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From: Bryan Black, PE Anna Zaklikowski	Project: Umatilla Basin Regional Aquifer Recovery Assessment
CC:	
Date: February 4, 2009	Job No: 86502
Re: Task 1.H – Assess Water Treatment Needs and Regulatory Approach	

The Oregon Water Resources Department (OWRD) designated four ~~groundwater aquifers within the Umatilla Basin as~~ Critical Groundwater Areas (CGAs) in the Umatilla Basin due to their documented overdraft (OWRD 2003). As a result, use of additional groundwater for irrigation in the CGAs has been curtailed causing adverse impact to the economies of Umatilla and Morrow counties. To increase water availability in the CGAs, OWRD has begun a technical assessment of the feasibility of storing water from Columbia River and other surface sources during high flow periods in shallow sediment and deeper basalt aquifers for subsequent recovery and use during the irrigation season. The project has been divided into several tasks. This technical memorandum includes a summary of information regarding the regulatory framework that governs treatment requirements for aquifer injection of source water.

EXECUTIVE SUMMARY

The feasibility of the winter water storage approach is heavily dependent on the level of water treatment that will be required for the injection of alluvial aquifer stored water into the Columbia River Basalt Group aquifer (basalt aquifer). The Oregon Administrative Rules (OAR) 690-350 for Aquifer Storage and Recovery (ASR) require that injection source water comply with drinking water standards, treatment requirements, and performance standards established by the Department of Human Services (DHS) Drinking Water Program under OAR 333-061 or maximum measurable levels of regulated compounds administered by the Department of Environmental Quality (DEQ).

A review of OAR 333-061-0032(7) indicates that as long as the project is designed to withdraw alluvial groundwater from locations greater than 200 feet from a surface water source, it is classified as “groundwater” and is thus not required to provide filtration or disinfection. However, disinfection could be triggered by OAR 333-061-0032(6) depending on the results of groundwater quality monitoring for presence of total coliforms. If triggered, disinfection will be required to inactivate biological contaminants prior to injection. It should be understood that

these rules have been adopted to regulate operation of public water systems. Application of these rules to the types of systems proposed in this project will require further discussions with DHS and DEQ once a specific permit application has been submitted to OWRD as part of overall project permitting process.

A comparison of water quality parameters detected in native groundwater samples with drinking water standards (Primary Maximum Contaminant Levels [MCLS]) indicates that nitrate is the only compound exceeding its standard of 10 milligrams per liter (mg/L) as nitrogen in several samples. Nitrate concentrations as nitrogen ranged up to 17.4 mg/L. Water containing nitrate concentrations exceeding the Maximum Contaminant Level will not be used for ASR injection.

OBJECTIVES

The main objective of this task is to develop alternatives for treating ASR source water that are cost effective and meet regulatory standards. Specifically, the project conducted the following activities:

- Review available recharge source water and native alluvial aquifer groundwater quality data. Augment the available data with new data collected during this project.
- Review regulations pertaining to water quality requirements governing ASR and surface water treatment.
- With input from DHS and DEQ, establish guidelines for ASR source water quality using groundwater, natural treatment approaches and engineered approaches (with emphasis in how the filtration standard in the Safe Drinking Water Act can be evaluated and achieved cost effectively).
- Develop a regulatory strategy and approach applicable to this project and other future projects.

INTRODUCTION

The storage approach currently under investigation in this project is to convey and apply surface water from the Columbia and Umatilla Rivers to recharge shallow alluvial aquifers in Morrow and Umatilla counties. Groundwater from the shallow aquifers will be withdrawn, conveyed to ASR injection wellheads, and injected into the underlying basalt aquifer for storage and later recovery during the summer irrigation season. This approach was the focus of a pilot alluvial aquifer recharge study in the Echo Meadows site in Umatilla County conducted during the spring of 2008. Additional surface water and groundwater samples were collected for analysis in 2008 during annual recharge activities conducted by the County Line Water Improvement District. The test wells at both sites are located greater than 500 feet from surface water sources and recharge areas. The sites are identified in the area map shown in Appendix A. The approach

under evaluation and water quality data collected during the pilot recharge study are compared against ASR regulations to identify treatment requirements applicable to the storage approach.

AQUIFER STORAGE AND RECOVERY REGULATIONS

In Oregon, ASR projects are jointly regulated by the OWRD, DHS, and Oregon Department of Environmental Quality's (DEQ) Water Quality Program. In general, OWRD regulates licensing, permitting, and water rights for ASR projects while relying on DEQ and DHS to provide comments and recommended conditions for ASR limited licenses and permits. DEQ works with OWRD to ensure that ASR projects meet Oregon's groundwater quality requirements under OAR 340-040 and other applicable rules (e.g., Underground Injection Control (UIC) requirements OAR 340-044). As the regulatory agency responsible for administering and enforcing drinking water regulations in Oregon, DHS ensures that ASR source water meets national drinking water standards, as referenced in OAR 333-061.

Specifically, OAR 333-061-0032 establishes "Treatment Requirements and Performance Standards for Surface Water, Groundwater Under Direct Influent of Surface Water (GWUDI), and Groundwater." It describes the level of treatment required for surface water, GWUDI, and groundwater as three types of source water for use by "public water systems". Groundwater typically does not require filtration or disinfection. The level of treatment increases from a lower cost option of disinfection for groundwater (if microbial contaminants are found), to a combination of filtration and disinfection for GWUDI, to full filtration and disinfection treatment for direct surface water sources. The main difference between the level of treatment requirements between GWUDI and surface water is the degree to which natural filtration credits can be obtained by filtering surface water through natural sediments (e.g., stream bank infiltration, etc.). The proposed approach for classifying the source water used in this project and its commensurate level of treatment are presented in a next section below.

Additionally, OAR 690-350-0010(6) stipulates that "injection source water for ASR shall comply with drinking water standards, treatment requirements, and performance standards established by the Oregon Health Division (HD) under OAR 333-061-0030 and 0032 or the maximum measurable levels established by the Environmental Quality Commission (EQC) under OAR 340-040, whichever is more stringent." OAR 333-061-0030 establishes "Maximum Contaminant Levels (MCLs) and Action Levels" for contaminants regulated under the Safe Drinking Water Act (SDWA) (40 CFR Parts 141 – 149), including inorganic and organic chemicals, disinfection byproducts, turbidity, microbiological contaminants, radionuclides, and secondary contaminants. Results from the surface water and alluvial aquifer water quality data collected during this project are compared against MCLs and action levels in the next section below.

Finally, OAR 340-040 establishes guidelines and standards for the protection of groundwater quality to its highest beneficial use, which in most cases and in the case of the CGAs, is drinking water (340-040-0020(3)). As indicated in OAR 690-350-0010(6)(d), if injection source water

contains constituents that are detected at greater than 50 percent of the established levels, the ASR limited license permit “may require the permittee to employ technically feasible, practical and cost-effective methods to minimize concentrations of such constituents in the injection source water.” The water quality data available for this project are reviewed to assess compliance with these regulations and to consider feasible treatment alternatives.

ASR SOURCE WATER CLASSIFICATION AND TREATMENT REQUIREMENTS

As presented above, based on OAR 333-061-0032, the required level of treatment for ASR source water is dependent on the source water classification as surface water or groundwater. Groundwater can be further distinguished as either “groundwater” or GWUDI. These distinctions are important as the source water classification determines what set of drinking water treatment regulations apply. Because of the higher potential for bacteriological contamination, surface water and GWUDI sources are required to be provided with disinfection and in most cases, filtration (OAR 333-061-0032(1)(b)). On the other hand, groundwater is exempt from filtration requirements and in most cases from disinfection requirements depending on source water quality. Since the ASR source water considered in this project is not planned to be surface water, regulations applicable to surface water sources that are not naturally filtered will not be discussed further in this memorandum.

Groundwater Classification

As required by OAR 333-061-0032(7), groundwater sources used for the purposes of ASR injection must evaluate their source(s) for the potential to be GWUDI. GWUDI is defined in the National Primary Drinking Water Regulations and OARs as “Any water beneath the surface of the ground with significant occurrence of insects or other macroorganisms, algae, or large-diameter pathogens such as *Giardia lamblia* or *Cryptosporidium*, or significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions (OAR 333-061-0020(74)).”

OAR 333-061-0032(7) includes criteria designed to determine whether a groundwater source is “groundwater” or GWUDI based on distance from surface water sources, as follows:

- 500 feet within a fractured bedrock or layered volcanic aquifer;
- 200 feet within a coarse sand, gravel and boulder aquifer;
- 100 feet within a sand and gravel aquifer; or
- 75 feet within a sand aquifer.

Based on hydrogeological assessment of the proposed recharge areas for this project (IRZ 2009), the alluvial aquifer sediments primarily fall in the “sand and gravel” and “coarse sand, gravel and boulder” categories. Therefore, if the ASR source water is withdrawn from the recharged alluvial aquifer to meet the distance criteria above, it will be classified as “groundwater “. Groundwater that is used for injection must meet water quality criteria provided in OAR 333-061-0030.

Filtration is not required under OAR 333-061-0032 and disinfection is not required unless triggered by microbial contamination according to the requirements of OAR 333-061-0032(6).

“Groundwater” Treatment Requirements

Disinfection requirements for systems using groundwater are addressed in OAR 333-061-0032 (6). Systems using groundwater are not required to provide continuous disinfection unless the following two conditions are met ((6)(a)):

- (1) When there are consistent violations of the Total Coliform Rule attributed to source water quality;
- (2) When a potential health hazard exists as determined by the Department.

However, these requirements have been established for “public water systems” and not the type of system proposed in this project. For example, the requirements for the monitoring of coliform bacteria in public water systems are to be consistent with the Total Coliform Rule provided in OAR 333-061-0030(4), which are based on the population served by the water system (OAR 333-061-0036(5)). This project proposes systems which will not produce water directly for drinking water distribution. Since this system is not a “public water system” the requirements of the Total Coliform Rule should not apply. The need for ongoing monitoring of the microbial quality of the injection water requirements of groundwater quality protection rules OAR 340-040 will have to be discussed further with DHS and DEQ.

One question – do the municipalities get their water from the same basalt layers that will be used for ASR? If so, isn’t this the driver on groundwater treatment for ASR, as opposed to simply treating ASR water that will be for ASR municipal projects?

GWUDI Treatment Requirements

If due to project design constraints, ASR source groundwater was classified as GWUDI, treatment requirements have to comply with the requirements of OAR 333-061-0032(1). Compliance with these rules generally requires removal and/or inactivation of pathogenic microorganisms through a combination of filtration and disinfection to meet the microbial treatment requirements provided in **Table 1**.

Table 1. Microbial Treatment Requirements for GWUDI Sources (OAR 333-061-0032(1)(a))

Organism	Log Removal and/or Inactivation
<i>Cryptosporidium</i>	2-log (99%)
<i>Giardia</i>	3-log (99.9%)
Viruses	4-log (99.99%)

It may be possible to obtain filtration credits of up to 2.0 log removal for *Giardia* and *Cryptosporidium* (OAR 333-061-0032(8)) for percolating surface water through native materials

under the “Natural Filtration Credit” option described below. Otherwise, an engineered filtration system would be required. Regardless of filtration requirements, these systems would also require disinfection.

Natural filtration credit is granted based on the results of water samples collected for Microscopic Particulate Analysis (MPA) when the MPA risk scores are all less than 20. Natural filtration must be demonstrated to achieve at least 2.0 log removal of *Giardia* and *Cryptosporidium* through the completion of a site-specific study that establishes that the local hydrogeologic setting is capable of providing the adequate log reduction in the number of particles in the *Giardia* and *Cryptosporidium* size range between the surface water and the groundwater sources. If groundwater as ASR source water is classified as GWUDI, additional MPA sampling must be conducted during implementation of the recharge project in order to assess the degree of natural filtration credit that can be obtained.

SOURCE WATER QUALITY EVALUATION

Samples were collected from shallow alluvial aquifer wells during the period March through October of 2008 for the characterization of water quality and analysis of parameters regulated by the SDWA. The test well locations are referenced in the maps included in Appendix A. Results of the water quality analysis are presented in Appendix B. Primary MCLs, secondary MCLs, and action levels, where applicable, are indicated for each parameter measured.

All samples collected were in compliance ~~will~~ with all primary MCLs with the exception of nitrate. Nitrate exceeded the MCL of 10 mg/L-N in test wells UMAT 1177 and DMPW2 in the Echo Meadows recharge site and wells UMAT 1571, MORR 968, and MORR 956 located in the County Line site. An additional seven wells were tested at the Echo Meadows site which had concentrations of nitrate below the MCL. Slight exceedences of the secondary MCLs for iron, manganese, and total dissolved solids were found in several wells. All results for synthetic and volatile organic compounds were below method detection limits as well as primary MCLs.

Water containing nitrate concentrations exceeding the MCL will not be used for injection into the ASR system.

REFERENCES

Oregon Water Resources Department. 2003. *Groundwater Supplies in the Umatilla Basin*. OWRD Groundwater Section, Pendleton, Oregon. April.

Appendix A: Test Well Locations

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Appendix B: Water Quality Data

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