State of Oregon
Department of Environmental Quality Memorandum

To: DEQ Staff and Interested Parties **Date:** June 19, 2009

From: Neil Mullane, Division Administrator

Section: Water Quality Division

Subject: Internal Management Directive - *Implementing Oregon's Recycled Water Rules*

I am pleased to report that the Internal Management Directive *Implementing Oregon's Recycled Water Rules* has been completed and is available at http://www.deq.state.or.us/wq/pubs/pubs.htm#imds. Use of the IMD is important in implementing an effective and consistent recycled water program, and DEQ staff involved with permitting recycled water projects should begin using the IMD.

This document provides guidance to DEQ staff involved with the permitting of recycled water projects, including but not limited to permit writers, compliance inspectors, land application staff, and engineers. The IMD addresses a number of permitting implementation issues that were identified during revision of the Recycled Water Rules. The IMD also satisfies DEQ's obligations under a Memorandum of Understanding with five other state agencies to develop permitting guidance following adoption of the new rules and represents the collaborative efforts of DEQ, other state agencies, and external stakeholders to encourage water reuse activities in the state.

The primary objectives of the Recycled Water IMD are:

- To clarify recent changes in the rules and provide consistent program implementation;
- To guide DEQ staff on the use of discretionary authority;
- To clarify when consultation with other state agencies occurs; and
- To facilitate better communication between DEQ and wastewater facility owners/operators, recycled water users, and the public.

The IMD was developed following the Water Quality Division's procedures for IMD development. DEQ regional staff and management reviewed the IMD as did external stakeholders, such as the Oregon Association of Clean Water Agencies. I recognize and greatly appreciate the efforts of everyone involved with the development of this document. Moreover, I value the efforts that DEQ staff and management will put forward in implementing the Recycled Water Program through the procedures described in the IMD. As a team, we will remain committed to working together to improve this and other documents as state-wide interest in recycled water and water reuse continues to grow.

If you have questions or need further assistance, please contact Ron Doughten (doughten.ron@deq.state.or.us) at 503.229.5472 or Judy Johndohl (johndohl.judy@deq.state.or.us) at 506.229.6896

This page left intentionally blank.

INTERNAL MANAGEMENT DIRECTIVE

IMPLEMENTING OREGON'S RECYCLED WATER USE RULES

June 2009
Version 1.0

State of Oregon
Department of Environmental Quality

Water Quality Division
Community and Program Assistance
811 SW Sixth Avenue
Portland, OR 97204
Phone: 503.229.5696
Toll Free: 800.452.4011
www.deq.state.or.us

This document supersedes any previous guidance documents or materials developed by DEQ on recycled or reclaimed water reuse.

TABLE OF CONTENTS

1. Introduction 9
1.1 Purpose 9
1.2 Scope 9
1.3 Why This IMD Is Needed 9
1.4 Changes and Updates 10
2. Recycled Water Rules Overview 11
2.1 Applicability 11
2.1.1 Recycled Versus Reclaimed Water 11
2.1.2 Resource Value 11
2.1.3 Waters of the State 12
2.1.4 Manmade Lakes and Impoundments 12
2.1.5 Recycled Water Use Permit Exemptions 13
2.1.6 Tribal Lands 13
2.1.7 Land Treatment Systems 13
2.2 Recycled Water Beneficial Purposes 14
2.2.1 Beneficial Purposes in Rule 14
2.2.2 Authorizing Other Beneficial Purposes 15
2.3 Classes of Recycled Water 17
2.4 Public Health and Environmental Concerns 17
2.4.1 Multiple Barriers 18
2.4.2 Indicator Organisms 18
2.4.3 Aerosol Generation 18
2.4.4 Groundwater Protection 20
2.4.5 Surface Water Protection 21
2.4.6 Transporting Recycled Water 22
2.5 Water Quality and Quantity Considerations 23
2.5.1 Water Quality and Beneficial Purposes 23
2.5.2 Blending 23
2.5.3 Storage and Water Quality 24
2.5.4 Maintaining Water Quality 25
2.6 Coordination with Other State Agencies 25
2.6.1 Water Right Registration with the Oregon Water Resources Department 26
2.6.2 Recycled Water Use Plan Review by the Department of Human Services 27
2.6.3 Other State and Local Agencies 27
2.7 Public Notice 28
2.8 Responsibility for Compliance 28
2.9 Permitting Process 28
3. Putting the Permit Together 30
3.1 Permit Application 30
3.1.1 Permit Documentation 30
3.1.2 Permitting Artificial Groundwater Recharge 31
3.2 Format of the Permit 34
3.3 Schedule A - Discharge Limitations 35
3.3.1 Bacteria and Turbidity Requirements 35

3.3.2 Recycled Water Class and Beneficial Purpose 36
3.3.3 Surface Water, Groundwater, and Other Limitations 36
3.3.4 Additional Permit Limits and Conditions 36
3.4 Schedule B - Monitoring and Reporting Requirements 37
3.4.1 Monitoring Requirements 37
3.4.2 Sampling 40
3.4.3 Approved Analytical Methodologies 40
3.4.4 Annual Reports 42
3.5 Permit Renewals and Modifications 43
3.5.1 Permit Renewals 43
3.5.2 Permit Modifications 43
4. Reviewing the Recycled Water Use Plan 45
4.1 Recycled Water Use Plan Overview 45
4.1.1 Division 55 Requirements for a RWUP 45
4.1.2 Guidelines for a RWUP 46
4.1.3 Review and Approval Process 46
4.1.4 Site Visits and Site Authorizations 47
4.2 Common Content for RWUPS 47
4.2.1 Class(es) of Water and Beneficial Purposes 47
4.2.2 Wastewater Treatment 47
4.2.3 Recycled Water Monitoring and Sampling 48
4.2.4 System Maintenance and Contingency Procedures 49
4.2.5 Recycled Water Transmission, Storage, Distributions, and Plumbing 49
4.2.6 Public Health and Environmental Controls 49
4.2.7 Site Management Practices 54
4.3 Guidelines for a RWUP That Includes Irrigation 59
4.3.1 Land Application Site 59
4.3.2 Crops 62
4.3.3 Irrigation System Design 63
4.3.4 Irrigation Water Quality 63
4.3.5 Soil and Crop Monitoring 65
4.3.6 Water Application Rates 66
4.3.7 Land Application Site Records 67
4.4 Specific Guidelines for RWUPS That Include Artificial Groundwater Recharge 68
5. Reviewing the System Design 70
5.1 Regulatory Requirements - Review of Plans and Specifications 70
5.1.1 Performance Requirements and Guidelines for Technical Review 70
5.2 Plan Submittal Requirements 70
5.3 Unit Processes - Reliability and Redundancy in Treatment Systems 71
5.3.1 Disinfection 72
5.3.2 Filtration 73
5.3.3 Alarms, Controls, and Standby Power 74
5.3.4 Redundancy 75
5.3.5 Aquifer Recharge (AR) Systems 75
5.4 Alternative Treatment Process (Equivalent Treatment) 75
5.4.1 Technologies Approved by Other States or Independent Organizations 75
5.4.2 Technologies Not Approved by Other States or Independent Organizations 76

5.5 Satellite Facilities 77
5.6 Storage, Transmission, Distribution, and Irrigation Systems 79
5.6.1 Storage 79
5.6.2 Transmission and Distribution System Requirements 79
5.6.3 Irrigation Systems 82
5.6.4 Dual Plumbing Systems 83
5.6.5 Preventing Cross Connections 83
5.6.6 Consideration at Point of Use 83
6. Contacts and References 85
6.1 Contacts 85
6.2 Bibliography and Resources 85
6.3 Glossary 89

TABLES

Table 1. Summary of permitting requirements for wetlands. 12
Table 2. Recycled water beneficial uses identified in rule. 14
Table 3. Recycled water Classes identified in rule, based upon level of treatment..... 17
Table 4. EPA guidelines for limiting public exposure to aerosols generated through spray irrigation systems. 19
Table 5. Strategies for managing biofilm development in recycled water systems. 25
Table 6. Summary of agencies involved in the permitting recycled water use. 25
Table 7. The RWUP must be reviewed by the Department of Human Services under specfic conditions. DHS provides comment or approval, depending upon the proposed beneficial purpose. 27
Table 8 Rules that must be complied with for the permitting of Artificial Groundwater Recharge..... 31
Table 9. Summary of recycled water permit requirements. 34
Table 10. List of approved analytical methods for bacterial and turbidity testing (as of May 2009). 41
Table 11. Examples of major and minor recycled water permit modifications..... 44
Table 12. Public access requirements designed to minimize exposure to recycled water..... 50
Table 13. List of possible methods for meeting public and personnel notification requirements at recycled water use sites. This is not an exhaustive list of options. The posting of signs alone is not sufficient to meet the notification requirements of the rule..... 51
Table 14. Recommended design and operation features to restrict direct contact with recycled water.... 52
Table 15. Summary of irrigation setback distances, in feet, required in rule for various Classes of recycled water. 53
Table 16. Summary of site management practices identified in rule. Most practices relate to signage (S) requirements or harvest/irrigation (H/I) restrictions..... 55
Table 17. Summary of land application site selection factors. 60
Table 18. General hazard from salinity of irrigation water. 64
Table 19. Recommended alarms for various types of recycled water systems..... 74
Table 20. Common irrigation systems, factor affecting choice of use, and special measures for irrigation with recycled water. This information is general and provided to assist in reviewing and approving irrigations systems. 82
Table 21. Recycled water beneficial purposes identified in rule that may require dual plumbing and cross-connection considerations. 83

FIGURES

Figure 1. Location of GWMAs in Oregon (as of February 2009). 22
Figure 2. Summary of DEQ actions unique to the recycled water permitting process. Green boxes identify processes managed by the permit writer; yellow boxes identify processes that are passed to others for review. 29
Figure 3. Only two of the three methods for AR may be permitted by DEQ. Direct Injection of recycled water into the aquifer is not allowed by UIC rules. 33
Figure 4. General considerations on recycled water monitoring..... 39
Figure *5*. Areas receiving recycled water must be appropriately marked or signed as identified in the rule. However, consideration should be given to site specific conditions. For example, Irrigated Area "A" includes two tax lots under the same ownership. Signage should typically occur around the perimeter. Irrigated Area "B" includes all or part of three tax lots with different owners. Since the three fields are adjacent and contiguous, signage between the fields may be reduced or eliminated.

Special consideration should be given to the boundaries adjacent to the Elementary school and the Recreational Area. The area around Irrigated Area "C" is under the same ownership. Depending on actual site conditions, signage may be reduced or eliminated..... 58
Figure 6. Illustration of the three types of satellite systems: interceptor, extraction, and upstream. Satellite systems are connect to the central collection system, but wastewater is treated and reused locally, which reduces infrastructure costs associated with the storage and transmission of recycled water at the central wastewater treatment facility. 78
Figure 7. DEQ-approved special construction designs for recycled water systems..... 81

APPENDICES

Appendix A. Sample Permit Language
Appendix B. WRD Registration of Reclaimed Municipal Water Use
Appendix C. Frequently Asked Questions on water reuse projects and water rights
Appendix D. Recycled Water Use Plan Checklist
Appendix E. Additional Technical Considerations on Recycled Water Quality

ACRONYMS

AR	Artificial Groundwater Recharge
DEQ	Oregon Department of Environmental Quality
DHS	Oregon Department of Human Services
EC	Electrical Conductivity
EFU	Exclusive Farm Use
EPA	United States Environmental Protection Agency
GWMA	Groundwater Management Area
IMD	Internal Management Directive
NPDES	National Pollutant Discharge Elimination System
NRCS	United States Department of Agriculture Natural Resource Conservation Service
RWUP	Recycled Water Use Plan
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Limit
WPCF	Water Pollution Control Facilities
WRD	Oregon Water Resources Department

1. INTRODUCTION

The Oregon Administrative Rules, Chapter 340, Division 55 (OAR 340-055), "Recycled Water Use", prescribe the requirements for the use of recycled water for beneficial purposes while protecting public health and the environment. The Oregon Department of Environmental Quality (DEQ) is responsible for implementing these rules. DEQ coordinates closely with other state agencies to ensure consistency; in particular, the Oregon Department of Human Services (DHS) and the Oregon Water Resources Department (WRD) also play key roles in implementing these rules. This document serves as guidance to DEQ personnel implementing the rules.

In addition to this document, DEQ may write additional policy or guidance to assist in interpreting DEQ's recycled water use program and policy.

1.1 Purpose

The primary objectives of this Internal Management Directive (IMD) are to:

- Clarify recent changes in the Recycled Water Rules and provide guidance for consistent implementation by department staff;
- Guide department staff on the use of discretionary authority when approving other beneficial purposes, alternative treatment methodologies, alternative public notification and site specific RWUP conditions;
- Clarify when consultation with other state agencies occurs; and
- Facilitate better communication with wastewater facility owners/operators and recycled water users on the applicability of Oregon's Recycled Water Use Rules.

This IMD is not intended to be an in-depth technical guide. The science, technical, and regulatory considerations associated with water reuse continue to develop. Where possible, references to technical documentation are provided.

1.2 Scope

This IMD applies to the reuse of treated wastewater generated by domestic wastewater treatment facilities operating under a DEQ-approved National Pollutant Discharge Elimination System (NPDES) or Water Pollution Control Facilities (WPCF) permit. This IMD was developed based on issues identified by the Water Reuse Task Force during the rulemaking process, DEQ staff, public comment, and external stakeholders. This IMD does not apply to the reuse of commercial or industrial wastewaters, gray water, or on-site treatment systems.

1.3 Why This IMD Is Needed

This IMD will ensure effective and consistent implementation of the revised Recycled Water Use Rules.

DEQ personnel will use this IMD to:

- Review and approve RWUPs;
- Develop site specific conditions, if necessary, that become part of the NPDES and WPCF permit requirements; and

- Address technical issues that arise during the treatment and use of recycled water.

Supplemental technical information and implementation tools are included as appendices. They provide additional information for drafting permits, evaluating reuse plans, and reviewing operations. The appendices may be updated at a different frequency than the IMD.

1.4 Changes and Updates

Updates to the IMD will occur as-needed as new information, technology, concerns, and issues arise, and as staff time allows. Any interim addenda to the IMD will be reviewed by DEQ staff and management and then be published to the web with the IMD.

Any comments, concerns, or suggestions on this IMD should be communicated to:

Biosolids and Water Reuse Program Coordinator
Oregon Department of Environmental Quality
811 SW 6th Ave
Portland, OR 97204
ph: 503.229.5472

2. RECYCLED WATER RULES OVERVIEW

2.1 Applicability

Recycled water refers to any treated effluent from a domestic wastewater treatment system that (as a result of treatment) is suitable for a direct beneficial purpose [OAR 340-055-0010(13)]. The April 2008 revisions to Oregon's Recycled Water Use Rules allow the use of recycled water for beneficial purposes so long as the use provides a resource value, protects public health, and protects the environment [OAR 340-055-0007]. Recycled water use in Oregon requires at a minimum:

1. A NPDES or WPCF permit, and
2. A Recycled Water Use Plan (RWUP).

2.1.1 Recycled Versus Reclaimed Water

The revised water reuse rules substitute "recycled water" for "reclaimed water". Recycled water emphasizes the value of treated effluent as a state water resource and as an important urban and rural sustainability activity. Any new or renewed permit, including the associated RWUP, should use the recycled water terminology. Existing permits referring to reclaimed water may be interpreted as referring to recycled water.

2.1.2 Resource Value

The distinction between beneficial purpose and disposal requires careful consideration of recycled water's resource value. For most recycled water use projects, the resource value can be established by asking: "Does the recycled water replace another water source that would normally be used under the same circumstances?" If the answer is yes, the recycled water provides a resource benefit and is a beneficial purpose. Recycled water may also provide other resource benefits, such as supplying nutrients to a growing crop. In this case, if the nutrient value of the recycled water is replacing some of the chemical fertilizer that would normally be needed to grow the crop, then the nutrient content of the recycled water provides a resource value and is a beneficial purpose.

Variations in operational or environmental conditions may change the resource value. For example, recycled water provides a clear resource value when irrigating a healthy coastal pasture in a typical dry August. Irrigation of the same pasture during a normal December does not qualify as a beneficial purpose because natural precipitation meets the water needs. **To be permitted under OAR 340-055, recycled water must provide a resource value during use.**

Finally, although some uses of recycled water may provide a resource value, they may not be permitted under the Recycled Water Use Rules because they involve discharges to Waters of the State.

2.1.3 Waters of the State

Wetlands

Natural wetlands, enhanced or restored wetlands, and wetlands constructed for mitigation purposes are Waters of the State. Consequently, the introduction of recycled water into a wetland is treated as a surface water discharge and permitted under a NPDES permit [OAR 340-055-0017(9)]. Discharges to these types of wetlands may not be permitted under a WPCF permit and are not subject to the Recycled Water Use Rules (Table 1).

Engineered wetlands constructed on non-wetland sites and managed for wastewater treatment are treatment systems and are not subject to the Recycled Water Use Rules.

Recycled water discharged to man-made wetlands without a hydraulic connection to surface water or groundwater that are not used for treatment or constructed for mitigation purposes should be considered landscape impoundments.

Table 1. Summary of permitting requirements for wetlands.

NPDES Permit Required	Non-Surface Water Discharge
• Natural Wetland • Enhanced or restored wetlands • Constructed wetlands for mitigation	• Constructed wetland on non-wetland sites managed for wastewater treatment • Constructed wetlands on non-wetland sites without a hydraulic connection to surface water

Natural Lakes and Reservoirs

A lake is a body of water that is inland, not part of the ocean, and created from a natural water source. For purposes of permitting, lakes also include ponds and man-made features created by obstructing natural surface water flow (i.e., reservoirs). Although recycled water use in lakes, reservoirs, and other surface water features may provide a resource benefit, discharges into these types of systems are permitted as a surface water discharge using a NPDES permit.

Irrigation Canals

Public or private irrigation canals located wholly or partially within or bordering the state within its jurisdiction are Waters of the State [OAR 340-055-0010(18)]. Recycled water discharges to irrigation canals are permitted as surface water discharges using a NPDES permit. However, private irrigation ditches which do not combine or effect a junction with natural surface or underground waters are considered distribution systems, and may be permitted under the Recycled Water Use Rules.

2.1.4 Manmade Lakes and Impoundments

A manmade lake or impoundment is a constructed or engineered body of water that is outside of a natural drainage. OAR 340-055 identified three types of impoundments: (1) landscape impoundments (such as golf course water ponds), (2) restricted recreational impoundments, and (3) nonrestricted recreational impoundments (such as recreational lakes, water features

accessible to the public, and public fishing ponds). Recycled water use in impoundments that are hydraulically isolated from ground and surface waters may be permitted under OAR 340-055. Recycled water use in existing impoundments that leak 1/8-inch or more per day to the subsurface require additional consideration of impacts to groundwater and may be subject to both OAR 340-055 (recycled water) and OAR 340-040 (groundwater). Impoundments used specifically as part of wastewater treatment (e.g., treatment lagoons) are exempt from Division 55 rules and subject to ORS 215.213 and 215.283.

2.1.5 Recycled Water Use Permit Exemptions

OAR 340-055-0013 specifically exempts recycled water use for landscape irrigation or reuse in treatment plant processes (e.g., mixing of polymers) if **all** of the following four conditions are satisfied:

1. The water is oxidized and disinfected;
2. The water is used at the site of generation or an auxiliary site that operates under the same permit;
3. Spray and/or drift does not occur off-site; and
4. Public access is restricted.

DEQ staff should request the permittee to notify DEQ of any exempt water reuse at the treatment (or auxiliary) facility and report the quantity reused with the monthly Discharge Monitoring Report (DMR). If recycled water is used exclusively for exempt uses, the facility is not required to develop a RWUP for DEQ review and approval. However, facilities should be encouraged to develop a RWUP for their own operations. Exempt recycled water use should be identified in the Permit Evaluation Report.

2.1.6 Tribal Lands

All wastewater treatment operations on Tribal Lands, including recycled water use, are exempt. Recycled water that moves to or from Tribal Lands or across state boundaries may require a DEQ-issued permit. Confer with the DEQ Water Reuse Coordinator to determine the need for a permit in special situations.

2.1.7 Land Treatment Systems

The treatment of wastewater through land treatment systems (e.g., "spray disposal", infiltration basins designed for treatment, or hyporheic discharge) falls outside the scope of the Recycled Water Use Rules provided treatment occurs at the point of generation and the effluent remains under the control of the wastewater treatment facility. However, many of the access and exposure controls used in recycled water programs to protect public health and the environment (e.g., using low-trajectory sprinklers, establishing setbacks, restricting or preventing site access, development of an appropriate operations plan, etc.) are applicable to land treatment systems.

Currently permitted land treatment systems should be encouraged to adopt best management practices from the Recycled Water Use Rules to protect public health and the environment. Moreover, DEQ personnel should encourage currently permitted systems to explore recycled water use programs that beneficially use treated effluent as a resource (e.g., agricultural

irrigation). The EPA guidance document *Process Design Manual – Land Treatment of Municipal Wastewater Effluents* (EPA/625/R-06/016, September 2006) should be consulted when permitting land treatment systems.

2.2 Recycled Water Beneficial Purposes

2.2.1 Beneficial Purposes in Rule

The Recycled Water Use Rules identify a number of approved beneficial purposes for use with defined Classes of water. Table 2 summarizes the beneficial purposes identified in rule and categorizes them into three general categories. **Beneficial purposes identified in rule may not be authorized for use with a lower (i.e., less treated) Class of water.**

Table 2. Recycled water beneficial uses identified in rule.

Beneficial Purpose	Class A	Class B	Class C	Class D	Nondisinfected
Irrigation					
Fodder, fiber, seed crops not intended for human ingestion, commercial timber	Yes	Yes	Yes	Yes	Yes
Firewood, ornamental nursery stock, Christmas trees	Yes	Yes	Yes	Yes	No
Sod	Yes	Yes	Yes	Yes	No
Pasture for animals	Yes	Yes	Yes	Yes	No
Processed food crops	Yes	Yes	Yes	No	No
Orchards or vineyards if an irrigation method is used to apply recycled water directly to the soil	Yes	Yes	Yes	No	No
Golf courses, cemeteries, highway medians, industrial or business campuses	Yes	Yes	Yes	No	No
Any agricultural or horticultural use	Yes	No	No	No	No
Parks, playgrounds, school yards, residential landscapes, other landscapes accessible to the public	Yes	No	No	No	No
Industrial, Commercial, or Construction					
Industrial cooling	Yes	Yes	Yes	No	No
Rock crushing, aggregate washing, mixing concrete	Yes	Yes	Yes	No	No
Dust control	Yes	Yes	Yes	No	No
Nonstructural fire fighting using aircraft	Yes	Yes	Yes	No	No
Street sweeping or sanitary sewer flushing	Yes	Yes	Yes	No	No

Beneficial Purpose	Class A	Class B	Class C	Class D	Nondisinfected
Stand alone fire suppression systems in commercial and residential buildings	Yes	Yes	No	No	No
Non-residential toilet or urinal flushing, floor drain trap priming	Yes	Yes	No	No	No
Commercial car washing	Yes	No	No	No	No
Fountains when the water is not intended for human consumption	Yes	No	No	No	No
Impoundments or Artificial Groundwater Recharge					
Water supply for landscape impoundments including, but not limited to, golf course water ponds and non-residential landscape ponds	Yes	Yes	Yes	No	No
Restricted recreational impoundments	Yes	Yes	No	No	No
Nonrestricted recreational impoundments including, but not limited to, recreational lakes, water features accessible to the public, and public fishing ponds	Yes	No	No	No	No
Artificial groundwater recharge	Yes	No	No	No	No

DEQ should evaluate all beneficial purposes, including those identified in rule, for public health and environmental impacts based upon actual recycled water quality and site specific conditions at the reuse site. Recycled water quality should also be reviewed to verify it is appropriate to the proposed beneficial purpose and provides a resource benefit. Recycled water use proposals that fail to protect public health, the environment, or provide a resource benefit should not be approved under the Recycled Water Use Rules.

2.2.2 Authorizing Other Beneficial Purposes

DEQ may approve other beneficial purposes currently not identified in rule [OAR 340-055-0016(6)]. If a request is made to use recycled water for a beneficial purpose not identified in rule, DEQ requests the permittee or applicant to provide the information necessary to evaluate the proposal. The types of information requested may include, but is not limited to:

- Recycled water quality data;
- Recycled water quantity data;
- Data on the quantity and quality of water necessary for the proposed beneficial purpose;
- Description of the recycled water's resource value for the use;
- Technical and scientific facts that support the proposed use;

- Pilot studies;
- Epidemiological data;
- Possible adverse affects to public health or the environment;
- Exposure pathways;
- Potential for offsite migration;
- Adjacent land uses; and
- Examples of other jurisdictions (e.g., states, countries, etc.) or facilities using recycled water in the proposed manner.

Consultation with other DEQ personnel or state agencies may be necessary for the approval of alternative beneficial purposes, such as:

- If an alternate beneficial purpose uses Class C, Class D, or nondisinfected recycled water, DEQ must confer with DHS [OAR 340-055-0016(6)].
- Alternative beneficial purposes that change the quantity of water flow should be submitted to the WRD for review and comment.
- Alternative beneficial purposes proposed in GWMAs and with possible connections to groundwater should be considered with the DEQ regional hydrogeologist.
- Alternate beneficial purposes should be discussed with the Water Reuse Program Coordinator.

DEQ will evaluate the proposed beneficial purpose based upon the scientific and technical merits of the use and consult with the appropriate personnel and agencies. DEQ may approve an alternate beneficial purpose if the use: (1) is protective of public health, (2) is protective of the environment, and (3) provides a resource value. Based upon case-specific information, DEQ should specify in the permit or ask that the RWUP include conditions appropriate for protection of public health and the environment at the reuse site, which may include the following:

- Sampling and monitoring information, including sampling locations, parameters, and frequency;
- Appropriate setback distances;
- Access and Exposure restrictions that account for the production of aerosols and human contact that may occur; and
- Site Management practices, including signage and notification procedures.

The regional DEQ staff should authorize the alternative beneficial purpose in writing to the permittee. A copy of the approval and permit conditions should be sent to the DEQ Water Reuse Coordinator who will maintain a list of approved beneficial purposes to facilitate the approval of other similar requests. Although prior approval of an alternate beneficial purpose may expedite the approval process, prior approval alone is not sufficient justification for approval—each request must be evaluated on its own merits.

2.3 Classes of Recycled Water

The rules identify four Classes of disinfected recycled water, and a nondisinfected recycled water. Although these Classes of water are similar to the Levels defined in previous rules, the correlation is inexact. Any new or renewed permit, including the associated RWUP, should refer to the Classes of Water described in Table 3.

Table 3. Recycled water Classes identified in rule, based upon level of treatment.

	Class A	Class B	Class C	Class D	Nondisinfected
Former Level	IV	III	II	Enhanced I	I
Oxidized	□	□	□	□	□
Disinfected	□	□	□	□	
Filtered	□				
Turbidity (NTU)					
24-hr mean	2				
5% of time during a 24-hr period	5				
Maximum at any time	10				
Monitoring Frequency	hourly				
Total coliform (organisms/100 mL)					
7-day median	2.2	2.2	23		
Maximum in any sample	23	23			
Maximum in 2-consecutive			240		
Monitoring Frequency	daily	3/wk	1/wk		
E. coli					
30-day log mean				126	
Maximum in any sample				406	
Monitoring Frequency				1/wk	
Beneficial Purposes	More				Less
Conditions on use	Less Restrictive				More Restrictive

Although the rules allow the use of nondisinfected recycled water, nondisinfected water should be assumed to contain significant levels of pathogenic organisms and to carry the highest public health risk. Consequently, DEQ should encourage facilities currently permitted to use nondisinfected water to treat their effluent to Class D or better for reuse applications.

2.4 Public Health and Environmental Concerns

DEQ encourages the use of recycled water for beneficial purposes provided the recycled water use is protective of the environment and public health [OAR 340-055-0005]. The primary concerns with recycled water use include the transmission of waterborne pathogens and adverse impacts to the environment due to harmful organic and inorganic contaminants. The following discussion should provide some guidance for evaluating potential public health and environmental impacts with recycled water use.

2.4.1 Multiple Barriers

The concept of multiple barriers involves using a series of barriers to prevent, to extent practicable, the transmission of pathogens and harmful organic and inorganic contaminants contained in recycled water to the public or environment. For recycled water systems, barriers commonly include (1) source control programs designed to reduce pathogen and contaminant concentrations, (2) a combination of treatment processes to reduce pathogen or contaminant concentrations, and (3) environmental controls, such as setbacks, access and exposure control, and site management practices. By using multiple barriers, a degree of public health and environmental protection can be maintained even should one of the barriers fail [(Asano, et al. 2007), pp. 263-264].

The Recycled Water Use Rules address multiple barriers by requiring more environmental controls when using less treated recycled water. However, each individual project is unique and should be evaluated to determine if additional permit limits and conditions are required to protect public health and the environment [OAR 340-055-0016(5)]. During the permitting process, DEQ should review the wastewater sources, the treatment system, the recycled water quality and quantity, as well as the management practices with each proposed beneficial purpose. Since the strengths and weaknesses of the barriers will vary with each individual project, the DEQ approved treatment processes, monitoring requirements, and site management practices should be appropriate to the specific project. In addition, alternatives to setbacks [OAR 340-055-0016(6)] and public outreach [OAR 340-055-0016(8)] may be appropriate based upon specific circumstances.

2.4.2 Indicator Organisms

Since it is impractical to monitor for all possible pathogenic organisms of concern, the recycled water rules rely on the measurement of indicator organisms, specifically total coliform or *E. coli*, to establish the treatment Class (Table 3). The concentration of indicator organisms is not necessarily representative of the presence or concentrations of viruses, parasites, or organisms from non-human origin. Consequently, disinfection in combination with appropriate environmental controls is used to protect public health and the environment.

2.4.3 Aerosol Generation

The transmission of pathogens via aerosols is a concern with recycled water use. The definition of an aerosol, as used by the National Institute for Occupational Safety and Health (NIOSH), is a suspension of tiny particles or droplets in the air, such as dusts, mists, or fumes. These particles may be inhaled or absorbed by the skin, and can sometimes cause adverse heath effects for workers [(National Institute for Occupational Safety and Health (NIOSH) Division of Applied Research and Technology 2008)]. Functional definitions used by EPA include particles less than 50 µm in diameter suspended in air. Since most viruses and pathogenic bacteria are within this size range and are present in recycled water, inhalation of aerosols is a possible means of direct human infection [(USEPA 2004), pg 98]. Aerosol generation can occur in a variety of beneficial purposes, including irrigation, industrial, commercial, or construction uses. During permitting, DEQ should consider recycled water aerosols and include a brief exposure summary in the Permit Evaluation Report.

Aerosols from Spray Irrigation

Although the setbacks, access and exposure controls, and site management practices described in the rule are generally sufficient to protect public health at sites using spray irrigation, DEQ should make a qualitative evaluation of public exposure to aerosols for beneficial purposes utilizing spray irrigation by considering the following factors:

1. **Recycled Water characteristics.** Recycled waters with lower treatment contain higher levels of bacteria and present a potentially higher risk of human exposure to pathogenic organisms.
2. **Irrigation characteristics.** High profile, high pressure spray irrigation systems that produce a fine mist of small droplets will tend to travel farther than low profile, low pressure systems that produce comparatively larger droplets.
3. **Atmospheric conditions.** Bacteria and viruses in aerosols remain viable and travel farther with increased wind speed, increased relative humidity, decreased temperature, and darkness.
4. **Exposure potential.** Irrigation with recycled water in high density or high traffic areas has a higher potential for human exposure than in sparsely populated areas.

If any two of the above four factors suggests higher risk of public exposure to aerosols, DEQ should carefully review the design and operational controls described in the RWUP. In unusual or high-risk situations, DEQ may consider additional exposure controls at the reuse site. Table 4 lists some design and operational guidelines developed by EPA for limiting aerosol exposure from spray irrigation systems [(USEPA 2004), pg. 100]. **DEQ must provide justification when requesting additional aerosol exposure controls at spray irrigation sites.**

Table 4. EPA guidelines for limiting public exposure to aerosols generated through spray irrigation systems.

Design features:
• Setback distances, which are sometimes called buffer zones • Windbreaks, such as trees or walls around irrigated areas • Low pressure irrigation systems and/or spray nozzles with large orifices to reduce the formation of fine mist • Low-profile sprinklers • Surface or subsurface methods of irrigation
Operational measures:
• Spraying only during periods of low wind velocity • Not spraying when wind is blowing toward sensitive areas subject to aerosol drift or windblown spray • Irrigating at off-hours, when the public or employees would not be in areas subject to aerosols or spray

Aerosols in Cooling Water and Other Applications

Aerosols generated in cooling water systems may represent a public health concern[1]. As with spray irrigation systems, DEQ should carefully consider public exposure to aerosols generated

[1] DHS has also identified *Legionella* as a potential concern in cooling water systems (e.g., evaporative cooling).

from cooling water systems and ensure that the RWUP includes the appropriate exposure controls. Specific considerations include, but are not limited to the following:

- California distinguishes between cooling systems that create a mist and those that do not. Systems that create a mist must be operated with drift eliminators and/or biocides if public or employees are potentially exposed to the mist [(California Title 22, 13552.8(a)(3)].
- Employee education programs can also be used as a strategy for promoting awareness of aerosol generation in the workplace.
- If workplace hazards are of particular concern with a reuse application, the permit writer may need to confer with Oregon OSHA for additional guidance.

2.4.4 Groundwater Protection

Recycled water may not be authorized for use unless the groundwater quality protection requirements in OAR 340, division 40 are met. The Recycled Water Use Rules specifically require the wastewater treatment system owner to demonstrate that recycled water will be used or land applied in manner and at a rate that minimizes the movement of contaminants to groundwater or does not adversely impact groundwater quality [OAR 340-055-0020][2].

When evaluating a recycled water use proposal, DEQ should review water quality information and application rate information submitted by the wastewater treatment plant owner. If the recycled water use is not expected to have any reasonable impact on groundwater, a conclusion of "no reasonable impact on groundwater" should be made in the Permit Evaluation Report. If the information is insufficient to make a determination, DEQ should request additional information from the applicant.

Specific recycled water uses identified in rule that have greatest possibility of impacting groundwater include irrigation projects, landscape/recreational impoundments, and AR. Consider the following when evaluating these types of recycled water projects:

- Irrigation projects with properly functioning and maintained irrigation systems that are designed to apply recycled water at agronomic or consumptive rates (whichever is limiting) should not have an adverse effect on groundwater. DEQ should verify that the RWUP appropriately describes how water application rate calculations will be made and irrigation managed to prevent groundwater impacts.
- Properly designed impoundments generally do not represent a threat to groundwater.
- If groundwater impacts are likely or intended, such as with AR, the applicant must submit technical information and reports on the potential for adverse impacts to groundwater quality [OAR 340-040-0030(2)]. If upon review and evaluation of the aforementioned

[2] Under ORS 468B.150 through ORS 468B.190, activities regulated by DEQ must prevent contamination of Oregon's groundwater resource while striving to conserve and restore this resource and to maintain the high quality of Oregon's ground water resource for present and future uses [ORS 468B.155; ORS 468B.160(2); ORS 468B.160(6)].

technical information and reports, DEQ determines that adverse groundwater quality impacts are likely, DEQ may not authorize the beneficial purpose [OAR 340-0020].

Groundwater Management Areas and Other Sensitive Areas

OAR 340-055-0020 states DEQ may require additional conditions to be met for recycled water projects located in a designated GWMA. When a recycled water use project is proposed in a GWMA (Figure 1), the DEQ permit writer should confer with the DEQ regional hydrogeologist and land application coordinator to determine if additional permit limits, conditions, or management practices consistent with the GWMA Action Plan may be required to ensure that recycled water use is protective of groundwater.

2.4.5 Surface Water Protection

Unless specifically authorized for periodic discharge under a NPDES permit, recycled water may not enter surface waters. Some of the surface water protections incorporated into the permit or RWUP include:

- Schedule A of the permit contains language prohibiting surface runoff or discharges to surface waters.
- Special consideration of design capacity and overflows from impoundments or lagoons will generally be made during engineering plan review.
- The RWUP should include provisions for managing irrigation water drainage and preventing surface water discharges at irrigation sites.

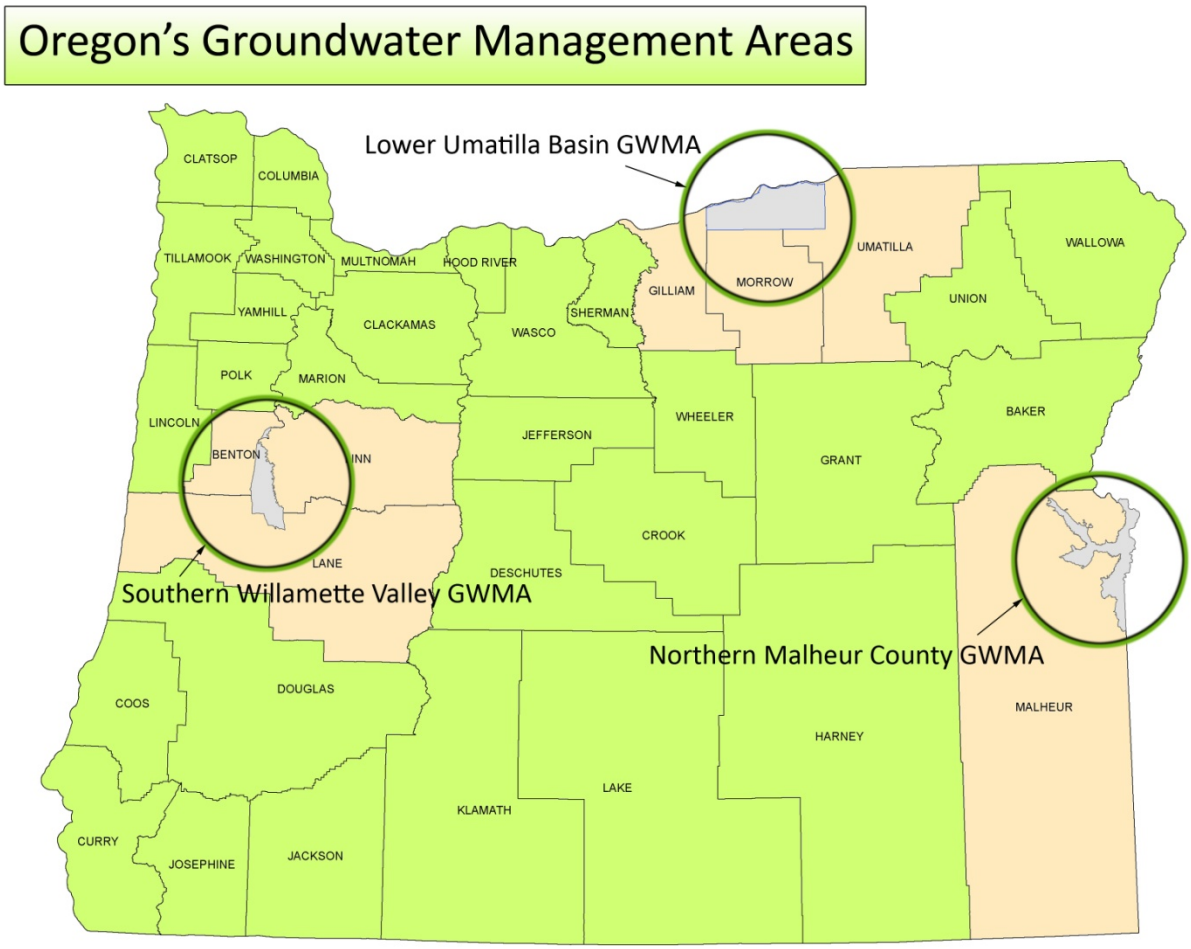

Figure 1. Location of GWMAs in Oregon (as of February 2009).
See http://www.deq.state.or.us/wq/groundwater/groundwater.htm for updated information.

2.4.6 Transporting Recycled Water

Vehicles used to transport or distribute recycled water may not be used to transport potable water supplies, unless DEQ provides written approval [OAR 340-055-0017]. If it is not possible to purchase separate vehicles to transport potable and non-potable water, other alternatives may be appropriate, such as:

- Cooperative agreements with neighboring jurisdictions to share use of recycled water trucks; or
- Disinfecting the vehicle water tanks with a shock chlorine treatment that results in a minimum chlorine residual of 0.2 mg/L measured in the tank residue after four hours based on DHS drinking water requirements [OAR 333-061-0032(5)(b)]. Sampling and testing tank residue prior to filling with potable water supplies should also indicate a fecal coliform concentration equal to or less than 20/100 mL, or the total coliform concentration equal to or less than 100/100 mL in representative samples of the tank residue [OAR 333-061-0032(2)(b)(A)].

2.5 Water Quality and Quantity Considerations

2.5.1 Water Quality and Beneficial Purposes

DEQ should review the physical and chemical characteristics of the recycled water and the proposed beneficial purposes for the following reasons:

- To determine if additional permit limits or conditions are required to protect public health or the environment [OAR 340-055-0016(5)];
- To ensure that the application rates and site management practices in land application projects do not reduce the productivity of EFU-zoned agricultural lands [ORS 215.246]; and
- To assist the treatment system owner, end user, or both in managing recycled water use in order to avoid the creation of nuisance conditions (e.g., WPCF, Schedule F, Section B, Condition 2), such as attracting vectors or forming objectionable odors.

Representative recycled water quality data should be included in the RWUP with the permit application, including the quantity of recycled water to be used and the concentrations of major constituents. If the information provided is inadequate, DEQ should request the appropriate water quantity and quality information from the applicant. DEQ should not approve recycled water projects unless the recycled water quality, permit limits and conditions, and site management practices are protective of public health and the environment. Appendix E includes some recycled water quality considerations for use with various beneficial purposes.

2.5.2 Blending

On a case-by-case basis, DEQ may approve in writing the blending (or mixing) of recycled water with "other waters" [OAR 340-055-0017(3)]. "Other waters" refers to any water not originating from the wastewater treatment process and may include, but is not limited to potable water, ambient (surface) waters, groundwater, harvested rainwater, building foundation water, industrial process water, and stormwater.

Blending implies an intentional mixing of a supplemental water source with recycled water to create a final water product that is of different quality or quantity than either of the original sources. Most commonly, recycled water is blended with other sources during peak irrigation periods when the quantity of recycled water is insufficient to meet irrigation demand. Blending may also be used to alter the water chemistry to create a final water product that meets the needs of a defined beneficial purpose. Blending should not be used as a substitute for wastewater disinfection (i.e., to reduce the concentration of pathogenic organisms) or filtration (i.e., to reduce turbidity).

Blending does not include the passive addition of precipitation (i.e., rain or snow) to storage lagoons, irrigation ponds, or impoundments. However, stormwater runoff may significantly alter the quantity and quality of the recycled water, and on a case-by-case basis, the mixing of stormwater into recycled water may require special consideration in the RWUP.

In order to obtain authorization to blend recycled water, the rule requires that the wastewater treatment system owner submit to DEQ, at a minimum, the following information [OAR 340-055-0017(3)]:

- An operations plan;
- A description of any additional treatment process;
- A description of blending volumes; and
- A range of final recycled water quality at the compliance point identified in the NPDES or WPCF permit.

Blending Considerations

DEQ approval of blending must take into account a number of factors such as the quantity and quality of the blended water, the reliability of source delivery, and consistency of the source water. Some of the specific factors DEQ should consider when approving a blending proposal include:

- The need for blending (i.e., quantity or quality);
- The proposed end use(s) (e.g., If a facility is approved for multiple end uses, blended water may not be appropriate for all end uses);
- The compliance monitoring point;
- Controls/variability on the "other sources" of water (i.e., consistency and reliability);
- The addition of other limiting constituents of concern that may limit the end use of the blended water source; and
- Preventing cross connections with potable water sources if potable water is blended with recycled water.

Monitoring of Blended Water

Blending can affect the chemical, physical, and biological characteristics of the recycled water supply, and DEQ should specify the appropriate monitoring requirements in the permit, considering the following:

- If the source of water that is blended with the recycled water is "cleaner" than the original recycled water, no changes to the compliance monitoring program are likely required.
- If blending can potentially change the Class of recycled water, bacteria (and turbidity) monitoring should occur immediately after blending to ensure the blended water meets the treatment Class requirements for the beneficial purpose.
- If the source of water that is blended with the recycled water results in physical or chemical changes to the water chemistry (e.g., blending with industrial waters) that may adversely affect public health, the environment, or the resource value, compliance monitoring should occur after blending has occurred.

2.5.3 Storage and Water Quality

For purposes of this IMD, the storage of recycled water refers to the holding of recycled water in enclosed tanks, open reservoirs, or lagoons that occurs after treatment but prior to reuse. Storage may be necessary to balance differences that occur in the generation and use of

recycled water. Storage may occur at the treatment facility, at an intermediate location, or at the point of reuse. DEQ should consider a number of factors when reviewing projects proposing the storage of recycled water, including capacity (i.e., quantity), water quality changes, and environmental/public health considerations.

2.5.4 Maintaining Water Quality

If DEQ determines that recycled water quality degradation following treatment will adversely affect public health, the environment, or reduce the resource value for the beneficial purpose, DEQ should discuss water quality concerns with the permittee and request that appropriate controls and management strategies be included in the RWUP. Biofilm development, in particular, can significantly affect recycled water quality. Table 5 lists some management strategies for controlling the development of biofilms in recycled water systems that may be included by the permittee in the RWUP.

Table 5. Strategies for managing biofilm development in recycled water systems.

Category	Solution
Monitoring	• Collect water samples and analyze for chlorine residual, bacteria, turbidity, and nutrients
Operations	• Maintain chlorine residual of 1-2 mg/L • Minimize residence times in storage
Maintenance	• Periodically flush transmission and distribution lines to remove sediments; mechanically clean/remove biofilms

Maintaining a chlorine residual in the transmission and distribution systems may be an effective management strategy for preventing the growth of biofilms, preventing the formation of offensive odors, and overall maintaining recycled water quality.

2.6 Coordination with Other State Agencies

The Permit Writer must ensure that the appropriate persons or agencies review the permit (Table 6), RWUP, and other information submitted with the recycled water use proposal. **The Permit Writer must address comments and ensure that all water resource, public health, and environmental considerations are addressed before issuing the permit.**

Table 6. Summary of agencies involved in the permitting recycled water use.

Who: **Department of Environmental Quality, DEQ**	**Who**: **Water Resources Department, WRD**
What: Concerned with recycled water *quality* issues and environmental quality. • Lead permitting authority for recycled water use. • Manages the permitting process. • Writes the permit. • Engineering plan review. • Reviews and approves the RWUP. **When**: Throughout the life of the permit	**What**: Concerned with water *quantity* issues. • Reviews Registrations of Recycled Water Use. • Approves engineering plans for lagoons and retention structures[#]. • Permits Aquifer Storage and Recovery. **When:** A Water Right Registration must be submitted with the permit application. Approval of engineering plans for lagoons and retention structures during permit approval.

Who: **Department of Human Services, DHS** **What**: Primarily concerned with *Public Health* issues. • Reviews all RWUPs involving Class C, D, or nondisinfected water. • Reviews proposed beneficial purposes using Class C, D, or nondisinfected water. • Approves any use of recycled water for direct human consumption or as a supply for a pool, spa, or public bath house. • May submit comments on RWUPs. **When**: DEQ submits the RWUP for review during the permitting process. DHS provides written comments within 2 weeks.*	**Who**: **Other Agencies** **What**: Case-by-case consultations on specific issues. Ex: County planners for resolving land use issues. **When**: As needed. When in doubt, contact the agency and clarify what role, if any, they will play in the permitting process.

* Follow up with DHS if no response received within 2 weeks.
#Storage structures that exceed 10-feet in height and 9.2 acre-feet require a Dam Safety certification from WRD [ORS 540.400]. Structures of this size may also require a separate permit from WRD (see http://www.wrd.state.or.us/OWRD/SW/dams_in_oregon.shtml_specs.shtml).

2.6.1 Water Right Registration with the Oregon Water Resources Department

Any person using or intending to use recycled water must file a Registration of Recycled Water Use[3] with WRD [ORS 537.132(2)] (http://www.oregon.gov/OWRD/mgmt_reclaimed.shtml). The permittee bears responsibility for contacting WRD to determine any underlying water right requirements [OAR 340-055-0017(4)]. The permittee should also confer with WRD on existing recycled water use projects when changes to flow and/or use may result in changes to the recognized water rights.

The permittee should submit a completed registration of recycled water use form to DEQ with a new recycled water use application. WRD requires DEQ signature on the registration form, which indicates that DEQ has completed the statutory obligations of ORS 537.132(1) pertaining to recycled water use. **The DEQ permit writer is responsible for signing the registration form and forward it onto WRD. A copy of the signed form should be included with the permit evaluation report.**

Based upon the information provided in the Registration, WRD may deny the use of recycled water or request special measuring or reporting requirements [OAR 340-055-0025(1)(h)]. If the WRD requires monitoring or reporting requirements on the recycled water use, the applicant must submit those to DEQ in the RWUP [OAR 340-055-0025(1)(h)]. Monitoring and reporting requirements imposed by WRD may be in addition to those required by DEQ.

Registration forms may be obtained:

- On the internet at: http://www.oregon.gov/OWRD/PUBL/forms-shtml; or

[3] As of May 2009, the name of the registration form is "Registration of Reclaimed Municipal Water Use".

- By mail at: Oregon Water Resources Department
  725 Summer Street NE
  Salem OR, 97301

WRD Authorization for Artificial Recharge

When a new or modified permit application is received for the beneficial purpose of AR the applicant must also provide verification from WRD that an authorization for AR has been initiated [OAR 340-055-0025(3)(e)]. Since OAR 340-055 does not require a limited license or water right from WRD prior to issuing a recycled water use permit for AR, Schedule D should include a condition that AR may not occur without first obtaining the limited license or water right. (The permittee should submit a copy of the WRD approval to DEQ prior to using recycled water for AR at a specified location.) If WRD ultimately denies the limited license or water right for AR, then DEQ must deny the AR proposal. The same facility may re-apply to use recycled water for AR at a different location which must undergo a separate evaluation by DEQ and WRD.

2.6.2 Recycled Water Use Plan Review by the Department of Human Services

DEQ, not the applicant, must present the RWUP to DHS for either comment or approval under the situations identified in Table 7.

DHS should provide a written response to DEQ, via letter or email, within two weeks of the request. DEQ will honor any requests by DHS for additional time to review the plan and/or proposed reuse. DEQ may include limits or conditions suggested by DHS in the water quality permit and RWUP, as appropriate. DEQ must address DHS comments prior to issuing a permit for the use of Class C, D, or nondisinfected water.

Table 7. The RWUP must be reviewed by the DHS under specific conditions. DHS provides comment or approval, depending upon the proposed beneficial purpose.

Comment	Approval
• Any proposed reuse of Class C, Class D, or nondisinfected water [OAR 340-055-0016(2)(b)]. • Any proposed new beneficial purpose of Class C, Class D, or nondisinfected water not authorized in rule [OAR 340-050-0016(6)].	• Any proposed use of recycled water for direct human consumption, regardless of treatment Class [OAR 340-055-0017(5)]*. • Any proposed use of recycled water, regardless of treatment Class, as a source of supply for a public pool, spa, or bathhouse [OAR 340-055-0017(6)]*.

*DHS provides ongoing regulation (i.e., inspection, monitoring, and reporting) for all public water systems. DHS licenses and inspects all public spas, pools, and bathhouses once they have been approved.

2.6.3 Other State and Local Agencies

The Governor's Executive Order No. EO 05-04 directs DEQ, DHS, WRD, and the Department of Consumer and Business Services (DCBS) to collaborate and work to resolve issues with other relevant agencies regarding water reuse, particularly as it pertains to water reuse pilot projects. DEQ may need to coordinate and confer with other agencies to permit new or innovative water

reuse applications. DEQ staff should confer with the DEQ Water Reuse Coordinator on special projects requiring coordination with agencies other than DHS or WRD.

2.7 Public Notice

Public Notice of RWUPs is required and should generally occur at the same time as the associated NPDES or WPCF permit under OAR 340-045-0027. The Public Notice for the proposed issuance of the permit must inform interested persons that the RWUP is available for review. Modifications to the recycled water use program or RWUP during the effective permit period are also subject to Public Notice, depending upon whether or not the modifications are major or minor. In general, any change in the recycled water treatment that results in a lower level of treatment or any change in approved beneficial purpose is subject to Public Notice.

2.8 Responsibility for Compliance

Any person having control over treatment, distribution, or use of recycled water must comply with Division 55 Recycled Water Use Rules [OAR 340-055-0012 (1) & (2)]. DEQ does not oversee contracts between wastewater treatment facilities and recycled water users. Consequently, it is important that all those having control over the treatment, distribution, and/or use of the recycled water are fully aware of permit limits and conditions, and their respective responsibilities, including all conditions/requirements described in the RWUP. It is up to the permittee and recycled water user to establish any agreement to maintain compliance with the rules. The RWUP may include a discussion on the roles and responsibility of the recycled water generator and user(s).

If violations of OAR 350-055 are discovered, DEQ has the authority to bring enforcement action against the appropriate entity after investigation, which may include the wastewater treatment facility, the recycled water distributor, and/or the recycled water user [OAR 340-055-0012 (1) & (2)]. Enforcement action will follow the procedures described in OAR 340-012, Enforcement Procedure and Civil Penalties.

2.9 Permitting Process

In addition to the general procedures for issuing NPDES and WPCF permits described in OAR 340-045, recycled water permitting requires DEQ to sign and submit a Registration of Recycled Water Use to WRD as well as review and approve a RWUP. Figure 2 provides details on the permitting considerations unique to recycled water use.

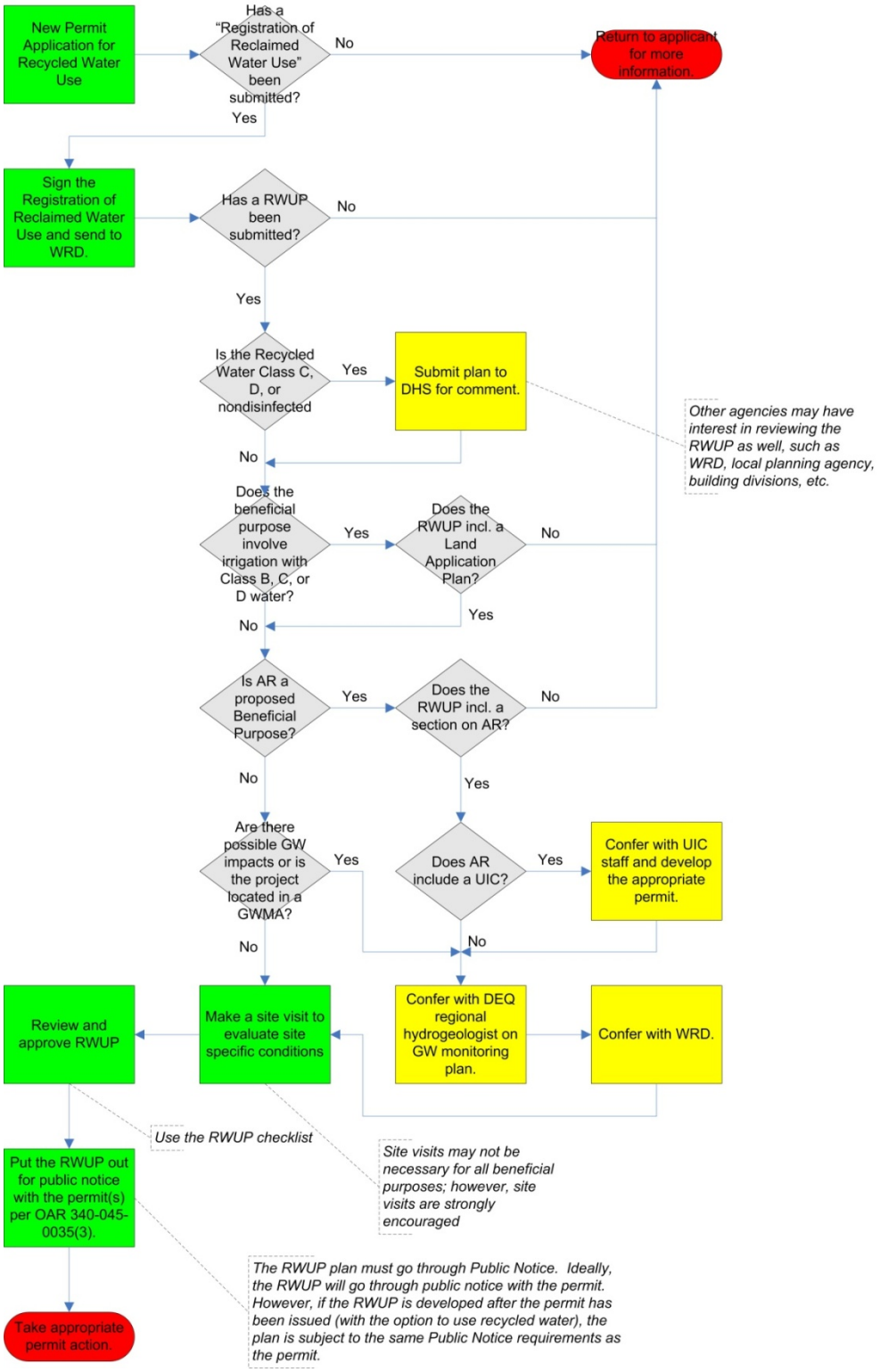

Figure 2. Summary of DEQ actions unique to the recycled water permitting process. Green boxes identify processes managed by the permit writer; yellow boxes identify processes that are passed to others for review.

3. PUTTING THE PERMIT TOGETHER

3.1 Permit Application

A NPDES or WPCF permit for recycled water use is required in the following situations:

1. Any wastewater treatment owner providing recycled water for use [OAR 340-055-0016(1)].
2. A person using recycled water from a wastewater treatment system and providing additional treatment for a different Class of water [OAR 340-055-0017(2)].

   When another person or facility provides additional treatment which results in a different Class of water, DEQ will issue two permits—one to the original wastewater treatment facility and the second to the person or facility providing additional treatment. If the Class of water remains unchanged by additional treatment, OAR 340-055 does not require another permit.

3. NPDES permit holders that wish to use of Class A water for AR via an Underground Injection Control (UIC) system, must register the UIC system with DEQ. If the UIC cannot be "rule authorized", a separate WPCF permit may be required for the UIC system.

3.1.1 Permit Documentation

In addition to the standard requirements (i.e., permit application, engineering plans) to be submitted with a new or renewed NPDES or WPCF permit, a facility proposing the use of recycled water must also submit:

- A Registration of Recycled Water Use with the WRD; and
- A facility specific RWUP.

DEQ should consider permit applications that fail to submit this documentation as incomplete. Depending on the beneficial purpose, the permit writer may also request one or more of the following:

- Information for the approval of an alternative beneficial purpose;
- Information for the approval of alternative treatment processes;
- A Land Use Compatibility Statement (LUCS);
- A summary of recycled water quantity and quality (for evaluating public health and environmental impacts)[4];
- Site specific information at the point of reuse[5]; and

[4] Recycled water quantity and quality information will generally be provided with the RWUP.

[5] Most of this information should have been included with the RWUP, however, additional details may be required for specific uses of recycled water

- Registration of a UIC system with DEQ UIC staff (http://www.deq.state.or.us/wq/uic/uic.htm).

3.1.2 Permitting Artificial Groundwater Recharge

Recycled water used for AR involves multiple rules and requires additional consideration by DEQ (Table 8), such as:

- All AR projects must satisfy the groundwater quality requirements of OAR 340-040, including the development of a groundwater monitoring program [OAR 340-055-0025(3)(a)].
- Any AR system utilizing a subsurface injection system should be reviewed by DEQ's UIC staff for compliance with UIC rules[6].
- When permitting an AR project, the permit writer should seek the assistance of the regional hydrogeologist to review the recycled water quality treatment and monitoring requirements as well as to assist in evaluating the groundwater monitoring plan which is incorporated into the RWUP.
- It is also appropriate to seek assistance from WRD to ensure that all water rights issues have been fully addressed.

Table 8 Rules that must be complied with for the permitting of Artificial Groundwater Recharge.

Artificial Groundwater Recharge Method	Recycled Water Rules (OAR 340-055)	Groundwater Rules (OAR 340-040)	UIC Rules (OAR 340-044)
Surface Infiltration	✓	✓	
Subsurface (Vadose) Injection	✓	✓	✓
Direct Injection	Currently Not Allowed by UIC Rules[7]		

AR Water Quality

DEQ should review the quality of recycled water used for AR to ensure that it satisfies the requirements of a number of different rules.

- The Recycled Water Use Rules allow AR only for recycled water treated to Class A standards [OAR 340-055-0012(7)(F)].
- The groundwater rules specify a minimum level of treatment to drinking water standards (OAR 340-040-0020(3) by the time the recycled water reaches the aquifer. The anti-

[6] As a general rule, if the infiltration system is wider than it is deep, it is a surface infiltration system. If the system is deeper than it is wide, it is a UIC.

[7] Direct injection of recycled water into a subsurface aquifer is prohibited by UIC rules. ASR projects utilizing other water sources are licensed and permitted by WRD. WRD will typically confer with DEQ and DHS to ensure that ASR projects satisfy UIC, groundwater, and drinking water requirements. Applicants should be informed that the use of recycled water in ASR projects is currently prohibited DEQ rules. Any inquiries on the permitting of ASR using other water sources should be directed to WRD.

degradation policy of OAR 340-040-0020(2) may require additional treatment to meet background water quality.

- The water quality standards (OAR 340-041) require wastes discharged to the state to be disinfected, after treatment, equivalent through mixing with sufficient chlorine to provide a residual of at least 1 mg/L after 60 minutes of contact time unless otherwise specifically authorized by the permit OAR 340-041-0007(16).

Some of the recycled water quality factors that may need consideration include (1) microbiological quality, (2) total mineral content (i.e., TDS), (3) constituents prone to precipitation such as phosphates, (4) toxic constituents such as heavy metals, (5) nutrients (e.g., NO_3-N), and (6) trace organic constituents [(Asano, et al. 2007), pg 1255].

A chlorine residual can be used to confirm treatment effectiveness and ensure that the bacteria limit has been met when the recycled water is discharged into the recharge system. Typically, chlorine will escape in gaseous form and no residual will be present once the recycled water reaches the aquifer. For this reason, the chlorine residual can typically be measured directly after the contact chamber.

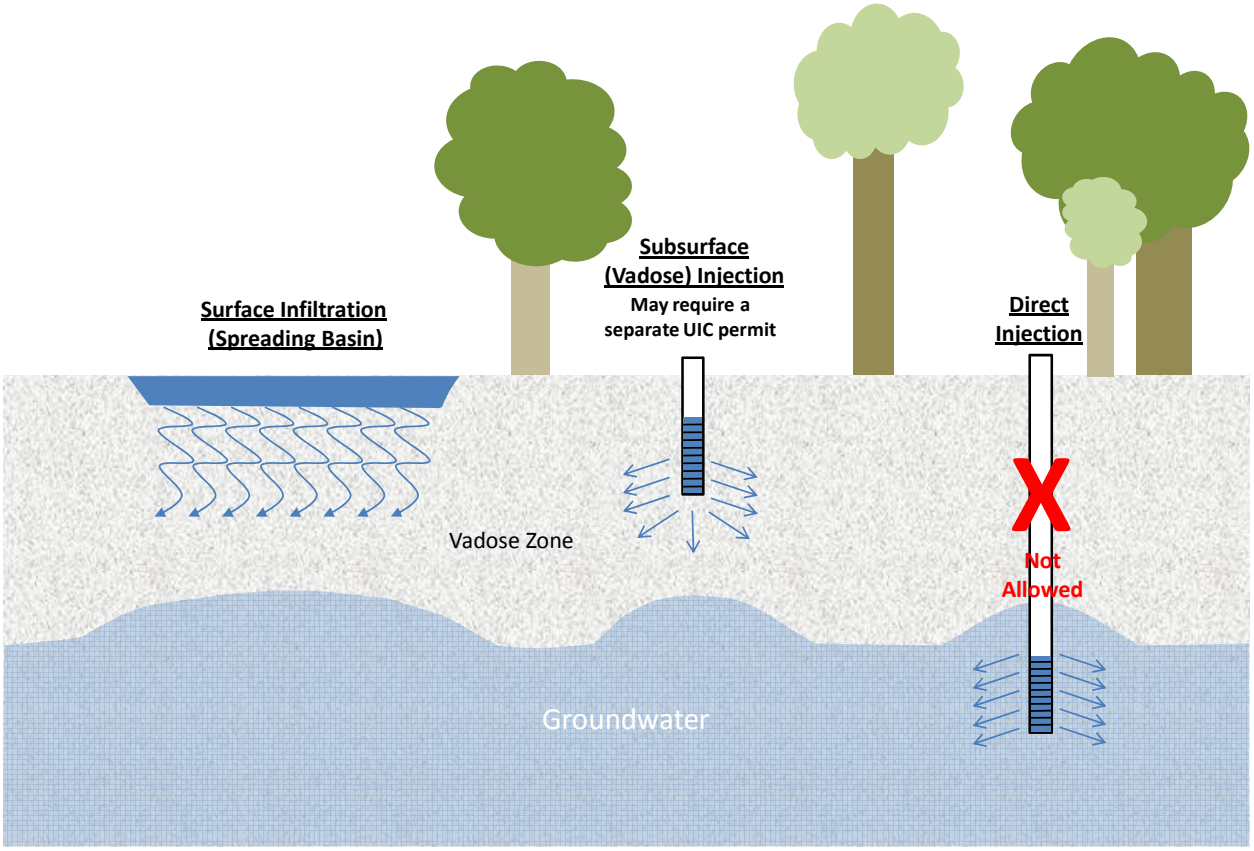

Figure 3. Only two of the three methods for AR may be permitted by DEQ. Direct Injection of recycled water into the aquifer is not allowed by UIC rules.

AR Compliance Monitoring Point

Recycled water used for AR must meet the water quality standards by the time the recycled water reaches the aquifer. If the recycled water has been treated to the appropriate water quality standards at the treatment facility, compliance monitoring may occur at the end of the treatment train, as water exits the disinfection chamber. If the treatment system relies on natural attenuation by movement through the underlying media (i.e., subsoil), compliance monitoring of recycled water in the vadose zone beneath the infiltration system may be necessary. Water quality monitoring in the vadose zone can be achieved through the use of lysimeters installed beneath the recharge basin. The type, number, and depth of lysimeters will be dependent upon the site specific conditions and operations, such as depth to groundwater, underlying geology, groundwater depth, groundwater flow, etc. Details on AR monitoring and the location of the compliance monitoring point should be reviewed with the DEQ regional hydrogeologist.

3.2 Format of the Permit

For most recycled water permits, recycled water use conditions will be specified in one or more of the following locations:

- Schedule A – Waste Discharge Limitations;
- Schedule B – Monitoring and Reporting;
- Schedule D – Special Conditions; and
- The RWUP.

Table 9 identifies the major requirements for recycled water use, and their locations in the permit or RWUP.

Table 9. Summary of recycled water permit requirements.

Requirement	Sch. A	Sch. B	Sch. D	RWUP
Class(es) of Recycled Water	✓			✓
Beneficial purpose(s)	✓			✓
Alternative beneficial purpose	✓			✓
Discharge Limitations specific to the Class(es) of Water (i.e., oxidation, disinfection, filtration)	✓			✓
No discharge to surface water or groundwater unless authorized	✓			
Limits to nutrient and hydraulic loading at agricultural sites	✓			✓
Water Quality Compliance Monitoring Point		✓		✓
Monitoring requirements specific to the Class(es) of Water		✓		✓
Additional Monitoring based on use (e.g., AR)		✓		✓
Water Sample Collection and Analysis		✓		✓
Annual Reporting		✓		✓
Maintaining a RWUP			✓	
Recycled Water Use Permit Exemptions			✓	
Alternate Treatment technology			✓	✓
Water Quality Limitations (if any)				✓
Management Practices for maintaining water quality				✓
Water application rates (agronomic, consumptive, etc.)				✓
Site management				✓
Setback distances				✓
Access and Exposure restrictions				✓
Public/employee notification methods				✓
Contingency Operations				✓
Best Management Practices				✓

In general, permit limits or conditions included in Schedules A, B, and D of the permit should relate to recycled water quality under the control of the wastewater treatment facility. This includes any additional limits or conditions imposed on the treatment facility prior to delivering the water to the end user. The permit will also include any limits or conditions on groundwater

or surface water. Appendix A contains some sample language that can be included in a recycled water use permit.

The RWUP will generally describe any limits and conditions required following delivery of recycled water to the end user, such as access and exposure restrictions, site specific setbacks at irrigation sites, site management practices, signage, site specific monitoring, contingency operations, etc. Appendix D includes a RWUP checklist that can assist with DEQ review of the plan.

3.3 Schedule A - Discharge Limitations

3.3.1 Bacteria and Turbidity Requirements

OAR 340-055 requires monitoring to establish the Class of Recycled Water, which includes bacteria and, for Class A, turbidity. The rule defines the monitoring parameters, frequency, and criteria limits for each of the Classes of water (Table 3).

Bacteria

Compliance monitoring for bacteria in Class A, B, C, and D waters must occur before the water can be used for a beneficial purpose. In the disinfection process, pathogenic bacteria are reduced in number[8] and water quality degradation that occurs after delivery to the water user(s) should be no different than that which would occur with other sources of water (e.g., groundwater or surface water). Consequently, additional monitoring to establish the recycled water treatment Class is generally not necessary. However, compliance with the bacteria standard should occur following any intentional changes in water quality, such as blending. Bacteria monitoring may also need to occur in unusual circumstance when unintentional changes in water quality could result in a reuse that is not protective of public health, the environment, or make it unsuitable for the proposed end use. The need for bacteria monitoring following disinfection should be evaluated on a case-by-case basis, based upon the recycled water system and specific concerns associated with the beneficial purpose. DEQ must be able to justify the need for bacteria monitoring following treatment and should consider:

- Regulatory constraints in the reuse application (e.g., groundwater recharge);
- Treatment processes (e.g., disinfection, blending);
- Exposure issues (e.g., human contact);
- Environmental concerns (e.g., water bodies listed for bacteria); and
- Operational restrictions (e.g., clogging of valves and nozzles).

Nondisinfected waters do not require compliance monitoring for bacteria.

[8] Even highly treated Class A water cannot be assured to be pathogen free. However, bacterial regrowth that occurs following disinfection and prior to reuse should generally be of nonpathogenic bacteria. Furthermore, following treatment, the conditions for the replication of viruses and parasites such as *Giardia* and *Cryptosporidum* are unfavorable [(Asano, et al. 2007), pg. 145]. Regardless, pathogens have potential to "amplify" and "regrow" in the environment.

Turbidity

Turbidity monitoring is required for Class A waters only, and is typically made using a continuous flow turbidity monitor [(Asano, et al. 2007), pg. 145]. Although turbidity and bacteria counts may correlate, low turbidity does not imply the absence of microorganisms, and turbidity should not be used as a surrogate for bacterial monitoring. Unless otherwise approved in writing by DEQ and specified in Schedule B of the permit, compliance monitoring for turbidity must occur after filtration and immediately prior to disinfection [OAR 340-050-0012(7)(c)(A)], (Asano, et al. 2007), pg. 143].

3.3.2 Recycled Water Class and Beneficial Purpose

Schedule A of the permit should identify the Class(es) of recycled water produced as well as the intended beneficial purposes. Since permit limits and conditions, monitoring requirements, and RWUP contents are based upon the beneficial purpose, the addition of new beneficial purposes or a change to a less-treated Class of water is a permit modification.

3.3.3 Surface Water, Groundwater, and Other Limitations

With the exception of AR, recycled water may not be discharged to Waters of the State under Division 55. Schedule A of the permit should include conditions prohibiting discharge to waters of the state, including both surface and groundwater. Schedule A should also contain limitations on:

- The creation of nuisance conditions;
- Overloading of land with nutrients, organics, or other pollutant parameters;
- Impairment of existing or potential beneficial uses of groundwater; and
- The use of recycled water must conform to the RWUP approved by DEQ.

3.3.4 Additional Permit Limits and Conditions

Recycled water may have chemical or physical characteristics that limit its use for some beneficial purposes (e.g., salt toxicity to crops). Similarly, a recycled water use project may be located in an area with the potential for significant public contact or in an environmentally sensitive area. Under these types of situations, OAR 340-055-0016(5) allows DEQ to include additional permit limits and conditions necessary to protect public health, the environment, or both.

If the Permit Writer determines that additional limits or conditions are necessary, he/she must provide justification for the additional limits. At a minimum, the justification should include:

- Identification of the parameters of concern;
- The risk to the public or the environment;
- The media (i.e., water, air, soil, etc.) affected;
- The mechanism of transport to the receptor; and
- The limits/conditions necessary to reduce the risk and how those limits/conditions were derived.

When establishing the limits or conditions, DEQ should consider various factors such as:

- Precedents in other DEQ permits;
- Precedents in other states;
- Federal or state guidance;
- Scientific literature;
- Economics;
- Alternatives to achieving the same solution; and
- Feasibility of implementing.

The permit writer should discuss additional permit limits or conditions with the DEQ Water Reuse Coordinator. The Coordinator will maintain a list of additional permit limits and conditions for specific beneficial purposes that can be reviewed for program consistency.

The Permit Writer should provide the permittee with the opportunity to comment on the additional limits/conditions and propose alternate approaches to managing the risk, such as alternative treatment options, alternate beneficial purposes, setbacks, access and exposure restrictions, site management practices, etc.

3.4 Schedule B - Monitoring and Reporting Requirements

3.4.1 Monitoring Requirements

NPDES and WPCF recycled water permits include self-monitoring requirements for facilities generating recycled water. Self monitoring data needs to reflect the quantity and quality of recycled water generated and used, as well as the operations, maintenance, and overall status of the treatment and reuse program.

The permit writer must be able to justify the monitoring requirements imposed on a recycled water use program. When establishing a monitoring program, the permit writer must consider the following:

- Monitoring parameters, including physical (e.g., flow, turbidity), chemical (e.g., nutrients), and biological (e.g., pathogens);
- Parameter limitations (i.e., numerical limits), when appropriate;
- Compliance monitoring point(s);
- Monitoring frequency;
- Type of sample collected (e.g., grab, composite, continuous flow);
- Sampling methods; and
- Analytical methods

The monitoring program should also consider:

- Quality assurance and quality control measures in both sample collection and analytical activities;
- Data management; and
- Data reporting.

The monitoring parameters, compliance monitoring point, and monitoring frequencies are described in Schedule B of the permit.

Monitoring Parameters

OAR 340-055-0012 specifies monitoring for bacteria (total coliform or *E. coli*) and turbidity (for Class A water only). When chlorine is used as the disinfecting agent, DEQ may require monitoring for a minimum chlorine residual [OAR 340-055-0022(2)]. In the case of other disinfecting agents such as UV radiation or ozone, DEQ may include additional monitoring requirements in the permit to ensure adequate disinfection has occurred [OAR 340-055-0022(2)].

Additional monitoring parameters may also be specified by the permit writer to characterize flow and demonstrate treatment system operations[9].

Monitoring parameters may also be established based upon the beneficial purpose. For example, some irrigation projects may include monitoring for nutrients (e.g., TKN, NO_3+NO_2-N, NH_3, and Total Phosphorus) or TDS to demonstrate compliance with loading rate limitations during land application. Other beneficial purposes may have specific monitoring requirements. The need for additional monitoring parameters should be established on a case-by-case basis.

[9] The DEQ matrix of monitoring and reporting requirements lists the following monitoring parameters: total flow (influent and effluent); flow meter calibration; BOD and TSS (influent and effluent); and pH (influent and effluent).

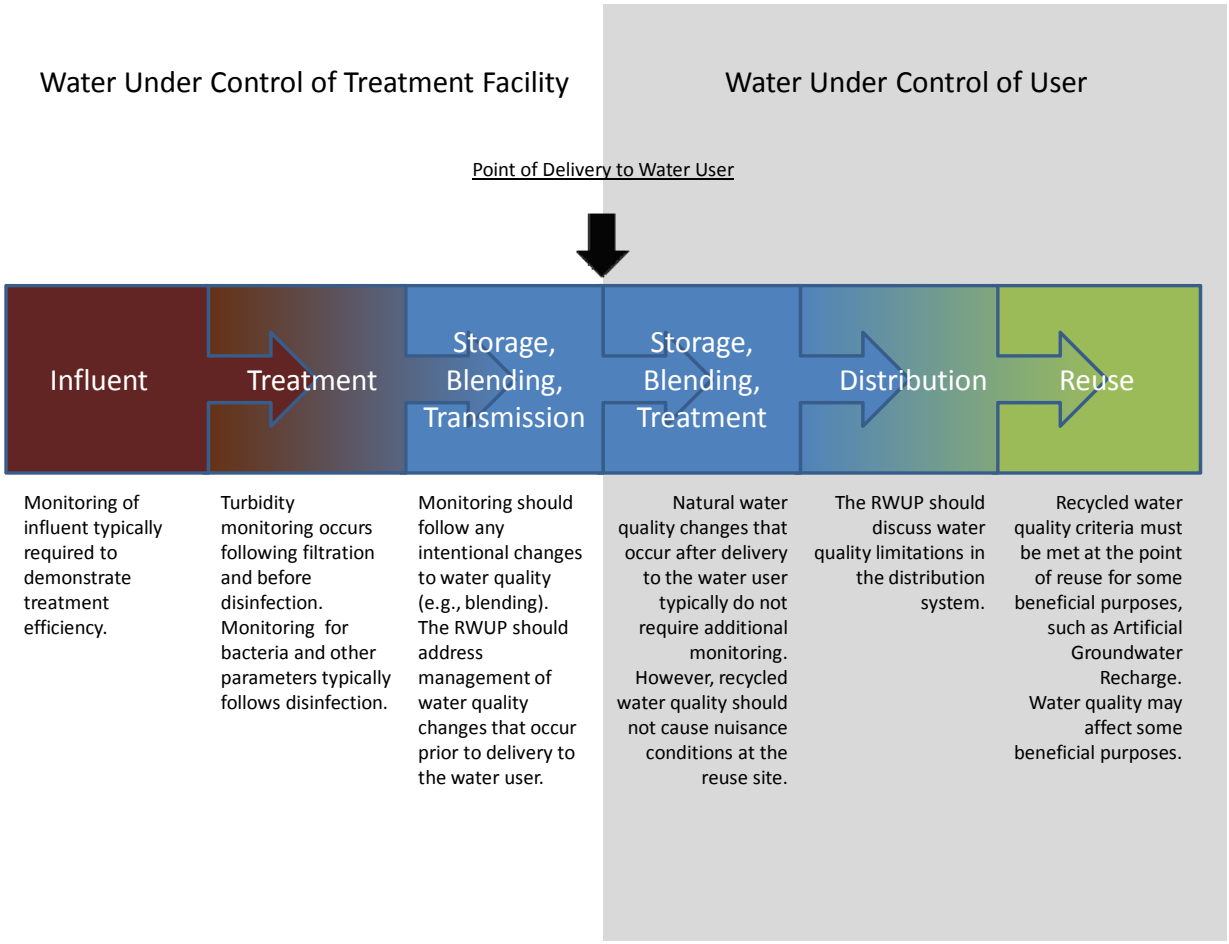

Figure 4. General considerations on recycled water monitoring.

Monitoring Point

Although the compliance monitoring point will usually be established immediately following disinfection for practical considerations, monitoring may occur at any uniquely defined point prior to reuse. Selecting the appropriate compliance monitoring point will take into account the treatment process, facility design (i.e., treatment train, blending, additional treatment, etc.), general accessibility, and beneficial purpose. The permit writer should confer with the DEQ plan review engineer, the permittee, and the water user to determine the most appropriate sampling locations for compliance monitoring. Monitoring should occur following any intentional changes to water quality that occurs prior to delivery to the water user (e.g., blending). When compliance monitoring occurs immediately following disinfection and water quality changes prior to delivery to the end user may result in public health or environmental concerns specific to the proposed beneficial purpose, DEQ may request that the RWUP include a discussion on best management practices to maintain water quality that is protective of public health and the environment during reuse.

A facility that produces multiple Classes of water will likely have multiple compliance monitoring parameters, monitoring points, and frequencies.

Monitoring Frequency

OAR 340-055-0012 specifies the frequency of bacteria and turbidity monitoring required for each recycled water Class. For bacteria monitoring, the rule specifies a frequency of daily, 3-times/week, or weekly and includes acceptance criteria such as a "30-day log mean" (Class D) or median value "based upon the last seven days" (Classes A, B, and C). The seven day median value is intended to be made from the last seven consecutive samples that are **representative** of the treatment process and operating conditions. The seven consecutive samples do not need to be collected on seven consecutive days. However, collecting seven samples on a single day is not acceptable, nor is selectively choosing seven previous samples out of a larger number. When samples are collected more frequently than specified in the rule (e.g., following an upset in the treatment system or during startup), those should be used in the calculation.

For other monitoring parameters, the monitoring frequency should be sufficient to reasonably characterize the recycled water stream.

3.4.2 Sampling

Sample Type

Recycled water monitoring can occur "in-stream" using a continuous probe or on a discrete sample. Most often, compliance monitoring samples will be collected as a "grab" or "composite" sample. When continuous monitoring equipment is used (e.g., turbidity), the RWUP plan should describe the equipment's operations, maintenance, and QA/QC requirements.

The permit writer should choose the type of sample carefully, based upon the parameter, the purpose of monitoring, and the practicality of sample collection.

Methodologies

Sample collection methods for parameters commonly monitored in water are described in 40 CFR 136 and 141 as well as Standard Methods for the Examination of Water and Wastewater. However, some analytical methods require special collection activities which may be referenced in the analytical method (http://www.nemi.gov).

3.4.3 Approved Analytical Methodologies

Analytical testing methods for determining compliance with federal and state water quality standards must comply with 40 CFR Part 136, or if Part 136 does not prescribe a method, then with the most recent addition of *Standard Methods for the Examination of Water and Waste Water* published jointly by the American Public Health Association, American Water Works Association, and Water Pollution Control Federation [OAR 340-041-0061(14)].

Table 10. List of approved analytical methods for bacterial and turbidity testing (as of May 2009).

Parameter	Currently Approved Analytical Methodology	EPA	Standard Methods 18th, 19th, 20th Ed.	Standard Methods Online	AOAC, ASTM, USGS, Other
Total Coliform	membrane filtration (MF), single step	p. 124*	9222 D	9222 D-97	
	Most Probable Number (MPN), 5 tube, 3 dilution	p. 114*	9221 B	9221 B-99	
	MF, single step or two step	p. 108*	9222 B	9222 B-97	B-0025-8†
Total Coliform in the presence of Chlorine	MPN, 5 tube, 3 dilution	p. 114*	9221 B	9221 B-99	
	MF2 with enrichment	p. 111*	9222 (B+B.5c)	9222 (B+B.5c)-97	
E. coli	MPN 7, 9, 15, multiple tube, multiple tube/multiple well; or		9223 B	9223 B-97	991.15 Colilert® Colilert-18®
	MF two step or MF single step	1603			mColiBlue-24®
Turbidity	Nephelometric method	180.1, Rev 2.0 (1993)	2130 B	2130 B-01	ASTM D1889-94,00 USGS I-3860-85$
Total Residual Chlorine	Amperometric direct		4500-Cl D	4500-Cl D-00	ASTMO D1253-86 (96), 03
	Amperometric direct, low		4500-Cl E	4500-Cl E-00	
	Iodometric direct		4500-Cl B	4500-Cl B-00	
	Back titration ether end-point		4500-Cl C	4500-Cl C-00	
	DPD-FAS		4500-Cl F	4500-Cl F-00	

Parameter	Currently Approved Analytical Methodology	EPA	Standard Methods 18th, 19th, 20th Ed.	Standard Methods Online	AOAC, ASTM, USGS, Other
	Spectrophotometric, DPD		4500-Cl G	4500-Cl G-00	
	Electrode				Orion#

*USEPA. 1978. Microbiological Methods for Monitoring the Environment, Water, and Wastes. Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, Cincinnati, OH EPA/600/8-78-017.
$Fishman, M.J., et al. "Methods for Analysis of Inorganic Substance in Water and Fluvial Sediments," U.S. Department of the Interior, Techniques of Water-Resource Investigations of the U.S. Geological Survey, Denver, CO, Revised 1989.
#Orion Research Instruction Manual, Residual Chlorine Electrode Model 97-70, 1977, Orion Research Incorporated, 840 Memorial Drive, Cambridge, MA 02138. The calibration graph for the Orion residual chlorine method must be derived using a reagent blank and three standard solutions, containing 0.2, 1.0, and 5.0 mL 0.00281 N Potassium iodate/100 ml solutions, respectively.
†USGS. 1989. U.S. Geological Survey Techniques of Water-Resource Investigations, Book 5, Laboratory Analysis, Chapter A4, Methods for Collection and Analysis of Aquatic Biological and Microbiological Samples, U.S. Geological Survey, U.S. Department of the Interior, Reston, VA.

The IDEXX Colilert methods are not currently approved for regulatory compliance monitoring of total coliform.

Analytical methodologies continue to advance and improve; consequently, new or updated analytical technologies may be approved for use by EPA or DEQ. Alternate analytical methodologies should not be approved by regional DEQ staff without conferring with the Water Reuse Coordinator.

3.4.4 Annual Reports

An annual report on recycled water use must be submitted by the permittee to the regional DEQ office and the Water Reuse Program Coordinator by the 15th of January of each year following operations. The annual report describes the effectiveness of the system to comply with the approved RWUP, the recycled water rules, and the permit limits and conditions [OAR 340-055-0022(3)]. The annual report also measures the overall success of the recycled water use program. Information in the annual report may include, but is not limited to:

- Description of changes to treatment facilities;
- Description of changes to processes specific to production of recycled water;
- Results of site inspection reports;
- Description of any operational problems (e.g., system upsets, overflows , etc.) and the corrective actions taken;
- Description of changes in the beneficial purpose (e.g., crop changes, water delivery times, supplemental water sources, etc.);

- Location and amount of recycled water used for each beneficial purpose;
- Recycled water volume produced;
- Recycled water characteristics including bacteria and turbidity, if appropriate, and other required monitoring results;
- Results from any site monitoring (e.g., soil monitoring), when required by the permit or RWUP;
- A summary of the resource value of recycled water use (e.g., harvest yields from an agricultural irrigation project, fertilizer savings, or saving from use of other water sources);
- Any planned or anticipated changes to the treatment facility equipment or operations during the next calendar year; and
- Description of any proposed/anticipated changes in water reuse operations (including major changes in agricultural practices, such as crops).

3.5 Permit Renewals and Modifications

3.5.1 Permit Renewals

On the permit renewal application, the applicant indicates if any major changes in the treatment or disposal of treated effluent have occurred since the previous application, including changes to the recycled water use program. If changes in the recycled water program have occurred, then an updated RWUP should be submitted with the application. DEQ reviews and approves any changes in the RWUP at the time of renewal, and the plan is published with the permit for Public Notice. If changes in recycled water use operations include new or modified uses of Class C, Class D, or nondisinfected water, plan review by DHS is required.

If a facility has previously been operating a recycled water use program and that program no longer complies with the current rules, the RWUP must be revised to comply with the current rules.

If the facility has been operating a recycled water program for nondisinfected water, the facility should provide justification why the effluent cannot be disinfected and show that existing conditions at the irrigation site have not changed in a manner that could create potential human health hazards or exposure concerns.

3.5.2 Permit Modifications

Modifications (Table 11) to a recycled water use program, including the RWUP, are considered permit modifications and are subject to OAR 340-045-0055.

- Major modifications of NPDES and WPCF permits are subject to Public Notice requirements.
- Modifications that result in (significant) changes to stream flow may require modification of the WRD registration.
- Major modifications of both WPCF and NPDES permits may also be subject to DHS comment if they involve the use of Class C, Class D, or nondisinfected water.
- Minor modifications to the recycled water use program do not require public notice.

Table 11. Examples of major and minor recycled water permit modifications.

Major Modifications	Minor Modifications
• Changes in the Treatment System • New beneficial purposes • Change to a lower (less treated) Class of water	• Change to a higher level of treatment (i.e., higher Class) without a change in end uses • Increased monitoring or reporting requirements • Dropping beneficial purposes • Minor changes in the RWUP, such a changes in terminology (e.g., reclaimed water to recycled water) or formatting changes

4. REVIEWING THE RECYCLED WATER USE PLAN

4.1 Recycled Water Use Plan Overview

4.1.1 Division 55 Requirements for a RWUP

The recycled water plan explains how the wastewater treatment facility and recycled water user(s) will comply with the Recycled Water Use Rules and describes operational details of the recycled water program. OAR 340-055-0025 identifies the minimum requirements for a RWUP. DEQ, DHS, or WRD may comment on plan content to clarify compliance with the rules and assure operations are protective of public health and the environment.

The RWUP must, at a minimum, include the following information [OAR 340-055-0025(1)]:

- Wastewater treatment system, including treatment efficiency capability;
- Treatment methods that will be used to achieve a specific Class of recycled water;
- Estimated quantity of recycled water to be delivered to the recycled water user, at what frequency, and for what beneficial purpose;
- Contingency procedures;
- Monitoring and sampling procedures;
- System maintenance plan;
- Notification method of the public and personnel at the use area, if applicable; and
- Measuring and reporting requirements identified by the WRD.

Facilities using Class B, C, D, or nondisinfected recycled water for irrigation must include the following information in the RWUP [OAR 340-055-0025(2)]:

- Land application site, location, and site characteristics, including the zoned land use of the irrigation site and surrounding area, site map with setbacks, and distances to nearest developed property from all boundaries of the irrigation site;
- Irrigation system, including storage, distribution methods, application methods and rates, and shut off procedures;
- Characterization of soils and crops or vegetation grown at the land application site;
- Site management practices including the timing of application, methods used to mitigate potential aerosol drift; and
- Public access control and how the public and personnel will be notified of recycled water use.

Facilities using Class A water for AR must include the following information in the RWUP [OAR 340-055-0025(3)]:

- Groundwater monitoring plan following OAR 340-040-0030(2);
- Determination if the recharge will be to a drinking water protection area;
- Description of soils and characteristics;

- Distance from the recharge area to the nearest point of withdrawal and the retention time in the aquifer until the time of withdrawal; and
- Verification from WRD that a request for authorization for this use has been initiated.

Conditions in a RWUP are NPDES or WPCF permit requirements [OAR 340-055-0025(4)] and are enforceable. Violations of the RWUP must be handled as permit violations following standard Compliance and Enforcement procedures [OAR 340-012] and guidance.

4.1.2 Guidelines for a RWUP

OAR 340-055 does not specify a format for the RWUP. Appendix D contains a basic RWUP template and checklist, including major section headings. Although a facility does not have to use a DEQ-developed RWUP template, all of the information required by OAR 340-055-0025 must be present.

A RWUP needs to be kept current to address new circumstances in recycled water production, treatment processes, monitoring, the addition of new reuse sites, or changing/expanding uses. During permit renewal, DEQ reviews the existing RWUP to ensure that major changes or updates in operations have been incorporated in the plan or addressed in the permit. If deviations between operations and the RWUP are identified, DEQ should request the RWUP be appropriately updated. DEQ can request that RWUPs that have been significantly amended or supplemented during the life of a permit be revised and the supplemental information incorporated into the main document during permit renewal.

4.1.3 Review and Approval Process

RWUP review and approval is part of the permitting process (Figure 2). Key points to consider are:

- Regional DEQ personnel review and approve the RWUP and coordinate the review by others. A written response to the applicant should be made within 30-days of plan receipt. New plans may go through multiple iterations, which may require additional time.
- Before approving or modifying a RWUP using Class C, D, or nondisinfected water, the plan must be submitted to DHS for comment [OAR 340-055-0016(2)(b)].
- Any special monitoring or reporting conditions identified by WRD must be incorporated into the plan.
- Recycled water use projects in sensitive areas (e.g., GWMAs) may require review by the DEQ regional hydrogeologist.
- Health and Safety Managers or other responsible parties in industrial, commercial, or construction situations should be given the opportunity to review the plan.
- DEQ may not approve a RWUP that has not addressed issues identified by DHS or WRD.
- RWUPs must go out for Public Notice. The RWUP should go out for Public Notice with the permit. Facilities should begin the RWUP development, review, and approval well before submitting the permit application.

- If a new RWUP is developed after a permit has been issued, formal Public Notice of the RWUP is required.
- DEQ must approve all RWUPs in writing. A copy of the DEQ approval letter should be kept with the final plan by the regional DEQ office.

4.1.4 Site Visits and Site Authorizations

The recycled water use program does not issue permits or authorizations for individual reuse sites (i.e., irrigation sites) using a separate procedure. Reuse sites are identified in the RWUP and are subject to Public Notice with the permit. When reuse sites are added to the RWUP during the life of the permit, only the updated or new information is subject to public comment. Site conditions, restrictions, management practices, etc. for each reuse site must be described in the RWUP. Significant changes to reuse sites should be considered permit modifications and treated appropriately.

With the exception of Class A recycled water systems, site visits should be made to reuse sites prior to approving the RWUP. Although the RWUP will describe the requirements needed to protect public health and the environment with recycled water use, each site will have unique features and may require special access and exposure controls, setbacks, and/or site management practices.

There are no site specific requirements (i.e., buffer zones, etc.) for the use of Class A recycled water systems, but there are general requirements for public outreach through notification and signage. While a general description of public outreach is necessary, Class A systems generally do not require site specific conditions in the RWUP.

4.2 Common Content for RWUPS

4.2.1 Class(es) of Water and Beneficial Purposes

Beneficial purposes lie at the heart of the recycled water use program and can influence wastewater treatment, monitoring, as well as public health and environmental concerns. Beneficial purposes must be identified in the RWUP [OAR 340-055-0025(1)(c)], and should include:

- A list or table of beneficial purposes and the Class(es) of water.
- The name, address, and phone number of the owner(s) and user(s) of each site receiving recycled water

4.2.2 Wastewater Treatment

The RWUP must describe wastewater treatment operations at the treatment facility [OAR 340-055-0025(1)(a)]. The description should include information on the quantity and quality of both wastewater treated and recycled water produced. Wastewater treatment system operations described in other documents (e.g., operation plans, etc.) may be referenced in the RWUP. However, current copies of those documents must be readily available to DEQ and should be DEQ approved. The following information is pertinent to describing the wastewater treatment system:

- A general description of the treatment system, including treatment efficiency capability (an overall flow diagram showing the entire treatment and reuse process recommended) [OAR 340-055-0025(1)(a)];
- A brief description of the quantity (gpd), and origin (% domestic, % commercial, % industrial) of wastewaters processed in the treatment facility;
- The operating volumes (gallons) of each component of the wastewater processing stream (diagram recommended);
- A detailed, step-by-step description of the unit processes used to a specific class of recycled water [OAR 340-055-0025(1)(b)];
- A description of any blending operations, including the source of the water, estimates of the blending ratios; and
- A summary of the quantity and quality of recycled water produced.

4.2.3 Recycled Water Monitoring and Sampling

The RWUP must describe monitoring and sampling procedures [OAR 340-055-0025(1)(e)], including water quantity and quality. Since monitoring and sampling may vary based upon recycled water Class and/or the beneficial purpose, monitoring and sampling procedures must provide the relevant level of detail. For each Class and Beneficial Purpose combination, the RWUP should provide the following information[10]:

- Recycled water quantity:
  - Estimate of quantity of recycled water produced;
  - Measurement techniques (e.g., flowmeters, flumes);
  - Frequency (e.g., weekly, monthly, seasonal);
  - Location (i.e., at a point representative of recycled water volume sent to distribution systems).
- Recycled water quality:
  - Water quality parameters, units, and analytical characterization[11]. Actual data from previous monitoring operations may be provided.
  - Sample type (e.g., continuous, grab, composite);
  - Sampling methods (e.g., autosampler, bailer);
  - Frequency (e.g., weekly, monthly);
  - Location (i.e., a point that is representative of the recycled water quality; a diagram or schematic is recommended);
  - Analytical methods (e.g., specific EPA, Standard Methods, etc. references);
  - Field Quality Assurance/Quality Control (QA/QC) procedures (e.g., field equipment calibration, field equipment decontamination, sample duplicates, field blanks, rinse water blanks, trip blanks);

[10] The recycled water monitoring and sampling described in the RWUP must match any requirements in Schedule B.

[11] The exact data needed to characterize the recycled water may vary based on the specific beneficial purpose(s), but may include the following common parameters: E. coli, total coliform, turbidity, BOD, TSS, TKN, NH_4-N, NO_3-N, total P, K, Ca, Mg, Na, pH, TDS, etc. See also Schedule B of the permit.

- Laboratory QA/QC procedures.

4.2.4 System Maintenance and Contingency Procedures

The RWUP must include a maintenance plan that describes how the wastewater treatment system equipment and facility processes will be maintained [OAR 340-055-0025(1)(f)], as well as a description of contingency procedures [OAR 340-055-0025(1)(d)][12]:

- A description of the alarm devices or equipment that will be furnished to provide warning of loss of power, and/or failure of processing equipment essential to the generation of recycled water;
- A description of the standby power systems used to ensure that all essential processes operate during interruptions; and
- A description of the redundant treatment systems that will be furnished to provide warning of loss of power and/or failure of process equipment essential to the recycled water generation.

4.2.5 Recycled Water Transmission, Storage, Distributions, and Plumbing

The RWUP should include a description of the recycled water transmission, storage, and distributions systems, including considerations to avoid cross connections[13]:

- A characterization of all proposed recycled water storage facilities (short-term, long-term, and emergency), including: facility location(s), dimensions (feet), operating capacity (gallons), and pollution controls (e.g., liners, barriers, or other controls to prevent spills, overflows, or other upsets);
- A description of the recycled water transmission system used to move recycled water from the treatment facility to storage facilities, satellite facilities, or reuse site(s), including labelling or other identification mechanisms used to prevent cross connections with other systems;
- A description of how all piping, valves, and other portions of the recycled water distribution and plumbing systems will be constructed and marked to prevent cross-connection with potable systems; and
- A description of measures (e.g., chlorine residual, filtration), if any, used to manage water quality changes following treatment.

4.2.6 Public Health and Environmental Controls

For each identified beneficial purpose, the RWUP should identify potential public health and environmental concerns as well as the measures taken to control adverse effects on public health and the environment. The RWUP must include a description of public and personnel notification procedures in the reuse area (when required) [OAR 340-055-0025(1)(g)].

[12] The information in the RWUP must agree with that reviewed and approved by DEQ during plan review.

[13] The information in the RWUP must agree with that reviewed and approved by DEQ during plan review.

Access and Exposure Controls

Managing access and exposure to recycled water is the primary mechanism for protecting public health at reuse sites. OAR 340-055 identifies "Access and Exposure" controls for each Class of water identified in the rule (Table 12). Access and exposure controls fall into the following general categories: notification, preventing access, restricting access, and setbacks and buffers. The RWUP must specify how the appropriate access and exposure measures will be implemented.

Table 12. Public access requirements designed to minimize exposure to recycled water.

Class of Water	Access and Exposure Requirements
Nondisinfected	OAR 340-055-0012(3)(f) Public access to the irrigation site must be prevented
Class D	OAR 340-055-0012(4)(f): (A) Animals used for production of milk must be restricted from direct contact with the recycled water. (B) When using recycled water for irrigation of sod, ornamental nursery stock, or Christmas trees, the personnel at the use area must be notified that the water used is recycled water and is not safe for drinking. The recycled water use plan must specify how notification will be provided.
Class C	OAR 340-055-0012(5)(f) (A) When irrigating for a beneficial purpose defined in subsection (4)(a) of this rule, the access and exposure requirements defined in subsection (4)(f) of this rule must be met. (B) During irrigation of a golf course, a cemetery, a highway median, or an industrial or business campus, the public must be restricted from direct contact with the recycled water. (C) If aerosols are generated when using recycled water for an industrial, commercial, or construction purpose, the aerosols must not create a public health hazard. (D) When using recycled water for an agricultural or horticultural purpose where sprinkler irrigation is used, or an industrial, commercial, or construction purpose, the public and personnel at the use area must be notified that the water used is recycled water and is not safe for drinking. The recycled water use plan must specify how notification will be provided.
Class B	OAR 340-055-0012(6)(f) (A) During irrigation of a golf course, the public must be restricted from direct contact with the recycled water. (B) If aerosols are generated when using recycled water for an industrial, commercial, or construction purpose, the aerosols must not create a public health hazard. (C) When using recycled water for an agricultural or horticultural purpose where sprinkler irrigation is used, or an industrial, commercial, or construction purpose, the public and personnel at the use area must be notified that the water used is recycled water and is not safe for drinking. The recycled water use plan must specify how notification will be provided.
Class A	OAR 340-055-0012(7)(f) When using recycled water for an agricultural or horticultural purpose where spray

Class of Water	Access and Exposure Requirements
	irrigation is used, or an industrial, commercial, or construction purpose, the public and personnel at the use area must be notified that the water used is recycled water and is not safe for drinking. The recycled water use plan must specify how notification will be provided.
Exempted Use	OAR 340-055-0013 (3) Spray or drift or both from the use does not occur off the site; and (4) Public access to the site is restricted.

Notification

OAR 340-055 requires notification of recycled water use for all Classes of recycled water and for all end uses. Notification is different from the DEQ-initiated Public Notice procedure required during the permitting process. Notification is an active communication process (or outreach) by the recycled water generator and/or user to persons that may come in direct contact with the recycled water. The rule specifically identifies two audiences at (or near) a recycled water use site—personnel (or employees) and the public, which may include but is not limited to the following types of people:

- Employees working at a recycled water use site (e.g., farm workers, landscapers, maintenance personnel);
- Property owners and residents adjacent to a proposed site who may be affected by recycled water use activities, such as aerosol drift or surface runoff;
- Golfers or other recreationalists; and
- Other interested parties as identified by the permittee, water user, DEQ, WRD, or DHS.

As with other aspects of recycled water use, the exact audience and procedures used to satisfy the notification requirement(s) will vary depending upon the Class of water produced and the specific reuse application. Table 13 lists some possible personnel and public notification procedures.

Table 13. List of possible methods for meeting public and personnel notification requirements at recycled water use sites. This is not an exhaustive list of options. The posting of signs alone is not sufficient to meet the notification requirements of the rule.

Personnel (Employee) Notification
• New employee orientation program • Facilities health and safety training program • Posted information on bulletin boards • Worker training program
Public Notification
• Signed membership agreement (i.e., golf courses) • Information fliers/pamphlets provided to golfers • Letters sent to occupants of adjacent properties (i.e., homes, businesses, etc.) • Publication in local media

Although signs may be part of public outreach on recycled water use, the posting of signs alone is not sufficient to meet the notification requirements of the rule. (Signage is identified as a site management practice and is a passive communication mechanism.)

Preventing Access

All public access to irrigation sites using nondisinfected water must be prevented [OAR 340-055-0012(3)(f)]. Generally, public access prevention includes the erection of physical barriers to prevent access to the site in combination with posting appropriate signage along the perimeter of the property. The method used to prevent public access must be evaluated for individual sites and be based upon the likelihood of contact and exposure to recycled water[14]. The measures used to prevent public access must be described in the RWUP [OAR 340-055-002(2)(e)].

Restricting Access

The rule restricts the access of milk producing animals to direct contact with recycled water (Class C and D) and restricts the public from direct contact with recycled water used for landscape irrigation (Class C) and golf courses (Class B and C). Access restrictions are less stringent than those required to prevent access.

Table 14 lists some design and operational features intended to restrict contact with recycled water. Public access control mechanisms must be described in the RWUP [OAR 340-055-0025(2)(e)].

Table 14. Recommended design and operation features to restrict direct contact with recycled water.

Milk-producing animal access restrictions (Class C and D water)
• Limit spray irrigation upwind of grazing areas (aerosol control) • Prevent runoff into grazing areas (standard water control) • Prohibit grazing on pastures receiving recycled water for 15 days after irrigation ceases [(USEPA 2004), pg. 167] • Maintain setbacks
Public access restrictions (Class B and C)
• Irrigate during off hours or during periods of low public contact (e.g., use of irrigation controllers) • Irrigate only when conditions preclude the off-site migration of recycled water via transport by wind or surface runoff • Install barriers such as fencing, tall vegetation, a cable, or other material strung around the perimeter of the application area • Maintain setbacks • Post signage

The use of fencing at irrigation sites with appropriate signage and setbacks are the preferred methods of access restrictions on property used for agricultural irrigation. However, access control measures on rural private land used for agricultural irrigation may be less strict than in more densely populated areas. The decision to approve irrigation sites without barriers such as

[14] Some type of access control at sites utilizing nondisinfected water must be present, even in rural or remote areas.

fencing should only be made after DEQ has conducted a site visit to review site conditions. Alternate access control measures could be implemented such as requiring the recycled water user (i.e., irrigator) to inform any individuals seeking access to the property on the use of recycled water. Any person having access to the site should be informed of necessary precautions to take while at the site (e.g., avoid contact with mists, standing water, and washing hands/footwear).

Setbacks and Alternative Setbacks

Setbacks establish safety buffers between recycled water use and surface waters, potable water supply wells, and areas accessible to the public. The buffer distance is the distance from the edge of the sprinkler pattern (in the case of sprinkler irrigation) or the edge of the applied water (in the case of surface irrigation) to the feature. Although buffers are required at sites using spray irrigation, the use of setbacks may also be appropriate in other reuse applications to protect public health or the environment. Table 15 lists the setback distances for the various Classes of recycled water required by rule.

Table 15. Summary of irrigation setback distances, in feet, required in rule for various Classes of recycled water.

	Nondisinfected OAR 340-055-0012(3)(e)	Class D OAR 340-055-0012(4)(e)	Class C OAR 340-055-0012(5)(e)	Class B OAR 340-055-0012(6)(e)	Class A OAR 340-055-0012(7)(e)
Direct soil application. Distance to site property line†	*	10'	10'	0'	
Sprinkler Irrigation. Distance to site property line‡	*	100'	70'	10'	
Distance from any irrigation to water supply source	150'	100'	100'	50'	
Sprinkler irrigation to food preparation area or drinking fountain	*	70'	70'	10'	#

* Nondisinfected: Other site specific setback distances for irrigation necessary to protect public health and the environment must be established in the recycled water use plan and must be met when irrigating.

Class A: Where sprinkler irrigation is used, recycled water must not be sprayed onto an area where food is being prepared or served, or onto a drinking fountain.

†Soil applied irrigation includes flood, border, ridge and furrow, subsurface manifold and wicking systems, and drip irrigation methods.

‡Sprinkler irrigation involves pressurized application including water guns, center pivot overhead sprinklers, wheel roll, fixed and movable impact sprinklers, and conventional sprinklers.

OAR 340-055-0016(7) gives DEQ authority to "…consider and approve on a case-by-case basis, a setback distance other than what is required…" in the rule. "For a reduced setback distance, it must be demonstrated to the department that public health and the environment will be adequately protected. The recycled water use plan must include any approved alternative setback distance."

More or less stringent setbacks may be proposed by the permittee, DEQ, or other public agencies (i.e., DHS, WRD). Public health concerns and environmental concerns must be evaluated for any alternative setback. The following considerations are pertinent to establishing alternate setbacks:

- The rule gives DEQ authority to impose other setbacks with the use of nondisinfected water [OAR 340-055-0012(3)(e)]. When establishing an alternative setback, the permit writer needs to address site specific considerations, such as the public health or environmental concern, the mechanism of transmission, and additional risk factors (e.g., topography, geology, climate, wells, population, etc.) that support the alternative setback.
- DEQ must justify imposing more stringent setbacks. DEQ should identify the environmental concern, the mechanism of transmission, and any additional risk factors (e.g., topography, geology, climate, wells, populations, etc.) that necessitate the more stringent setbacks(s).
- Less stringent setbacks than those specified in the rule must demonstrate that public health and the environment will be adequately protected. Typically, this will involve showing (1) the lack of a public or environmental receptor, (2) the absence of a pathway to any receptor, and (3) how other factors reduce the public health or environmental risk, such as windbreaks, topography, geology, etc.
- Alternate access and control measures or site management practices (e.g., controllers that activate valves based on wind speed or direction, vegetative barriers, topography, low trajectory sprinklers, remoteness of site, etc.) may be approved provided that in combination with the reduced setback, public health and the environment are adequately protected. Although the precedent of less stringent setbacks at other reuse sites may be used as part of the justification, precedent alone is not sufficient to reduce setbacks.
- Setback distances may be altered at agricultural irrigation sites based on site characteristics or method of application such as, but not limited to:
    - Sprinkler irrigation creating aerosol and/or wind drift;
    - Use of valves activated by wind speed or direction;
    - Vegetative or wall barriers/wind breaks;
    - Topography;
    - Low trajectory sprinklers, low pressure sprinklers, low profile sprinklers and or spray nozzles with large orifices to reduce the formation of fine mist;
    - Presence of surface waters;
    - Site proximity to other land uses; and
    - Remoteness of site.

4.2.7 Site Management Practices

The rule identifies a number of site management practices (Table 16), which when used in combination with setbacks and access and exposure restrictions, are intended to protect public health and the environment at reuse sites. Site management practices at irrigation sites must be identified in the RWUP, including but not limited to the timing of application, methods used to

mitigate potential aerosol drift, posting of signs or public outreach, and special management restrictions [OAR 340-055-0025(2)(d)].

Table 16. Summary of site management practices identified in rule. Most practices relate to signage (S) requirements or harvest/irrigation (H/I) restrictions.

Class of Water	Category*	Site Management Practice
Nondisinfected	H/I	OAR340-055-0012(3)(g) (A) Irrigation with recycled water is prohibited for 30 days before harvesting.
	H/I	(B) Sprinkler irrigation is prohibited unless authorized in advance and in writing by the department based on demonstration that public health and the environment will be adequately protected from aerosols.
Class D	S	OAR340-055-0012(4)(g) (A) When irrigating, signs must be posted around the perimeter of the irrigation site stating recycled water is used and is not safe for drinking.
	H/I	(B) Irrigation of fodder, fiber, seed crops not intended for human ingestion, sod, commercial timber, firewood, ornamental nursery stock, or Christmas trees is prohibited for three days before harvesting.
Class C	S, H/I	OAR340-055-0012(5)(g) (A) When irrigating for a beneficial purpose defined in subsection (4)(a) of this rule, the site management requirements defined in subsection (4)(g) of this rule must be met.
	S	(B) When using recycled water for a landscape impoundment or for irrigating a golf course, cemetery, highway median, or industrial or business campus, signs must be posted at the use area and be visible to the public. The signs must state that recycled water is used and is not safe for drinking.
	H/I	(C) Irrigation of processed food crops is prohibited for three days before harvesting.
	H/I	(D) When irrigating an orchard or vineyard, the edible portion of the crop must not contact the ground, and fruit or nuts may not be harvested off the ground.
	O	(E) When using recycled water for a landscape impoundment, aerators or decorative fixtures that may generate aerosols are allowed only if authorized in writing by the department.
Class B	S, H/I	OAR340-055-0012(6)(g) (A) When irrigating for a beneficial purpose defined in subsection (4)(a) of this rule, the site management requirements defined in subsection (4)(g) of this rule must be met.
	S	(B) When using recycled water for a landscape impoundment or for irrigating a golf course, cemetery, highway median, or industrial or business campus, signs must be posted at the use area and be visible to the public. The signs must state recycled water is used and is not safe for drinking.

Class of Water	Category*	Site Management Practice
	H/I	(C) Irrigation of processed food crops is prohibited for three days before harvesting.
	H/I	(D) When irrigating an orchard or vineyard, the edible portion of the crop must not contact the ground, and fruit or nuts may not be harvested off the ground.
Class A	S	OAR340-055-0012(7)(g) When using recycled water for a landscape impoundment, restricted recreational impoundment, nonrestricted recreational impoundment, or for irrigating a golf course, cemetery, highway median, industrial or business campus, park, playground, school yard, residential landscape, or other landscapes accessible to the public, signs must be posted at the use area or notification must be made to the public at the use area indicating recycled water is used and is not safe for drinking. The recycled water use plan must specify how notification will be provided.

* Categories: S = Signage requirement; H/I = Harvest or Irrigation restriction; O = Other

Signage

The Recycled Water Use Rules identify signage requirements under site management practices for specific end uses. As part of a recycled water program's operational requirements, recycled water use must be marked to prevent cross-connections [OAR 340-055-0030(5)]. Plumbing codes may also require signage in buildings where recycled water is used.

Signs are passive communication tools to inform the public and personnel (i.e., employees) that recycled water is in use at a reuse site. The RWUP should describe the signage practices to be followed by the facility. The following list includes some practices to be followed when marking is required (Adapted from American Water Works Association, California-Nevada Section 1992):

- Signs should contain appropriate language indicating that recycled water is used and is not safe for drinking, such as:

  RECYCLED WATER USED – NOT SAFE FOR DRINKING

  Since Oregon has a significant Spanish-speaking population, signs should also be written in Spanish such as:

  AGUA DE REUSO – NO SALUDABLE PARA BEBER

  If the surrounding communities have populations that speak other languages, signs should be posted in languages representative of the population base.

- Lettering size should be appropriate to the reuse site, but must be readable from an appropriate distance.
- Signs should contain the universal symbol for do not drink.

- Sites should have signs posted around the perimeter at locations visible to the public and employees as well as points of likely access to the site, such as along roads, driveways, and paths from the surrounding area into the property.
- Impoundments or recreational features should also include appropriate warnings against swimming such as: "NO SWIMMING" or (Spanish) "NO NADAR".
- Signs must be durable and withstand outside weather conditions (when appropriate).
- Signs should be routinely inspected and maintained.
- Potable and nonpotable water sources must be clearly identified when both sources are delivered to the same location.

Signage with Agricultural Irrigation

The rule does not prescribe the number, placement, or distance between signs located on agricultural properties. Since each agricultural land application site is unique, signage requirements should be based upon actual site conditions, with specific consideration for public access and adjacent property use. In general, signage at agricultural irrigation sites should be based upon the following considerations:

- Signage should occur at all major access points to fields irrigated with recycled water. Major access points can be identified as roads or gates entering the fields. If multiple, adjacent fields are irrigated with recycled water, signage should be placed at major access points around the perimeter of the combined fields.
- At least one sign should be placed on each side of the irrigated area.
- The distance between signs along public roads should appropriate to site conditions and surrounding land use. For example, signage along major roads and highways or areas with higher population densities should be more frequent than in remote rural areas.
- Signage along shared property boundaries with different owners should be based upon the adjacent property use. Unless the adjacent property also irrigates with recycled water, the minimum number of signs is one. If the adjacent property includes public lands with high traffic (e.g., schools or parklands), signage should be more frequent. If the adjacent property contains a residence or other public building near the property line, at least one sign should be visibly placed along the property line near the building.
- Less frequent signage may be appropriate along shared property boundaries with small likelihood for public access (e.g., fields lined with wild blackberries).

In some cases, signage requirements at irrigation sites may be waived or significantly reduced (Figure 5). For example, if an agricultural irrigation site is completely surrounded by private property under the same control and ownership and the property surrounding the irrigated field(s) is not receiving recycled water, the requirements for signage may be waived. Or, a reuse site surrounded by other reuse sites that are appropriately signed may also be waived. As another example, adjacent farms both using recycled water may not need the same frequency/type of sign posting as other locations. **If signage has been reduced or waived, the RWUP should describe the alternative site management practices that will be used to minimize contact with recycled water and protect public health.**

Alternative Methods of Public Outreach

DEQ may also, on a case-by-case basis, approve an alternative method for public outreach where it considers the method will assure an equivalent degree of public protection [OAR 340-055-0016(8)]. Every site should be individually evaluated and the signage requirements described in the RWUP.

When evaluating alternative methods of public outreach, DEQ should consider such factors as:

- Remoteness of site;
- Adjacent land uses;
- Likely public access;
- Usual wind direction;
- Native language(s) of area populations.

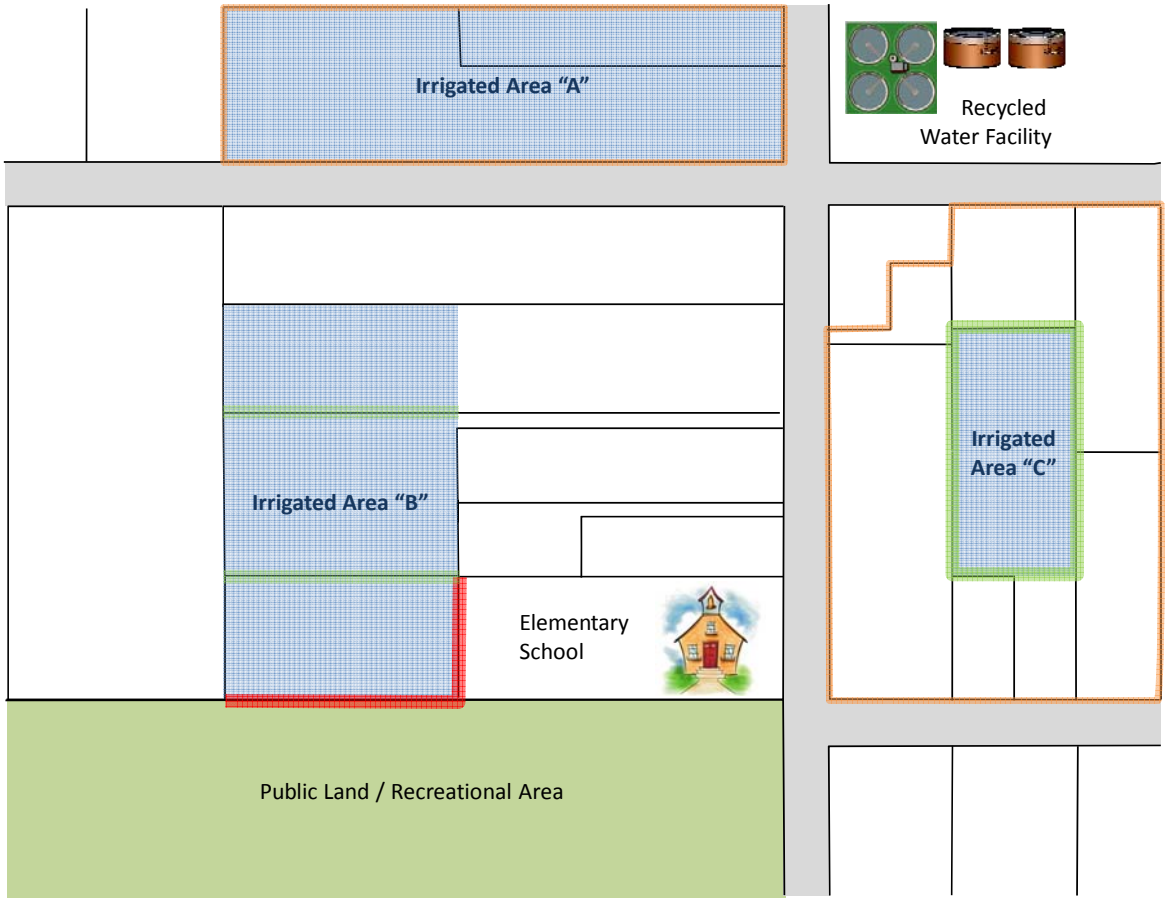

Figure *5*. Areas receiving recycled water must be appropriately marked or signed as identified in the rule. However, consideration should be given to site specific conditions. For example, Irrigated Area "A" includes two tax lots under the same ownership. Signage should typically occur around the perimeter. Irrigated Area "B" includes all or part of three tax lots with different owners. Since the three fields are adjacent and contiguous, signage between the fields may be reduced or eliminated. Special consideration should be given to the boundaries adjacent to the Elementary school and the Recreational Area. The area around Irrigated Area "C" is under the same ownership. Depending on actual site conditions, signage may be reduced or eliminated.

Special Site Management Restrictions

The rule identifies site management restrictions based upon the Class of recycled water. However, additional site management restrictions may be appropriate at agricultural irrigation sites to protect public health from indirect exposure to pathogens. Specific site management restrictions identified in the rule include:

- **Grazing Livestock.** Grazing animals are allowed without restriction on fields irrigating with Class A-D recycled water except if the animals are used for milk production [OAR 340-055-0012(4)(f)(A)]. In the case of dairy cows, goats, or other animals used for milk production, the animals must be restricted from direct contact with the recycled water. Nondisinfected recycled water may not be applied to pasture land.
- **Processed Food Crops versus Raw Food Crops.** Food crops that will be processed before consumption (i.e., thermo-processed) may be irrigated with Class A, B or C recycled water. However, irrigating with Class B or C recycled water is prohibited for three days before harvesting processed food crops [OAR 340-055-0012(5)(g)(C)]. Fruit or nuts from orchards or vineyards may only apply Class A, B or C recycled water by an irrigation method that applies the water directly to the soil [OAR 340-055-0012(5)(a)(C)]. Orchard or vineyard produce in direct contact with the ground may not be harvested [OAR 340-055-0012(5)(g)(D)]. For all other agricultural use, including food crops that will be consumed raw, only Class A recycled water may be used for irrigation.

4.3 Guidelines for a RWUP That Includes Irrigation

Although DEQ does not regulate agricultural activities, agricultural operations can result in both point and nonpoint source impacts on the environment, including groundwater, surface water, and soils[15]. If Class B, C, D, or nondisinfected water is used for irrigation, the RWUP must include additional information specific to land application activities [OAR 340-055-0025(2)]. This section may be omitted for irrigation projects utilizing Class A recycled water.

4.3.1 Land Application Site

Site Selection

A site description, including soils, crops, limiting factors, and management practices, must be included in the RWUP [OAR 340-055-0025(2)(a)].

Site selection may be the single most important strategy for managing public health and environmental impacts resulting from the irrigation of recycled water. Site visits by DEQ staff to evaluate site suitability should occur before recycled water use is permitted. Irrigation sites should also be periodically reviewed and visited during facility inspections to verify that site conditions (esp. land use) remain unchanged and operations are in compliance with the permit and RWUP. A number of publications provide technical information on site selection criteria for

[15] The Oregon Department of Agriculture (ODA) regulates agricultural activities to prevent and control pollution of surface and groundwaters. Area specific information of water quality plans and ODA's administrative rules may be found at http://www.oregon.gov/ODA/NRD/water_quality_front.shtml. DEQ is not required to confer to ODA when permitting land application activities.

irrigation and land application sites. Some of the major site selection factors to consider when reviewing or approving a land application site have been summarized in Table 17.

Table 17. Summary of land application site selection factors.

Factor	Selection Criteria	Source
Topography	Sites with steep slopes or that would drain into surface water features present challenges for recycled water use. Slight bowl-shaped sites minimize runoff concerns.	Site Visit
Geology	Irrigation sites should be located on stable geological formations. Geological formations which may speed the transport of recycled water to groundwater (e.g., fractured basalt) require attention to hydraulic loading rates.	Site Visit Geologic Maps
Soils		
Texture	Soil texture is an indirect measurement of other soil properties. Medium textured soils are generally the most suitable for recycled water applications.	Site Visit
Slope	Erosion and runoff potential increases with increasing slope. Slopes greater than 12% are generally not suitable for irrigation	Site Visit
Flooding Hazards	Areas subject to frequent flooding are generally unsuitable for agricultural irrigation with recycled water. These sites often have other limiting factors as well.	Site Visit Soil Survey
Drainage Class	Very poor and poorly drained soils are subject to ponding and runoff problems. Excessively drained soils may can result in groundwater issues and require site management for hydraulic loading.	Site Visit Soil Survey
Depth to Groundwater	Sites with shallow groundwater limit the soil filtering capacity and present risk to groundwater quality impacts. Sites with a minimum of 4 feet to groundwater at the time of application are best suited for recycled water applications.	Site Visit
Effective Depth	Shallow soils (< 2' to restrictive layer) limit root development and often have limited capacity to hold and treat recycled water.	Site Visit Soil Survey
Saturated Hydraulic Conductivity	Much like drainage class, soils with very low or very high permeabilities present special problems for recycled water use.	Field Testing
Available Water Holding Capacity (AWHC)	Soils with a low AWHC (e.g., sands) have limited ability to hold water and require careful management of hydraulic loading.	Lab Testing Soil Survey
pH	Soil pH values of 6-7 are optimal. High or low pH soils affect the availability and movement of nutrients in the soil.	Lab Testing
Salinity	Soils high in salts cause plant stress and often have structural problems. Recycled waters high in TDS would	Lab Testing

Factor	Selection Criteria	Source
	exacerbate these problems.	
Climate		
Precipitation	Irrigation during high precipitation events or during the wet season (in Western Oregon) is generally unnecessary. Recycled water use may not be a beneficial purpose under these conditions.	Oregon Climate Service Residents
Freezing Conditions	Irrigation of recycled water to frozen or snow covered ground is generally inappropriate and can result in runoff or ponding.	
Wind	Wind speed and direction are important factors when evaluating the potential for the movement of aerosols off-site. Wind sensors can be used to control irrigation under adverse conditions.	Oregon Climate Service
Artificial Drainage	Artificial drainage, surface or tile drains, can quickly carry recycled water to surface water features. Even during dry summer months, preferential flow into tile drains can result in the rapid transport of irrigation water. Tiled sites should not discharge to surface water.	Residents Farm Services Maps
Land Use	Adjacent land use can have dramatic impacts on recycled water irrigation site selection. Aerosols and odors resulting from an irrigation lagoon or irrigation systems can create unhealthy and unpleasant conditions to nearby populations. Deposition of aerosols that may contain pathogens on adjacent crops can result in additional public health concerns. Nearby drinking water sources may limit application.	Site Visit
Zoning	Irrigation with recycled water on Land zoned EFU without land use review. Irrigation of recycled water on other zoned lands requires a LUCS from the local planning authorities.	County Planning
Crop/Vegetation	The crop or site vegetation can have a dramatic impact on the success of a recycled water project. Poorly performing crops and/or poorly managed sites (e.g., predominantly weeds) increase the chances of environmental problems from erosion, runoff, or deep infiltration.	Site Visit

Lands Zoned for Exclusive Farm Use

The 2001 Legislature passed Senate Bill 212 (SB 212) in response to growing concern of land use requirements when biosolids and recycled water are land applied on EFU zoned land. The legislation amended ORS 215.213 and 215.283 and defines the land application of recycled (reclaimed in statute language) water as an allowed permitted use on EFU land. However, the land application of recycled water is subject to the issuance of a permit from DEQ.

In January 2002, DEQ issued guidance that describes DEQ's procedures for addressing land use considerations on EFU-zoned lands [*2001 Land Application Laws & DEQ's Procedure for Proposals to Land Apply Recycled Water, Industrial Process Water, and Biosolids on Exclusive Farm Use (EFU) Lands*, (ODEQ 2002)]. The allowed uses related to recycled water in EFU zones include:

- The treatment of recycled water that occurs as a result of the land application;
- Establishment and use of facilities, including buildings, equipment, aerated and nonaerated water impoundments, pumps and other irrigation equipment, that are accessory to and reasonably necessary for the land application to occur;
- Establishment and use of facilities, including buildings and equipment, that are not on the tract on which the land application occurs for the transport of recycled water to the tract on which the land application occurs if the facilities are located within a public right of way or other land if the landowner provides written consent and the owner of the facility complies with ORS 215.275(4); and
- The transport of recycled water by vehicle to a tract on which the water will be applied to land [ORS 215.246(4)].

Because land application is listed as an allowed use in ORS 215.213(1), counties may not impose additional land use restrictions or conditions on land application practices, beyond those specified in the statute. Treatment resulting from a process other than land application or incidental changes during transportation or storage is not allowed under SB 212. Facilities, equipment, or uses on the same land where land application takes place are included as an allowed use if they are secondary or subordinate to the primary function of the land application. Treatment as a primary function would not be allowed on EFU land under ORS 215 without a LUCS.

In addition to public health and environmental concerns, Oregon statutes require DEQ to determine whether recycled water application rates and site management practices for the land application of recycled water on EFU-zoned land ensure continued agricultural, horticultural, or silvicultural production and do not reduce the productivity of the tract [ORS 215.246(1)(a)]. This requirement is generally satisfied when land application of recycled water occurs at agronomic rates on sites suitable for irrigation. However, the quality and quantity of recycled water should be reviewed to verify that application rates are appropriate and will not result in decreased site productivity (see section 0- 4.3.4 Irrigation Water Quality).

4.3.2 Crops

The RWUP must include a description of crops grown on the site(s) [OAR 340-055-0025(2)(c)] and may include some or all of the following information:

- List of proposed crops;
- Projected harvest (e.g., bu/ac, number of cuttings, protein content, etc.);
- Crop nutrient needs (i.e., fertilizer)—specifically N and P from OSU Fertilizer Guide or other sources;
- Any crop sensitivities to water quality, if available (e.g., salts, B, chloride, etc.);

- Crop specific typical rooting depths of crops selected;
- Monthly and annual projected crop water needs from OSU irrigation planning guide or other sources;
- Timing of application (e.g., spring, summer, fall, winter irrigation amounts for seen to be applied);
- Cropping program (e.g., double cropping, no till, etc.); and
- Any harvest restrictions due to treatment Class of the recycled water.

4.3.3 Irrigation System Design

A description of the irrigation system, including storage, distribution methods, application methods and rates, and shutoff procedures must be included in the RWUP [OAR 340-055-0025(2)(b)]. The RWUP should also describe irrigation inspection and maintenance procedures. (See section 0 - 5.6.3 Irrigation Systems for additional discussion on irrigation system design.)

Irrigation Ditches

Discharge of recycled water may occur to irrigation ditches without hydraulic connections to surface water or groundwater. Under this definition, irrigation ditches form part of an agricultural irrigation project's distribution system, and are not Waters of the State[16]. Irrigation ditches distributing recycled water must not discharge to surface waters. The use of irrigation ditches for distribution should be avoided in areas where excessive loss to the subsurface may occur and result in impacts to the underlying aquifer.

As open sources of recycled water, the setbacks, access and control restrictions, and site management practices utilized around irrigation ditches must be consistent with the Class of water to prevent public contact and exposure.

4.3.4 Irrigation Water Quality

Recycled water used for irrigation must be applied at rates that are protective of public health, the environment, and will not decrease the productivity of EFU-zoned land. DEQ should review the recycled water quality and application rates described in the RWUP and verify it adequately protects surface water, groundwater, crops, and soils. The three primary recycled water quality concerns include: salinity, nutrients, and trace constituents. Oregon State University and the Pacific Northwest Extension publication Managing Irrigation Water Quality for Crop Production in the Pacific Northwest [(Hopkins, et al. August 2007)] provides general guidance on water quality considerations for irrigation

Salinity

Excessive application of salts may affect crops, soils, and groundwater. Table 18 summarizes the general crop hazards from saline irrigation water identified by OSU.

[16] Irrigation canals are considered Waters of the State and require a NPDES permit (see 0 - Irrigation Canals).

Table 18. General hazard from salinity of irrigation water.

Water EC (mmhos/cm or dS/cm)	Water TDS (mg/L or ppm)	Salinity hazard and effects on management.
< 0.25	<160	Very low hazard. No detrimental effects on plants, and no soil buildup expected.
0.25-0.75	160-480	Low hazard. Sensitive plants may show stress; moderate leaching prevents salt accumulation in soil.
0.75-2.0	480-1280	Medium hazard. Salinity may adversely affect plants. Requires selection of salt-tolerant plant, careful irrigation, good drainage, and leaching.
2.0-3.0	1280-1920	Medium-high hazard. Will require careful management to raise most crops.
>3.0	>1920	High hazard. Generally unacceptable for irrigation, except for very salt-tolerant plants where there is excellent drainage, frequent leaching, and intensive management.

[Source: (Hopkins, et al. August 2007)]

Irrigation of saline waters on soils can result in excessive salt buildup and decreased infiltration rates. Sodic soils, which are particularly vulnerable, often occur in geographic depressions in drier regions of the state, and may be identified in the NRCS soil survey. DEQ should verify that recycled water application rates will not result in reducing soil productivity or soil quality due to excessive salt buildup.

DEQ should verify that recycled application rates will not result in adverse groundwater impacts due to salinity. In general, irrigation sites at high risk for impacting groundwater (e.g., shallow soils or excessively drained soils) are typically not appropriate for the land application of saline recycled water.

Nutrients

DEQ should verify that nutrients in recycled water are applied at agronomic rates and will not result in public health or environmental impacts. In general, the RWUP plan should account for the N and P needs of the crop and that supplied in the recycled water. Ammonia and nitrate nitrogen are readily available to plants and provide immediate fertilizer value. Nitrate in particular is mobile and can leach to groundwater if over-applied. Phosphorus concentrations in recycled water will generally not be a concern. However, irrigation rates should not result in surface water runoff or erosion that may carry P-laden soils or water to surface waters, particularly in TMDL-limited areas. The Oregon State University Extension Service maintains nutrient management guides for the most commonly cultivated crops in Oregon (http://extension.oregonstate.edu/catalog/details.php?sortnum=0134&name=Fertilizer+Guides), which should be the primary source for agronomic rate calculations.

Recycled water irrigation rates should be calculated based upon the agronomic information provided in the OSU Fertilizer Guides. Alternate crop and area specific agronomic information may be supplied by an OSU Extension Agent or a professional agronomist. If the calculation of an agronomic application rate limits the quantity of recycled water to less than that required by the crop (i.e., water application rate), the recycled water may need to be supplemented with an additional water source. Recycled water mixed with another source prior to use (i.e., blended water) requires additional consideration during permitting.

Nutrient loading and agronomic rate determinations should be discussed in the RWUP. An agronomic loading summary should also be included in the annual report. The summary should account for the nitrogen inputs from both recycled water and fertilizer amendments to demonstrate that nitrogen (and other nutrients) is not over-applied.

Trace Constituents

Typically, the concentrations of trace elements in recycled water fall well below levels that are likely to cause adverse effects on soils or plant growth. In fact, many trace elements essential for plant growth (e.g., B, Cu, Fe, Mn, Mo, Zn) may be present in recycled water and provide a resource value. Consequently, DEQ typically does not screen recycled water for trace constituents unless the wastewater influent or blending with other sources (e.g., with industrial sources) may result in elevated concentrations of trace constituents. The OSU publication, *Managing Irrigation Water Quality* (Hopkins, et al. August 2007) and the EPA publication, *2004 Guidelines for Water Reuse* (USEPA 2004) both contain additional information on trace constituents. Any requests to monitor or screen recycled water for trace constituents should be discussed with the permittee and the DEQ Water Reuse Coordinator.

4.3.5 Soil and Crop Monitoring

OAR 340-055 does not specify requirements for site monitoring at agricultural irrigation sites. However, DEQ recommends soil monitoring before recycled water application begins to establish a record of initial site conditions. Periodic soil and crop monitoring are also recommended to allow long-term changes in soil and crop quality to be followed.

Soil monitoring (e.g., nutrient and moisture monitoring) and crop monitoring (e.g., nutrient) may also be useful site management tools for preventing and managing environmental impacts to surface and groundwater, such as:

- Adjusting nutrient or water application rates to prevent environmental impacts resulting from recycled water quality limitations (e.g., high salinity or nutrients) or
- Managing less than ideal site conditions (e.g., saline soils, GWMAs).

If DEQ identifies a need for soil or crop monitoring with a specific recycled water project, it should be discussed with the permittee, recycled water user, and DEQ Water Reuse Coordinator. In some cases, the permittee or recycled water user may propose soil monitoring or crop monitoring or both as an alternative approach for managing the application rates of nutrients or salts.

4.3.6 Water Application Rates

The RWUP must describe the application rates and timing of recycled water use [OAR 340-055-0025(2)(b)]. Managing water application rates is the major site management practice for controlling surface water runoff and groundwater impacts that may result from recycled water use at irrigation sites. The RWUP should specify the method used to determine the recycled water application rate as well as the controls on application timing. Although some exceptions may be specified in the RWUP, as a rule, agricultural irrigation with recycled water should only occur when needed—such as during the growing season when precipitation does not meet demand. Moreover, the quantity of water applied to the site should meet the requirements of the crop while not exceeding the capacity of the soil to accept and store water, after accounting for inputs and losses to the system.

A large number of factors affect the water application rate, and a full technical discussion is beyond the scope of this document. However, some principal considerations associated with water application are discussed below to assist with DEQ approval of the RWUP.

Net Irrigation Requirement

The net irrigation requirement, or difference between the crop water requirement and the effective precipitation, depends on the crop, climate, and growing season to name just a few factors. The Oregon State University Extension Service publication, *Oregon Crop Water Use and Irrigation Requirements*, provides crop-specific evapotranspiration data and net irrigation requirements for numerous crops in various geographic zones in Oregon. This document should be the standard reference for determining net irrigation requirements with recycled water. Other methods of determining water application rates may be approved by DEQ, based on site specific conditions and agronomic needs[17]. The crop net irrigation requirement should be part of the crop description included in the RWUP.

Leaching Fraction

A leaching requirement may be included when determining water application rates. Leaching fractions are excess water applied to the soil to move salts below the rooting zone, but above the water table, thereby avoiding impacts to either plant growth or groundwater. Leaching fractions are commonly used in drier regions to prevent the buildup of salts in the rooting zone. Leaching fractions are most appropriate in low rainfall areas with deep soils and a large distance to groundwater. The RWUP should specify if a leaching fraction has been included when determining the water application rate.

Irrigation Efficiency

Some water loss and inefficiency (e.g., wind drift, leakage, overlapping spray patterns) occur during irrigation. Different irrigation systems have different irrigation efficiencies (Table 20), and the recycled water application rate may be adjusted to account for losses in irrigation efficiency.

[17] A detailed guidance for determining crop water needs, *Crop Evapotranspiration – Guidelines for Computing Crop Water Requirements*, is available from the Food and Agricultural Organization of the United Nations website (http://www.fao.org/docrep/X0490E/X0490E00.HTM, retrieved 1/19/2009).

The RWUP should specify the irrigation efficiency of the irrigation system and discuss any adjustments to the application rate made to account for irrigation efficiency.

Irrigation Scheduling

Irrigation scheduling involves determining the time and required depth of irrigation throughout the growing season. Some of the factors affecting irrigation scheduling include: stage of crop development, meteorological conditions, and soil moisture. When using recycled water, irrigation scheduling may also consider other factors such as access and exposure restrictions to limit human contact with recycled water. Under the simplest scenario, irrigation scheduling is based upon irrigating a fixed number of calendar days based upon the stage of plant growth. More sophisticated methods may involve soil moisture probes to account for actual plant needs. For example, irrigation projects in GWMAs may require soil moisture monitoring to control groundwater impacts. Irrigation projects adjacent to residential areas may require wind sensors to shut off irrigation systems when wind speed and direction may result in the drift of aerosols off-site. The actual irrigation scheduling method should be specified in the RWUP and should account for conditions at the irrigation site.

Artificial Drainage

An artificial drainage system may be necessary to remove excess water from the agricultural reuse site. Excess water may occur from excessive irrigation, heavy precipitation, and/or losses from the distribution system (i.e., leaks or seepage). Excess water may occur as surface runoff (particularly in poorer draining soils) and should not exit the irrigation site. Excess water can also occur in the subsurface (particularly in well to excessively drained soils) and impact groundwater sources. Excess surface water removed through shallow open drains or excess groundwater removed through deep open drains or underground pipes must not connect to surface waters, but should be returned to a wastewater treatment facility or further reused on-site.

4.3.7 Land Application Site Records

The RWUP should include a summary of the land application site records that will be maintained by the permittee, the water user, or both that are necessary to demonstrate compliance with the Recycled Water Use Rules, the permit, and the land application plan (described in the RWUP). The types of records that should be considered may include, but are not limited to, the following:

- Site name and location;
- Crops grown, yield (tons/ac), and time of harvested;
- Method of application (sprinkler, surface, etc.);
- Area (acreage) receiving recycled water;
- Daily recycled water application rate (in/ac);
- Daily supplemental water application rate (in/ac);
- Monthly recycled water application rate (in/ac);
- Monthly supplemental water application rate (in/ac);

- Monthly loading rate of limiting constituent, such as nutrients (e.g., NO_3-N, NH_4-N, P) or salts (lbs/ac), as identified on a case-by-case basis;
- Type, rate (lbs/ac), area, and date(s) of supplemental fertilizer use, including N, P, and K;
- Crop rotation information, including the type and acreage of each crop to be irrigated with recycled water the following year; and
- System operation and maintenance activities.

4.4 Specific Guidelines for RWUPS That Include Artificial Groundwater Recharge

A detailed description of operations is required when Class A recycled water is used for AR [OAR 340-055-0025(3)]. This section may be omitted from plans in which AR is not an identified use. Information that should be included in the RWUP includes:

- A groundwater monitoring plan in accordance with OAR 340-040-0030(2). If a separate groundwater monitoring plan has been developed, it may be incorporated into the RWUP by reference;
- A map identifying the groundwater recharge area, groundwater flow direction, the location of any drinking water protection area, and the location of the nearest point of withdrawal;
- The estimated retention time of recycled water in the aquifer;
- General geology and hydrogeology, such as stratigraphy, structure, aquifers, aquitards and low permeability layers; groundwater quality;
- Uppermost aquifer characteristics such as:
    - Type (confined versus unconfined);
    - Material (alluvial, dunal, fractured, volcanic, or other);
    - Depth to uppermost aquifer;
    - Depth to seasonal high water table;
    - Hydraulic conductivity;
    - Storage coefficient;
    - Estimated porosity;
    - Calculated hydraulic gradient;
    - Fluctuations in groundwater flow and direction;
    - Contour map of potentiometric surface (i.e., groundwater table);
    - Calculated groundwater flow velocities; and
    - Interconnection with surface water bodies or other aquifers.
- AR site characteristics, including:
    - USGS topographic map;
    - A description of topographical characteristics of the sites, including slope, landform (i.e., convex, concave), and site landscape position (i.e., upland, terrace, side slope, etc.);
    - The locations of any perennial or seasonal drainages;
    - NRCS soil maps and soil series descriptions;

- Descriptions of soils, including: soil texture; structure; rooting abundance and depth; color; presence, depth, and distribution of mottling; drainage class; pore size, continuity and abundance; coarse fragment content (percent by volume); depth to groundwater (both permanent and seasonal); depth to and identification of any restrictive layers (i.e., bedrock, hardpan, fragipan, etc.);
- Information on the soil infiltration rate (e.g., saturated hydraulic conductivity, K_{sat}), permeability, and available water holding capacity (AWHC);
- Climatic information such as, mean annual and monthly precipitation, evaporation and temperature; the average length of the growing season; average dates of first and last frost; the number of days the mean temperature drops below 0 ºC (32 ºF); stormwater runoff potential; and prevailing wind direction and intensity; and
- Any other information requested by WRD.

- Verification from WRD that a request for authorization for this use has been initiated.

5. REVIEWING THE SYSTEM DESIGN

5.1 Regulatory Requirements - Review of Plans and Specifications

Oregon Revised Statutes (ORS) 468B.055 requires DEQ review and approval for the construction, installation, or modification of disposal systems, treatment works, and sewerage systems. Oregon Administrative Rules Chapter 340 Division 52 prescribes the requirements and procedures to obtain approval of plans as required by ORS 468B.055.

5.1.1 Performance Requirements and Guidelines for Technical Review

Per OAR 340-052-0020, DEQ is responsible for evaluating the degree of reliability and flexibility the system may have to operate as designed, considering component breakdown likelihood, wastewater quantity and strength variations, alternate modes of operation, permit requirements, and effluent quality needs. DEQ may use as guidelines any and all available and pertinent technical sources in reviewing plans. Pertinent technical sources in reviewing plans for recycled water systems include, but are not limited to the following:

- *2004 Guidelines for Water Reuse*, (USEPA 2004);
- *Water Reuse, Manual of Practice SM-3*, (WEF 1989);
- *Use of Reclaimed Water and Sludge in Food Crop Production*, (National Research Council 1996);
- *Wastewater Disinfection, Manual of Practice FD-10*, (WEF 1996);
- *Handbook of Chlorination and Alternative Disinfectants*, (White 1998);
- *Wastewater Engineering*, (Tchobanoglous, et al. 2002); and
- *Guidelines for the Distribution of Non-potable Water* (American Water Works Association, California-Nevada Section 1992)

DEQ may also use guidance from other state programs, such as the Washington Department of Ecology's Orange Book (http://www.ecy.wa.gov/programs/wq/reclaim/advisorycommittee/Orange%20Book.pdf).

5.2 Plan Submittal Requirements

An engineering report should be prepared for all new recycled water systems. This report should follow the general guidelines for wastewater treatment systems predesign reports (ODEQ 1994). Recycled water projects vary in complexity; therefore, reports will vary in content and the detail presented will depend on the scope of the proposed project. The engineering report should contain sufficient information to assure DEQ that the degree of treatment and reliability is commensurate with the requirements for the proposed use, and that the distribution and use of the recycled water will be protective of human heath and the environment.

In additional to the information requested for wastewater treatment system predesign reports, a recycled water engineering report should include the following:

- The intended beneficial uses;
- Treatment system reliability features such as automated diversions and alarms;

- Contingencies to prevent inadequately treated recycled water from being delivered to the user. This may be included as part of the control measures and should include:
    - A list of conditions which would require an immediate diversion to take place;
    - A description of the diversion procedures;
    - A description of the diversion area including capacity, holding time and return capacities;
    - A description of the plans for activation of supplemental supplies (if applicable); and
    - A plan for the management of any inadequately treated effluent.
- A description of all supplemental water supplies, including a description of the purpose, source, quality, quantity, and cross connection controls measures;
- A description transmission and distribution system features to conform to the rules;
- Except for Class A recycled water systems, a description of the irrigation area and system including what will be irrigated, method of irrigation, details on application equipments (sprinkler heads, drip tube, etc), protection measures of drinking water fountains and designated outdoor eating areas, measures to be taken to exclude or minimize public contact, and the proposed irrigation schedule if public access is included;
- Except for Class A recycled water systems, a map of the irrigation area showing:
    - Setback distances;
    - Location of domestic water supply facilities in or adjacent to the use area;
    - Site containment measures (if applicable); and
    - The direction the drainage and a description of the area to which the drainage will flow.
- If the project includes surface impoundments, the following information should be provided:
    - The type of use or activity to be allowed on the impoundment;
    - Description of the degree of public access;
    - The conditions under which the impoundment can be expected to overflow and the expected frequency; and
    - The direction of the drainage and a description of the area to which the drainage will flow.
- For proposed cooling system uses, the type of system (e.g., cooling tower, spray, condenser), the biocide used, details on the type of drift eliminator, and the potential for employee or public exposure and mitigation measures to be employed.

5.3 Unit Processes - Reliability and Redundancy in Treatment Systems

In order to meet the requirements for all classes of recycled water, the wastewater must be fully oxidized. Fully oxidized wastewater is wastewater in which organic matter has been stabilized such that the biochemical oxygen demand (BOD) does not exceed 30 mg/L (or 50 mg/L for lagoons), is non-putrescible, and contains dissolved oxygen. What differentiates the classes of

recycled water is the level of disinfection and the additional reliability and redundancy features. These are discussed in this section.

5.3.1 Disinfection

Disinfection is the primary mechanism for the destruction of pathogenic organisms to prevent the spread of waterborne diseases. It is not practical to monitor pathogenic organisms directly. Instead, indicator organisms are used as surrogate measures of disinfection effectiveness. Studies have shown that these indicator organisms are good surrogates in properly designed disinfection systems. Although a full discussion of disinfection technologies is beyond the scope of this document, the following performance issues should be considered when evaluating a recycled water system's disinfection process:

- **Upstream treatment process.** Biological and mechanical removal of organic material in the early treatment train directly effects the effectiveness of treatment at the disinfection step;
- **Types of organisms present.** Bacteria encased in polysaccharide polymers (i.e., biofilms) are more difficult to kill; viruses, protozoa, and other organisms have different responses to disinfectants.

Chlorination

The key design features of a chlorine disinfection system are:

- Adequate initial mixing;
- Adequate initial dosage;
- Adequate contact time; and
- Optimizing plug flow conditions in the contact chamber.

Design criteria for these features can be found in many engineering texts books (e.g. *Handbook of Chlorination and Alternative Disinfectants*, (White 1998). DEQ's minimum design criteria for treated wastewaters discharged to waters of the state is thorough mixing with sufficient chlorine to provide a residual of at least 1 part per million after 60 minutes of contact time. This design criterion is sufficient for Class D recycled water. Class C, B, and A recycled water require a higher level of disinfection and may require additional dosage, contact time, and/or optimization of plug flow conditions. Other states prescribe chlorine treatment of 1 to 5 mg/L for 15 to 90 minutes to meet this higher level of disinfection. In general, DEQ recommends a minimum velocity gradient of 500 second^{-1}, a 1 to 5 mg/L initial dosage, a minimum Ct factor of 90 minute*mg/L, and a contact chamber length to width ratio of 72:1 (a minimum L:W ratio of 40:1 is acceptable if diffusion baffles are provided).

The formation of disinfection by-products is a serious concern with chlorine disinfection. Many disinfection by-products (DBPs) can cause environmental impacts at low concentrations. Special consideration should be given to groundwater recharge programs that utilize recycled water disinfected with chlorine.

UV Radiation Disinfection

UV radiation destroys viruses, bacteria, and protozoa in wastewater without the generation of harmful disinfection byproducts. UV radiation requires the shortest contact time and can effectively treat peak or sporadic influent loads. If a periodic discharge to a surface water or wetland is anticipated, recycled water disinfected by UV radiation does not generally pose a threat to aquatic systems due to chlorine residuals or DBPs (USEPA 1999).

Effluent characteristics can have significant impacts on UV system performance. UV disinfection is most effective when applied to water with relatively low total suspended solids (TSS), high transmittance, and small particle size. Particle sizes greater than 10 µm effectively shield organisms from radiation treatment [(Asano, et al. 2007), pg 688]. Organisms show widely diverse responses to UV treatment. Validation testing with a virus surrogate may be required to demonstrate effectiveness for sensitive end uses. The design of the UV system should account for upstream processes and their effectiveness in removing solids and reducing turbidity. Influent characteristics can also affect UV system performance, which can be significant such as with stormwater events that increase sediment loading or contribute humic material to the influent stream. Wastewaters with high absorbtivities require higher UV dosages to be effective.

Recycled waters disinfected by UV radiation have propensity for bacteria regrowth, which can be a significant issue in transmission and distribution lines. Facilities that disinfect by UV radiation and move water through long transmission lines or require storage prior to reuse, may need to utilize chlorine and maintain a chlorine residual to control biofilm development. Biofilm control with UV disinfected waters should be discussed in the RWUP.

Ozone Disinfection

Ozone is generally used by medium to large facilities that have secondary treatment. Ozone is a highly effective bactericide and is widely believed to be more effective at destroying viruses than chlorine [(Asano, et al. 2007), pg. 666]. Ozone disinfection includes additional benefits such as effectively reducing trace organics and increasing dissolved oxygen in the effluent. However, complex ozonation systems require operator training, regular system maintenance, and careful handling of off gases for operator safety [(USEPA 1999)]. Like chlorine, ozone produces disinfection by-products that must be considered for some end uses—especially if the influent stream may contain brominated compounds [(Asano, et al. 2007), pp. 670-671]. Moreover, ozone residuals can be acutely toxic to aquatic life, which is a consideration if surface water discharges periodically occur.

Additionally, facilities that disinfect by ozonation and move water through long transmission lines or require storage prior to reuse, may need to utilize chlorine and maintain a chlorine residual to control biofilm development.

5.3.2 Filtration

Filtration to remove suspended material is required for Class A water. As discussed above, research has shown that turbidity greater than 2 NTU may impact disinfection effectiveness. The turbidity of biologically treated wastewater can fluctuate over short periods of time.

Filtration assures that the disinfection system is not impacted by turbidity. This is an additional barrier between potential pathogens and the public.

For Class A water, turbidity monitoring must occur on an hourly basis at a minimum. However, as a practical matter, a continuous turbidimeter should be installed at a location representative of the turbidity prior to disinfection. This turbidimeter should be connected to an alarm system and automated control system that will prevent the distribution of recycled water that does not meet the turbidity criteria. The recommended control strategy is a high turbidity alarm at 2 NTU and a shut off of the system when turbidity is greater than 5 NTU for more than 1 hour. Some facilities have the capability of shunting higher turbidity recycled water to controlled land application sites. In these cases, an automatic valve is installed.

The present state of research shows that adequate public protection is provided when filtration occurs before disinfection in the treatment train. However, DEQ may allow exceptions [OAR 340-055-0012(7) (c)(A)]. This exception provides an opportunity to existing facilities operating treatment systems with limited options to place filtration before disinfection to provide additional studies showing equivalency, or to show adequate public health protection for specific uses. Filtration following disinfection must be approved as described in 0-5.4 Alternative Treatment Process (Equivalent Treatment). Existing facilities with reversed treatment systems (i.e., filtration following disinfection) should evaluate the treatment train during major plant upgrades and consider moving filtration before disinfection.

5.3.3 Alarms, Controls, and Standby Power

Alarm devices are required to provide warning of power loss and failure of process equipment essential to the proper system operations [OAR 340-055-0033(2)]. Table 18 lists some recommended alarms for various types of recycled water systems.

Table 19. Recommended alarms for various types of recycled water systems.

System	Recommended Alarm
All systems	Plant and pump power loss
Chlorine disinfection systems	Chlorine solution flow (e.g., low pressure switch), low chlorine residual
UV disinfection systems	Low transmittance, low intensity, low power
Class A systems	High turbidity, high trans-filter pressure

The recycled water system must have sufficient standby power to fully operate all essential treatment processes, unless otherwise approved by DEQ [OAR 340-055-0030(3)]. Examples where full standby power is not necessary include:

- The NPDES permit allows discharge year round and the use of recycled water is not needed to meet discharge effluent limits.
- The system has adequate storage capacity prior to treatment to hold the water for the duration of a reasonably anticipated outage.

- There is adequate standby power to properly treat the recycled water and transfer it to a storage facility, AND the amount of storage is adequate to hold the recycled water for the duration of a reasonably anticipated outage.

5.3.4 Redundancy

The recycled water system must have a sufficient level of redundant treatment facilities and monitoring equipment to prevent inadequately treated recycled water from being used or discharge to public waters [OAR 340-055-0030(4)]. Redundancy requirements are site specific based on the Class of water and potential exposure to the public. The lower the level of recycled water treatment and the greater the potential exposure to the public, the greater are the redundancy requirements. In any case, the treatment facility should be fully redundant at the design dry weather flows. Alarm and continuous instrumentation should also be fully redundant.

5.3.5 Aquifer Recharge (AR) Systems

Applicants for an AR system must submit technical information and reports on the system showing that the system will meet drinking water standards and have no potential for adverse impacts to groundwater quality [OAR 340-040-0030(2)]. Generally, reverse osmosis and/or other advanced treatment systems are required to meet these requirements. Some AR systems may also be subject to the Underground Injection Control (UIC) requirements.

5.4 Alternative Treatment Process (Equivalent Treatment)

On a case-by-case basis, DEQ may authorize an alternative wastewater treatment process not specified in the rules provided the treatment is equivalent to and can achieve the recycled water quality required for a specific beneficial purpose [OAR 340-055-0017(1)]. An alternative equivalent treatment may consist of a specific unit process (e.g. different types of filters), a treatment process (e.g. direct filtration), or a complete treatment chain. DEQ encourages the development of new technology and will approve projects provided adequate documentation is submitted. The burden of proof for demonstrating new processes, treatment systems, and technologies lies with the design engineer. Once an alternative treatment method is approved for a specific facility, DEQ may use the monitoring results for other projects in Oregon proposing similar conditions and providing recycled water for the same (or similar) beneficial purpose. When approving alternative treatment processes, the DEQ regional engineer will verify that the treatment technology is appropriate for the wastewater treatment system and proposed beneficial purposes, and if acceptable, will send written approval of the technology to the wastewater treatment system owner. Approvals of recycled water systems and supporting documentation should be sent to the DEQ Water Reuse Coordinator to be maintained on file.

5.4.1 Technologies Approved by Other States or Independent Organizations

Treatment technologies approved by other states, particularly those with strong water reuse programs (e.g., CA, AZ, FL), or national organizations (e.g., WEF, WERF, WateReuse) are generally acceptable for use in Oregon. Oregon DEQ approves projects on a case-by-case basis and does not approve specific treatment technologies. Therefore, DEQ will only review projects which are proposed for construction. To obtain approval, the permittee must submit the

appropriate documentation from the other state and/or organization to the DEQ regional engineer for review.

5.4.2 Technologies Not Approved by Other States or Independent Organizations

Approval of projects proposing alternative treatment processes that have not been approved by other states or national bodies, new uses of treatment technologies, or unique configurations of treatment technologies are made by the DEQ regional engineering staff in consultation with DEQ regional permitting staff and the DEQ Water Reuse Coordinator. Consultation with other state agencies may be required for systems utilizing new and/or unconventional disinfection and/or filtration systems.

The following types of information should be submitted by the permittee/applicant to support the request:

- Reuse applications for which recycled water will be used;
- Objectives of the treatment system (i.e., Class of water and additional treatment to be produced by the system);
- Detailed schematics of the treatment system;
- Operating parameters and how varying wastewater characteristics may affect operations;
- A literature review of the treatment technology;
- Demonstration of the treatment system in operation at other facilities, highlighting both similarities and differences in operating conditions between the demonstration and proposed systems;
- Objective technical and scientific data showing treatment effectiveness and reliability (may include validation testing/pilot projects);
- Discussion of system operation and maintenance;
- Details on sampling, analysis, and reporting on system performance;
- Any specialized training/knowledge required to operate the system; and
- An emergency operations plan that can be implemented should the system fail without resulting in adverse effects to human health or the environment

When evaluating a request for alternative treatment technologies, the following factors should be considered:

- Type of reuse application: water quality, time of delivery, volume;
- Wastewater characteristics: influent quality, quantity and variability;
- Reuse water quality requirements: pathogens, nutrients, dissolved solids;
- Trace constituents: current and future removal capability;
- Compatibility with existing treatment: hydraulic or physical space limitations;
- Flexibility: adaptability to changing regulations or new beneficial purposes;
- Operating and maintenance requirements: technical expertise, availability of parts and supplies, frequency;

- Energy requirements: impacts of treatment on energy supplies;
- Chemical inputs: addition of chemicals which may affect treatment and/or reuse options;
- Personnel requirements: training and supervision; and
- Environmental constraints: noises, odors, by-products requiring disposal

Special conditions or monitoring requirements associated with the alternative treatment process (e.g., data collection activities or pilot projects) should be identified in Schedule D of the permit.

5.5 Satellite Facilities

Satellite treatment systems treat wastewater at facilities located near the point of reuse rather than at the centralized system, thereby reducing infrastructure costs associated with the storage and transmission of recycled water to and from the centralized treatment plant. Residuals (e.g., solids) generated at satellite facilities are transported to the centralized facility for processing. *Water Reuse, Issues, Technologies, and Applications* [(Asano, et al. 2007), pp. 725] identifies three categories of satellite facilities:

1. **Interception Type** – the wastewater to be treated is intercepted before it reached the collection system. A typical application for this type of satellite facility is a high-rise commercial building. OHSU utilizes an interception type treatment system at its South Waterfront Medical Office Building in Portland. Recycled water is blended with other water sources and used for landscape irrigation, toilet flushing, and cooling water. The wastewater treatment system operates independently from the City of Portland and is permitted independently.
2. **Extraction Type** – the wastewater to be treated is extracted from a collection system main, trunk or interceptor sewer. Typical applications for this type of satellite system include landscape irrigation, commercial buildings, or commercial or industrial reuse application, such as cooling water. The quantity of water extracted for treatment varies based upon the demand of the water user. The Upland Hills Water Reclamation Plant [(Asano, et al. 2007), pp. 760-761] in San Bernardino County, California, is an extraction type satellite facility for landscape irrigation at a golf course. Extraction type satellite facilities owned by the main wastewater treatment facility can likely be permitted under an existing permit. Facilities owned by other parties would require a separate water quality permit.
3. **Upstream Type** – the wastewater to be treated is collected from a remote community or development and treated at a local treatment facility; however, the system connects to the centralized collection system. Some or all of the wastewater may be treated at the upstream facility. Typical applications for this type of satellite system include landscape irrigation and agricultural irrigation projects. Upstream satellite systems owned by the central wastewater treatment facility can likely be permitted under an existing permit. Facilities owned by other parties would require a separate water quality permit. Upstream type systems that are not connected to the centralized system need to be permitted separately.

Satellite treatment facilities require special consideration to recycled water quantity and quality. The supply of wastewater to the satellite facility as well as the demand for recycled water generated from satellite facilities can fluctuate significantly. Often, the recycled water supply must be supplemented with other sources to satisfy demand. When supplemental water is mixed with the recycled water stream, blending considerations must be addressed (see 0 - 2.5.2 Blending). Likewise, wastewater characteristics entering the system may vary. For example, wastewater collected in an interception type system typically has not undergone significant transformations and different types of screening and treatment will be required. The quality of influent entering extraction or upstream type facilities depends on the nature of the wastewater in the collection systems. Separate sampling and monitoring requirements may be required to characterize the influent quality to satellite treatment facilities.

Water quality limitations, sampling, monitoring, and reporting requirements for satellite treatment facilities should be described in the permit.

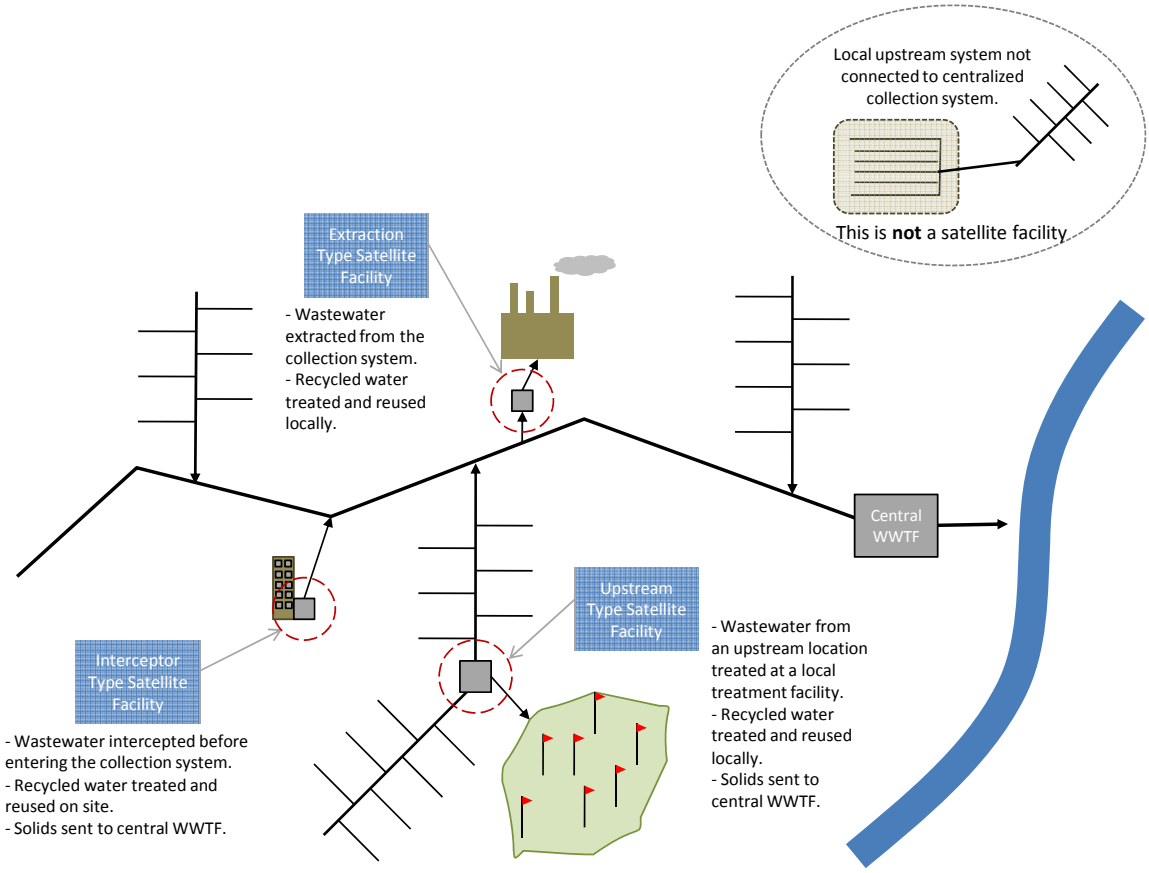

Figure 6. Illustration of the three types of satellite systems: interceptor, extraction, and upstream. Satellite systems are connect to the central collection system, but wastewater is treated and reused locally, which reduces infrastructure costs associated with the storage and transmission of recycled water at the central wastewater treatment facility.

5.6 Storage, Transmission, Distribution, and Irrigation Systems

DEQ reviews and approves recycled water storage, transmission, distribution, and irrigation systems. The review and approval of plumbing requirements for the recycled water use within commercial buildings is beyond the scope of this document. However, before permitting and approval of end uses can occur, DEQ should ensure that the appropriate plumbing review has occurred. The primary concern with distribution and plumbing systems is preventing cross-connections between the potable water supply and recycled water systems.

5.6.1 Storage

General considerations for the design of recycled water storage facilities should be similar to those for wastewater storage systems. Consideration should be given to maintaining the appropriate water balance in the storage systems to prevent adverse environmental impacts, such as:

- The design and operation of recycled water storage facilities should be sufficient to accommodate recycled water under adverse weather conditions (i.e., heavy precipitation, accumulation of stormwater), temporary delays in distributing water for end use (e.g., maintenance of irrigation equipment), or other conditions which may preclude reuse.
- New storage lagoon design as well as the geology and topography of the storage site(s) should minimize the transmission of recycled water to groundwater. DEQ recommends use of a synthetic liner; however, a bentonite or native clay liner may be approved provided that at least 1 foot of 10^{-7} permeability material is provided. Design criteria should follow current DEQ guidelines for the construction of liners [(DEQ 1996)].
- Existing storage lagoons (including existing irrigation lagoons) converted for use with recycled water should be leak tested. If leakage exceeds 1/8-inch of water per day after accounting for other losses (i.e., withdrawals, evaporation), measures should be taken to reduce leakage.
- Unless specifically designed to accept stormwater, stormwater runoff should be prevented from entering storage lagoons or other storage facilities.
- No additional discharge of recycled water into an open storage facility should occur if the capacity has reached or exceeded a critical threshold (e.g., no water may be discharged into a storage lagoon that has less than two feet of freeboard).
- Water balance records, accounting for inputs and outputs, should be maintained for all storage facilities.
- High level alarms should be provided.

Access and Exposure restrictions at storage facilities should correspond to those identified in OAR 340-055 for specific Classes of recycled water. Storage design and operation considerations should be described in the RWUP.

5.6.2 Transmission and Distribution System Requirements

Transmission and distribution systems move recycled water through pumps, pipelines, ditches, and channels. Generally, transmission lines refer to the movement of water between primary

and satellite treatment facilities, to and from storage locations, and from central facilities to "turnout" locations or distribution hubs. The treatment facility typically maintains control of the recycled water in the transmission lines. Distribution lines refer to the movement of recycled water to a final point of reuse. The recycled water user typically controls water within the distribution system. Actual responsibility for the recycled water in the transmission and distribution lines may vary from system to system.

Guidelines for Distribution of Nonpotable Water, published by the California-Nevada Section of the American Water Work Association (American Water Works Association, California-Nevada Section 1992), provides the basic criteria on distribution system requirements DEQ uses when evaluating a facility's distribution plan [OAR 340-055-0030(5)]. The rule specifically requires that construction and marking of distribution systems be consistent with sections (2), (3), (4), and (5) of this document, unless otherwise approved in writing by DEQ or required by the rules. Recycled water must be distributed through pipes that are appropriately identified by color (i.e., "purple pipe") and labelled.

The AWWA Guidelines recommend 10-foot horizontal and 1-foot vertical separations between potable water, recycled water, and sewage lines. Therefore, in situations where the potable water, recycled water, and sewage lines are parallel, a 20-foot horizontal and 2-foot vertical separation between the potable water and sewage lines is required (recycled water line in between). For situations where this is impractical, DEQ may allow special constructions options (Figure 7).

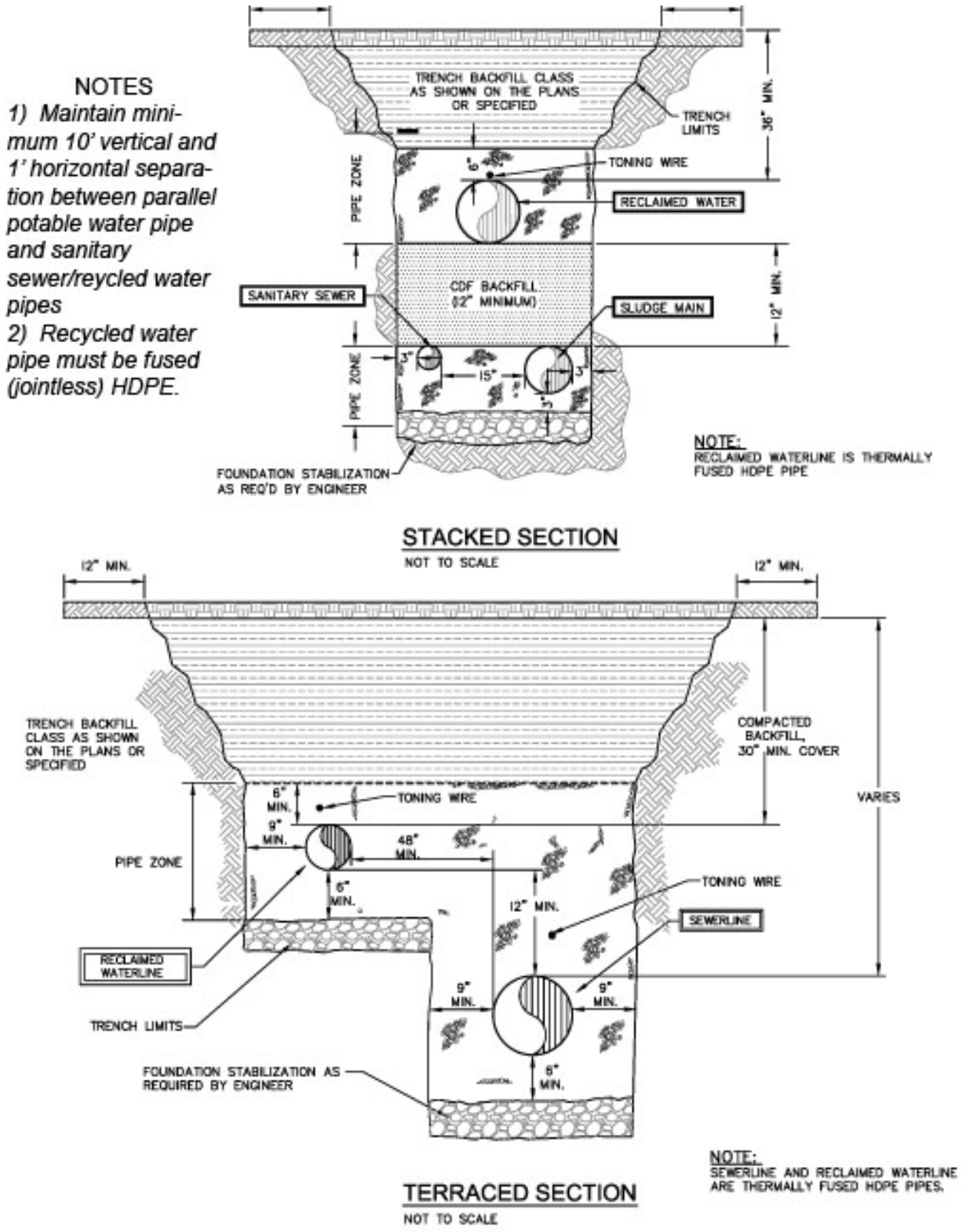

Figure 7. DEQ-approved special construction designs for recycled water systems.

5.6.3 Irrigation Systems

Irrigation system design is a complex process that involves a number of technical considerations, and should be completed by an irrigation system specialist. However, system design may affect recycled water use significantly, and the DEQ regional engineer, the DEQ regional land application specialist, or other qualified DEQ staff should review and approve the system to ensure it is appropriate to the Class of recycled water and the beneficial purpose. The appropriate irrigation system can significantly reduce or eliminate odor, aerosol, ponding, and runoff that may occur with recycled water use; the irrigation system design can also minimize potential groundwater impacts from irrigation. Table 20 lists common irrigation systems, factors affecting choice of system, and special measures that may be needed with recycled water systems.

Table 20. Common irrigation systems, factor affecting choice of use, and special measures for irrigation with recycled water. This information is general and provided to assist in reviewing and approving irrigations systems.

Irrigation Method	Factors affecting choice	Special measures for irrigation with recycled water	Irrigation Efficiency (approximate)*
Surface Irrigation (Flood, Furrow, and Border)	• Low cost • Leveling may be required (furrow and border) • Low irrigation efficiency • Low (flood) to Medium (furrow and border) level of health protection	• Low level of wastewater treatment necessary. • Protection of field workers, possible of crop handlers and consumers required. • Appropriate crop selection necessary.	• 65-90%
Sprinkler Irrigation	• Medium to high cost • Medium irrigation efficiency • Leveling not required • Low level of health protection, esp. with aerosol generation • Advanced sprinklers can reduce exposure to pathogens by 1 log unit.	• Minimum distance (setback distance) from drinking water supply wells, houses, and road required. • Water quality restrictions. • Anaerobic wastes should not be used due to odor nuisance • Generally may not be used with nondisinfected water [OAR 340-055-0012(3)(g)(B)]	• 70-80%
Subsurface and Drip Irrigation	• High cost • High irrigation efficiency • Higher yields • Highest level of health protection • Localized irrigation systems and subsurface irrigation can reduce exposure to pathogens by 2-6 log units.	• No special protection measures required. • Water quality restriction for the prevention of emitter clogging. • Appropriate management to avoid exposure to reclaimed water.	• 70-90%

*The irrigation efficiency provided here is a broad range. Actual irrigation efficiencies should be specified with the irrigation design in the RWUP. [Adapted from (World Health Organization 2006), pp. 76-78 and (Asano, et al. 2007), pp. 982-983]

5.6.4 Dual Plumbing Systems

The state plumbing requirements for "Reclaimed Water Systems" are described in Chapter 19, Part II, of the 2008 Oregon Plumbing Specialty Code. The authority to review, approve, and permit plumbing generally resides with a local permitting authority, such as the city or county. In some cases, jurisdiction may reside with the Oregon Department of Consumer and Business Services, Building Codes Division. The Building Codes Division maintains a list of local permitting authorities on their website: http://bcd.oregon.gov/jurisdictions/ci/index.html. When a reuse application proposes use of a plumbing configuration that has not been described in the plumbing codes, the OBCS can approve plumbing through an alternative method ruling or a local jurisdiction may approve a site specific application. The DEQ may be asked to review such a proposal and/or submit documentation that the proposed use of the recycled water meets the requirements of OAR 340-055.

Table 21. Recycled water beneficial purposes identified in rule that may require dual plumbing and cross-connection considerations.

Residential*	**Industrial**
• Stand-alone fire suppression system ***All other uses of recycled water in residential structures are currently prohibited by state plumbing codes**	• Cooling
Commercial	**(Landscape) Irrigation#**
• Toilet/urinal flushing • Floor drain trap priming • Stand-alone fire suppression system • Car washing • Fountains	• Golf Courses • Cemeteries • Highway medians • Industrial/business complexes **#Landscape irrigation systems that use blended water or are supplemented by potable water sources**

5.6.5 Preventing Cross Connections

Cross-connections between a potable water supply system and a recycled water distribution system are not authorized unless the connection is through an air gap separation approved by DEQ [OAR 340-055-0033(6)]. Cross-connections may be necessary, such as when supplementing recycled water supplies with potable water to maintain flow when recycled water alone does not meet demand. Alternately, a reduced pressure principle backflow prevention device may be used only when approved in writing by both DEQ and the potable water system owner. Use of a backflow device may necessitate annual testing to ensure on-going functioning and protection of the potable water supply.

5.6.6 Consideration at Point of Use

For most end uses, the combination of site restrictions, public notification, and signage satisfies DEQ's requirements to protect public health. However, a number of additional considerations should be made when evaluating recycled water use at the end point.

- **Irrigation tools and equipment.** For all recycled water applications where public access is not restricted, the use of purple irrigation equipment, including flow control knobs, solenoids, valve boxes, and sprinkler heads is expected. Additionally, the use of low-trajectory sprinkler heads and microspray systems should be used to reduce the creation of aerosols. Existing facilities should replace existing irrigation systems with purple components and lower aerosols spray equipment as updates and changes are made.
- **Controllers.** Controllers automatically open and close distribution valves at set times. The use of controllers should be a considered in areas with high public exposure to limit irrigation to times when potential public access is low (e.g., irrigation of golf courses and landscapes during the night). The *Guidelines for Distribution of Nonpotable Water* [(American Water Works Association, California-Nevada Section 1992), pp. 28-29] describes the specifications for controllers.
- **Moisture Sensors.** Moisture sensors can be used in conjunction with controllers to limit irrigation to times when the soil is dry, thereby avoiding excessive application. This may be particularly useful for irrigation in early spring (and late fall) in western Oregon when irrigation rates may exceed hydraulic need. May also be useful in GWMAs or other sensitive environments where over irrigation may result in adverse impacts.
- **Retrofitting an existing irrigation system.** Prior to retrofitting an existing irrigation system, a cross-connection test may be necessary to demonstrate that the system is independent from the potable water system. The requirement for testing should be made based upon the history and use of the existing system. Also, the complete system should be mapped and pressure tested.
- **Hoses, Hose Bibs, and Quick Couplers.** Standard hose bibs should not be used on recycled water irrigation systems. Quick couplers should be used to prevent the connection of potable and nonpotable systems. In addition, hoses used with recycled water systems should not be used with potable water systems. If a quick coupler system for a potable water source is within 60-feet of the recycled water source, appropriate signage/labelling must be made on both systems [(American Water Works Association, California-Nevada Section 1992), pp. 31-32, 35].

6. CONTACTS AND REFERENCES

6.1 Contacts

Oregon Department of Environmental Quality
Water Reuse Coordinator
811 SW 11th Ave
Portland OR 97210
ph: 503.229.5472
http://www.deq.state.or.us/

Oregon Department of Human Resources
Health Services
Office of Environmental Public Health
800 NE Oregon St.
Portland, OR 97232
ph: 971.673.0400
http://oregon.gov/DHS/ph/ophs/index.shtml

Oregon Water Resources Department
725 Summer Street NE
Salem OR 97301
ph: 503.986.0900
http://www.oregon.gov/OWRD/

Department of Consumer and Business Services
Building Codes Division
P.O. Box 14470
Salem, OR 97309-0404
503-378-4133
http://www.cbs.state.or.us/external/bcd/index.html

6.2 Bibliography and Resources

Allen, Richard G., Luis S. Pereira, Raes Dirk, and Martin Smith. *Crop Evapotranspiration Guidelines For Computing Crop Water Requirements.* Rome: Food and Agricultural Organization of the United Nations, 1998.

American Public Health Association, American Water Works Association and Water Environment Federation. "Standard Methods for the Examination of Water and Wastewater (20th Edition)." Washington: APHA, 1998.

American Society of Agronomy and Soil Science Society of America. ***Methods of Soil Analysis. Part 3. Chemical Methods (Soil Science Society of America Book Series, No. 5)****.* Edited by Donald L Sparks. Madison, WI: Soil, 1996.

American Water Works Association, California-Nevada Section. "Guidelines for Distribution of Nonpotable Water." 1992.

Asano, Takashi, Franklin L. Burton, Harold L. Leverenz, Ryujiro Tsuchihashi, and George Tchobanoglous. *Water Reuse Issues, Technologies, and Applications.* McGraw-Hill, 2007.

"California Health Laws Related to Recycled Water." *Water Code, Title 22, Chapter 7, Article 7, Section 13552.8.* June 2001.

Camann, David E. "A Model for Predicting Dispersion of Microorganisms in Wastewater Aerosols." *Wastewater Aerosols and Disease Proceedings of a Symposium, September 19-21, 1979, EPA-600/9-80-028.* Cincinnati, OH: United States Environmental Protection Agency Health Effects Research Laboratory, 1980. 46-70.

Cueneca, Richard H, Jeffery L Nuss, Antonio Martiniz-Coho, Gabriel G Katul, and José McFaci González. *Oregon Crop Water Use and Irrigation Requirements, EM 8530.* Corvallis: Oregon State University Extension, June 1992.

Cupps, Katharine, and Emily Morris. *Case Studies in Reclaimed Water Use, 05-10-013.* Washington State Department of Ecology, June 2005.

English, Marshall J, Robert Mittelstadt, and J Ronald Miner. *Irrigation Management Practices Checklist for Oregon, EM 8644.* Corvallis, OR: Oregon State University Extension Service, August 1996.

Feaga, Jeff, Richard Dick, Michael Louie, and John Selker. *Nitrates and Groundwater: Why Should We Be Concerned with Our Current Fertilizer Practices?, Special Report 1050.* Oregon State University Agricultural Experiment Station, January 2004.

"Guidelines Establishing Test Procedures for the Analysis of Polluntants Under the Clean Water Act; National Primary Drinking Water Regulations; and National Secondary Drinking Water Regulations; Analysis and Sampling Procedures; Final Rule." *Code of Federal Regulations, Part 122, 136, et al, Title 40.* March 12, 2007.

"Guidelines Establishing Test Procedures for the Analysis of Pollutants; Analytical Methods for Biological Pollutants in Ambient Water; Final Rule." *Code of Federal Regulations.* Federal Register, July 21, 2007.

"Guidelines Establishing Test Procedures for the Analysis of Pollutants; Analytical Methods for Biological Pollutants in Wastewater and Sewage Sludge; Final Rule." *Code of Federal Regulations, Parts 136 and 503, Title 40.* Federal Register, March 26, 2007.

Hansen, Hugh J, and Walter L Trimmer. *Irrigation Runoff Control Strategies, PNW 287.* Pacific Northwest Extension, October 1997.

—. *Irrigation System Walk-through Inspection Analysis.* Pacific Northwest Extension, October 1997.

Hopkins, Bryan G., Donald A. Horneck, Robert G Stevens, Jason W. Ellsworth, and Dan M. Sullivan. *Managing Irrigation Water Quality for Crop Production in the Pacific Northwest, PRW 597-E.* Pacific Northwest Extensio, August 2007.

National Institute for Occupational Safety and Health (NIOSH) Division of Applied Research and Technology. *NIOSH Safety and Health Topic: Aerosols.* 08 31, 2008. http://www.cdc.gov/niosh/topics/aerosols/default.html (accessed 01 12, 2009).

National Research Council. "Use of Reclaimed Water and Sludge in Food Crop Production." Washington DC: National Academy Press, 1996.

Nyle, Brady C, and Ray R Weil. *The Nature and Properties of Soils, 14th Ed.* Upper Saddle River, NJ; Columbus, OH: Pearson Prentice Hall, 2008.

Oregon Department of Environmental Quality. "2001 Land Application Laws & DEQ's Procedure for Proposals to Land Apply Reclaimed Water, Industrial Process Water, and Biosolids on Exclusive Farm Use (EFU) Lands." Portland: Oregon Department of Environmental Quality Water Quality Division, January 08, 2002.

—. "Groundwater Review Prioritization Worksheet." Portland: Oregon Department of Environmental Quality Water Quality Division, March 1996.

—. "Internal Management Directive. Operations, Monitoring and Management (OM&M) Plans for Land Application of Non-Sanitary Wastewater." Portland: Oregon Department of Environmental Quality Water Quality Division, November 2002.

Petterson, S.A.and N.J. Ashbolt. *WHO Guidelines for the Safe Use of Wastewater and Excreta in Agriculture.* http://www.who.int/water_sanitation_health/wastewater/mrareview.pdf (accessed 01 10, 2009).

Pettygrove, G Stuart, and Takashi Asano. *Irrigation with Reclaimed Municipal Wastewater--A Guidance Manual.* Chelsea, MI: Lewis Publishers, Inc., 1984.

Pour, Bijan N. "Guidelines for Land Application of Industrial Wastewaters." Portland: Oregon Department of Environmental Quality Water Quality Division, December 1992.

"Recycled Water Use." *Oregon Administrative Rules, Chapter 340, Division 55.* Salem: Oregon State Archives, May 5, 2008.

"Regulations Pertaining to NPDES and WPCF Permits." *Oregon Administrative Rules, Chapter 340, Division 45.* Salem: Oregon State Archives, October 5, 1976.

"Review of Plans and Specifications." *Oregon Administrative Rules.* Salem: Oregon Secretary of State, Oregon State Archives, 11 15, 1994.

Selker, John. *Irrigation System Maintenance, Groundwater Quality, and Improved Production, EM 8862.* Oregon State University Extension Service, April 2004.

S**elker, John, Jason Smesrud, and Mario Hess.** *Development of Extension Materials Supporting Sustainable Irrigation Systems Infrastructure.* Corvallis, Oregon: Oregon State University Department of Bioresource Engineering, December 1997.

Shock, Clint. *Drip Irrigation: An Introduction, EM 8782-E.* Oregon State University Extension Service, October 2006.

Smesrud, Jason, et al. *Western Oregon Irrigation Guides, EM 8713.* Corvallis, OR: Oregon State University Extension Service, May 2000.

Tchobanoglous, George, Franklin L Burton, H David Stensel, and Metcalf & Eddy. "Wastewater Engineering: Treatment and Reuse." McGraw Hill Higher Education, May 2002.

Trimmer, Walter L. *Estimating Water Flow Rates, EC 1369.* Oregon State University Extension Service, September 1994.

Trimmer, Walter L, and Hugh J Hansen. *Irrigation Scheduling, PNW 288.* Pacific Northwest Extension Publication, October 1994.

—. ***Sizing Irrigation Mainlines and Fittings,*** *PNW 290.* Pacific Northwest Extension, October 1997.

USEPA. "Guidelines for Water Reuse; EPA/625/R-04/108." Cincinnati, OH: U.S. Environmental Protection Agency Office of Research and Development National Risk Management Research Laboratory, August 2004.

—. "Process Design Manual Land Treatment of Municipal Wastewater Effluents, EPA/625/R-06/016." Cincinnati, OH: U.S. Environmental Protection Agency Land Remediation and Pollution Control Division National Risk Management Research Laboratory Office of Research and Development, September 2006.

—. "SW-846 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods." Washington DC: United States Environmental Protection Agency Office of Solid Waste and Emergency Response, 1992.

—. "Wastewater Technology Fact Sheet: Ozone Disinfection, EPA 832-F-99-063." Washington DC: United States Environmental Protection Agency Office of Water, September 1999.

—. "Wastewater Technology Fact Sheet: Ultraviolet Disinfection." Washington DC: United States Environmental Protection Agency, September 1999.

—. "Wastewater Technology Fact Sheet: Chlorine Disinfection, EPA 832-F-99-062." Washington DC: United States Environmental Protection Agency Office of Water, September 1999.

—. "Water Recycling and Reuse: The Environmental Benefits, EPA 909-F-98-001." San Francisco: United States Environmental Protection Agency Water Division Region IX, 1998.

Vomocil, James A., and J. Hart. *Irrigation Water Quality, FG 76.* Oregon State University Extension Service, January 1998.

Water Environment Federation and the American Water Works Association. "Using Reclaimed Water To Augment Potable Water Sources: A Special Publication, 2nd Edition." Alexandria, BA: Water Environment Federation and the American Water Works Association, 2008.

WEF. "Wastewater Disinfection, Manual of Practice FD-10." Washington DC: Water Environment Federation, 1996.

—. "Water Reuse, Manual of Practice SM-3." Washington DC: Water Environment Federation , 1989.

White, Geo. Clifford. "Handbook of Chlorination and Alternative Disinfectantsn." Wiley-Interscience, December 1998.

World Health Organization. *Guidelines for the Safe Use of Wastewater, Excreta, and Greywater, Volume 2 Wastewater Use in Agriculture .* Geneva: WHO Press, 2006.

6.3 Glossary

Artificial Groundwater Recharge, AR - The process of adding water to an aquifer for the purpose of restoring and managing groundwater resources. The groundwater may or may not be withdrawn downstream from the injection location. [Fact Sheet: Aquifer Storage & Recovery and Artificial Groundwater Recharge, 08-WQ-024]

Aquifer Storage and Recovery, ASR - The process of storing water in an aquifer during times when water is plentiful (typically during the winter wet season) and recovering the water during times when it is needed. [Fact Sheet: Aquifer Storage & Recovery and Artificial Groundwater Recharge, 08-WQ-024]

Area of ground water concern – An area of the state subject to a declaration by the Department of Environmental Quality under ORS 468B.175 or the Department of Human Services under ORS 448.268. [ORS 468B.150(1)]

Beneficial Purpose – A purpose where recycled water is utilized for a resource value, such as nutrient content or moisture, to increase productivity or to conserve other sources of water. [OAR 340-055-0010(2)]

[Designated] Beneficial Use –The purpose or benefit to be derived from a water body as designated by the Water Resources Department or the Water Resources Commission. [OAR340-041-0002(17)] (Beneficial use has specific meaning and implications under OAR 340-041, therefore use of this term should be avoided except when intended to be used within appropriate context of the Water Quality Standards.)

Distribution System – The network of pipes, ditches, channel, etc. used to move recycled water at the reuse site. Generally, recycled water in the distribution system is under the control of the water user.

Ground water management area – An area in which contaminants in the ground water have exceeded the levels established under ORS 468B.165, and the affected area is subject to a declaration under ORS 468B.180. [ORS 468B.150(3)]

Landscape Impoundment – A body of water used for aesthetic purposes or other function that does not include public contact through activities such as boating, fishing, or body-contact recreation. Landscape impoundments include, but are not limited to, golf course water ponds or non-residential landscape ponds. [OAR 340-055-0010(7)]

Nonrestricted Recreational Impoundment – A constructed body of water for which there are no limitations on body-contact water recreation activities. Nonrestricted recreational impoundments include, but are not limited to, recreational lakes, water features accessible to the public, and public fishing ponds.OAR 340-055-0010(8)

Processed Food Crops – Those crops that undergo thermoprocessing sufficient to kill spores of *Clostridium botulinum*. [OAR 340-055-0010(12)]

Sprinkler Irrigation – The act of applying water by means of perforated pipes or nozzles operated under pressure so as to form a spray pattern.

Transmission System – The network of pipes, ditches, channel, etc. used to move recycled water between the treatment facility, storage facilities, and to the water user. Generally, recycled water in the transmission system remains under the control of the treatment plant.

Waters of the State – Lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Oregon, and all other bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters that do not combine or effect a junction with natural surface or underground waters) that are located wholly or partially within or bordering the state or within its jurisdiction. [OAR 340-055-0010(18)]

Wetlands – Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. [OAR 141-085-0010(226)]

APPENDIX A – SAMPLE PERMIT LANGUAGE

Permit Face Page

The face page of the permit gives general information about the system for which the permit is issued (gathered from the permit application).

1. *Permit expiration date (, WPCF 5-10 years, NPDES 5 years)*
2. *Permit number and file number*
3. *"Issued To"- person(s) or entity for which the permit has been applied for.*
4. *"Sources covered by this permit"- WPCF should include all outfalls and the method of disposal, NPDES should include all outfalls.*
5. *"Plant type and Location"- should give brief description*
6. *"Receiving System Information"*
7. *Wastewater system classifications should be listed for both treatment system class and collection system class. If one is not classified, N/A should be designated.*
8. *EPA reference number-NPDES only*
9. *Application number and date received*
10. *Page numbers should match up with listed schedules*

Schedule A, Waste Discharge Limitations

For Recycled water, effluent limits are intended to minimize the discharge of pollutants and protect public health.

An outfall number should be designated for the land application/irrigation of recycled water. For all new permits and permit renewals/modifications, the following conditions should be included:

Recycled Water Outfall Number 00( )

(1) No discharge to state waters is permitted. Recycled water shall be treated to the appropriate level and reused for the following beneficial purposes:

Level of Treatment	Beneficial Purpose	Alt. Approval
(List class here)	(List beneficial purposes here)	(Yes/No)
(List class here)	(List beneficial purposes here)	(Yes/No)

All recycled water use distributed on land for dissipation by evapotranspiration and controlled seepage shall follow sound irrigation practices so as to prevent:

(a) Prolonged ponding of treated recycled water on the ground surface;
(b) Surface runoff or subsurface drainage through drainage tile;
(c) The creation of odors, fly and mosquito breeding or other nuisance conditions;
(d) The overloading of land with nutrients, organics, or other pollutant parameters;
(e) Impairment of existing or potential beneficial uses of groundwater.

(2) Prior to use, the recycled water shall receive at least Class ( ) treatment as defined in OAR-340-055 to: *(select the appropriate)*

Non-disinfected Water

Oxidize the wastewater.

Class D

Oxidized and must not exceed a 30-day log mean of 126 E.coli organisms per 100 mL and 406 E.coli organisms per 100 mL in any single sample.

Class C

Oxidized and must reduce Total Coliform to 240 organisms per 100 mL in two consecutive samples, and a seven-day median of 23 organisms per 100 mL.

Class B

Oxidized and must reduce Total Coliform to a 7-day median of 2.2 organisms per 100 mL and a maximum of 23 organisms per 100 mL.

Class A

Oxidized, filtered, and

Prior to disinfection, turbidity must not exceed an average of 2 nephelometric turbidity units (NTUs) within a 24-hour period, 5 NTUs more than five percent of the time within a 24-hour period and 10 NTUs at any time.

After disinfection, Total Coliform must not exceed a median of 2.2 organisms per 100 mL based on results of the last seven days that analyses have been completed, and 23 total coliform organisms per 100 mL in any single sample.

(3) All use of recycled water shall conform to the Recycled Water Use Plan approved by the Department. Upon approval of the Recycle Water Use Plan, the Plan shall become enforceable through this permit.

Groundwater

No activities shall be conducted that could cause an adverse impact on existing or potential beneficial uses of groundwater.

Notes:

- *If the facility produces more than one Class of water, uniquely identify subsequent outfalls.*
- *When listing beneficial purposes, use the actual language in the rules.*
- *Note if the beneficial purposes went through the alternative approval process. The approval information must be kept on file with the permitted facility and DEQ.*

Schedule B, Minimum Monitoring and Reporting Requirements

Depending on the treatment process and the use of recycled water, the permit writer may include any or all of the following parameters as appropriate:

Recycled Water Outfall 00( ) (When discharging recycled water)

Recycled water monitoring parameters shall be measured and samples collected from (identify the monitoring location).

Item or Parameter	Minimum Frequency	Type of Sample
Total Flow (MGD) or Quantity Irrigated (inches/acre)	Daily	Measurement
Flow Meter Calibration	Annually	Verification
Quantity Chlorine Used	Daily	Measurement
Chlorine Residual	Daily	Grab
pH	2/Week	Grab
E. coli	Weekly (Class D)	
Total Coliform	Weekly (Class C) 3/Week (Class B) Daily (Class A)	Grab
Nutrients (TKN, NO_2+NO_3-N, NH_3, Total Phosphorus)	Quarterly	Grab
Turbidity	Hourly	Measurement

Groundwater Monitoring Requirements *(for AR projects ONLY)*

Groundwater monitoring shall occur in accordance with the monitoring plan described in the Recycled Water Use Plan.

Reporting Procedures

By no later than 15 January of each year that recycled water is generated and used, the permittee shall submit to the Department an annual report describing the effectiveness of the recycled water system to comply with the approved Recycled Water Use Plan, the rules of Division 55, and the

limitations and conditions of this permit applicable to the reuse of recycled water. One copy of the annual report shall be submitted to the regional DEQ office; a second copy will be submitted to the DEQ Reuse Water Coordinator.

Notes:

- *Identify the monitoring point for establishing compliance with the Class of water*
- *Identify if additional monitoring requirements are included in the RWUP.*
- *Reporting should include the sources and quantities of blended waters*
- *All reuse annual reports should specify a common date of 15 January.*

Schedule C, Compliance Schedule

(WPCF permits ONLY)

Schedule D, Special Conditions

(1) The permittee shall meet the requirements for use of recycled water under Division 55, including the following:
  (a) No recycled water shall be released by the permittee until a Recycled Water Use Plan is approved by the Department.
  (b) All recycled water shall be managed in accordance with the approved Recycled Water Use Plan. No substantial changes shall be made in the approved plan without written approval of the Department.
  (c) Any person having control over the treatment or distribution or both of recycled water may distribute recycled water only for the beneficial purposes identified in this permit and the associated Recycled Water Use Plan. Moreover, all reasonable steps must be taken to ensure that the recycled water is used only in accordance with the standards and requirements of the rules of Division 55, the conditions of this permit, and the Recycled Water Use Plan.
  (d) The permittee shall notify the Department within 24 hours if it is determined that the treated effluent is being used in a manner not in compliance with OAR 340-055. When the Department offices are not open, the permittee shall report the incident of noncompliance to the Oregon Emergency Response System (telephone number: 800.452.0311)
  (e) No recycled water shall be made available to a person proposing to use recycled water unless that person certifies in writing that they have read and understand the provisions in these rules. This written certification shall be kept on file by the sewage treatment system owner and be made available to the Department for inspection.

(2) All recycled water used at the treatment plant site (or satellite facility operating under the same permit) for landscape irrigation or in plant processes is exempt from the Division 55 rules if:
  (a) The recycled water is an oxidized and disinfected wastewater
  (b) The recycled water is used at the site where is it generated or at an auxiliary wastewater or sludge treatment facility that is subject to the same NPDES or WPCF permit as the wastewater treatment system. Contiguous property to the parcel of land upon which the treatment system is located is considered the wastewater treatment system site if under the same ownership;
  (c) Spray or drift or both from the use does not occur off the site; and
  (d) Public access to the site is restricted.

Notes:

- *Do **not** include the development of a Recycled Water Use Plan as a special condition*
- *Minor updates (e.g., changing language from reclaimed water to recycled water or updating a plan to use a Department template) to the RWUP may included as a special 90-day condition. Minor updates do not include changes in Class of water or changes in approved beneficial purposes*
- *The Recycled Water Use Plan is an integral part of the permit and all conditions are enforceable*
- *The RWUP should be approved by the Department before issuing the permit*
- *The RWUP must go through public notice like the permit*

Oregon Water Resources Department

Registration No. *(Dept. Use Only)*

Registration of Reclaimed Municipal Water Use

"Reclaimed water" means water that has been used for municipal purposes and after such use has been treated in a sewage treatment system and that, as a result of treatment, is suitable for a direct beneficial purpose or a controlled use that could not otherwise occur. (ORS 537.131 and 537.132)

NOTE: *Please type or print in dark ink. If your registration is found to be incomplete or inaccurate, we will return it to you. If any requested information does not apply to your registration, insert "n/a."*

Registrant(s) _____
(owner of the land where reclaimed water is to be used)

Mailing Address _____

_____
City *State* *Zip* *Daytime Telephone No.*

1. Municipal Discharge Permit

NPDES Permit No. _____ *Effective Date* _____ *Expiration Date* _____

WPCF Permit No. _____ *Effective Date* _____ *Expiration Date* _____

Date use of Reclaimed Water began, or is scheduled to begin _____

Annual Period of Use: from _____ *to* _____

2. Supplier of the Municipal Water which produces the Reclaimed Water

If more than one supplier is used, please provide a list in the ***Remarks*** *section on page 4.*

Name of Supplier _____

Address _____

Telephone No. _____ *Fax No.* _____

Original Source of Municipal Supply _____

3. Supplier of Reclaimed Water

Name of Supplier _____

Name of Facility _____

Street Address of Facility _____

Name of Facility Owner _____

Address of Facility Owner _____

Telephone No. of Supplier _____ *Telephone No. of Facility* _____

Fax No. _____

4. User of Reclaimed Water

Name of Water User _____

Address _____

Telephone No. _____ *Fax No.* _____

5. Agreement/Contract

Period of Agreement and Contract _____

Term of Agreement _____

Special Limitations _____

6. Total Amount of Reclaimed Water

Enter the amount to be applied to beneficial use:

_____ *cubic feet per second, OR* _____ *gallons per minute*

If reclaimed water is to be used from more than one treatment facility, give the quantity from each.

7. Intended Use(s) of Reclaimed Water

_____

(If for more than one use, give the quantity of reclaimed water from each treatment facility for each use.)

*If for **IRRIGATION**, or other land application, state the **TOTAL** number of acres to receive reclaimed water under each use*;

Irrigation _____

Other (describe) _____

(Temperature Control, Mitigation, Wetland, etc.)

8. Description of Delivery System

Include dimensions and type of construction of diversion works, length and dimensions of supply ditches or pipelines, size and type of pump and motor. If for irrigation, describe the type of system (i.e., flood, wheel line, hand line, drip, other).

_____

_____

_____

9. Existing Water Rights

Please provide a description of all the existing water rights appurtenant to the lands where the reclaimed water will be applied.

Application No. _____ *Permit No.* _____

Certificate No. _____ *Decree vol & pg* _____

(Only one number needs to be provided. Attach a separate list if more than one water right is involved.)

10. Property Ownership

Do you own all the land where you propose to divert, transport and use water?

❑ Yes *(Skip to section no. 11 "Historic Disposal Method")*

❑ No *(Please check the appropriate box below and, in the **Remarks** section, list the names and addresses of all affected landowners.**)*

- ❑ *I have a recorded easement or written authorization permitting access.*
- ❑ *I do not currently have written authorization or an easement permitting access.*

***If more than 25 landowners are involved, a list is not required. Contact WRD for instructions.*

11. Historic Disposal Method

Has the reclaimed water being registered in this process been discharged into a natural watercourse for 5 or more years?

❑ No *(Skip to section no. 12 "Signature")*

❑ Yes *(Please answer the following questions)*

*a) Name of the receiving natural watercourse:*_____

*b) Description of the location where the discharge historically entered the natural watercourse:*_____

_____

c) Does the amount of reclaimed water proposed for use under this registration represent 50% or more of the total average daily flow of the natural watercourse? ❑ Yes ❑ No

12. Signature

I/We certify that the information provided in this application is an accurate representation of the proposed reclaimed water use and is true and correct to the best of my knowledge:

_____ _____

Signature of Registrant *Date* *Supplier's Signature* *Date*

_____

Signature of Co-Registrant *Title* *Date*

_____

DEQ Signature *Date*

NOTE: This registration must be accompanied by a map which shows the location of the treatment plant, approximate location of conveyance system (pipelines, canals, etc.) and place of use. The map must be drawn to scale with the scale stated on the map. The land area where the reclaimed water is to be applied shall be identified on the map. Topographic maps with the facilities and place of use shown will meet the map requirement.

Remarks

Last Revision:October 29, 1996

Information and Instructions for Completing Municipal Reclaimed Water Registration Form

The Oregon Water Resources Department (WRD), Department of Environmental Quality (DEQ) and municipal effluent dischargers joined together to support passage of Senate Bill 204 in the 1991 legislative session. Passage of SB204 allows treated municipal effluent to be put to other beneficial uses without acquiring a water right. The effluent is to be treated and discharged under either a national pollutant discharge elimination system (NPDES) or water pollution control facilities (WPCF) permit. The legislation, codified in ORS 537.131, 537.132 and 540.610(h), directs any person using or intending to use treated municipal effluent to file a registration form with the WRD. ORS 537.132 also provides a process to resolve claims of injury made by other water right holders. This letter includes a form to use when registering reclaimed water use and provides guidance when completing the form.

The enclosed form is to be used to register the use of reclaimed municipal water. The registration only applies for instances where the reclaimed water is used for a different beneficial use. There is no fee associated with registering use of reclaimed municipal water. A registration will not be accepted if the reclaimed municipal water is discharged into a stream to be re-diverted for beneficial use. The form requests the information required by the statute. Once completed, the registration form is to be submitted to the WRD Region where the use is to occur.

Background

The practice of disposing of treated municipal effluent has occurred as long as municipal effluent collection systems have existed. WRD records contain water right permits and certificates dating to the early 60s authorizing the land application of treated municipal and industrial effluent. Beginning in the mid-70s, municipalities were faced with increased pressure to either stop discharging effluent into streams or to treat their effluent to produce a much higher quality of water which could be discharged into the receiving stream. Land application of treated effluent has increased over time to reduce discharges and improve water quality while providing a source of water and nutrients for various crops.

In many locations, municipal effluent being discharged into streams accounts for a large portion of the total flow in the receiving stream during the low flow period. Reduction of municipal discharge into streams resulted in water users claiming injury due to reduced streamflows. This put the water users, effluent discharges, DEQ and WRD in a difficult regulatory situation. Available options included: stopping the discharge to improve the water quality in the streams and allow the land application of the effluent; require the construction of very expensive treatment facilities capable of treating municipal effluent to near drinking water standards; or, require dischargers to obtain water use permits which would result in the discharge of effluent or compensation of water right holders during low flow periods. The result was passage of SB 204 by the 1991 legislature.

Following is a further explanation of the information being requested on the form:

The registration form is to be submitted in the name of the user of the reclaimed water. The form requests both the users name and address. This will provide information to the WRD watermaster should questions arise regarding the use of the reclaimed water.

1. Municipal Discharge Permit

The use of reclaimed municipal water can only occur under either an NPDES or WPCF permit. Unlike a water right, NPDES and WPCF permits are issued for set periods of time. Please identify the discharge permit which authorizes the use of the reclaimed water and the expiration date.

2. Supplier of the Municipal Water which produces the Reclaimed Water

Registration of reclaimed water only applies to water that has been used for municipal purposes and has subsequently been treated in a sewage treatment system. Please list the name of the municipal water supplier which serves the area generating the sewerage. The original source of municipal water such as the name of the stream, reservoir or groundwater is to be listed.

3. Supplier of Reclaimed Water

Provide information about the sewage treatment facility that is supplying the treated reclaimed water. Include the name of the organization responsible for the treatment and the specific facility which is supplying the reclaimed water.

4. User of Reclaimed Water

The name of the reclaimed water user may be the same as that listed for the registrant. If so, state "same as registrant." If the reclaimed water user is different than the registrant, provide name and requested information.

5. Agreement/Contract

Note any agreements which may exist between the reclaimed water supplier and registrant or user. The agreement may be attached or the information may be placed on the registration form. This question is looking for any limitation which may impact the use of reclaimed water.

6. Total Amount of Reclaimed Water Enter the rate of flow at which the reclaimed water is to be delivered to the place of use.

This information can be entered as cubic feet per second (cfs), gallons per minute (gpm) or acre feet per day (acfd). If more than one treatment facility is supplying the reclaimed water, then the rate from each treatment facility is to be listed. Additional pages may be attached as needed.

7. Intended Use(s) of Reclaimed Water

Provide the intended use of the reclaimed water. This should be the same as listed in the NPDES or WPCF permit. If the use is land application such as irrigation or temperature control, then the total number of acres served is to be listed.

8. Description of Delivery System

Describe the delivery system from the treatment facility to the place of use. This includes any pipes, canals or other facilities used to transport the reclaimed water.

9. Existing Water Rights

Oregon Revised Statute 540.610 provides a presumption to rebut forfeiture of water rights which authorize the same use in the same location as served by the reclaimed water. A listing of all valid water rights appurtenant to the lands receiving reclaimed water is to be included here. Either the application, permit, certificate or decree volume and page number need be listed. Additional pages or copies of the water right(s) may be attached to the registration form.

10. Property Ownership

This question is asking for ownership or easement information for the lands crossed by the delivery system and for the place of use. The appropriate box is to be checked or copies of the appropriate document(s) is to be attached. Note whether the reclaimed water is delivered by a district or company who owns or manages the distribution system and relevant easements. In this case, list the name, address and contact person for the company or district.

11. Historic Disposal Method

List information regarding the historic discharge into a water course. The information provided will be used when responding to claims of injury made by other water users in the stream system. The registrant is to supply information as to whether the reclaimed water being registered has ever been discharged into a watercourse. If the reclaimed water has been discharged into a watercourse, the registrant is to determine if the discharge represented 50% of the streamflow.

12. Signature

The form is to be signed by the registrants.

Remarks

Add any additional information that you feel is related to the review of the registration. This space may be used to complete answers if more space is required. Additional pages may also be added.

For more information or assistance in completing the registration please contact the WRD Region office in your area.

APPENDIX C – FREQUENTLY ASKED QUESTIONS ON WATER REUSE PROJECTS AND WATER RIGHTS.

When can a water user reuse water under an existing right?

A water right holder may recapture wastewater remaining on his/her property and reapply that water. The water must be re-used for the original beneficial use and in the location authorized under the water right. The recaptured water may be used under the existing water right and without any additional authorizations.

Similarly, a municipality can reuse treated effluent. The reclaimed water must be used within the authorized service area and for uses that could occur under a municipal water right.

When can water be reused under a registration of recycled water?

Effluent may be reused for other beneficial purposes if the reuse is authorized by a NPDES or WPCF permit. A person intending to use the recycled water must file a reclaimed water registration with the WRD. Use of the reclaimed water may occur outside the original service area, and for other purposes than originally authorized.

When does a water reuse project require a new water right?

Water reuse project that do not fit into the two categories described above will generally require a new water right.

What is the review process for a reclaimed water registration?

The WRD does not conduct a public interest review for recycled water registrations, but a recycled water registration may be subject to a notice requirement. If the following circumstances all apply, the WRD will notify persons with water rights that may be affected by ruse of the effluent:

- The municipality discharge wastewater into a natural waterway for five or more years;
- The discharge is more than 50-percent of the average flow; and
- The discharge would cease as a result of the reuse.

The affected water right holders will have a preference to use the recycled water if they show that the cessation of municipal discharge impairs their ability to obtain water under their water right.

[Information provided by WRD]

APPENDIX D – RECYCLED WATER USE PLAN TEMPLATE & CHECKLIST

OVERVIEW

A Recycled Water Use Plan, RWUP, describes in detail the operational requirements of a recycled water use program and serves as the main administrative tool for Oregon's recycled water use program. A facility must have a Department approved RWUP plan prior to providing or distributing recycled water for use OAR340-055-0025 and the RWUP must be approved by the Department in writing (OAR 340-055-0016(2)(b)).

A recycled water use plan needs to be kept current to address new circumstances in recycled water production, treatment processes, monitoring for new substances and the addition of newly authorized sites or changing/expanding uses. Consequently, RWUPs need to be reviewed and kept current on regular basis. Moreover, when changes to recycled water operations occur, both the Department and the permittee need to be aware of those changes.

- OAR 340-055-0016(4) indicates that when the conditions or limitations in a permit, including RWUP, conflict with limitation or conditions in OAR 340-055, the existing permit controls until the permit is modified or renewed. In any event, the permittee should be encouraged to seek clarification from the Department when such discrepancies are discovered.
- Before approving or modifying a RWUP using of Class C, D, or nondisinfected water, the plan must be submitted to DHS for comment [OAR 340-055-0016(2)(b)].
- During permit renewal, the permittee/applicant and the Department should review existing RWUPs to ensure that major changes or updates in operations have been incorporated in the plan. The permittee can facilitate Department review by highlighting any changes in operations from previous RWUPs.
- Wastewater treatment system owners/operators should review their plans during preparation of the annual reports and confirm that the previous year's operations were consistent with the plan. If deviations between operations and the plan are identified, the RWUP should be appropriately updated.
- Plans that have been amended or supplemented during the life of a permit should generally be revised and the supplemental information incorporated into the main document during permit renewal.

GENERAL CONSIDERATIONS

The following general considerations assist in the development and general usefulness of the RWUP.

- The permittee or applicant—not DEQ—bears responsibility for writing a RWUP.
- The RWUP must demonstrate compliance with the requirements set forth in OAR 340-055.
- The plan should be a useable document for the treatment plant owner and water user, not simply a regulatory document.

- The plan should provide operations details on the recycled water program, including treatment at the treatment facility as well as operations at the point of reuse.
- Operational details and conditions should be clearly stated in the plan. However, the plan should incorporate flexibility where appropriate by using language such as "…unless otherwise approved in writing by the Department."
- The plan should include formulas, worksheets, and other technical tools that will be used by the facility when implementing the plan.
- The scale and level of detail included in the RWUP may correspond to the size and complexity of the recycled water use program.
- A draft RWUP must be submitted for review to the appropriate DEQ regional office.
- After the RWUP has gone through Public Notice and is considered to be approved by DEQ, the regional office will mail a letter to the permittee indicating that action has been taken on the plan and approved by DEQ.

Recycled Water Use Plan
For
<Permittee Name>
<NPDES/WPCF> Permit No. <number>
File No. <number>

Facility:
<Legal Name>
<Common Name>

Physical Address
<Address>
<City> <State> <Zip>

Mailing Address (if different)
<Address>
<City> <State> <Zip>

Contact: <Name>
Phone: <XXX.XXX.XXXX>
Email: <name@facility>

<Month> <Year>

INTRODUCTION

Provide an introduction to facility and the recycled water program. Also include the following information:

- ☐ A statement that the current RWUP supersedes any previously plans
- ☐ A brief description of the lines of authority and communication within the recycled water program, including the recycled water user(s); and
- ☐ Contact information of parties responsible for various aspects of environmental compliance.

BENEFICIAL PURPOSES

Beneficial purposes lie at the core of the recycled water use program and can influence wastewater treatment, monitoring, as well as public health and environmental concerns. Beneficial purposes must be identified in the RWUP [OAR 340-055-0025(1)(c)]. Include:

- ☐ A list or table of beneficial purposes and the Class(es) of water. Ex:

Beneficial Purpose	**Class of Water**	**Quantity (mgd)**	**Frequency**
<Beneficial Purpose 1>	Class <A, B, C, D>	<number>	<April - October>
<Beneficial Purpose 2>	Class <A, B, C, D>	<number>	<Year Round>
<etc.>	<etc.>	<etc.>	<etc.>

- ☐ The name, address, and phone number of the owner(s) and user(s) of each site receiving recycled water

WASTEWATER TREATMENT

The RWUP must describe wastewater treatment operations at the treatment facility [OAR 340-055-0025(1)(a)]. The description should include information on the quantity and quality of both wastewater treated and recycled water produced. If the wastewater treatment system operations are described in other documents, those documents may be referenced in the RWUP. Current copies of those documents must be readily available to the Department and should have been approved. The following information is pertinent to describing the wastewater treatment system:

- ☐ A general description of the treatment system, including treatment efficiency capability(an overall flow diagram showing the entire treatment and reuse process recommended);
- ☐ A brief description of the quantity (gpd), and origin (% domestic, % commercial, % industrial) of wastewaters processed in the treatment facility;
- ☐ The operating volumes (gallons) of each component of the wastewater processing stream (diagram recommended);
- ☐ A detailed, step-by-step description of the unit processes used to a specific class of recycled water [OAR 340-055-0025(1)(b)];
- ☐ A summary of the quantity of recycled water produced;
- ☐ A description of any blending operations, including the source of the water, estimates of the blending ratios;
- ☐ A summary of the recycled water quality supplied to each beneficial purpose. The exact data needed to characterize the recycled water may vary based on the specific end use(s), but may include the following common parameters: *E. coli*, total coliform, turbidity, BOD, TSS, TKN, NH_4-N, NO_3-N, total P, K, Ca, Mg, Na, pH, TDS, etc.[1]

[1] Recycled water quality information should generally include at a minimum the basic physical parameters, bacteria, and nutrients. Additional information such a mineral or metals concentrations (e.g., Ca, Mg, TDS, Fe, Mn, etc.) may be necessary for specific end uses, such as boiler water, agricultural irrigation, or other beneficial purposes that may be sensitive to recycled water quality.

RECYCLED WATER MONITORING AND SAMPLING

The RWUP must describe monitoring and sampling procedures [OAR 340-055-0025(1)(e)]. Monitoring and sampling applies to both recycled water quantity and quality. DEQ, WRD [OAR 340-055-0025(1)(h)], or other agencies may specify monitoring requirements. Since monitoring and sampling may vary based upon the Class of water and/or the beneficial purpose, monitoring and sampling procedures must provided the relevant level of detail. For each Class of Water-Beneficial Purpose combination, provide the following information:

- ☐ Recycled water quantity:
  - Estimate of quantity of recycled water produced;
  - Measurement techniques (e.g., flowmeters, flumes);
  - Frequency (e.g., weekly, monthly, seasonal);
  - Location (i.e., at a point representative of recycled water volume sent to distribution systems);

- ☐ Recycled water quality:
  - Parameters and estimated concentrations (e.g., E. coli, total coliform, turbidity, BOD, TSS, TKN, NH_4-N, NO_3-N, total P, K, Ca, Mg, Na, pH, TDS, etc.); Actual data from previous monitoring operations may be provided.
  - Sample type (e.g., continuous, grab, composite);
  - Sampling methods (e.g., autosampler, bailer);
  - Frequency (e.g., weekly, monthly);
  - Location (i.e., a point that is representative of the recycled water entering the distribution systems; a diagram or schematic is recommended);
  - Analytical methods (e.g., Standard Analytical Methods, DEQ approved methods);
  - Field Quality Assurance / Quality Control (QA/QC) procedures (e.g., field equipment calibration, field equipment decontamination, sample duplicates, field blanks, rinse water blanks, trip blanks);
  - Laboratory QA/QC procedures ;

SYSTEM MAINTENANCE AND CONTINGENCY PROCEDURES

The RWUP must include a maintenance plan that describes how the wastewater treatment system equipment and facility processes will be maintained [OAR 340-055-0025(1)(f)], as well as a description of contingency procedures [OAR 340-055-0025(1)(d)].

- ☐ The facility's operations and maintenance plan may be included by reference in the information is provided in another document. However, the referenced document must be readily available to DEQ and should have been previously approved by the Department.
- ☐ A description of the alarm devices or equipment that will be furnished pr provide warning of loss of power, and/or failure of processing equipment essential to the generation of recycled water [2]
- ☐ A description of the standby power systems used to ensure that all essential processes operate during interruptions [3]

---

[2] OAR 340-055-0030(2) Alarm devices. Alarm devices are required to provide warning of power loss and failure of process equipment essential to the proper operation of the wastewater treatment system and compliance with this division.

[3] OAR 340-055-0030(3) Standby power. Unless otherwise approved in writing by the department, a wastewater treatment system providing recycled water for use must have sufficient standby power to fully

- ☐ A description of the redundant treatment systems that will be furnished to provide warning of loss of power and/or failure of process equipment essential to the recycled water generation [4]

RECYCLED WATER TRANSMISSION, STORAGE, DISTRIBUTION, AND PLUMBING

The RWUP should include a description of the recycled water transmission, storage, and distributions systems, including plumbing considerations to avoid cross connections.

- ☐ A characterization of all proposed recycled water storage facilities (short-term, long-term, and emergency), including: facility location(s), dimensions (feet), operating capacity (gallons), and pollution controls (e.g., liners, barriers, or other controls to prevent spills, overflows, or other upsets);
- ☐ A description of the recycled water transmission system used to move recycled water from the treatment facility to storage facilities, satellite facilities, or reuse site(s), including labelling or other identification mechanisms used to prevent cross connections with other systems; and
- ☐ A description of how all piping, valves, and other portions of the recycled water distribution and plumbing systems will be constructed and marked to prevent cross-connection with potable systems
- ☐ A description of measures (e.g., chlorine residual, filtration) used to control water quality, if any, during recycled water transmission, storage, or distribution.

PUBLIC HEALTH AND ENVIRONMENTAL CONTROLS

For each identified beneficial purpose, the RWUP should identify potential public health and environmental concerns as well as the measures taken to control adverse effects on public health and the environment. The RWUP must include a description of public and personnel notification procedures in the reuse area (when required) [OAR 340-055-0025(1)(g)]. For each Beneficial Purpose, provide the following information:

- ☐ Identify any public health (e.g., aerosols, direct contact) and environmental concerns (e.g., groundwater, surface water)
- ☐ A detailed description of an access and exposure controls employed at reuse sites, such as fences, windbreaks, etc.
- ☐ A description of personnel and public notification procedures, including samples of any written materials
- ☐ A map Identifying the reuse site and setbacks to property lines, water supply sources, and food preparation/drinking fountains (these features should be identified on the map)
- ☐ Specific site management practices used at reuse sites designed to protect public health and the environment, including
    - Signage
    - Irrigation scheduling, when appropriate
    - Grazing, crop, and/or harvest restrictions, when appropriate

---

operate all essential treatment processes. The department may grant an exception to this section only if the wastewater treatment system owner demonstrates that power failure will not result in inadequately treated water being provided for use and will not result in any violation of an NPDES or WPCF permit limit or condition or Oregon Administrative Rule.

[4] OAR 340-055-0030(4) Redundancy. A wastewater treatment system that provides recycled water for use must have a sufficient level of redundant treatment facilities and monitoring equipment to prevent inadequately treated recycled water from being used or discharged to public waters.

- ☐ Stormwater control measures, when appropriate
- ☐ Overflow control measures, when appropriate
- ☐ Decontamination procedures for equipment, facilities, or vehicles that contact recycled water.
- ☐ A reference to (or description of) groundwater monitoring activities, if required

For Class B, C, D, or nondisinfected water used for irrigation ONLY.

LAND APPLICATION PLAN

When Class B, C, or D water is used for irrigation, the RWUP must also address various aspects of the land application program, including characterization of the land application site, the irrigation system, the soils and crops, site management practices, and public access control or notification [OAR 340-055-0025(2)(a)-(e)]. Although a Land Application Plan is not required for irrigation with Class A waters, many of the operational considerations are applicable to higher level of treatment and the permittee/applicant should be encouraged to develop an operations plans. Unless a plan for irrigation with Class A water is identified in Schedule D of the permit to protect public health or the environment (e.g., to comply with a GWMA Action Plan), the Department cannot require development of a Land Application Plan for Class A recycled water. A separate land application plan should be submitted for each irrigation system/project. (Multiple land application plans may be included in a single RWUP.) This section may be omitted of the RWUP if irrigation is not an identified beneficial purpose.

Site Description. The RWUP must identify and describe the land application site(s), which should include the following information:

- ☐ Zoning of the irrigation site and neighboring properties;
- ☐ A site map with setbacks, location(s) of and distances to property boundaries, water supply sources, food preparation or drinking fountains, and nearest developed property
- ☐ Street address (if any) and legal descriptions (i.e., county, township, range, section, tax lot) of each site receiving recycled water
- ☐ Location(s) of fields irrigated with recycled water
- ☐ A map(s) identifying:
    - field acreage;
    - the location of any drinking water wells, agricultural dry wells, drainage ditches, surface water features, etc.,
    - the locations of pump station(s), storage lagoon(s), surge basin(s), irrigation distribution system(s), etc.
- ☐ A Land Use Compatibility assessment, such as
    - Zoning
    - Historical land use
    - Present land use
    - Future land use
    - Adjacent land uses

Site Characterization.

The RWUP must provide a site characterization, including a description of soils and crops (or vegetation) at the land application site. A full site characterization should also include information on topography, hydrology, geology, and climate:

- ☐ USGS topographic map
- ☐ A description of topographical characteristics of the sites, including slope, landform (i.e., convex, concave), and site landscape position (i.e., upland, terrace, side slope, etc.)

- ☐ The locations of any perennial or seasonal drainages
- ☐ NRCS soil maps and soil series descriptions
- ☐ Descriptions of soils[5], including: soil texture; structure; rooting abundance and depth; color; presence, depth, and distribution of mottling; drainage class; pore size, continuity and abundance; coarse fragment content (percent by volume); depth to groundwater (both permanent and seasonal); depth to and identification of any restrictive layers (i.e., bedrock, hardpan, fragipan, etc.);
- ☐ An estimate of or actual information on the soil infiltration rate (e.g., saturated hydraulic conductivity, Ksat), permeability, and available water holding capacity, AWHC
- ☐ Regional and local hydrogeology, when required (see AR section for contents)
- ☐ Climatic information including, mean annual and monthly precipitation, evaporation and temperature; the average length of the growing season; average dates of first and last frost; the number of days the mean temperature drops below 32 F; stormwater runoff potential; and prevailing wind direction and intensity

Crops.

A description of particular crops grown on the land application sites (fields), which should include the following information and may be provided in a table:

- ☐ List of proposed crops (e.g., all and everything that is planning on growing on land application sites),
- ☐ Projected harvest (e.g., bu/ac, number of cuttings, protein content, etc.)
- ☐ Current OSU Fertilizer Guides (FG)/other approved agronomic rates (e.g., identified FG guides , or submitted scientific literature to be approved with the RWUP),
- ☐ Crop fertilizer needs—specifically N and P (e.g., OSU total nitrogen numbers, site-specific crop needs that are under the OSU FG, nitrogen numbers according to submitted scientific literature),
- ☐ Any crop sensitivities to water quality (e.g., salts, B, chloride, etc.)
- ☐ Crop specific typical rooting depths of crops selected,
- ☐ Monthly and Annual projected crop water needs (e.g., OSU irrigation planning guide, historic localized crops specific water needs),
- ☐ Timing of application (e.g., spring, summer, fall, winter irrigation amounts for seen to be applied),
- ☐ Double Cropping (e.g., whether or not the concept to be optimized under land application program),
- ☐ List any harvest restrictions due to pathogen issues in the wastewater or wastewater solids (i.e. reclaimed water).

Irrigation System.

The RWUP must include a description of the irrigation system which should include:

- ☐ A description and plot of the irrigation system layout and controls, including but not limited to (engineering plans and specifications recommended):
  - Storage;
  - distributions methods,

[5] Although general soil characteristics can be gathered from the NRCS soil survey, actual soil characteristics can vary widely from those mapped or described. An actual field investigation by a soil scientist is strongly, especially for projects in sensitive areas (e.g., GWMAs, TMDL limited watersheds, etc.). Field investigations should include soil examination to a depth of 5-feet. The actual number of soil pits or bore holes will depend upon the irrigation site characteristics, such as total area and site variability.

- application methods;
- start up procedures;
- typical daily operations (e.g., draining distribution lines to minimize potential odors during startup on the following day);
- shutoff procedures;
- nozzle design

☐ A description of irrigation system operations, including how loading and resting rates will be managed and monitoring in irrigation areas to assure that excess soil saturation, groundwater contamination, and runoff will not occur (e.g., moisture monitoring);
☐ A description and plot of the drainage system layout and controls, including the locations of and connections to surface water features;
☐ An irrigation system maintenance plan;

Application Rates and Irrigation Scheduling.
In order to protect groundwater and surface water, the land application plan needs to address the irrigation scheduling, including consideration for both water application and nutrient application:

☐ An estimated irrigation schedule, including monthly budget calculations:
- A summary of the recycled water quality before and after any blending delivered to the irrigation site, BOD, TSS, TKN NO_3-N, NH_4-N, total P, K, Ca, Mg, Na, SAR, pH TDS
- The quantity of recycled water required to meet the crop nutrient needs, including the methods (assumptions and equations) used to calculate the agronomic rate
- Estimated monthly and annual water application rates that account for crop irrigation requirement, leaching fractions, and irrigation efficiency
- The methods (i.e., assumptions and equations) used to calculate water application rates (i.e., hydraulic loading calculations and agronomic loading calculations), including accounting for leaching fraction, irrigation efficiency, moisture control, etc.;
- An indication of which factor limits recycled water application, either the hydraulic loading rate or agronomic loading rate

☐ Supplemental Water. A description of the land applied supplemental fresh water should include both quantity and quality information.
☐ Precipitation. A description of the average natural precipitation quantities in the specific area that the land application sites are located should be included.
☐ Supplemental Fertilizer. A description of supplemental fertilizer (i.e., commercial, chemical, manure, etc.) applications to the land application sites should include both quantity applied and fertilizer type (quality).

Site Monitoring Plan.
The RWUP should include a description of water and nutrient loadings to the land application site. The site monitoring plan may include information on:

☐ Soil Sampling. A description of any soil sampling and monitoring as needed as part of the nutrient balance and soil salinity tracking on land application sites regarding soil fertility and crop toxicity
☐ Soil Moisture Monitoring. A description of a particular soil moisture sampling and monitoring protocol, as part of the hydraulic balance and prescribed leaching fraction tracking/monitoring on land application sites
☐ Biomass (Crop) Sampling. A description of a particular biomass sampling and monitoring protocol, as part of the nutrient (nitrogen) balance and site-specific nutrient uptake tracking, and crop health on land application sites.

- ☐ Recycled Water Application Monitoring. A description of site-specific wastewater monitoring protocol out on the land application sites (fields) in regards to irrigation accounting of the wastewater, as part of the hydraulic balance, which in turn helps to determine nutrient (nitrogen) loadings

For Class A water used for Artificial Groundwater Recharge ONLY.

ARTIFICIAL GROUNDWATER RECHARGE (AR) PLAN

A detailed description of Artificial Groundwater Recharge operations is required when AR is an identified beneficial purpose. This section may be omitted from plans in which AR is not an identified use.

- ☐ A groundwater monitoring plan in accordance with OAR 340-040-0030(2). If a separate groundwater monitoring plan has been developed, it may be incorporated into the RWUP by reference.
- ☐ A map identifying the groundwater recharge area, groundwater flow direction, the location of any drinking water protection area, and the location of the nearest point of withdrawal.
- ☐ The estimated retention time of recycled water in the aquifer.
- ☐ General geology and hydrogeology, such as stratigraphy, structure, aquifers, aquitards and low permeability layers; groundwater quality.
- ☐ Uppermost aquifer characteristics such as:
    - Type (confined versus unconfined)
    - Material (alluvial, dunal, fractured, volcanic, or other)
    - Depth to uppermost aquifer
    - Depth to seasonal high water table
    - Hydraulic conductivity
    - Storage coefficient
    - Estimated porosity
    - Calculated hydraulic gradient
    - Fluctuations in groundwater flow and direction
    - Contour map of potentiometric surface (i.e., groundwater table)
    - Calculated groundwater flow velocities
    - Interconnection with surface water bodies or other aquifers
- ☐ AR site characteristics, including
    - USGS topographic map
    - A description of topographical characteristics of the sites, including slope, landform (i.e., convex, concave), and site landscape position (i.e., upland, terrace, side slope, etc.)
    - The locations of any perennial or seasonal drainages
    - NRCS soil maps and soil series descriptions
    - Descriptions of soils[6], including: soil texture; structure; rooting abundance and depth; color; presence, depth, and distribution of mottling; drainage class; pore size, continuity and abundance; coarse fragment content (percent by volume); depth to groundwater (both permanent and seasonal); depth to and identification of any restrictive layers (i.e., bedrock, hardpan, fragipan, etc.);

[6] Although general soil characteristics can be gathered from the NRCS soil survey, actual soil characteristics can vary widely from those mapped or described. An actual field investigation by a soil scientist is strongly, especially for projects in sensitive areas (e.g., GWMAs, TMDL limited watersheds, etc.). Field investigations should include soil examination to a depth of 5-feet. The actual number of soil pits or bore holes will depend upon the irrigation site characteristics, such as total area and site variability.

- Information on the soil infiltration rate (e.g., saturated hydraulic conductivity, Ksat), permeability, and available water holding capacity, AWHC
- Climatic information including, mean annual and monthly precipitation, evaporation and temperature; the average length of the growing season; average dates of first and last frost; the number of days the mean temperature drops below 32 F; stormwater runoff potential; and prevailing wind direction and intensity
- Any other information requested by WRD

☐ Verification from WRD that a request for authorization for this use has been initiated.

RECORDS AND REPORTING

RWUPs should contain information on the recycled water use program's record keeping and reporting requirements, including:

☐ A description of the types of records which will be maintained by the facility, such as: effluent quality monitoring; recycled water system performance; on-going system maintenance records; inspection reports; sources and quantities of supplemental water; quantity of recycled water generated; final use of recycled water generated; site monitoring records; irrigation records; etc.

☐ A description of the reporting procedures (i.e., annual report) such as: responsibility for reporting; report contents, date of report, etc.

Irrigation

The sustainability of a recycled water irrigation project depends mostly on the irrigation water quality and its impacts on surface water, groundwater, crops, and soils. The three primary recycled water quality concerns include: salinity, nutrients, and trace constituents. Salinity and nutrient are discussed in the

Recycled water may contain measurable concentrations of other trace constituents that may be of value or have adverse effects on crops or soils. Trace constituents include low concentrations of basic elements and metals as well as organic compounds. Many of the trace elements are essential for plant growth (e.g., B, Cu, Fe, Mn, Mo, Zn), but begin to exhibit toxicity at higher concentrations. Typically, the concentrations of trace elements in recycled water fall well below levels that are likely to cause adverse effects on plant growth. However, long-term recycled water applications can result in the accumulations of trace elements in the soil, which can potentially result in plant toxicity and groundwater contamination. Some crops accumulate trace elements in plant tissue, which can pose health risks to human and animals at high concentrations. **Error! Reference source not found.** provides EPA-recommended limits for trace constituents in recycled water and should be used as a starting point for evaluating trace element concentrations in recycled water. Other sources of scientifically valid information may also be used to assess recycled water quality for agricultural irrigation. Soil or crop monitoring should be considered for recycled water quality that exceeds the long-term use recommendation.

Table 1. EPA Recommended Limits for Constituents in Recycled Water for Irrigation.

Constituent	Long-Term Use, mg/L	Short-Term Use, mg/L	Remarks
Aluminum	5.0	20	Can cause nonproductiveness in acid soils, but soils at pH 5.5 to 8.0 will precipitate the ion and eliminate toxicity.
Arsenic	0.10	2.0	Toxicity to plants varies widely, ranging from 12 mg/L for Sudan grass to less than 0.05 mg/L for rice.
Beryllium	0.10	0.5	Toxicity to plants varies widely, ranging from 5 mg/L for kale to 0.5 mg/L for bush beans.
Boron	0.75	2.0	Essential to plant growth, with optimum yields for many obtained at a few tenths mg/L in nutrient solutions. Toxic to many sensitive plants (e.g., citrus) at 1 mg/L. Usually sufficient quantities in reclaimed water to correct soil deficiencies. Most grasses are relatively tolerant at 2.0 to 10 mg/L.
Cadmium	0.01	0.05	Toxic to beans, beets, and turnips at concentrations as low as 0.1 mg/L in nutrient solution. Conservative limits recommended.
Chromium	0.1	1.0	Not generally recognized as an essential growth element. Conservative limits recommended due to

Constituent	Long-Term Use, mg/L	Short-Term Use, mg/L	Remarks
			lack of knowledge on toxicity to plants.
Cobalt	0.05	5.0	Toxic to tomato plants at 0.1 mg/L in nutrient solution. Tends to be inactivated by neutral and alkaline soils.
Copper	0.2	5.0	Toxic to a number of plants at 0.1 to 1.0 mg/L in nutrient solution.
Fluoride	1.0	15.0	Inactivated by neutral and alkaline soils.
Iron	5.0	20.0	Not toxic to plants in aerated soils, but can contribute to soil acidification and loss of essential phosphorus and molybdenum.
Lead	5.0	10.0	Can inhibit plant cell growth at very high concentrations.
Lithium	2.5	2.5	Tolerated by most crops at concentrations up to 5 mg/L; mobile in soil. Toxic to citrus at low doses - recommended limit is 0.075 mg/L.
Manganese	0.2	10.0	Toxic to a number of crops at a few-tenths to a few mg/L in acidic soils.
Molybdenum	0.01	0.05	Nontoxic to plants at normal concentrations in soil and water. Can be toxic to livestock if forage is grown in soils with high levels of available molybdenum.
Nickel	0.2	2.0	Toxic to a number of plants at 0.5 to 1.0 mg/L; reduced toxicity at neutral or alkaline pH.
Selenium	0.02	0.02	Toxic to plants at low concentrations and to livestock if forage is grown in soils with low levels of selenium
Tin, Tungsten, & Titanium	-	-	Effectively excluded by plants; specific tolerance levels unknown
Vanadium	0.1	1.0	Toxic to many plants at relatively low concentrations.
Zinc	2.0	10.0	Toxic to many plants at widely varying concentrations; reduced toxicity at increased pH (6 or above) and in fine-textured or organic soils.
Constituent	**Recommended Limit**		**Remarks**
pH	6.0		Most effects of pH on plant growth are indirect (e.g., pH effects on heavy metals' toxicity described above).
TDS	500 - 2,000 mg/l		Below 500 mg/L, no detrimental effects are usually noticed. Between 500 and 1,000 mg/L, TDS in irrigation water can affect sensitive plants. At 1,000 to 2,000 mg/L, TDS levels can affect many crops and careful management practices should be followed. Above 2,000 mg/L, water can be used regularly only for tolerant plants on permeable

Constituent	Long-Term Use, mg/L	Short-Term Use, mg/L	Remarks
			soils.
Free Chlorine Residual	<1 mg/l		Concentrations greater than 5 mg/l causes severe damage to most plants. Some sensitive plants may be damaged at levels as low as 0.05 mg/l.

[Adapted from: (U.S. Environmental Protection Agency 2004), pg. 25]

Industrial, Commercial and Construction Uses

Industrial, commercial, and construction uses of recycled water include a variety of beneficial purposes. Public health and environmental concerns must be evaluated on a case-by-case basis, accounting for water quality considerations as well as public access and exposure to recycled water. Table 2 lists some general reclaimed water quality issues associated with industrial reuse. Table 3 provides a summary of some of the water quality issues that should be considered with other commercial or construction uses. The issues provided here should be used as a starting point for evaluating recycled water quality in industrial, commercial, and construction uses.

Table 2. General issues with recycled water quality used in industrial processes.

Parameter	Issues
Alkalinity	Effects pH stability
Ammonia	Interferes with formation of free chlorine residual, causes stress corrosion in copper-based alloys, stimulates microbial growth.
Calcium and Magnesium	Scale formation
Hydrogen Sulfide	Corrosion, odors
Iron	Scale formation, staining
Microbiological water quality	Potential for biofouling
Nitrate	Stimulates microbial growth, interferes with dyeing
pH	May affect chemical reactions, solubility of constituents
Phosphorus	Scale formation, stimulates microbial growth
Residual organics	Microbial growth, slime and scale formation, foaming in boilers
Silica	Scale formation
Sulfate	Corrosion
Suspended solids	Deposition, "seed" for microbial growth

[Source: (Asano, et al. 2007), pg. 1110]

Table 3. General implementation considerations for various industrial, commercial, and construction reuse applications that may be affected by recycled water quality.

Reuse Application	Implementation Considerations
Fire Suppression	• Stagnation and water quality degradation. Use a looped distribution system and periodically flush the system. • Storage volume must be sufficient to meet peak day and hourly

Reuse Application	Implementation Considerations
	needs. Flow requirements require consideration of pipe sizing. • Cross connection with potable supplies
Toilet and Urinal Flushing	• Color and odor. Maintain aesthetic characteristics with a chlorine residual • Cross connections with potable supplies • Maintaining system pressure
Car Washing	• High solids concentrations. Use a potable or further treated recycled water source to eliminate spotting and improve drying
Dust control & Street cleaning	• Color and odor. Maintain aesthetic characteristics with a chlorine residual • Decontamination of vehicles transporting recycled water
Public water features (i.e., non-consumptive fountains)	• Color and odor. Maintain aesthetic characteristics with a chlorine residual • Nutrients may cause growth of algae and foster mosquitos
Cooling systems	• Aerosols and *Legionella sp.* Use disinfectant residual and clean system on a regular schedule. • Fouling due to biofilm growth. Maintain disinfectant residual. • Scaling and salt buildup from evaporation and concentration. Limit cycles of concentration or use nanofiltration. • Cross connection with potable supplies

[Adapted from: (Asano, et al. 2007) pp. 1169-1202]

The Oregon Department of Human Services has identified *Legionella* as a concern in cooling water systems. The following table provides some disinfection criteria that may be useful for controlling the growth of Legionella.

Table 4. Disinfection requirements for the control of Legionella in cooling water systems.

Disinfectant	Typical dose, mg/L	Contact time, min
Ozone	0.3	20
Chlorination		
Continuous	3-5	20
Intermittent	5-10	60 (once per day)
Hyper	10-30	360-1440

[Source: (Asano, et al. 2007), pg. 1440]

Impoundments

Water quality concerns with recycled water use in impoundments are primarily associated with (1) eutrophication, (2) odors, and (3) algal blooms. Since recycled water in impoundments is the identified beneficial purpose, additional changes in the water quality that occur in the impoundment are natural changes that may occur as a result of weather or other natural conditions. The following table includes some general considerations for water quality in impoundments.

Table 5. General considerations for recycled water use in impoundments. Other site-specific or project–related issues may also be identified during permitting. Issues that may be applicable to a specific recycled water use project should be addressed in the RWUP.

Consideration	**Issues**
Water Quality	• Eutrophication • Odors • Algal blooms
Public Health	• Public access restriction apply to impounds using Class B or C water
Environment	• Hydraulic connection to groundwater • Overflow and runoff to surface water
Wildlife	• Residual chlorine can adversely affect aquatic organisms • Trace organic and inorganic (e.g., metals) constituents can accumulate in wildlife. • Dissolved oxygen depletion due to excessive BOD or COD
Operations and Maintenance	• Mosquito control • Introduction of nuisance plants (i.e., aquatic weeds) • Stormwater control • Overflow control

[Adapted from: (Asano, et al. 2007), pp. 1203-1243]