City of Philomath
Oregon

Water Management and Conservation Plan

Adopted March 14, 2011

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City of Philomath Water Management And Conservation Plan

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1. Introduction

Recognizing the potential for continued growth, and also recognizing the characteristics of a water supply system based on surface waters, the Philomath City Council and Administration desire a Water Management and Conservation Plan to assist them in managing the City's water supply and distribution system.

In recent years, the City of Philomath has obtained most of its water from Marys River, which flows eastward through the southern portions of Philomath. The City has four permits for withdrawal from Marys River, the oldest from 1939.

A well, adjacent to 11th Street north of Pioneer Street, provides a backup source for the City's needs. When drilled in 1977, this well was a primary source of water, but water from Marys River proved to be of higher quality, and the well now serves as a secondary source. The well could be used during brief periods when summer demands exceed the capacity of the Water Treatment Plant and storage reservoirs.

Throughout this document, reference is made to the City's August 2005 Water System Master Plan. Any reference to "Master Plan" indicates the August 2005 document.

Brief History

In the past, Philomath and Corvallis both obtained water from the Rock Creek Watershed, in the foothills west of Philomath. A transmission line from Rock Creek passed through Philomath as it conveyed water to Corvallis, and a connection allowed distribution of some of this water to Philomath.

Each community grew until additional water sources were required, and each community developed its own water production and treatment systems. Connection to the Rock Creek transmission line remained in place for emergency needs, but the City of Philomath has never experienced such an emergency. Presently, gravity-flow conditions are no longer possible through this connection, due to 1993 construction of a reservoir in the Philomath system. Additional facilities are required if the intertie is to be re-established.

In order to develop a comprehensive strategy to provide for Philomath's future water need, the City has recently been considering additional water sources and provisions, including

- additional water rights
- interconnection with City of Corvallis system
- conservation plans

On February 13, 2006, the City adopted Ordinance 735, establishing a Water Usage Curtailment Plan. This Plan defines four types of emergency conditions related to water supply, and the corresponding actions required to inform citizens and curtail water consumption.

In September 2006, the City reached an agreement with the City of Corvallis to re-establish the intertie to the Rock Creek transmission line, providing the City of Philomath with an additional source of water.

Population and Water Demand

Philomath population has increased consistently for more than 60 years. When the WTP was constructed in 1985, the population was approximately 2750; presently the population is approximately 4710. The WTP is now operating at its capacity for brief periods of peak consumption during summer months.

Continued growth is anticipated, bringing with it the need for increased volumes of water. The Master Plan identifies several projects intended to improve the City's capacity to treat and provide water to its citizens. These projects include expansion of the WTP

and construction of storage reservoirs, among other projects.

Water Rights

Presently, the City has adequate water rights to serve current and projected demands. This is partly due to having water rights with seniority over other uses, including the State's 1964 in-stream water right.

As noted in the City's Water System Master Plan (August 2005), however, rights to withdraw water are not necessarily equivalent to a reliable supply. During extended dry months, river flow rates can drop low enough that water right seniority becomes an issue; *i.e.*, not all permitted water users are able to withdraw –or maintain in stream– desired quantities of water. During these brief periods, the 11th Street well is available to provide additional water. As of the date of this plan, such an emergency has not occurred.

Management and Conservation Plan

The City Council and Administrators desire to properly manage the water resource for its citizens. They recognize and understand the cyclic nature of river discharge rates, and the potential for reduced river flows during summer months.

As a result, the City has requested development of this Water Management and Conservation Plan.

2 - Summary

2.1. Recommendations

2.1-1) ***Establish a water audit*** to identify, quantify and monitor unmetered consumption. Include:

- Estimate for hydrant flushing
- Irrigation of any City property not metered
- Construction
- Street flushing

Also include metered consumption in the audit.

2.1-2) ***If possible, establish a standard meter-reading schedule***, coinciding with meter-reading at production facilities. The Master Plan indicates meter reading is presently not at the same time of each month and consequently the tabulation of monthly values of production, consumption and system losses may be misleading.

It is understood the City has a limited number of staff available for reading water meters. But if production and consumption meters are read on standard and corresponding schedules, it will provide greater understanding of system losses. Because consumption and losses seem to peak in the summer when the Mary's River source is likely to be at its lowest, it is important to understand and identify any losses that can be reduced during those sensitive months.

Include these meter readings in the Water Audit (refer to Recommendation 2.1-1).

2.1-3) ***Complete the system connection agreement with the City of Corvallis.*** The Master Plan indicates the City's water rights are adequate for the planning period, but potential low flow rates in Mary's River present management concerns that might be avoided if an intertie agreement provides water during periods of low river flow.

2.1-4) ***Continue to seek additional water rights***, as recommended in the Master Plan.

2.1-5) ***Distribute educational material regarding water conservation and xeriscape landscaping***. Refer to Appendix 'B' and Appendix 'C' for examples.

2.1-6) ***Establish a water meter testing and maintenance program.*** Meters older than 15-years should be identified, tested and replaced if not functioning correctly. Old meters tend to under-register water use, and may account for some system losses. If an old meter is not immediately replaced, it should be tested annually.

2.1-7) ***After all above are complete and if the annual leakage exceeds 10% of production, establish a program to locate leaks in the system.***

2.1-8) ***Review and consider updating the Water Management and Conservation Plan*** at least as often as the Water System Master Plan is updated.

2.2. Existing Uses and Consumption

Philomath is a growing community. Water consumption is primarily residential, and is anticipated to remain so in the planning period of the Master Plan. Consumers also include schools, businesses, restaurants and industrial users.

Presently, all residential and commercial water customers are metered, and the billing rates are based on metered consumption.

According to the Master Plan[1], which includes data through the year 2002, average monthly demand peaks in July and August and is approximately twice the demand observed during Winter and Spring months.

Refer to **§6** of this Water Conservation and Management Plan for additional information about water consumption.

[1] Refer to §5.3 of the Master Plan, pages 5-2 through 5-4

2.3. Existing System Losses

All water systems have losses. For the purpose of this document, "losses" refers to any water produced by the WTP and wells but unaccounted for by metered uses. This includes:

- Water discharged during hydrant tests,
- Water discharged during street flushing,
- Water consumed by contractors during construction activities,
- Leaks from the system

The Water Master Plan indicates annual losses are approximately 12.4% of the water produced by the treatment plant and the 11th Street well, and also assesses this as not excessive, considering the system's age.

The Master Plan also indicates[2] system losses reflect seasonal variation. However, these variations do not repeat the apparent pattern of consumption. The recommended water audit is anticipated to lead to better understanding of the relationship between production and losses, and perhaps to identification and reduction of losses.

The City Public Works Department believes most of the apparent system "loss" is due to accounting rather than due to physical leakage. It is anticipated the establishment of recommended meter-reading and –accounting changes will identify the apparent losses.

[2] Refer to §5.4, page 5-5 of Master Plan

3 - Background

This Water Management and Conservation Plan (WMCP) is intended to comply with Oregon Administrative Rules regarding WMCPs, and also to comply with the 2003 Guidebook for Oregon Municipal Water Suppliers.

The City of Philomath presently does not have a WMCP.

Philomath is in Benton County, approximately 2-miles west of Corvallis, the county seat. Philomath has an interesting history reflecting many aspects of regional development and growth. At one time the home of eight sawmills and with an economy based on the forest-products industry, recent years have seen a downturn of the timber industry. Though logging and forest products still play a valued role in Philomath business and education, there has been a shift toward other industry and commerce. The City has a growing residential community whose livelihood is unrelated to the timber industry.

Located in the Willamette Valley, in the foothills of the Coast Range, Philomath typically has significant rainfall during winter months. The Willamette Valley also typically has predictable dry periods during July, August and September. It is during these dry months that the City's water demands increase and the primary source, Marys River, simultaneously has decreasing discharge rates.

Marys River also provides water to other users, notably for irrigation associated with agriculture.

4 - Planning Area

Section 2 of The Master Plan describes and illustrates the Planning Area in detail.

The Urban Growth Boundary is the Planning Area addressed in this Water Management and Conservation Plan and in the Master Plan. It includes approximately 2,560-acres, of which approximately 1,300-acres are outside the present City Limits.

The present population is approximately 4710. The Master Plan provides[1] estimates of future population by means of a best-fit exponential model, based on empirical data. The predictor model appears to represent annual growth of 2.5-3.0%.

Specific predictions are:

10-years	year 2016	5500 people, approximately
20-years	year 2026	6750, approximately

[1] Refer to §2.4.2.2 of Master Plan

5 - Supply

5.1 Marys River

The City of Philomath obtains most of its water from Marys River, which flows eastward through the southern portions of Philomath. The City has four permits for withdrawal from Marys River, the oldest from 1939.

Marys River water is treated at the City's Water Treatment Plant located on south 9th Street. See Appendix 'A' for Marys River water quality information.

The present capacity of the WTP is approximately 1-million gallons per day (mgd). This is approximately equal to the present maximum daily demand during summer peak periods.

See Section 5.8 regarding endangered and sensitive species in Marys River.

5.2 11th Street Well

A well, adjacent to 11th Street north of Pioneer Street, provides a backup source for the City's needs. When drilled in 1977, this well was a primary source of water, but water from Marys River proved to be of higher quality, and the well now serves as a secondary source.

- **The well could be used during** brief periods of summer when demands exceed the capacity of the Water Treatment Plant and storage reservoirs;

- **The well could be used during** brief periods during the winter, when large storm events result in Marys River turbidity that is difficult to treat.

- **The well could be used when maintenance requires the Water Treatment Plant to be temporarily shut down.**

The well shaft extends through approximately 77-feet of terraced deposits and 190-feet of basalt (total depth approximately 267-feet). The 12-inch casing is extended approximately 80-feet below ground surface, and is perforated between 76- and 80-feet. Static water level was originally approximately 17-feet below ground surface.

The pump is presently operated for short duration at approximately 300-gallons per minute (gpm) without causing excessive drawdown of groundwater. This rate is approximately equal to the present average daily consumption, and is thus an important component of water supply to the City.

5.3 Connection to City of Corvallis Water System

In 2006, the City of Philomath completed an agreement with the City of Corvallis to make a new connection to a Corvallis water line.

The water line is a transmission line conveying water from the Rock Creek watershed southwest of Philomath through Philomath.

See Appendix 'A' for Rock Creek water quality information.

5.4 Storage

The City of Philomath presently has one storage reservoir, with a second planned.

The existing reservoir is a 1.25 million gallon cast-in-place concrete reservoir constructed in 1994. It is located on Neabeack Hill in east Philomath. Historically, this reservoir has been used to provide water to consumers during peak consumption.

The Master Plan identifies a need for additional storage to ensure adequate volumes are available for fighting a fire.

The proposed reservoir is a 1.75-million gallon reservoir in the Starlight Village subdivision in the west hills of Philomath.

Together, the two reservoirs will provide a buffer for water consumption during peak hours and will also help to provide adequate fire flows.

5.5 Water Quality of Existing Supply Sources

Both sources yield potable water. According to the Master Plan, the 11th Street well produces water that is "…relatively hard and has iron concentrations near the EPA secondary water quality limits". Also, when the well is pumped heavily for long duration, the water quality worsens. The City now treats well water with polyphosphates to sequester iron and with chlorine to reduce likelihood of contamination.[1]

[1] Refer to §4.2.3.2, page 4-6, of the Water Master Plan.

5.6 Adequacy and Reliability of Water Supply

The City's principal source of water is the Water Treatment Plant, drawing water from Marys River. Marys River is also used for agricultural irrigation; most of the year, the river is a reliable and ample source of water for these uses.

During some winter storm events, turbidity in Marys River becomes difficult to treat, and the City's supply is supplemented by the 11th Street well and water stored in reservoirs. These episodes are typically of short duration, and the supplemental sources have proved to be adequate. Storage will be increased with the construction of a new reservoir in the Starlight Village subdivision.

River discharge diminishes during summer months. Unusually dry weather has the potential to result in short periods when river discharge is less than the sum of permitted users, which includes agricultural irrigators and the State of Oregon. Even during these short periods, river flow rate has historically remained adequate for the City's permitted use.

The Philomath City Council has recently approved an agreement to connect the City's water system to the City of Corvallis transmission line passing through Philomath. This line conveys water from the Rock Creek watershed southwest of Philomath to Corvallis. The agreement provides for as much as 60 million gallons per year to be drawn from this connection. Refer to Appendix 'A' for Rock Creek water quality information.

With the addition of the interconnection, combined with the City's other available sources, Philomath has a high-quality water supply which is sufficient for the 20-year planning period represented by the Water System Master Plan.

5.7 Water Rights and Permits

Section 4.2 of the Master Plan provides information about the City's current water rights. Table 4-1 of the Master Plan is provide here for convenient reference:

Master Plan Table 4-1 Water Rights Summary					
Source	**Permit Rate**	**Application No.**	**Permit No.**	**Certificate No.**	**Priority Date**
Marys River	1.0 cfs (449 gpm)	N/A	S13556	TO5623	3/11/1939
Marys River*	1.0 cfs (449 gpm)	T8527	NA	NA	12/8/1952
Marys River*,**	0.19 cfs (86 gpm)	T8527	NA	NA	11/5/1964
Marys River	3.5 cfs (1571 gpm)	S68266	S49245	NA	1/28/1985
11th St. Well	0.56 cfs (250 gpm)	G7903	G8108	62441	3/9/1977
11th St. Well	0.22 cfs (100 gpm)	G10613	G9728	NA	12/15/1981

*The City has applied to OWRD to transfer the point of diversion to the Water Treatment plant. The request to change from irrigation to municipal has been granted.

**The City owns a portion of this right. The City's total withdrawal rate is 0.32-cfs.

5.8 Endangered Species, Water Quality Limitations and Ground Water

OAR 690-086-0140(5)(i) requires a discussion of

- Any streamflow-dependent species that are listed by any agency as sensitive, threatened or endangered that are present in a water source,
- Any listing of the water 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.

5.8.1 Sensitive, Threatened or Endangered Species

The State of Oregon has listed streams that are considered "Essential Salmonid Habitat". Marys River has been given this designation from Philomath's western boundary downstream to the confluence with Willamette River. This designation indicates the presence of certain salmonids that have been classified as sensitive, threatened or endangered.

In addition, personal communication with Oregon Department of Fish and Wildlife staff indicates the following listed fish species exist in Marys River:

Federal "Threatened" List:

Oregon Chub	*Oregonichthys crameri*	Marys River is included in broader basin that is home to the Oregon Chub.
Chinook Salmon	*Oncorhynchus tshawytscha*	Juveniles use Marys River and similar streams as refuge water during high water events.
Steelhead[2]	*Oncorhynchus mykiss*	Juveniles use Marys River and similar streams as refuge water during high water events.

Oregon "Sensitive" List:

Western Brook Lamprey	*Lampetra richardsoni*
Pacific Lamprey	*Lampetra tridentata*

[2] In addition to juvenile steelhead in Marys River, spawning adults are possibly present. ODF&W reports that spawning steelhead have been observed in the past in tributaries of Marys River.

5.8.2 Water Quality

The current Oregon Department of Environmental Quality (DEQ) listing of water quality impaired bodies of water is their 2004/2006 Water Quality Assessment Database Integrated Report. That report includes three entries for Marys River adjacent to the City of Philomath:

Applicable Reach (River Miles)	Parameter	Applicable Season	Listing Criteria
0 to 41.1	Dissolved Oxygen	Jan 1 – May 15	Spawning: Not less than 11.0 mg/L or 95% of saturation
0 to 41.1	Iron	Year Round	Table 20 Toxic Substances
0 to 41.1	Manganese	Year Round	Table 20 Toxic Substances

In addition, two entries apply to River Miles 0 to 13.9, downstream of Philomath.

Note: City of Philomath is adjacent to River Miles 22 to 24, approximately.

5.8.3 Ground Water

The Oregon Region 16 Water Master confirms there are presently no locations in Benton County that are considered “critical ground water areas”.

6 - Consumption, Metering and Projections

6.1 Consumption

Although the economy and population have on occasion reflected downturns in the timber industry, in general the population has increased consistently for the past 60-years.

Water consumption is primarily residential, and is anticipated to remain so in the planning period of the Master Plan. Consumers also include schools, businesses, restaurants and industrial users.

According to the Master Plan[1], which includes data through the year 2002, average monthly demand peaks in July and August and is approximately twice the demand observed during Winter and Spring months.

From Table 5-2 in the Master Plan:

Month	Average Consumption (million gallons)
January	10.7
February	9.2
March	9.7
April	9.1
May	12.2
June	15.7
July	19.8
August	20.8
September	15.1
October	12.1
November	9.4
December	9.1

The City must provide water in excess of these amounts because of system losses.

[1] Refer to §5.3, pages 5-2 through 5-4 of the Master Plan

6.2 Metering

All consumers in Philomath have metered service lines.

Billing rates are based on the quantity of water consumed.

6.3 Projections

Section 5.5 of the Water System Master Plan presents the prediction for future water demands. Table 5-6 from the Master Plan is presented here for ease of reference:

Master Plan Table 5-6 (excerpt)		
	Year 2015	**Year 2025**
Average Day Demand	0.633-mgd	0.799-mgd
Maximum Month Demand	0.990	1.250
Maximum Day Demand	1.304	1.644
Peak Hour Demand	3.165	3.995

7 -System Losses

All water systems have losses. For the purpose of this document, "losses" refers to any water produced by the WTP and wells but unaccounted for by metered uses. This includes:

- Water discharged during hydrant tests,
- Water discharged during street flushing,
- Water consumed by contractors during construction activities,
- Leaks from the system

The Water Master Plan indicates[1] system losses also reflect seasonal variation.

From Table 5-5 of the Master Plan:

Month	Average System Loss (million gallons)	Average System Loss as a Percentage of Water Production
January	1.0 MG	8.7%
February	1.4	12.8
March	2.0	17.3
April	2.3	19.9
May	1.4	10.6
June	2.1	11.9
July	2.7	12.0
August	1.8	8.2
September	2.1	12.0
October	0.8	6.0
November	1.5	13.9
December	1.6	15.3

The Master Plan notes the reading of meters, both at production facilities and at consumer meters, is not at the same time of each month, and that it may be misleading to examine too closely the monthly values tabulated. However, it is important to note that the system losses, both as a quantity and as a percentage of

[1] Refer to §5.4, page 5-5 of the Master Plan

production, do not echo the pattern of production. While consumption diminishes by half between the peak Summer months and Winter months, system losses decrease by considerably less, and they increase when tabulated as a percentage of production.

Because peak consumption and peak system losses occur during months when the Marys River source is anticipated to be at its lowest, it is important to understand and identify system losses during those sensitive months.

The recommended water audit and standardized meter-reading schedules may reveal some aspect of system losses that would allow their reduction.

8 - Water Usage Curtailment

On February 13, 2006, the City adopted Ordinance #735, establishing a Water Usage Curtailment Plan. The Plan defines four types of emergency conditions related to water supply, and identified corresponding actions to be taken by the City.

Following is a summary of Ordinance #735. The reader is referred to Ordinance #735 for complete information.

Emergency Level	***City Action***
1. Short-term shortage or limitation to water supply, storage or delivery due to temporary water system failure, mechanical or hydraulic breakdown, major firefighting event or water main break. Typically five days or less in duration.	*1. Upon public notification that this Alert exists, City water customers will limit water consumption to normal household and drinking water uses only.* *2. Municipal water use shall be limited in like fashion. Examples are irrigation of City property, water fountains, ornamental use, street cleaning.*
2. Significant loss of available stored water due to prolonged high water system demands or partial loss of treatment plant production. Typically seven days or less in duration.	*1. All stage 1 Actions will be put into effect.* *2. Institutional and commercial users shall be requested to implement voluntary curtailment of usage except as necessary to support ongoing operations.* *3. Use of water to clean, fill and maintain decorative fountains or ponds is prohibited unless the water is reclaimed. Swimming pools shall not be filled during Stage 2 Alerts.* *4. Use of water for construction, dust control, street or parking lot sweeping or building wash-down is prohibited.*

	Emergency Level	***City Action***
3.	A.) A shortage of water due to prolonged dry weather conditions resulting in sustained period of below-average surface water flow, B.) Upstream contamination of surface water rendering Mary's River unusable by the City. Duration may be as short as a day, or as long as several months	*1. All Stage 1 and Stage 2 actions will be put into effect.* *2. Irrigation of landscaping, turf and ornamental plants for residences shall only be performed if the event duration is more than five days, and shall be on an alternate-day schedule.*
4.	A short- or long-term total loss of surface water as a source, or a total loss of treatment plant production. Duration may be a week to several months.	*All Stage 1, 2 and 3 actions will be put into effect. Residential metered water rationing may also be implemented if necessary.* *Water use at hydrants will be restricted to fire-fighting only.* *All irrigation of landscape, turf or ornamental plants shall be prohibited.* *Commercial, industrial and institutional users shall be limited to only such water as is necessary for basic operations on a mandatory basis.*

The Water Usage Curtailment Plan specifically identifies some events as beyond the scope of the Plan: catastrophic events such as major earthquakes, floods, terrorist activity or highly uncharacteristic weather events. Any water supply emergencies following such events will be dealt with in accordance to County and State emergency management planning.

9 - Oregon Administrative Rules

The State of Oregon in its Administrative Rules (AR) specifies certain information that must be included in a Water Management and Conservation Plan. Following is a review of portions of OAR-690-086, and references to the Sections of this Plan where the information can be found.

OAR Reference	Requirement	Section of this Plan where Discussed
OAR 690-086-0140(1)	Sources, diversion, storage and regulation	§5
OAR 690-086-0140(2)	Current service area and estimate of population served	§4
OAR 690-086-0140(3)	Assessment of adequacy and reliability of existing water supply	§5.6
OAR 690-086-0140(4)	Quantification of the water delivered, including current and available historic average annual water use, peak seasonal use, and average and peak day use	§6
OAR 690-086-0140(5)	Regarding Water Rights held by the City:	
OAR 690-086-0140(5)(a)	Application, permit, transfer and certificate numbers	§5.7
OAR 690-086-0140(5)(b)	Priority dates	§5.7
OAR 690-086-0140(5)(c)	Source(s) of water	§5
OAR 690-086-0140(5)(d)	Types of beneficial uses specified in the right	§5.7
OAR 690-086-0140(5)(e)	Maximum instantaneous and annual quantity of water allowed under each right	§5.7
OAR 690-086-0140(5)(f)	Maximum instantaneous and annual quantity of water diverted under each right.	§5.7

OAR 690-086-0140(5)(g)	Average monthly and daily diversions under each right for the previous year, and if available for the previous five years	§5.7
OAR 690-086-0140(5)(h)	Currently authorized date for completion of development under each right	§5.7
OAR 690-086-0140(5)(i)	Identification of any streamflow-dependent species listed by a state or federal agency as sensitive, threatened or endangered that are present, 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.	§5.8
OAR 690-086-0140(6)	Customers served	§6
OAR 690-086-0140(7)	Identification and description of interconnections with other municipal supply systems	§5.3
OAR 690-086-0140(8)	Schematic of the system showing sources and other facilities	§4
OAR 690-086-0140(9)	Quantification and description of system leakage and losses.	§7
OAR 690-086-0150	Municipal Water Conservation	
0150(1)	Progress report on conservation measures	N/A
0150(2)	Use measurement and a statement of compliance with measurement standards in OAR 690 division 85	§6.2
0150(3)	Description of other conservation measures, if any	N/A
0150(4)	Specific Activities related to conservation measures	
0150(4)(a)	Annual water audit	§2.1-1
0150(4)(b)	Install meters if not fully metered	N/A
0150(4)(c)	Meter testing and maintenance program	§2.1-6

0150(4)(d)	Rate structure by which customers are billed according to consumption	§6.2
0150(4)(e)	If water audit indicates leakage exceeds 10%, a regularly scheduled and systematic program to detect leaks in the system using methods and technology appropriate to the size and capabilities of the City	§2.1-7
0150(4)(f)	Public education program to encourage efficient water use and landscaping requiring reduced water, and regular communication of conservation activities and schedule	§2.1-5
OAR 690-086-0150(5)	If the City proposes to expand or initiate diversion of water…provide sufficient information to demonstrate system leakage is currently no more than 15%	§7
OAR 690-086-0150(6)		N/A
OAR 690-086-0160	Water Curtailment	
-0160(1)	Type, frequency and magnitude of supply deficiencies during past 10 years, and ability of City to maintain delivery during long-term drought, natural disaster, source contamination, legal restrictions on use	§8
-0160(2)	A list of three or more stages of alert for potential water service difficulties	§8
-0160(3)	Description of pre-determined levels of severity of shortage or service difficulties that trigger curtailment under each stage of alert	§8
-0160(4)	Specific standby curtailment actions for each stage of alert	§8
OAR 690-086-0170	Municipal Water Supply	
-0170(1)	Current and future service areas, including population projections	§4.5

-0170(2)	Estimated schedule identifying when the City expects to fully exercise each water right and water use permit currently held	§5.7
-0170(3)	Estimated demand 10- and 20-years from present	§6.3
-0170(4)	Compare projected needs and sources to the City and any other suppliers to be served	N/A
-0170(5)	If expansion or initial diversion allocated under existing permits is required to meet demand in 10- and 20-years…	N/A Current rights are adequate
-0170(6)	If expansion or initial diversion allocated under existing permits is required to meet demand in 10-and 20-years…	N/A
-0170(7)	For any expansion or initial diversion of water allocated under existing permits is required to meet demand in 10-and 20-years…	N/A
-0170(8)	If acquisition of new water rights is necessary within the next 20 years…	N/A

Appendix 'A' – Water Quality

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Glossary of Water Quality Terms and Abbreviations

Alpha Pts	Alpha Particles.
Coliform	A group of bacteria naturally present. Used as an indication of presence of other bacteria.
MCL	Maximum Contaminant Level.
MCLG	Maximum Contaminant Level Goal.
NTU	Nephelometric Turbidity Unit. Smaller numbers indicate greater water clarity.
pCi/L	picoCuries per Liter. One Curie is the radioactivity of one gram of radium. A picoCurie is one-trillionth of a Curie.
pH	power (exponent) of Hydrogen. A measure of acidity. The negative logarithm of hydrogen ion concentration. Acids have pH less than 7.0, bases have pH greater than 7.0
ppb	parts per billion
ppm	parts per million
Primary Standards	Legally enforceable standards issued by the U.S. EPA.
TOC	Total Organic Carbon.
TT	Treatment Technique. A required process intended to reduce the level of a contaminant.

Table A-1
Water Quality – City of Philomath Water Treatment Plant

See Glossary on Page A-1 for definition of terms and abbreviations.

Data were provided by the City of Philomath Public Works Department, obtained from on-line data reported by Oregon Drinking Water Program.

Parameter	MCL	Maximum Reported	Range	Meets Regulations?
Turbidity	See Note 2	0.14NTU	0.05-0.14NTU	
Fluoride	4.0 mg/L	0.85 mg/L		YES
TOC, raw water	TT = 4 ppm			
TOC, finished water	TT = 2 ppm			
Nitrates	10 mg/L	0.44 mg/L		YES
Sodium	20 mg/L	20.2 mg/L		
Alpha Pts	15 pCi/L	Not Sampled for Alpha Particles		
Radium 226 and 228	5 pCi/L			

Notes:
1. See Glossary for abbreviations used.
2. Turbidity measurements represent November 2010

Table A-2
Water Quality – City of Philomath 11th Street Well

See Glossary on Page A-1 for definition of terms and abbreviations.

Data were provided by the City of Philomath Public Works Department, obtained from on-line data reported by Oregon Drinking Water Program.

Parameter	MCL	Maximum Reported	Range	Meets Regulations?
Turbidity	See Note 2			
Fluoride	4.0 mg/L	0.28 mg/L		YES
TOC, raw water	TT = 4 ppm			
TOC, finished water	TT = 2 ppm			
Nitrates	10 ppm	No Nitrates detected		YES
Sodium	20 ppm	39.4 mg/L		
Alpha Pts	15 pCi/L	Not Sampled for Alpha Particles		
Radium 226 and 228	5 pCi/L			

Table A-3
Water Quality –
Primary Standards: City of Corvallis Rock Creek Treatment Plant

See Glossary on Page A-1 for definition of terms and abbreviations.

The following data are obtained from the City of Corvallis 2010 Water Quality Report. The City of Corvallis averages test results. As a consequence, the City notes that some values in the indicated range of values are greater than the indicated maximum value. Contact the City of Corvallis regarding measurements and additional information.

Parameter	MCL	MCLG	Maximum Reported	Range	Likely Source	Meets Regulations?
Turbidity	See Note 2	N/A	0.04 NTU	0.03-0.05NTU	See Note 3	YES
Fluoride	0.4ppm	0.4ppm	1.02 ppm	0.00-1.17 ppm	Added	YES
TOC, raw water	TT = 4 ppm	N/A	0.98 ppm	0.56-1.75 ppm	See Note 4	YES
TOC, finished water	TT = 2 ppm	N/A	0.55 ppm	0.50-0.70 ppm	See Note 4	YES
Nitrates	10 ppm	10 ppm	None Detected			YES
Sodium	20 ppm	N/A	6.98 ppm	N/A	See Note 5	YES
Alpha Pts	15 pCi/L	0.0	0.16 pCi/L	N/A	See Note 6	YES
Radium 226 and 228	5 pCi/L	0.0	0.27 pCi/L	N/A	See Note 7	YES

Notes:

3. See Glossary for abbreviations used.
4. MCL for turbidity is that TT of 95% of samples is less than 0.30 NTU.
5. Likely source of turbidity is soil runoff and stream sediment.
6. Likely source of TOC is naturally occurring carbon, often from leaves and other organic material.
7. Likely source of sodium is chlorination with sodium hypochlorite.
8. Likely source of Alpha particles is erosion of natural deposits.
9. Likely source of Radium 226 and 228 is erosion of natural deposits.

Appendix 'B' – Water Conservation at Home and Business

Much of the following material is adapted from City of Albany resources. The City of Albany provides a useful and practical collection of tips for conserving water in and around the home, which are listed in adapted form below. Refer also to the City of Albany website http://www.cityofalbany.net/publicworks/water/tips.php

Tips for Water Conservation in THE BATHROOM

Don't use the toilet as a wastebasket.	Many people dispose of cigarettes and small pieces of trash in the toilet. Each flush wastes 2 to 6 gallons of water.
Turn off the faucet when brushing your teeth or shaving.	Older faucets use between 2 and 5 gallons per minute. Swishing the razor in a partially filled sink is as effective as letting water run over the blade, and can save 300 gallons a month!
Take short showers or turn the water off when soaping up.	
Install low flow aerators on your sink and a low flow showerhead.	
Repair dripping faucets or leaking toilets.	Leaks are one of the largest water wasters in the home. A toilet that runs occasionally through the day may be wasting hundreds of gallons of water each month.
If your toilet was installed prior to 1993, use a milk jug or tank bank to displace some water.	Fill a plastic milk jug with water and place it in your tank away from the mechanism. This will reduce the amount of water with each flush. However, if you find the flushes are less effective, remove the jug. Flushing twice with the tank bank will waste more water than flushing once without it. Do not use a brick - the brick will dissolve and damage your toilet mechanism.
If you take baths, plug the drain before turning on the water.	When the water does become hot, it will quickly warm up the cool water that came out first.

Tips for Water Conservation in THE LAUNDRY ROOM

Wash only full loads of laundry or use the load size selector on your machine.	Even when using the load size selector, it is more efficient to wash a full large load than several full small loads.
If your laundry has a sink, install a low flow aerator on the faucet.	These inexpensive devices are easy to install and may save 2 gallons per minute or more.
Pretreat stains to prevent having to wash more than once.	
Consider replacing an older washing machine.	Some new models use as little as 12 gallons per load (compared to 40 for standard top loading machines) and offer faster spins that reduce drying time.

Tips for Water Conservation in THE KITCHEN

Run the dishwasher only when it is full.	It will use the same amount of water regardless of how many dishes are inside, so get the most bang for your water buck.
If you wash dishes by hand, don't let the rinse water run.	Fill the second basin with rinse water, or turn the water off between rinsing.
Don't run water to wait for it to get cool.	Fill a pitcher with water and store it in the refrigerator.
Check and repair leaks often.	Leaks are one of the largest wasters of water in the home.
Save the "waiting to get hot" water.	Use it to water plants, or put it in a pitcher in the fridge to drink later.
Don't let the faucet run while you scrub vegetables.	Instead, put a stopper in the sink and partially fill it.
Don't use warm water to thaw out food.	Put frozen food in the microwave, or in the refrigerator the night before.

Tips for Water Conservation OUTDOORS

Use a rain gauge or clean tuna can to measure irrigation water.	Most lawns require only one inch of water each week once established. Increase watering during times of extended high temperatures (above 90 degrees). Decrease irrigation after rainfall.
Don't water unless your lawn needs it!	Use a screwdriver to test the moisture of your soil. Push the blade of the screwdriver into the ground; it will become difficult to push when the soil is dry. If this happens less than six inches into the ground, then it's time to water!
Water early in the morning (4-8 a.m.) or in the evening (6-8 p.m.).	Watering in the morning offers some advantages over watering in the evening: air temperatures are usually cooler, thus you lose less water to evaporation; and you are less likely to encourage harmful fungus growth.
Don't water when it is very windy or when it has just recently rained.	
Water less often but for longer periods of time.	Watering every day for just a few minutes actually reduces the health of your lawn. Deep soaks encourage deep roots which makes your plants more drought tolerant.
If water begins to run off your lawn, try the spray and wait technique.	The time until your soil becomes saturated and the water runs off will vary with soil composition. Clay soils are more likely to be harder for water to penetrate. If water begins to run off your lawn, try the spray and wait technique: irrigate until the water runs off, wait 30 minutes for it to soak in, and repeat until you have applied the desired amount for that day.
Avoid under-watering your lawn.	It is easy to tell if you are under-watering your lawn. Watch for brown spots, or wilting, or do the trample test. Walk on your lawn -if your footprints remain, increase your watering time.

Tips for Water Conservation OUTDOORS, continued

Use sprinklers that release large droplets close to the ground rather than those that spray a fine mist in the air.	Finer sprays lose more water to evaporation before it ever reaches the ground.
Install drip or soaker hoses in flower and vegetable beds.	These hoses deliver water right to the base of the plant, where it is most needed.
Check your irrigation system regularly.	
Look for broken nozzles or sprinkler heads	
Do not water hard surfaces like your driveway or sidewalk.	
Consider using native or low-water-use plants in your landscaping.	Refer to Appendix 'C' for suggestions and resources.
Mulch around your plants to reduce water evaporation.	Three inches of mulch also helps protect against weeds and still allows water to penetrate to the roots.

Appendix 'C' – Xeriscape Landscaping

TABLE OF CONTENTS

Definition

The use of "xeriscaping" was coined in 1981 by a special task force of the Denver Water Department, Associated Landscape Contractors of Colorado and Colorado State University to describe landscaping with water conservation as a major objective[1]. A compound of the Greek *xeros*, dry, and "-scape," as in landscape, "xeriscaping" refers to creating a landscape design that has been carefully tailored to withstand drought conditions.

[1] Colorado State University Extension Service, Fact Sheet 7.228

Bibliography and References

Many gardening books include information and details about xeriscape gardening. A few publications available from the Oregon State University Extension Service are:

Title	Extension Service Document	Author	Publisher	Price	Notes
Water Efficient Landscape Plants	EC1546	OSU Extension	OSU Extension	$5.50	Contained in this Appendix. Copy also available at for review at City Hall
Sustainable Gardening The Oregon Washington Master Gardener Handbook		OSU Extension	OSU Extension	$30.00	Available at OSU Bookstore or through OSU Extension
Basic Design Concepts for Sustainable Landscapes	EC1533	OSU Extension	OSU Extension	$2.00	Available at OSU Bookstore or through OSU Extension
Alternative Crops for the Columbia Basin	EM8915	OSU Extension	OSU Extension	$10.00	Available at OSU Bookstore or through OSU Extension

Additional information is also available on the internet from various organizations. Samples are:

Oregon State University Extension	www.extension.oregonstate.edu www.extension.oregonstate.edu/gardening/
City of Albany	http://www.cityofalbany.net/publicworks/env_services/efficient-plants/index.htm
Colorado State University Extension	www.ext.colostate.edu www.ext.colostate.edu/pubs/garden/07228.html
Xeriscape Landscaping Organization	http://xeriscapelandscaping.org/
Eartheasy	http://eartheasy.com/grow_xeriscape.htm

EC 1546 • Revised April 2004
$5.50

WATER-EFFICIENT LANDSCAPE PLANTS

Oregon State University | Extension Service

Contents

Plant lists

WATER-EFFICIENT LANDSCAPE PLANTS

This publication will help you select plant materials for landscaping. It contains more than 370 water-efficient landscape plants for the Pacific Northwest.

The best advice in plant selection is to find the right plant for the right place. Consider all of the factors that make up the environment in your yard—minimum and maximum temperatures, frost occurrence, seasonal rainfall distribution, humidity, soil characteristics, water availability, wind, and duration and intensity of sunlight. Every plant tolerates a range of conditions for each of these factors. The combined effects of all of them determine plant adaptability. Consult plant nurseries, Master Gardeners, or reference books to determine which plants will grow well in your specific environment.

PLANNING A WATER-EFFICIENT LANDSCAPE

Besides selecting water-efficient plants, there are several things you can do to reduce the amount of water needed in your landscape. Many of these suggestions are based on the concept of "xeriscaping," a term coined in the 1980s to describe water-efficient landscaping. Key steps to establishing a successful water-efficient landscape include:

- Starting with a landscape plan
- Improving your soil
- Selecting appropriate plants
- Getting your plants off to a good start
- Watering wisely
- Mulching
- Taking care of your plants

Neil Bell, community horticulturist, Marion and Polk counties; Ann Marie VanderZanden, former Master Gardener state coordinator; and Linda McMahan, community horticulturist, Yamhill County; Oregon State University.

Research has shown that these water-saving guidelines can reduce landscape water use by 60 to 80 percent. Details on these topics are available in the following OSU Extension Service publications:

- *Basic Design Concepts for Sustainable Landscapes,* EC 1533
- *Conserving Water in the Garden: Designing and Installing a New Landscape,* EC 1530
- *Conserving Water in the Garden: Landscape and Lawn Care,* EC 1531
- *Plant Selection for Sustainable Landscapes,* EC 1534

See page 3 for ordering instructions for these and other related publications.

ESTABLISHING YOUR LANDSCAPE

Proper soil preparation prior to planting can have a major impact on subsequent water use and plant performance. Proper soil preparation, in fact, can significantly expand the range of plants that can be grown in a water-efficient way in our area.

Watch for warning signs of very poor soil. Is your soil dry and cracked in summer? Is it difficult to dig in the soil, whether wet or dry? Does water pool on the surface and drain slowly, or run off without seeping in? All of these conditions indicate that the soil is low in organic matter.

Low organic matter and compaction are two soil-quality challenges that often occur together. Root growth usually is restricted in such soils. Plants, even water-efficient plants, cannot obtain sufficient water and nutrients without difficulty.

Adding organic matter to the soil prior to planting can make your soil a better environment for any kind of plant. Composted leaves, yard waste, and mint hay are examples of organic amendments that are readily available to home gardeners at reasonable cost. The addition of 3 to 4 inches of mulch following planting also will substantially reduce water requirements. See EC 1561, *Improving Garden Soils with Organic Matter.*

Keep in mind that even water-efficient plants require regular water during their first year. This requirement can be reduced by planting in the early fall, thus giving the root system time to get established during mild, wet winter weather. If you plant in the spring, try to plant as early as the weather allows, between mid-February and mid-April. By July, the plants' root systems will be better established and able to take up more water.

Understanding Plant Names

The Latin binomial system or botanical name is the preferred method of referring to plants. Swedish botanist Carl Linnaeus developed this system of plant classification in the 1700s. The first word of the name is the genus (e.g., *Acer*), and the second is the specific epithet (e.g., *rubrum*). The specific epithet often is mistakenly referred to as the species; in reality, species refers to a group of plants within the same genus.

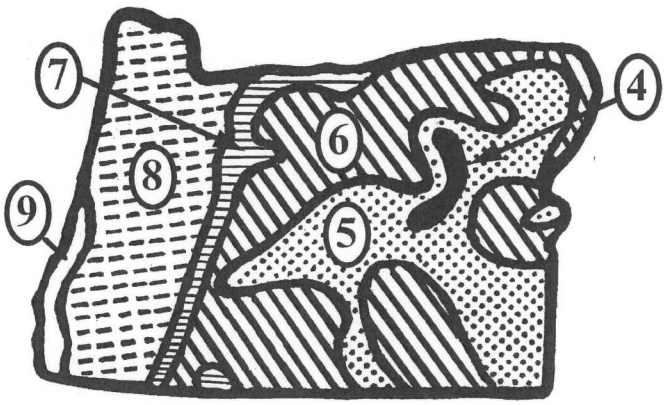
Many ornamental plants also are referred to using a cultivar name in addition to the Latin binomial (e.g., *Acer rubrum* 'October Glory' or *Acer rubrum* cv. October Glory). A cultivar is a cultivated variety that has unique characteristics that differ from the species. To come true to type, many cultivars need to be propagated vegetatively (by cuttings, grafting, or division).

Using the common name to refer to a plant often is confusing because many plants do not have a common name, or they share a common name with others. To further complicate the situation, the same common name may be used in different regions to describe different plants. Additionally, one plant might have several common names.

Plant Hardiness Zones

Plant hardiness zones depict minimum winter temperatures. (See map below.) A plant species that flourishes in one part of a given zone is likely to be adaptable in other parts of the same zone or in a warmer zone. The zones given in this publication indicate the minimum zone where a plant is expected to be hardy. If multiple species are available, hardiness might vary among them.

Some gardeners question a zone rating when a plant fails to survive its first winter. A single test, however, rarely is reliable. A small, young plant may be tender, but may become quite hardy as it grows older. Other conditions also may affect the degree of hardiness. Furthermore, no single winter is quite average; some are more severe than others in suddenness of freezing or in severity of frost.



Oregon plant hardiness zone map. (Extracted from the USDA's national plant hardiness zone map, based on average annual minimum temperature in °F.)

Zone 4 = -30 to -20
Zone 5 = -20 to -10
Zone 6 = -10 to 0
Zone 7 = 0 to 10
Zone 8 = 10 to 20
Zone 9 = 20 to 30

ANNUALS

Eschscholzia californica
(California poppy)

Botanical name	Common name	Hardiness	Height	Width	Flowering	Remarks
Abutilon hybrids*	Flowering maple	H	2–3'	2–3'	Spring–summer (white, yellow, pink, red)	Maple-like leaves, drooping, bell-like flowers.
Arctotis species*	African daisy	H	18"	18"	Summer–fall (many colors)	Many seed-grown varieties.
Argemone mexicana	Prickly poppy	T	2'	18"	Summer–fall (yellow)	Prickly, blue leaves on long-blooming plants.
Argyranthemum frutescens	Marguerite daisy	H	4'	4'	Summer	Big, white daisy flowers.
*Brachycome iberidifolia**	Swan River daisy	HH	8–18"	18"	Summer (blue, violet, white)	Finely divided leaves; flowers are faintly fragrant.
Calandrinia umbellata	Rock purslane	HH	6"	—	Summer (pink)	—
*Calendula officinalis**	Pot marigold	HH	2'	2'	Summer (orange, yellow)	Will bloom any time of the year; often overwinters.
Catharanthus roseus	Rose periwinkle	T	10–14"	—	Summer–fall (pink, red, white)	Not for coastal gardens; best in a warm site.
*Celosia cristata**	Cockscomb	HH	10–24"**	—	Summer–fall (red, yellow, orange, pink, cream)	Taller varieties can be used for cutting.
*Cleome hasslerana**	Spider flower	HH	3–4'**	12–18"**	Summer–fall (white, violet, pink)	Performs best in rich, well-amended soil.
*Cosmos bipinnatus**	Garden cosmos	T	1–4'**	8–18"**	Summer–fall (many colors)	Excellent foliage effect; good cut flower.

Unless otherwise indicated, all of the listed plants prefer full sun.
Hardiness: T=tender annual (does not tolerate frost); HH=half-hardy annual (tolerates light frost); H=hardy annual (tolerates heavy frost, might overwinter)
**Multiple cultivars available.*
***Size depends on cultivar.*

Botanical name	Common name	Hardiness	Height	Width	Flowering	Remarks
Dimorphotheca species*	African daisy	T	2'	2'	Summer–fall (white, yellow)	Seed-grown selections available.
Dorotheanthus bellidiformis	Livingstone daisy	T	3"	12"	Summer (pink)	Fleshy, bright green leaves; flowers attract bees.
Echium vulgare		H	2–3'	1'	Summer (blue, white, pink)	Best with good drainage; spectacular spikes of flowers.
Eschscholzia californica	California poppy	H	6"–1'	6"–1'	Summer–fall (orange, white)	Will often overwinter; self-sows readily.
Felicia species*	Blue marguerite	H	6–14"	1–3'	Summer (blue)	Foliage is quite aromatic.
*Gaillardia pulchella**	Blanketflower	H	18–20"	—	Summer–fall (red, yellow)	Pubescent, greenish-gray foliage.
*Gazania x hybrida**	Gazania	H	6–12"**	6–10"**	Summer–fall (cream, yellow, pink, orange, red)	Will often overwinter; foliage may be green with silvery gray on underside.
Gilia capitata	Blue thimble flower	T	8–30"	8"	Summer (blue)	Flower spikes look like pincushions; native to West Coast.
Gilia tricolor	Bird's eyes	T	10–20"	8"	Summer (violet)	—
Glaucium flavum	Sea poppy	H	2'	18"	Summer (yellow, orange)	Gray-green foliage.
Gomphrena species*	Globe amaranth	T	8–24"**	10-12"**	Summer (white, lavender, rose)	Good for cutting, drying.
*Helianthus annuus**	Common sunflower	HH	2–10'**	—	Summer–fall (yellow, red)	Huge range of cultivars; great for kids and wildlife.
*Helichrysum bracteatum**	Strawflower	HH	1–3'**	—	Summer–fall (red, orange, yellow, white)	Good for cutting, drying; pick flowers before bracts open.
Hunnemannia fumariifolia	Mexican tulip poppy	H	2'	2'	Summer (yellow)	Needs good drainage.
*Lavatera trimestris**	Lavatera	H	21–48"**	—	Summer (many)	Good cut flower, similar to hollyhock; self-sows readily.

Annuals

Botanical name	Common name	Hardiness	Height	Width	Flowering	Remarks
*Limonium sinuatum**	Statice	HH	18"	1'	Summer (many)	Mediterranean native, good as a cut flower both fresh and dried.
Lisianthus species* (may be seen as *Eustoma grandiflorum*)	Texas bluebell	HH	8–40"**	6–12"	Summer (blue, red, pink, white)	Good cut flower.
Mesembryanthemum species*	Ice plant	T	6"	9"	Summer (many)	Oval, fleshy leaves have small blisters that resemble ice.
*Papaver rhoeas**	Shirley poppy	H	12–36"**	—	Summer (pink, white, red)	May be used as cut flower; will self-sow.
Portulaca species*	Moss rose	T	6–10"**	6–12"**	Summer (white, orange, yellow, pink)	Prefers a hot, sunny site.
Ricinus communis	Castor bean	HH	12'	5'	Summer (white)	Seeds are poisonous, avoid contact with foliage; do not plant if children present.
*Salvia farinacea**	Texas violet	HH	1–2'**	1–2'**	Summer–fall (blue, white)	Many cultivars; good as cut or dried flower.
*Salvia splendens**	Scarlet sage	HH	10–30"**	—	Summer–fall (red, purple, white)	—
*Sanvitalia procumbens**	Creeping zinnia	HH	6"	12"	Summer–fall (yellow)	Trailing habit is good for containers.
*Senecio cineraria**	Dusty miller	H	12–18"	—	Summer (yellow)	Grown for silvery foliage.
*Tropaeolum majus**	Nasturtium	HH	18"–4'	18"	Summer (many)	Both climbing and bush types exist, many selected forms and colors.
*Verbena x hybrida**	Garden verbena	T	10"–3'**	6–18"**	Summer (many)	Flowers are fragrant.
Zinnia grandiflora	Rocky Mountain zinnia	H	12"	12"	Summer (yellow)	Blooms better with some supplemental water.

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BASICS

Xeriscaping: Creative Landscaping no. 7.228

by C. Wilson and J.R. Feucht [1(10/07)]

Quick Facts...

Proper planning is the first step in landscaping to reduce water use.

Steep slopes with south and west exposures require more frequent water to maintain the same plant cover as east or north slopes.

Terracing slopes reduces runoff.

Limit irrigated bluegrass turf to small or heavily used areas.

Soil preparation is a key to water conservation.

Proper irrigation practices and system design can lead to 30 to 80 percent water savings.

Colorado State University Extension

Xeriscaping (zer-i-skaping) is a word originally coined by a special task force of the Denver Water Department, Associated Landscape Contractors of Colorado and Colorado State University to describe landscaping with water conservation as a major objective. The derivation of the word is from the Greek "xeros," meaning dry, and landscaping — thus, xeriscaping.

The need for landscaping to conserve water received new impetus following the drought of 1977 throughout the western states and the recognition that nearly 50 percent of the water used by the average household is for turfgrass and landscape plantings.

Unfortunately, many homeowners have cut back on turfgrass areas by substituting vast "seas of gravel and plastic" as their answer to water conservation. This practice is not only self-defeating as far as water conservation is concerned, it also produces damaging effects to trees and shrubs. It is not xeriscaping.

Planning — An Important First Step

Whether you want to redesign an old landscape or start fresh with a new one, a plan is a must. The plan does not have to be elaborate but should take into consideration the exposures on the site. As a rule, south and west exposures result in the greatest water losses, especially areas near buildings or paved surfaces. You can save water in these locations simply by changing to plants adapted to reduced water use. However, don't be too quick to rip out the sod and substitute plastic and gravel. Extensive use of rock on south and west exposures can raise temperatures near the house and result in wasteful water runoff.

Slope of Property

Slope or grade is another consideration. Steep slopes, especially those on south and west exposures, waste water through runoff and rapid water evaporation. A drought-resistant ground cover can slow water loss and shade the soil. See fact sheet 7.230, *Xeriscaping: Ground Cover Plants*, for suggested ground covers. Strategically placed trees also can shade a severe exposure, creating cooler soil with less evaporation. Terracing slopes helps save water by slowing runoff and permitting more water to soak in.

Reduce Irrigated Turf

Avoid narrow strips of turf, hard to maintain corners, and isolated islands of grass that need special attention. Not only is maintenance more costly, but watering becomes difficult, often wasteful. If your yard is already landscaped, see 7.234, *Xeriscaping: Retrofit Your Yard*, for information on ways to evaluate and eliminate unneeded turfgrass areas.

Bluegrass turf can be reduced to areas near the house or that get high use. In outlying areas, use more drought-resistant grasses or even meadow mixes containing wildflowers, particularly if your property is large. Refer to 7.232, *Xeriscaping: Turf and Ornamental Grasses*, for suggested alternatives to bluegrass.

Soil Preparation

Proper soil preparation is the key to successful water conservation. If the soil is very sandy, water and valuable nutrients will be lost due to leaching below the root zone. If your soil is heavy clay, common in this area, you will lose water through runoff.

A good soil, one that supports healthy plant life and conserves moisture, has a balance of rather coarse soil clusters (aggregates), sand and pore spaces. The "ideal" soil has as much as 50 percent by volume pore space, with the soil itself consisting of a good balance of sand, silt and clay.

A major problem with heavy soils is that clay tends to dominate the soil complex. Clay is composed of microscopic crystals arranged in flat plates. When a soil has a high number of these crystals, they act much like a glue, cementing the particles of sand and silt together and resulting in a compact, almost airless soil.

Steps to Xeriscaping

- *Evaluate your property's exposure and slope and how your family uses the yard.*
- *Reduce irrigated turf where appropriate and replace it with low-water alternatives.*
- *Prepare the soil. This is your best opportunity.*
- *Irrigate properly.*
- *Use mulch to save water, inhibit weeds and improve the soil.*
- *Select appropriate plants.*

Such soils usually repel surface water, resulting in runoff. What water does get into these soils is held so tightly by the clay itself that plants cannot use it. Plants in a clay soil, even though it is moist, often wilt from lack of moisture. Plant roots also need air to thrive. In clay soils, air spaces are small and may be filled with water, so plant roots often suffer from oxygen starvation.

In very sandy soils, the opposite is true. Sandy soils have very large pore spaces. Because the particles are large, there is little surface area to hold the water, so sandy soils tend to lose water rapidly.

A good soil is not made in just one year. Add organic matter annually to garden areas. In areas to be sodded or seeded, add organic amendments as a one-time procedure. Take advantage of this one time before seeding or sodding by doing a thorough, complete job. This encourages deep roots that tap the water stored in the soil and reduces the need for wasteful, frequent water applications

Xerigation — Saving Water with Proper Irrigation

Proper irrigation practices can lead to a 30 to 80 percent water savings around the home grounds. If a sprinkler system is already installed, check it for overall coverage. If areas are not properly covered or water is falling on driveways and patios, adjust the system. This may mean replacing heads, adding more heads, or changing heads to do a more efficient job.

With the system on, observe places that are receiving water where it is not needed. Overlaps onto paved areas or into shrub borders may result in considerable water waste. Overwatering trees and shrubs may lead to other problems.

Irrigate turf areas differently than shrub borders and flower beds. North and east exposures need less frequent watering than south and west exposures. Apply water to slopes more slowly than to flat surfaces. Examine these closely and correct inefficiencies in irrigation system design.

If you do not have a sprinkler system and are just beginning to install a landscape, you can avoid the pitfalls of poorly designed and installed systems. Have a professional irrigation company do the job correctly. Make sure the system is designed to fit the landscape and the water needs of the plants and that it is zoned to reduce unnecessary applications of water. Coordinate the landscape design itself, selection of plants and the irrigation system to result in a sensible water-saving scheme.

Consider a drip system for outlying shrub borders and raised planters, around trees and shrubs, and in narrow strips where conventional above-ground systems would result in water waste.

If you use hoses instead of an underground system, you can observe water patterns. Instead of watering the entire lawn each time, spot water based on visible signs of need, such as turf that begins to turn a gray-green color.

Avoid frequent, shallow sprinklings that lead to shallow root development. Compact soils result in quick puddling and water runoff. They need aeration with machines that pull soil plugs.

Trees and shrubs separate from the lawn are best watered with deep root watering devices.

Xerimulch the Landscape

Properly selected and applied mulches in flower and shrub beds reduce water use by decreasing soil temperatures and the amount of soil exposed to wind. Mulches also discourage weeds and can improve soil conditions.

There are two basic types of mulches: organic and inorganic. Organic mulches include straw, partially decomposed compost, wood chips, bark, and even ground corncobs or newspapers. Inorganic mulches include plastic film, gravel and woven fabrics. Sometimes a combination of both organic and inorganic is used.

If soil improvement is a priority, use organic mulches. Wood chips and compost are most appropriate. As these materials break down, they become an organic amendment to the soil. Earthworms and other soil organisms help incorporate the organic component into the soil. Organic mulch is preferred because most soils in this area are low in organic content and need organic amendments to improve aeration and water-holding capacity.

Inorganic mulches, such as plastic film, effectively exclude weeds for a time, but they also tend to exclude the water and air essential to plant roots. Woven fabrics and fiber mats are preferred over polyethylene films. Fabrics and mats exclude weeds yet allow water and air exchange. Used in combination with decorative rock or bark chunks, they often outlast the less expensive but short-lived polyethylene films. For more information, refer to 7.214, *Mulches for Home Grounds*.

Selecting Plants

Carefully select plants to be compatible with soil, exposure and irrigation systems. For recommended plants, see:

- 7.229, *Xeriscaping: Trees and Shrubs.*
- 7.230, *Xeriscaping: Ground Cover Plants.*
- 7.231, *Xeriscaping: Garden Flowers.*
- 7.234, *Xeriscaping: Retrofit Your Yard.*

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