if storage/available supply can be prioritized for critical stages of crop need.

Catastrophic Damage: The district manager is authorized to contact media to alert patrons of possible supply or safety issues.

Media Contacts (as listed in the Oregon Blue Book):

KLTW-FM (95.1), Soft Adult Contemporary;

KWLZ-FM (96.5), Classic Rock

854 NE 4th, Bend 97701; 541-383-3825; Fax: 541-383-3403; Keith Shipman

KRCO-AM (690), Classic Country

PO Box 690, Prineville 97754; 541-447-6770; Fax: 541-383-3403; Keith Shipman

KRDM-AM (1240), Spanish

1514 SW Highland Ave., Suite A, Redmond 97756; 541-548-7621; Fax: 541-504-8145; Juan Zendejas

Central Oregonian

558 N Main St., Prineville 97754; 541-447-6205

SECTION 4: WATER SUPPLY ELEMENT

OAR 690-086-0270

SECTION 4.1: Long Range Water Demand Projections - OAR 690-086-0270(1)

OID will continue to investigate various sources of accurate information on events that effect crop water use or water supply. With respect to population changes and water demand, Central Oregon in general is one of the fastest growing portions of the state (source Oregon Economic and Community Development Department). Since 1990, Crook County has grown in population from approximately 14,000 to 24,000 people. The City of Prineville has grown from approximately 5,400 to nearly 10,000. However, the urban influence and conversion of agricultural lands to urban uses near Prineville is not expected to be as strong as that experienced by districts nearer to Bend and Redmond. Developments such as the new Department of Corrections facility near Madras may influence other economic development and result in urban expansion into the district. OID continues to monitor these trends but does not anticipate needing significant additional water supplies. As a result of urbanization in the Prineville area, the district is working to preserve agricultural lands by transferring water rights from lands as they are developed to other lands. In conjunction with these transfers, the district will explore alternatives for modification of the district boundary.

SECTION 4.2: Projected Water Needs and Size and Reliability of Water Rights Permits and Contracts - OAR 690-086-0270(2)

OID anticipates that agricultural demand for water will remain relatively constant during the next 20 years. Urbanization may result in modest changes in water demands. However, the effect of these changes on the district's available water supply is not expected to be significant and can be accommodated within the district's water rights.

SECTION 4.3: Potential Water Sources - OAR 690-086-0270(3)

The district will investigate other sources of water. Water stored by the BOR in Prineville Reservoir provides a potential source of additional water if new water requirements are larger than anticipated. However at this time the district's infrastructure cannot adequately distribute more water from that source.

The district is monitoring water demands and will work with the landowners to improve water use efficiency if water demands increase as a result of land divisions. In addition, the district will evaluate whether infrastructure improvements are needed to improve the efficiency of deliveries or to convey additional supplies.

SECTION 4.4: Comparison of Potential Water Sources - OAR 690-086-0270(4)

No evaluation of additional sources of water has been done at this time. There is still approximately 50% of the federal storage in Prineville Reservoir available for contracts. Any new uses of ground water in the upper Deschutes Basin would need to be mitigated to protect flows in the Deschutes River Scenic Waterway.

SECTION 4.5: Evaluation of the Effects of Long Range Water Needs - OAR 690-086-0270(5)

1. OID has not investigated options outside of either the Ochoco Watershed or the Crooked River Watershed. Within the ten-year planning period of this WMCP, it is expected that water service contracts with the BOR will meet current and future needs.
2. Urbanization of lands within the district is an issue, but so far not a major problem. However the District is working with the County on issues to make sure that all deliveries can be maintained. The District attempts to insure that delivery easements are recorded for each new partition or plat.
3. Other land use trends that affect the district are large farms being split up into smaller units. These units still may be of a large size (100 acres). However more water deliveries need to be made. This results in higher overhead for the district. In subdivision of land the District secures a water delivery agreement. This insures a primary and secondary contact, single point delivery pressurized systems within the subdivision and provides the end user with an understanding of the quantity and timing of the delivery.

SECTION 5: ADDITIONAL REQUIREMENTS

OAR 690-086-0225

SECTION 5.1: List of Affected Governments, Copy of Comments - OAR 690-086-0225(5)

At least 30 days prior to submitting a draft plan to OWRD, each agricultural water supplier must make the draft plan available for review by each affected local government.

Consistent with these rules, OID provided the draft plan to Crook County and the City of Prineville for review 30 days prior to submitting a draft plan to OWRD. As a courtesy, the district also included North Unit Irrigation District and the local office of the BOR.

SECTION 5.2: Submittal of Updated Plan, Implementation Schedule - OAR 690-086-0225(6)

The primary implementation activities identified in this WMCP involve capital improvement projects which can take significant time to implement given funding constraints and construction timelines. With respect to available current supplies, the district can generally meet existing needs and does not anticipate significant impacts from urbanization over the next ten years. For these reasons, OID proposes to update the WMCP in ten years. An updated plan will be submitted to WRD by December 31, 2017.

SECTION 6: BACKGROUND INFORMATION

History of District

As early as 1905, plans were made to irrigate the Ochoco Valley, however because of difficulty in obtaining financing, the proposed project did not materialize until 1916 when OID was organized. Several cooperative studies on proposed reservoirs sites and reports prepared by US Reclamation Service and the State of Oregon, were developed during the period of 1914 – 1916. The test pits in the foundations of the proposed sites were excavated using pick and shovel. Feasibility was established and construction by either the US Reclamation Service or State of Oregon was recommended. The lands comprising the project were used as a nucleus for the formation of the OID under the laws of the State of Oregon, at the time authorization and construction by the BOR was considered remote.

Immediately after World War I, as a part of the Veterans Farm Settlement Program by the State of Oregon, authorization was granted to construct Ochoco Dam on Ochoco Creek 5.5 miles east of the City of Prineville. The dam was constructed during the period from 1918 to 1921 using private capital. Permit No. R-528, was issued by the State of Oregon to allow the construction of Ochoco Dam and storage of the waters in Ochoco Reservoir for irrigation purposes. Twenty two thousand (22,000) acres were to be irrigated by the water stored behind Ochoco Dam.

In 1929 and 1930, the OID was near bankruptcy. The farmers could not pay their water assessment due to crop losses as a result of water shortages and low crop and livestock prices. The water shortages were due to inadequate runoff, excessive leakage around the north end of dam, excessive canal seepage and breaks in the canals. 1930 was one of the driest years on record resulting in extremely low runoff into Ochoco Reservoir, with farm delivery of 0.15 ac-ft/acre. The dry years, along with financial difficulties experienced by the growers, forced the District to be re-organized in 1935. With re-organization, total acres to be irrigated were reduced to 8,500.

To increase the reliability of the district's water supply and the amount of land that could be irrigated, authorization was sought for the construction of the Prineville Dam on the Crooked River. The Crooked River Project was authorized by the 84th Congress on August 6, 1956, and construction of Prineville Dam began in November, 1958, and was dedicated as Prineville Dam and Reservoir on October 20, 1962. The reservoir has a storage capacity of 155,000 ac-ft. OID purchased 52,600 ac-ft of storage space for irrigation. An additional 7,000 ac-ft of storage was purchased from the uncommitted storage space provided for under the original authorization Act bringing the total storage space to 59,600 ac-ft. The construction of Prineville Dam on Crooked River made it possible for the District to increase the irrigated land to a total of 20,000 acres.

The Certificate of Water Right for the district issued by the State establishes that the flow rate shall be limited to one-fortieth of one cfs per acre, or it's equivalent for each acre irrigated, and shall be further limited to a diversion of not to exceed 4.0 ac-ft per acre for each acre irrigated. The District now has a total of 20,150 irrigated acres and stores 600 ac-ft for industrial use. There are a total of 750 water users within OID with 571 users with acreage of 25 acres and less. Also, there are 166 users with acreage of 1.0 acre and less. Approximately 2/3 of these are in small parcel subdivisions and 1/3 are scattered throughout the District. Approximately half of the

small parcel subdivisions are delivered water at one point. Water is distributed both in pipelines and open ditch.

Climate

Climate in the Ochoco Valley is influenced by Pacific Ocean air masses moving eastward over the Cascade Range located 50 miles to the west. Precipitation, which is mainly derived from the easterly movement of low pressure systems originating in the North Pacific in winter is accordingly low, thus a dry, semi-arid type of climate results.

Climate in the area is characterized by low annual precipitation, moderate to high temperatures, and a reasonably good growing season. Two weather stations provide data. One near Prineville at the radio station (official US Weather Service station), and one at the OSU Experiment Station (“Grimed” weather station location) located about 5 miles west of Prineville in the Powell Butte area.

Average annual precipitation is about 9 inches, with only about 1.1 inches falling during the months of June, July and August. Fall rains typically begin in October, with snow during November, December, January and February in varied amounts. Rains again occur in March, April and May. Thunderstorms occurring during the summer months are often accompanied by heavy rains and lightning. However, these storms are infrequent, brief, and with typically narrow storm paths, thus preventing any significant amounts of overall soil moisture. Many times the lightning is unaccompanied by rain. July temperature averages 66° F with an average annual growing season of 105 +/- days. Normal maximum daily temperatures in July and August are typically +/- 90° F, with a few days exceeding 100° F. However, it is not uncommon to experience frost in May and September.

Soils

Soils are generally light colored loam or sandy loam containing small quantities of gravel or pebbles. They are low in organic matter content, slightly alkaline and slightly calcareous. Drainage is, for the most part, satisfactory, except for small areas adjacent to Crooked River. Substrata are usually partially consolidated gravelly materials. Most of the soils are of good quality, suitable for all climatically adapted crops.

Soils have been mapped by NRCS (formerly SCS) and Oregon State University (OSU), with a published report and maps available in NRCS office in Redmond, or online at the NRCS website.

Water Resources Department Agricultural WMCP Review Worksheet

| | |
|-----------|--|
| Supplier: | |
| Reviewer: | |
| Date: | |

| OAR 690-086-0240 – System Description | |
|--|--|
| (1) General location of water right acreage, numbers of the associated water right certificates and permits and a description of relevant conditions of the water rights including the seasons of use and the uses of any other permitted withdrawals by the supplier; | |
| (2) Source(s) of water; storage and regulation facilities; and a summary of any transfer, rotation, exchange or intergovernmental cooperation agreements; | |
| (3) A schematic of the system showing storage and distribution facilities, drainage systems, measurement stations, generalized district boundaries, points of diversion and locations of major operational spills; | |
| (4) Current water use, including peak and average annual diversions and, when available, water reuse and return flows; | |
| (5) A summary of major classifications of user accounts showing water right acreages, the number of accounts of each classification, and the beneficial uses for which water is provided (irrigation, frost protection, temperature control, agricultural use, livestock, domestic, etc.); | |
| (6) Types of on-farm irrigation systems common within the supplier's accounts; | |
| (7) A general characterization of crops commonly grown and the estimated average and peak consumptive use of the crops; and | |
| (8) A description of the operation and maintenance program. | |

OAR 690-086-0250 – Water Conservation Element

| | |
|--|--|
| (1) A progress report on the conservation measures scheduled for implementation in the water management and conservation plan previously approved by the Department, if any; | |
| (2) A description of the water supplier's agricultural water measurement program and a statement that the program complies with the measurement and reporting standards in OAR 690, Division 85, that a time extension or waiver has been granted, or that the standards are not applicable; | |
| (3) A description of other conservation measures currently implemented by the water supplier; | |
| (4) Short- and long-term goals of the water supplier to improve water management; | |
| (5) An evaluation of the opportunities for improving water use efficiency which includes: | |
| (a) A description of losses of water from canals, pipelines, and laterals, including any operational spills; | |
| (b) An assessment of the extent to which water deliveries are insufficient to meet crop needs; | |
| (c) A list of alternative conservation measures to reduce the losses of water identified in (a) of this subsection and address any insufficiencies of water deliveries identified in (b); and | |
| (d) An assessment of existing and future alternatives to finance conservation measures including an analysis of the possibility of applying for the allocation of conserved water (OAR 690-018-0010 to OAR 690-018-0090). | |
| (6) For each of the following conservation measures not currently being implemented, an evaluation of whether implementation of the measure is feasible and appropriate for ensuring the efficient use of water and the prevention of waste: | |
| (a) Promotion of energy audits offered through local electric utilities for district water users; | |
| (b) Conversion to metered, pressurized deliveries to all parcels of one acre or less; | |

| | |
|---|--|
| (c) Piping or lining earthen canals; | |
| (d) Modifying distribution facilities and district policies to increase the flexibility of water deliveries; | |
| (e) Provision of on-farm irrigation scheduling assistance; | |
| (f) Construction of re-regulating reservoirs; | |
| (g) Adoption of rate structures that support and encourage water conservation; | |
| (h) Each of the conservation measures listed in (5)(c);and any other conservation measures identified by the water supplier that would improve water use efficiency; and | |
| (i) Any other conservation measures identified by the water supplier that would improve water use efficiency. | |
| (7) A description and estimated schedule for implementation of each of the following conservation measures: | |
| (a) An information and education program aimed at improving the efficiency of use of water delivered. The program should address all types of uses served and include voluntary water use audits; and | |
| (b) Any other conservation measures identified as feasible and appropriate under (6). | |
| (8) A program to monitor and evaluate the effectiveness of the conservation measures which are implemented. | |
| OAR 690-086-0260 – Water Allocation/Curtailment Element | |
| (1) A description of the frequency and magnitude of past supply deficiencies and current capacity limitation. The description shall include an assessment of the ability of the water supplier to maintain delivery during drought or other source shortages. | |

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| (2) A description of the water supply situation(s) that cause the water allocation/curtailment element to be implemented, including identification of the supply situations which trigger warnings to users or public notice of impending shortage; and | |
| (3) A description of the procedure used to allocate water during water shortages. | |
| OAR 690-086-0270 – Water Supply Element | |
| (1) An estimate of the water supplier's long-range water demand projections for 20 years; | |
| (2) A comparison of the projected water needs and the size and reliability of water rights permits or other current water supply contracts held by the water supplier; | |
| (3) A list of potential sources of water, including conservation and reuse, to supply the long-range needs; | |
| (4) A comparison among the potential sources of additional water considering costs, availability, reliability, and likely environmental impacts; | |
| (5) An evaluation of the effects of the following factors on long-range water needs: | |
| (a) Regional options for meeting future water needs; | |
| (b) Urbanization and other land-use trends; | |
| (c) Provisions in affected local governments' comprehensive plans relating to agricultural lands, urbanization, water resources, water supply, public facilities and services, and any other pertinent plan element or ordinance relating to uses or lands served, or proposed to be served, under the long-term water supply plan. | |
| OAR 690-086-0225 – Additional Requirements | |
| (5) A list of the affected local governments to whom the plan water made available pursuant to OAR 690-086-0220 (6) and a copy of any comments on the plan provided by the local governments. | |

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| <p>(6) A proposed date for submittal of an updated water management and conservation plan based on the proposed schedule for implementation of conservation measures, any relevant schedules for other community planning activities, and the rate of growth of or other changes expected by the water supplier; or an explanation of why submittal of an updated plan is unnecessary and should not be required by the Department.</p> | |
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December 3, 2003 - dp

Oregon Administrative Rules Chapter 690, Division 86 Water Management and Conservation Plans

690-086-0010

Purpose

(1) The Water Resources Commission has adopted a statewide policy on Conservation and Efficient Water Use (OAR 690-410-0060). The policy requires major water users and suppliers to prepare water management and conservation plans. These rules provide a process to ensure the efficient use of the state's water resources and to facilitate water supply planning consistent with water supplier and Department capabilities. The Commission shall evaluate implementation of these rules within three years and every three years thereafter.

(2) Many regions of Oregon face periodic and increasingly frequent water shortages during summer periods. Urbanization is resulting in a continually expanding need for municipal water supplies. In addition, many communities are faced with the need to reduce their impacts on the resource in response to state or federal listings of stream-flow dependant species as sensitive, threatened or endangered, water quality problem, and other flow issues. It is increasingly important to the state's economy to maintain adequate stream flows to support aquatic life, provide recreational opportunities and maintain water quality. The continued implementation of conservation measures can help restore streamflows, stabilize water supplies and provide for future needs for economic development and growth.

(3) Pursuant to ORS 540.610(3) the use of water at a rate or duty which is less than the maximum amount allowed under a water right that is achieved through improved water

management practices is not a forfeiture under certain circumstances. However, conserved water may only be used on additional acres or for other purposes not included in the original right after allocation of conserved water under ORS 537.455 to 537.500 or under other specific statutory authorizations.

(4) Effective water management requires an evaluation of the adequacy of water supplies to meet current and future needs, identification of planned modifications in water systems, and development of new water supplies. However, the approval of a water management and conservation plan shall not substitute for compliance with Statewide Planning Goals or any other comprehensive land use planning requirement or constitute approval of applications for water rights, water reservations, water storage facilities, transfers, permit amendments, or extensions of time for permits.

(5) Water management and conservation plans will provide information important in water resources planning and management. In addition, the plans may provide support for applications for water use permits and water right transfers, permit amendments, and requests for extensions of permits, approvals of exchanges, and reservations of water. Due regard shall be given to any relevant approved water management and conservation plans during Department consideration of these applications and requests.

(6) Regional cooperation will improve water management and help to facilitate implementation of conservation measures. Water suppliers required under OAR 690-086-0010 to 690-086-0920 to prepare water

management and conservation plans, and any other suppliers or users, may jointly submit a single plan that addresses the suppliers' conservation opportunities and water development needs.

(7) A water management and conservation plan that has been approved under these rules may, at the option of the water supplier, be used to satisfy a condition requiring preparation of a conservation plan in an emergency use permit issued pursuant to OAR 690-019-0040 and a requirement for submittal of a curtailment plan in times of a declared or likely drought under an order issued pursuant to ORS 536.780 and OAR 690-019-0090.

(8) Many water use permits that have been issued to water suppliers include conditions requiring preparation of water conservation, long-term water supply, and other water management plans. These rules provide standards for the preparation of such plans. Unless other more specific or stringent requirements are included in a permit, water management and conservation plans that have been approved under OAR 690-086-0915 shall be deemed to meet the permit condition.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02

Definitions

690-086-0020

General Definitions

As used in OAR 690-086-0010 to 690-086-0920:

(1) "Affected local governments" means any local government as defined in OAR 690-005-0015, within whose jurisdiction the diversion, conveyance, or use of water is

established or proposed within the context of the water management and conservation plan.

(2) "Commission" means the Water Resources Commission.

(3) "Conservation" has the meaning provided in OAR 690-400-0010.

NOTE: OAR 690-400-0010(5) defines conservation as eliminating waste or otherwise improving efficiency in the use of water while satisfying beneficial uses by modifying the technology or method for diverting, transporting, applying or recovering the water; by changing management of water use; or by implementing other measures.

(4) "Department" means the Water Resources Department.

(5) "Director" means the Director of the Water Resources Department or designee.

(6) "Waste" has the meaning provided in OAR 690-400-0010.

NOTE: OAR 690-400-0010(16) defines waste as the continued use of more water than is needed to satisfy the specific beneficial uses for which a right was granted. The need for water shall be based on using the technology and management practices that provide for the efficient use of water considering:

- (a) The economic feasibility of use of the technology and management practices by the water user;
- (b) The environmental impacts of making modifications;
- (c) The available proven technology;
- (d) The time needed to make modifications;
- (e) Local variations in soil type and weather; and
- (f) Relevant water management plans and subbasin conservation plans.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02

690-086-0030

Definitions for Municipal Water Suppliers

As used in OAR 690-086-0100 to 690-086-0170 and 690-086-0900 to 690-086-0920:

(1) “Authorized water uses” means all water uses known and approved by a municipal water supplier. These uses include all metered uses and any other approved uses such as fire-fighting, fire training, system operation needs, reuse, or miscellaneous uses.

(2) “Benchmark” means the specific incremental activities that a municipal water supplier plans to have completed in implementing conservation measures.

(3) “Extended permit” means a municipal or quasi-municipal water use permit conditioned by an extension order under OAR chapter 690, division 315 or 320 to provide that diversion of water beyond the maximum rate diverted under the permit or previous extension(s) shall only be authorized upon issuance of a final order approving a water management and conservation plan.

(4) “Low water use landscaping” means conserving water through designing landscapes for low water use, irrigating efficiently, improving soil and planting low water use plants.

(5) “Metering” means using water meters or other continuous recording devices to measure and to maintain a record of all water diverted and delivered.

(6) “Municipal water supplier” means a publicly or privately owned water distribution system that delivers potable water for community needs, either to individual customers or another distribution system, or that delivers water primarily for commercial or industrial uses.

(7) “System leak detection” means a program to monitor leakage throughout the transmission and distribution systems of a municipal water supplier.

(8) “System leakage” means all water that is lost from a municipal water supply system, not including major breaks that are

expeditiously repaired, and un-metered authorized or unauthorized uses.

(9) “Water audit” means an analysis of a municipal water supply system that includes a thorough accounting of all water into and out of the system to identify system leakage and metered or estimated use for authorized and unauthorized water uses. The audit also includes an analysis of the water supplier's own water use to identify alternatives to increase efficiency.

(10) “Water curtailment element” means a program to accomplish a specific reduction in the amount of water used or lost within a specific time in response to an emergency or other short-term shortage.

(11) “Water service connections” means water supply connections to the water delivery system, including the water supplier's own connections, but does not include connections for uses such as fire hydrants, fire sprinkler systems with flow alarms or detector-checks, water line blow-offs and drains, stand-by emergency interties, valve controlled drinking fountains or other similar intermittently used equipment or facilities.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02, Renumbered from 690-086-0110

690-086-0040 Definitions for Agricultural Water Suppliers

As used in OAR 690-086-0210 to 690-086-0920:

(1) “Agricultural water supplier” means any public or private organization, including but not limited to an irrigation district formed under ORS Chapter 545, a drainage district formed under ORS Chapter 547, a water improvement district formed under ORS

Chapter 552, a water control district formed under ORS Chapter 553, a corporation organized under ORS Chapter 554, an unincorporated private association or a ditch company, the primary purpose of which is to supply water to others for agricultural uses.

(2) “Agricultural water measurement” means using measuring devices, including but not limited to weirs, flumes, submerged orifices, gaging stations, and meters, to quantify the rate of flow and the volume of water in a water delivery system.

(3) “Water allocation/curtailment element” means a program to equitably allocate, under existing priorities, a reduced water supply among the water right holders dependent on the supply in response to an emergency or other short-term shortage.

Stat. Auth.: ORS 536.027, 537.211 and 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02, Renumbered from 690-086-0210

Municipal Water Management and Conservation Plans

690-086-0100 Applicability

(1) Municipal water suppliers are encouraged to prepare water management and conservation plans, but are not required to do so unless a plan is prescribed by a condition of a water use permit; a permit extension; or another order or rule of the Commission.

(2) Water management and conservation plans submitted in order to comply with a permit extension order issued after November 1, 2002, are subject to the requirements of these rules.

(3) Until November 1, 2003, water management and conservation plans submitted for purposes other than to comply with a permit extension order issued after the effective date of these rules shall be reviewed under OAR chapter 690, division 86 adopted by the Commission in 1994, unless the water supplier requests the Department to apply the standards in these rules. After November 1, 2003, all new and updated water management and conservation plans are subject to these rules.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 4 2002, f. & cert. ef. 11-1-02

690-086-0110 [Renumbered to 690-086-0030]

690-086-0120 General Provisions

(1) Each municipal water supplier required to submit a water management and conservation plan shall exercise diligence in implementing the approved plan and shall update and resubmit a plan consistent with the requirements of these rules as prescribed during plan approval.

(2) Benchmarks and implementation schedules for conservation measures and other water supply development activities may be modified through the subsequent approval of an updated plan.

(3) Progress reports submitted by municipal water suppliers will be used in determining whether five-year benchmarks are being met, whether the Department will authorize additional diversion of water under extended permits, and/or if schedule changes proposed in updated plans are reasonable and appropriate.

(4) Progress reports submitted by municipal water suppliers shall include:

(a) A list of the benchmarks established under OAR 690-086-0150 and a description of the progress of the municipal water supplier in implementing the associated conservation or other measure;

(b) Average monthly and daily diversions under each right held by the water supplier for the previous five years;

(c) A description of the results of the annual water audit required under OAR 690-086-0150(4)(a); and

(d) A comparison of quantities of water used in each sector as identified and described in OAR 690-086-0140(6) with the quantities of water used in each sector for the previous five years.

(5) Upon receipt of a progress report the Department shall give public notice in the weekly notice published by the Department and provide an opportunity for written public comment. The Department shall provide copies of any comments received to the municipal water supplier.

(6) A master plan prepared under the requirements of the Department of Human Resources Health Division or the water supply element of a public facilities plan prepared under the requirements of the Department of Land Conservation and Development which substantially meets the requirements of OAR 690-086-0125 to 690-086-0170 may be submitted to meet the requirements of these rules.

(7) In the development of a water management and conservation plan, each municipal water supplier shall consult with the planning departments or appropriate officials of affected local governments to obtain information related to demand projections in comprehensive land use plans early in the development of the plan.

(8) At least 30 days prior to submitting a draft plan to the Department, a municipal water supplier shall make the draft plan available for review by each affected local government along with a request for comments relating to consistency with the local government's comprehensive land use plan.

(9) Each municipal water supplier preparing a water management and conservation plan is encouraged to develop and implement a program to involve the supplier's customers in the preparation of the plan. Recommendations include making the plan available for public inspection and conducting public meetings to provide information and gather input on the plan.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02

690-086-0125 Municipal Water Supplier Plan Elements

A water management and conservation plan submitted by a municipal water supplier shall include:

(1) A municipal water supplier description as described under OAR 690-086-0140;

(2) A municipal water conservation element as described under OAR 690-086-0150;

(3) A municipal water curtailment element as described under OAR 690-086-0160;

(4) A municipal water supply element as described under OAR 690-086-0170;

(5) A list of the affected local governments to whom the draft plan was made available pursuant to OAR 690-086-0120(6) and a copy of any comments on the plan provided by the local governments;

(6) A proposed date for submittal of an updated plan within no more than 10 years based on the proposed schedule for implementation of conservation measures, any relevant schedules for other community planning activities, and the rate of growth or other changes expected by the water supplier; or an explanation of why submittal of an updated plan is unnecessary and should not be required by the Department; and

(7) If the municipal water supplier is requesting additional time to implement metering as required under OAR 690-086-0150(4)(b) or a benchmark established in a previously approved plan, documentation showing additional time is necessary to avoid unreasonable and excessive costs.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 4 2002, f. & cert. ef. 11-1-02

690-086-0130 Criteria for Approval of a Plan Submitted by a Municipal Water Supplier

In order to approve a plan by a municipal water supplier under OAR 690-086-0915, the Department must find that:

(1) The plan includes each of the required elements under OAR 690-086-0125;

(2) The projections of future water need in the water management and conservation plan are reasonable and consistent with available land use plans and the municipal water supplier has demonstrated a need for the quantity of water to be diverted during the next 20 years under each permit held by the supplier;

(3) For each of the water conservation measures required under OAR 690-086-0150(4) and, as applicable, OAR 690-086-0150(5), the plan includes a reasonable and appropriate schedule with five year

benchmarks for implementation of conservation activities;

(4) If applicable, for each of the water conservation measures required under OAR 690-086-0150(6), the plan includes:

(a) A reasonable and appropriate schedule with five year benchmarks for implementation of conservation activities; or

(b) Documentation to demonstrate that implementation of the measure is neither feasible nor appropriate to ensure efficient use of water and the prevention of waste and the supplier has used a suitable methodology in evaluating the measure;

(5) The identification of resource issues under OAR 690-086-0140(5)(i) is accurate and complete;

(6) The water curtailment element required under OAR 690-086-0160 satisfactorily promotes water curtailment practices and the coordination of usage regulation, taking into account state water law and local conditions, or is substantially the same as a curtailment plan prepared pursuant to ORS 536.780 and OAR 690-019-0090 and approved by the Department within the previous five years;

(7) If during the next 20 years the maximum rate of water diverted under an extended permit will be greater than the maximum rate authorized for diversion under the extension or previously approved water management and conservation plan;

(a) The plan includes a schedule for development of any conservation measures that would provide water at a cost that is equal to or lower than the cost of other identified sources, unless the supplier has provided sufficient justification for the factors used in selecting other sources for development or the supplier serves a population of less than 1,000;

(b) Increased use from the source is the most feasible and appropriate water supply alternative available to the supplier; and

(c) If mitigation is legally required to address limitations or restrictions on the development of permits for which resource issues are identified under OAR 690-086-0140(5)(i), the plan contains documentation that the supplier is complying with the mitigation requirements. The Department may consult with federal and state agencies in making this determination; and

(8) After January 1, 2042, for review of water management and conservation plans that propose to increase the maximum rate of water diverted under an extended permit that the additional diversion of water will not impair or be detrimental to the public interest.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 4 2002, f. & cert. ef. 11-1-02

690-086-0140 Municipal Water Supplier Description

The water supplier description element shall include at least the following information:

(1) A description of the supplier's source(s) of water; including diversion, storage and regulation facilities; exchange agreements; intergovernmental cooperation agreements; and water supply or delivery contracts;

(2) A delineation of the current service areas and an estimate of the population served and a description of the methodology(ies) used to make the estimate;

(3) An assessment of the adequacy and reliability of the existing water supply considering potential limitations on continued or expanded use under existing water rights

resulting from existing and potential future restrictions on the community's water supply;

(4) A quantification of the water delivered by the water supplier that identifies current and available historic average annual water use, peak seasonal use, and average and peak day use;

(5) A tabular list of water rights held by the municipal water supplier that includes the following information:

(a) Application, permit, transfer, and certificate numbers (as applicable);

(b) Priority date(s);

(c) Source(s) of water;

(d) Type(s) of beneficial uses specified in the right;

(e) Maximum instantaneous and annual quantity of water allowed under each right;

(f) Maximum instantaneous and annual quantity of water diverted under each right to date;

(g) Average monthly and daily diversions under each right for the previous year, and if available for the previous five years;

(h) Currently authorized date for completion of development under each right; and

(i) Identification of any streamflow-dependent species listed by a state or federal agency as sensitive, threatened or endangered that are present in the source, any listing of the source as water quality limited and the water quality parameters for which the source was listed, and any designation of the source as being in a critical ground water area.

(6) A description of customers served including other water suppliers and the estimated numbers; general water use characteristics of residences, commercial and

industrial facilities, and any other uses; and a comparison of the quantities of water used in each sector with the quantities reported in the water supplier's previously submitted water management and conservation plan and progress reports;

(7) Identification and description of interconnections with other municipal supply systems;

(8) A schematic of the system that shows the sources of water, storage facilities, treatment facilities, major transmission and distribution lines, pump stations, interconnections with other municipal supply systems, and the existing and planned future service area; and

(9) A quantification and description of system leakage that includes any available information regarding the locations of significant losses.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02

690-086-0150 Municipal Water Conservation Element

The water conservation element shall include at least the following:

- (1) A progress report on the conservation measures scheduled for implementation in a water management and conservation plan previously approved by the Department, if any;
- (2) A description of the water supplier's water use measurement and reporting program and a statement that the program complies with the measurement standards in OAR chapter 690, division 85, that a time extension or waiver has been granted, or that the standards are not applicable;

(3) A description of other conservation measures, if any, currently implemented by the water supplier, including any measures required under water supply contracts;

(4) A description of the specific activities, along with a schedule that establishes five-year benchmarks, for implementation of each of the following conservation measures that are required of all municipal water suppliers:

(a) An annual water audit that includes a systematic and documented methodology for estimating any un-metered authorized and unauthorized uses;

(b) If the system is not fully metered, a program to install meters on all un-metered water service connections. The program shall start immediately after the plan is approved and shall identify the number of meters to be installed each year with full metering completed within five years of approval of the water management and conservation plan;

(c) A meter testing and maintenance program;

(d) A rate structure under which customers' bills are based, at least in part, on the quantity of water metered at the service connections;

(e) If the annual water audit indicates that system leakage exceeds 10 percent, a regularly scheduled and systematic program to detect leaks in the transmission and distribution system using methods and technology appropriate to the size and capabilities of the municipal water supplier; and

(f) A public education program to encourage efficient water use and the use of low water use landscaping that includes regular communication of the supplier's water conservation activities and schedule to customers;

(5) If the municipal water supplier proposes to expand or initiate diversion of water under an

extended permit for which resource issues have been identified under OAR 690-086-0140(5)(i), a description of the specific activities, along with a schedule that establishes five-year benchmarks, for implementation of a system-wide leak repair or line replacement program to reduce system leakage to no more than 15 percent or sufficient information to demonstrate that system leakage currently is no more than 15 percent.

(6) If the municipal water supplier serves a population greater than 1,000 and proposes to expand or initiate diversion of water under an extended permit for which resource issues have been identified under OAR 690-086-0140(5)(i), or if the municipal water supplier serves a population greater than 7,500, a description of the specific activities, along with a schedule that establishes five-year benchmarks, for implementation of each of the following measures; or documentation showing that implementation of the measures is neither feasible nor appropriate for ensuring the efficient use of water and the prevention of waste:

(a) A system-wide leak repair program or line replacement to reduce system leakage to 15 percent, and if the reduction of system leakage to 15 percent is found to be feasible and appropriate, to reduce system leakage to 10 percent;

(b) Technical and financial assistance programs to encourage and aid residential, commercial and industrial customers in implementation of conservation measures;

(c) Supplier financed retrofitting or replacement of existing inefficient water using fixtures, including distribution of residential conservation kits and rebates for customer investments in water conservation;

(d) Adoption of rate structures, billing schedules, and other associated programs that support and encourage water conservation;

(e) Water reuse, recycling, and non-potable water opportunities; and

(f) Any other conservation measures identified by the water supplier that would improve water use efficiency.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02, Renumbered from 690-086-0140(2)

690-086-0160 Municipal Water Curtailment Element

The water curtailment element shall include at least the following:

(1) A description of the type, frequency and magnitude of supply deficiencies within the past 10 years and current capacity limitation. The description shall include an assessment of the ability of the water supplier to maintain delivery during long-term drought or other source shortages caused by a natural disaster, source contamination, legal restrictions on water use, or other circumstances;

(2) A list of three or more stages of alert for potential shortage or water service difficulties. The stages shall range from a potential or mild alert, increasing through a serious situation to a critical emergency;

(3) A description of pre-determined levels of severity of shortage or water service difficulties that will trigger the curtailment actions under each stage of alert to provide the greatest assurance of maintaining potable supplies for human consumption; and

(4) A list of specific standby water use curtailment actions for each stage of alert ranging from notice to the public of a potential alert, increasing through limiting nonessential water use, to rationing and/or loss of service at the critical alert stage.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02, Renumbered from 690-086-0140(3)

690-086-0170 Municipal Water Supply Element

The water supply element shall include at least the following:

(1) A delineation of the current and future service areas consistent with state land use law that includes available data on population projections and anticipated development consistent with relevant acknowledged comprehensive land use plans and urban service agreements or other relevant growth projections;

(2) An estimated schedule that identifies when the water supplier expects to fully exercise each of the water rights and water use permits currently held by the supplier;

(3) Based on the information provided in section (1) of this rule, an estimate of the water supplier's water demand projections for 10 and 20 years, and at the option of the municipal water supplier, longer periods;

(4) A comparison of the projected water needs and the sources of water currently available to the municipal water supplier and to any other suppliers to be served considering the reliability of existing sources;

(5) If any expansion or initial diversion of water allocated under existing permits is necessary to meet the needs shown in section (3) of this rule, an analysis of alternative sources of water that considers availability, reliability, feasibility and likely environmental impacts. The analysis shall consider the extent to which the projected water needs can be satisfied through:

(a) Implementation of conservation measures identified under OAR 690-086-0150;

(b) Interconnection with other municipal supply systems and cooperative regional water management; and

(c) Any other conservation measures that would provide water at a cost that is equal to or lower than the cost of other identified sources.

(6) If any expansion or initial diversion of water allocated under existing permits is necessary to meet the needs shown in section (3) of this rule, a quantification of the maximum rate and monthly volume of water to be diverted under each of the permits;

(7) For any expansion or initial diversion of water under existing permits, a description of mitigation actions the water supplier is taking to comply with legal requirements including but not limited to the Endangered Species Act, Clean Water Act, Safe Drinking Water Act; and

(8) If acquisition of new water rights will be necessary within the next 20 years to meet the needs shown in section (3) of this rule, an analysis of alternative sources of the additional water that considers availability, reliability, feasibility and likely environmental impacts and a schedule for development of the new sources of water. The analysis shall consider the extent to which the need for new water rights can be eliminated through:

(a) Implementation of conservation measures identified under OAR 690-086-0150;

(b) Interconnection with other municipal supply systems and cooperative regional water management; and

(c) Any other conservation measures that would provide water at a cost that is equal to or lower than the cost of other identified sources.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS

537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02, Renumbered from 690-086-0140(4)

Agricultural Water Supplier Water Management and Conservation Plans

690-086-0210 [Renumbered to 690-086-0040]

690-086-0220 General Provisions

(1) Certain agricultural water suppliers must have approved conservation plans to transfer water rights within the boundaries of the districts to other land within the districts (ORS 540.572 to 540.578). These rules provide the standards for those conservation plans.

(2) Each agricultural water supplier required to submit a water management and conservation plan shall exercise diligence in implementing the approved plan and shall update and resubmit a plan consistent with the requirements of OAR 690, division 86 as prescribed during plan approval.

(3) Any agricultural water supplier participating in the water transfer provisions in ORS 540.572 to 540.578 and OAR 690-021-0070 to 690-021-0700 shall submit an annual report describing progress-to-date in implementing a water management and conservation plan.

(4) Water management and conservation plans submitted by agricultural water suppliers shall meet the requirements listed in OAR 690-086-0225 to 690-086-0270.

(5) A water conservation plan prepared in accordance with criteria of the Bureau of Reclamation and substantially meeting the requirements of OAR 690-086-0225 to 690-

086-0270 may be submitted to meet the requirements of these rules.

(6) At least 30 days prior to submitting a draft plan to the Department, an agricultural water supplier shall make the draft plan available for review by each affected local government.

(7) Each agricultural water supplier preparing a water management and conservation plan is encouraged to develop and implement a program to involve the supplier's patrons in the preparation of the plan. Recommendations include making the plan available for public inspection and conducting public meetings to provide information and gather input on the plan.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02

690-086-0225 Agricultural Water Supplier Plan Elements

A water management and conservation plan submitted by an agricultural water supplier shall include:

(1) An agricultural water supplier description as described under OAR 690-086-0240;

(2) An agricultural water conservation element as described under OAR 690-086-0250;

(3) An agricultural water allocation/curtailment element as described under OAR 690-086-0260;

(4) An agricultural water supply element as required under OAR 690-086-0270;

(5) A list of the affected local governments to whom the draft plan was made available pursuant to OAR 690-086-0220(6) and a copy of any comments on the plan provided by the local governments;

(6) A proposed date for submittal of an updated plan based on the proposed schedule for implementation of conservation measures, any relevant schedules for other community planning activities, and the rate of growth of or other changes expected by the water supplier; or an explanation of why submittal of an updated plan is unnecessary and should not be required by the Department.

Stat. Auth.: ORS 536.027, 537.211 and 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 4 2002, f. & cert. ef. 11-1-02

690-086-0240 Agricultural Water System Description

The description of the water system shall include at least the following information:

- (1) General location of water right acreage, numbers of the associated water right certificates and permits and a description of relevant conditions of the water rights including the seasons of use and the uses of any other permitted withdrawals by the supplier;
- (2) Source(s) of water; storage and regulation facilities; and a summary of any transfer, rotation, exchange or intergovernmental cooperation agreements;
- (3) A schematic of the system showing storage and distribution facilities, drainage systems, measurement stations, generalized district boundaries, points of diversion and locations of major operational spills;
- (4) Current water use, including peak and average annual diversions and, when available, water reuse and return flows;
- (5) A summary of major classifications of user accounts showing water right acreages, the number of accounts of each classification, and the beneficial uses for which water is provided (irrigation, frost protection,

temperature control, agricultural use, livestock, domestic, etc.);

- (6) Types of on-farm irrigation systems common within the supplier's accounts;
- (7) A general characterization of crops commonly grown and the estimated average and peak consumptive use of the crops; and
- (8) A description of the operation and maintenance program.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02

690-086-0250 Agricultural Water Conservation Element

The water conservation element shall include at least the following:

- (1) A progress report on the conservation measures scheduled for implementation in the water management and conservation plan previously approved by the Department, if any;
- (2) A description of the water supplier's agricultural water measurement program and a statement that the program complies with the measurement and reporting standards in OAR chapter 690, division 85, that a time extension or waiver has been granted, or that the standards are not applicable;
- (3) A description of other conservation measures currently implemented by the water supplier;
- (4) Short- and long-term goals of the water supplier to improve water management;
- (5) An evaluation of the opportunities for improving water use efficiency which includes:

- (a) A description of losses of water from canals, pipelines, and laterals, including any operational spills;
- (b) An assessment of the extent to which water deliveries are insufficient to meet crop needs;
- (c) A list of alternative conservation measures to reduce the losses of water identified in subsection (a) of this section and address any insufficiencies of water deliveries identified in subsection (b) of this section; and
- (d) An assessment of existing and future alternatives to finance conservation measures including an analysis of the possibility of applying for the allocation of conserved water (OAR 690-018-0010 to 690-018-0090).
- (6) For each of the following conservation measures not currently being implemented, and evaluation of whether implementation of the measure is feasible and appropriate for ensuring the efficient use of water and the prevention of waste:
 - (a) Promotion of energy audits offered through local electric utilities for district water users;
 - (b) Conversion to metered, pressurized deliveries to all parcels of one acre or less;
 - (c) Piping or lining earthen canals;
 - (d) Modifying distribution facilities and district policies to increase the flexibility of water deliveries;
 - (e) Provision of on-farm irrigation scheduling assistance;
 - (f) Construction of re-regulating reservoirs;
 - (g) Adoption or rate structures that support and encourage water conservation;
 - (h) Each of the conservation measures listed in OAR 690-086-0250(5)(c); and

- (i) Any other conservation measures identified by the water supplier that would improve water use efficiency.
- (7) A description and estimated schedule for implementation of each of the following conservation measures:
 - (a) An information and education program aimed at improving the efficiency of use of water delivered. The program should address all types of uses served and include voluntary water use audits; and
 - (b) Any other conservation measures identified as feasible and appropriate under section (6) of this rule.
 - (8) A program to monitor and evaluate the effectiveness of the conservation measures which are implemented.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02, Renumbered from 690-086-0240(2)

690-086-0260 Agricultural Water Allocation/Curtailment Element

The water allocation/curtailment element shall include at least the following:

- (1) A description of the frequency and magnitude of past supply deficiencies and current capacity limitation. The description shall include an assessment of the ability of the water supplier to maintain delivery during drought or other source shortages.
- (2) A description of the water supply situation(s) that cause the water allocation/curtailment element to be implemented, including identification of the supply situations which trigger warnings to users or public notice of impending shortage;

(3) A description of the procedure used to allocate water during water shortages.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02, Renumbered from 690-086-0240(3)

690-086-0270 Agricultural Water Supply Element

The long-range water supply element shall include at least the following:

- (1) An estimate of the water supplier's long-range water demand projections for 20 years;
- (2) A comparison of the projected water needs and the size and reliability of water rights permits or other current water supply contracts held by the water supplier;
- (3) A list of potential sources of water, including conservation and reuse, to supply the long-range needs;
- (4) A comparison among the potential sources of additional water considering costs, availability, reliability, and likely environmental impacts;
- (5) An evaluation of the effects of the following factors on long-range water needs:
 - (a) Regional options for meeting future water needs;
 - (b) Urbanization and other land-use trends;
 - (c) Provisions in affected local governments' comprehensive plans relating to agricultural lands, urbanization, water resources, water supply, public facilities and services, and any other pertinent plan element or ordinance relating to uses or lands served, or proposed to be served, under the long-term water supply plan.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02, Renumbered from 690-086-0240(4)

Water Management and Conservation Plan Review and Enforcement

690-086-0900 Water Management and Conservation Plan Review, Approval and Enforcement

- (1) The rules in OAR 690-086-0900 to 690-086-0920 set out the process and criteria for the Department's review, approval and enforcement of the water management and conservation plans submitted by agricultural and municipal water suppliers. The rules apply to the submittal and review of draft plans, proposed final plans, and subsequent updates.
- (2) During the plan review and approval process, the Department may allow additional time for a municipal water supplier to implement water metering under OAR 690-086-0150(4)(b) or a benchmark established in a previously approved plan if the water supplier shows that additional time is necessary to avoid unreasonable and excessive costs.
- (3) Notwithstanding any of the requirements of these rules, except OAR 690-086-0150(2) and 690-086-0250(2), the Department may approve a water management and conservation plan if the plan is generally consistent with the applicable criteria and includes a schedule for completion within five years of any additional work necessary to satisfy the requirements.
- (4) Any plan approval that contains a requirement that a municipal water supplier

complete additional work under section (3) of this rule shall preclude additional diversion of water under an extended permit beyond the need quantified for the next two years.

*Stat. Auth.: ORS 536.025 & ORS 536.027 Stats.
Implemented: ORS 537.230, ORS 537.630 & ORS
539.010 Hist.: WRD 4 2002, f. & cert. ef. 11-1-02*

690-086-0905 Notice of Submittal of a Draft Plan or Updated Plan

(1) The Department shall notify affected local governments, affected Indian tribes, and all persons on the Department's weekly mailing list that a draft water management and conservation plan prepared under the requirements of OAR 690-086-0125 or 690-086-0225 has been submitted to the Department and is available for review.

(2) Any person may review and submit written comments on the draft plan within 30 days of the notification in section (1) of this rule. Written comments submitted under this subsection must cite specific provisions of concern in the draft plan, describe how each of the provisions cited do or do not satisfy the requirements of OAR chapter 690, division 086, suggest any modification in each provision that would be necessary to satisfy the relevant requirement, and include information to support any suggested modifications.

*Stat. Auth.: ORS 536.027, ORS 537.211 & ORS
540.572 Stats. Implemented: ORS 537.230, ORS
537.630 & ORS 539.010 Hist.: WRD 11-1994, f. &
cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02,
Renumbered from 690-086-0910(1) & (2)*

690-086-0910 Preliminary Review of Draft Plans

(1) The Department shall undertake a preliminary review of the draft plan and the comments received pursuant to OAR 690-086-0905 to determine whether the plan

includes the required elements of OAR 690-086-0120 to 690-086-0170 or 690-086-0220 to 690-086-0270.

(2) For a plan submitted by a municipal water supplier, the Department shall review the plan to determine if the information and analyses in the plan are sufficient for the Department to make the determination required under OAR 690-086-0130.

(3) For a plan submitted by an agricultural water supplier the Department shall review the plan to determine whether:

(a) The plan includes the information required in OAR 690-086-0240;

(b) The water supplier has complied with the requirements of OAR 690-086-0250 and has included a description of the actions to be taken in the implementation of water conservation measures that are feasible and appropriate for ensuring the efficient use of water and the prevention of waste; considering:

(A) The economic feasibility of the measures for the water supplier;

(B) Any likely adverse environmental impacts of implementation of the measures;

(C) Whether the measures are available and proven;

(D) The time needed to implement the measures;

(E) The effects of local variations in soil type and weather on the potential for successful implementation of the measures; and

(F) Whether the measures are consistent with other relevant water management plans and subbasin conservation plans.

(c) The water allocation/curtailment element prepared under OAR 690-086-0260 satisfactorily promotes water curtailment

practices and the coordination of usage regulation, taking into account state water law and local conditions, or is substantially the same as a curtailment plan prepared pursuant to ORS 536.780 and OAR 690-019-0090 and approved by the Department within the previous five years; and

(d) The water supplier has included the information required in OAR 690-086-0270, and, in the list of potential sources of water to meet projected demands, included the development of any conservation measures which are available at a cost which is lower than the cost of other identified sources or has provided sufficient justification for the factors used in selecting other sources for development.

(4) Upon completion of the preliminary review and no later than 90 days after receipt of a draft plan, the Department shall:

(a) After considering public comments, provide the Department's written comments on the plan to the water supplier and any person who submitted comments pursuant to OAR 690-086-0905; or

(b) After considering public comments if the Department determines that the draft plan includes the required plan elements under OAR 690-086-0125 or 690-086-0225, and for municipal water supply plans, that the plan meets the criteria under OAR 690-086-0130, issue a final order approving the plan pursuant to OAR 690-0086-0915(4) or (5) and notify any person who submitted comments pursuant to OAR 690-086-0905 of the issuance of the order.

(5) The Department shall include in its written comments prepared under section (4) of this rule:

(a) For each deficiency identified in the review, a citation of the relevant statute or rule;

(b) To the extent possible, identification of any constraints to implementation of the water management and conservation plan and recommendations on appropriate actions to secure any identified new sources of water;

(c) An evaluation of the extent to which a request for additional time under OAR 690-086-0900(2) satisfies the relevant requirements of the rules;

(d) A prescribed reasonable period of time of not less than 60 days, identified in consultation with the water supplier, for the water supplier to respond to the Department's review and to submit a proposed final plan; and

(e) Copies of any written comments received pursuant to OAR 690-086-0905.

(6) If the Department does not meet the 90-day deadline in section (4) of this rule:

(a) For purposes of ORS 540.572, a plan submitted by an agricultural water supplier after November 1, 2002, is deemed approved for the period from the expiration of the 90-day deadline until 120 days after the Department provides written comments under section (5) of this rule; and

(b) For municipal water suppliers whose additional diversion of water under an extended permit is only authorized upon issuance of a final order approving a water management and conservation plan, notwithstanding OAR chapter 690, division 315, the Director may by order authorize diversion of an additional specified quantity of water as necessary to prevent harm to public welfare, safety and health.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02

690-086-0915

Final Review of Plans

(1) Upon receipt of a proposed final plan, the Department shall evaluate the plan to determine if it includes the required elements of OAR 690-086-0125 to 690-086-0170 for municipal water suppliers or OAR 690-086-0225 to 690-086-0270 for agricultural water suppliers. The evaluation shall be limited to a review of modifications in the plan and issues that were identified in the Department's written comments provided under OAR 690-086-0910 and, if any deficiencies are identified, the Department's review shall cite the relevant statute or rule.

(2) If the Department determines that the final plan does not include the required elements of OAR 690-086-0120 to 690-086-0170 or 690-086-0220 to 690-086-0270, the Department shall consult with the water supplier and may provide additional time to correct any discrepancies.

(3) For a water management and conservation plan submitted by a municipal water supplier, the Department shall review the plan to determine if the information and analyses in the plan are sufficient for the Department to make the determination required under OAR 690-086-0130.

(4) For a water management and conservation plan submitted by a municipal water supplier, if the Department determines that the proposed final plan includes the required elements under OAR 690-086-0120 to 690-086-0170 and meets the applicable criteria under OAR 690-086-0130, the Department shall issue a final order approving the plan and notify the water supplier and any person who submitted comments pursuant to OAR 690-086-0905 of the approval. The Department's order shall include the following:

(a) A quantification of the maximum amount of water to be diverted during the next 20 years under each extended permit, or for a longer period as specified for an extended reservoir permit;

(b) The date on which an updated plan shall be submitted to the Department. A municipal water supplier may submit an updated plan at any time prior to the date specified if necessary to accommodate unanticipated events, but the Department shall not require submittal of an updated plan earlier than five years after issuance of the order approving the plan; and

(c) A schedule for submittal of five-year progress reports on implementation of the water conservation and supply measures described in the plan.

(5) For a water management and conservation plan submitted by an agricultural water supplier, if the Department determines that the proposed final plan satisfies the relevant requirements or if the water supplier satisfactorily corrects any identified discrepancies, the Department shall issue a final order approving the plan and notify the water supplier and any person who submitted comments pursuant to OAR 690-086-0905 of the approval. The Department shall specify in the order approving the plan if an updated plan shall be required and, if so, the date on which the updated plan shall be submitted to the Department. The Department shall not require submittal of an updated plan earlier than five years after issuance of the order approving the plan.

(6) The Department shall issue a final order denying approval of the plan and notify the water supplier and any person who submitted comments pursuant to OAR 690-086-0905 of the issuance of the order if:

(a) The Department determines that the proposed final plan does not contain the plan

elements required under OAR 690-086-0125 or 690-086-0225;

(b) For municipal water suppliers, the plan does not meet the criteria under OAR 690-086-0130;

(c) The municipal water supplier has failed to adequately justify a request for additional time to implement water metering under OAR 690-086-0150(4)(b) or a benchmark established in a previously approved plan; or

(d) The work plan submitted under OAR 690-086-0900(3) is insufficient for completing the additional work necessary to satisfy the requirements of these rules.

(7) The Department may deny approval of a water management and conservation plan if the water supplier fails to submit a final plan to the Department within 120 days after receipt of the Department's preliminary review.

(8) If the Department issues a final order denying approval of the plan, the water supplier may request that the Department reconsider the order and the Director appoint a five-member review board to review the plan. The board shall include at least two individuals from the basin in which the supplier is located who are engaged in similar uses of water, the local watermaster, and other individuals knowledgeable about water use practices and water conservation. After reviewing the plan and evaluating any additional information presented by the water supplier and the Department, the board may recommend that the Department:

(a) Reconsider the decision not to approve the plan;

(b) Reconsider the decision not to approve the plan contingent on the water supplier agreeing to specified modifications; or

(c) Reaffirm the original decision not to approve the plan.

(9) The Department shall notify the water supplier, the members of the review board, and any person who submitted comments pursuant to OAR 690-086-0905 of any action taken based on the board's recommendation.

(10) The water supplier or a person who has submitted comments pursuant to OAR 690-086-0905 may, within 30 days of a notification pursuant to OAR 690-086-0910(5)(b) or section (4), (5), (6), or (9) of this rule, appeal a decision by the Department to approve or to not approve a plan to the Commission. The Commission may deny the appeal or may accept the appeal and remand the plan to the Department to seek resolution of the issues identified in the appeal and, if the issues are not resolved, to initiate a contested case proceeding pursuant to ORS 183.413 and OAR chapter 690, divisions 1 and 2.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 4 2002, f. & cert. ef. 11-1-02, Renumbered from 690-086-0910(7)

690-086-0920 Enforcement

If the Director determines that a water supplier has failed to submit a water management and conservation plan as required under OAR 690-086-0010 to 690-086-0270 or has failed to satisfactorily implement an approved water management and conservation plan, the Director may proceed with one or more of the following actions:

(1) Provide an additional, specified amount of time for remedy;

(2) Initiate an evaluation of the supplier's water management practices and facilities to determine if the use of water is wasteful;

(3) Initiate regulation of water use under OAR 690-250-0050 to eliminate waste;

(4) Rescind a previous approval of a water management and conservation plan; and

(5) If the submittal of the water management and conservation plan is required under a condition of a permit or an extension approved under OAR chapter 690, division 315 or 320, assess a civil penalty under OAR 690-260-0005 to 690-260-0110 or cancel the permit.

Stat. Auth.: ORS 536.027, ORS 537.211 & ORS 540.572 Stats. Implemented: ORS 537.230, ORS 537.630 & ORS 539.010 Hist.: WRD 11-1994, f. & cert. ef. 9-21-94; WRD 11-1994, f. & cert. ef. 9-21-94

Oregon Administrative Rules Chapter 690, Division 85 Annual Reports and Serious Water Management Problem Areas

690-085-0005

Purpose

These rules establish procedures and requirements for the annual reporting of water use by governmental entities pursuant to ORS 537.099. These rules also establish procedures for designation of serious water management problem areas pursuant to ORS 540.435.

*Stat. Auth.: ORS 537 & ORS 540 Stats. Implemented:
Hist.: WRD 13-1988, f. & cert. ef. 8-10-88*

690-085-0008

Definitions

As used in OAR 690-085-0010 and 690-085-0015:

(1) “Change in channel conditions” includes but is not limited to scour, siltation, accumulation of debris, accumulation of aquatic growth, and the removal of aquatic growth.

(2) “Commission” means the Water Resources Commission.

(3) “Control” means a natural constriction of the channel, a long reach of the channel, a stretch of rapids, or an artificial structure downstream from the gage that determines the stage-discharge relation at the gage.

(4) “Continuous stage recorder” means any device that accurately and continuously records the rise and fall of a water surface with respect to time.

(5) “Department” means the Oregon Water Resources Department.

(6) “Director” means the Director of the Water Resources Department.

(7) “Economic hardship” means a financial burden of an extraordinary nature. Examples of situations causing such a burden include, but are not limited to, the following: the entity is required to report on an unusually large number of diversions or locations, the costs of measuring and reporting for a diversion or location greatly exceed the normal costs associated with a similar volume of water, or the costs of measuring and reporting threaten the entity's fiscal ability to continue operating.

(8) “Flume” means a specially shaped open channel flow section which may be installed in a canal, lateral, or ditch to form a control.

(9) “Governmental entity” includes any state or federal agency, local government as defined in ORS 294.004, irrigation district formed under ORS Chapter 545, water control district formed under ORS Chapter 553, and any other special purpose district organized under state law.

(10) “Open channel flow measurement” means a series of velocity, depth, and width measurements taken across an open channel using a velocity meter and a calibrated tape measure as described in references listed in OAR 690-085-0015(4)(f).

(11) “Point of diversion” means the point at which water is appropriated from its source.

(12) “Shift” means a correction that is derived from a flow measurement and applied to the gage height to obtain a true flow or discharge throughout a specific time sequence.

(13) “Staff gage” means a device constructed for the measurement of water depth. It shall allow accurate reading to 1/100th of a foot.

(14) “Velocity meter” means a device designed and constructed to the specifications cited in the reference listed in OAR 690-085-0015(4)(f)(C) for measuring stream velocity in open channels.

(15) “Water use” means water diverted or pumped from the source, or in the case of non-diverted water, the water available to satisfy the right.

(16) “Weir” means an overflow structure built across an open channel to form a control.

*Stat. Auth.: ORS 537 & ORS 540 Stats. Implemented:
Hist.: WRD 7-1991, f. & cert. ef. 8-7-91*

690-085-0010 Governmental Entities to Submit Annual Water-Use Reports

(1) By December 31 of each year, any governmental entity holding water rights shall submit to the Department a report detailing monthly water use under the rights for each point of diversion. Reporting shall be for the previous water year (October 1 to September 30). A governmental entity shall not be required to submit a report under this rule for water rights held because of default in repayment of loans or other debts owed to the state.

(2) The report shall be submitted on forms supplied by, or in a format acceptable to the Department. It shall include:

(a) The name and address of the reporting entity;

(b) The monthly volume of water diverted or pumped from natural flow and/or stored water for each major category of use at each point of diversion listed on the water rights, except as noted in subsections (2)(c), (d), and (e) of

this rule. The volume of water diverted or pumped shall be determined as prescribed in OAR 690-085-0015;

(c) For in-reservoir uses, the volume of water impounded on approximately the same day each month;

(d) For instream water rights, the monthly volume of water flowing through the channel for at least one point covered by the water right;

(e) For instream uses supplied from storage, the volume of stored water released every month.

(3) Except as provided in section (4) of this rule, the reported monthly volumes of water shall be accurate within plus or minus 15 percent by October 1992.

(4) The governmental entity may assume the volume of water used each month, if any, is the maximum quantity allowed under the right and report that volume if:

(a) The water right is for storage of less than 9.2 acre-feet of water for in-reservoir use or specifies a rate less than 0.1 cfs; or

(b) The Director has approved a time extension for compliance with section (3) of this rule or the Commission has waived compliance with any of the requirements of OAR 690-085-0015.

(5) The Director may grant a time extension for compliance with section (3) of this rule:

(a) To qualify for an extension, the governmental entity shall:

(A) Show that compliance with section (3) of this rule would cause an economic hardship;

(B) Show that an allowance of additional time would enable it to meet the accuracy standards prescribed in section (3) of this rule; and

(C) Submit a compliance schedule detailing the steps, including the implementation time of those steps, it will take to meet section (3) of this rule.

(b) Once the time extension is approved, the governmental entity shall submit a progress report on the compliance schedule in conjunction with each annual water use report;

(c) The Director may rescind his approval if the governmental entity fails to comply with the compliance schedule;

(d) The Director may modify the terms of any compliance schedule under this rule at the request of the governmental entity.

(6) The Commission may waive compliance with section (3) of this rule and/or any of the requirements of OAR 690-085-0015. The qualify for a waiver, the governmental entity shall show that:

(a) Complying with the rule(s) would cause an economic hardship on the governmental entity; and

(b) The information to be collected would not materially aid water management because:

(A) The regulation for or of the use is unlikely due to the absence of other water rights; or

(B) Use of water is unlikely to materially affect water availability from the source since the quantity of water allowed by the right in relation to the quantity of water available from the source is de minimis; or

(C) Another similar situation exists.

Stat. Auth.: ORS 537 & ORS 540 Stats. Implemented: Hist.: WRD 13-1988, f. & cert. ef. 8-10-88; WRD 7-1991, f. & cert. ef. 8-7-91

690-085-0015

Methods for Measuring and Computing Water Use

(1) Beginning October 1992, methods shall be approved in advance by the Department except those prescribed in sections (4) and (5) of this rule which are approved by the Department. The methods prescribed in sections (4) and (5) of this rule are designed to meet OAR 690-085-0010(3). Alternate methods will be accepted by the Department if the conditions specified in section (6) of this rule are met. Any method is subject to review by the Department.

(2) In Critical Groundwater and Serious Water Management Areas measuring requirements may be different. In such cases the more stringent measuring requirements will take precedence.

(3) Where practical, water use shall be measured at each point of diversion. However, measurements may be taken at a reasonable distance from the point of diversion if the following conditions are met:

(a) The measured flow shall be corrected to reflect the flow at the point of diversion. The correction will be based on periodic flow measurements at the point of diversion taken in conjunction with flow measurements at the usual measuring point;

(b) If the measured flow includes flow contributions from more than one point of diversion, the measured flow shall be proportioned to reflect the flow at each point of diversion using the method prescribed in subsection (a) of this section;

(c) A description of the correction method shall be submitted with the annual report the first time it is used and any time it is changed, or once every five years, whichever is shorter.

(4) Approved methods for measurements made in open channels are as follows:

(a) The following requirements apply for all approved methods of measurement in open channels:

(A) Copies of all measurement notes, rating curves, and calculations shall be retained for three years and made available to the Department upon request. For each method of measurement, installation, and measurement procedures shall be as described in the references listed in subsection (4)(f) of this rule;

(B) Channels shall be equipped with a staff gage and/or a continuous stage recorder which shall be installed in a location that provides an accurate reading of the control crest depth at all elevations and as described in the references listed in subsection (4)(f) of this rule. If only a staff gage is installed, an observer shall read the staff gage and record the reading at uniform intervals, and as close as practical before and after the time regulation of the diversion flow rate occurs. At no time shall the periodic interval be greater than three days. A continuous stage recorder may be used in lieu of periodic staff gage readings;

(C) The method of measurement shall conform with the U.S. Geological Survey method for velocity-area measurements as described in the references listed in subsection (4)(f) of this rule;

(D) Where practical, the rate of flow may be determined by measuring the amount of time needed to fill a container of known capacity;

(E) For very low flows that cannot be measured by any of the above methods, the rate of flow may be determined by setting a portable weir or flume in the channel. The weir or flume shall be installed as described in the references listed in subsection (4)(f) of this rule;

(F) Once a rating curve has been established, computation of reported monthly volume

shall be as described by references listed in subsection (4)(f) of this rule with additional information available from the Department.

(b) The Velocity-area Method:

(A) A rating curve for the control shall be established and maintained as described in references listed in subsection (4)(f) of this rule. The distribution of open channel flow measurements shall be sufficient to establish a full range of values for the entire stage-discharge relation. Close attention shall be given to the upper end (high flows) and the lower end (low flows) of the curve;

(B) Open channel flow measurements shall be taken at least once every six weeks, and at any time there is a change in channel conditions which may alter flow conditions across the control;

(C) Readings taken from a staff gage shall be consistent with paragraph (4)(a)(B) of this rule.

(c) The Weir Method:

(A) A weir shall be installed and maintained as described in the references listed in subsection (4)(f) of this rule. Upstream from the weir a staff gage and/or continuous stage recorder shall be installed in a location that measures static head above the weir crest at all elevations and in accordance with the references listed in subsection (4)(f) of this rule;

(B) When only a staff gage is installed, reading of the staff gage shall be consistent with paragraph (4)(a)(B) of this rule;

(C) A rating curve shall be established for the weir as prescribed for the Velocity-area Method in paragraph (4)(b)(A) of this rule;

(D) Open channel flow measurements shall be taken at least once every eight weeks, and at any time there is a change in channel

conditions which may alter flow conditions across the weir.

(d) The Flume Method:

(A) A flume shall be installed and maintained as described in the references listed in subsection (4)(f) of this rule. A staff gage and/or continuous stage recorder shall be installed upstream from the flume in a location that measures static head and in accordance with the references listed in subsection (4)(f) of this rule;

(B) When only a staff gage is installed reading of the staff gage shall be consistent with paragraph (4)(a)(B) of this rule;

(C) A rating curve shall be established for the flume as prescribed for the Velocity-area Method in paragraph (4)(b)(A) of this rule;

(D) Open channel flow measurements shall be taken at least once every eight weeks, and at any time there is a change in channel conditions which may alter flow conditions through the flume.

(e) For a diversion monitored by the Department or a U.S. Geological Survey gaging station, it is sufficient to report:

(A) The gaging station number if the station is at the point of diversion; or

(B) The gaging station number and the appropriate correction, per section (3) of this rule, for adjustment back to the point of diversion, if the station is a reasonable distance from the point of diversion;

(C) The current operation of any station by the Department or U.S. Geological Survey does not guarantee the continued operation or usage of the station for water use reporting purposes.

(f) The following references provide guidance and requirements for the methods and installations prescribed in this rule:

(A) "Measurement and Computation of Streamflow", Volumes 1 and 2, 1982, USGS WSP 2175;

(B) "Techniques of Water-Resources Investigations of the United States Geological Survey", Book 3, Chapters A6-A8, A10, A13, and A14;

(C) "Water Measurement Manual", U.S. Department of the Interior, Bureau of Reclamation.

(5) Approved methods for measurements made in pipes are as follows:

(a) The Flow Meter Method:

(A) The flow meter shall be capable of recording cumulative volume;

(B) The flow meter shall be capable of measuring the full range of discharge from the source of water for which it is to be used;

(C) The flow meter shall be installed and maintained according to the manufacturer's specifications and in such a manner that there shall be a full pipe of water at all times during which water is being pumped;

(D) There shall be no diversions of water between the source of water and the flow meter installation;

(E) The manner in which the flow meter has been installed is subject to inspection and approval by the Director;

(F) In the case of flowing artesian wells with pumps, the flow meter shall be installed in a manner which will allow measurement of both pumped and flowing discharge.

(b) The Power Consumption Method:

(A) This method shall not be used for flowing artesian wells;

(B) A power meter shall be dedicated to one pump only;

(C) The ratio of electric power consumption per quantity of water pumped shall be determined annually by physically measuring the volume of water pumped during a two-hour test. The test shall be conducted under normal operating conditions;

(D) A record of the method and equipment used to determine the ratio of power consumption to volume of water pumped, and the monthly power readings for each well shall be retained for three years. The record shall be made available to the Department upon request.

(c) The Time of Operation Method:

(A) This method shall not be used for flowing artesian wells;

(B) A meter that accumulates operating time of the pump shall be installed and dedicated to one pump only;

(C) The volume of water pumped per unit time shall be determined annually by physically measuring the flow during a two-hour test. This test shall be conducted under normal operating conditions;

(D) A record of the method and equipment used to determine the volume of water pumped per unit time and the monthly accumulated operating times shall be retained for three years. The record shall be made available to the Department upon request.

(6) Alternate methods for reporting water use:

(a) An alternate method may be used if a registered professional engineer certifies to the Department that the method will report water use within an accuracy of plus or minus

15 percent. The governmental entity shall submit a description of the method and the certification by the registered professional engineer to the Department;

(b) The Department may review any alternate method at any time and may require modification to the method if the Department determines that the method does not accurately report water use as required in OAR 690-085-0010(3).

[Publications: The publication(s) referred to or incorporated by reference in this rule are available from the office of the agency.]

Stat. Auth.: ORS 537 & ORS 540 Hist.: WRD 7-1991, f. & cert. ef. 8-7-91

690-085-0020 Serious Water Management Problem Areas

(1) The Commission may adopt a rule to designate an area as having serious water management problems and may order any affected water right holders to submit annual water use reports if it finds that:

(a) Ground water decline in the area is of such magnitude that the aquifer does not recover annually;

(b) There are frequent water management disputes between water users in the area that cannot be privately resolved;

(c) Substantial interference exists between wells;

(d) The exercise of ground water rights interferes with flow of water in a nearby stream, to the detriment of senior surface water rights;

(e) The diversion of water from streams is in such quantities that interference with nearby wells occurs; or

(f) There are frequent occurrences of surface or ground water shortages caused by use of water from streams or wells. Shortages may be evidenced by complaints from water right holders, requests to regulate water use, degraded water quality, or failure to meet administrative restrictions or minimum streamflows.

(2) The Commission may direct that a hearing be held to determine if an area has serious water management problems upon receipt of a complete petition with sufficient evidence of a serious management problem from a water right holder in the area, or from the director of a state or federal agency. The Commission may also hold a hearing to determine if an area has serious water management problems on its own motion.

(3) A petition for hearing shall include recommended boundaries of the area proposed for designation, a description of the water management problems in the area, a summary of data on water availability and use for the area, and a proposed water management and annual water use reporting program. This proposed program should include a description of any measuring devices to be required, information which would be submitted on any annual water use reports and proposed procedures for regulation of water use. The Commission shall review the data and recommendations in the petition and determine if a hearing shall be held.

(4) The hearing shall be held in the area proposed for designation as having serious water management problems. Notice of the hearing shall be published in a local newspaper at least two weeks before the hearing. Additionally, the Department shall mail notice of the hearings to water rights holders in the area when feasible.

(5) Alternative proposals for measuring devices, methods of obtaining data, or formats for reporting data may be presented to the

Department within 30 days after the hearing date.

(6) If the Commission determines there is a serious water management problem, it shall adopt a rule which specifies the nature of the problem, the boundaries of the area involved, who is required to install measuring devices, specifications for the types of measuring devices and annual reports, and timelines for implementation.

(7) The Commission may consider amendment of a rule designating a serious water management problem area upon receipt of a petition to initiate rulemaking or on the Commission's own motion.

Stat. Auth.: ORS 537 & ORS 540 Stats. Implemented: Hist.: WRD 13-1988, f. & cert. ef. 8-10-88

690-085-0030 Failure to Report

(1) The Director may order regulation or termination of deliveries of water to and use of water by any water right holder who fails to satisfactorily install or maintain a measuring device or to submit a report required by OAR 690-085-0020. Notice of intended regulation shall be served on the person by certified mail, return receipt requested. Regulation shall become effective not earlier than 30 days after the date of mailing of the notice. Regulation shall not become effective if the person satisfactorily complies within 30 days from the date of mailing of the notice or if the person is granted an extension of time under section (2) of this rule.

(2) A water right holder required under OAR 690-085-0010 or 690-085-0020 to submit an annual water use report may request in writing a 60-day extension of time to submit the report. The Director may grant the extension upon finding that the additional time is needed by the person or government

entity to compile and submit accurate and complete information.

Stat. Auth.: ORS 537 & ORS 540 Stats. Implemented:

Hist.: WRD 13-1988, f. & cert. ef. 8-10-88

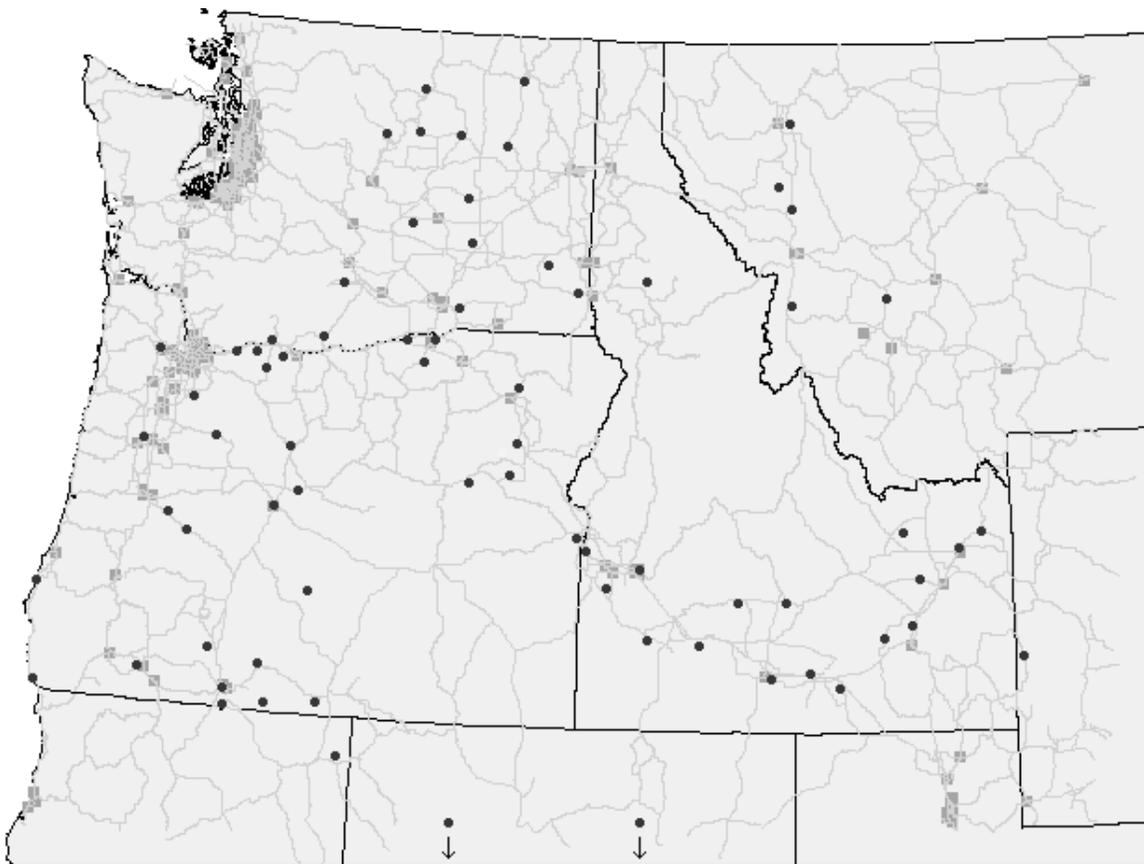
AgriMet Program Overview

AgriMet: The Pacific Northwest Cooperative Agricultural Weather Network

<http://www.usbr.gov/pn/agrimet/index.html>

In 1983, in cooperation with the Bonneville Power Administration (BPA), the Bureau of Reclamation (Reclamation) began “piggy-backing” a network of automatic agricultural weather stations onto Reclamation’s regional Hydromet satellite telemetry network. The Hydromet network is a series of automated data collection platforms that provide information necessary for near-real-time management of Reclamation’s water operations in the Pacific Northwest. As a subset of the overall Hydromet network, this agricultural network, dedicated to crop water use modeling and other agricultural applications, has been identified as AgriMet.

The present AgriMet network consists of over 70 agricultural weather stations located throughout the Pacific Northwest (see map below). Three stations operated by the NOAA Air Resources Laboratory in Idaho Falls, Idaho provide the weather data required to model evapotranspiration at Aberdeen, Kettle Butte, and Montevieu, Idaho. Over 20 stations east of the Continental Divide in Montana are managed by the Bureau of Reclamation Great Plains Region.



The AgriMet network is sponsored by the US Bureau of Reclamation with additional support from the Northwest Energy Efficiency Alliance, the USDA Agricultural Resource Service , the USDA Natural Resources Conservation Service , land grant universities, the Cooperative Extension System, electric utilities, power companies, and other public and private agencies and organizations.

Real-time AgriMet data is transmitted from individual stations photo to Reclamation's receive site in Boise, Idaho through the Geostationary Operational Environmental Satellite GOES-8, GOES-9 and DOMSAT satellites. Each station transmits data at regular intervals of 4 hours; some stations transmit on an hourly basis. Data collection intervals within this 4-hour or hourly transmit period are dependent on the specific sensor equipment at each station. Types of data collected at each station varies. The data is processed on minicomputers running the OpenVMS operating system at the Boise Regional Office, then made available on the World Wide Web.

Data are reviewed daily for quality control purposes, but all numbers should be considered provisional unless officially released by appropriate Reclamation personnel. AgriMet is available online at: www.usbr.gov/pn/agrimet/index.html.

IRRIGATION MANAGEMENT WITH LIMITED WATER

The following document on stretching irrigation water supplies may be useful to your district's patrons and can be part of district provision for on-farm irrigation scheduling, provided that the measure is feasible and appropriate for your district in ensuring the efficient use of water and prevention of waster under 690-086-0250 (6e). It is not necessary for an irrigator to take a field completely out of production when the water supply is inadequate to meet crop demands. The Extension Bulletin included below is designed to assist irrigators with planning and management during drought or other circumstances of limited water supplies.

Also included at the end of this document is an Irrigation System Walk-Through Inspection Analysis. This inspection will help identify components that need maintenance, repair, replacement, or other attention.

Stretching Irrigation Water Supplies

PNW 323 • Revised 2005

A Pacific Northwest Extension publication (Oregon, Idaho, Washington)

By M. English, Clint Shock, Roberto Nunez and Howard Neibling

[Originally prepared by Walter L. Trimmer, former Extension irrigation specialist, Oregon State University; revised by Marshall English, Extension irrigation management specialist, Clint Shock, Superintendent Malheur Experiment Station, Roberto Nunoz, Hood River Experiment Station, Oregon State University, and Howard Neibling, Extension Irrigation Specialist, Univ. of Idaho]

In a drought, every gallon of water saved is important. There are many places in a typical irrigation operation where water is lost. Here are some prudent management practices that can conserve water and possibly make the difference between making a profit or taking a loss.

Note: These practices are designed for individual farms *only*. In a river basin, changes in practices have various effects. Greater water use efficiency on one property may actually reduce the amount of irrigation return flows, thereby changing either the amount or the timing of water available to neighboring farms.

Five basic ways

Five general ways to conserve water are: (1) scientific irrigation scheduling, (2) applying the water as uniformly as practical, (3) reducing spray losses, leakage and runoff, (4) changing cultural practices, and (5) partially irrigating some crops.

Another way to conserve irrigation water is to convert flood and furrow irrigation systems to sprinkler and drip systems. In many cases the new pressurized systems will be substantially more efficient than the surface systems. This is a longer range alternative that should be analyzed carefully in times of drought. Investing in new systems when water supplies are uncertain may increase the financial risk in some cases.

Irrigation Scheduling

This is your first step (see PNW 288, *Irrigation Scheduling*, for more information). Irrigation scheduling helps you determine how much water crops use, when to irrigate, and how much water the soil can store. Use scientific irrigation scheduling to determine when to irrigate, then run the irrigation system only long enough to refill the root zone. Most irrigation systems have the capacity to apply too much water early and late in a season. If you apply too much water, it will percolate below the root zone where it is effectively lost to the crop. If you apply water too frequently the evaporative losses are unnecessarily high. Increase the intervals between irrigations to nearly the maximum for that crop and soil in order to minimize evaporation from wet soil surfaces. For example, if the suggested refill point for potatoes is 65 percent of available capacity, do not irrigate until soil moisture is approaching that level. The AgriMet web page (www.usbr.gov/pn/agrimet) provides accurate estimates of daily water use, and various types of soil moisture sensors are available to help provide ideal irrigation timing.

For side-rolls, hand-lines, and solid set systems, determine how long to run the system by probing to find the depth of water penetration. Probe within a few feet of the lateral, halfway between sprinklers, two or three times during irrigation.

Odd set times may pose problems when a system is run at night and labor is geared to a 12-hour set. Use a time clock to shut off systems automatically. Straighten side-roll systems in daylight so you can easily move them in darkness.

Applying water as uniformly as possible

No irrigation system applies water with perfect uniformity - some areas will be over-irrigated while others are under-irrigated. When water is *not* applied uniformly, extra water is often applied to a field to get adequate coverage of the driest areas.

Uniform application requires correct nozzle size, sprinkler spacing, and system pressure. Evaluate the irrigation system design and correct any distribution problems, especially if poor uniformity has shown up in previous years.

Use a lateral offset program on side-roll or hand-move systems (Figure 1). This simple practice will reduce the effective lateral spacing by half after two irrigations---enough to raise uniformity about 10 percent and reduce percolation loss by about the same amount (see PNW 286, *Stationary Sprinkler Systems*, for more information). The only additional equipment required is a short swingline coupled with a little more management of the system.

Be sure that your sprinkler lines all have the same size nozzles and the correct nozzle size. Check all nozzles for wear; replace worn nozzles with new ones.

Use the correct pressure. Know what the best nozzle pressure is for your specific sprinkler spacing, then check the pressure of the sprinkler discharge at the farthest, lowest and highest points. If a lateral rises or falls more than 15 vertical feet, install flow-control nozzles to improve irrigation uniformity.

High winds distort application uniformity. Normally, high winds occur only for short periods of a day or two, so avoid irrigating during these periods. If irrigation water is delivered continuously, you may need an on-farm pond for temporary storage.

Reducing spray losses, leakage and runoff

Keep evaporation and wind drift losses to a minimum by avoiding irrigation during periods of high wind and temperature. Sprinkler losses from a 5/32" nozzle will be about 9 percent in winds of about 5 mph and a temperature of 80°F. These losses will increase to 20 percent if the wind increases to 15 mph. With 15-mph wind and temperatures of 100°F, the losses from evaporation and wind drift can reach 26 percent. Be sure that nozzle size and system pressure give you an application rate that matches the infiltration rate of the soil. Small nozzles have higher losses than large nozzles, but larger nozzles can cause soil sealing and erosion. Practices such as dammer diking, straw mulching, or application of polyacrylamide (PAM) reduce runoff and erosion and enable you to use larger nozzles.

Prevent runoff caused by excess application rates on fine-textured soils (see PNW 287, *Irrigation Runoff Control*, for more information). Even local runoff that redistributes water within the field contributes to losses when it forms small ponds, then infiltrates the soil and percolates beyond the root zone. Users of center pivot and solid-set systems can apply extremely light rates at frequent intervals to limit surface water movement. This practice, however, increases evaporation. Check water depth. During each application, apply the greatest depth of water that's possible without runoff or deep percolation. Runoff can be significantly reduced by tillage practices such as dammer-dikers that create mini-basins along the furrows. Reduce nozzle size on side-roll, hand-move, and solid-set systems to match soil intake rates. (When you do this, you may have to reduce spacing to avoid a reduction in uniformity.)

Inspect for leaks. Poorly maintained irrigation systems may leak more than 10 percent of their water. Inspect flexible couplers, particularly the quick couplers on aluminum pipe. Replace gaskets that have become hard and cracked. Clean out any sand or silt behind the gasket to assure a watertight seal. Be sure to clean sand from automatic drains in center pivots and side-rolls. This sand can keep the drain from closing when you apply pressure.

Surface irrigation:

Apply water uniformly on surface irrigation systems. Make the output of all siphons and gates as uniform as possible. If a shorter surface irrigation is already uniform, shorten

irrigation set times from uniform 12- or 24 hour sets. You may have to make set changes at odd hours of the day or night. Probe the soil to keep track of the “wetted front” to determine irrigation effectiveness.

Applying water uniformly requires moving the water quickly across the field. Larger stream sizes are one way to accomplish this. Large stream sizes by themselves can erode furrows and cause large amounts of runoff, but runoff losses can be minimized by the various methods listed below:

- (i) Irrigate on the “hard” rows compacted by tractor traffic. Consider furrow packing of “soft” rows to improve water advance. However, in fields with low infiltration rates it may be necessary to irrigate in “soft” rows.
- (ii) Surge flow irrigation is another way to move water to the end of the furrows quickly. It has been particularly effective in southeastern Oregon. A comprehensive discussion of surge flow irrigation is available on a web site hosted by the Malheur Experiment Station (go to www.cropinfo.net, then go to the list of sites for *Water Quality* and pick *Best Management Practices* and scroll down to *Surge Irrigation*).
- (iii) Use “cut-back” irrigation on furrows, corrugation, and border strips to reduce stream sizes when water approaches the end of the field. After the water has advanced most of the way across the field, cut back the flow rate by about half. You can do this by starting two siphons per furrow, then “cutting back” to one, or by partially closing gates or valves. With experience you will learn the level of cutback water flow that will sustain water flow down the length of the furrows.
- (iv) Use pump back systems to recapture runoff (see *Best Management Practices* at www.cropinfo.net). Maybe the most important surface irrigation conservation practice is a tailwater reuse pit or pond. You can reuse water by collecting runoff water at the end of the field and pumping it back to the top of a farm through an inexpensive pipeline. Reused tailwater is usually less expensive, including both equipment and operating costs, than purchasing additional water from an irrigation district. This is true even when water is available. Open-impeller pumps that can pump trash are required for this purpose. The tailwater system does not disrupt regular production practices. Expect water savings between 30 and 60 percent.

Another water conservation technique is to only irrigate every other furrow.

Reduce losses in supply ditches by lining ditches and using gated pipe for the head ditch. Inspect earthen ditch banks for rodent damage, weeds, sediment, and debris that cause water losses. Clean out weeds and trash-but not silt, which provides a natural seal. A clean ditch will lower water delivery losses to infiltration.

Use checks to control erosion in steep ditches. Farm ditch slopes should be no steeper than 1 / 10 foot per 100 feet. This slope limits water velocity in the ditch and prevents scouring the natural silt. Erosion of the ditch can result in excessive infiltration losses.

Changing cropping patterns and cultural practices

Changing cropping patterns can reduce the need for water by selecting crops that require less water. If possible, substitute shorter-season crops into your rotation. Alfalfa, corn, and sugar beets need water all season; but wheat, barley, rye, and some vegetables need water only early in the season. It is also possible to choose varieties of crops with shorter growing seasons. For example, shorter-season corn varieties are available. These varieties do not have as much yield potential, but they are more likely to produce a crop in a water-short year. Depending on the location, a number of crops can produce a respectable yield with only one irrigation near a critical-growth stage, such as flowering (see following section on partial irrigation). Sometimes, the best way to reduce water use is by eliminating the last irrigation of the season.

Don't *overextend* the water supply by irrigating too much land; that can result in crop failure. Plant drought-tolerant crops on any remaining un-irrigated land to minimize wind erosion.

Be ready to change. Set realistic yield goals and change your fertilizing program when you expect reduced yields. Use a soil test to avoid excess fertilizer. Over-fertilized crops will suffer greater damage and sharper yield reductions when water is short. Control water-using weeds with a minimum of tillage.

Consider herbicides or mowing rather than tillage. Every cultivation results in the loss of moisture from the soil.

In general, be conservative with crop inputs. Try to keep cash costs low on cropland subject to drought. This minimizes the financial risk associated with drought.

Partial irrigation

When water supplies are severely restricted, net profits can be maximized by partial irrigation of certain crops. Wheat, alfalfa, and other drought-tolerant crops can be safely under-irrigated by 15 or 20 percent. A partial irrigation strategy may involve reducing *irrigation adequacy* (i.e. reducing the water applied with each irrigation) or concentrating limited water at critical stages of crop development. Large deficits are normally not advisable; deficits on the order of 15 percent are often about optimal. However if water supplies are severely limited, larger deficits may be appropriate for low valued crops. Some crops that are very sensitive to water stress should not be deficit irrigated at all. Onion yield and market grade are both sacrificed with partial irrigation. Potatoes can be severely affected by stress, particularly during tuber set and development, resulting in unmarketable tubers.

Reducing irrigation adequacy

Reducing the water applied with each irrigation will cause some degree of crop stress in part of the field, but will substantially reduce water lost as deep percolation in the rest of the field. The reduction in yields will be small and the effect on net income will be

negligible if the irrigation deficits are kept to 15 or 20 percent for relatively drought tolerant crops such as alfalfa and wheat.

Because of the non-uniformity of soils and uneven patterns of applied water, some parts of a field will always receive more water than others. Consequently, when most of a field has been fully irrigated parts of the field may still be slightly under-irrigated. The term irrigation adequacy refers to the fraction of a field that is fully irrigated.

Standard irrigation practices are designed for 90 percent adequacy, which means that enough water will be applied to fully irrigate (or actually over-irrigate) about 90 percent of the field while 10 percent will be under-irrigated to some extent. But when water is in short supply profits may be maximized by fully irrigating less of the field. Yields will be reduced in the parts of the field receiving the least water, but research has shown that field *average* yield reductions may be small while water savings may be significant. Figure 1 illustrates a case where a 20 percent reduction in water applied to a winter wheat crop resulted in approximately 4 percent reduction in yields.

Don't schedule irrigations to keep the driest parts of the field (the hot spots) fully irrigated. Instead, focus on areas of the field that represent average conditions and schedule to keep those areas fully irrigated. This approach might be used where field soils are highly variable. In such cases the farm manager must decide what fraction of the field should be fully irrigated based on the distributions of the different soil types and the proportions of the field that would be most adversely affected.

Optimal timing

Concentrating irrigations at critical stages of crop development and withholding water at other times can maximize the productivity of water. The most appropriate times to irrigate depend upon the crop. Examples of crop-specific strategies are:

- a) *Alfalfa*: the productivity of water is greatest early in the season. Yields of alfalfa per unit of water used are highest for the first cutting and decrease with later cuttings. The best strategy is to concentrate irrigations at the beginning of the season (always subject to need, as determined by scientific irrigation scheduling). Figure 2 shows alfalfa yields per unit of water for several successive cuttings in California's Central Valley.
- b) *Small grains*: the boot, flowering and soft dough stages of growth are most critical. Crop water use between the boot and flowering stages is relatively less productive, and irrigations after soft dough are the least productive. Referring back to Figure 1, the data point labeled T3-C, which had the highest yields per unit of applied water, was irrigated only twice in the season, just prior to boot and at the beginning of flowering.
- c) *Orchards*: the growing season for fruit trees can be divided into three phases, as illustrated in Figure 3. The first phase includes early fruit development (fruit cell division and rapid early fruit growth). The second phase, called the lag phase, is a period of slow fruit growth and relatively greater growth of woody parts of the tree. The third phase is a final period of rapid fruit growth.

Fruit trees, especially stone fruits, are quite sensitive to water stress during the first and third phases, but partial irrigation during the lag phase will generally have little or no impact on fruit production and tree health. Consequently, when water is in short supply, under-irrigation should be timed to occur during the mid-season (phase II) period. (Note, however, that partial irrigation of cherries during the second phase may be difficult to manage because that phase for cherries is very short, about 2 weeks.) Irrigation of fruit trees can be also reduced substantially after harvest, but it should not be suspended completely. During that time the canopy produces the reserves that the tree will use the following spring. Severe stress after harvest may weaken the tree for several years and reduce economic potentials. Therefore, in a drought year, it is not advisable to use all available irrigation water during fruit development to produce a good crop in the current year at the expense of tree health in future years

Irrigation scheduling for partial irrigation

When partial irrigation is practiced, whether by reduced irrigation adequacy or strategic irrigation timing, accurate information about soil moisture conditions in the field is especially important. Scientific irrigation scheduling should be implemented with particular care. It is essential that you know what the nominal (full) irrigation requirement is before calculating the partial irrigation requirement. It is recommended that:

1. Both cumulative crop evapotranspiration (ET_c) and soil moisture measurements can be used to estimate soil water content. Both techniques are subject to error, and comparing the results obtained with both methods can reveal errors in one or the other that may otherwise go undetected.
2. The soil water content at field capacity should be determined as accurately as possible for any site where soil moisture is measured.
3. Soil moisture measurements should be made at more than one point in the field to be sure that readings are representative of field-wide conditions.
4. For central pivot irrigation at least one soil moisture monitoring point should be located close to the section of the field where each irrigation rotation begins; irrigation scheduling should be keyed to soil moisture at that point to avoid a time lag between when soil moisture reaches the critical point and when water is actually applied. Many center pivots and linear move systems are limited to an application rate of $\frac{1}{2}$ inch or less per day. If part of a field falls below the critical point for irrigation it may be impossible to refill the soil profile quickly.

Figure 1
Sensitivity of Winter Wheat to Crop Water Stress When Water Deficits Are Small
wheat yields: Hermiston

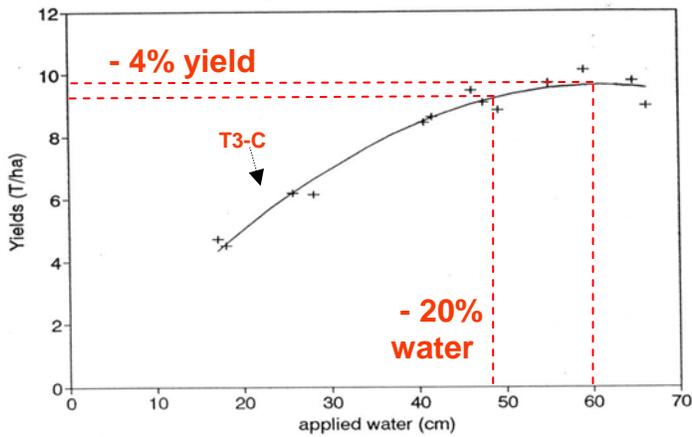


Figure 2
Declining Alfalfa Growth Rates
With Later Cuttings

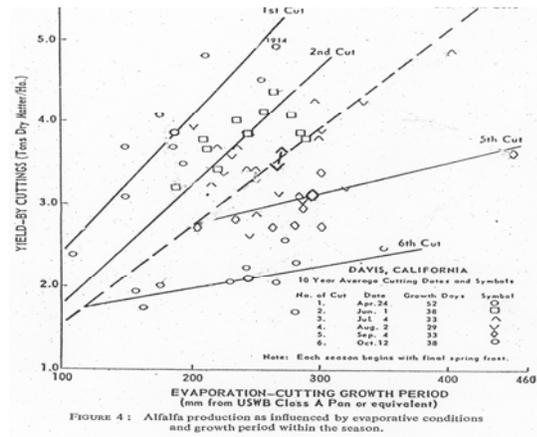
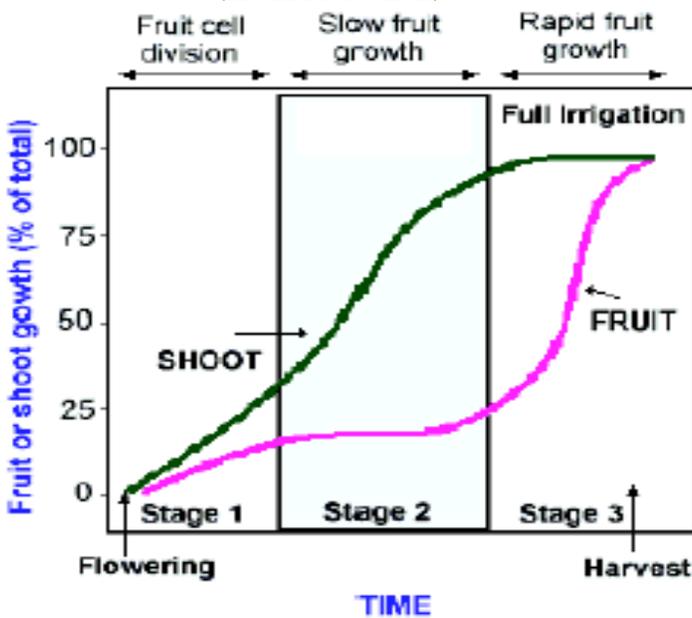


Figure 3
Critical Growth Phases For Fruit Trees
 (from R. Nunoz)



Irrigation System Walk-Through Inspection Analysis

This "walk-through" worksheet provides a method for making an organized inspection of an entire irrigation system, both hydraulics and hardware. This inspection will help identify components that need maintenance, repair, replacement, or other attention—so that the system will provide the most satisfactory, safe, and efficient performance.

Suction system

Inspect system from water supply to pump intake. Generally, suction line should provide smooth water flow with a minimum of fittings that cause obstructions, water turbulence, or head losses.

From surface supplies and shallow wells

Note: On shallow wells with aboveground pump mounting, consider pulling suction line to make starred (*) checks.

| | OK | Needs attention |
|---|-------|-----------------|
| 1. Trash screening device (if used) clean and properly placed. | _____ | _____ |
| *2. Intake screen clean, good condition, properly placed. | _____ | _____ |
| *3. Foot or check valve operating smoothly. | _____ | _____ |
| *4. Suction line does not collapse when pumping. | _____ | _____ |
| *5. Suction pipe size/pump capacity properly matched to maintain flow velocity at 5 feet per second (fps) or less (preferably 2-3 fps). | _____ | _____ |
| *6. Maximum elevation rise from water surface to pump impeller eye does not exceed 10 feet. Required net positive suction head (NPSH) must not exceed NPSH available; see pump performance curve. | _____ | _____ |
| *7. Suction pipe inlet submerged adequately to prevent entrance of air and eddying of water. | _____ | _____ |
| *8. Suction line free of air leaks. | _____ | _____ |
| 9. No unnecessary or undersized plumbing fittings in suction line to increase friction losses. | _____ | _____ |
| 10. Elbows, bends of flanged type. | _____ | _____ |
| 11. Couplings flanged or smooth interior bore. | _____ | _____ |
| 12. Eccentric adapter to pump with 12° taper (not over 28°). | _____ | _____ |
| 13. Eccentric adapter installed with slope on bottom side. | _____ | _____ |
| 14. Straight pipe at least 4 diameters in length before pump inlet to reduce water turbulence, cavitation. | _____ | _____ |
| 15. Horizontal suction line to pump sloped upward at least ¼ inch per foot. | _____ | _____ |
| 16. High point of suction line at pump entrance to eliminate air entrapment. | _____ | _____ |
| 17. Vacuum gauge or port installed on suction line. | _____ | _____ |
| 18. No part of suction piping smaller in diameter than pump suction inlet. | _____ | _____ |
| From deep wells | | |
| 1. Well casings properly located and perforated to allow water intake without cascading or introducing air into impellers. | _____ | _____ |
| 2. Bowls set below water drawdown level. | _____ | _____ |
| 3. Bowl settings properly adjusted. | _____ | _____ |

Pump and fittings

Inspect pump assembly with its associated inlet and discharge fittings. Consider motor separately.

OK

Needs attention

Aboveground centrifugal pumps

| | | |
|--|-------|-------|
| 1. Sturdy pump base with pump firmly attached. | _____ | _____ |
| 2. Intake pipe firmly supported within 3 feet of pump. | _____ | _____ |
| 3. Discharge pipe firmly supported within 3 feet of pump. | _____ | _____ |
| 4. Impeller rotates freely in casing. | _____ | _____ |
| 5. Pump operates with no excess vibration. | _____ | _____ |
| 6. Bearings in good condition. | _____ | _____ |
| 7. Shaft properly aligned with motor. | _____ | _____ |
| 8. Impeller firmly attached to shaft. | _____ | _____ |
| 9. Stuffing, seals, shaft packing adjusted for proper water drip lubrication. | _____ | _____ |
| 10. Wear ring in good condition with no deposition, cavitation, or abnormal configuration. | _____ | _____ |
| 11. Water velocity in pipeline at 5 fps or less. | _____ | _____ |
| 12. Pressure gauge or port at pump discharge. | _____ | _____ |
| 13. Discharge increaser has 12° taper (maximum 28°). | _____ | _____ |
| 14. Increaser near as possible to pump. | _____ | _____ |
| 15. Straight pipe run out of pump discharge to minimize turbulence (for flow measurement). | _____ | _____ |
| 16. No unnecessary or undersized fittings in discharge line that increase friction losses: | | |
| Size, location of tees | _____ | _____ |
| Size, location of elbows, bends | _____ | _____ |
| Size, location of valves | _____ | _____ |
| Size, location of couplings, unions | _____ | _____ |
| Size, location, taper of enlargers | _____ | _____ |
| 17. Flow meter with low flow restriction. | _____ | _____ |
| 18. Air relief valve at high point in system to release trapped air. | _____ | _____ |
| 19. Isolation valve on primer pump. | _____ | _____ |

Deep well turbines

| | | |
|---|-------|-------|
| 1. Sturdy motor base; motor firmly supported. | _____ | _____ |
| 2. Discharge pipe firmly supported. | _____ | _____ |
| 3. Pump operates with no excess vibration. | _____ | _____ |
| 4. Pump lubricated with turbine-type oil. | _____ | _____ |
| 5. Oilers working properly. | _____ | _____ |
| 6. Working airline in well to measure drawdown. | _____ | _____ |
| 7. Water velocity in pipeline at 5 fps or less. | _____ | _____ |
| 8. Pressure gauge or port in discharge line. | _____ | _____ |
| 9. Concentric discharge fitting, if appropriate. | _____ | _____ |
| 10. Straight pipe run out of pump discharge to minimize turbulence (for flow measurement). | _____ | _____ |
| 11. No unnecessary or undersized plumbing fittings in discharge line that increase friction losses: | | |
| Size, location of tees | _____ | _____ |
| Size, location of elbows, bends | _____ | _____ |
| Size, location of valves | _____ | _____ |
| Size, location of couplings, unions | _____ | _____ |
| Size, location, taper of enlargers | _____ | _____ |
| 12. Flow meter with low-flow restriction. | _____ | _____ |
| 13. Air relief valve at high point in system to release trapped air. | _____ | _____ |

For Further Reading

Hansen, Hugh J., and Walter L. Trimmer, *Irrigation Runoff Control Strategies*, Pacific Northwest Extension publication PNW 287.

Trimmer, Walter L., and Hugh J. Hansen, *Irrigation Scheduling*, Pacific Northwest Extension publication PNW 288.

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Nishihara, A. and C. Shock. 2001. Benefits and Costs of Applying Polyacrylamide (PAM) in Irrigated Furrows. Available at <http://www.cropinfo.net/bestpractices/bmppamreport.html> accessed 1 April 2005.

Nishihara, A. and C. Shock. 2001. Cost and Benefits of Surge Irrigation. Available at <http://www.cropinfo.net/bestpractices/bmpsurgereport.html> accessed 1 April 2005.

Shock, C.C. 2005. Instrumentation for Soil Moisture Determination. Available at: <http://www.cropinfo.net/AnnualReports/1997/instrumentation.wq.html>

Goldhamer, D.A. 2003. Managing irrigation in fruit and nut trees during drought. Drought Tip 92-09, University of California, Davis.

Goodwin, I. and Boland, A. M. 2002. Scheduling deficit irrigation of fruit trees for optimizing water use efficiency. In: Deficit Irrigation Practices, FAO Water Report No. 22, Rome.

Contact your local county Extension office for information on obtaining these publications.

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