APPENDIX H: OVERVIEW OF GROUNDWATER QUALITY

ESA Adolfson performed a brief analysis of groundwater issues in South Deschutes County based upon existing information.

In general, the water quality in the shallow aquifer of Deschutes County is threatened by nitrate contamination from widespread use of septic systems. The effluent from these conventional septic wastewater systems has been shown to contribute to nitrate levels in the upper 100 feet of the shallow aquifer. The contaminated groundwater not only affects the local water supply wells, it also impacts water quality of the Deschutes and Little Deschutes Rivers in areas where the groundwater discharges into the river.

Groundwater in this region occurs in most of the fractured bedrock as well as the alluvial deposits, which consist of shallow fine to coarse sand, fine to coarse gravel and cinder fluvial deposits. Most wells in the study area are screened in these fluvial deposits. Less permeable silts and clays comprise much of the lacustrine deposits but overall the shallow aquifer is considered unconfined. Many of these soils are derived from pumice deposits which are relatively low in organic matter and have high porosity. The soils in the region are highly permeable with no intervening layer protecting the aquifer. The high permeability allows for swift downward migration of water from precipitation and septic effluent. The water table generally ranges in depth from less than two feet to about thirty feet below ground surface.

Groundwater velocities are generally low and oxic (oxygen rich or at least containing oxygen) near the water table surface (Rich, 2005). However, at depths ranging from near zero to more than fifty feet below the water table, groundwater becomes suboxic (low in oxygen) where conditions are conducive to denitrification. Denitrification is the microbially facilitated geochemical process where nitrates are reduced or removed through a process which results in the production of harmless molecular nitrogen (N_2) through a series of intermediate gaseous nitrogen products. Denitrification helps limit nitrate contamination in the groundwater, but requires anaerobic (without oxygen) conditions; therefore, any oxic portions of an aquifer remain vulnerable to nitrate contamination.

In a study conducted by the USGS, an attempt was made to better understand the relationship of oxic and suboxic conditions in the aquifer near La Pine Oregon (USGS, 2007). While the distribution of oxic and suboxic conditions varies widely throughout the region, the findings of the La Pine study determined that oxic groundwater tended to be present near the outside edge of a river meander bend (edge closest to the margin of the valley floor) (USGS, 2007). However, not all outside edges were oxic. In areas where the width of the riparian environment adjacent to an outside edge was relatively narrow, oxic groundwater conditions were found. Groundwater samples taken from the center of riparian zones were always suboxic (USGS, 2007). Therefore, the relatively narrow wetlands identified in the project area such as Wetlands 15, 14, 72, and 52 or the wetlands located near the outside edge of a river meander bend such as Wetlands10, 29a-c combined with 28 a-b and 27a-c, and 35 are likely the last defenses against nitrate contributions to the Deschutes and Little Deschutes rivers. The ORWAP scores for these examples vary; however as noted above, the scores do not account for overall size of the wetland and the underlying groundwater conditions. A more thorough examination in

light of the findings of the USGS study may offer more guidance in interpreting the value scores of the identified wetlands and making determinations for Goal 6 Water Quality Resources.

LITERATURE CITATIONS

Rich, Barbara et. al., *in collaboration with* Deschutes County Environmental Health Division, Oregon Department of Environmental Quality and US Geological Survey. Undated. *La Pine National Decentralized Wastewater Treatment Demonstration Project,* 1999 – 2005.

U.S. Geological Survey (USGS). 2007. *Ground Water Redox Zonation near La Pine, Oregon: Relation to River Position within the Aquifer-Riparian Zone Continuum,* Scientific Investigations Report 2007-5239,