

Water Management and Conservation Plans

A Guidebook for Oregon Municipal Water Suppliers

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Prepared by:
Economic and Engineering Services, Inc.

Prepared for:
League of Oregon Cities,
Oregon Water Utilities Council, and
Special Districts Association of Oregon

In Association with
Oregon Water Resources Department

Participants

Preparation of this Guidebook was overseen by a Review Committee organized by the League of Oregon Cities and the Oregon Water Utilities Council. LOC and OWUC gratefully acknowledge the contributions by members of the Review Committee. These individuals are:

Willie Tiffany, League of Oregon Cities
Lorna Stickel, Portland Water Bureau
Dan Bradley, Oregon Water Utilities Council
Paul Eckley, City of Salem
Tom Penpraze, City of Corvallis
Adam Sussman, Oregon Department of Water Resources
Doug Parrow, Oregon Department of Water Resources
Rob Schab, Coos Bay/North Bend Water Board

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This document was authored by the following staff of Economic and Engineering Services, Inc. (EES):

Wade Hathhorn, President
Andrew Graham, Project Manager
Timothy Henkle, Staff Planner

Formatting and graphic design were provided by Christine Rains of Christine Rains Graphic Design.

Web Links to this Document

This document can be viewed and downloaded from the Web at:

<http://www.orcities.org/publications/>

The Oregon Administrative Rules 690-086 and 690-315 are located on the web at <http://www.wrd.state.or.us>

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Acronyms

AWWA	American Water Works Association
DEQ	Oregon Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
LCDC	Oregon Land Conservation and Development Commission
NOAA	National Oceanic and Atmospheric Administration
OAR	Oregon Administrative Rules
ORS	Oregon Revised Statutes
ODFW	Oregon Department of Fish and Wildlife
WMCP	Water Management and Conservation Plan
WRD	Oregon Water Resources Department

1. Introduction

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his Guidebook offers direction on preparation of Water Management and Conservation Plans (WMCPs) for municipal water suppliers in Oregon. Development of this Guidebook was sponsored jointly by the League of Oregon Cities (LOC), the Oregon Water Utilities Commission (OWUC)¹ and the Special Districts Association of Oregon. In addition, staff from the Oregon Water Resources Department (WRD) served on a Review Committee that oversaw development of this document.

The purpose of this Guidebook is to assist municipal water suppliers in preparing WMCPs that meet revised State requirements found in Oregon Administrative Rules (OAR) 690-086. By doing so, it is hoped that management and stewardship of water resources throughout the State will be improved, while serving the present and future supply needs of the State's citizens and communities.

WMCP Description

A WMCP is a plan developed by a water supplier such as a city water system, water district, or a private organization that describes the water system and its needs, identifies its sources of water, and explains how the water supplier will manage and conserve those supplies to meet present and future needs. As such, a WMCP is a long term water management and conservation tool. Preparation of a WMCP is intended

to represent a pro-active evaluation of the management and conservation measures that suppliers can undertake.

The requirement for completing such plans is tied to the revised rules surrounding water permit extensions as described under OAR 690-315. These rules call for all suppliers serving over 1,000 people to complete a WMCP in association with water permit extensions. OAR 690-086 details the requirements of WMCPs.

Similarly, some agricultural water suppliers may also need to prepare WMCPs. However, this Guidebook was prepared solely to assist municipal water suppliers in the preparation of a WMCP and does not address associated requirements for agricultural water suppliers.

Update of Division 86

Oregon's municipal water suppliers are permitted to "grow into" their water rights over a period of time. Historically, the Department routinely issued five-year extensions to suppliers to continue developing municipal permits. Once a community grew to a size where the permit was fully used, the community submitted proof of perfection of the right and WRD issued a certificate of water right. In 1989, the statutes were amended to also allow many municipal water suppliers to certificate their water rights in 25 percent increments while continuing to develop the balance

¹ OWUC is a committee of the American Water Works Association, Pacific Northwest Section.

of the permit. These approaches are different than the procedures applied to holders of non-municipal permits where the timelines for construction of facilities to divert and use the water authorized under a permit and for the submittal of final proof documenting the beneficial use of water are less flexible.

In 1997, the state Attorney General issued advice to the Department that affected permit extensions in two major ways: (1) In considering whether to grant an extension, the Department may evaluate the public interest of continued development under the permit, and (2) in granting a permit extension, the Department must authorize the extension for the full period of time that the permittee anticipates needing to complete development under the permit rather than for fixed five-year increments. However, the advice did indicate that subsequent extensions could be granted if development of the permit takes longer than originally expected.

In 1998 while incorporating the advice of the Attorney General into the Department’s administrative rules, both Department staff and the municipal stakeholders agreed that municipal extension issues were unique, warranting a separate rule development process to focus on their resolution. In order to move forward with the rulemaking, an exemption was created that allowed for continued development of municipal permits despite the expiration of previously granted extensions. In addition, the Department agreed to convene the Community Water Supply Work Group to review issues associated with permit extensions and to recommend changes, where appropriate, to current laws and rules. The work group included representatives from municipalities, environmental organizations, and WRD.

In 2001, after several meetings with the Community Water Supply Work Group, the Department proposed an approach which linked long-term permit extensions to the development of a WMCP. Municipalities would be granted extensions allowing development of their permits over a long period of time, consistent with the needs of the community. In turn, municipal sup-

pliers would be required to complete WMCPs showing prudent management and conservation of the resource. This approach was adopted as rule by the Water Resources Commission in October 2002.

Under the revised rules, a municipal permittee can ask for a long-term extension to complete development of the permit. The period of the extension will depend on the municipality’s projections of how long it will take to fully use the quantity of water allowed under the permit. However, under the extension the municipality will not be authorized to initiate or expand their use of water under the permit beyond current authorized quantities. This authorization will be granted through the Department’s review and approval of the municipality’s WMCP. The Department will authorize the use of water under extended permits in 20-year blocks, as long as the WMCP provides clear justification that the water will be needed and the municipality is managing and conserving water in a responsible manner.

The rules are contained in Oregon Administrative Rules (OAR) Chapter 690, Divisions 86 and 315—the former of which is the focus of the material described in this Guidebook. The updated rules include several key concepts:

- The historic procedure of renewing permit extensions every five years is eliminated. Municipal permittees can now request extensions based on the period of time that will be needed to fully develop the permit. Depending on the particular circumstances, an extension can be issued for as long as 50 years, or even longer with sufficient documentation.
- Most future municipal water right extensions will include a requirement that the supplier prepare or update a WMCP within three years of approval of the extension and “freezing” the quantity of water that may be diverted or pumped under the extended permit pending completion of the WMCP.

- The supplier will be required to gain WRD approval for any expansion of the use of water under an extended permit. This approval will be provided based on a demonstration in the supplier’s WMCP that the water will be needed in the next 20 years. In approving a WMCP, WRD will grant the authorization to use the increased quantity of water. This “green light” water will represent a limit on the extent to which the community is authorized to pump or divert water until an updated WMCP is submitted and approved by WRD. Suppliers may submit updated plans seeking authorization for additional “green light” water at any time.
- ^a WRD’s review of any WMCPs that are submitted after January 1, 2042 and that request authorization to increase water diversions will include an evaluation of competing needs, environmental needs and other public interest considerations.
- Water conservation is now viewed as a critical element in the State’s water supply inventory. Water suppliers will need to show in their WMCPs that they have considered a range of water management and conservation actions to minimize their needs and to develop their supplies in an environmentally responsible manner. Conservation actions must be considered as an alternative to increased development of water.
- All water suppliers must implement a core group of water conservation measures. Some water suppliers must also consider the feasibility of a range of additional conservation actions. In general, those water suppliers serving a population greater than 7,500 must consider the additional actions and must document the basis for any decision not to implement the additional conservation measures. Some water suppliers serving smaller communities will also need to consider the wider range of conservation actions if they are expanding their use of sensitive resources.

There are many additional elements to preparing a WMCP, and these are explained in other sections of this Guidebook.

How to Use this Guidebook

To use this Guidebook, water suppliers should first review the Section 2 titled “Quick Summary of Division 86.” This section explains who must prepare a WMCP and provides timelines for preparation and submittal to WRD. The summary also provides a brief overview of the kind of information a WMCP should contain, along with an explanation of how WRD will evaluate these plans.

Any water supplier preparing a WMCP should next review the “Guidance for Preparing WMCPs.” This section offers checklists of the content of a WMCP. It explains each specific item required in the OAR-690-086, and provides step-by-step information on how to develop a plan. In some cases, planning activities cannot be fully explained within this Guidebook alone. Therefore, the Guidance section also lists published resources for additional information.

Appendices B and C contain sample plans for two representative water systems. The sample plans are intended to assist water suppliers understand the content of a WMCP. However, they should not be viewed as “templates” for preparation of a WMCP. Each water supplier preparing a WMCP will need to review its own water supplies, community needs and other individual circumstances, in order to prepare a WMCP that meets State requirements.

This Guidebook also contains several additional appendices selected to provide information of value to water suppliers preparing a WMCP. The additional appendices include:

- Division 86 in its entirety
- Information Resources from the 1998 EPA Water Conservation Plan Guidelines
- Sample Outline for a WMCP
- Curtailment Ordinance
- Examples of Municipal Conservation Measures

By following the information contained in this Guidebook, municipal water suppliers throughout the State will be better prepared to meet the requirements of the updated Division 86 regarding WMCP preparation.

2. Quick Summary of Division 86

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his section summarizes the Oregon Administrative Rules (OAR) 690-086 and 690-315 as they relate to water management and conservation plans (WMCPs). This summary is provided in a question and answer format so that readers can quickly and easily find topics of interest.

The complete OAR-690-086 is included in Appendix A of this Guidebook and reference to a website link is found on page ii. In addition, more detailed

discussion about how to comply with OAR 690-086 and 690-315 is provided in Section 3 of this Guidebook. Note that though there is significant overlap in the summary below with Section 3, some topics are adequately described below and needed no further description in Section 3.

Where appropriate, at the end of each answer are cross references to the Section 3 or applicable ORS, OAR, or both for easy reference.

What is a WMCP?

A WMCP is a plan created by a water supplier documenting the supplier's use, management, and conservation of water resources. OAR 690-086 governs the requirements for developing a WMCP. Portions of 690-315 (Permit Extensions) also affect a WMCP. In 2002, changes went into effect which expanded the scope of OAR 690-086 and 690-315. The Oregon Water Resources Department (WRD) is the state agency with the responsibility to make sure the requirements of 690-086 and 690-315 are met.

Why is a WMCP required?

In many cases, a WMCP is a condition of approval for a water right permit or permit extension. The rules in OAR 690-086 and 690-315 provide a process to promote efficient use of the state's water resources and to facilitate water supply planning. A WMCP is the tool which the state uses to require water suppliers to implement water conservation measures and plan for future demands.

A WMCP helps a water supplier support applications to WRD which request water use permits and transfers, reservations of water, and permit amendments, extensions, and exchanges. A WMCP helps WRD and other interested parties evaluate efforts of a water supplier to efficiently use water.

OAR 690-086-0010

How does a WMCP relate to water rights for a municipal water supplier?

An approved WMCP provides the basis for WRD to authorize increased diversion of water under existing permits that have been extended or that include conditions limiting the use of water pending a more complete justification of the water supplier's need for additional water.

OAR 690-315-0010(4), 690-315-0090(3)

Who must submit a WMCP?

Almost all municipal or quasi-municipal water suppliers who request water right extensions and new water rights must submit WMCPs. Exceptions are made for water suppliers who submit a water right extension if 1) those suppliers have a service population of less than 1,000 or 2) those suppliers demonstrate that they will apply water to full beneficial use in less than 5 years. However, WRD has the discretion to require even these suppliers seeking a permit extension to submit a WMCP where there are special conditions involved. WRD will inform water suppliers of the need to submit a WMCP in the order approving an extension.

OAR (water right extensions): 690-315-0010(4), 690-315-0090(3)-(5)

ORS (new water rights): 537.150, 537.615

What if a WMCP has already been submitted and approved?

Suppliers will not need to resubmit a new WMCP simply to make it consistent with the revised OAR 690-086 if their current WMCP was approved by WRD. However, since a WMCP must be periodically updated, resubmitted, and approved by WRD, any future updates that are required to be submitted after November 1, 2003, must meet the criteria in the current OAR 690-086.

OAR 690-086-0915(4)(a)

Which OAR should suppliers use: the revised or the old OAR?

Language in OAR 690-086 was revised and adopted in 2002 by the Water Resources Commission. Therefore, suppliers who submit a WMCP to comply with a permit extension order issued by WRD after November 1, 2002 will need to use the revised OAR 690-086. Also, after November 1, 2003, all WMCPs submitted to WRD will need to meet the criteria of the revised OAR 690-086. Suppliers who submit a WMCP for purposes other than to comply with a permit extension order (e.g. to secure a newwater right permit) before November 1, 2003 can use OAR 690-086 adopted by the Water Resources Commission in 1994. In these instances, suppliers can request WRD apply the criteria as currently found in OAR 690-086 instead.

How is a WMCP related to a Water System Master Plan?

A WMCP generally involves a more comprehensive evaluation of water supply alternatives, including water conservation programs, than a Water Master Plan. A Water Master Plan is more water supply facilities oriented. However, both a WMCP and a Master Plan are tools to help water suppliers plan for the future. In this regard, Division 86 allows a Water Master Plan to substitute for a WMCP if the Master Plan substantially satisfies the requirements of a WMCP. Due to overlap of the plans, water suppliers should consider updating an outdated master plan while creating a WMCP and wrapping the WMCP within the master plan.

Guidance Section 3.2.3

OAR 690-086-120 (6)

When does a WMCP need to be submitted?

For a water right extension, a WMCP must be submitted within three years of WRD issuing an order approving the extension. Then, within ten years, a water supplier must submit an updated WMCP. There are some exceptions, however. When approved with a work plan, an updated WMCP must be submitted within five years. See the next question and answer for a description of a work plan. Also, a water supplier who chooses to submit an application for one or more additional diversions of water before the next scheduled WMCP update may be required to submit an updated WMCP if the need for the diversion is not given in the existing plan. Exhibit 2.1 diagrams the typical lifecycle of a WMCP, from water right permit application to water right certification. Note that the Exhibit 2.1 represents a typical lifecycle, but it may not depict the same time frames and processes experienced by all water suppliers due to suppliers' differing needs.

Water suppliers who request new water rights, in most cases, will be required to submit a WMCP within two years from issuance of the water right permit.

OAR 690-315-0090(3), 690-086-0125(6)

What is a work plan?

After submitting a WMCP and revising that WMCP based on comments from WRD, some WMCPs may still not meet WMCP Division 86 rule requirements. In these cases, WRD may require the water supplier 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. Water suppliers who are required to submit a work plan generally will be given five years to meet this schedule. However, water suppliers will be only allowed to divert water beyond the need listed in an extended permit for the next two years until the work plan schedule is satisfied.

*Guidance Section 3.7
OAR 690-086-900(3) and (4)*

What are the major elements of a WMCP?

A WMCP has the following four elements:

- Description of the municipal water supplier,
- water conservation element,
- water curtailment element, and
- water supply element.

A description of each of these elements follows.

What should the water supplier description include?

This element sets the stage for the rest of the elements by providing current information about the water supplier and the water supplier's system. Required components of this section include sources of water, service area, present and anticipated service population, adequacy and reliability of water supply, water use characteristics, water rights, interconnections with other water systems, water system demand, maps, and leakage estimates.

*Guidance Section 3.3
OAR 690-086-0140*

What should the water conservation element include?

The water conservation element should include past, current, and future water conservation measures performed or to be performed by the water supplier. Future conservation measures must include benchmarks in five year increments extending out for the life of the WMCP.

Division 86 lists specific conservation measures for the water supplier to implement and also requires some water suppliers to address additional measures. These additional measures apply to a water supplier of a given size or having known water resource issues. (See next question.) In addressing these additional measures, the supplier is generally required to evaluate the feasibility of each of the measures and to implement any of the measures that the supplier concludes are feasible.

Guidance Section 3.4

OAR 690-086-0150

Which water suppliers must address the additional conservation measures described above?

Water suppliers must address the additional conservation measures if at least one of the following conditions are met:

- A water supplier serves a population greater than 7,500.
- A water supplier serves a population between 1,001 and 7,500 and proposes to expand or initiate diversion of water under an extended permit for which resources issues have been identified under OAR 690-86(5)(i). Water resource issues may include the presence of listed species, surface water quality impairment, or a critical groundwater area.

Guidance Section 3.4.2

OAR 690-086-0150(6), OAR 690-086-140(5)(i)

What is a benchmark?

A benchmark is an action a water supplier commits to doing and a schedule for carrying out water conservation activities between the time a WMCP is submitted to WRD and the next progress report or WMCP update. This definition is specific to Division 86.

Guidance Section 3.4

OAR 690-086-0030(2)

What should the water curtailment element include?

The water curtailment element will help water suppliers react quickly and effectively to meet a community's needs in the event of a water supply emergency, such as supply shortage due to drought, contamination, or infrastructure failure.

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

Guidance Section 3.5

OAR 690-086-0160

What should the water supply element include?

The water supply element should describe and support future water supply needs of the supplier. These needs must be based upon population projections and anticipated development as found in comprehensive land use plans, where available, or other similar planning documents. Water supply needs must be estimated for 10 and 20 years, though a water supplier may estimate for longer periods.

A water supplier which requires expansions or initial diversions of water associated with existing permits also is required to consider alternative supply options and address environmental impacts upon the supply source(s).

Guidance Section 3.6
OAR 690-086-0170

What additional information must be considered when creating a WMCP?

There are several additional items which must be considered when creating a WMCP. Not all items apply to all water suppliers.

- The supplier must include a list of affected local governments to whom a draft WMCP was made available for review and comment and any comments from those local governments.
- The water supplier 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 water supplier considering other scheduled community planning activities and the rate of population growth or other changes expected by the water supplier.
- If the water supplier believes future updated WMCPs are unnecessary, the water supplier must explain why.
- If a water supplier has requested additional time to implement metering or a benchmark established in a previously approved WMCP, the supplier must document the reason additional time is necessary to avoid unreasonable and excessive costs.

Guidance Section 3.7.1
OAR 690-086-0125

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. In particular, WRD will use the following criteria:

- A need for water over the next 20 years is demonstrated using information from appropriate planning documents.
- Benchmark actions are reasonable and appropriate for required conservation measures.
- The manner in which recommended conservation measures were evaluated is suitable.
- Resource issues identified are accurate and complete.
- Curtailment plan satisfactorily promotes effective curtailment practices.
- Where appropriate, a WMCP includes a cost comparison of alternative water sources, including conservation.
- Where appropriate, a WMCP includes compliance with mitigation requirements.

OAR 690-086-0130

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

The typical process is as follows: 1) A water supplier submits a WMCP to WRD, 2) WRD issues public notice of the receipt of the WMCP, 3) WRD prepares a preliminary review of the WMCP considering any public comments, 4) the water supplier responds to WRD's review by revising the WMCP, as appropriate, and 5) WRD issues an order approving the WMCP (see Exhibit 3.8). The preliminary review process can take as little as 90 days. However, approval of a WMCP that does not meet the criteria may take substantially longer than 90 days. For deficient WMCPs, a work plan may be developed by WRD. A work plan provides strict direction for future activity, but allows approval of a WMCP. (See "What is a workplan?" in this section.)

Guidance Section 3.8

OAR 690-086-0900 to 0920

When can a water supplier begin diverting additional water?

A water supplier may begin diverting water on issuance of a new permit unless WRD approved the permit with conditions. For approved permit extensions, the rate of diversion under the permit will be frozen until the water supplier submits a WMCP and WRD issues an order approving the WMCP.

OAR 690-315-0090(3)

What will WRD's order approving a WMCP include?

The order will include the following:

- The maximum amount of water authorized for diversion during the next 20 years,
- the date the next update of the WMCP should be submitted to WRD (typically within 10 years), and
- a schedule to submit progress reports (typically every 5 years).

An order may include a requirement to meet the elements described in a work plan.

OAR 690-086-0915

What recourse does a water supplier have if WRD's decision to divert additional water is unfavorable?

Most, if not all, decisions by state agencies allow affected parties to contest agency decisions. WRD also has a process in place to address contested decisions. At the request of the supplier, the process can include review of WRD's decision by a review board that includes representatives of other water suppliers.

OAR 690-086-0915(8)-(10)

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

Progress reports are submitted no less than every five years to WRD. These reports must describe the water supplier's progress toward implementing the benchmarks called out in the WMCP and may describe other related topics which describe progress. The progress reports will help WRD determine whether a water supplier is diligent in developing its water right. WRD may use the progress reports when considering approval of the next WMCP update.

Guidance Section 3.4.4 and 3.7.2

OAR 690-086-0120(3)-(5)

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

Since Division 86 requires that future water use estimates be consistent with land use and population projections, water suppliers should use the information contained within comprehensive land use plans of each affected local government. A draft WMCP must be submitted to each affected local government with a request for comments about how the pertinent sections in the WMCP match the local government's comprehensive land use plan.

OAR 690-086-0120(7) and (8)

What is required in terms of public involvement?

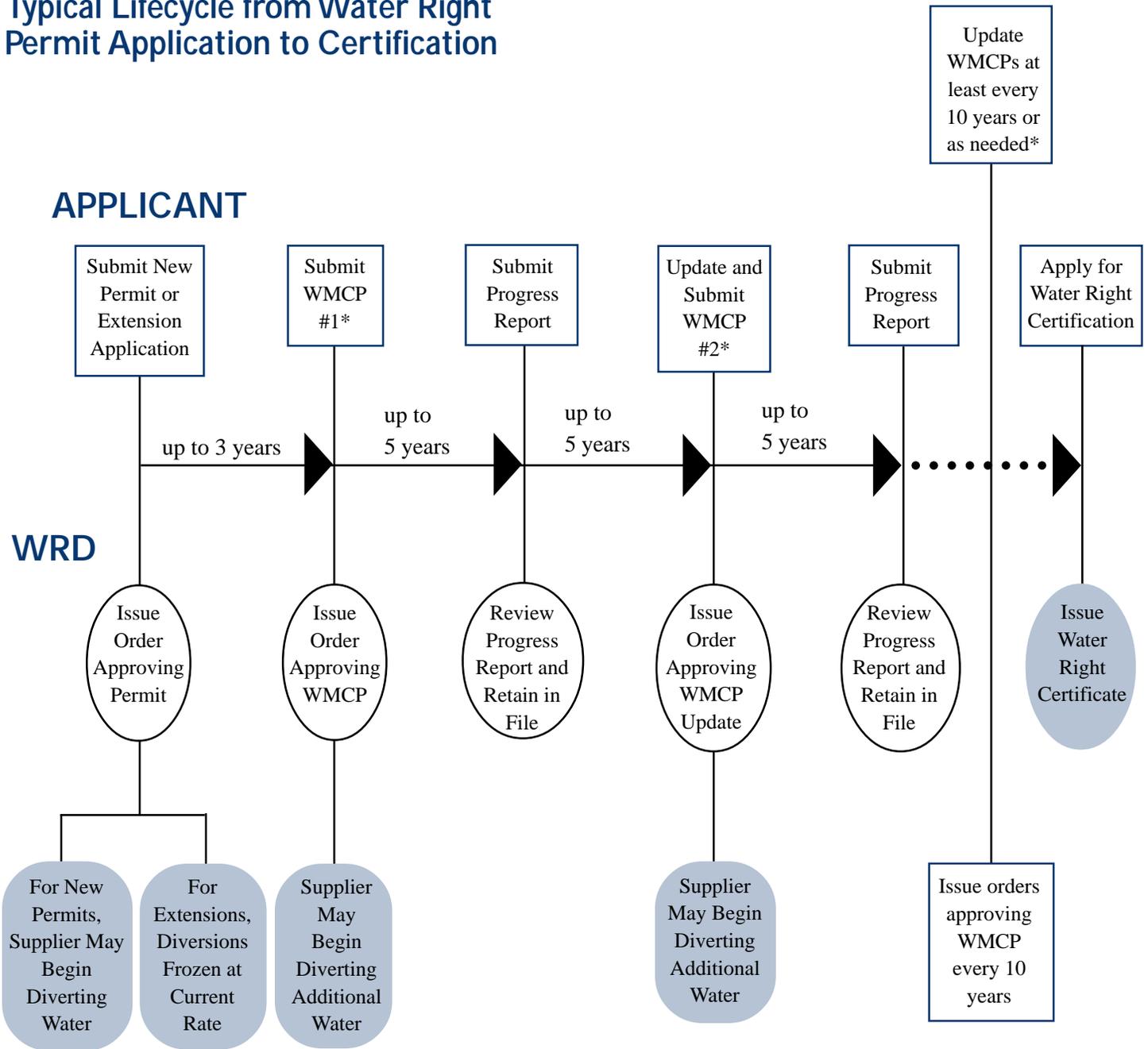
Though Division 86 does not require public involvement, it encourages water suppliers to involve the public during the preparation of a WMCP. Division 86 suggests making the WMCP available for public inspection and conducting public meetings to provide information and gather input.

*Guidance Section 3.2.7
OAR 690-086-0120(9)*

Will WRD recognize the benefits of conservation actions implemented prior to an extension application or WMCP?

The purpose of a WMCP is to document a sound and responsible approach to managing water resources. Where a water supplier 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 supplier, these past actions could potentially serve to meet some or all of the required conservation actions.

Exhibit 2.1 Typical Lifecycle from Water Right Permit Application to Certification



* Each new WMCP or WMCP update must forecast and justify water use for 20 years.

Note: The lifecycle displayed above is a representation of a typical water right lifecycle. The time frame and process shown may not mirror the time frame and process experienced by all water suppliers.

3. Guidance

Section 3.1 Introduction

This section is intended to describe in detail the new Oregon Administrative Rules in Chapter 690 Division 86 (Division 86), how they apply to water providers, and how water providers can write effective Water Management and Conservation Plans (WMCPs). Where the Quick Summary (Section 2) offered a brief look at the requirements of Division 86, Section 3 provides greater detail and presents new material regarding the requirements. It also describes how to assemble a WMCP. Here, readers will find out how to project future water demand, create conservation measure benchmarks, and write a curtailment plan, if a water supplier does not already have one. Since WMCP requirements can be dependent upon the number of customers served by the water supplier, this section was written for water suppliers of all sizes.

The organization of this section is based on the layout of Division 86 and is written in a step-by-step format. This format will prove useful in the development of WMCPs. Section 3.2, *Getting Organized*, lists helpful preliminary steps, which will make the process of developing a WMCP easier. Section 3.3, *Preparing the Water Supplier Description*; Section 3.4, *Preparing the Water Conservation Element*; Section 3.5, *Preparing a Water Curtailment Plan*; and 3.6, *Preparing a Water Supply Element* mirror the four major ele-

ments of a WMCP as described in Division 86. Refer to each of these subsections for detailed guidance.

In addition, readers will find other useful sections. Section 3.7, *Finalizing the Plan Document and On-Going Tasks* discusses the finishing touches for a WMCP and highlights how water suppliers can improve their chances of having any future WMCPs approved quickly. Finally, Section 3.8, “*WRD Review Process*” describes the process used by the Oregon Water Resources Department (WRD) to review WMCPs.

While reading Section 3, water providers may wish to refer to the sample WMCPs in Appendix B and Appendix C. Appendix B represents a fictitious water supplier which supplies water to 3,000 customers while Appendix C depicts another fictitious water supplier who serves 18,000 customers.

Throughout this section, readers will note the use of a “tip” icon. This icon indicates the location of a helpful tip which may prove useful to a water supplier during the development of a WMCP.



There are two other icons found throughout Section 3. Division 86 include some items relevant to all water suppliers who prepare a WMCP. Other items, however, apply only to water suppliers meeting certain conditions. Throughout this section, the following icons are used:

This icon indicates that every supplier preparing a plan should include the item under discussion.



This icon indicates that not all suppliers are required to address the item under discussion. Each supplier should review the information presented below and determine whether the item applies to them under Division 86.



Exhibit 3.1 pulls all these items with the check box icons or together into an easy to read checklist. Water suppliers may wish to mark in the boxes provided those items that apply to them to keep better organized. Also, suppliers may wish to check each item off after that item has been completed. Finally, for those wishing to go straight to the source, Division 86, found in Appendix A, can be consulted for information.

Exhibit 3.1**Guidance Section Checklist**

For all the tasks that apply, place a check in the first box. Check the second box once the task is completed. Boxes pre-checked represent tasks required to be performed by all water suppliers.

Sections and Tasks		OAR Reference	Guidance Pg. No.
Water Supplier Description			
<input checked="" type="checkbox"/>	Description of supplier's source(s)	690-086-0140 (1)	18
<input checked="" type="checkbox"/>	Delineation of current service area	690-086-0140 (2)	19
<input checked="" type="checkbox"/>	Assessment of adequacy and reliability of existing supplies	690-086-0140 (3)	19
<input checked="" type="checkbox"/>	Quantification of present and historic use	690-086-0140 (4)	20
<input checked="" type="checkbox"/>	Summary of water rights held	690-086-0140 (5)	20
<input checked="" type="checkbox"/>	Description of customers served and water use summary	690-086-0140 (6)	21
<input checked="" type="checkbox"/>	Identification of interconnections with other suppliers	690-086-0140 (7)	22
<input checked="" type="checkbox"/>	System schematic	690-086-0140 (8)	22
<input checked="" type="checkbox"/>	Quantification of system leakage	690-086-0140 (9)	22
Water Conservation Element			
<input checked="" type="checkbox"/>	Full metering of systems	690-86-0150 (4)(b)	24
<input checked="" type="checkbox"/>	Meter testing and maintenance program	690-86-0150 (4)(c)	25
<input checked="" type="checkbox"/>	Annual water audit	690-86-0150 (4)(a)	26
<input type="checkbox"/>	Leak detection program	690-86-0150 (4)(e)	27
<input type="checkbox"/>	Leak repair or line replacement program	690-86-0150 (6)(a)	28
<input checked="" type="checkbox"/>	Rate structure based on quantity of water metered	690-86-0150 (4)(d)	29
<input type="checkbox"/>	Rate structure and billing practices that encourage conservation	690-86-0150 (6)(d)	31
<input checked="" type="checkbox"/>	Public education program	690-86-0150 (4)(f)	32
<input type="checkbox"/>	Technical and financial assistance programs	690-86-0150 (6)(b)	33
<input type="checkbox"/>	Retrofit/replacement of inefficient fixtures	690-86-0150 (6)(c)	33
<input type="checkbox"/>	Reuse, recycling, non-potable opportunities	690-86-0150 (6)(e)	34
<input type="checkbox"/>	Other measures, if identified by supplier	690-86-0150 (6)(f)	34
<input checked="" type="checkbox"/>	Progress report on previous WMCP	690-86-0150(1)	36
<input checked="" type="checkbox"/>	Documentation of water use measurement and reporting	690-86-0150(2)	36
<input checked="" type="checkbox"/>	List of measures already implemented or required under contract	690-86-0150(3)	36
Water Curtailment Element			
<input checked="" type="checkbox"/>	Assessing water supply	690-086-0160(1)	38
<input checked="" type="checkbox"/>	Stages of alert	690-086-0160(2)	39
<input checked="" type="checkbox"/>	Triggers for each stage of alert	690-086-0160(3)	39
<input checked="" type="checkbox"/>	Curtailment actions	690-086-0160(4)	40
Water Supply Element			
<input checked="" type="checkbox"/>	Delineation of current and future service areas	690-086-0170(1)	42
<input checked="" type="checkbox"/>	Population projections for service area	690-086-0170(1)	42
<input checked="" type="checkbox"/>	Prepare schedule to fully exercise each permit	690-086-0170(2)	42
<input checked="" type="checkbox"/>	Prepare demand forecast	690-086-0170(3)	43
<input checked="" type="checkbox"/>	Comparison of projected need and available sources	690-086-017 (4)	45
<input type="checkbox"/>	Analysis of alternative sources	690-086-0170(5), (8)	45
<input type="checkbox"/>	Quantification of maximum rate and monthly volume	690-086-0170(6)	46
<input type="checkbox"/>	Mitigation actions under state and federal laws	690-086-0170(7)	46
Other Items			
<input checked="" type="checkbox"/>	List of affected local governments and their comments	690-086-0125 (5)	47
<input checked="" type="checkbox"/>	Date for submittal of next update	690-086-0125 (6)	48
<input type="checkbox"/>	Documentation, where additional time is requested to meet previous benchmarks or metering	690-086-0125 (7)	48

Section 3.2 Getting Organized

As with any planning effort, some up-front effort to organize will pay dividends by making the process smoother and more efficient. This section briefly outlines some ideas for organizing the planning process. This section is “optional” in that the suggestions contained here are not required by Division 86.

3.2.1 Establish Plan Objectives

It may be useful for the water supplier to list some objectives of the planning process right at the outset. This can help guide any staff working on the plan. Examples of potential objectives include:

- Meeting State requirements for the WMCP;
- Improving management of one or more of the supplier’s water sources;
- Minimizing costs of operations, maintenance and capital investments, while meeting desired levels of service;
- Maintaining reliability of water supply at some pre-determined level defined by the supplier;
- Reducing reliance on a given source of supply, while increasing use of another source that is more effective in meeting the water supplier’s specific needs in the long term;
- Reduce potential exposure to liability under the Endangered Species Act, for any sources of water that contain species listed as threatened or endangered (or species that may be listed in the future);
- Maintaining customer satisfaction.

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

3.2.2 Early Discussion with WRD Staff

Municipal water suppliers are encouraged to contact the Oregon Water Resources Department (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. This early contact may save time later in the process. This can also help water suppliers understand better the specific criteria that WRD will apply in evaluating their individual plan.

3.2.3 Linkage to Master Plan, if Applicable

Some water suppliers may determine that it would be effective to include the content of a WMCP within a Water System Master Plan developed for submittal to the Oregon Health Division. If a Master Plan is also needed, this can streamline the planning process and reduce expenses.

3.2.4 Establish a Planning Team

Depending on the size and complexity of a water system, staff assigned to develop the plan may range from one person to a dozen or more. Some water suppliers 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 municipalities in which suppliers share interconnections or conjunctive uses of source. This would be particularly true where outside service providers are needed for services such as leak detection, water audits, alternatives analysis, rate studies, and cost-benefit analysis of water conservation options. 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.

3.2.5 Assembling Information

The checklist in Exhibit 3.1 shows the type of information that may be needed to prepare a WMCP. Not every water supplier will need all of the information listed. At the beginning of the planning process, the water supplier 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 water supplier'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. This includes, for example, land use plans, estimates of current population, and projections of future population, lists of threatened and endangered species and water quality impairments. The list of source information at the beginning of each subsection provided throughout this Section can be used as a starting point, as the water supplier determines what information is needed and where it could be obtained.

3.2.6 Develop Outline of Plan Document

It may be helpful early on to develop a complete outline of the WMCP. Appendix E contains a suggested outline. Water suppliers may wish to use or modify this outline as they organize to prepare a plan.

3.2.7 Provide for Public Involvement, if Desired

Division 86 encourages water suppliers to involve the public as they develop a WMCP. However, public involvement is not required. Therefore, each water supplier should determine the appropriate need and level of public involvement for their specific plan¹.

Public involvement techniques may include:

- Distributing information on flyers inserted with customer bills, articles in a water supplier newsletter or posted on a Web site;
- 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 meetings of City Councils or other public boards and commissions, as well as local community, environmental and business groups;
- Making the plan available for public comment, at water supplier offices, local libraries, posting on a Web site, or through other means.

3.2.8 Funding for Plan Preparation

There are no funding sources specifically earmarked for preparing WMCPs. Water suppliers 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 money for community and economic development, state loans under the Drinking Water State Revolving Fund, and other sources may potentially be available. However, to tap these sources of funding in many cases a community may need to link plan development to a proposed capital project that would receive funding.

¹ It should be noted that Division 86 requires that the draft plan be provided to each affected local government for them to review with respect to their land use plans. This must be done at least 30 days prior to submitting the plan to WRD. The water supplier must provide documentation in the plan that this was done.

Section 3.3

Preparing the Water Supplier Description

After assembling the basic information for the plan, the next step is to begin the preparation of a description of the water supply system, its current service territory, and a summary of available water rights. The steps here are intended to create an inventory of the supplier's sources of water and the facilities used to divert, treat, 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 Water Management and Conservation Plan (WMCP) are outlined under OAR 690-086-140 and are listed in the Exhibit 3.1 in a checklist format.

In the sections below, 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.

3.3.1 Sources of Information

The information needed to prepare this section of the WMCP may often be found in previous reports of the water supply system, including prior master plans, facilities plans or prior WMCP. In addition, the supplier will have to collect data on current and historic water use (over the past five years), as well as summaries of the supplier's current water rights, inter-governmental or exchange agreements for water, and/or water supply or delivery contracts. The supplier will also need a comprehensive summary of the facilities used to divert, treat, store, and deliver water to its customers, along with a legal description or map delineating the supplier's current service area and urban and public service boundaries, if applicable.

The following is a list of helpful sources of information:

Sources of Information

- Prior master plan, facilities plan, or WMCP
- Internal documentation of agreements or contracts for water delivery or purchase
- Water sales billing records and production data
- Drawings of the water supplier's system, "as-builts", system plans, or "record drawings," or CAD drawings
- City or County land use plans
- Interviews with system operators
- Water rights documents
- Summaries of threatened or endangered species from the Oregon Department of Fish and Wildlife, NOAA Fisheries, or U.S. Department of Fish and Wildlife.
- Service boundary agreements and maps
- Capital improvement plans or infrastructure plans

3.3.2 Specific Elements of the Water Supplier Description

More detailed descriptions of the requirements set forth under the rule for describing a supplier are outlined below.



Description of Supplier's Source(s) *OAR 690-086-0140 (1)*

The rule calls for a description of each source of water for the municipal entity, 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.

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 the township, range,

and 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 water supplier should have on file. WRD’s “Water Rights Information System ” database can also be consulted. This database can be accessed online at <http://www.wrd.state.or.us/>. In addition, this information is available by contacting your local watermaster through the Department or online at <http://www.wrd.state.or.us/staff/watermasters.shtml> .

The description of the diversion should also 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 injury to protected aquatic species, as well as any pumps and their capacity used for raw water diversion. Similar descriptions would apply for a ground water right, including a summary of the well depth, screened interval, diameter, and installed pumping capacity.

For storage rights, the source description should include summaries of the name of the river or stream from which water is diverted or stored, as well as brief descriptions of the size of the reservoir, height and crest (width) of the dam, and normal operating pool level.

In addition, the rule requires the supplier to provide brief description of any additional sources of water, including exchange or intergovernmental agreements for water or supply or delivery contracts with other suppliers. The description of these agreements should identify the entity with whom 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.



Delineation of Current Service Area
OAR 690-086-0140 (2)

The intent of this element of the water supplier description is to provide a brief summary of the current area which the supplier serves, along with an estimate

of the population served within that area. The delineation is normally created by providing a map of the current service area boundaries for the supply agency. This map should depict the legal boundaries of the service area for the supply agency and should include reference to associated municipal boundaries (if applicable). Often times, the service area boundaries coincide with municipal boundaries, while others are comprised of a portion of existing city limits or unincorporated portions of a county. The map should be supplemented with a general description of the size of the service area in acres (or square miles) and location with regards to other prominent features, such as municipal or county entities and adjacent water suppliers.

This portion of the water supplier description is also to include an estimate of the population served within the supplier’s boundaries and service areas and public facilities boundaries. The method used to calculate the population estimate should be included.



Assessment of Adequacy and Reliability of Existing Supplies
OAR 690-086-0140 (3)

In conducting this assessment, the supplier should first examine a summary of the water rights held by the supplier 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. Moreover, there are often seasonal limits on the quantity of available water, especially during late summer, early fall. Examples include periodic reduced flow from a spring or well or 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.

A review of historic production records may provide information about reliability of each source.



In addition, the supplier should assess the reliability of those source(s) with regards to existing or future restrictions, such as those that may be imposed through priority date, protection of threatened or endangered species, instream flow requirements, statewide stream clean up plans, threats of future contamination and loss of access from nearby pollution sources, or groundwater limits established by the state (e.g. groundwater limited on 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 and a summary constructed of the actual water available to the supplier, subject to any noted conditions of reliability with regards to continued or expanded use under each water right. Water supplier's needs may include needs for redundancy, emergency backup, etc.

The American Water Works Association, Pacific Northwest Section (AWWA- PNWS) wrote a handbook titled "So You Think You Need More Water?" to help small water systems plan for additional supply. The handbook discusses supply reliability and methods to determine reliability. Water suppliers may find it a useful tool to complete this rule requirement. The handbook is available on the world wide web at <http://www.pnws-awwa.org/pub.cfm>



Quantification of Present and Historic Use

OAR 690-086-0140 (4)

The rule requires the supplier to provide a description of present and historic use that quantifies annual and peak seasonal use in terms of volume and average and peak day use in terms of rate. The information for these numbers should conform to the annual water use reporting required under OAR Chapter 690 Division 85.

The numbers for annual and peak season use can come directly from the annual water use reporting. It would be useful to include graphic depiction (plots) of historic annual and monthly water use for the past five years (if available).

In addition, the supplier must include quantification of average and peak day use. Average day use can be determined by simply dividing annual use (by volume) by 365. Peak day use may be determined from meter records or power consumption data, provided either meters or the relationship between power use and flow exist. Otherwise, peak day use can often be estimated by using a ratio of between 2.0-3.0 times average day demand (ADD). Typical numbers for peak day use are between 2.2-2.7 times average day demand. If estimates are used, the supplier should provide discussion of the assumptions used in making those calculations. In addition, the supplier should initiate a program to more accurately monitor water diversions and pumping if not already doing so.

Moreover, information on the source of water use data should be included as part of the discussion for this element of the plan.



Summary of Water Rights Held

OAR 690-086-0140 (5)

The rules require that a table be provided listing all water rights held by the supplier including Aquifer Storage Recharge (ASR) rights if applicable. Note that there are a variety of water right types, such as permitted, certificated, statutory, limited licenses etc. which should be included in the table. For some water suppliers, such as suppliers who share permitted rights with other utilities, sufficient description of the arrangements with these other water suppliers should be included in addition to the table.

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

- Application, permit, transfer and certificate numbers (as applicable);
- Priority date(s);
- Source(s) of water authorized under the right

- Type(s) of beneficial uses specified in the right;
- Maximum instantaneous and annual quantity of water allowed under each right;
- Maximum instantaneous and annual quantity of water diverted under each right to date;
- Average monthly and daily diversions under each right for the previous year, and if available for the previous five years;
- Currently authorized date for completion of development of each permit; and
- 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 involved; and
- Any designation of the groundwater source as being in a critical ground water area or ground water limited areas

As part of creating this table, the supplier must identify the presence of any streamflow-dependent species that have been listed by a state or federal agency as being either sensitive, threatened or endangered in each source. Details concerning these designations can be found online through the Oregon Department of Fish and Wildlife at: <http://www.dfw.state.or.us/> or by contacting Department staff directly.

In addition, the supplier must identify any listing of a source as being water quality limited, as determined by the Oregon Department of Environmental Quality (DEQ). Under section 303(d), DEQ is required by the federal Clean Water Act to maintain a list of stream segments that do not meet water quality standards. A listing of 303(d) impaired streams and the parameters for which the listed was designated can be found at <http://www.deq.state.or.us/> or by contacting Department staff directly.

This section also calls for ground water right holders to identify any source in their inventory that is part of a designated critical ground water area. To date, WRD has declared six critical ground water areas: Cow Valley near Vale; The Dalles in Wasco County; Cooper Mountain-Bull Mountain southwest of Beaverton and

Tigard; and the Butter Creek, Ordinance and Stage Gulch areas in Morrow and Umatilla Counties. The Commission also started critical area proceedings in the Christmas Valley/Fort Rock Basin in 1984. In 1986, the Commission opted to withdraw the area from further appropriation, except for certain small uses.



Description of Customers Served and Water Use Summary

OAR 690-086-0140 (6)

The supplier is to develop a description of the customers served and general water use characteristics for each customer class (i.e., residential, industrial, commercial, etc.). The intent is to identify the characteristics of water consumption among customer classes. This description could include a general overview of the typical residential user, including general range of lot sizes, landscaping, and water use patterns, if available. Descriptions would also be included for typical commercial users, as well as any prominent industrial facilities, such as a mill, food processing plant, or manufacturing facility. The latter would identify any special demands for water and current or planned use of water recycling or reuse.

This description should also include 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 or associated progress reports.

Possible sources of information that may be useful in this regard include:

- Oregon Community Profiles: <http://www.econ.state.or.us/COMPROF.HTM>
- Oregon Blue Book: <http://bluebook.state.or.us/local/local.htm>
- Center for Population Research and Census: <http://www.upa.pdx.edu/CRPC/>
- U.S. Census Bureau: <http://www.census.gov/datamap/www/41.html>
- Local Comprehensive Land Use Plans (City or County Planning Staff or Council of Governments)
- Water System Master Plan

**Identification of Interconnections with Other Suppliers**

OAR 690-086-0140 (7)

A description should be developed of all existing or planned interconnections with other suppliers, including details of the capacity of the service, length of contract, the contractual arrangement for water (i.e., minimum purchase quantities, maximum limits, and delivery restrictions, if any), and any other details that would describe the availability or reliability of that service.

**System Schematic**

OAR 690-086-0140 (8)

The rule calls for the supplier to provide a schematic (or map) of the water supply system that shows the sources of water, storage facilities, treatment facilities, major transmission and distribution pipelines, pump stations, interconnections with other supply systems, and the existing and planned future service area. This schematic may be taken directly from any Water System Master Plan or other similar plans and should include all the items listed above (along with any major planned improvements in the future).

**Quantification of System Leakage**

OAR 690-086-0140 (9)

The final element of the water supplier description is quantification and description of system leakage, as well as any available information regarding the locations and details of significant loss. Quantification of system leakage is defined under OAR 690-086-0030 (8) as: “... *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.*” The typical means for estimating system leakage is to take the difference between metered diversions (at the source) and metered customer use, corrected for any un-metered use such as a park irrigation, main flushing, fire fighting, treatment plant operations, street cleaning, and other known uses. The details of estimating system loss are discussed further in Section 4 of this guidance. Additional assistance may be obtained through the Ameri-

can Water Works Association (AWWA) Manual M36 “*Water Audits and Leak Detection.*”

The review of system leakage should also contain descriptions of the details (as known) regarding any major losses, including the location and estimated volume or rate of leakage.

Section 3.4

Preparing the Water Conservation Element

Water conservation provides an important tool in meeting the water supply needs of communities. Division 86 identifies certain conservation activities that must be implemented by all water suppliers submitting a Water Management and Conservation Plan (WMCP). OAR 690-086 also includes several measures that must be evaluated by some suppliers. Where a water supplier determines that a specific conservation activity is not suitable for its service area, the supplier must document why in the WMCP.

This section explains in detail the water conservation requirements of Division 86. It also provides guidance to water suppliers on how to develop this element of the WMCP.

Some of the water conservation measures listed in Division 86 must be addressed by all water suppliers. Other measures need to be addressed only by suppliers that are of a certain size or have other characteristics. A checklist, Exhibit 3.1, lists all of the items in Division 86. Check marks show those measures required of all suppliers.

The Water Conservation Element in Division 86 includes the term “benchmarks.” A benchmark is both an action which a water supplier commits to doing and a schedule for carrying out water conservation activities between the time a plan is submitted to WRD, and the next progress report or plan update (e.g. 5 and 10 years). Each water supplier can propose benchmarks that are appropriate for its specific circumstances. In reviewing a WMCP, WRD will evaluate

whether these benchmarks are suitable. For examples of benchmarks, see the Sample Plans in Appendix B & C. Water conservation should not be confused with water curtailment. As used in Division 86, water conservation is the elimination of waste or the implementation of other measures to more efficiently meet the needs of the community. Curtailment represents measures taken in response to a short term supply emergency when not all needs can be met. Water curtailment is discussed in Section 3.5.

3.4.1 Sources of Information

Many resources are available to support development of a water conservation program. These include books and other publications, as well as conferences and events sponsored by organizations like the American Water Works Association (AWWA). The following box lists a few helpful sources of information. Additional sources are listed in Appendix D.

In addition to these sources, many water conservation plans have been developed by water suppliers in Oregon and other western states, and can serve as useful examples. Contact with other water suppliers to exchange 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 water supplier. The Pacific Northwest Section of AWWA has a Conservation Committee that meets several times each year to exchange information and develop programs.

3.4.2 Developing a Package of Specific Water Conservation Actions

Division 86 identifies a variety of water conservation actions to be considered in WMCPs. These include items such as water system audits, leak detection, rate structures, public education, technical assistance, retrofits of inefficient water-using devices, water reuse, and other actions. Some of these actions must be considered by all water suppliers that submit a WMCP. Other actions must be considered by some suppliers, but not others. For those actions that must be consid-

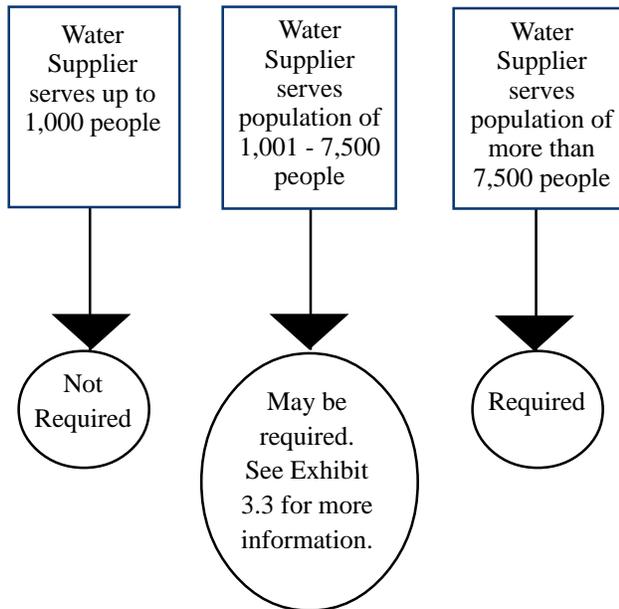
Sources of Information

- *Water Conservation Plan Guidelines* (EPA 1998)
- AWWA Waterwiser Web Site:
www.waterwiser.org
- *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.
- AWWA Pacific Northwest Section Conservation Committee (www.pnws-AWWA.org)
- *Handbook of Water Use and Conservation* (Vickers, 2001)
- *Manual M-6, Water Meters – Selection, Installation, Testing and Maintenance*, Third Ed., (AWWA 1986).
- *Manual M-36, Water Audits & Leak Detection* (AWWA)
- *Drought Management Handbook* (AWWA 2002)
- Regional Water Providers Consortium:
www.conserveh2o.org

ered, Division 86 requires that the supplier either describe how they will implement the action or document why implementation is not feasible.

Under the rules, there is a group of conservation measures that will be referred to here as “Additional Conservation Measures.” These are listed in OAR 690-086-0150(6) and discussed in Section 3.4.3 in this Guidebook. In brief, the smallest water suppliers do not need to discuss these measures in their WMCP. Medium-sized water suppliers may need to consider these measures, but only under certain conditions. The larger water suppliers must consider these measures and provide discussion of them in the plan. Exhibits 3.2 and 3.3 provide more detailed information.

Exhibit 3.2 Do Additional Conservation Measures Apply?



In the sections below, 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. However, all water suppliers are encouraged to consider all actions.

 **Full Metering of Systems**
86-0150(4) (b)

Division 86 requires that all systems that are not fully metered must propose a program to fully meter their system within five years after approval of the WMCP. The program must start immediately after approval of the plan, and must state the number of meters to be installed each year. Full metering means that all sources of water are metered, and all customers are metered.

Source meters may include meters on a well, a surface water diversion, or an interconnection that delivers water from an adjacent water supplier system. Customer meters or “service meters” are meters that measure water delivered to a single customer, such as

a home, apartment complex, office building, supermarket, industrial facility or any other customer. Deliveries of water to wholesale customers, such as another community that purchases water, must also be metered.

Many systems in the State of Oregon are already fully metered. For these systems, the WMCP should simply indicate that all sources of supply are metered and that all customers are metered.

Other systems do not meter customers (or sometimes sources), or only meter some of their customers (or sources). In their WMCP, these systems will need to include a plan for full metering. In developing this plan, the system will likely want to consider issues such as:

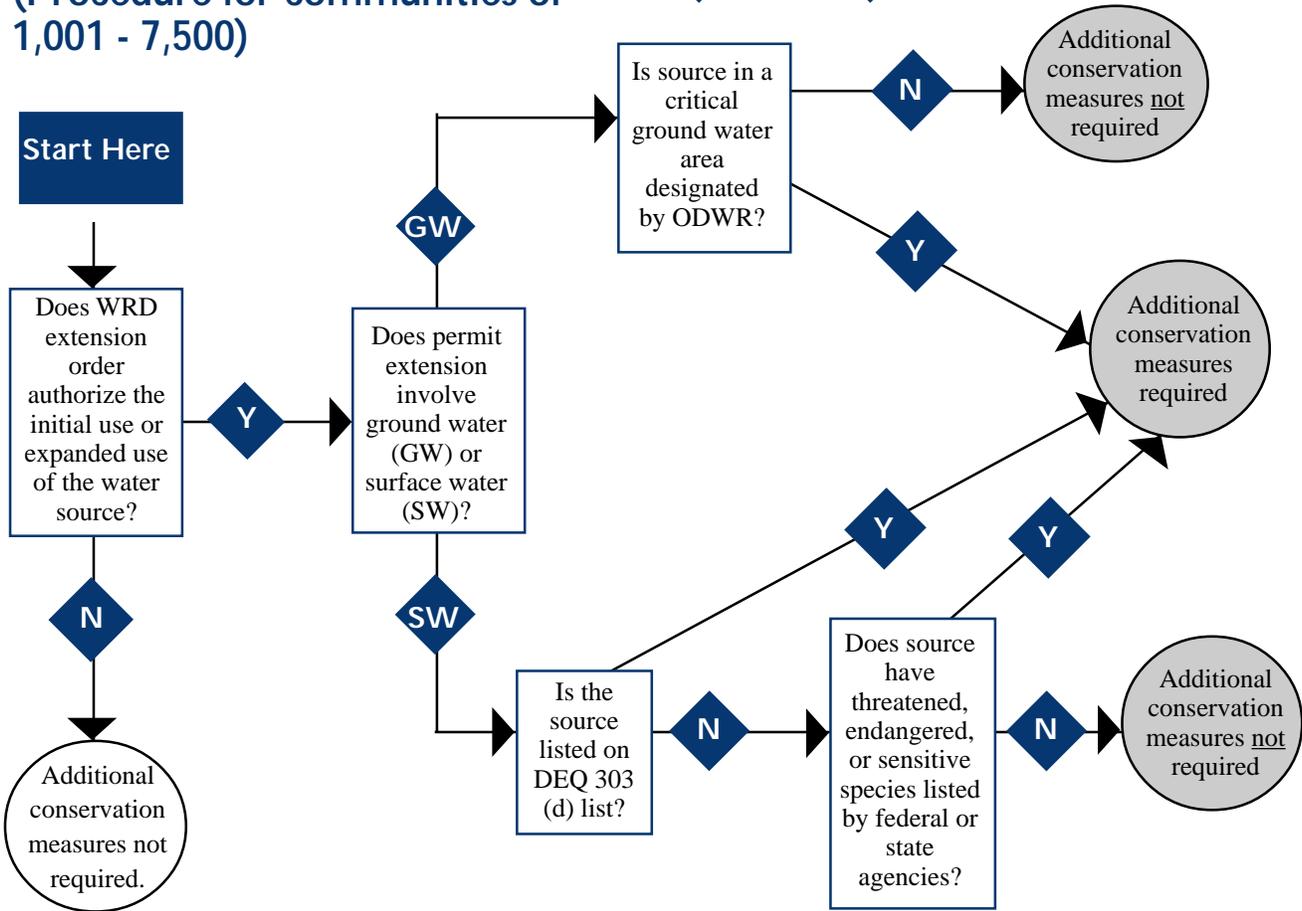
- The available technologies for metering;
- Appropriate sizing of meters to optimize accuracy, including consideration of accuracy at variable flow rates;
- The operational aspects of metering, including any necessary changes to billing practices;
- Capital cost of meters and any upgrades needed for the billing system;
- Operational costs of reading meters and entering data, including effects on the billing system; and
- Any issues and timing considerations involved in changing from an unmetered system to a metered system.

As discussed above, OAR 690-86-0150 (4) (b) require the plan to achieve full metering within five years of plan approval. However, it should be noted that the Rules at 86-0900 (2) allow WRD some discretion to allow extra time. To obtain extra time, the water supplier must show this is needed “to avoid unreasonable and excessive costs.”

AWWA publishes a Manual (M-6) titled “*Water Meters – Selection, Installation, Testing and Maintenance.*” This manual can be helpful in determining how best to comply with this item in Division 86.

Exhibit 3.3
Requirement to Plan for
Additional Conservation Measures
(Procedure for communities of
1,001 - 7,500)

N No **GW** Groundwater
Y Yes **SW** Surface water



Meter Testing and Maintenance Program

OAR 86-0150(4)(c)

Division 86 requires that water suppliers review and consider the adequacy of their program for testing and maintaining water meters. The specifics of such a program will depend upon the size, capabilities and need of the supplier. In the context of the water supply industry, meter calibration and maintenance generally focuses on source meters that measure production from a well, flows from a treatment plant, flows from a wholesale supplier, or similar data. At a minimum, water suppliers should document their approach to maintaining and calibrating meters to ensure they provide data within reasonable limits of accuracy. If the supplier plans to upgrade or replace meters in the future, this

should be discussed. Readers should also see the discussion of Division 85 in Section 3.4.4 below.

Customer meters are another source of data for purposes of documenting demand, assessing effects of water conservation actions, and performing water audits at the system level. If a utility has developed a program to strategically test and calibrate meters for large customers, this should be documented. It is also suggested that water suppliers provide information on the ages of their customer meters (e.g., in five year blocks) and available information on failure rates based on customer complaints or meter reading data. The supplier should also describe any programs to systematically replace or upgrade customer meters, if applicable. Suppliers who anticipate a complete replacement of customer meters to incorporate new tech-

nology or to improve overall performance should provide information on their plans and anticipated schedule.



Annual Water Audit

OAR 86-0150 (4) (a)

Water audits enable suppliers to document all uses of water. Division 86 requires that all water suppliers submitting a WMCP carry out a system-wide water audit every year. The process and results must be described in the WMCP.

At its simplest, a water audit may involve simply comparing the annual quantity of water produced with the annual quantity of water metered and sold to all customers. For small water systems with limited data collection and management capabilities, this may be adequate. However, for more advanced systems, or for small systems where this approach indicates a large difference between production and sales, more information will be needed.

It is recognized that some systems may need time to develop and carry out an auditing process. Auditing will require a commitment of staff time to extract and review data, perform calculations, and report results. Not all systems currently have a system in place to routinely gather and store data needed for an audit. If necessary, the water supplier may propose benchmarks for phasing in an annual auditing process.

AWWA has a complete manual titled *Water Audits and Leak Detection* (M-36, AWWA 1990). The manual provides step-by-step procedures and includes worksheets, tables, conversion factors, and other helpful tools for completing a water audit.

A system-wide water audit is a process of comparing the total amount of water withdrawn or diverted with the amount of water sold, delivered, used or lost. In essence, a water audit provides a “water balance” to determine where in the system the water produced goes. One outcome of a water audit is a quantitative estimate of total water loss from leaking water mains. Together with other information, this can assist a wa-

ter supplier develop an effective program of leak detection, leak repair and rehabilitation and replacement of water mains. Where audits lead a water supplier to control losses or improve billing practices, this can contribute to a utility’s financial performance.

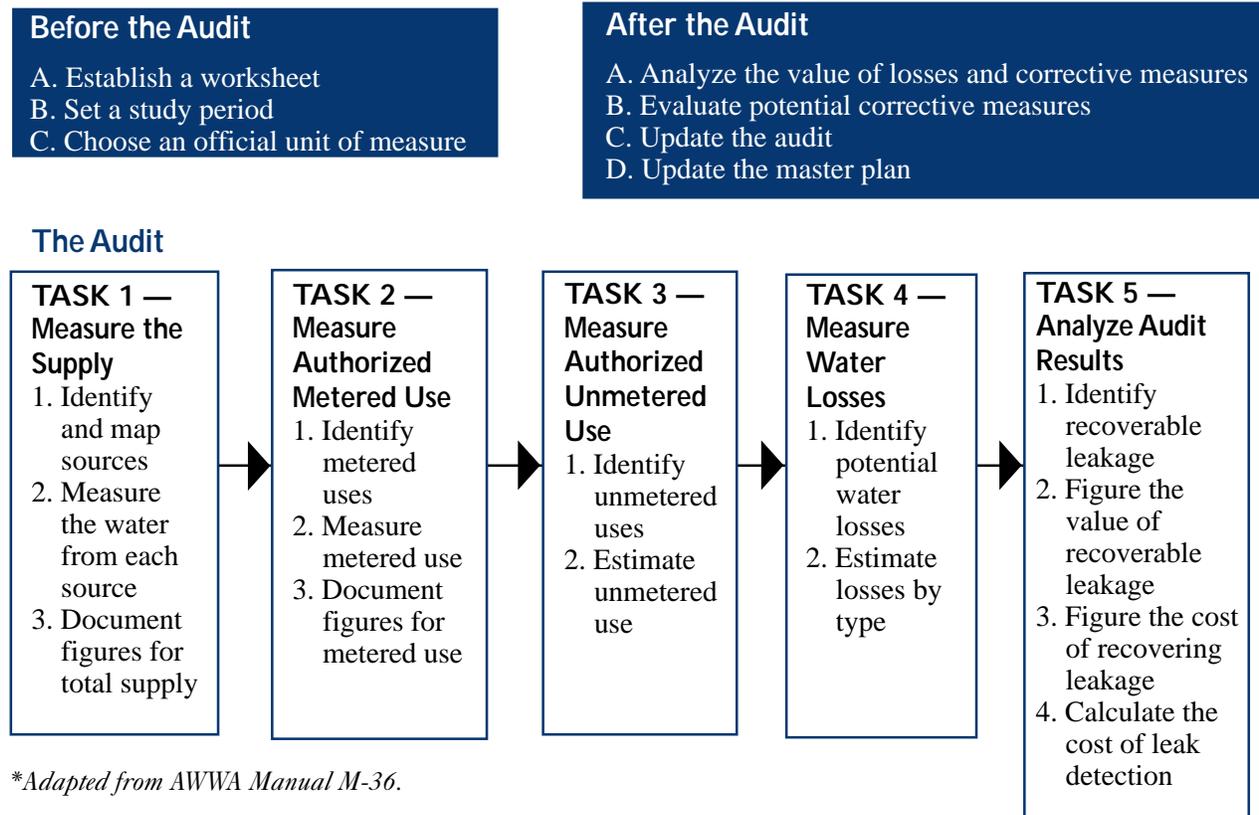
A water audit generally involves gathering information from the water supplier’s own records of production and account billings. Some of this information does “double-duty” in meeting other requirements of a WMCP. For example, production data is required to meet the State’s requirements on water use measurement and reporting (see Section 3.3.2). Billing data on customer usage is needed to prepare the water supplier description (see Section 3.4.4). Documentation on the supplier’s program for testing source meters is required. Usually, some additional information will also be needed for a comprehensive audit.

In any water system, there will be a difference between water produced and water sold to customers. Almost universally, more water is produced than sold. Sources of this difference include:

- Meter inaccuracy, both source and customer meters;
- Authorized uses that are not metered or billed (e.g., flushing mains to maintain water quality; fire-fighting; using hydrants for street cleaning and construction sites; policies allowing certain uses associated with the supplier or local government to go unbilled; etc.)
- Evaporation from open reservoirs;
- Unauthorized uses of water;
- Leakage from transmission lines;
- Leakage from water mains and other components of the distribution system;
- Other conditions.

An audit provides a technique for the water supplier to fully itemize these sources, and either measure or estimate the amount of water for each item. Exhibit 3.4 summarizes this process. Units of measurement must be consistent and must be applied to the same time-period for all components of water use or loss. Typically, this period-of-time is an entire year.

Exhibit 3.4 Basic Steps in Conducting a Water Audit*



One result of the water audit will be the estimated amount of leakage experienced by the water supplier. This information should be reported in the WMCP. Where the audit indicates leakage is greater than 10 percent, OAR 690-086-150(4)(e) requires that the water supplier develop and carry out a leak detection program. The audit results will also be used in regards to the leak repair and line replacement program required of some water suppliers (86-0150 [6] [a]). These items are discussed in greater detail, below.

OAR 690-086 does not specify the calculation for determining 10 percent leakage. It is suggested that the leakage be calculated as a percentage of total source production, on an annual basis. Total source production is the sum of all water produced from all water sources, including any water purchased.



Leak Detection Program

OAR 86-0150 (4) (e)

As noted above, Division 86 requires any water supplier with leakage greater than ten percent to put in place a leak detection program. The Rules indicate that this program:

- Must be “regularly scheduled and systematic;”
- Must address the distribution system as well as any water transmission facilities (e.g., pipelines or canals that convey water from the supplier’s source to its distribution system);
- Can use methods and technology appropriate to the supplier’s size and capabilities.

The leak detection program discussed here applies solely to the water supplier’s own facilities. Leakage in an individual customer’s water pipes or equipment is a different issue. Since customer leakage is recorded

as water sold to the customer, it will show up as metered demand. Fixing leaks on the customer side of the meter is not a requirement but a supplier may wish to address this issue through public information and technical assistance programs (see further discussion below).

AWWA Manual M-36, titled *Water Audits and Leak Detection* provides guidance on leak detection. Detecting and repairing leaks can save significant volumes of water, thereby reducing pumping and/or treatment costs to the water supplier. Visible leaks can be identified through diligent attention by meter readers and work crews. Fire hydrants can be a source of leaks and should be periodically checked to see if repairs or adjustments are needed.

Water mains, and associated fittings and valves may also leak. Service lines leading from the water main to the customer meter can leak also. Sometimes these leaks become visually apparent at the surface. However, many leaks can continue for months or years without being noticed. Specialized equipment and techniques are needed to identify hidden leaks, and many vendors perform this service. Some larger utilities purchase leak-detection equipment and train their own staff in leak-detection techniques.

Those suppliers meeting the 10 percent threshold must describe their leak detection program in the WMCP. Suggested elements of this description are:

- List leaks that have been identified and repaired in the past several years, and/or estimate the number of leaks reported per year. Provide any available information on the cause of those leaks
- Describe other potential causes of leakage, either known or suspected;
- Discuss considerations such as age or piping materials that may help target parts of the water system most susceptible to deterioration.
- Provide a brief table listing piping ages by decade, if this information is available and useful for describing the leak detection program;

- List any leak detection activities performed in the past 10 years (or longer, if this information is useful, their findings, and actions taken to repair leaks or replace deteriorating lines;
- Describe the planned approach to perform leak detection on a regular and systematic basis. The supplier may wish to indicate the number of lineal feet to be tested in each year, broken down by pipe-size, material, or location. Leak detection methods should be briefly described;
- Indicate steps to be taken in the event significant leakage is detected.

Benchmarks for this activity could include the dates by which certain milestones will be met, such as a number of lineal feet of main or transmission line; or a percentage of the piping in the distribution system.



Leak Repair or Line Replacement Program

OAR 86-0150(5) and (6)(a)

Division 86 requires a leak repair or line replacement program for water suppliers who must address those additional conservation measures. This includes those suppliers that qualify for Additional Conservation Measures (see above), *if* the supplier also has water system leakage of 15 percent. It also applies to water suppliers expanding or initiating diversion of water, if resource issues have been identified in the source water (i.e. threatened or endangered species, 303(d) list, or critical ground water area). The amount of leakage can be determined through the water audit process described above. All of these water suppliers will need to show they have considered measures to reduce leakage to 15%. Some may need to show they have considered measures to reduce leakage to 10 percent.

Leak Repair Program: Once leaks have been detected the water supplier will need to determine when they should be repaired. Obviously, many leaks should be repaired as soon as possible to reduce losses from the system and avoid damage to property and facilities. However, in some cases cost-benefit consider-

ations may indicate that repairs should be deferred. This is particularly true where damage to other facilities such as fiber-optic lines could occur; where lines underlie roadways causing higher restoration costs; or where line repair could divert staff time and financial resources that would be better spent on other activities, such as rehabilitation and replacement of other parts of the water system or other water conservation measures. A water supplier can also indicate the schedule of upcoming activities to replace water mains throughout the system, if they have plans for this type of replacement activity.

In the WMCP the water supplier should explain how decisions will be made to repair leaks, and how costs and other factors will be considered. For example, a supplier could identify a certain magnitude of leakage, in gallons per minute, that would dictate an immediate response, compared with smaller leaks where discretion would be applied.

Line Replacement Program: Line replacement can be most effective if it is planned and budgeted well in advance. Line replacement will be more efficient if careful consideration is given to determine which lines should be replaced and when. Considerations include the age, materials, and history of leakage.

Line replacement includes not only water mains, but also service lines leading to customer meters. Service lines and associated fittings can be a significant source of leakage.

In the WMCP, water suppliers subject to this particular requirement should explain what portions of their system will be replaced, and when. The supplier should also explain what factors were used to select lines for replacement, and to develop the schedule of program implementation.

If cost is a significant factor that will limit the supplier's ability to replace water lines, the WMCP should clearly document the estimated cost for different amounts of line replacement. The WMCP should clearly explain why this cost indicates that a more

extensive line replacement program would be infeasible or inappropriate. The supplier may wish to provide comparisons with the costs of other types of conservation activity, the supplier's annual operations budget, and/or important capital projects needed to meet other key objectives such as water quality or compliance with regulatory requirements. Where the cost of line replacement is compared with the cost of alternative conservation actions, it may be helpful to state the cost per unit of water saved.



Rate Structure Based on Quantity of Water Metered

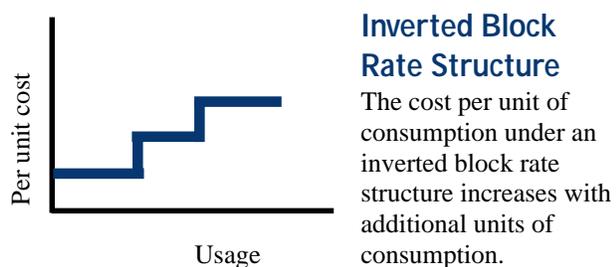
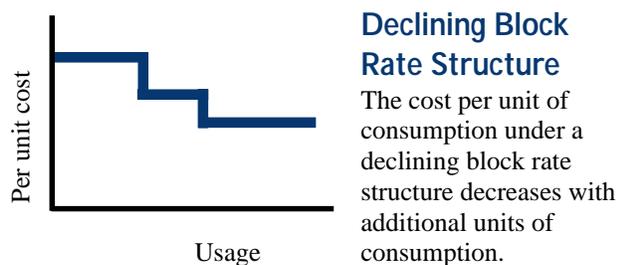
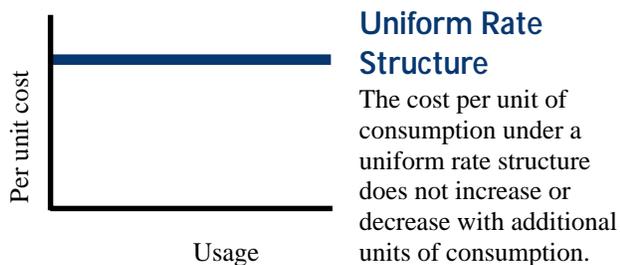
OAR 86-0150(4)(d)

Division 86 requires any water supplier submitting a plan to put in place a rate structure in which customer bills are based, at least in part, on the quantity of water metered at the service connection. The price of water is becoming more important not only because it generates the funds needed to pay utility bills, but also because it can shape the way water is used by customers. Prices that do not fully reflect the cost of water can lead to excess levels of water use. Prices that more fully reflect the cost of water will lead to more efficient use and provide a proper price signal.

In general, this requirement means that water suppliers may not use a "flat rate" in which the customer receives the same bill no matter how much water they use. Instead, a supplier must put in place a rate structure with at least part of the consumption billed using a "commodity rate." A commodity rate involves charging the customer based on the number of units of water consumed (e.g., gallons or cubic feet). Some typical rate structures that meet this requirement would include: a uniform charge, a declining block charge and an inverted block charge. Exhibit 3.5 provides an overview of each of the water use charge rate structures.

Under a uniform rate structure, the cost per unit does not change with consumption, though the more water used, the higher the total bill. From the perspective of customer understanding and rate administration/billing, this is a simple and straightforward approach.

Exhibit 3.5 Overview of Variable Charge Rate Structures



The declining block rate structure is a bit more complex. The number of blocks (e.g., 3 stepped blocks) and size of the blocks (e.g., 0 – 10 CCF) may vary. However, the number of blocks should be reasonable (i.e., 2 – 4 blocks) for reasons of simplicity and administration. Declining block rates may imply that there are certain economies of scale with additional consumption, and not necessarily a “volume discount.” Depending upon the utility, this may or may not be a true statement. Adequate rationale for the use of a declining block structure should be given in the WMCP.

An inverted block rate structure attempts to send a price signal to consumers that their consumption costs more, as more water is consumed. This may or may not be the proper price signal regarding the utility’s

water resource costs. As with the declining block rate structure, the number and size of each block may vary, but should be reasonable for purposes of customer understanding and rate administration.

A contemporary rate structure will be composed of both a commodity rate, as described above and a fixed charge. A fixed charge is the same for each bill regardless of the amount of water use. A utility has costs on the system that do not relate to the amount of water used. The fixed charge is in place to cover costs such as meter reading, billing and other costs incurred per customer or per account. A fixed charge is generally established to help cover these fixed costs. The base fee is usually expressed as a service charge/customer charge or meter charge.

- The service charge/customer charge is typically the same for all customers and expressed as a \$/customer/month.
- The meter charge is a fixed fee that increases with the meter size. This charge is generally expressed in \$/size meter/month.

The overall goal of a rate structure would be to collect the amount of revenue needed to cover utility costs, in addition to having a commodity charge that allows the customer the ability to control at least a portion of their bill through changing their water use.

For purposes of conservation, it should be noted that the increasing block (inverted block) structure is the most desirable. However, all three rate structures listed above meet the basic requirement in Division 86-0150 (4) (d).

As with the other actions discussed here, water suppliers that do not currently have this type of rate structure may propose a schedule for carrying out this item, with benchmarks to indicate a date by which the appropriate rate structure will be put in effect.

Setting rates is a critical area in water system management, because revenues must be adequate to meet costs, including operations and maintenance costs and debt service on capital facilities. At the same time,

rates are sometimes used to achieve important policy goals, such as allowing low-income or fixed-income customers to have access to water to meet basic needs at relatively low cost. In changing from one rate structure to a new rate structure, water suppliers must take many factors into account, such as revenue stability, customer financial impact, impact on customer water use, and the management policy of the utility, to name a few. Sound analysis is needed to ensure a new rate structure strikes the appropriate balance among the base fee and commodity rates, as well as among different “blocks” of a block rate structure.

AWWA Manual M-1, *Principles of Water Rates, Fees and Charges*, offers guidance on many aspects of rates for water utilities, including the rate structures listed above. In many cases, considerable expertise may be needed to put in place an effective rate structure that meets all the financial needs of the water system while sending an appropriate price signal to customers regarding their water use.



Rate Structure and Billing Practices that Encourage Conservation

OR 86-0150(6)(d)

Water suppliers subject to the “*Additional Conservation Measures*” must consider adopting rate structures, billing schedules and other associated programs that support and encourage water conservation. In general, discussion of the following types of activities can be used to demonstrate compliance with this requirement:

Rate Structures:

- Base fee and commodity charge using increasing block-rate (the per-unit charge increases as metered consumption passes one or more thresholds – also known as “inverted block” rates)

- Base fee and commodity charge using a seasonal differential that charges more per unit of water consumed in the dry season (on-peak), compared with the wet season (off- peak).
- A uniform rate that utilizes a commodity charge, if this represents a change from a flat rate that did not utilize a commodity charge.
- Other rate structures, if the water supplier can demonstrate they meet the requirement for encouraging water conservation.

As noted above, AWWA Manual M-1 provides general guidance on these types of rate structures, as well as information on other aspects of setting rates for water utilities.

Billing Practices:

- Meter reading and billing of customers on a monthly or bi-monthly basis, so that customers receive bills relatively close to the time the water was used; thereby providing a timelier price signal.

Other Programs:

Other programs in this category could include items such as:

- Information included with each bill to show the customer how the current bill compares with that customer’s previous bills or with other customers served by the same water system;
- Information included with each bill to show the customer how water savings could decrease the amount billed (including reduced sewer charges, if sewer charges are based on water consumption);
- Information included with each bill to show the customer techniques for reducing water use.
- Other activities that inform customers of the financial benefits of reducing water use. For example, these activities could be part of the public education program (see below) as long as there is a clear link between the information provided and the customer’s understanding of financial benefits to them from reduced water use.

It should be noted that the first three items listed above require a fairly sophisticated computerized billing system. A basic billing system would not be able to handle these comparisons. A small utility may benefit more from customer education and suggestions for reducing water bill (mailings/newsletter/workshops), instead of purchasing a new billing system.

A water supplier may propose alternative rate structures, billing practices and other programs, different from those listed above. If alternative approaches are proposed, the water supplier should demonstrate in the WMCP that their proposed approach meets the requirement to support and encourage conservation



Public Education Program

OAR 86-0150(4)(f)

Division 86 requires all water suppliers submitting a WMCP to have a public education program to encourage efficient water use, including low water use landscaping. The program must include regular communication with customers, to provide information on the supplier’s water conservation activities and schedule.

Many utilities across the country have gained experience with public education programs promoting water conservation over the past 20 years. These programs can be coupled with similar programs involving solid waste and recycling, storm water management, and other municipal programs where appropriate. A range of activities can be considered, including:

- Distribution of simple brochures providing tips for water savings. These can either be included in customer bills, sent in separate mailings, or made available at locations such as the water supplier’s headquarters, city hall or other local government center, public libraries or other distribution points;
- Development of a portable or fixed display to be set up at community events, county fairs, public library, schools, or other public buildings.

- Provision of standardized water conservation educational materials and/or water saving products, in partnership with private sector partners such as restaurants, hotels, lawn and garden centers, or home improvement stores.
- Establishing a “speakers bureau” providing speakers to give presentations at civic organizations, chambers of commerce, or other venues.
- Use of newsletters or press releases to publicize key programs, unique customer achievements, or other information that promotes awareness of water conservation.
- Presentations or use of standard curriculum in local schools, to promote awareness among school children and by extension, their families.
- Distribution of certain devices that have a public awareness value in addition to their direct impact on water use (e.g., rain gauges, rain barrels, yard signs for dormant lawns, decals and bumper stickers, etc.)
- Advertising campaigns using billboards, buses, radio, or television.
- Few, if any, water suppliers would carry out all of these activities. The public education program may be very different from one supplier to another. The “right” program will depend on the size and staff resources of the water supplier, the impact on its annual budget, the region of the state, limitations on the water source, and characteristics of the customer base in that community.

In the WMCP, the water supplier should describe their existing and proposed public information program, and indicate why this program is appropriate given their community’s particular needs and circumstances.

Many public outreach activities lend themselves to collaborative approaches with other water suppliers that can greatly reduce the cost and staff time needed for carrying out a public education program. Many water conservation brochures, educational curriculum materials, and other information items have been developed in standard formats that can be used by any water system. The Pacific Northwest Section of AWWA has a standing Conservation Committee that can provide information on accessing these types of products.



In addition, water suppliers in different regions of the State may find it beneficial to pool resources to purchase materials, share staff, or collaborate in other ways to meet this requirement at an affordable cost.

Finally, many suppliers find it beneficial to “pilot” conservation measures and measure their effectiveness and efficiency before a full measure is implemented.

- apartment managers, building maintenance staff, or grounds maintenance staff.
- Providing training opportunities to businesses that provide goods or services to a water supplier’s customers. This could include landscaping businesses, construction contractors, air conditioning contractors, building centers, and lawn and garden centers.
- Technical and financial assistance to local parks and golf courses to improve irrigation management and/or purchase improved control systems.
- Public information items that provide technical information to assist customers save water (also see discussion of public education, above).

The number and type of activities to be carried out will naturally vary from one water supplier to another. Some water suppliers serving a smaller population or having limited resources may propose only limited activity in this category. Other water suppliers with large and diverse service areas may identify a wide range of technical and financial assistance programs for different groups of customers.

Appendix D lists a wide range of water conservation measures that may be addressed through technical and financial assistance programs. In general, only a small number of these measures may apply to the smallest water systems; while many of the measures listed in the Appendix could apply to systems in a large metropolitan setting.



Technical and Financial Assistance Programs

OAR 86-0150(6)(b)

Technical and financial assistance programs include activities such as:

- Rebate programs, where the cost of purchasing water-efficient fixtures or equipment can be partially offset;
- Cost-share programs where the cost of a customer’s water conservation measures will be paid, in whole or in part, by the water supplier;
- Water audits offered to some individual customers to assess their water uses and identify opportunities for water savings;
- Providing training opportunities for customers to learn about specific types of water saving equipment or actions. These may be targeted towards specific groups such as homeowners,



Retrofit/Replacement of Inefficient Fixtures

OAR 86-0150(6)(c)

In the past 20 years, there have been many improvements in the efficiency of plumbing fixtures and water using equipment. Water suppliers can reduce demand by either providing some types of water use efficient equipment to customers, or providing financial incentives for customers to invest in water-efficient products.

This activity can include:

- Distribution of water conservation kits containing items such as low-flow showerheads, toilet leak detection and repair materials, toilet tank displacement bags, and faucet aerators.
- Rebates for purchase of water-efficient toilets and washing machines;
- Rebates for purchase of more specialized equipment such as air-cooled ice machines in hotels and restaurants; single-pass cooling equipment in buildings; and various types of water-using equipment in industrial facilities.

As with the other activities listed in this section, the extent of retrofits and replacements will vary from one water supplier to another. In some areas, these retrofits and replacements may have already been accomplished. Some types of water conservation devices (e.g., showerheads), may have been distributed by power companies to improve energy efficiency associated with hot water. In communities that have seen rapid growth in recent years, many homes and businesses may already have water-efficient toilets and other fixtures. The need and applicability of retrofits should be assessed by the water supplier, and selection of activities should be documented in the WMCP.



Reuse, Recycling, Non-potable Opportunities

OAR 86-0150(6)(e)

Water suppliers covered by this provision should document that they have considered whether and how reuse, recycling and use of non-potable waters could reduce the need for withdrawals or diversions of raw water. Categories that may be included in this discussion include:

- Enhanced treatment of municipal wastewater to allow reuse for non-potable purposes. This may involve consideration of treatment plant upgrades, a separate piping system to deliver reclaimed water, pumping plants if needed, and a market for the reclaimed water. Reclaimed

water is typically used for irrigation or industrial purposes. Careful coordination with municipal wastewater treatment authorities is needed to develop an effective project of this nature.

- Recycling of process water within a single industrial facility (or group of facilities).
- Use of domestic “graywater” for onsite irrigation, flushing of toilets, or other non-potable uses, where laws permit such use.

These techniques may have less widespread applicability, compared with some of the other water conservation measures discussed in this Guidebook. In discussing application of these techniques, the water supplier may wish to discuss factors such as the relative cost in comparison with other sources of supply, legal restrictions, environmental needs, the applicability of these measures to the specific customer base served by that supplier, and the likely acceptance of these approaches by customers and consumers.



Other Measures, if Identified by Supplier

OAR 86-0150(6)(f)

In addition to the measures discussed above, water suppliers should explain any additional water conservation activities they plan to carry out. In this way, the WMCP can present the full picture of a water suppliers conservation program.

This item will be especially important if a water supplier finds that other activities provide greater benefits or are more cost-effective. In this case, the water supplier should provide information showing that the proposed activities are an appropriate substitute for one or more of the activities discussed previously.

² “Waste” is defined in OAR 690-400-0010 (16) and includes considerations such as economic feasibility, environmental impacts of making modifications, available technology, and other considerations. See OAR 690-086-0020(6) for more information.

3.4.3 Assessing Measures to Include in WMCP

The previous section listed a wide range of water conservation activities. Division 86 indicates that some of these must be discussed by all water suppliers submitting a WMCP. Other measures must be considered only by some water suppliers (see Exhibits 3.2 and 3.3). For these “additional conservation measures” Division 86 requires that these are considered, but does not require implementation if the water supplier demonstrates that the measures are not feasible or appropriate to ensure efficient use of water and the prevention of waste² (86-0130 [4] [b] and 86-0150[6]). For any measures that are found to be infeasible or inappropriate, the water supplier must provide documentation of this finding, and must show that they have used a suitable methodology to evaluate these activities.

There are many different approaches to evaluating water conservation measures. The key for a WMCP is that a water supplier must show they have systematically analyzed any activities they do not plan to implement. For example, considerations in this review may include:

- Type of customers in the supplier’s service area, and the applicability of a water conservation activity 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 water supplier (e.g. annual operations and maintenance budget, per unit cost of other capital projects, etc.).
- Effectiveness of a given conservation action to meet a community’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 water supplier believes that a given measure will reduce revenues and cause significant financial problems, this should be explained. However, it should be noted that

conservation activities and water rates can be managed jointly to overcome this issue and there are many examples of water suppliers implementing water conservation without undermining financial performance.

- Staff resources and operational capacity to provide the activity. For example, if a water system’s billing system cannot generate bills that compare current water use to past water use for each customer, then the water supplier may find this type of measure is not feasible, at least for the present time.
- Amount of water savings that could be expected from a specific activity. If the water supplier finds 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. Where this is the case, the water supplier should document and explain the situation.
- Results of studies measuring the effectiveness and/or efficiency of a conservation measure, including comparison of effectiveness compared with other conservation measures to be implemented.

For any of the items listed above, or other obstacles that water suppliers identify and document, the water supplier 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. A water supplier should explain how progress could be made on these issues between submittal of the WMCP, submittal of the next progress report (five years) and submittal of the next WMCP update (within ten years).

For further information on evaluation techniques, see the reference sources indicated above and in Appendix D.

3.4.4 Additional Requirements for the Water Conservation Element



Submit Progress Report Related to Previous WMCP

If the water supplier has previously submitted a WMCP to WRD, the supplier must provide a progress report on the conservation measures that were identified. The exact form of the progress report is not mandated in the Rules. However, an effective progress report would identify the actions that were listed in the previous plan, state the benchmarks that were defined for each action, and indicate whether those benchmarks were achieved. If any benchmarks from a previous plan were not achieved, the progress report should explain why.



Provide Documentation of Water Use Measurement & Reporting

Another division within the OAR provides that all governmental entities holding water rights must submit an annual report of water use for each water right. This is Chapter 690, Division 85. The report is due by December 31 of each year. Reports must indicate the amount of water diverted or pumped in each month of the previous water year (October 1 – September 30). There are specific requirements for reporting use of impounded water and release of stored water as well. The Division 85 rule identifies specific methods that can be used for measurement, as well as standards for accuracy. For further details on these requirements, see OAR 690-085.

Examples of the governmental entities required to report water use are cities, towns, counties and water districts, among others. Private water suppliers are exempt from this requirement, unless their water rights permit specifically indicates they must provide this information.

Division 86 discussed in this Guidebook require that a WMCP include a description of the water supplier's

program to comply with the water use and measurement rule. The WMCP must also include a statement that the program complies with the measurement standards in Division 85. However, if a time extension or waiver has been granted, or the standards are not applicable, the supplier can provide that information instead.

For water suppliers who are fully in compliance with Division 85, it is anticipated that providing this information in the WMCP will be relatively straightforward. The supplier can simply indicate that the measurement program complies with the rule, and that reports are submitted by December 31 of each year.

Any water suppliers that are not fully in compliance should indicate the steps they will take to meet the Division 85 requirements in the future, and a schedule for achieving compliance. In this case, progress reports on the WMCP submitted in the future can be used to document achievement of the requirements. Some water suppliers may have been granted a time extension or waiver. WRD is authorized to grant waivers under circumstances described in Division 85-0010 (6) for reasons such as economic hardship, and for very small diversions that have a minimal effect on the water source. In cases where a time extension or waiver has been provided, the water supplier should document this and provide a brief explanation in the WMCP.



Provide List of Conservation Measures Already Implemented or Required Under Contracts

Division 86 requires the water supplier to describe any other conservation actions not covered above that are currently implemented. In addition, the Rules require a description of any conservation actions required under the terms of any contracts to purchase water from another supplier. The Rules do not indicate any special format for this information.

For example, if a water supplier is currently providing low-flow showerheads to its customers, and this is not a measure listed in the supplier's previous WMCP, then the water supplier should list and de-

scribe this measure in its new WMCP. The type of description is up to the supplier. For example, a supplier could describe the customer category targeted by this activity, and the purpose; the number of devices distributed; number of accounts affected; amount of funding expended or budgeted annually; or other descriptive information to convey the overall magnitude of the activity. If available, a supplier could also estimate the quantity of water saved, although this is not required.

Providing this information will help WRD evaluate the water supplier's overall water conservation program, including areas where the supplier is doing more than required under law.

3.4.5 Criteria for WRD Review of the Water Conservation Element

Division 690-086-0130 (3) and (4) list 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 (690-130 [3]). Evaluation of the proposed schedule for implementation will include consideration of the benchmarks described in the plan. WRD will evaluate whether these benchmarks are suitable, given the specific circumstances facing that water supplier.

As discussed above, there are some measures which the water supplier may propose not to implement for various reasons (see Section 3.4.3). In these cases, suppliers have some flexibility to adopt or further bolster conservation measures which meet the needs of the suppliers in exchange. WRD will review the documentation provided in the WMCP and determine whether the supplier has used a suitable methodology in evaluating each measure that was rejected and that the mix of measures will indeed represent an appropriate effort on the part of the supplier to make efficient use of water.

Section 3.5 Preparing a Water Curtailment Plan

Water suppliers with a well-defined water curtailment plan in place are ready to contend with a short-term emergency water shortage. For water suppliers without such a plan or with an outdated plan, this subsection will assist in the development of an effective plan. This information is based on the Oregon Administrative Rules Chapter 690-086-160.

The following text describes water curtailment plans, their role, and how water suppliers 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 water suppliers can use to immediately reduce and meet demand, respectively.

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 whereas curtailment plans require specific customer activities in the later, more severe stages of shortages.

Suppliers should have legislation in place allowing for the supplier to decree an emergency. Within the legislation, authority should be given to the supplier to enact the curtailment plan once an emergency has been decreed. Once the emergency is over, the supplier returns to normal service conditions. A sample ordinance is provided in Appendices F.

Some of the conservation measures discussed in Section 4 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 conservation 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 resulting in major water treatment and distribution equipment failure, contamination of water supply³, and earthquakes and other 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 water suppliers within the drought area to adopt and implement a water conservation or curtailment plan. (See ORS 536.700) Water suppliers should consider any past curtailment plans that may have been required under drought declarations that may still be in effect for the supplier service areas, but note that these plans may not satisfy all the requirements within Division 86 described in this Guidebook.

3.5.1 Sources of Information

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

³ Water supply contamination also can have a more gradual impact upon supplies. For example, a detected underground plume of known contaminants can take up to a few months to reach a well. Plumes which are estimated to take a longer time reaching a water source probably do not require the use of a water curtailment plan.

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). Therefore, as a second preliminary step, water providers are encouraged to build additional time into the curtailment plan process to allow for public input.

3.5.2 Developing a Curtailment Plan

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

- A 10 year assessment of water supply deficiencies and capacity limitations
- Three stages of alert
- Situations which trigger each stage of alert
- A list of curtailment actions for each stage of alert

Each of these requirements are described below in detail. Water suppliers 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.



Assessing Water Supply

To assess the likelihood that a water supplier may experience a short-term emergency water supply shortage in the future, suppliers should consider the last 10 years of a water system. For example, suppliers should answer the following questions.

- Were there any supply deficiencies, such as a droughts or mechanical failures?
- If so, how frequently?
- What was the magnitude (e.g., in millions of gallons per day (gpd)) of each deficiency?
- At present, what is the capacity limitation of the system?

A WMCP should include answers to these questions. Regarding the last bullet in the list above, capacity limitations may be defined as bottlenecks in the system infrastructure, such as undersized pumps, or small storage capacity compared to maximum day demand. Not including water right permits or extensions, sources also may have natural limitations, such as maximum regeneration rates for wells. Describe these limitations in the WMCP as well.

Also, a water supplier is required to provide a clear picture of the system’s current ability to withstand an emergency water situation. How has demand been met in past emergencies? Will these same techniques be employed to meet demand during future emergencies? Are the community sources of water vulnerable to contamination? Are there additional steps to ensure an adequate source of water during these emergencies? Include a description of the assessment in the WMCP. Water suppliers with vulnerability assessments may wish to coordinate curtailment development with these assessments.



Stages of Alert

The next three components of a curtailment plan are interconnected. As a water shortage becomes more severe, the curtailment plan must have pre-defined levels or stages of restrictions. Once enacted, these restrictions represent a measured response to an emergency supply shortage and are intended to progressively reduce demand. The minimum number of stages allowed by Division 86 is three. Some communities may choose to include more stages (e.g. up to five). Additional stages would allow less severe restrictions between each stage but may also be slightly more complex to communicate to the public. Examples of the incremental stages of alert are mild, moderate, severe, critical, and emergency.

In situations where the Governor declares that a severe, continuing drought exists, preference may be given to water that is used for the human and/or livestock watering. In locations where water providers may want to use this provision, WMCPs must include

a level of alert which allows for essential (life/safety) uses of water such as drinking, cooking, sanitation, and fire fighting. See OAR 690-019-0070 (Drought Mitigation Rules) for further information.



Triggers for Each Stage of Alert

As mentioned previously, a curtailment plan must have predefined stages of restrictions. These restrictions are triggered by specific emergency conditions. For example, the first stage of alert may be triggered by a percentage drop in available source capacity or a percentage drop in pumping capabilities for diversion.

Adding triggers into curtailment plans is important because triggers provide water suppliers an ability to legally impose restrictions once the emergency conditions of the trigger have been met. Also, triggers are set points of reference which can avoid any guessing about when to impose restrictions during an emergency.

It is recommended (but not a requirement of Division 86) that triggers for supply, demand, and capacity be developed. These should be used in a combination determined by the water supplier when deciding to ramp up or down the stage of alert.

Below are potential triggers for each of these three factors, in order of mild to progressively severe (adapted from “*Water Resources Planning*”, AWWA Manual M50).

Examples of Triggers for the Mild Stage of Alert

- Supply—Well drops 250 feet, for example
- Demand—Use reaches 14 mgd for three consecutive days, for example
- Capacity—Use reaches 60 percent of capacity, for example

Examples of Triggers for the Moderate Stage of Alert

- Supply—Well drops 300 feet, for example
- Demand—Use reaches 90 percent ability to refill elevated storage, for example
- Capacity—Use reaches 85 percent of capacity, for example

Example of Triggers for the Emergency Stage of Alert

- Supply—Well drops to 350 feet (nearly dry), for example
- Demand—Not able to fill elevated storage, for example
- Capacity—Use reaches 90 percent of capacity, for example



Curtailment Actions

If curtailment triggers establish *when* to impose restrictions, curtailment actions establish the *type* of restrictions to impose. Division 86 does not specify all types of restrictions to impose at each stage, however it does provide the inner and outer limits of restrictions: curtailment actions must start with a notice to the public of a potential alert, increase to the limiting of non-essential uses of water, and ending with rationing and/or loss of service at the most critical stage of alert. The specific curtailment actions chosen should be sufficient to respond to any foreseeable situation in which access to supply/supplies is partially or wholly impaired.

Establishing curtailment actions may be a difficult task, especially when going through the process of determining actions for the latter stages of alert. In these latter stages, curtailment actions translate into severe restrictions or complete restrictions for specific non-essential activities, such as lawn watering, directly and severely impacting your customers. Water providers may wish to consider the use of public input to assist in this process to establish curtailment actions during plan development. The public should include customers from each customer classes. These customers can provide valuable insight as to the types of activities they are willing to restrict in the event of an emergency which may result in more effective curtailment actions. Customers can also help avoid major omissions to the list of curtailment actions.

Though not required in Division 86, water suppliers may wish to establish goals for each set of curtailment actions. For example, as a result of stage two curtailment actions, suppliers could set a goal of 10 percent reduction of off-peak demand. The exact goals will vary from one supplier to another.



Below are some examples of curtailment actions water suppliers could include in their curtailment plan. The examples progress from mild to severe (adapted from AWWA's "*Water Resources Planning*" manual, p 90).

- Public notification
- Voluntary irrigation schedule
- Closing of ornamental fountains
- Five day watering schedule and time-of-day schedule
- Waste of water ordinance enforced
- Hand irrigation only
- Open interconnection with neighboring water supplier
- Public pools closed
- Emergency water rate imposed
- Industry asked to reduce consumption by 10 percent (voluntary)
- Outdoor use banned
- Residential water use restricted to 75 gallons per day per person
- More stringent emergency rate increase imposed
- Commercial car washes closed
- Industry asked to reduce consumption by 20 percent
- Eliminate all uses not directly involved with health, sanitation, or safety
- Close public schools and offices
- Shut down industrial operations

Create well-defined procedures that ensure the plan can be carried out properly once it is enacted. A curtailment plan will 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.) whom to contact in the event of a short term water supply shortage, the process and method to communicate restrictions to the public at each stage of alert, the process of enforcement of any water restrictions, and other actions specific to the curtailment plan.



3.5.3 Final Recommended Steps

Once a curtailment plan has been developed, water providers should consider performing the following tasks:

- ***Encourage affected local governments to adopt the plan.*** The affected local governments may be municipalities, in which case city councils must adopt the plan, water districts, in which case the board or commission must adopt the plan, or some combination of the two. Regardless, it is important to note that curtailment plans are unenforceable unless adopted. Though WRD does not require adoption, it is highly recommended a plan is adopted as soon as possible in order to speed a water supplier's curtailment response to the emergency.
- ***Periodic review and revision.*** Since water providers may obtain new sources, staff changes, or new potential events leading to a shortage are realized, water suppliers should review and update curtailment plans on a regular basis.

- ***Ensure communication with other suppliers.*** In cases where water shortages are widespread (e.g. regional), different water suppliers may have different needs and stages of alert. Water suppliers should work together to coordinate water curtailment messages and avoid confusion among customers and the public.

Section 3.6 Preparing the Water Supply Element

In the water supply element, the water supplier should explain why additional water is needed under the permit(s) to be extended. The water supply element provides a long-range supply plan in which the supplier prepares a demand forecast and compares the projected demand to available supplies. Where additional water is needed, the water supplier should explain what sources it plans to use. The water supplier should also show how management of the resource through activities such as water conservation, can contribute to meeting customers' needs.

The required elements for this section of the Water Management and Conservation Plan (WMCP) are outlined under OAR 690-086-170. For a summarized list of these items, see Exhibit 3.1.

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 Water Supplier Description, Section 3.3.

3.6.1 Sources of Information

Various sources of information may be useful in preparing the water supply plan. In general, these include information obtained from the water supplier's own records; information related to local land use planning; 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 sources of information:

Sources of Information

- Billing and meter records
- Prior master plan, facilities plan, or WMCP
- 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 Oregon Water Resources Department database or request from your local Watermaster
- Summaries of operational constraints related to the availability of water from each source.
- AWWA Manual M-50, Water Resources Planning
- Forecasting Urban Water Demand (Billings and Jones)

The delineation of current and future service areas should be coordinated with existing area land use plans, as adopted under LCDC guidance and approved under regional comprehensive land use plans and urban service agreements. The required submittal here may be done by preparing a map showing the present and future (or anticipated) service area boundaries for the water supply agency in relation to neighboring (or shared) municipal boundaries, unincorporated portions of a county, or other legal boundaries that may be shared or adjoined by the water supplier’s present and future service areas.



Population Projections for Service Area

OAR 690-086-0170 (1)

The water supplier must also provide available data on population projections and anticipated development within the service area. These projections must be consistent with comprehensive land use plans, urban service agreements, or other relevant documents that guide land use and utility services. This information will be used in preparing a forecast of future needs for water (see Demand Forecast, below).

3.6.2 Specifics of Water Supply Element

This section provides more detailed guidance on preparing each item required for the Water Supply Element. 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.



Delineation of Current and Future Service Areas

OAR 690-086-0170(1)

The rule calls for the supplier to prepare a delineation of current and future service areas consistent with state land use laws. Within the State of Oregon, land use planning is guided by the 19 goals set forth by the Land Conservation and Development Commission (LCDC). Coordination for this planning effort is often done at the City or County level and often sponsored through local Council of Governments.



Prepare Schedule to Fully Exercise Each Permit

OAR 690-086-0170 (2)

The supplier must prepare a schedule that identifies when the water supplier expects to fully exercise each of the water rights currently held by the supply agency. This request amounts to indicating the expected schedule for certification of each of the supplier’s permits. This schedule should be consistent with the supplier’s extension request(s).

The process of certification involves procedures for “*proving up*” the use allocated under a given permit, as defined by the rules governing beneficial use. Under present Oregon law, municipal water right permits can be “*perfected*” or certified at 25 percent increments of the permitted total certificated for the full amount when the rate allowed under the right has been diverted or withdrawn. For example, a permit to use 10 cfs may be certificated at 2.5, 5, 7.5 and 10 cfs. The prepared schedule must indicate when the supplier expects to be using the full quantity of water allowed under each permit and describe the methods and assumptions used in determining those date(s).

It should be noted that full certification will eventually eliminate the need to seek a permit extension under OAR 690-315 and eliminate the need for justification for incremental increases in the quantities of water used for that particular right. However, full certification may not eliminate the requirement for a WMCP and continued WMCP implementation.

It is important to note that certification of a permit can only be done by a Certified Water Rights Examiner. A more complete guide to water law and water right certification is available from the Oregon Department of Water Resources in their publication titled, “*An Introduction to Oregon’s Water Laws and Water Rights System.*” To obtain a free copy, simply call the Department or go online at <http://www.wrd.state.or.us/law/index.shtml>.



Prepare Demand Forecast

OAR 690-086-0170 (3)

Preparation of a demand forecast for the supplier’s service area is a critical element of a WMCP. The water supplier must provide a forecast for 10- and 20-year time frames. A longer time period may also be included, if the water supplier wants to extend the forecast.

There are number of ways to develop demand forecasts, ranging from very simple methods to more sophisticated statistical based forecasts. The intent here is to highlight several approaches and provide the

reader with additional references regarding the details of each approach.

It is important to remember that there are a number of factors that dictate water use, including weather, population change, manufacturing and operational requirements, income, lot sizes, personal habits within the community, social patterns, and other economic and social behavior. The degree to which these factors are incorporated into the demand forecast is up to the individual supplier. Also, redundancy and backup supply needs will be important when forecasting future water needs. Each supplier must decide on an appropriate means for projecting future demand and be prepared to explain why this approach is appropriate for that supplier. Suppliers should link forecasts in regional planning efforts where applicable.

Summaries of three fundamental methods are provided below:

- **Per capita forecast.** – This is the simplest of the methods presented. It requires less expertise, time and data, in comparison with the other methods described below. Here, the supplier simply estimates the rate of annual water demand increase based on the projected increase in total service area population. This produces an aggregate estimate of future need. The technique is more readily applicable to suppliers whose customer base is homogeneous (e.g., dominated by residential users of a similar lot-size and economic standing).

In order to complete the forecast, a starting point must be determined from which to base the forecast in the present. The simplest approach is to use the water consumption number from the most recent year as the base. However, the supplier should make a judgment as to whether that base year is representative or not. If it was unusually hot or dry, or other unusual conditions occurred, a different year may provide a suitable base. An average of several years could also be used, if the supplier’s customer base has not changed a great deal.

Using this method once a base number is determined, then projections of future demand are simply found by increasing projected demand by the rate of increase in population.

- **Simple disaggregated forecast.** – A disaggregated forecast looks at several different categories of demand within the service area. Since these categories may grow (or decline) at different rates, it can produce a more accurate picture of future needs. However, this type of forecast requires more time, data, and expertise than the per-capita approach.

The different categories used in a disaggregated forecast are typically taken from the water supplier’s billing system. Therefore, this approach requires a billing system that tracks different customer groups (often rate classes). Some examples of categories that may be used are:

Simple Breakdown	Advanced Breakdown
Residential	Single-family residential
Non-residential	Multi-family residential
Non-revenue water ⁴	Commercial
	Industrial
	Schools
	Parks
	Government customers
	Irrigation meters
	Non-revenue water

For the base (present) year estimate, a similar approach to that described above may be used or other approach deemed reasonable by the supplier.

- **Advanced modeling using statistical techniques.** – The most sophisticated of the techniques presented here is based on using formal statistical tools to prepare a more advanced forecasting model. In this approach, water use is related to a variety of driving factors such as population, climate, season, employment, price, or other demo-

graphic or economic factors. This category involves building mathematical models that relate annual water use (Q) to a series of independent variables such as population, climate, and price (represented here by x, y, and z): $Q = ax + by + cz + d$

Where the coefficients a, b, c, and d are determined through a standard mathematical calculation known as “least squares.” Using known data over a given period of time (say five to ten years), the method of least squares is applied to an equation like the one shown above to arrive at estimates for a, b, c and d. Then by knowing forecasts for x, y, and z (in this case population, climate and price), future estimates of demand (Q) can be made.

The technique allows the forecast to reflect changes associated with a variety of variables. It requires considerable training and experience, and much more extensive data compared with the other methods discussed above. The tools needed to perform regression analysis are often included in standard computerized spreadsheets (e.g., Microsoft Excel) or can be found in specialized statistical software packages designed to allow for standard time series analysis of data or multiple regression modeling. This technique is often employed with the assistance of consultants with specified expertise in this area.

Regardless of the forecasting method used, the resulting demand projections should be compared to similar numbers that may have been developed for a prior (current) water master plan for the supply agency.

Several books and manuals that address the subject of demand forecasting are listed in the sources at the beginning of this section, or in the bibliography in Appendix D.

⁴ Non-revenue water is not recorded by customer meters. It results from operational uses and unavoidable losses. See discussion of water audits.



Comparison of Projected Need and Available Sources

OAR 690-086-0170 (4)

Water suppliers should compare the projected demand, including the demands of other suppliers (such as wholesale customers), with the existing sources of water identified in Section 3.3.2. Will projected demand exceed the current permitted diversions from these sources? Along with a discussion this comparison, water suppliers should also consider and discuss the reliability of the sources to meet projected demand.

One way to compare needs and sources is to prepare a table or graph that identifies source capacity at 10 and 20 years together with projected demands for the same years.



Analysis of Alternative Sources

OAR 690-086-0170(5) and (8)

Some water suppliers are required to analyze alternative water supplies for meeting future needs. This requirement will come into play if projected demand will exceed current diversions authorized under an existing permit. If so, the water suppliers will either need to:

- Expand current diversion under existing permits,
- Acquire water from another supplier,
- Add a new diversion under existing permits, or
- Acquire new rights within the next 20 years.

An analysis should be provided that considers the availability, reliability, feasibility, and the likely environmental impacts of diverting water from proposed sources. Answering the following questions in the WMCP will help water suppliers meet the requirements of Division 86.

- How available are the sources of water? Is access to these sources guaranteed or are there impediments which may prohibit use? Will future development of senior water rights impinge upon the water supplier's junior rights? Are sources available short or long term?
- Will the sources be reliable enough to meet demands? Are there seasonal restrictions on the source, for example, which are intended to protect fish or Clean Water Act requirements?
- If the sources are available and reliable, does the water supplier consider it feasible to divert water from these sources? Consider the financial, political, and operational impacts of diversion.
- If a water supplier were to divert water from any of the sources, are there any known environmental impacts upon the sources or other permitting type impediments to any of the sources.
- Are there public preferences of sources?

Two other alternative sources must receive consideration as well. First, water conservation to reduce demand must be considered. Specifically, water providers must show how water conservation measures identified in Section 3.4.2 can help meet demand. Therefore, any water savings that can be achieved through those identified conservation measures should be quantified and used to adjust future water needs downward. Water supplies must also consider other conservation measures that would yield water at a unit cost less than the costs associated with the other identified sources. Those conservation measures with a lower unit cost must be identified and assessed in the WMCP.

Second, in addition to conservation measures, water suppliers must consider how interconnections to other suppliers and/or cooperative regional water management efforts can help meet the projected supply needs of water suppliers.

Water providers 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.



The result of the alternatives analysis will be a proposed mix of source development, water conservation, and/or interconnections to meet the forecast demands. In the WMCP, the water supplier should clearly state what combination of sources and other activities are preferred, based on this analysis of alternatives. The reasons for selecting each activity or source should be clearly stated.

WRD will give due consideration to the supplier's judgment related to the appropriate resource mix if the plan documents the basis for the decision and the evaluation that the supplier has performed reflects a good faith effort to understand the economic costs and to minimize the impacts on other water users of the supplier's development choices. This illustrates the importance of documentation in the plan of the costs of the alternatives and an objective review of the impacts of the supplier's water use on other uses, including instream flows for fish and other aquatic species.



Quantification of Maximum Rate and Monthly Volume

OAR 690-086-0170(6)

If any expansion or initial diversion of water under an existing permit is needed to meet increased demand for water in the next 20 years, the supplier must identify and request the amount of additional water, both in terms of the maximum rate of withdrawal and the volume of water to be diverted in the maximum month during that 20 year period. The supplier will take the

results from the 20-year forecast (or longer) and determine how much water will be withdrawn in association with each permit over that same period.

WRD will evaluate the supplier's documented need for the additional water and include in the order approving the WMCP an authorization for the use of quantity of water needed. This authorization will establish a limit on the extent to which the supplier will be allowed to divert water under the permit until the plan is updated and the authorization is reviewed.



Mitigation Actions Under State and Federal Laws

OAR 690-086-0170(7)

The rule states that for any expansion (or initial) diversion of water under an existing permit a description must be prepared of the mitigation actions that are being taken by the supplier to comply with associated state and federal law, including (but not limited to) the federal Endangered Species Act, Clean Water Act, Safe Drinking Water Act, and permit conditions.

The purpose of this element is to address potential issues that may affect the species habitat or resource protection related concerns associated with the operation and maintenance of a diversion or reservoir facility. Some of the more notable elements of concern include: (From Oregon Association of Clean Water Agency's *Endangered Species Act Assessment Manual*.)

- **Direct diversion of water**
 - ✓ Intakes and screens
 - ✓ Instream flow effects
 - ✓ Hydraulic continuity
 - ✓ Water quality impacts
- **Diversion dam or structures**
 - ✓ Fish passage and bypass
 - ✓ Predator attraction and control
 - ✓ Sediment transport
 - ✓ Spillage effects
 - ✓ Water quality impacts
- **Reservoir operations**
 - ✓ Fish passage and bypass

- ✓ Flow regulation and releases
- ✓ Pool operation and water levels
- ✓ Flushing and spillage effects
- ✓ Water quality impacts

The description of the mitigation actions should include a report of the actions planned under other regulatory requirements previously described. The description does not need to include any new, additional mitigation actions above and beyond the requirements of these other regulations.

Additional assistance with these issues is available through a separate manual created by the Oregon Association of Clean Water Agencies titled, “*Endangered Species Act Assessment Manual*.” A free copy of the manual can be obtained online at: <http://www.oracwa.org/>.

Section 3.7 Finalizing the Plan Document and On- Going Tasks

3.7.1 Finalizing the Plan

When the water supplier has completed the various elements described in previous sections, they can be assembled into a complete Water Conservation and Management Plan (WMCP). Division 86 does not prescribe an exact format and organization for the Plan, apart from the requirement that it contain the four main elements discussed previously⁵. Appendix E contains a representative outline of a plan document, which water suppliers may wish to use or modify.

One technique that may help to streamline review of the water supplier’s WMCP is providing an Executive Summary. The Executive Summary can lay out the needs of the water supplier in terms of additional “green light” water. The Executive Summary should also clearly state how the water supplier has met the requirements of the Division 86 Rules, including linking future demand to the population projections contained in local land use plans and considering the conservation actions listed in the Rule.



To prepare an effective Executive Summary, water suppliers should carefully review the criteria the Oregon Water Resources Department (WRD) will use in reviewing plans. These criteria are highlighted throughout this Guidebook, and are listed in OAR 690-086-0130. Water suppliers can use the Executive Summary to explain, in brief, how they have met the applicable criteria and why they should receive the requested allotment of water.

Division 86 recognizes that in some cases a water supplier may be unable to provide all required elements of a WMCP. In this case, a water supplier may negotiate a “work plan” with WRD to complete the missing elements over some period of time. In these cases, WRD will issue an order approving an extension with a requirement to complete the work plan usually within five years. In general, a work plan will outline the steps necessary to satisfy the requirements of Division 86.

There are three additional items the completed plan must have, in addition to the four main required elements described in this guidance section. These are:



A list of the affected local governments to whom the plan was made available and a copy of any comments received from them;

⁵ I.e. the Water Supplier Description, and the Water Conservation, Curtailment and Supply Elements.



A proposed date for submittal of an updated plan, within no more than 10 years. The water supplier must explain why this date is appropriate, considering the proposed schedule for implementation of conservation measures, schedules for other community planning activities, and growth or other changes anticipated. If a water supplier determines that submittal of an updated plan should not be required, they should explain why.



Some municipal water suppliers may find it necessary to request additional time to implement full metering; or to complete a conservation benchmark listed in its previous WMCP. If this is true, the water supplier should explain why additional time is needed. WRD will evaluate this request based on whether additional time is needed to avoid unreasonable and excessive costs.

It is anticipated that most public organizations 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 water supplier's policy. It is suggested that adoption occur after approval by WRD, to allow for any changes that occur through the WRD review process.

Section 3.7.2 On-Going Tasks

Completion and approval of the WMCP marks a time period during which the water supplier must manage water resources for which they were approved in a diligent and an efficient manner. This includes following through with the action items identified in the conservation section of the WMCP and any other action items identified in other sections. Water suppliers must keep a keen eye on the benchmarks proposed and approved in their WMCPs and ensure those benchmarks are met. Suppliers must also note when progress reports are due and the next WMCP update is required to be submitted.

Section 3.8 WRD Review Process

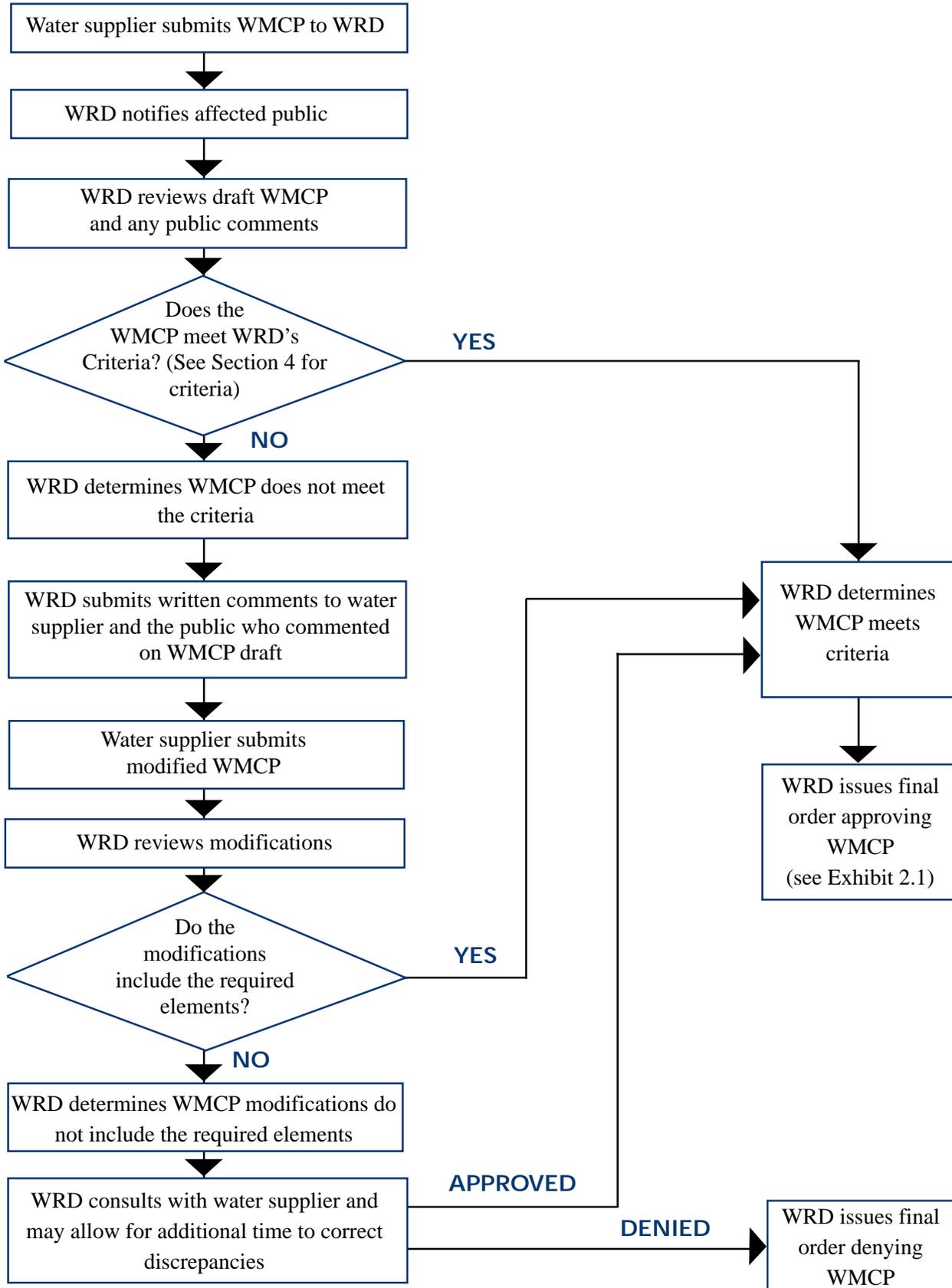
This section discusses WRD's review process after a water supplier completes and submits a WMCP. Water suppliers should anticipate that WRD may request changes in the WMCP once initially submitted, and should plan and budget accordingly. One element of WRD's review will be progress made on benchmarks identified in the previous WMCP and any progress report. Early contact with WRD can help to minimize changes later in the process.

Review criteria used by WRD are described in Section 2. Also in Section 2 is a description of the review process; Exhibit 3.8, however, expresses this process in a flow chart format. Specifically, a WMCP will be issued a final order of approval if it meets the review criteria. For WMCPs that do not meet the criteria, WRD will comment on any deficiencies and request that the water supplier make changes to their WMCP. After the water supplier makes changes, the WMCP is resubmitted to WRD and 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 suppliers if the supplier is making a good faith effort to meet the criteria for WMCPs.

Once a water supplier receives a final order approving their WMCP, the water supplier may begin diverting additional water. Readers may recall that some orders may have conditions such as a work plan requirements, which may allow for minimal diversion until the condition(s) are met.

In general, the review process may take as few as 90 days for WMCPs which meet the review criteria upon first submittal to WRD. For those WMCPs that do not meet the criteria, the review process will take longer. In this latter scenario, water suppliers have a minimum of 60 days to make changes to their WMCPs per feedback from WRD.

Exhibit 3.6 Review Process for Water Management and Conservation Plans



Appendix A

Oregon Administrative Rules 690-086 ("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 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 regula-

tion, 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/ Curtailement 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 success-

- ful 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

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Appendix B

Large Community Sample Plan (Cedar City)

Cedar City, Oregon

Water Management and Conservation Plan

May 2003

Note to Readers:

This sample plan has been developed solely for purposes of the Guidebook on Water Management and Conservation Plans (WMCPs). It offers an example of a WMCP based on a fictional community. The information presented was assembled from various sources and is intended for illustrative purposes only. Therefore, some of the information may not be fully consistent from one section to another.

The overall organization and approach to planning can serve as an example to water suppliers preparing their own plans. However, the specific mix of water supply and conservation actions described in this sample plan will not be applicable to every water supplier. Each community and water supplier is unique and should develop a WMCP to match its own specific needs and circumstances.

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(Note: In an actual plan, Appendices would be inserted as applicable.)

Executive Summary

Cedar City is submitting this Water Management and Conservation Plan (WMCP) in accordance with Oregon Administrative Rules (OAR) 690-315 and 690-086. This WMCP is related to permit extension applications associated with three of the City's four water rights.

Overview of Plan Findings

Cedar City provides water to its own citizens, with a population of approximately 18,000 people. Cedar City also serves as the only source of supply for the Town of Blue Falls, which serves an additional 950 people.

Cedar City diverts water from the Red Cedar River, and also has several wells that provide ground water supplies. One of the City's four water rights is fully certificated, and the other three water rights are not fully perfected at this time.

This WMCP documents additional demands projected over the next 20 years. Maximum Day Demand (MDD) is projected to rise from 6.0 million gallons per day (mgd) in 2002 to 7.3 mgd in 2023. Average day demand (ADD) is projected to rise from 3.1 mgd to 3.8 mgd over this time period.

To meet these needs, the City will institute an expanded water conservation program that meets the requirements of the Division 86 rules, and plans to install additional well capacity. The water conservation program is projected to reduce ADD by 0.21 mgd by year 2023. The expanded well capacity will provide an additional 1.1 mgd on an average day basis, and 1.25 mgd on a peak day basis.

To support the expanded pumping, the City is requesting that authorized use for the Granite Lake permit be expanded from the current level of 0.8 cfs to a new level of 3.25 cfs. This is consistent with a permit extension application submitted to WRD by the City. WRD has issued an order approving this expanded use, conditioned on completion of this WMCP. The requested expansion of authorized use is shown in Table ES-1.

**Table ES-1
Summary of Expanded Use Requested**

Permit No.	Source	Original Application ¹	Current Authorization		Total Authorization Requested ²	
		Instantaneous Rate (cfs)	Instantaneous Rate (cfs)	Peak Monthly Volume (MG)	Instantaneous Rate (cfs)	Peak Monthly Volume (MG)
S-199853	Red Cedar River	9	8.1	105	no change	no change ³
S-115389	Johnson Springs	0.55	0.55	10	no change	no change ³
S-295687	Johnson Springs	2.8	1.25	19.4	no change	no change ³
G-356689	Granite Lake Wells Nos. 1, 2, 3, and 4	3.5	1.24	19	3.17	57

MG = million gallons cfs = cubic feet per second

¹ This is the "face value" of the water right, including any unperfected quantity.

² Includes amount previously authorized plus new expansion.

³ The City reserves the right to request expanded use in future extension applications.

Compliance with Division 86 Rules

The City believes that this Plan fully complies with the requirements of OAR 690-086. Required elements that are included in this plan are listed below:

- **Water Supplier Description:** This WMCP contains all the required content for a water supplier description, including a discussion of supply sources, service area, adequacy of supplies, water usage, water rights and other information.
- **Water Conservation Element:** A water conservation program is described that builds upon the City's ongoing efforts and meets the Division 86 requirements. A summary of the program and associated benchmarks is included in Table ES-2.
- **Water Curtailment Element:** A curtailment program is provided, that includes three stages of alert, triggers for implementing each stage, and a suite of curtailment actions that will reduce water usage in the event of an emergency water supply shortage.
- **Water Supply Element:** This WMCP projects water demand consistent with the City's service area and expected population growth as documented in the City's Comprehensive Land Use Plan. Several alternative means of meeting growth in demand are considered, with documentation provided in appended material. The City's plan for meeting future needs of its own citizens and those of the Town of Blue Falls is described and provides the documentation associated with the City's planned expansion of water withdrawals.
- **Other Required Material:** This WMCP was circulated to affected local governments, and their comments are included as appendices. A date for the next update of year 2013 is suggested, with a progress report to be submitted in 2008.

For convenience of WRD staff in reviewing this WMCP, Section 1 contains a cross-reference key, indicating where each item required can be found in this document.

**Table ES-2
Conservation Program**

Benchmark	Start Date	Frequency
Source meter calibration (Red Cedar River)	2004	Every 5 years
Source meter calibration (Johnson Springs)	2005	Every 5 years
Source meter replacement (Granite Lake well)	2006	Calibrate every 5 years thereafter
Master meter calibration (Town of Blue Falls)	2009	Every 5 years thereafter
Install meters on unmetered customer accounts	2004	Annually through 2008 (completion)
Customer meter calibration (4" and larger)	On-going	3 years
Amend Blue Falls supply contract to require customer meters	2011	N/A
Perform annual water audit	2003	Annual
Improve audit capabilities through additional metering	See Sec. 3.2.1	See Section 3.2.1
Institute formal tracking of authorized unbilled uses	2004	Annual
Test oldest 25% of lines over 10" diameter	2004	Complete by 2010
Test additional lines, as needed coincident with road repairs	2004	Tie to road repair schedule
Change all flat rate residential customers to commodity rate	2004	Annually to 2008 (completion)
Complete rate study to assess change to inverted block rates	2005	N/A
Evaluate incorporating bill history capability in new billing system	2007	N/A
Continue free leak detection tests	Current	On-going
Advertise via the conservation web page and the Cedar City Inquirer	April 2004	On-going
Write three conservation articles for The Cedar City Inquirer	June 2004	Annually
Develop a web page for water conservation on the City's web site	December 2003	On-going
Distribute brochures at two community events each year	January 2004	Annually
Distribute brochures in key city offices frequented by customers	January 2004	On-going
Distribute free water conservation kits to residential customers who respond to mailed-out information	April 2003	On-going
Offer \$200 rebates for irrigation audits to commercial and industrial customers with high peaking factors	March 2005	Annually
Offer a \$1,000 rebate to the ten largest commercial and industrial water users to study re-use and recycling of water on-site	2003	3 years
Install rain sensors for irrigation systems in city parks	May 2004	1 installation annually for three years

Introduction

Cedar City has developed this Water Management and Conservation Plan (WMCP) to address the City's long-term water supply needs and to meet requirements of Oregon Administrative Rules (OAR) Chapter 690 Division 86. This WMCP is related to permit extensions for the City's water rights from the Red Cedar River and several wells. A 20-year planning period, beginning in 2004, has been analyzed for the Cedar City water system.

The plan is being submitted to the Oregon Water Resources Department for review. Upon approval by the Department, it will be adopted by the City Council and administered by the Public Works Director.

1.1 Overview of Existing System and Community Served

Cedar City draws water from three primary sources: Johnson Springs, the Red Cedar River, and the Granite Lake Well. Combined, these sources have the capacity to provide approximately 7.0 million gallons per day (mgd). Water is distributed to customers via approximately 105 miles of water pipe varying in size up to 30 inches in diameter. Four reservoirs and two standpipes are available to provide storage and two booster stations control service pressures within the system.

Cedar City has a population of approximately 18,000, based on the year 2000 Census. The basis for growth projections used in this WMCP is the City's Comprehensive Plan, prepared in 1996. Growth has been substantial in the past ten years, and further growth is anticipated. Additional water will be needed to provide adequate supplies for the community. The City plans to install a new well field to augment existing supplies and provide adequate water for future growth.

Cedar City also provides water through an intertie to the Town of Blue Falls, with a population of 950 people. Cedar City is the only source of supply for Blue Falls.

1.2 Proposed Dates for Future Submittals

Cedar City anticipates submitting its next update of the WMCP ten years from now, in 2013. As required under OAR 690-86, a progress report will be submitted five years from now, in year 2008.

1.3 Plan Organization

This Plan is organized into the following sections:

- Section 1: Introduction
- Section 2: Description of Cedar City Water System
- Section 3: Water Conservation Element
- Section 4: Water Curtailment Element
- Section 5: Water Supply Element

The following elements required in the Division 86 Rules are included in this document:

Table 1-1
Cross-references between WMCP Sections and
Division 86 Requirements

Item	OAR Reference	Section
<i>Water Supplier Description</i>		
✓ Description of supplier's source(s)	690-086-0140 (1)	2.2
✓ Delineation of current service area	690-086-0140 (2)	2.1
✓ Assessment of adequacy and reliability of existing supplies	690-086-0140 (3)	2.3
✓ Quantification of present and historic use	690-086-0140 (4)	2.1
✓ Summary of water rights held	690-086-0140 (5)	2.2
✓ Description of customers served and water use summary	690-086-0140 (6)	2.1
✓ Identification of interconnections with other suppliers	690-086-0140 (7)	2.3
✓ System schematic	690-086-0140 (8)	2.2
✓ Quantification of system leakage	690-086-0140 (9)	2.4
<i>Water Conservation Element</i>		
✓ Full metering of systems	690-86-0150 (4)(b)	3.2.1
✓ Meter testing and maintenance program	690-86-0150 (4)(c)	3.2.1
✓ Annual water audit	690-86-0150 (4)(a)	3.2.2
✓ Leak detection program	690-86-0150 (4)(e)	3.2.3
✓ Leak repair or line replacement program	690-86-0150 (6)(a)	3.2.3
✓ Rate structure based on quantity of water metered	690-86-0150 (4)(d)	3.2.4
✓ Rate structure and billing practices that encourage conservation	690-86-0150 (6)(d)	3.2.4
✓ Public education program	690-86-0150 (4)(f)	3.2.5
✓ Technical and financial assistance programs	690-86-0150 (6)(b)	3.2.6
✓ Retrofit/replacement of inefficient fixtures	690-86-0150 (6)(c)	3.2.6
✓ Reuse, recycling, non-potable opportunities	690-86-0150 (6)(e)	3.2.7
N/A Other measures, if identified by supplier	690-86-0150 (6)(f)	N/A
N/A Progress report on previous WMCP	690-86-0150 (1)	N/A
✓ Documentation of water use measurement and reporting	690-86-0150 (2)	3.4
✓ List of measures already implemented or required under contract	690-86-0150 (3)	3.1
<i>Water Curtailment Element</i>		
✓ Assessing your water supply	690-086-0160(1)	2.3
✓ Stages of alert	690-086-0160(2)	4
✓ Triggers for each stage of alert	690-086-0160(3)	4
✓ Curtailment actions	690-086-0160(4)	4
<i>Water Supply Element</i>		
✓ Delineation of current and future service areas	690-086-0170 (1)	2.1, 5.1
✓ Population projections for service area	690-086-0170 (1)	5.2
✓ Prepare schedule to fully exercise each permit	690-086-0170 (2)	5.6
✓ Prepare demand forecast	690-086-0170 (3)	5.3
✓ Comparison of projected need and available sources	690-086-0170 (4)	5.4
✓ Analysis of alternative sources	690-086-0170 (5) and (8)	5.4
✓ Quantification of maximum rate and monthly volume	690-086-0170 (6)	5.5
N/A Mitigation actions under state and federal laws	690-086-0170 (7)	5.7
<i>Other Items</i>		
✓ List of affected local governments and their comments	690-086-0125 (5)	1.4
✓ Date for submittal of next update	690-086-0125 (6)	1.2
Documentation, where additional time is requested to meet previous	690-086-0125 (7)	N/A
N/A previous benchmarks or metering		

1.4 Review by Affected Local Governments

This WMCP was provided in draft form to the Town of Blue Falls Director of Public Works and the Johnson County Planning Director for their review and comment. Comment letters are included in the Appendices. All of the comments have been addressed in this final plan document.

Section 2

Description of Cedar City Water System

2.1 Service Area, Customer Characteristics, and Water Usage

Cedar City serves the entire population within its city limits, as well as some customers outside city limits but within the Urban Growth Boundary (UGB). Exhibit 2-1 shows the city limits, water service area and urban growth boundary. The City also delivers water on a wholesale basis to the Town of Blue Falls. Both Cedar City and Blue Falls are located within Johnson County.

Cedar City provides water to residential, commercial and industrial customers, as well as schools, and municipal facilities. Exhibit 2-2 displays the number of service connections from 1993 through 2002. Over that time-period, the number of connections grew by about 16 percent.

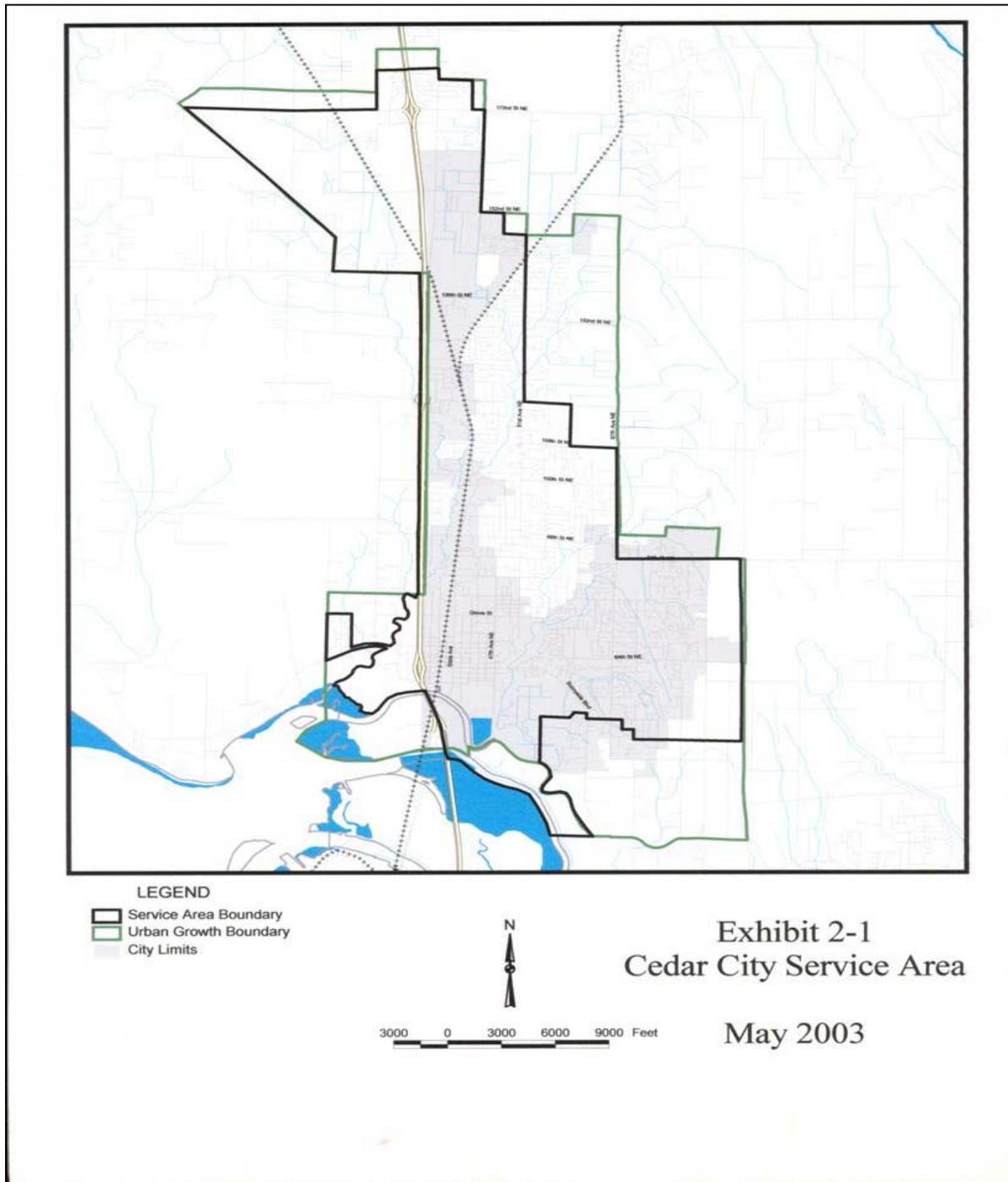
The breakdown of water uses by customer category is shown in Exhibit 2-3 for year 2002. Total water sold has increased by 11 percent over the past seven years, as shown in Table 2-1 and Exhibit 2-4. Sales to the top five customers by volume are shown in Table 2-2.

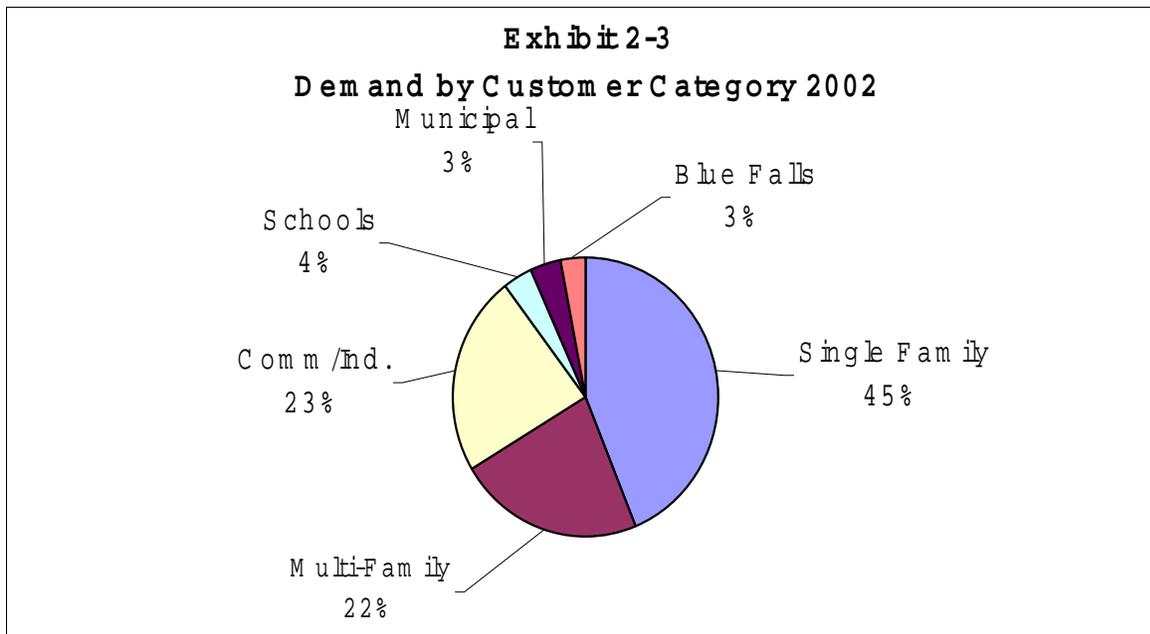
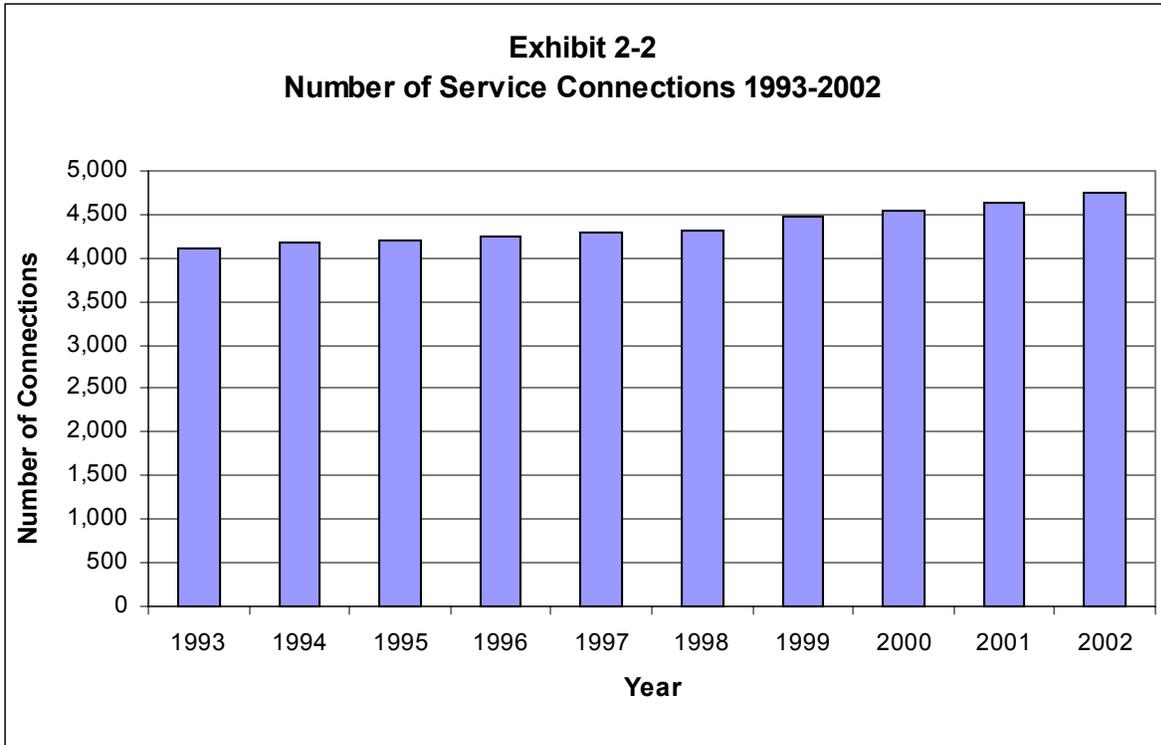
Category	1996	1997	1998	1999	2000	2001	2002
Single Family	1.11	1.14	1.19	1.19	1.24	1.23	1.27
Multi-Family	0.65	0.62	0.62	0.65	0.66	0.64	0.65
Commercial/Industrial	0.59	0.65	0.56	0.58	0.66	0.71	0.67
Schools	0.11	0.11	0.1	0.12	0.14	0.13	0.11
Municipal	0.06	0.07	0.09	0.07	0.09	0.08	0.1
Blue Falls	<u>0.08</u>	<u>0.09</u>	<u>0.09</u>	<u>0.08</u>	<u>0.09</u>	<u>0.1</u>	<u>0.09</u>
Total	2.52	2.59	2.56	2.61	2.79	2.79	2.80

(1) 45% of single-family customer accounts are currently metered. Sales to unmetered accounts are estimated, based on data from metered accounts.

Average day production in year 2002 was 3.13 mgd. Peak day demand occurred on August 12, 2002, and was 6.02 mgd. This represents a peaking factor of approximately 1.9.

The peaking factor is driven by peaking characteristics of the various customer classes served by the City. For example, residential uses exhibit a pronounced peaking pattern in the summer months due to outdoor irrigation of turf and landscape materials. Many commercial customers in Cedar City also have extensive turf that is irrigated. Uses at City parks and schools also increases substantially, with highest use occurring typically in August. In contrast, the City's large industrial customers have peak uses that may occur at any time of year and do not coincide with irrigation peaks.





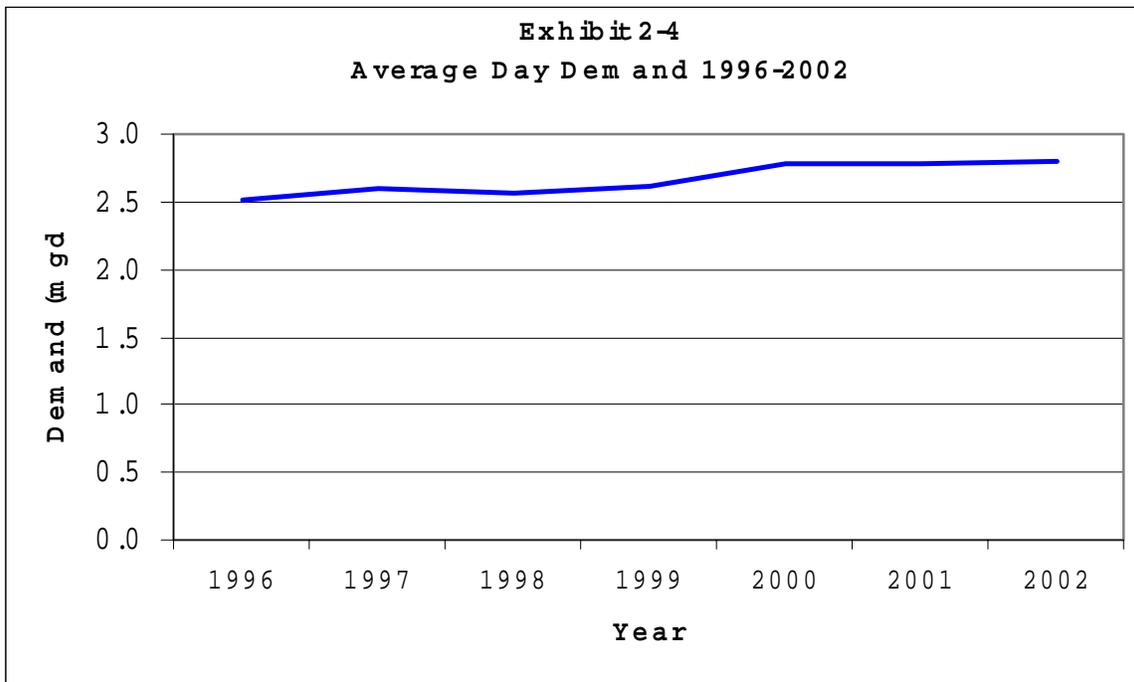


Table 2-2
Top Five Customers in Cedar City

Customer	Average Day Demand (gpd)				
	1998	1999	2000	2001	2002
<i>Pacific Coast Controls Inc.</i>					
4" meter	138,374	159,038	116,060	147,578	123,087
2" meter	<u>4,932</u>	<u>4,222</u>	<u>6,636</u>	<u>4,658</u>	<u>5,126</u>
sub-total	143,306	163,260	122,696	152,236	128,213
<i>NDSA</i>					
irrigation meter	57,246	43,225	38,822	44,359	46,760
meter	<u>5,921</u>	<u>12,729</u>	<u>12,493</u>	<u>22,063</u>	<u>12,478</u>
sub-total	63,167	55,953	51,315	66,422	59,238
Federated Foods	18,410	14,148	19,784	20,860	23,093
Bluestone Park (irrig.)	4,522	5,134	4,279	5,828	5,128
Johnson Academy	<u>3,948</u>	<u>4,519</u>	<u>4,224</u>	<u>4,768</u>	<u>4,648</u>
Total	233,352	243,015	202,297	250,113	220,320

Source: Spreadsheet, "Large Users" from Cedar City Public Works

2.2 Sources of Supply

Cedar City draws water from three primary sources: Johnson Springs, the Red Cedar River, and the Granite Lake Well. Combined, these sources have the capacity to provide approximately 7.0 mgd. Water rights for these sources are shown in Table 2-3. Exhibit 2-5 also displays the City's sources of supply.

**Table 2-3
Cedar City
Existing Permits/Certificates**

Name	Application	Permit	Transfer	Certificate	Source	Use	Nominal Rate (cfs)	Authorized Rate	Priority Date	Limitations
1	S-235467	S-19985	N/A	N/A	Red Cedar River	Municipal	9	8.1	5/12/1926	Federal listed species and 303(d) listed water body.
2	D-285213	D-285213	N/A	115389	Johnson Springs	Municipal	0.55	0.55	1889	none
3	S-356659	S-295687	N/A	N/A	Johnson Springs	Municipal	2.8	1.25	11/16/1963	none
4	G-415685	G-356689	N/A	N/A	Granite Lake Well Nos. 1, 2, 3, and 4	Municipal	3.5	1.24	5/25/1985	none

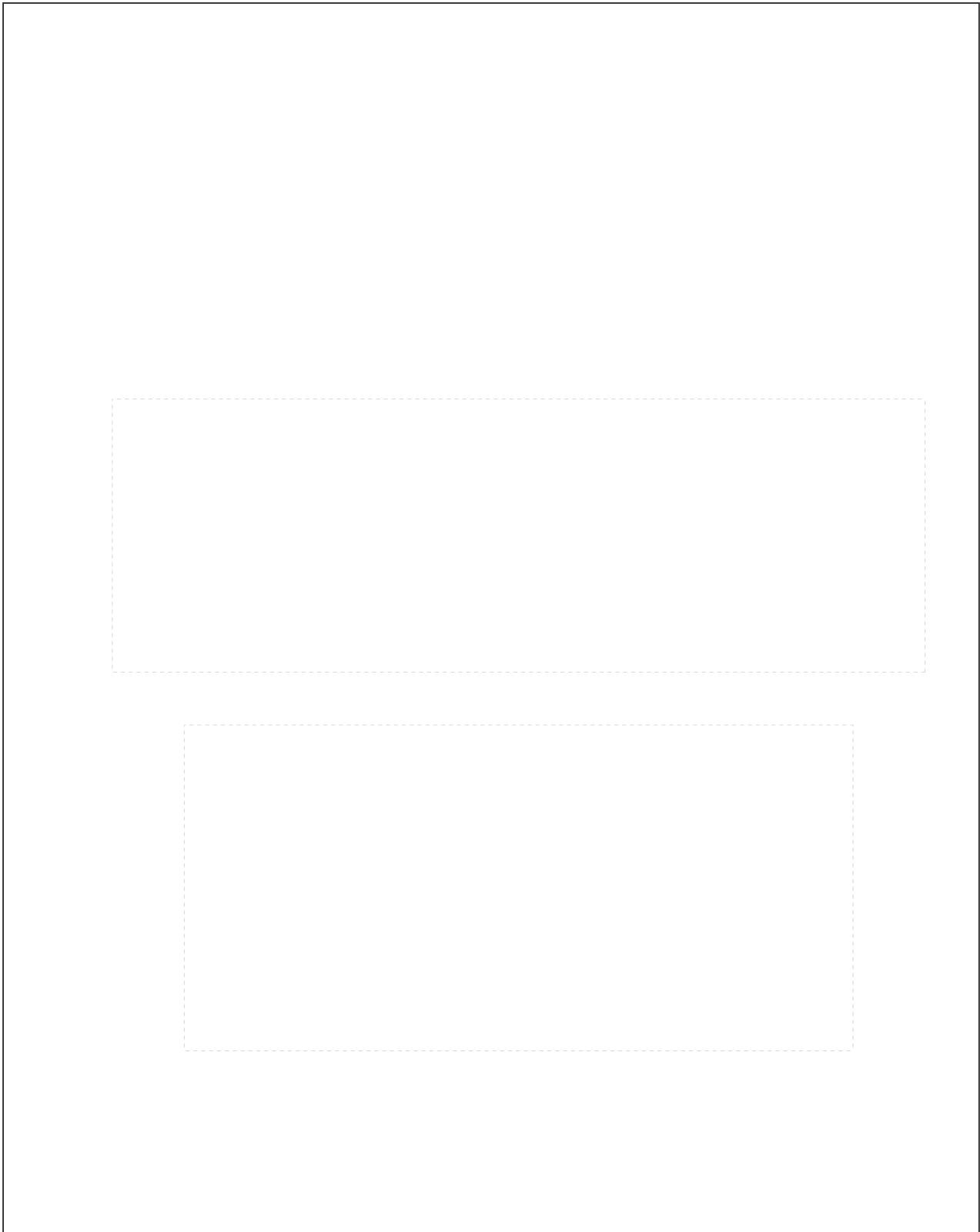
The City's diversion on the Red Cedar River has resource issues as identified in OAR 690-86-140 (5). Specifically, Steelhead are listed as threatened under the Federal Endangered Species Act (ESA). Steelhead use the Red Cedar River as spawning and rearing habitat. In addition, the river is listed on the 303(d) list, indicating water quality impairment for temperature and fecal coliform. The City anticipates continued access to water supply from the river under its existing water right. However, to the extent that new sources of supply are needed, the City anticipates developing additional ground water from deep wells, rather than increased use of the Red Cedar River (see section 5.4).

2.3 Adequacy and Reliability of Supply Sources

At this time, the City's sources of supply are sufficient to meet its needs, and the needs of the adjacent town of Blue Falls. However, as indicated in Section 5 of this WMCP, additional water will be needed to meet future needs as growth occurs.

Reliability of the City's supplies is good, in part due to use of three different sources of supply. If one source is interrupted due to an emergency, the other two sources can be increased. While this may result in reduced supply to some pressure zones, the distribution system can be used to move water throughout the system. During drought conditions in the early 1990's the City's supplies proved adequate to meet community needs.

The City has an intertie with the Town of Blue Falls, to deliver water to Blue Falls (Exhibit 2-5.) This is a one-way interconnection, as Blue Falls does not have its own source of supply.



A comparison between production and billed sales indicates that the water system produces approximately 10 to 13 percent more water than is delivered to customers through their meters. Table 2-4 displays this comparison for the past seven years. The difference between production and sales is termed “*non-revenue water*”. It includes water used for beneficial purposes, such as flushing of water mains to meet water quality objectives, uses of water for fire fighting, and authorized withdrawals from fire hydrants at construction sites. It may also include some unauthorized uses, leakage and other losses. The city does not have a means to directly measure flushing, firefighting and other authorized uses. Water main leaks occur occasionally and are repaired. However, there have been no major leaks in the past 10 years that would result in major losses to the system. In the absence of direct measurements, and given the amount of non-revenue water shown above, it is estimated that system leakage must be well under ten percent.

Table 2-4
Non-Revenue Water (mgd)

	1996	1997	1998	1999	2000	2001	2002
Production	2.88	2.98	2.92	3.03	3.09	3.16	3.13
Billed Sales	2.52	2.59	2.56	2.61	2.79	2.79	2.80
Non-Revenue Water	0.36	0.39	0.36	0.42	0.30	0.37	0.33
Percentage of Total Production	12.43%	13.01%	12.44%	13.90%	9.71%	11.66%	10.51%

Section 3

Water Conservation Element

In accordance with OAR 690-086-150, this section describes water conservation activities the City plans to implement during the next 20 years. Some of these activities are ongoing, while others will be new.

3.1 Existing Conservation Program

Cedar City has been carrying out water conservation activities since 1995. These activities include regular distribution of promotional materials at City Hall and mailing of a brochure on water conservation once per year to all residential customers. In 2001 the city installed a 500 square foot garden demonstrating low-water using landscape materials at Blakely Park in the city center. In addition, most Cedar City residents have received low flow showerheads from B&E Power, as part of an energy efficiency campaign. The City encourages water efficiency throughout its own facilities, including posting of signs that encourage employees to avoid waste wherever possible. In addition, six high-efficiency toilets were installed at City Hall and four at Blakely Park in year 2000. An additional 10 high-efficiency toilets are planned for installation in other City facilities in 2003.

3.2 Proposed New Conservation Program

In order to meet the requirements of the newly revised Division 86 Rules, Cedar City has evaluated implementation of additional conservation measures. These measures are described below.

Cedar City anticipates developing new sources of supply to meet growing demand (see Section 5). Use of water conservation programs can potentially reduce the need for new supply, or at least defer projects to a later time-period. Both of these can potentially reduce costs to the City's water customers.

In considering the applicability of various water conservation actions, it is important to assess their cost-effectiveness, compared with the alternative of developing new supplies. An engineering study completed in 1999 indicated that installation of new ground water supplies would cost \$650,000. Based on the assumptions documented in that report, construction of this project would yield an additional 0.5 mgd on an annual average basis. This equates to approximately \$1.30 per gpd of long-term supply. This value was used as a cost-effectiveness threshold for comparing the cost of water conservation projects that could achieve long-term reductions in demand. Conservation actions that cost less than this amount are deemed to be cost-effective, while actions costing more are not cost effective for Cedar City. All of the actions listed below met the cost-effectiveness target, except where noted.

(Note: The cost-effectiveness information presented above is entirely hypothetical, and should not be used in actual WMCPs, your own cost effectiveness analysis should be used.)

3.2.1 Source and Customer Metering Program

Source Meters

Cedar City's three sources of supply are fully metered, and have been since the current facilities were installed. However, the existing meters were installed during the 1970's and 1980's and have not been calibrated in recent years. Cedar City will calibrate the meter associated with the Red Cedar River treatment plant in year 2004; and the meter at Johnson Springs in 2005. Source meters will be re-calibrated every five years thereafter. Depending on the results of the calibration procedure, meters will be adjusted or replaced as necessary. Meters will be judged adequate if calibration indicates they are registering within 5 percent of true flows.

The meters on wells at Granite Lake are the oldest in the system. Rather than calibrating these meters, they will be replaced with new meters in 2006 at the same time the well houses are upgraded in accordance with the City's Capital Improvement Plan.

Under a contract for water supply with the City of Blue Falls, Cedar City owns and maintains a master meter. This meter was upgraded in 1999 and is believed to be accurate. Therefore, the City does not anticipate calibration or replacement in the near future. Calibration will be conducted when the meter reaches an age of 10 years (i.e., in 2009), or sooner if data indicates measurement error.

Customer Meters

The new State Rules at OAR 690-086-150 (4) require that a water supplier fully meter all retail accounts within five years of approval of a WMCP. Cedar City's municipal code requires that all multifamily residential, commercial and industrial, and municipal customers have water meters. Single-family residences constructed since 1989 have been required to have meters, but most older houses do not have meters. Unmetered residences represent approximately 55 percent of the housing stock in Cedar City. In accordance with the State Rules, the City will amend its municipal code to require all single family residences to have meters by year 2008. Meter installation will be carried out by Public Works crews. This activity will be financed through a rate surcharge applied to unmetered accounts, which will be collected beginning in fiscal year 2004. As part of this process, the City also plans to evaluate upgrading meters on all accounts throughout the City, to utilize new meter-reading technology and reduce operational costs. While the latter measure is not required by the State, it will help the City improve operational efficiencies and customer service.

Customer meters may become less accurate as they age, and occasionally fail altogether. The City currently attempts to calibrate all customer meters 4" and larger at least once every 3 years. Meters are generally replaced when they reach an age of 20 years. There are approximately 190 meters of this size in the system. Smaller meters are replaced when failures occur, as reported by customers or city meter readers. The City will continue these policies in the future as part of its overall approach to metering.

The Town of Blue Falls, which receives water on a wholesale basis from Cedar City, does not currently have customer meters. Cedar City does not have jurisdiction over metering practices in Blue Falls, under the current Water Supply Contract. However, when the current contract is up for renewal in year 2011, Cedar City will require Blue Falls to install customer meters. Advance notice of this requirement will be provided at the time this WMCP receives final approval, to allow for advance planning by the Town Council of Blue Falls. Table 3-1 shows the benchmarks for the source and customer metering program.

**Table 3-1
Metering Benchmarks**

Benchmark	Start Date	Frequency
Source meter calibration (Red Cedar River)	2004	Every 5 years
Source meter calibration (Johnson Springs)	2005	Every 5 years
Source meter replacement (Granite Lake well)	2006	Calibrate every 5 years thereafter
Master meter calibration (Town of Blue Falls)	2009	Every 5 years thereafter
Install meters on unmetered customer accounts	2004	Annually through 2008
Customer meter calibration (4" and larger)	On-going	3 years
Amend Blue Falls supply contract to require customer meters	2011	N/A

3.2.2 Water System Audits

The updated Division 86 Rules require the City to perform a water audit of the system annually. This must include a method to estimate any un-metered uses, both authorized and unauthorized. The data compiled for this WMCP represent the City's first effort at a system audit. Estimated data indicates that "non-revenue" water is currently on the order of 10 to 11 percent of total system production. This estimate is somewhat limited, in that actual data is not available from the 55 percent of single-family residential accounts that are currently unmetered. Therefore, the auditing capability will improve over time, as additional meters are installed (see Section 3.2.1).

The City does not currently track unbilled uses of water. These unbilled uses include fire-fighting; flushing mains to maintain water quality; and back-flushing of filters at the Red Cedar River water treatment plant. It also includes authorized uses of water from fire hydrants by construction contractors and a private company contracted to perform street sweeping. These uses cannot be accurately measured, but can be estimated in the future. The City will develop an annual estimate of these uses, by contacting the Cedar City Fire Department and authorized contractors. Beginning in January 2004, City crews responsible for line flushing will be required to maintain a daily log of estimated volumes flushed (minutes times estimated flushing rate in gpm). City crews that repair line leaks will maintain a similar log to estimate leakage volumes.

As required under the new Rules, a system audit will be performed by public works staff in March of each year, when data on billed sales and estimated uses is fully available for the previous year. The audit will include a comparison of all water produced from the City's sources of supply; water delivered to all customers; and estimated unbilled uses.

Audit results will be maintained in files of the Director of Public Works. Where audit results indicate an unacceptable level of unaccounted for water, the Director will take appropriate steps to identify the source and carry out corrective measures. The City will report annual audit results in its WMCP Progress Report to be submitted in year 2008, and in the next WMCP update scheduled for submittal in year 2013. Table 3-2 shows the benchmarks for the water system audits.

Table 3-2
System Audit Benchmarks

Benchmark	Start Date	Frequency
Perform annual water audit	2003	Annual
Improve audit capabilities through additional metering	See Section 3.2.1	See Section 3.2.1
Institute formal tracking of authorized unbilled uses	2004	Annual

3.2.3 Leak Detection and Repair or Replacement of Water Mains

Based on the data provided in Section 2.4 of this WMCP, total non-revenue water is approximately 10 to 11 percent. Since much of this represents water that is used for authorized purposes, but not billed, system leakage is believed to be well below ten percent. Based on this estimate of system leakage, the State Rules do not require a leak detection program. However, the City believes that leak detection activities are part of an overall sound management program. Therefore, the City will contract out leak detection with the objective of testing 25 percent of the water mains by year 2010. The oldest portions of the system, constructed in the 1950's of asbestos-concrete (AC) pipe, will be tested first. Testing of other areas will be timed to coincide with road and sewer line improvement projects, to reduce the costs of any line replacement that is deemed necessary.

The City will fund line repair and replacement needs through its water rates, as part of the City's overall rehabilitation and replacement program for water system infrastructure. Where possible, the City will also seek funding from state and/or federal sources. Table 3-3 shows the benchmarks for the leak detection and repair program.

Table 3-3
Leak Detection Benchmarks

Benchmark	Start Date	Frequency
Test oldest 25% of lines over 10" diameter	2004	Complete by 2010
Test additional lines, as needed coincident with road repairs	2004	Tie to road repair schedule

3.2.4 Water Rates and Billing Practices

The City currently has a rate structure that includes a flat rate for unmetered single-family residential customers, and a base charge/commodity rate for all other customers. The commodity rate includes a uniform-block rate structure in the metered single-family category, the multifamily category, and the municipal category. Commercial and industrial customers have a declining block rate structure that charges less per unit of water as the customer's use increases.

The Division 86 rules require all water suppliers to have a rate structure that is based, at least in part, on the quantity of water metered at the service connection. The City's existing rate structure meets this requirement, for all metered services. As noted in Section 3.2.1, all unmetered services will have meters installed by year 2008 and will also meet this requirement.

For water suppliers serving a population over 7,500 the Division 86 Rules require consideration of rate structures that "*support and encourage water conservation.*" Cedar City serves a population of approximately 18,000, and therefore is subject to this requirement. While the City believes that its current rate structure is suitable for the Cedar City community, the City will review its rate structure to assess whether it should be changed. Therefore, a rate study will be commissioned by a qualified analyst specializing in utility finances. The rate study will be carried out by the end of fiscal year 2005. It will include an evaluation of changing to an inverted block rate structure for all customer classes, and will assess the impact on the City's water customers. The City Council will then determine whether to make alterations in the existing rate structure.

The City currently bills its customers approximately every 60 days. This practice will be continued in the future. The City's existing computer system and billing software do not permit providing customers with consumption history in each bill. However, the City anticipates upgrading its billing system by year 2007. At the time a new billing system is selected, the City will review available systems to determine whether consumption history can be generated in the new system to be purchased. The final decision on a new billing system will be made by the City Council, and will factor in cost, operational considerations, and customer service needs.

Table 3-4 shows benchmarks for the water rates and billing practices.

Benchmark	Start Date	Frequency
Change all flat rate residential customers to commodity rate as meters are installed (see Table 3-1)	2004	Annually to 2008 (completion)
Complete rate study to assess change to inverted block rates	2005	N/A
Evaluate incorporating bill history capability in new billing system	2007	N/A

3.2.5 Public Education

As described in Section 3.1, Cedar City currently carries out public education activities to encourage wise use of water by customers as well as City employees. The City will expand its public education program as follows:

- Continue free leak detection tests for customers who suspect a leak. City staff will help determine the location of the leak if the leak is outdoors and offer free brochures with conservation information and a free conservation kit when applicable (see below for a description of the brochures and kits).
- Publish three water conservation articles in the City's bi-monthly newsletter, *The Cedar City Inquirer*, which all water customers receive by mail. Articles' topics will include tips to reduce seasonal peak demand (outdoor measures); tips to reduce base demand (indoor measures); information about available water conservation programs, such as incentives for commercial and industrial users; and introductions of other important conservation related measures described herein, such as the conservation web page.
- Create a water conservation web page to be published on the City's web site. The site will contain information about how to conserve water, programs available to customers, and a link to AWWA's Waterwiser site.
- Distribute water conservation brochures at community events twice per year and provide brochures at key city office sites frequented by customers. Brochures include tips on water saving irrigation techniques and methods to reduce consumption indoors.

Table 3-5 summarizes the benchmarks for public education.

Benchmark	Start Date	Frequency
Continue free leak detection tests	Current	On-going
Advertise via the conservation web page and the Cedar City Inquirer	April 2004	On-going
Write three conservation articles for The Cedar City Inquirer	June 2004	Annually
Develop a web page for water conservation on the City's web site	December 2003	On-going
Distribute brochures at two community events each per year	January 2004	Annually
Distribute brochures in key city offices frequented by customers	January 2004	On-going

The City views these actions as essential to supporting the overall water conservation program. However, estimating water savings from public education is subject to extensive assumptions and was not attempted with the limited budget available for water conservation planning.

3.2.6 Technical and Financial Assistance (includes Retrofits and Replacements)

Cedar City's conservation program consists of targeted efforts to reduce peak demand by the residential, commercial, and industrial classes. This is appropriate for the Cedar City water system because peak demand is the primary reason that new source development needs to be considered. Reduction in peak demand may help to delay or minimize the need for new source projects, with cost savings to the City's customers.

Cedar City will initiate a program that offers technical and financial assistance and finances retrofit and replacement of existing fixtures. The program will include distribution of free water conservation kits to residential customers. The kits will include an automatic-stop hose nozzle, a hose repair kit, and an irrigation gauge (to measure volume of water applied).

The kits will be advertised on the City's web site and in one or more of the City's newsletter articles (depending upon customer demand to the kits). The kits will also be distributed to customers when warranted during a water leak detection visit.

Technical and financial assistance will also be extended to the commercial and industrial classes. The City will offer a \$200 subsidy for irrigation audits to commercial and industrial customers with high seasonal peaking. To qualify for the subsidy, participating customers must have the irrigation audits performed by a certified Irrigation Auditor. Ten new customers will be notified of the opportunity by mail annually for the first few years. Because of the small size of Cedar City's commercial and industrial base and limited number of customers in either of these classes that contribute significantly to peak demand, it is likely that in future years, customers who already received notification of the incentive program will receive additional notifications.

Table 3-6 shows the benchmarks for the technical and financial assistance program in this category are as follows:

Benchmark	Start Date	Frequency
Distribute free water conservation kits to residential customers who respond to mailed-out information.	April 2003	On-going
Offer \$200 rebates for irrigation audits to commercial and industrial customers with high peaking factors.	March 2005	Annually

3.2.7 Reuse and Recycling of Water

Cedar City has considered opportunities available for water re-use, recycling, and non-potable water. At this time, using water from the City's wastewater treatment plant was deemed infeasible due to the expense compared to the expense of supplying well water. The City's cost effectiveness measure for water conservation actions is \$1.30 per gpd of long-term water savings. The City performed a rough analysis, which showed that the cost to construct reuse infrastructure, coupled with on-going costs, was at least \$13.00 per gpd of water reused. This is several times the cost to supply well water. The

construction costs included 4" pipe installation to a nearby customer and modifications to the wastewater treatment plant. These one-time expenses were spread out over a 25-year-period. Pumping costs and maintenance we added as on-going costs.

If there were several adjacent customers willing to participate in a reuse program, the costs may be competitive with the cost to provide well water. However, the City does not believe a market exists for reuse wastewater among the users within close proximity to the wastewater treatment plant. In sum, the cost to provide reuse water from the wastewater treatment plant is much more expensive than the cost to provide water from the City's wells. Therefore, the City finds the reuse option inappropriate as well as infeasible.

In an effort to encourage customers to utilize water reuse, recycling, and non-potable water opportunities unassociated with wastewater treatment plant effluent, Cedar City will offer rebates to the ten largest commercial and industrial water users. The rebates will pay for the services of a registered Professional Engineer to study the customer's business operations and determine opportunities for water reuse. Each rebate will be for \$1,000 or half the cost of the study, whichever is less. These ten businesses are the same ones that are being offered a rebate for having an irrigation audit performed. The rebate offer will be repeated once every three years. The letter to this year's selected group was mailed on March 17th. Table 3-7 shows the benchmarks for the reuse and recycling of water.

Table 3-7
Reuse and Recycling Benchmarks

Benchmark	Start Date	Frequency
Offer a \$1,000 rebate to the ten largest commercial and industrial water users to study re-use and recycling of water on-site.	2003	3 years

3.2.8 Other Measures (Not Required)

To serve as an example to its customers in managing water resources efficiently and effectively, the City will install rain sensors at three city parks to avoid irrigation during or immediately after a rain event. This action is not required under the Division 86 Rules but is consistent with the City's overall program for managing water supplies. Table 3-8 shows the benchmarks for the optional measures.

Table 3-8
Other Measures
(Not Required)

Benchmark	Start Date	Frequency
Install rain sensors for irrigation systems in city parks.	May 2004	1 installation annually for three years

3.3 Estimated Water Savings

City staff have estimated the water savings that are anticipated from the conservation program. These estimated savings are shown in Table 3-9. Total anticipated savings are 193,000 gpd by year 2013 and 213,000 gpd by year 2023. These savings will reduce the total need for water and allow the City to withdraw less water from its supply sources.

Table 3-9
Projected Conservation Savings to Year 2013
(Measures selected in WMCP)
(savings in gpd)

Measure	2013	2023
Metering of all un-metered accounts	51,000	51,000
Replace toilets in City facilities	4,000	4,000
Repair water main leaks	35,000	40,000
Residential Conservation Kits	40,000	40,000
Rain Sensors for City Parks	8,000	8,000
Irrigation Audits (large customers) ²	30,000	35,000
Reuse/recycling (large customers) ²	25,000	35,000
Water system audit	support ¹	support ¹
Meter testing, mtce., replacement	support ¹	support ¹
Adjust water rates	support ¹	support ¹
Public education	support ¹	support ¹
Total	193,000	213,000

Footnotes:

- 1) These items are viewed as supporting other conservation measures, and no separate estimate was made at their water savings.
- 2) Savings depend on interest by private sector. Will be evaluated in next WMCP Progress Report, due in 2008.

Many of the actions included in the conservation program are identified as supporting water conservation, but are not included in the quantitative estimate of savings. These measures are more difficult to quantify, and overlap with the savings associated with other measures listed. Therefore, they are not quantified independently at this time, but are recognized as contributing to the overall water efficiency of the City and its customers.

3.4 Water Use Measurement and Reporting

Cedar City's water use reporting is done in compliance with OAR 690-085. The report is submitted annually by December 31st on the form provided by the Water Resources Department using the "Flow Meter Method" approved by the Department in OAR 690-085-0015 (5).

Source meters are located at each well and the surface water diversion, which record cumulative water volume over the full range of discharge. These meters are read weekly by City personnel. There have been no diversions or withdrawals in the last 10 years that were not recorded and the reported monthly volumes are accurate within plus or minus 15 percent.

Section 4

Water Curtailment Element

The City Council is in the process of adopting a water curtailment ordinance. This ordinance allows Cedar City’s City Manager authority to promulgate a water supply emergency and enact the water curtailment plan. In the event that a stage three water emergency is determined, the ordinance allows for the policing of customer activities and the issuance of citations (warning and fines) to encourage customers to abide by the curtailment plan measures. A copy of the draft ordinance is included in Appendix X (of this Water Management and Conservation Plan Guidebook).

Table 4-1 describes the City’s proposed curtailment plan. Included within the plan are three stages of alert, the trigger for each stage, the goals for the implemented curtailment measures per stage, and the curtailment measures.

Table 4-1
Cedar City
Proposed Curtailment Plan

Stage	Trigger	Goal	Implementation Measures
Mild	Use reaches * 85% of capacity for three consecutive days and/or state drought declaration affecting service area	Awareness and 5% reduction in consumption	<ul style="list-style-type: none"> ■ Implement curtailment plan ■ Disseminate informational brochures on conservation methods ■ Put up posters and sandwich boards throughout the City ■ Coordinate outreach to customers through direct means (web page) and indirect means (media) ■ Voluntary irrigation schedule based on north and south side customers irrigating every fifth day during the early morning or evening. ■ Flushing lines for essential needs only ■ Turn off city fountains and post a sign describing why
Moderate	Use reaches 90% * Capacity for two consecutive days	10% reduction in consumption	<ul style="list-style-type: none"> ■ Continue with “<i>Mild</i>” stage measures except where noted below ■ Irrigation schedule implemented in “<i>Mild</i>” stage mandatory ■ Close City pool, eliminate city street cleaning, line flushing (unless health of customers at risk), and City park irrigation ■ No use of city supplied water to wash vehicles ■ Request businesses reduce consumption by 10% ■ Hosing of pavement not permitted except when necessary for public health or safety
Critical	Use reaches 95% capacity for one day*	15% reduction in consumption	<ul style="list-style-type: none"> ■ Continue with “<i>moderate</i>” stage measures, except where noted below ■ Outdoor use prohibited, except hand watering of new trees and shrubs ■ No use of city supplied water to fill private swimming pools

The following staff will have responsibilities for the following tasks in the event the water curtailment plan is enacted.

- John Smith, Ombudsman: All direct and indirect media outreach efforts
- Sally Jones, Police Department: Enforce curtailment measures
- Jack Brown, Water Department: Work with businesses to reduce consumption
- Judy Doe, Water Department: Coordinate with public pools, street cleaning company, and Water Department to ensure activities are commensurate with curtailment plan.

Section 5

Water Supply Element

5.1 Service Area Assumptions for Planning Period

For purposes of this WMCP, it is assumed that the Urban Growth Boundary (UGB) will not change during the 20-year planning period. It is also assumed that the general character of the community will remain constant, and that the City of Blue Falls will remain as a wholesale customer to Cedar City. No other wholesale customers are anticipated to be added during the planning period. These assumptions are consistent with the City's Comprehensive Land Use Plan (1996).

5.2 Demographic Projections

Projected growth in population, households and employment was obtained from the Comprehensive Land Use Plan. The City Planning Department and Johnson County planners reviewed the projections and confirmed that they remain valid for use in planning for the water system.

These projections are shown in Table 5-1. They indicate overall growth of 28 percent from year 2000 to 2020. Growth in households and employment ranges from 19 percent to 31 percent. The City of Blue Falls is not included in Table 5-1, and will be treated as a separate demand load in the demand forecast.

Table 5-1
Demographic Forecast
Cedar City Water System ¹

Category	2000	2002 ²	2010	2013	2020	2023 ³	% Growth 2000-2025
Population	18,043	18,328	19,466	19,906	20,934	23,136	28%
Single-family Households	4,540	4,596	4,819	4,911	5,124	5,582	23%
Multifamily Households	3,400	3,438	3,831	3,978	4,322	4,469	31%
Employment	3,987	4,009	4,096	4,172	4,348	4,726	19%

Source: Cedar City Comprehensive Plan (1996)

¹ Does not include Town of Blue Falls.

² 2002 value interpolated between 2000 and 2010, using straight line interpolation.

³ 2023 value extrapolated using same growth rate as between 2010 and 2020.

5.3 Water Demand Forecast

Using the demographic forecast shown above, Cedar City developed a forecast of water demand. The major steps in this process included developing a forecast of average day demand (ADD) for the retail customers; developing a forecast of maximum day demand (MDD) for the retail customers, and obtaining a forecast of ADD and MDD from the Town of Blue Falls, which receives water as a wholesale customer. Each of these components of projected demand is described below.

5.3.1 Average Day Demand – Retail Customers

The forecast of ADD to year 2023 is shown in Table 5-2. The following methodology was used to develop the ADD forecast for retail customers:

	2002	2013	2023
Single-Family Residential			
SF Households ⁽¹⁾	4,596	4,911	5,582
Water-Use per SF Household (gphd)	276	276	276
Single-family Demand (mgd)	1.27	1.4	1.5
Multifamily Residential			
MF Households ⁽¹⁾	3,438	3,978	4,469
Water-Use per MF Household (gphd) ⁽³⁾	189	189	189
Multifamily Demand (mgd)	0.65	0.8	0.8
Non-Residential			
Employment ⁽¹⁾	4,009	4,172	4,726
Water-Use per Employee (gped) ⁽⁴⁾	197	197	197
Base Non-residential Demand (mgd)	0.79	0.8	0.9
Additional Increment for Large Industrial Development ⁽⁵⁾ (mgd)	N/A	0.1	0.2
Total Non-residential (mgd)	0.8	0.9	1.1
<i>Non-Revenue Water</i> ⁽⁶⁾	0.3	0.3	0.4
Retail Demand Subtotal	3.0	3.4	3.9
<i>Additional Conservation</i> ⁽⁷⁾ (mgd)	N/A	-0.19	-0.21
Retail Demand with Additional Conservation (mgd)	3.0	3.2	3.7

gphd = gal. per household per day; gped = gal. per employee per day

(1) Does not include Town of Blue Falls

(2) Demographic projections from Cedar City Comprehensive Plan.

(3) Multifamily water use assumed to be 85% of single-family use per household.

(4) Non-residential water use factor based on year 2000 retail sales to non-residential accounts, divided by estimate of employment in 2000.

(5) Assumes that two large industrial customers, each consuming 0.05 mgd (0.1 mgd total), will be added to the system every ten years.

(6) Non-revenue water in future years estimated as 10 percent of deliveries. This is reduced from years 000-2002, when this value averaged 12 percent, as a percent of water delivered (not produced).

(7) Based on projected savings. See Conservation Element of this WMCP.

- Daily water use per single-family household in year 2002 was calculated from available billing data and demographic data (see Tables 2-1 and 5-2). This water use is 276 gallons per household per day (gphd). Similar values were calculated for water use in the multi-family sector and non-residential sector, comprising commercial/industrial, schools, and municipal water uses grouped together. The water use factor calculated for multi-family residential use is 189 gphd. The water use factor calculated for non-residential use is 197 gallons per employee per day (gped). For purposes of these calculations, the water use levels are initially held constant. Conservation savings are then subtracted, below.
- The number of single-family households, multi-family households and employees projected for years 2013 and 2023 were obtained from Table 5-2. These values were then multiplied by water use per household or water use per employee, to obtain projected demand in each of these years.

- An additional increment of demand was identified for new, large industrial customers. This represents water that is available for industrial-oriented economic development, consistent with the City’s economic development program. For this purpose, it was assumed that up to two new large customers, consuming 50,000 gpd, would be added to the City every 10 years. This amounts to 100,000 gpd (0.1 mgd) in year 2013, and 200,000 gpd (0.2 mgd) in year 2023. This amount is in addition to the current demand associated with large customers (see Table 2-2).
- A non-revenue water component was added to the projected billed sales. This was calculated as 10 percent of total retail water sold, which is consistent with recent experience.
- It is expected that Cedar City’s expanded water conservation program (see Section 3.3) will lead to water savings. It is estimated that the conservation program will achieve savings of 0.19 mgd in year 2013 and 0.21 mgd by 2023 (see Table 3-1). This amount was subtracted from the other demands listed above. The net result will be a reduction in water use levels.

5.3.2 Maximum Day Demand – Retail Customers

Maximum day demand was projected by applying a peaking factor to the projected average day demand (see Table 5-3). Based on the ratio of average day demand to maximum day demand (ADD/MDD) in recent years for retail customers, this peaking factor is approximately 1.9. It should be noted that this is slightly different from the overall system peaking factor, which includes deliveries to Blue Falls. With this peaking factor applied to the demands calculated above, maximum day demand is projected to be 6.1 mgd in year 2013 and 6.9 mgd in year 2023. Conservation savings are anticipated to affect peaking, and this effect will be tracked for future updates of the WMCP.

**Table 5-3
Projected Maximum Day Demand
Cedar City Retail Customers**

	2002 (Actual) ⁽¹⁾	2013 ⁽²⁾	2023 ⁽²⁾
Average Day Demand	3.0	3.2	3.7
Peaking Factor	1.89	1.9	1.9
Maximum Day Demand	5.8	6.1	6.9

(1) 2002 MDD within City Limits calculated as system-wide MDD of 6.02 less wholesale MDD of 0.27 delivered to Blue Falls.
 (2) Projections use peaking factor of 1.9 (3-year average from 2000-2002), for consistency in projecting maximum day demands.

5.3.3 Projected Demand for Town of Blue Falls

As noted above, Cedar City anticipates that the Town of Blue Falls will continue to be served as a wholesale customer. Projected needs were obtained from the Blue Falls Director of Public Works and are documented in a letter dated January 10, 2003. The Town’s ADD and MDD needs are shown in Table 5-4. The peaking factor for Blue Falls is higher than in Cedar City, reflecting a near 100 percent residential character with extensive irrigation. Opportunities to reduce peaking will be explored with Blue Falls prior to renewal of the water supply contract in 2011.

	2002		2013		2023	
	ADD	MDD	ADD	MDD	ADD	MDD
Blue Falls ⁽¹⁾	0.09	0.27	0.10	0.30	0.11	0.33

Peaking factor for deliveries to Blue Falls (average 2000-2002): 3.0

(1) 2002 based on actual data. Projections based on information provided by Blue Falls Director of Public Works.

5.3.4 Summary of Demand Forecast

Table 5-5 summarizes total projected system demand, including both retail customers and the Town of Blue Falls. Total ADD for the system is projected to rise to 3.8 mgd by year 2023. Total MDD is projected to rise to 7.3 mgd. This represents an increase of 22 percent over total system demand in year 2002.

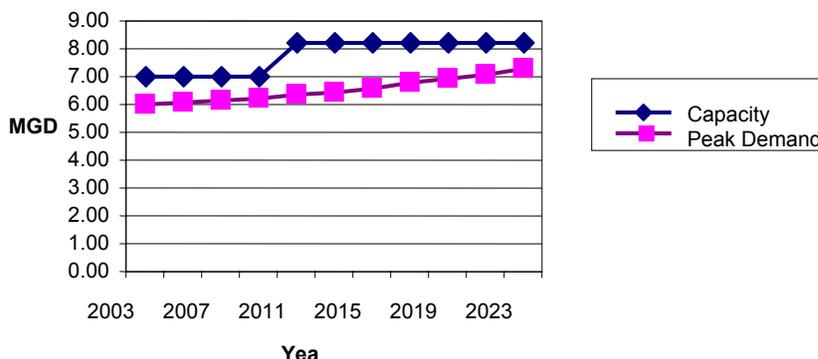
	2002 (Actual)	2013	2023
<i>Average Day Demand (ADD)</i>			
Retail System	3.0	3.2	3.7
Blue Falls	<u>0.09</u>	<u>0.10</u>	<u>0.11</u>
Total ADD	3.1	3.3	3.8
<i>Maximum Day Demand (MDD)</i>			
Retail System	5.8	6.1	6.9
Blue Falls	<u>0.27</u>	<u>0.30</u>	<u>0.33</u>
Total MDD	6.0	6.4	7.3

5.4 Capacity Needs and New Source Development

As shown in the demand forecast above, Cedar City's demand is projected to rise by 22 percent over the next 20 years. Cedar City will need to add capacity to ensure that available supplies are sufficient to meet projected demand. In addition, the City requires some excess capacity to provide adequate supply in case one of its sources must be shut-down in an emergency.

Exhibit 5-1 displays projected maximum day demand, together with a planned expansion of supply capacity from 7.0 mgd to 8.25 mgd. The maximum day demand trend incorporates the City's water conservation program, as discussed in Section 3 of this WMCP. With this capacity added in year 2009, the City will have adequate capacity to meet its customers' needs through at least 2023 including back-up supply for emergencies.

**Exhibit 5-1
Comparison of Supply and Demand to 2023**



The City evaluated several alternatives to determine how best to meet future needs. These alternatives include:

- Expanded water conservation, above and beyond the program described in Section 3;
- Acquisition of water from other communities through intertie;
- Expansion of diversion facilities and water treatment plant at Red Cedar River;
- Expansion of transmission capacity from Johnson Springs;
- Expansion of well capacity at Granite Lake;
- Installation of new wells in the Grand Prairie area near 132nd Street and Maple Way.

These alternatives are analyzed in detail in a report titled “*Cedar City Supply Alternatives Comparison*,” dated November 15, 2001. This report is attached as an Appendix to this WMCP. The report found that expanded water conservation activities cannot fully supply the need at a reasonable cost. A suite of additional water conservation projects was evaluated, with costs ranging from \$3.15 to 20.40 per 1,000 gpd of summer season water savings. The cost of new wells at various locations would range from 1.80 to 4.35 per 1,000 gpd of new peak supply capacity. Based on this comparison, new supply capacity was judged to be more cost effective than additional conservation. For further information, see the report cited above.

It should be noted that the water conservation measures the City is implementing under the new Division 86 rules reduce the size of new capacity needed, and will minimize the effects of growth on water resources utilized by the City. The conservation actions committed to in this WMCP are projected to save over 200,000 gpd by year 2023. This conservation program reduces the amount of new water development needed, by the same quantity.

Purchase of water supply from other water suppliers is not feasible or desirable. The nearest community that could be considered would be the Mountain Home Water District (MHWD). MHWD’s nearest water lines are over 12 miles from Cedar City, which would require installation of a costly pipeline. In addition, MHWD does not have excess water rights. Therefore, this solution is not feasible.

The report also assessed the relative merits of the various capacity additions listed above. The City determined that additional diversions from the Red Cedar River are less desirable than new ground water capacity, due to potential issues associated with steelhead populations in the river. Additional diversions could reduce flows below critical levels in some years, creating undesirable effects on steelhead habitat.

Therefore new ground water capacity appears to be the best option for meeting the City's needs. Adding transmission capacity from Johnson Springs would require an investment of \$xx million. In addition, retaining the ability to expand the transmission capacity from Johnson Springs could be advantageous in the future, by ensuring that the City continues to have backup supply for the Cedar River in low flow years. This is the case because Johnson Springs and the Red Cedar River treatment plant serve the same pressure zones in the City's water distribution system. Installing a new well field at a new location would require new water rights.

Expanding capacity at the Granite Lake well field could be done under the existing permit for this location. Moreover, the middle aquifer at this location is very productive. Therefore, the report cited above recommended that Cedar City proceed with expansion of capacity at the Granite Lake well field, under its permit for this site. The City plans to install two new wells adjacent to the existing well, adding pumping capacity of 1.25 mgd.

Table 5-6 shows the City's water supply capacity, with the addition of the new wells.

Table 5-6		
Existing and Planned Supply Capacity		
Source	Peak Capacity (mgd)	Flow Rate (cfs)
<i>Available Supply:</i>		
Johnson Springs	1.00	1.8
Red Cedar River	5.20	8.04
Granite Lake Well	<u>0.80</u>	<u>1.24</u>
Sub Total Existing Capacity	7.00	11.08
Proposed development of Granite Lake Well Nos. 2 and 3	<u>1.25</u>	<u>1.93</u>
Total Planned Capacity	8.25	13.01

5.5 Water Rights to Support Supply Addition

Based on this plan, the City is requesting an permit extension of the permit for the Granite Lake well field, to allow for installation of new wells and pumping at an expanded instantaneous rate of up to 3.25 cfs. This expansion of permitted pumping will allow the City to continue delivering water to its customers and the Town of Blue Lake through at least 2023.

In accordance with the Division 86 requirements for a WMCP, Table 5-7 shows anticipated monthly pumping under the Granite Lake water right, to meet projected demand through the end of the 20-year planning period. Pumping authorization from other sources will remain unchanged from current authorizations.

**Table 5-7
Estimated Monthly Pumping from Proposed New Wells
by End of Planning Period**

Month	Total Gallons Pumped
January	33,500,000
February	33,500,000
March	33,500,000
April	33,500,000
May	40,000,000
June	50,000,000
July	57,000,000
August	57,000,000
September	50,000,000
October	40,000,000
November	33,500,000
December	33,500,000

Table 5-8 summarizes the City's request for expanded use of water rights.

**Table 5-8
Summary of Expanded Use Requested**

Permit No.	Source	Original Application ¹	Current Authorization		Total Authorization Requested ²	
		Instantaneous Rate (cfs)	Instantaneous Rate (cfs)	Peak Monthly Volume (MG)	Instantaneous Rate (cfs)	Peak Monthly Volume (MG)
S-199853	Red Cedar River	9	8.1	105	no change	no change ³
S-115389	Johnson Springs	0.55	0.55	10	no change	no change ³
S-295687	Johnson Springs	2.8	1.25	19.4	no change	no change ³
G-356689	Granite Lake Well Nos. 1, 2, 3, and 4	3.5	1.24	19	3.17	57

MG = million gallons cfs = cubic feet per second

¹ This is the "face value" of the water right, including any unperfected quantity.

² Includes amount previously authorized plus new expansion.

³ The City reserves the right to request expanded use in future extension applications.

5.6 Schedule for Utilization of All Water Rights

Based on the information presented in this plan, Table 5-9 indicates Cedar City's anticipated schedule for full utilization of existing water rights.

**Table 5-9
Schedule for Utilization of Water Rights**

Permit	Certificate	Source	Use	Rate (cfs)	Full Utilization
S-199853	No	Red Cedar River	Municipal	9	2030
D-285213	115389	Johnson Springs	Municipal	0.55	current
S-25687	No	Johnson Springs	Municipal	2.8	2025
G-356689	No	Granite Lake Well Nos. 1,2,3, and 4	Municipal	3.5	2028

5.7 Mitigation Issues

The Division 86 rules require the water supplier to provide a description of mitigation actions being taken to comply with legal requirements, such as the Federal Endangered Species Act, Clean Water Act, and Safe Drinking Water Act. At the present time, the City is not required to undertake any mitigation actions under state or federal regulations or other requirements.

The expansion of supply indicated above will have the effect of avoiding increased reliance on the Red Cedar River. Since the Red Cedar River is the source that supports a steelhead population, and is also listed as impaired under the Clean Water Act, Section 303 (d), the City believes that developing new ground water supplies at the Granite Lake site is a responsible action to meet the community's needs in an environmentally responsible manner.

Appendix C

Small Community Sample Plan (Gales Rock)

Water Management and Conservation Plan Gales Rock, Oregon

May 2003

Note to Readers:

This sample plan has been developed solely for purposes of the Guidebook on Water Management and Conservation Plans (WMCPs). It offers an example of a WMCP based on a fictional community. The information presented was assembled from various sources and is intended for illustrative purposes only. Therefore some of the information may not be fully consistent from one section to another.

The overall organization and approach to planning can serve as an example to water suppliers preparing their own plans. However, the specific mix of water supply and conservation actions described in this sample plan will not be applicable to every water supplier. Each community and water supplier is unique and should develop a WMCP to match its own specific needs and circumstances.

Gales Rock Water Management and Conservation Plan: Contents

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Executive Summary

The City of Gales Rock presents its 2003 Water Management and Conservation Plan (WMCP) to the Water Resources Department (WRD) and interested parties. The City is submitting this plan in response to permit extensions to four of its water rights. Those extension applications triggered the need to prepare a Water Management and Conservation Plan (WMCP) as directed under Oregon Administrative Rules (OAR) 690-315 and 690-086. The extensions also from the City's authorized rate of diversion at 1.65 mgd.

The City believes this WMCP outlines a plan to effectively manage its present water rights and provide a means for developing a comprehensive strategy for meeting its municipal water supply needs over the next 20 years. Moreover, the plans attempts to enhance management techniques of the state's water resources, including an increased effort to improve the efficiency of the water system, thereby meeting the intent of the regulations defined under the new Division 86 rules.

E.1 Meeting the WMCP Criteria

Approval of this WMCP is contingent upon Gales Rock meeting the criteria outlined under OAR 690-086-0130. In accordance, the City has prepared a concise statement addressing each of the review criteria cited in that regulation.

- *Inclusion of specific elements under 690-086-125:* the current plans includes specific sections that address each – a description of the City's water supply system and history, an updated conservation plan, a new curtailment plan, and a 20-year supply strategy, as well as a list of affected local governments to whom the plan has been made available and a proposed schedule for update in 2012. A draft of Gales Rock's plan was made available to Blaine County and the Chinook Tribe from which no comments were received.
- *Projections of future water need:* the City is projecting to need only a limited increase in water over the next 20 years. Presently, the City uses about 0.74 mgd on an average annual day, with a peak demand of about 1.65 mgd. By 2020, this demand increases only 0.1 mgd to 0.84 mgd for an average annual day. The 2020 peak day is also expected to increase modestly to between 1.84 and 1.93 mgd (depending on the results of the City's planned conservation). These projections are consistent with the City's planning data for increases in population and employment and have been reviewed for consistency with comprehensive plans developed by the Blaine County Council of Governments (BCCOG).
- *Water Conservation Measures under OAR 690-086-0150:* the City has developed a conservation program targeted at reducing peak day demand. That program is designed to incorporate each of the elements noted under OAR 690-086-0150 (4) and address the

City's goal of reducing unaccounted water to under 10% and achieving a 5% reduction in peak day demand for years 2010 and 2020. A summary of the actions and related benchmarks for the conservation program are outlined in Table ES-1:

Table ES-1		
City of Gales Rock		
5-Year Conservation Benchmarks		
Benchmark	Date	Frequency
On-Going Efforts		
Complete leak detection survey and reporting	June 2003	N/A
Visual inspection of reservoirs	-	Annually
Meter testing program	-	On-call
Automated park irrigation	-	Daily
Leak detection visits	-	On-call
Production meter testing	-	5 years
Reduced operational usage at City facilities	-	Daily
Vendor's booth at Blaine County Fair	-	Annually
New Programs		
Improved water auditing (track non-revenue use)	October 2003	Annually
Initiate revolving meter (< 2") replacement	June 2003	20 years
Testing of meters > 2"	June 2003	5 yrs
Leak repair (all leaks from 2003 leak survey)	By Oct. 2004	-
Replace all existing cast iron pipe	By 2012	-
Distribute conservation brochures and kits	June 2003	Twice/Year
Distribute conservation kits (on-site leak repair)	June 2003	On-going
Install rain sensors in city parks	March 2004	-

- *Identification of Resource Issues:* The sources of water being drawn by the City are exclusively groundwater and do not impact local streams. The issues defined under OAR 690-086-140 (5) (i) do not apply.
- *Curtailment Plan:* The City developed a water emergency supply plan, approved by Council on April 16, 2002. Within that plan, is a curtailment plan that was prepared pursuant to ORS 536.780 and consistent with OAR 690-019-0090. The curtailment plan element represents one of three tools available to the City to meet a water emergency. The curtailment plan includes three stages of alert, triggers for each stage, and curtailment actions that will satisfactorily promote conservation practices.
- *Use beyond permit extension:* As part of this submittal, the City has developed a schedule for using water under each of its water rights to serve its anticipated 20-year demand. The City will not be looking for any new rights but will seek to make optimal use under its existing permits. By year 2020, the City will pump as much as 0.84 mgd on an average daily basis over the year and utilize as much as 1.84 to 1.93 mgd on a peak day – thereby utilizing between 75-80% of its present inventory of municipal rights totaling 2.43 mgd. The City intends to use this plan as record for that planned use and also

intends to certificate each of its unperfected rights by the time its submits an update to this plan in 2013.

- Based on the projections of water needed, the City requires WRD authorization to increase diversions from the current maximum rate of 1.65 mgd to 2.43 mgd as shown in Table 5-6. This increase will be necessary to construct the wells described above. The City expects the 2023 peak month demand to be 41,298,000 MG.

E.2 Proposed Schedule for Updating Plan

Following the administrative rules, the City proposes to submit a progress report on or before April 2008 (five years) to review noted benchmarking and water use progress. Since Gales Rock does not anticipate the need for any new source of water over the next 20-years, the City proposes to submit an updated WMCP at the end of the 10-year period in 2013.

Section 1

Overview

1.1 General System Description

The City of Gales Rock is located on the west side of the Cascade Mountain within the Central Valley. The City sits three miles east of the Blue River and serves drinking water to about 4,400 customers within its municipal boundary, which comprises approximately 1,700 acres.

Over 90% of its connections serve residential customers, including both single and multi-family accounts. The residential class is also the largest class among the City's users, as measured by consumption - accounting for about 80% of all water produced. By contrast, the commercial and industrial class has significantly fewer customers, accounting for about 15% of all water produced, making it the second largest consumer. The other classes of customers, public institutions, fire flow, and agriculture combined, represent 5% of consumption.

Historically, the City has been granted 2.64 mgd of water rights, of which 2.43 mgd is for municipal use and 0.21 mgd for irrigation. Operational constraints, however, limit production capacity to about 1.9 mgd, with service into seven pressure zones via withdrawal from seven wells. The capacities are limited due to water quality issues in one well and drawdown (hydraulic) restrictions with two others. To date, one of the municipal rights has been put to full beneficial use and fully certificated, while the others remain in permit status. The irrigation right has also been certificated.

1.2 Purpose

Recently, the City applied for permit extensions for six of its water rights. These applications for extension triggered the need to prepare a Water Management and Conservation Plan (WMCP) in association with Oregon Administrative Rule (OAR) 690-315 and 690-086.

The City last submitted a WMCP in 1995 in which Oregon Water Resources Department (WRD) identified specific recommendations to improve local management of water resources. Since that time, the City has made substantial progress in meeting those requests and is looking to coordinate this new plan with on-going efforts to comply with the Division 86 rules. The City is also coordinating this latest update of the WMCP with a renewal of its 20-year water master plan as defined under OAR 333-065.

1.3 Proposed Progress Report and Update Schedule

Following the administrative rules, the City proposes to submit a progress report on or before April 2008 (five years) to review noted benchmarking and water use progress. Since Gales Rock

does not anticipate the need for any new source of water over the next 20-years, the City is not planning to submit an updated WMCP until the required 10-year period in 2013.

1.4 Summary of Data Sources

Throughout this WMCP are references to data, most of which were obtained from City files including records of pumping withdrawal, customer billings, land use planning, operational control, and conservation program implementation. Historical data related to service area, such as connections and demand, was obtained from the City's utility billing system, the City's water demand management software system (SCADA), and the Water System Master Plan. Historic and future demographic data was also obtained in coordination with Blaine County's Council of Governments (BCCOG).

1.5 Input During Plan Development

To develop this WMCP, City staff from all relevant City departments including Water, Parks and Wastewater have worked together to examine a range of water management alternatives. A draft WMCP was also submitted to Blaine County with a request for comments. A final version of this plan was presented to City Council and approved on May 2, 2003.

1.6 Document Organization

This WMCP is organized in a manner consistent with the Division 86 rules. Section 2 describes the water supply system, including key demographic information, water consumption, and the type of infrastructure present in the water system. Section 3 identifies the conservation measures the City has implemented and proposed new measures with associated benchmarks for each new measure. Section 4 describes the three tools available to the City in the event of a water emergency, including a water curtailment plan. Section 5 uses the information presented in Section 2 to forecast future demand, compare that demand to present water rights, and assesses the need for additional source water diversions.

Section 2

Municipal Supplier Description

2.1 Service Area and Population

2.1.1 Service Area

The City presently serves drinking water to about 4,400 customers within its own limits, covering approximately 1,738 acres. The area is roughly divided in land use by about 54% single and multifamily dwellings, 34% industrial and commercial enterprises, 9% agriculture, and 3% other. A map of the City's service area is shown in Exhibit 2-1.

2.1.2 Population Estimates

Population estimates used in this report were provided by the City of Gales Rock Community Development Department. These estimates are consistent with the City's Comprehensive Land Use Plan (2000). As of 2002, the City served an estimated population of 4,408. A summary of population data for years 1998-2002 are shown in Table 2-1.

Table 2-1
City of Gales Rock
Population Estimates

Year	Total Population	Households
1998	3,856	1,665
1999	3,848	1,650
2000	4,012	1,670
2001	4,286	1,725
2002	4,408	1,750

A breakdown of this data reveals an approximate number of 2.5 persons per household, at an annualized growth rate in population of about 2.7 percent over the past 5 years. These numbers are comparable to many of the surrounding communities; however, the City of Gales Rock has a higher number of multifamily units, such as apartments and retirement home condominiums.

2.2 Source of Supply

2.2.1 Summary of Existing Sources

There are seven wells connected to the City's water distribution system. The locations of those wells are shown in Exhibit 2-1. The wells are served primarily by withdrawals from the local sand and gravel aquifer that underlies the City. The aquifer is situated within the Central Valley

watershed and is thought to be recharged by local rainfall, exchange with the Upper Salmon River and snowmelt from the nearby Bear Mountain range.

The City has access to municipal use water totaling 2.43 mgd, with an additional 0.21 mgd related to agricultural irrigation. This water is granted through a series of water rights that govern the withdrawals from seven wells. Table 2-2 describes those rights, including permit (or certificate) numbers, priority date, permitted rate, and other pertinent information.

Table 2-2
City of Gales Rock
Water Rights Summary

Permit No.	Priority Date	Certificate	Rate (cfs)	Use	Notes	Authorized Completion Date
G-1001	8/19/1923	1234	1.33	Municipal	Wells 1 and 2	N/a
G-1020	4/26/1956	-	0.55	Municipal	Well 3	2010
G-1030	9/16/1972	-	0.67	Municipal	Well 4	2010
G-1040	10/09/1981	-	1.21	Municipal	Wells 5 and 6	2010
G-1010	6/14/1931	0123	0.33	Irrigation	Well 7	N/a

However, Well 1 suffers from severe taste and odor problems and is limited in use due to water quality concerns. Also, Wells 5 and 6 have experienced declining capacity since being brought into service. These two wells are the newest in the City's inventory and annually produce just under 25% of its water. The problems with Wells 5 and 6 are thought to be associated with fouling or improper screen placement during construction. Recent testing of the wells indicates the City has access to about 1.9 mgd under limited peak withdrawal and a firm yield of about 1.4 mgd.

2.3 Summary of Recent Use

2.3.1 Average Annual Usage

Table 2-3 summarizes the average annual production from each of the City's seven wells over the past five years, as well as their relative percentage with regards to the City's total water production. No one well serves as the primary source for the City.

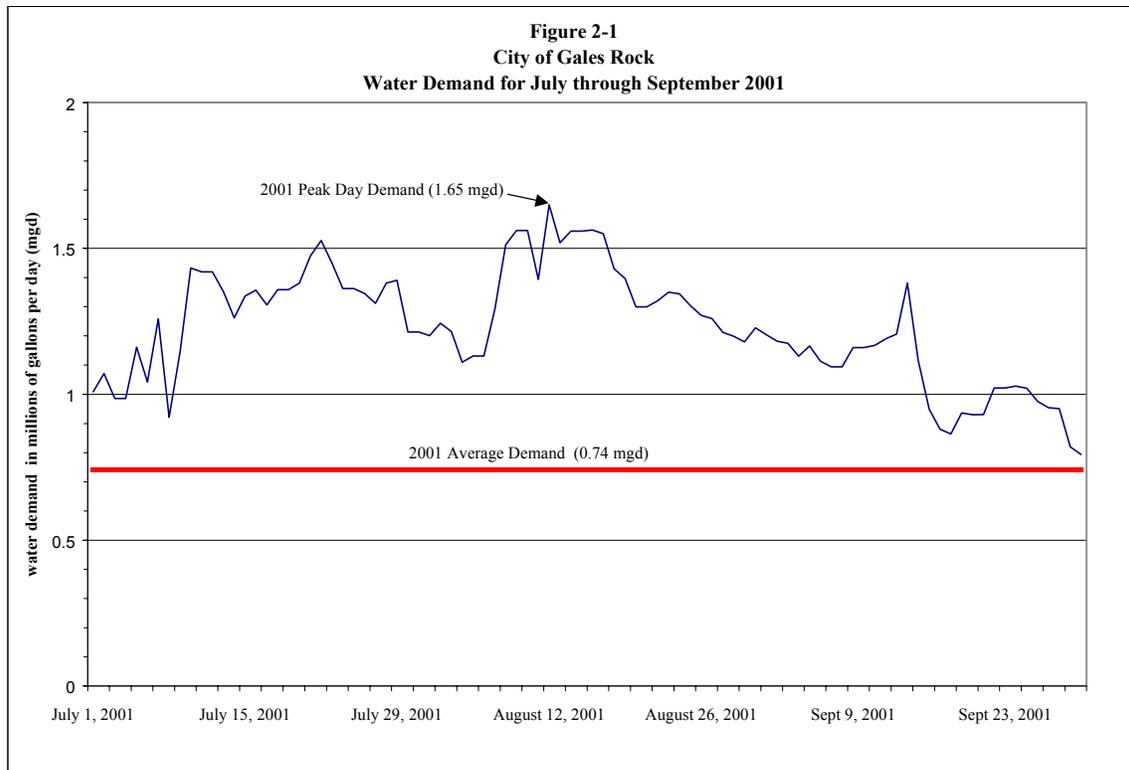
Table 2-3
City of Gales Rock
Summary of Recent Water Use

Well	Permit No.	Total Production in Million Gallons					% of Supply
		1998	1999	2000	2001	2002	
1	G-1001	10.6	11.6	14.4	15.3	17.0	6.25%
2	G-1002	31.7	34.9	43.1	45.9	51.1	18.75%
3	G-1020	61.9	61.3	64.7	63.9	66.4	25%
4	G-1030	41.5	43.3	39.6	39.5	42.3	15%
5	G-1040	46.7	44.1	41.6	41.2	39.8	15%
6	G-1050	46.7	44.1	41.6	41.2	39.8	15%
7	G-1010	10.4	10.9	11.1	11.4	12.2	5%
Totals (MG)		249.4	250.1	256.1	258.4	268.6	
Average Day (mgd)		0.68	0.69	0.70	0.71	0.74	

The numbers shown in Table 2-3 are consistent with the City's annual water use reporting, as required under OAR 690-085.

2.3.2 Seasonal Usage

A review of usage between 1998-2002 indicates a peak day demand of 1.65 mgd which occurred on August 12, 2001. In general, peak usage occurs each year between late July and early August. Figure 2-1 provides a graphical summary of the total system peak usage between July 1 and September 30, 2001. The resulting data indicate a peak day factor of about 2.3 (i.e. peak day use compared to annual average use). By comparison, this number is comparable to other communities of similar size and composition in the region. However, since the summer of 2001 was not abnormally dry, the peaking factor could trend higher if persistent periods of hot, dry weather were to be experienced in the future.



2.4 Water Customers Served

The City has historically tracked its water users under the following classifications:

- Residential
- Commercial/Industrial
- Agricultural
- Public/Institutional, and
- Fireflow

Customers identified as “Residential” represent at least one dwelling unit. For example, both single family, multi-family, condominiums, and mobile homes are found within this class. The “commercial/industrial” class includes all commercial and industrial customers within the city. The “Agricultural” class includes any type of customer with a service connection dedicated for the raising of livestock or edible or non-edible crops. “Public/Institutional” accounts include the hospital, federal, state, or municipal connections, and the school districts. “Fireflow” accounts are strictly dedicated meters to allow for fire flow in the event of a fire.

As of 2002, the City had a total of 1,828 customer accounts. A summary of account history from 1997 to 2002 is shown in Table 2-4. Of the total accounts, the residential class currently makes up about 95% of the total number of accounts.

Table 2-4
City of Gales Rock
Accounts per Customer Class

	1997	1998	1999	2000	2001	2002
Residential	1,512	1,548	1,593	1,668	1,686	1,728
Fire Meters	5	4	5	5	6	6
Public/Institutional	17	18	18	18	17	17
Commercial/Industrial	42	45	51	59	68	74
Agriculture	4	4	4	4	3	3
Total	1,580	1,619	1,671	1,754	1,780	1,828

It is typical for a utility to convert its various meter sizes to Equivalent Residential Units (ERUs) to characterize potential water usage throughout a wide range of connection sizes. An alternative way of examining water use is to treat all connections as if they were a typical residential meter size. Such normalization allows the use to be standardized based on meter size.

Table 2-5 provides a summary of the City's 2002 metered accounts and ERUs for each customer class by meter size. As shown in Table 2-5, as of 2002 the City had a total of 2,699 ERUs. The City's largest customer class remains residential users representing 58% of the ERUs in the system. 230 ERUs are fire flow connections which do not have a significant impact on overall water usage due to their infrequent use. Calculations within this WMCP do not incorporate "Fire Flow" accounts unless otherwise noted.

Table 2-5
City of Gales Rock
2002 Summary of Connections and ERUs (in Parentheses)

Meter Size	ERU Equiv	Agriculture	Public/ Institutional	Residential	Commercial / Industrial	Fire Flow ¹
¾"	(1)	1	4	1,572	14	0
		(1)	(4)	(1,572)	(14)	0
1"	(3)	2	5	108	26	0
		(6)	(15)	(324)	(78)	0
1 ½"	(5)	1	1	37	8	0
		0	(5)	(185)	(40)	0
2"	(8)	0	6	11	18	0
		(0)	(48)	(88)	(144)	0

Meter Size	ERU Equiv	Agriculture	Public/ Institutional	Residential	Commercial / Industrial	Fire Flow ¹
3"	(15)	0	0	0	5	0
		0	(0)	0	(75)	0
4"	(25)	0	1	0	3	4
		0	(25)	0	(75)	(100)
6"	(50)	0	0	0	0	1
		0	0	0	0	(50)
8"	(80)	0	0	0	0	1
		0	0	0	0	(80)
Total Meters		3	17	1,728	74	6
Total ERUs		(7)	(97)	(2,169)	(426)	(230)

¹Fire-standby connections will not be used in normalized water usage calculations (gpd/ERU)

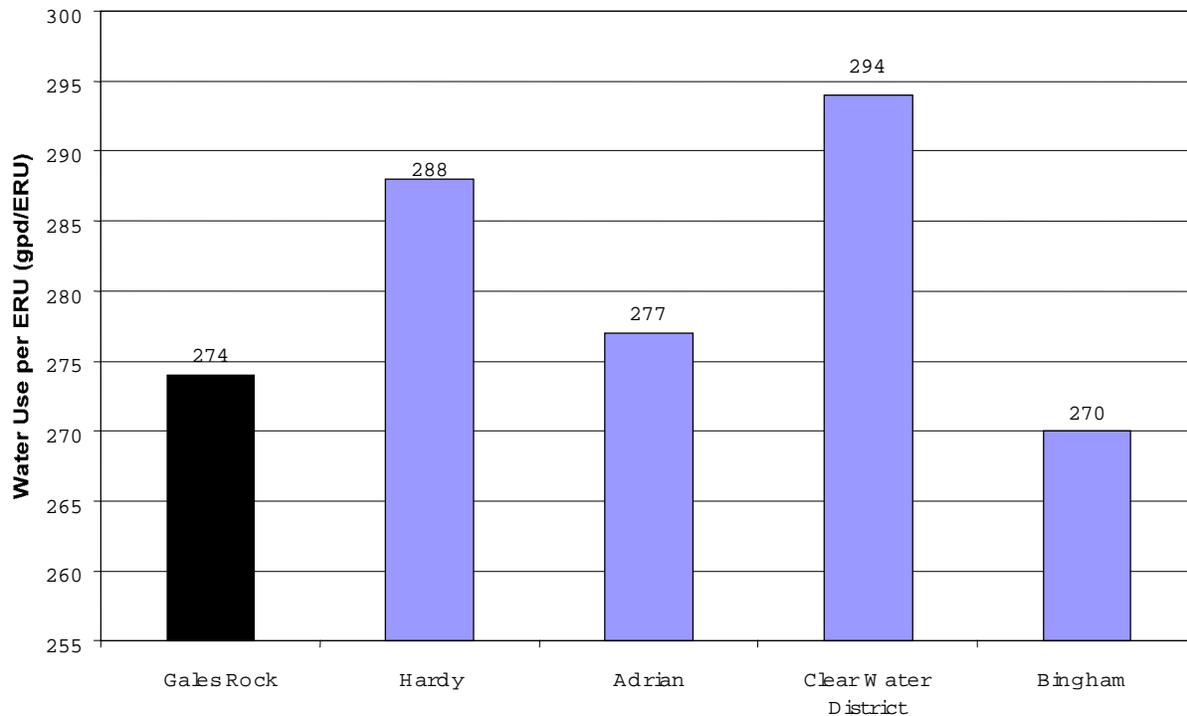
In analyzing water usage by customer class, the total number of connections was divided by class and normalized into ERUs. The average water use can be divided by the appropriate number of ERUs to obtain a history of normalized use, as shown in Table 2-6.

Year	Annual Water Use (mgd)	ERUs ¹	Water Use/ERU (GPD/ERU)
1998	0.68	2,493	273
1999	0.69	2,505	275
2000	0.70	2,589	270
2001	0.71	2,628	270
2002	0.74	2,699	274

¹ Fire Standby connections are not included in the total ERU amount

The City's usage per ERU is about average when compared to a majority of water users in the area. Figure 2-2 shows various other area water providers and their average water usage rates per ERU.

**Figure 2-2
Comparison with Area Water Suppliers**



2.5 Facilities Description

2.5.1 Source/Treatment

All wells are currently in compliance with state drinking water standards outlined under OAR 333-065. Wells 2, 3 and 6 are impacted by high manganese and hydrogen sulfide and treated for taste and odor related problems with aeration. Similarly, Wells 4 and 5 are also slightly impacted by hydrogen sulfide but currently are not treated to remove that compound. Withdrawals from wells 2, 3, and 6 are disinfected through the use of sodium hypochlorite, while wells 4 and 5 are disinfected through the use of gaseous chlorine.

2.5.2 Transmission/Distribution

The City has a system network of pipe sizes ranging from 2-inch to 12-inch pipes. The total linear feet of each nominal pipe size above 2-inch is shown in Table 2-7.

Table 2-7
City of Gales Rock
Summary of System Pipe Sizes

Nominal Pipe Size	Total Length (ft)	% of Total
2	29,312	46%
4	14,221	22%
6	9,312	14%
8	4,547	7%
12	6,762	11%

Approximately 48% of the pipes are cast iron, 28% ductile iron, and 24% PVC.

2.5.3 Finished Water Storage

The City has 4 above ground reservoirs totaling 1.67 million gallons. The location of each reservoir is shown in Exhibit 2-1. Summaries of available storage and overflow elevation for each reservoir are provided in Table 2-8.

Table 2-8
City of Gales Rock
Finished Water Storage Summary

Reservoir No.	Storage (gallons)	Overflow Elevation (ft)
1	300,000	250
2	300,000	355
3	500,000	433
4	500,000	450

2.5.4 Pump Stations

Each well has a pump house that pumps finished water into the reservoirs and out to the distribution network. Table 2-9 provides a summary of the capacities available at each well.

Table 2-9
City of Gales Rock
Summary of Pump Capacities

Well No.	Pump Capacity (gpm)
1	460
2	441
3	509
4	855
5	513
6	581
7	200

2.6 Interconnections

The City currently has interties with the cities of Hardy and Bingham. There are no intergovernmental agreements relating to water supply for the City. Use from these interties has been very limited. Discussions with the Public Works Directors of Hardy and Bingham have indicated that these interties should not be considered as alternative sources of supply, except in cases of emergency. Both Hardy and Bingham have limited access to existing groundwater resources and, as a result, are unable to commit portions of their supply for use by the City of Gales Rock as part of a wholesale arrangement. The intertie with Bingham, however, has been used three times over the past five years to support peak day demand in the City of Gales Rock. Consideration of this intertie as a reliable long-term source of supply is tied directly to Bingham's current plans to develop the Trillium reservoir system. The new reservoir, if approved by Oregon Water Resources Department, would supply an additional 5,000 acre-feet of water to four regional water providers, including the City of Gales Rock. The City of Gales Rock has currently reserved access to 500 acre-feet in that planned project. If constructed, the Trillium Reservoir project would provide about 1.1 mgd to the City of Gales Rock each year during the 150-day summer time period (May 15-October 15).

Further discussion of the City of Gales Rock's long term supply plans are outlined in section 5 of this report.

2.7 System Efficiency

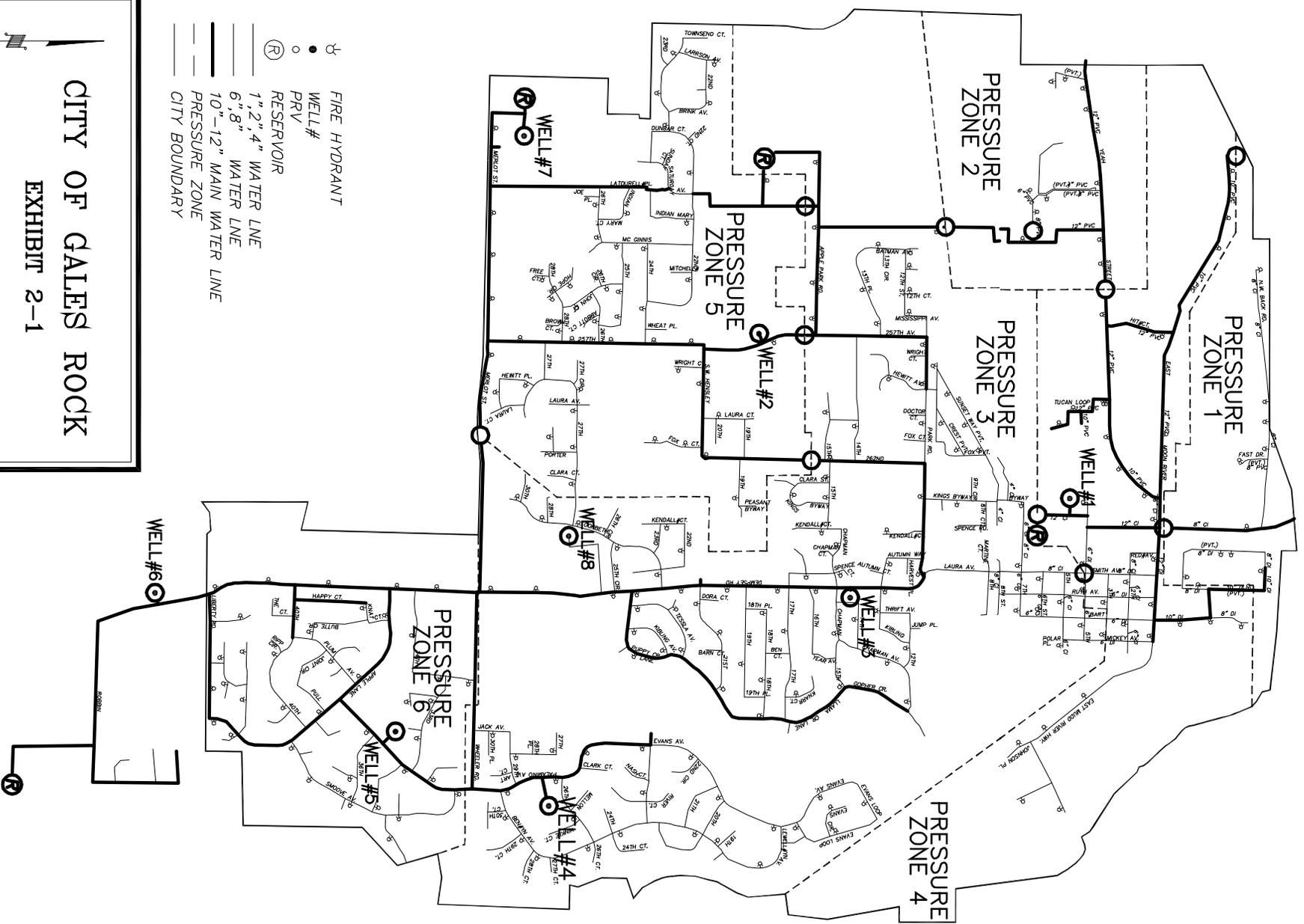
Unaccounted for water over the past 5 years has generally been between 15-17%. This number is presently computed by simply taking the difference between metered withdrawals at the wells and recorded use from the City's billing accounts. An unknown portion of the differences is a result of the absence of a methodology to track authorized, unmetered uses. In looking to improve system efficiencies, the City has aggressively pursued leak detection and repair and is presently performing an annual leak detection for pipes 4 inch in diameter and larger. A summary of water audit findings for the City for the period 1998-2002 is shown in Table 2-10. Additional details of the City's water auditing program are presented in Section 3.4.1.

Table 2-10
City of Gales Rock
Leakage Volume as a Percent of Production¹

1998	15.2%
1999	16.2%
2000	16.4%
2001	16.1%
2002	17.2%

¹ Rounded to the nearest 0.1%. Measured for twelve months starting on October 1.

The City is currently awaiting the findings of the on-going leak detection work to identify any known major points of loss. The City is also presently undertaking plans to replace its entire cast iron pipe inventory over the next ten years. A priority for that renewal and replacement is expected to come from the findings of next year's audit. The overall goal is to reduce annual losses to less than 10% of the total water pumped.



- ⊕ FIRE HYDRANT
- WELL #
- PRV
- Ⓡ RESERVOIR
- 1", 2", 4" WATER LINE
- 6", 8" WATER LINE
- 10"-12" MAIN WATER LINE
- PRESSURE ZONE
- CITY BOUNDARY

CITY OF GALES ROCK
EXHIBIT 2-1



Section 3

Conservation Element

In 1995, Gales Rock submitted a Water Management and Conservation Plan (WMCP) to Water Resource Department (WRD) describing, among other things, conservation measures available to the City. Since then, Gales Rock implemented some of these measures and continues to engage in conservation related activities. However, the breadth and depth of conservation measures required in the new Division 86 rules is greater than Gales Rock's existing measures. This section of the WMCP demonstrates the City's commitment to implement a new program which will improve its water resources management techniques and thereby meet the intent of the new rules.

While limited resources hamper the ability to offer a full scale conservation program as seen at larger cities, Gales Rock's new conservation program represents a targeted approach to encouraging customers to conserve. Specifically, Gales Rock chooses to focus efforts on conservation measures which are intended reduce peak demand by the residential, commercial and industrial classes. Gales Rock's efforts also represent a new level of commitment by the City to take steps necessary to ensure internal practices promote efficient water management.

On the following pages, the City describes the conservation measures implemented since its last WMCP, and then details its new conservation program per Division 86 rules. For easy reference, organization of this section of this WMCP closely matches the organization of the new rules.

3.1 Previous Efforts

As stated earlier, the City of Gales Rock submitted a WMCP to WRD in 1995. This plan identified conservation measures the City could implement to encourage customers to conserve and also reduce the operational uses of water. Since that was plan was submitted, the City has undertaken several of the activities recommended at that time.

- Water main leak detection program: In 2002, Gales Rock hired a leak detection company to survey water mains (4 inch and larger) throughout the service area. Problem areas will be placed on prioritized list and subsequently repaired. Last year, several leaks were found and placed on the prioritized list.
- Reservoirs and tank leak detection program: Gales Rock continues to regularly visually inspect reservoirs and tanks for leakage.
- Meter testing program: The testing program focused on suspect meters which were identified when the water billing staff recognized an unusual meter reading or pattern or from a call from a customer. The City uses AWWA's accuracy standards when testing and repairing or maintaining meters; if suspect meters are found to measure

outside of this standard, the meter is repaired or replaced. Production meters (meters measuring production at each well) are tested generally once every five years.

- City park irrigation: Park irrigation systems are fully automated and irrigation events are timed to occur during the evening or early morning to minimize evaporation and avoid contributing to peak.
- City's operational usage: The City has undertaken the following steps to reduce or encourage the reduction of operational uses of water:
 - Self-closing nozzles have been installed at maintenance facilities to reduce water loss during vehicle washing and other maintenance activities.
 - Hydrant testing protocols have been upgraded to include a "closed cap" procedure.
 - Two public fountains have been rebuilt to that recirculate water; new water is added only to offset evaporation.
 - Quarterly water usage reports are distributed to staff at the Parks Department and the wastewater treatment plant. The reports are used to monitor water consumption.
- Available customer program: Free leak detection visits are offered to customers upon request. A visit by City staff consists of a basic analysis of the likelihood of a line leak on the customer's property.

3.2 Water Use and Reporting

Gales Rock's water-use reporting is done in compliance with OAR 690-085. The report is submitted annually by December 31st on the form provided by the Water Resources Department using the "Flow Meter Method" approved by the Department in OAR 690-085-0015 (5).

Enders and Hauser brand meters are located at each well which record cumulative water volume over the full range of discharge. These meters are read weekly by City personnel. There have been no withdrawals in the last 10 years that were not recorded and the reported monthly volumes are accurate within plus or minus 15%.

3.3 Rate Structure and Metering

The City recently completed an update to its rates in association with the 2000 Water Master Plan. The City adopted a \$6.00 monthly base (meter) charge and a rate of \$1.35 per 100 cubic feet (ccf) of water used. All customer use in the City is monitored under metered accounts.

3.4 Additional Conservation Measures

The City has also undertaken several additional projects that were not identified in its 1995 WMCP, including:

- Annual sponsorship of a vendor's booth at the Blaine County fair to promote "wise use" of water and distribute water conservation pamphlets and free lawn watering gauges.
- Toilets with 3.5 gallons per flush and larger have been replaced at all city parks and other city facilities with high efficiency 1.6 gallons per flush models.

3.5 Planned Conservation Measures

The conservation program described within the following subsection was developed based on careful analyses of the characteristics of historical demand patterns and customer demographics, as described below.

The City's available water rights currently meet annual average and peak period demands. However, capacity limits based on operational elements are approaching the maximum summertime demands. For this reason, the City will focus its conservation measures on peak demand reduction and those elements of the customer base most affected by related activities. Historically, about half the annual consumption in each the residential, commercial, and industrial customer classes occurs during the months of June, July, August and September. Such peaking is typical in the Northwest, especially for residential customers. Gales Rock, however, also experiences a similar pattern for its commercial and industrial users, whose seasonal demand typically does not vary to such a great degree.

Accordingly, the City's conservation program will be focused on peak demand reduction for all three classes. And, although the City is already taking steps to reduce its own contribution to peak day, such as irrigating parks during the early mornings, it will also look to further encourage additional 'wise use' by City staff.

In year 2002, the estimated per capita consumption for the residential class was approximately 103 gallons - a low number in consideration of the fact that one of the city's immediate neighbors, the City of Hardy, measured per capita single family residential demand at 145 gallons during that same year. Gales Rock attributes the low per capita demand on the age of water-using fixtures in single and multi-family residences. Since over 30% of residences have been constructed or remodeled since 1994 (the year a federal mandate was invoked requiring low water use fixtures in new construction and remodels), the City estimates that essentially all of these homes have low water use fixtures now in place.

The City, however, recognizes the need to continue to build on its present conservation activities. To do so, the City is planning to undertake several new conservation actions over the next ten years. Details of those plans are outlined in the following subsections.

3.5.1 Improved Water Auditing

A water audit has been performed annually by the City since 1995. Over the past five years, the City's average annual unaccounted for water has been about 16% (see Table 2-10). Currently, the City's calculation relies on a simple computation between the amount pumped and that measured at customer's meters.

The City has not attempted to identify unmetered authorized or unauthorized uses in the past. The City believes that if it starts to track unmetered authorized uses, such as flushing, fire flow through hydrants, and street cleaning activities, then the annual estimate of unaccounted for water may improve, i.e. drop below 15%. The City will begin a program to track non-revenue water usage starting in October 2003 and factor this number into all subsequent auditing reports for year 2004 and beyond. In addition, the City will annually review water usage at city facilities to identify conservation opportunities.

3.5.2 Meter Testing and Maintenance

Meter testing and maintenance is performed on an "as needed" basis except for the production meters which are tested every five years. The City will continue testing the production meters every five years, but also will initiate a revolving meter replacement program in which all meters 2" and below will be replaced every 20 years. Starting in June 2003, all meters will be scheduled for replacement based on age and size priorities – the older, larger meters being replaced first. Additionally, all meters larger than 2" will be tested every five years for possible replacement starting at that same time.

3.5.3 Leak Detection and Repair

The City is currently awaiting results from a recent leak detection survey conducted on all city pipelines 4" and larger. The City plans to use the results to outline a maintenance program to repair all detected leaks.

The City also recently completed a 2002 update to its Water System Master Plan. In that plan, the City has scheduled the replacement of all existing old cast iron pipelines by year 2012. The plan outlines the replacement of approximately 60% of the oldest lines within the first 5 years, with the remaining 40% to be replaced between 2008-2012.

3.5.4 Public Education

Public education is an important component of the City's overall water conservation program. The following public education measures are planned:

- Continue free leak detection tests to residential customers who suspect a leak. City staff will help determine the location of the leak if the leak is outdoors and offer free brochures with conservation information and a free conservation kit when applicable (see below for a description of the brochures and kits).

- Distribute water conservation brochures at community events twice per year (including the Blaine County Fair) and provide brochures also at key city office sites frequented by customers. Brochures include tips on water saving irrigation techniques and methods to reduce consumption indoors.
- Provide information on City consumption programs with links to other water conservation sites on the City's website when a planned overhaul of the site is completed in 2005.

3.5.5 Additional Conservation Measures

Under Division 86 rules, the City is not required to specifically address the items listed under OAR 690-086-0150(6). However, the City is planning to distribute free water conservation kits to residential customers. The kits will include an automatic-stop hose nozzle, a hose repair kit, and an irrigation gauge (to measure volume of water applied).

The kits will be offered at the two planned annual public events and in one or more of the City's newsletter articles (depending upon customer demand for the kits). The kits will also be distributed to customers when warranted during any on-site water leak detection visits.

Additionally, the City's is committed to leading the community in the effective and efficient use of water and, beginning in June 2003, will install rain sensors at each of the two city parks to optimize irrigation use at those two facilities.

3.5.6 Conservation Savings

Gales Rock anticipates that the savings gained from the conservation measures identified above will reduce peak demand in years 10 and 20 by 5% of total system demand estimated for those years. Table 3-1 identifies the approximate percentage savings for each measure as estimated by Gales Rock staff.

Table 3-1
City of Gales Rock
5-Year Conservation Benchmark Savings

Measure	Savings
On-Going Efforts	
	Estimated
Complete leak detection survey and reporting	n/a
Visual inspection of reservoirs	0%
Meter testing and maintenance program	0.5%
Automated park irrigation	0.01%
Leak detection visits	0.01%
Production meter testing	n/a
Reduced operational usage at City facilities	0.01%
Vendor's booth at Blaine County Fair	0.01%
Planned Programs	
Improved water auditing (track non-revenue use)	n/a
Initiate revolving meter (< 2") replacement	0.01%
Testing of meters > 2"	1.0%
Leak repair (all leaks from 2003 leak survey)	3%
TOTAL	5%

The City anticipates that the greatest conservation savings will come from the meter testing and maintenance program and leak repair program. The meter testing and maintenance program will allow staff to locate and repair or replace malfunctioning meters. Experience indicates that once a faulty meter is repaired or replaced, average and peak demand associated with that meter decreases a substantial amount, depending upon how poorly the meter read before its repair or replacement.

3.6 Summary of 5-Year Benchmarks

A summary of the relevant benchmarks for the City's on-going and planned conservation activities are outlined in the Table 3-2.

Table 3-2
City of Gales Rock
5-Year Conservation Benchmarks

Benchmark	Date	Frequency
On-Going Efforts		
Complete leak detection survey and reporting	June 2003	N/A
Visual inspection of reservoirs	-	Annually
Meter testing program	-	On-call
Automated park irrigation	-	Daily
Leak detection visits	-	On-call
Production meter testing	-	5 years
Reduced operational usage at City facilities	-	Daily
Vendor's booth at Blaine County Fair	-	Annually
Planned Programs		
Improved water auditing (track non-revenue use)	October 2003	Annually
Initiate revolving meter (< 2") replacement	June 2003	20 years
Testing of meters > 2"	June 2003	5 yrs
Leak repair (all leaks from 2003 leak survey)	By Oct. 2004	-
Replace all existing cast iron pipe	By 2012	-
Publish conservation article in Gales Inquirer	June 2003	Annually
Distribute conservation brochures and kits	June 2003	Twice/Year
Distribute conservation kits	June 2003	On-going
Install rain sensors in city parks	March 2004	-

Section 4

Curtailment Plan Elements

The City of Gales Rock's water supply is ground water, a source less susceptible to seasonal fluctuations in weather patterns than surface water. Therefore, the City believes that there are two primary scenarios in which the City may not be able to meet demand: in the event of a mechanical or structural failure of the infrastructure (particularly problems associated with a well) or contamination. The City's response to water supply emergencies such as these is described below.

The City Council is in the process of adopting a water curtailment ordinance. This ordinance allows the City Manager authority to promulgate a water supply emergency and enact the water curtailment plan. In the event that a stage three water emergency is determined, the ordinance allows for the policing of customer activities and the issuance of citations (warning and fines) to encourage customers to abide by the curtailment plan measures. A copy of the draft ordinance is included Appendix F.

4.1 Tools at the City's Disposal

The City presently has three tools at its disposal to decrease or eliminate the effects of a water emergency and ensure an adequate supply of water for its customers. First, it has 2 million gallons of usable storage, however this volume fluctuates over the course of the day depending upon demand. As an emergency supply, it cannot be assumed reservoirs will be full in the event of a water shortage. Second, Gales Rock has interties with the City of Hardy and Bingham, which can supply 0.5 mgd and 0.25 mgd, respectively upon request. In sum, Gales Rock has 0.75 mgd available from these three interties which can be used to offset base demand.

Additional capacity may be made available subject to future construction of the Trillium Reservoir project.

It is anticipated that a water shortage experienced by Gales Rock will not be experienced simultaneously by any other water supplier; however, there is a remote possibility any one of the interties may not be an available source of supply in the event of an emergency. Therefore, the City has developed a water curtailment plan, the third tool available to answer a water supply emergency.

4.2 Water Emergency Response

Though the City's wells differ in individual capacity, each well (excluding well 1) produces a significant quantity to the overall supply. In fact, the City must in general maintain access to at least five of the six primary wells at any given time. Therefore, the City defines a water

emergency as a point in time when two or more of the main wells would be lost for a period beyond 24 hours.

In order to respond to such conditions, the City further defines the level of emergency based on the time for which those conditions would apply. In the case a water emergency is anticipated to last three days or less, the City will open all necessary interties first and then rely on 40% of its emergency storage to serve demand. If storage drops below 60% of the total 2 MG, then the City would invoke its curtailment plan to meet its demand. On the other hand, if such an emergency were expected to last greater than three days, the City would first open the interties and initiate the curtailment plan, while managing emergency storage to an extent practical. Moreover, under any circumstances where demand reaches 80% of actual capacity (at any given time), the curtailment plan shall be invoked.

It must be noted that no plan can anticipate the myriad of emergency scenarios. Factors such as weather, availability of mechanical parts, and customers' response to the curtailment plan, among other factors, will dictate the degree and speed to which the city responds to an actual event. Accordingly, the City anticipates that any emergency plan will have to remain flexible and be adjusted according to various factors at hand.

4.3 The Curtailment Plan

Table 4-1 describes the City's proposed curtailment plan. Included within the plan are three stages of alert, the trigger for each stage, the goals for the implemented curtailment measures per stage, and the curtailment measures.

Stage	Trigger	Goal	Implementation Measures
Mild	Use reaches * 80% of capacity	Awareness and 5% reduction in consumption	<ul style="list-style-type: none"> ■ Activate curtailment plan ■ Disseminate informational brochures on conservation methods ■ Put up posters and sandwich boards about the City ■ Coordinate outreach to customers through direct means (web page) and indirect means (media) ■ Voluntary irrigation schedule based on north and south side customers irrigating every fifth day during the early morning or evening. ■ Flushing lines for essential needs only ■ Turn off city fountains and post a sign describing why

Table 4-1 (cont'd)
City of Gales Rock
Proposed Curtailment Plan

Moderate	Use reaches 90% * Capacity	10% reduction in consumption	<ul style="list-style-type: none"> ■ Continue with “Mild” stage measures except where noted below ■ Irrigation schedule implemented in “Mild” stage mandatory ■ Close all pools, eliminate city street cleaning, line flushing (unless health of customers at risk), and City park irrigation ■ Request businesses reduce consumption by 10% ■ Hosing of pavement not permitted except when necessary for public health or safety
Critical	Use reaches 95% capacity*	15% reduction in consumption	<ul style="list-style-type: none"> ■ Continue with “Moderate” stage measures except where noted below. ■ No use of city supplied water to fill private swimming pools ■ Outdoor irrigation banned ■ No use of city supplied water to wash vehicles

*Capacity is defined as the total rate of water accessible at any given time through the series of City wells.

4.4 Staff Responsibilities

The following staff will have responsibilities for the following tasks in the event the water curtailment plan is enacted.

John Smith, Media Relations, City Manager’s Office: All direct and indirect media outreach efforts
 Sally Jones, Law Enforcement Officer, Police Department: Enforce curtailment measures
 Jack Brown, Water Foreman, Water Department: Work with businesses to reduce consumption
 Judy Doe, Supervisor, Water Department: Coordinate with public pools, street cleaning company, and Water Department to ensure activities are commensurate with curtailment plan.

Section 5

Municipal Water Supply Element

5.1 Future Service Area

5.1.1 Population

The City's present population is estimated at 4,408. Twenty-five year forecasts have been developed by the City's Planning Department and show a modest population increase through year 2025. At that time, the City is expected to support just under 5,000 people. These forecasts are consistent with the City's Water Master Plan (2000) and Comprehensive Land Use Plan (2000). Table 5-1 provides a summary of population data and estimates from 2000 to 2020. These estimates will provide the initial basis for long-term water supply forecasting.

Table 5-1
City of Gales Rock
Population Summary

Year	Total Population
2000	4,012
2001	4,286
2002	4,408
2005	4,520
2010	4,850
2020	5,150

The number shown between 2000 and 2010 reflect an annualized growth rate of 1.9%. This growth slows to just around 0.6% per year for the period 2010 to 2020.

5.1.2 Employment

Employment forecasts were also obtained from the State of Oregon Office of Economic Analysis (OEA) and are based on projected growth rates until 2020. These figures were adjusted by the City's Planning Department to account for industrial lands north of the city anticipated to be annexed in the future. Table 5-2 shows employment estimates until 2020. These estimates will also provide the basis for long-term water supply forecasting.

Table 5-2
City of Gales Rock
Employment Estimates

Year	Employment Estimate
2000	2410
2001	2575
2002	2690
2005	2780
2010	2990
2020	3105

By comparison to population, the number of jobs initially grows more quickly – at annualized rate of 2.1% for the period between 2000 and 2010 and then slows to just under 0.4% per year over the next ten years to 2020.

5.1.3 Land Use Development

Based on existing taxlot data the six primary land uses within the City's current service area are multi-family residential, single-family residential, agricultural, commercial, and industrial. Table 5-3 summarizes the total area for each land use categories. The single-family residential category takes up over 50% of the land within the existing city limits (not including transportation corridors).

Table 5-3
City of Gales Rock
Land Use Summary

Code	Land Use Description	Total Area (acres)	% of Total
MFR	Multi-Family Residential	57	3%
SFR	Single-Family Residential	883	51%
AGR	Agricultural	151	9%
COM	Commercial	171	10%
IND	Industrial	424	24%
OPN	Open Space	52	3%
Total		1,738	

It is anticipated that the City's major land use category will continue to be single-family residential. The City's long term growth should not significantly affect the current distribution of land use categories, and as such, each customer class should continue to exhibit the same share of the City's total water consumption.

The City's water service area boundaries coincide with those of its City limits. The City's Comprehensive Land Use Plan notes no growth will occur outside the city limits given the slow rate of growth and available land within the City. Therefore the service area will also not expand beyond the existing boundaries.

5.2 Future Demand

5.2.1 Average Annual Demand

The rate of growth in water demand is presumed to be driven by the two largest customer classes - residential and commercial/industrial. Under this approach, it is assumed that use by the other customer classes will remain relatively steady and will have little impact on future water consumption. It is also presumed that the character of the residential and commercial/industrial class remains relatively the same, as well.

Future demand was calculated by estimating the future number of ERU's and applying a standard rate of use per ERU. A number of 270 gallons per day per ERU was determined from the historical data reported in Section 2. The number of expected ERU's was then computed using the rates of growth for population and employment for the residential and commercial/industrial classes, respectively. The results of that forecast are shown in Table 5-4.

Table 5-4
City of Gales Rock
Average Daily Demand Forecast Summary

Year	Residential Demand (mgd)	Commercial/Industrial Demand (mgd)	Other (mgd)	Total (mgd)
2005	0.60	0.12	0.03	0.75
2010	0.64	0.13	0.03	0.80
2020	0.68	0.13	0.03	0.84

The average daily demand (ADD) is expected to increase from 0.74 mgd to 0.80 mgd over the period 2002 to 2010 – this is only an overall increase of just over 8% in that period. By 2020, the City's projected population is expected to require only an additional 0.04 mgd.

The other customer classes, such as Agriculture, Public/Institutional, and Fire Flow, are expected to remain static over the next twenty years. Specifically, decreases in agriculture consumption as a result of urban development expansion, will offset minor expected increases in the Public/Institutional classes. Fire Flow will not change unless the City experiences fires large enough to warrant the use of huge volumes of water. The next section discusses the results of conservation measures on peak day.

5.2.2 Peak Day and Conservation Measures

As described in Section 2, Gales Rock's peaking factor is 2.3 which brings the peak day estimate to 1.84 mgd in 2010 and 1.93 mgd by 2020. However, the City anticipates that its conservation program activities combined will reduce peak day demand by 5% in year 2010 and 2020. As such, peak day demand will be reduced to 1.75 mgd by 2010 and 1.80 mgd by 2020.

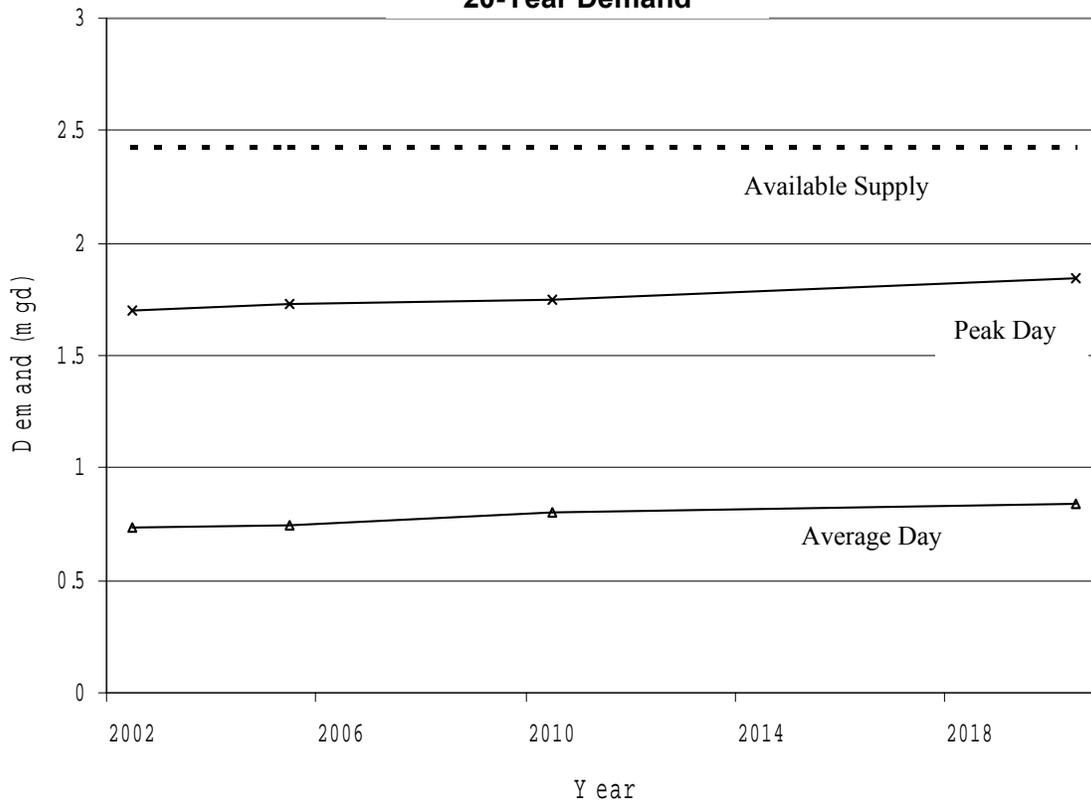
Table 5-5 describes peak and average day demand for the years 2005, 2015 and 2020.

**Table 5-5
City of Gales Rock
Water Demand Forecast**

Year	Average Day Demand (mgd)	Peak Day Demand (mgd)
2005	0.75	1.73
2010	0.80	1.84
2020	0.84	1.93

A graphical summary of the City's 20-year average and peak demands are shown in Figure 5-1 below.

**Figure 5-1
City of Gales Rock
20-Year Demand**



5.3 Long-Range Supply Plan

5.3.1 Capacity Assessment

The City's current well inventory will deliver about 1.9 mgd on a peak basis and 1.4 mgd regularly over the year. The 20-year forecast places peak day demands between 1.84 and 1.93 mgd (depending on conservation outcomes). Fortunately, the City has permitted access to municipal water totaling 2.43 mgd. Thus, the City must plan to expand its present capacity for withdrawals under its existing permits to accommodate additional access to water during peak periods of demand and to increase reliability throughout the system. Plans to do so include:

- The rehabilitation of wells 5 and 6 and possible aeration treatment for wells 1 and 2 (both of which are impacted by hydrogen sulfide).
- The construction of up to two additional wells in the local aquifer to be operated under the existing permits to achieve greater access to water. To accomplish this, the City would seek to establish the new wells as additional points of appropriation through the permit amendment process.

The City is planning to construct sufficient capacity to withdraw up to 2.2 mgd, allowing for reasonable access to needed capacity in excess of the estimated 20-year need. This added capacity will allow for required maintenance and down time of wells, access to sufficient water, and a modest margin of redundancy.

The City is also a potential partner in the construction of the Trillium Reservoir project. If constructed, the project would give the City access to 500 acre-feet of stored water during the annual period May 1 to October 31. This would allow for up to 1.1 mgd of water over the 150-day annual target period between May 15 and October 15. The City, however, would also have to fund the construction of a new treatment plant in order to make that water available. The City is presently conducting a feasibility assessment to investigate this option as part of an approved activity under its City's present Water Master Plan. No decision has yet been made regarding the City's plan to pursue the development of that project.

5.3.2 Projected 20-year Withdrawal

The long-range supply plan for the City will include diligent management of its existing water rights inventory to achieve minimal impact, while maintaining a high level of service to customers. Under that plan, the City will look to expand its withdrawals under each of its currently permitted (unperfected) water rights. The projected 20-year withdrawal under each permit is shown in Table 5-6. The numbers shown reflect the permitted (or perfected) capacity under each right and the projected withdrawal for both the maximum instantaneous rate and peak monthly volume. Note that due to taste and odor problems of Well 1, the City has chosen not to use full amount of certificated water.

Based on the projections of water needed, the impacts of conservation on demand, and available supply, the City requires WRD authorization to increase diversions from the current maximum rate of 1.65 mgd to 2.43 mgd as shown in Table 5-6. This increase will be necessary to construct the wells described above. The City expects the 2023 peak month demand to be 41,298,000 MG.

Table 5-6
City of Gales Rock
20-year Withdrawal Summary

Permit No.	Permitted Capacity		20-Year Peak Withdrawal		Notes
	Max. Rate (cfs)	Monthly Volume (MG)	Max. Rate (cfs)	Monthly Volume (MG)	
G-1001	1.33	25,786,000	0.66	10,664,000	Wells 1 and 2
G-1020	0.55	10,663,000	0.54	8,725,000	Well 3
G-1030	0.67	12,990,000	0.50	8,143,000	Well 4
G-1040	1.21	23,460,000	0.61	9,888,000	Wells 5 and 6
G-1010	0.33	6,398,000	0.20	3,878,000	Well 7

5.4 Schedule for Beneficial Use

The City currently operates seven wells under five separate water rights, four of which allow for municipal use and the other irrigation. Of the four municipal rights, only one has been certificated – that governing wells 1 and 2 (the irrigation right is also certificated). In order to solidify its present permits, the City has developed a timeline for applying beneficial use and certification of each unperfected right. That schedule is shown in Table 5-7. The City's water needs are based on the demand forecast previously presented with adjustments to reflect conservation savings.

Table 5-7
City of Gales Rock
Water Rights Perfection Schedule

Permit No.	Priority Date	Certificate	Rate (cfs)	Use	Perfection Schedule	Notes
G-1001	8/19/1923	C-1234	1.33	Municipal	Complete	Wells 1 and 2
G-1020	4/26/1956	-	0.55	Municipal	Summer 2010	Well 3
G-1030	9/16/1972	-	0.67	Municipal	Summer 2010	Well 4
G-1040	10/09/1981	-	1.21	Municipal	Summer 2010	Wells 5 and 6
G-1010	6/14/1931	C-0123	0.33	Irrigation	Complete	Well 7

The City plans to certificate all unperfected rights prior to the submittal of the updated WMCP in 2013.

Appendix D

Revised from the U.S. Environmental Protection Agency Water Conservation Plan Guidelines, Appendix D

(Note: Items in **BOLD** represent resources the Guidebook committee has found particularly useful.)

Guides, Manuals, and Handbooks

American Water Works Association. *Before the Well Runs Dry. Volume I. A Handbook for Designing a Local Water Conservation Plan.* Denver, CO: American Water Works Association, 1984.

American Water Works Association. *Evaluating Urban Water Conservation Programs: A Procedures Manual.* Denver, CO: American Water Works Association, 1993.

American Water Works Association. *Principles of Water Rates, Fees, and Charges. Manual M-1.* Denver, CO: American Water Works Association, 2000.

American Water Works Association. *Rehabilitation of Water Mains. Manual M-28.* Denver, CO: American Water Works Association, 2001

American Water Works Association. *Water Resource Planning. Manual M-50.* Denver, CO: American Water Works Association, 2001.

American Water Works Association Research Foundation. *Commercial and Institutional End Uses of Water.* Denver, CO: American Water Works Association Research Foundation, 2000.

American Water Works Association Research Foundation. *Residential End Uses of Water.* Denver, CO: American Water Works Association Research Foundation, 1999.

Harberg, Robert. *Planning and Managing Reliable Urban Water Systems.* Denver, CO: American Water Works Association, 1997. See Chapter 6 on The Role of Water Conservation and Shortage Response, which also has a bibliography.

_____ . *Conservation-Oriented Rates for Public Water Systems in Washington. Report to the Legislature.* Washington State Department of Health. December 1995.

_____ . *Evaluation of State Guidelines: Guidelines for State Water Conservation Plans (WITAF Project #559).* Denver, CO: American Water Works Association, August 1997. Prepared by Maddaus Water Management, et al.

_____. Model Guidelines for Water Conservation Plans: Guidance for State Water Conservation Plans (WITAF Project #559). Denver, CO: American Water Works Association, November 1997. Prepared by Maddaus Water Management, et al.

Baumann, Duane D., John J. Boland, and W. Michael Hanemann. *Urban Water Demand Management and Planning*. New York: McGraw Hill, 1998.

California Department of Water Resources. *Urban Drought Guidebook*. Sacramento, CA: Department of Water Resources, March 1991.

California Urban Water Conservation Council. *Memorandum of Understanding Regarding Urban Water Conservation in California*. Sacramento, CA: California Urban Water Conservation Council, as amended April 8, 1998.

California Urban Water Management Planning Act. *Established AB797, 1983, Amended AB 2661, 1990; AB11X, 1991; AB 1869, 1991; AB 892, 1993; SB 1017, 1994; AB 2853, 1994; AB 1845, 1995; SB 1011, 1995.*

Colorado State Office of Water Conservation. *Sample Water Conservation Plan for Cherry Creek Valley Water & Sanitation District*. Denver, OWC, not dated. Prepared with AquaSan, Network, Inc.

Connecticut Department of Environmental Protection, et al. *Water Companies Planning Guidance for Water Conservation*. Connecticut Department of Environmental Protection, Connecticut Department of Health Services, Connecticut Department of Public Utility Control, Connecticut Office of Consumer Counsel, Connecticut Office of Policy and Management, December 1990.

Dziegielewski, Benedykt, Eva M. Opitz, Michael Hanemann, and David L. Mitchell. *Urban Water Conservation Programs, Volume III: Experience and Outlook for Managing Urban Water Demands*. Carbondale, IL: Planning and Management Consultants, Ltd., 1995.

Kansas Water Office. *Water Conservation Planning Guidelines*. Topeka, KS: Kansas Water Office, 1986.

_____. *Municipal Water Conservation Plan Guidelines*. Topeka, KS: Kansas Water Office, November 1990.

Massachusetts Water Resources Commission. *Guidelines for Preparing a Concept Plan for the Protection and Management of Water Resource*. Boston, MA: Massachusetts Water Resources Commission, January 1990.

_____. *Water Conservation Standards for the Commonwealth of Massachusetts*. Boston, MA: Executive Office of Environmental Affairs, Massachusetts Water Resources Commission, October 1992.

New York Department of Environmental Conservation. *Water Conservation Manual for Development of a Water Conservation Plan*. Albany, NY: Bureau of Water Resources, DEC, Division of Water, January 1989.

_____. *Water Conservation Program Form*. Albany, NY: Bureau of Water Resources, DEC, June 29, 1989.

Phoenix Water Conservation and Resources Division. *Water Conservation Planning Guide*. Phoenix, AZ: City of Phoenix Water Conservation and Resources Division, November, 1990.

Ploeser, Jane H., J. Douglas Kobrick, and Betsy A. Henderson. "Non-Residential Water Conservation in Phoenix: Promoting the Use of Best Available Technologies," *1990 Annual Conference Proceedings; American Water Works Association*. Denver, CO: American Water Works Association, 1990.

Pontius, Frederick W. and Albert E. Warburton. "Conservation Legislation," *Journal of the American Water Works Association* Vol. 33, No. 10 (October 1991): 10-12.

Rhode Island Department of Environmental Management. *Rules and Regulations for Water Supply Management Planning*, Regulation DEM-DWSM-01-92. Providence, RI: Department of Environmental Management, Division of Water Supply Management. Amended August 13, 1992.

Rocky Mountain Institute. *Water Efficiency: A Resource for Utility Managers, Community Planners, and Other Decisionmakers*. Snowmass, CO: The Water Program, Rocky Mountain Institute, November 1991.

Shelton, Theodore B. and Susan E. Lance. *Designing a Water Conservation Program, An Annotated Bibliography of Source Materials*. New Brunswick, NJ: Rutgers Cooperative Extension, Rutgers University Cook College. U.S. Environmental Protection Agency, Office of Water, September 1993.

_____. **Overview of Conservation-Oriented Rate Structures for Public Water Systems - Questions & Answers. Washington State Department of Health. April 1995.**

Thornton, Julian. *Water Loss Control Manual*. McGraw-Hill Professional. June, 2002.

U.S. Bureau of Reclamation. *Achieving Efficient Water Management, A Guidebook for Preparing Agricultural Water Conservation Plans*. Washington, DC: Bureau of Reclamation, U.S. Department of the Interior, December 1996. Prepared by Hydrosphere Resource Consultants. \t "_blank" <http://www.usbr.gov/watershare/documents/Achieving%20Efficient%20Water%20Management.pdf>

_____. *1996 CVPIA Criteria for Water Management Plans*. Washington, DC: Bureau of Reclamation, U.S. Department of the Interior, 1996. \t "_blank" <http://www.uc.usbr.gov/amp/twg/99dec07/99nov9frn.pdf>

_____. *CVPIA Water Management Planning Guidebook*. Washington, DC: Bureau of Reclamation, U.S. Department of the Interior, 1997. \t "_blank" <http://209.21.0.235/documents/index.htm>

_____. *Reclamation Policy for Administering Water Conservation Plans Pursuant to Statutory and Contractual Requirements*. Washington, DC: Bureau of Reclamation, U.S. Department of the Interior, 1996.

Walski, Thomas M. *Analysis of Water Distribution Systems*. Krieger Publishing Company. November 1992. (See Chapter 7, Breaks and Water Loss).

Watson, Montgomery. *Water Conservation Guidebook for Small and Medium-Sized Utilities*. Denver, CO: American Water Works Association, Pacific Northwest Section Water Conservation Committee, August 1993.

Washington State Department of Ecology and Department of Health. *Conservation Planning Requirements, Guidelines and Requirements for Public Water Systems Regarding Water Use Reporting, Demand Forecasting Methodology, and Conservation Programs*. Olympia, WA: Ecology Publication #94-24 and Health PUB 331-008, March 1994.

_____. ***A Water Conservation Guide for Commercial, Institutional and Industrial Users*. New Mexico Office of the State Engineer, 1999.**

Wescoat, James L., Jr. *Integrated Water Development: Water Use and Conservation Practice in Western Colorado*. Chicago, IL: University of Chicago, Department of Geography, 1984.

Integrated Resource Planning

Beecher, Janice A. "Integrated Resource Planning Fundamentals," *Journal American Water Works Association* (June 1995): 34-48.

Beecher, Janice A. and Patrick C. Mann. *Integrated Resource Planning for Water Utilities*. Columbus, OH: National Regulatory Research Institute, 1992.

Call, Chris. "Demand Management as a Component of IRP: The Long and Winding Road," *Proceedings of Conserv96: Responsible Water Stewardship*. Denver, CO: American Water Works Association, 1996.

Domenica, Michael F., ed. *Integrated Water Resources Planning for the 21st Century: Proceedings of the 22nd Annual Conference, Cambridge, Massachusetts, May 7-11, 1995*. Cambridge, MA: American Society of Civil Engineers, 1995.

Fiske, Gary. *Integrated Resource Planning: A Balanced Approach*. Denver, CO: American Water Works Association, 1996.

Melendy, Cynthia A. "Integrated Resource Planning Overview and Benefits," *Proceedings of Conserv 96: Responsible Water Stewardship*. Denver, CO: American Water Works Association, 1996.

Small Systems

American Water Works Association, Pacific Northwest Section. *Water Conservation Guidebook for Small and Medium-Sized Utilities*. Denver, CO: American Water Works Association, (Prepared by Montgomery Watson, Inc. under the direction of the Water Conservation Committee), August 1993.

Community Resource Group, Inc. *Small Systems Guide to Developing and Setting Water Rates*. Springdale, Arkansas.

Male, J.W., J.B. Moriarty, T.H. Stevens, and C.E. Willis. "Water Supply Costs for Small Private Utilities," *Water Resources Bulletin* Vol. 27, No. 3 (June 1991): 521-526.

Rhorer, Kyle. "Small Systems — Conservation: It's Not Just for Big Systems," *Journal American Water Works Association*. May 1996.

Rural Community Assistance Program. *Household Water Conservation*. Leesburg, VA. (Not dated.)

_____. *Leak Detection and Repair*. Leesburg, VA. (Not dated.)

_____. *Small Community Water Conservation*. Leesburg, VA. (Not dated.)

_____. *Water Audits*. Leesburg, VA. (Not dated.)

_____. *Water Reuse*. Leesburg, VA. (Not dated.)

Trauth, K.M., B.J. Claborn, and L.V. Urban. "Water Resources Audit for Small Communities," *Journal of the American Water Works Association* Vol. 79, No. 5 (May 1987): 48-51.

Forecasting

Billings, Bruce R. and C. Vaughan Jones. *Forecasting Urban Water Demand*. Denver, CO: American Water Works Association, 0-89867-827-7, 1996.

Darmody, John, William Maddaus, Russell Beatty, Les Taylor, and Watana Yuckpan. "Water Use Surveys-An Essential Component of Effective Demand Management," *1996 Annual Conference Proceedings; American Water Works Association Water Resources*. Denver, CO: American Water Works Association, 1996.

Davis, W.Y. "Forecasting Municipal Water Demand and Conservation Evaluation: The IWR-MAIN System 5.1," *Water -Use Data for Water Resources Management: Proceedings of a Symposium*. American Water Resources Association, 1988: 787-795.

Feather, Timothy D. and Nick Braybrooke. "Conservation Planning, End-Use Analysis, and the Impacts on Maximum-Day Demand," *Proceedings of Conserv96: Responsible Water Stewardship*. Denver, CO: American Water Works Association, 1996. Nieswiadomy, Michael and Thomas P. Fox. "Calculating Water Savings Using a Spreadsheet Program," *Proceedings of Conserv96: Responsible Water Stewardship*. Denver, CO: American Water Works Association, 1996.

Planning and Management Consultants, Ltd. *IWR-MAIN Water Demand Analysis Software Version 6.0 (copyright): User's Manual and System Description*. Carbondale, IL: Planning and Management Consultants, Ltd., June 1994.

Weber, J.A. "Forecasting Demand and Measuring Price Elasticity," *Journal of the American Water Works Association* Vol. 81, No. 5 (May 1988): 57-65.

Measures

Ahlstrom, Scott B. "Obstacles to Implementing Reuse Projects," *Municipal Wastewater Reuse: Selected Readings on Water Reuse*. (EPA 430/09-91-022), September 1991.

American Water Works Association. *Water Audits and Leak Detection*. Denver, CO: American Water Works Association, 1990.

_____. *The Water Conservation Manager's Guide to Residential Retrofit*. Denver, CO: American Water Works Association, 1993.

_____. *Water Meters - Selection, Installation, Testing, and Maintenance*. Third Edition, Denver, CO: American Water Works Association, 1986.

Arizona Department of Water Resources. *Water Conservation Alternatives Inventory*. Tucson, AZ: Arizona Department of Water Resources, July 1990.

Asano, Takashi and Richard A. Mills. "Planning and Analysis for Water Reuse Projects," *Journal of the New England Water Works Association*. (January 1990): 38-47.

Baghdadi, A.H.A. and H.A. Mansy. "Mathematical Model for Leak Location in Pipelines," *Applied Mathematical Modeling* Vol. 12, No.12 (February 1988): 25-30.

Ball, Ken. Xeriscape™. *Programs for Water Utilities*. Denver, CO: American Water Works Association, 1990. Beecher, Janice A. and Ann P. Laubach. *Compendium on Water Supply, Drought, and Conservation*. Columbus, OH: National Regulatory Research Institute, 1989.

Bennett, Richard E. and Michael S. Hazinski. *Water Efficient Landscape Guidelines*. Denver, CO: American Water Works Association, 1993.

Borland, Dorothy, Liz Inman, Jill Kotewicz, Mark Leese, and Mark Upshaw. *Landscape Design and Maintenance Guidelines for Water Conservation*. January 1993.

California Department of Water Resources. *Water Conservation Reference Manual Urban Conservation Measures*. Sacramento, CA: California Department of Water Resources, office of Water Conservation, March 1984.

Chaplin, Scott Whittier. *Water-Efficient Landscaping, A Guide for Utilities and Community Planners*. Snowmass, CO: Rocky Mountain Institute Water Program, 1994.

Chesnutt, Thomas W., Anil Bamezai and Casey McSpadden. *Mapping the Conserving Effect of Ultra Low Flush Toilets: Implications for Planning*. Santa Monica CA: A&N Technical Services, Inc., June 1992.

Culpin, C. "Revenue Analysis of a Water Meter System," *Journal of the New England Water Works Association* Vol. 102, No. 4 (December 1988): 249-253.

Dean, Robert B. and Edda Lund. *Water Reuse: Problems and Solutions*. New York: Academic Press, 1981.

DeHart, D. "Conservation: A Benefit of Good Management," *Journal of the New England Water Works Association* Vol. 105, No. 1 (March 1991): 43-45.

Easton, W.P. "What is a Water Audit?" *Journal of the New England Water Works Association* Vol. 104, No. 2 (June 1990): 141-145.

Feucht, James R. *Xeriscaping. A Series of Reports*, Colorado State University Cooperative Extension, No. 7.228-7.232, June 1987.

Fiske, Gary S. and Ronnie Ann Weiner. *A Guide to Customer Incentives for Water Conservation*. Barakat & Chamberlin, Inc. California Urban Water Agencies, California Urban Water Conservation Council and U.S. Environmental Protection Agency, February 1994.

Flory, John E. and Thomas Panella. *Long-Term Conservation & Shortage Management Practices*. Tabors Caramanis & Associates. California Urban Water Agencies, February 1994.

Gadbury, D. "Metering Trials for Water Supply," *Journal of the Institution of Water and Environmental Management* Vol. 3, No. 2 (April 1989): 182-187.

Hanke, S.H. "Water Metering and Conservation," *Water/Engineering and Management* Vol. 128, No. 10 (1981): 57-59.

Kiefer, Jack. "Issues in the Estimation of Water Savings: Case Studies from Plumbing Retrofit Programs in Southern California," *Proceedings of Conserve93*. December 1993: 1439-1454.

Laird, Colin. *Water-Efficient Technologies, A Catalog for the Residential/Light Commercial Sector*. Snowmass, CO: Rocky Mountain Institute Water Program, 1991.

Lund, J.R. "Metering Utility Services: Evaluation and Maintenance," *Water Resources Research* Vol. 24, No. 6 (June 1988): 802-816.

Maddaus, William O. *Water Conservation*. Denver, CO: American Water Works Association, 1987.

Maloney, Stephen W. *Preventing Water Loss in Water Distribution Systems: Money Saving Leak Detection Programs*. Washington, DC: US Army Corps of Engineers, Construction Engineering Research Laboratory (Technical Report, N-86/05), 1986.

Metcalf & Eddy, Inc. *Wastewater Engineering: Treatment, Disposal, and Reuse*. Third Edition. New York: McGraw Hill, 1991.

Miller, K.J. "U.S. Water Reuse: Current Status and Future Trends," *Water, Environment, and Technology* Vol. 2, No. 11 (November 1990): 83-89.

Moyer, Ellen E. *Economics of Leak Detection - A Case Study Approach*. Denver, CO: American Water Works Association, 1985.

Ploeser, J.H., C.W. Pike, and J.D. Kobrick. "Nonresidential Water Conservation: A Good Investment," *Journal of the American Water Works Association* Vol. 84, No. 10 (October 1992): 65-73.

Rathnau, N.M. "Submetering = Water Conservation," *Water Engineering and Management*, Vol. 138, No. 3 (1991): 24-37.

Shuval, H.I. "Development of Health Guidelines for Wastewater Reclamation," *Water, Science, and Technology* Vol. 24, No. 7 (1991): 149-155.

Slater, William and Peter Orzechowski. *Drought Busters*. Los Angeles: Living Planet Press, 1991.

Smith, R.G. and M.R. Walker. "Water Reclamation and Reuse," *Research Journal of the Water Pollution Control Federation* Vol. 63, No. 4 (June 1991): 428-430.

Southworth, W.P. "What is a Water Audit?" *Journal of the New England Water Works Association* Vol. 104, No. 2 (June 1990): 141-145.

Sullivan, J.P. and E.M. Speranza. "Proper Metering Sizing for Increased Accountability and Revenue," *Journal of the American Water Works Association* Vol. 84, No. 7 (July 1992): 53-61.

U.S. Environmental Protection Agency. *Cleaner Water Through Conservation*. Washington, DC: USEPA (EPA/841/B/95/002), April 1995. \t "_blank" <http://www.epa.gov/OW/you/intro.html>

_____. *Fact Sheet: 21 Water Conservation Measures for Everybody*. Washington, DC: USEPA, Office of Water (EPA 570/9-91-100), 1991.

_____. *Guidelines for Water Reuse*. Cincinnati: USEPA Municipal Environmental Research Laboratory (EPA 600/88-80-036), 1980.

_____. *Manual: Guidelines for Water Reuse*. Washington, DC: USEPA, Office of Water (EPA/625/R-92/004), 1992.

_____. *Xeriscape Landscaping, Preventing Pollution and Using Resources Efficiently*. Washington, DC: USEPA, Office of Water (EPA/840/B/93/001), 1993.

Vickers, Amy. "Conservation Matters: What Makes a True Conservation Measure?" *Opflow*. June 1996: 8-9.

_____. "The Emerging Demand-Side Era in Water Management." *Journal of the American Water Works Association*. October 1991: 38-43.

_____. "The Energy Policy Act: Assessing its Impact on Utilities." *Journal of the American Water Works Association* Vol. 85 no. 8 (August 1993): 56-62.

_____. *Handbook of Water Use and Conservation*. New York: Lewis Publishing, 1999.

Vickers, Amy and E.J. Markus. "Creating Economic Incentives for Conservation," *Journal of the American Water Works Association* Vol. 84, No. 10 (1992): 42-45.

Wallace, Lynn P. *Water and Revenue Losses: Unaccounted for Water*. Denver, CO: American Water Works Association, 1987.

Walker, Robert E. and Gary F. Kah. *Landscape Irrigation Auditor Handbook*. Irrigation and Research Center, California Polytechnic State University, Version 5.5, June 1990.

Cost-Effectiveness Analysis

Andrews, Laurel, Bill Gavelis, Steve Scott, and Mike King. *Cost-Benefit Analysis of Water Conservation Measures, Part I & II*. Synergic Resources Corporation and Gary Kah Agtech, SRC Report, No. 7363-R6, July 1988.

Baumann, D.D., J.J. Boland, and J.H. Sims. *The Evaluation of Water Conservation for Municipal and Industrial Water Supply: Procedures Manual*. Carbondale, IL: Planning and Management Consultants, Ltd. (Army Engineer Institute for Water Resources Contract Report 80-1), April 1980.

Boland, John, Benedykt Dziegielewski, Duane Baumann, and Chuck Turner. *Analytical Bibliography for Water Supply and Conservation Techniques*. Carbondale, IL: Planning and Management Consultants, Ltd. (U.S. Army Engineer Institute for Water Resources, IWR Contract Report 82-C07), January 1982.

Brown and Caldwell Consultants. *Assessment of Water Savings from Best Management Practices*. Walnut Creek, CA: Brown and Caldwell Consultants, April 1991.

California Urban Water Conservation Council. *Guidelines to Conduct Cost-Effectiveness Analysis of Best Management Practices for Urban Water Conservation*. Los Angeles, CA: Californian Urban Water Conservation Council. Prepared by A&N Technical Services. September 1996.

Campen, James T. *Benefit, Cost and Beyond: The Political Economy of Benefit-Cost Analysis*. Cambridge, MA: Ballinger Publishing, 1986.

Davis, William Y. and Ben Dziegielewski. "Estimating the Benefits and Costs of Implementing Conservation Measures," *Proceedings of CONSERV 90: The National Conference and Exposition Offering Water Supply Solutions for the 1990s*. Phoenix, AZ, 1990.

Dziegielewski, Benedykt, Duane D. Baumann, and John J. Boland. *The Evaluation of Drought Management Measures for Municipal and Industrial Water Supply*. Institute for Water Resources, U.S. Army Corps of Engineers, CR 83-C-3, December 1983.

Dziegielewski, B., E. Opitz, J. Kiefer, and D. Baumann. *Evaluating Urban Water Conservation Programs: A Procedures Manual*. Carbondale, IL: Planning and Management Consultants, Ltd. (California Urban Water Agencies and American Water Works Association), 1993.

Macy, P.P. and William O. Maddaus. "Cost-Benefit Analysis of Conservation Programs," *Journal of the American Water Works Association* Vol. 81, No. 3 (March 1989): 43-47.

Maddaus, William O. "Evaluating the Benefits and Costs of Proposed Water Conservation," *Proceedings of CONSERV 90: The National Conference and Exposition Offering Water Supply Solutions for the 1990s*. Phoenix, AZ, 1990.

Maddaus, William O. and Peter P. Macy. *Benefit and Cost Analysis of Water Conservation Programs*. Pleasant Hill, CA: Brown and Caldwell Consulting Engineers, 1989

O'Grady, Kevin L., Eva M. Opitz, and Benedykt Dziegielewski. *Evaluating Urban Water Conservation Programs: Workbook*. Carbondale, IL: Planning and Management Consultants, Ltd. (Metropolitan Water District of Southern California), February/March 1994.

Pekelney, David M., Thomas W. Chesnutt, and W. Michael Hanemann. *Guidelines to Conduct Cost-Effectiveness of Best Management Practices for Urban Water Conservation*. Sacramento, CA: California Urban Water Conservation Council, 1996.

Pekelney, David M. and Thomas W. Chesnutt. *Reference Document: Program Design Tool and Savings Estimates*. Sacramento, CA: California Urban Water Conservation Council, 1996.

Sakrison, Rodney G. *Water Supply Source Selection Criteria: Determination of Cost-Effectiveness Thresholds*. Olympia, WA: Washington Department of Ecology.

Rates and Revenues

Agthe, Donald E. and Bruce Billings. "Equity, Price Elasticity, and Household Income Under Increasing Block Rates for Water," *American Journal of Economics and Sociology* Vol. 46 (July 1987): 273-286.
American Water Works Association. *Water Rates and Related Charges*. Denver, CO: American Water Works Association, 1986.

_____. *Managing the Revenue and Cash Flow Effects of Conservation*. Denver, CO: American Water Works Association, 0-89867-845-5, 1996.

Beecher, Janice A., Patrick C. Mann, Youssef Hegazy, and John D. Stanford. *Revenue Effects of Water Conservation and Conservation Pricing: Issues and Practices*. Columbus, OH: National Regulatory Research Institute, 1994.

Beecher, Janice A. and Patrick C. Mann. "The Role of Price in Water Conservation Evidence and Issues," *Proceedings of Conserv96: Responsible Water Stewardship*. Denver, CO: American Water Works Association, 1996.

Beecher, Janice A., Patrick C. Mann, and James R. Landers. *Cost Allocation and Rate Design for Water Utilities*. Columbus, OH: National Regulatory Research Institute, 1990.

Bhatt, N.R. and C.A. Cole. "Impact of Conservation on Rates and Operating Costs," *Journal of Water Resources Planning and Management* Vol. 111, No. 2 (April 1985): 192-206.

California Department of Water Resources. *Water Conservation Guidebook No. 9 - Guidebook on Conservation-Oriented Water Rates*. Sacramento, CA: State of California Department of Water Resources, October 1988.

California Urban Water Conservation Council. *Handbook for the Design, Evaluation, and Implementation of Conservation Rate Structures*. Los Angeles, CA: Californian Urban Water Conservation Council, (Prepared by Thomas W. Chesnutt, A&N Technical Services, et al.), September 1996.

Caswell, M., E. Lichtenberg, and D. Zilberman. "Effects Of Pricing Policies on Water Conservation and Drainage," *American Journal of Agricultural Economics* Vol. 72, No. 4 (November 1990): 883-890.

Chestnutt, Thomas W., Casey McSpadden, and John Christianson. "Revenue Instability Induced by Conservation Rates," *Journal American Water Works Association*. (January 1996): 52-63.

Chesnutt, Thomas W., John Christianson, Anil Bamezai, Casey N. McSpadden, and W. Michael Hanemann. *Revenue Instability and Conservation Rate Structures*. Denver, CO: American Water Works Association, 0-89867-818-8, 1995.

Chicone, David L., Steven C. Deller, and Ganapathi Ramamurthy. "Water Demand Estimation Under Block Pricing: A Simultaneous Equation Approach," *Water Resources Research* Vol. 22 (June 1986): 859-863.

Comer, D. and R. Beilock. "How Rate Structures and Elasticities Affect Water Consumption," *Journal of the American Water Works Association* Vol. 74, No. 6 (June 1982): 192-206.

Cuthbert, R.W. "Effectiveness of Conservation-Oriented Water Rates in Tucson," *Journal of the American Water Works Association* Vol. 81, No.3 (March 1989): 65-73.

Deming, J.L. "Establishing an Income Based Discount Program," *Journal of the New England Water Works Association* Vol. 106, No. 3 (September 1992): 203-205.

Farnkopf, John W. "Dissecting Rate Structures: Identifying Where Further Refinements are Warranted," *Proceedings of Conserv96: Responsible Water Stewardship*. Denver, CO: American Water Works Association, 1996.

Fox, Thomas P. "Analysis, Design and Implementation of a Conservation Rate Structure" *Proceedings of Conserv96: Responsible Water Stewardship*. Denver, CO: American Water Works Association, 1996.

Griffith, F.P. "Peak Use Charge: An Equitable Approach to Charging for and/or Reducing Summer Peak Use," *Canadian Water Resources Journal* Vol. 9, No. 3 (November 1984): 17-21.

Hasson, D.S. and D.G. Ovard. "Using Peaking Factors to Update Water Rates," *Journal of the American Water Works Association* Vol. 79, No. 6 (June 1987): 46-51.

Mann, Patrick C. and Don M. Clark. "Marginal-Cost Pricing: Its Role in Conservation," *Journal of the American Water Works Association*. August 1993.

Martin, W.E., H.M. Ingram, N.K. Laney, and A.H. Griffin. *Saving Water in a Desert City*. Washington, DC: Resources for the Future, 1984.

Martin, W.E. and S. Kulakowski. "Water Price as a Policy Variable in Managing Urban Water Uses: Tucson, Arizona," *Water Resources Research*, Vol. 27, No. 2 (1991): 157-166.

McNeill, Roger and Donald Tate. *Guidelines for Municipal Water Pricing*. Ottawa, Canada: Environment Canada, Social Science Series No. 25, 1991.

Mui, B.G., K.W. Richardson, and J.F. Shannon. "What Water Utility Managers Should Know About Developing Water Rates," *Water Engineering and Management*, Vol. 138, No. 12 (1991): 18-20.

Nieswiadomy, M.L. "Estimating Urban Residential Water Demand: Effects of Price Structure, Conservation, and Education," *Water Resources Research*, Vol. 28, No. 3 (1992): 609-615.

Ozog, Michael T. "Price Elasticity and Net Lost Revenue," *Proceedings of Conserv96: Responsible Water Stewardship*. Denver, CO: American Water Works Association, 1996.

Renshaw, E.F. "Conserving Water Through Pricing," *Journal of the American Water Works Association* Vol. 74, No. 1 (January 1982): 2-5.

Sang, W. H. "The Financial Impact of Water Rate Changes," *Journal of the American Water Works Association* Vol. 74, No. 9 (September 1982): 466-469.

Schlette, T.C. and D.C. Kemp. "Setting Rates to Encourage Water Conservation," *Water Engineering and Management* Vol. 138, No. 5 (May 1991): 25-29.

U.S. Bureau of Reclamation. *Incentive Pricing Handbook for Agricultural Districts*. Washington, DC: Bureau of Reclamation, U.S. Department of the Interior, April 1997. Prepared by Hydrosphere Resource Consultants. \t "_blank" <http://209.21.0.235/documents/index.htm>

_____. *Incentive Pricing Best Management Practice for Agricultural Irrigation Districts*. Washington, DC: Bureau of Reclamation, U.S. Department of the Interior, June 1998. \t "_blank" <http://209.21.0.235/documents/index.htm>

Public Involvement

American Water Works Association Research Foundation. *Public Involvement Strategies: A Manager's Handbook*. Denver, CO: American Water Works Association Research Foundation, 1996.

Baumann, D.D. "Information and Consumer Adoption of Water Conservation Measures," *Proceedings of the National Water Conservation Conference on Publicly Supplied Potable Water*. June 1982: 179-190.

Bickel, Blaine W., Hoback, Paul E., and Lamb, Conrad. "Match Your Vision and Image - A Lee's Summit, Missouri Case Study," *1995 Annual Conference Proceedings; American Water Works Association; Management and Regulations*. Denver, CO: American Water Works Association, 1995.

Chaplin, Scott. *Water Efficiency Sampler*. Snowmass, CO: Rocky Mountain Institute Water Program, December 1991.

Darilek, Alice. "Forming a State Water Conservation Program through Public Involvement," *Proceedings of Conserv93: The New Water Agenda*. Denver, CO: American Water Works Association, 1993.

DeHart, D. "Conservation: A Benefit of Good Management," *Journal of the New England Water Works Association* Vol. 105, No. 1 (March 1991): 43-45.

Dyballa, Cynthia. "Water Conservation Education and Outreach in the U.S.," *Hydrology and Water Resources Education, Training and Management, Water Resources Publication*. Littleton, CO: 1991.

Henning, Richard W. "How to Obtain and Maintain Public Involvement: The Key to Successful Conservation Programs," *Proceedings of Conserv96: Responsible Water Stewardship*. Denver, CO: American Water Works Association, 1996.

National Wildlife Federation. *A Citizen's Guide to Community Water Conservation*. Washington, DC: U.S. Environmental Protection Agency, 1989.

U.S. Environmental Protection Agency. *Building Support for Increasing User Fees*. Washington, DC: Office of Water, 1989.

Internet Resources

American Water Works Association:

<http://www.awwa.org/>

American Water Works Association WaterWiser:
The Water Efficiency Clearinghouse:

<http://www.waterwiser.org/>

American Water Works Research Foundation:

<http://www.awwarf.com/>

American Water Resources Association:

<http://www.awra.org/>

American Society of Plumbing Engineers:

<http://www.aspe.org>

Association of Metropolitan Water Agencies:

<http://www.amwa.net/>

Bureau of Reclamation, U.S. Department of the Interior:

<http://www.usbr.gov/main/index.html>

Green Seal:

<http://www.greenseal.org>

Institute for Water Resources, U.S. Army Corps of Engineers:

<http://www.iwr.usace.army.mil/>

National Drinking Water Clearinghouse:

http://www.nesc.wvu.edu/ndwc/ndwc_index.htm

National Drought Mitigation Center:

<http://enso.unl.edu/ndmc>

National Ground Water Association:

<http://www.ngwa.org/>

National Watershed Network:

<http://www.ctic.purdue.edu/watershed/>

[US_watersheds_8digit.html](#)

Natural Resource Conservation Service, U.S. Department of Agriculture:

<http://www.nrcs.usda.gov/>

Rural Community Assistance Program:

<http://www.rcap.org/>

**Regional Water Providers Consortium
(Portland Metro area)**

<http://www.conserveh2o.org>

Rural Water Association:

<http://www.ruralwater.org>

Universities Council on Water Resources:

<http://www.uwin.siu.edu/>

U.S. Environmental Protection Agency:

<http://www.epa.gov/owm/genwave.htm>

U.S. Geological Survey:

<http://www.usgs.gov>

U.S. Water News:

<http://www.uswaternews.com>

Water Education Foundation:

<http://www.water-ed.org>

Water Environment Federation:

<http://www.wef.org>

Water Online:

<http://www.wateronline.com/>

Water Quality Association:

<http://wqa.org/>

Water Share, U.S. Department of the Interior,
Bureau of Reclamation:

<http://www.watershare.usbr.gov>

Appendix E

Suggested Outline of a Water Management and Conservation Plan

Front Material

- Title Page
- List of Participants in developing Plan
- Table of Contents, List of Tables, List of Figures
- Acronyms and Abbreviations

Executive Summary

- Purpose and goals
- Brief overview of system, sources and water rights
- Table: “System at a Glance”
- Summary of key findings and recommendations
- Source(s) of supply and water management strategy
- Conservation measures and benchmarks
- Curtailment program
- Clearly indicate how plan elements meet requirements and WRD criteria for evaluation
- If additional time is needed to meet requirements, summarize proposed schedule (this would be proposed basis for a workplan to be negotiated with WRD)
- Overview map showing general location of system and sources of supply

Chapter 1: Introduction

- Brief description of water system and community served
- Purpose of WMCP and basis in Division 86
- Relationship to previous WMCP, if any (and Master Plan, if any)
- Proposed date of next progress report and next WMCP update
- Major sources of information utilized in developing WMCP (including land use plans, other providers’ plans, etc.)
- Organization of this document
- Include summary checklist of required content and where to find

Chapter 2: Water Supplier Description

- Introduction to chapter. Include checklist of required plan content and annotation showing where found in this chapter.
- Service area (include map)
- Customer Base: population served, number of service connections, distribution among customer classes, wholesale customers, other key customer characteristics
- Current and recent water use: annual use, average day demand, seasonal use, maximum day demand, demand by customer class, trends in demand and comparison with previous WMCP or progress reports (if applicable)
- Source(s) of supply: wells, springs, surface water diversions, major storage facilities (if applicable – not distribution system tanks), water purchased from other supplier(s)
- Tabular list of water rights
- Assessment of adequacy and reliability of sources
- Interconnections with other municipal supply systems
- Map or schematic of major system features: sources; transmission lines, pump stations, treatment facilities, interconnections, existing and planned service area, major distribution system features
- Description and quantification of system leakage, including locations of significant losses

Chapter 3: Water Conservation Element

- Introduction to chapter. Include checklist of required plan content and annotation showing where found in this chapter.
- Description of water use measurement and reporting program, and documentation of compliance with regulations
- Narrative or table listing previous benchmarks, status and reasons for any deficiencies (if applicable)
- If requesting additional time to implement metering requirement, or to achieve benchmarks, document reason and demonstrate why additional time needed to avoid unreasonable and excessive costs
- Narrative or table listing all water conservation activities required for this particular system and status of implementation to date (activities required of all systems; plus activities required of this individual system based on comparison of system characteristics with regulatory requirements); as well as any additional conservation activities that have been or will be implemented, that are not required under Division 86.
- Proposed implementation schedule and benchmarks for any required activities not yet implemented
- For any conservation activities which the supplier believes are neither feasible nor appropriate, documentation demonstrating why this is the case.
- For any required plan items that are not provided, identify proposed schedule to meet requirements within five years

Chapter 4: Water Curtailment Element

- Introduction to chapter. Include checklist of required plan content and annotation showing where found in this chapter.
- Description of past events (at least 10 years) that resulted in supply deficiencies, effects and counter-measures that were implemented
- Specific objectives of curtailment program
- Overview of curtailment program, defining at least three stages of alert
- Description of each Stage: including conditions or events that will trigger each stage, and actions to be taken in each stage
- Implementation program to enact curtailment program; or documentation of past enactment (not required in Division 86).
- Plans for periodic review and updating, if desired (not required in Rules)
- For any required plan items that are not provided, identify proposed schedule to meet requirements within five years

Chapter 5: Water Supply Element

- Introduction to chapter. Include checklist of required plan content and annotation showing where found in this chapter.
- Cross reference to service area description and map in Chapter 2
- Population projections (and other demographic projections if desired)
- Key issues involving land use and anticipated development that will affect demand in the future
- Projected demand for water for 10 year and 20 year time period (can include longer periods if desired)
- Comparison between projected demand and source capacity from Chapter 2
- If additional supply is needed beyond current authorizations, OR if new water rights will be needed within 20 years, include:
 - Analysis of source alternatives to meet this need, including conservation measures and interconnections with other suppliers;
 - Quantification of maximum rate and monthly volume of water needed under each permit; and,
 - Any mitigation actions to comply with legal requirements (e.g. Endangered Species Act, Clean Water Act, Safe Drinking Water Act)
- Maps of proposed new sources or expanded sources (if applicable)
- For any required plan items that are not provided, identify proposed schedule to meet requirements within five years

Plan Appendices (if needed)

- A. Documents providing more detailed analysis, data or documentation regarding any aspect of the WMCP, if the water supplier desires
- B. If applicable, workplan to meet all requirements within five years
- C. Contracts or other agreements with adjacent water suppliers
- D. Documentation that plan was provided for comment to local jurisdictions, and any written comments received
- E. Other appendices, as needed

Appendix F

Sample Water Curtailment Ordinance

I. WATER WASTE PROHIBITED. (a) It is unlawful to allow waste of city/district water by knowingly or negligently causing, authorizing or permitting such water to escape from its intended beneficial use into any river, creek, natural watercourse, depression, lake, reservoir, storm sewer, street, highway, road, or ditch.

(b) For the purpose of this section: (1) “waste” means the use of water in excess of the reasonable volume necessary to meet the beneficial use; and (2) “beneficial use” means the reasonable efficient use of water.

II. WATER CURTAILMENT AUTHORITY. (a) When the director determines that a critical water supply shortage threatens the ability of the city to deliver essential water to its customers, the director may activate emergency measures in compliance with the entitled “Water Curtailment Plan” adopted by _____ on _____, and on file with the _____ recorder.

(b) Upon declaration of a stage three critical water supply shortage by the director:

(1) No watering or irrigating of lawns, grass, or turf shall occur unless it is:

A. New lawn, grass, or turf that has been seeded or sodded after March 1 of the calendar year in which the restrictions are imposed, and in such cases it may be watered as necessary until established;

B. Athletic fields frequently used for organized play;

C. Golf course tees and greens; and,

D. Park and recreation areas of a particular significance and value to the community as approved by the city manager.

(2) No use of city-supplied water shall be allowed to clean, fill, or maintain levels in decorative fountains.

(3) No use of city-supplied water shall be allowed to fill swimming pools or other pools with a capacity in excess of 100 gallons, provided, however, that water may be added to swimming pools to replace volume lost due to evaporation and normal loss due to usage.

(4) No use of city-supplied water shall be allowed to wash sidewalks, walkways, streets, driveways, parking lots, or other hard surfaced areas except where necessary for public health or safety

(5) No use of City-supplied water shall be allowed to wash vehicles.

III. WITHHOLDING OF SERVICE. In the event that a citation is issued during the period of activated emergency measures for a violation of I or II, and the director determines that a second violation has occurred after the date of the citation and during the same emergency curtailment period, the director may:

(a) Install a flow restrictor on the street side of the water meter; or

(b) Terminate water service.

Appendix G

Examples of Municipal Water Conservation Measures

Sample Universe of Water Conservation Measures ⁽¹⁾

End Use	Conservation Measure	Customer Class
Shower	Low-flow showerheads (2.75 GPM)	SFR, MFR, COM
	Ultra-low flow showerheads (1.9 GPM)	SFR, MFR, COM
	Shower flow restrictors	SFR, MFR, COM
Faucets	Low-flow faucets	SFR, MFR, COM, IND, GVT
	Low-flow faucet aerators	SFR, MFR, COM, IND, GVT
Toilets	Gravity-flow tank-type ULFT	SFR, MFR, COM
	Pressurized tank type ULFT	SFR, MFR, COM
	<1 GPF ULFT	SFR, MFR, COM
Toilet Retrofit	Displacement bags	SFR, MFR, COM
	Displacement bottles	SFR, MFR, COM
	Displacement dams	SFR, MFR, COM
	Dual-flush adapters	SFR, MFR, COM
	Fill cycle regulators	SFR, MFR, COM
	Early closure flappers	SFR, MFR, COM
Leaks -Faucet	Faucet washers	SFR, MFR, COM
Leaks -Toilet	Flapper valves	SFR, MFR, COM
	Fill valves	SFR, MFR, COM
	Leak detection tablets	SFR, MFR, COM
Washers	Lower volume vertical axis	SFR, MFR
	Horizontal axis machines	SFR, MFR
Dishwashers	Lower volume dishwashers	SFR, MFR
Residential Misc.	Replace self-regenerating water softeners	SFR, MFR
	Point-of-use water heaters	SFR, MFR
	Individual dwelling unit sub-meters	MFR
	Separate irrigation sub-meters	MFR, COM,IND, IRR, GVT
	Metering all accounts	SFR, MFR, COM, IND, IRR,
	Water pressure regulator	GVT SFR, MFR
Residential Outdoor	Hose control nozzles	SFR, MFR
	Garden hose timers	SFR, MFR
	Drip irrigation system	SFR, MFR
	Bubbler/soaker irrigation system	SFR, MFR
	Automatic sprinkler system	SFR, MFR
	Soil sensors	SFR, MFR
	Rain sensors	SFR, MFR
	Water efficient plant material	SFR, MFR
	Xeriscaping	SFR, MFR

⁽¹⁾ Source: American Water Works Association (AWWA), undated, Integrated Resource Planning, A Balanced Approach to Water Resources Decision Making.

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End Use	Conservation Measure	Customer Class
Residential Outdoor (continued)	Turf replacement/reduction	SFR, MFR
	Irrigation scheduling	SFR, MFR
	Soil preparation/mulching	SFR, MFR
	Graywater systems	SFR, MFR
	Rainwater collector/cistern	SFR, MFR
	Swimming pool covers	SFR, MFR
Commercial Toilets	Commercial ULFT	COM, IND, GVT
	ULFT valve replacement	COM, IND
	Ultra-low flush urinals	COM, IND, GVT
	Ultra-low flush urinal valve replacement	COM, IND, GVT
	Infra-red activated flushing	COM, IND, GVT
Commercial Faucets	Pressure closing	COM, IND, GVT
	Spring loaded	COM, IND, GVT
	Infra-red activated	COM, IND, GVT
	Ultrasonic activated	COM, IND, GVT
	Foot operated	COM, IND, GVT
Commercial Misc.	Point-of-use water heaters	COM, IND, GVT
	Recirculating hot water systems	COM, IND, GVT
	Swimming pool covers	COM, GVT
	Centralized regeneration water softeners	COM, GVT
	Meter-controlled flushing water softeners	COM, GVT
Commercial Washers	Efficient machines (laundromat capacity)	COM, GVT
	Recycling machines	COM, GVT
	Batch washers	COM, GVT
	Tunnel washers	COM, GVT
	Rinse water reclaim systems	COM, GVT
	Ozonated washing machines	COM, GVT
Car Washes	Low volume car washes	COM, GVT
	Recirculating/counter-current car washes	COM, GVT
Air-Cooled Machinery	Air conditioners (HVAC)	COM, GVT
	Chillers	COM, GVT
	Pumps	COM, GVT
	Compressors	COM, GVT
	Ice-makers	COM, GVT
	Cold-water drinking fountains	COM, GVT
	Medical equipment	GVT
	(sterilizers, X-ray equipment, etc.)	GVT
	Laboratory equipment	GVT
	(pumps, deionizers, etc.)	
Food Handling	Water-efficient dishwashers	COM, GVT
	Recirculating dishwashers	COM, GVT
	Chemical sanitizer dishwashers	COM, GVT
	Conveyor dishwashers	COM, GVT
	Ultrasound dishwashers	COM, GVT
	Dishwasher water reuse systems	COM, GVT
	Warming tables with dry heat	COM, GVT
	Garbage disposers using recycled water	COM, GVT
	Off-site garbage disposal	COM, GVT
Heat Exchangers/ Boilers	Closed loop	COM, GVT
	Steam condensate return systems	COM, IND, GVT

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End Use	Conservation Measure	Customer Class
Cooling Towers Modifications	Drift eliminators Connections to alternative makeup sources Conductivity meters for blow-down control Flow meters on make-up and blow-down valves Fixed ppm discharge minimum requirements Eliminate/replace all single-pass cooling systems	COM, IND, GVT
Cooling Towers	Process changes to reach higher coolingtower of concentration (from standard 1-2 to 6 or more) -Ozonation systems -Acid treatment systems -Ion exchange systems -Lime softening systems -Sidestream filtration systems -Magnetic attraction systems -Electrostatic field generator systems	
Evaporative Cooler	Reroute and reuse blow down Thermostat controllers	COM, IND, GVT COM, IND, GVT
Solenoid and other automatic valves for water flow control	Timer controls/delay switches Mechanical motion-sensors Electronic motion sensors Float valves on make-up reservoirs Conductivity probes Temperature probes Master off-hour control valves	IND
Industrial washers and rinsers (least efficient -continuous running bath rinsers)	Quick-dump rinsers with timers or conductivity probes Counter current washers and rinsers Spray rinsing systems Air knives Drag-out elimination stages Return drains	IND
High pressure/low volume spray nozzles	Conveyor systems Washers and rinsers Warmers Chillers	IND
Closed system/batch dump chillers/warmers		IND
On-site water reclamation/treatment systems	Ultrafiltration Activated carbon filtration Ion exchange processes Reverse osmosis Vapor compression evaporation Deionized water reclaim loops	IND
Graywater: use reclaimed/ treated process water in a lower quality process or non-process use(includes required dual-plumbing modifications)	Cooling tower makeup systems Landscape irrigation systems Dust control systems Cleaning systems Once-through cooling systems Toilet flushing systems Fume/ gas scrubbing systems Quenching systems	IND

End Use	Conservation Measure	Customer Class
Waste stream separation to facilitate process water reclamation	Separation of sanitary water stream and process water stream Segregation of toxic from non-toxic constituent streams Sewer bypass connections between point of discharge and point of reuse Facilities for temporary storage of process water	IND
Custom industrial process operations (varies by industry)	Lower volume soap and water conveyor belt lubrication systems Lower volume bottle washer and rinser systems Dyebath recirculation systems High-pressure/ low-volume cleaning equipment	IND
Building Outdoor	Sub-meter for irrigation	COM, IND, GVT
Large Landscape	Drip irrigation systems Bubbler/Soaker irrigation systems High-efficiency sprinkler system Timers Soil sensors Rain sensors Computer stations Weather station hook-ups Water efficient plant material Xeriscaping Turf replacement/reducton Irrigation scheduling Soil preparation/mulching All weather artificial recreation surfaces Recirculating water features Graywater systems Storage reservoir and pumping systems to capture and use stormwater runoff	COM, IRR, IND, GVT COM, IRR, IND, GVT IRR, GVT COM, IRR, IND, GVT COM, IRR, IND, GVT COM, IRR, IND, GVT COM, IRR, IND, GVT IRR, GVT COM, IRR, IND, GVT COM, IRR, IND, GVT IRR, GVT
Distribution System	Leak detection and repair service training Periodic valve servicing and adjustment Periodic equipment servicing	UTL UTL UTL
Agricultural	Miscellaneous	

ABBREVIATIONS

SFR:	Single Family Residences	MFR:	Multi Family Residences
COM:	Commercial	IND:	Industrial
GVT:	Government and Exempt Institutions	IRR:	Irrigators/Large landscapers
UTL:	Utility	ULFT:	Ultra low flow toilet
GPM:	gallon per minute	ppm:	parts per million
GPF:	gallon per flush		
HVAC:	Heating, ventilation, and air-conditioning systems		