7.0 Conclusions

Examination of the most recent 10 years of summer average water quality data for Lake Owasso indicates that the summer average total phosphorus, chlorophyll *a*, and Secchi depth were 38 µg/L, 15.6 µg/L, and 2.1 m, respectively. Typically, the summer averages of the most recent 10 years of water quality data are used by the MPCA for considering listing of impaired waters on the 303(d) Impaired Waters list. Although most parameters, with the exception of chlorophyll *a* concentrations, meet the MPCA deep lake standards, the average total phosphorus concentration for the past 10 years is very close to the MPCA criterion. If lake water quality would decline even slightly, it is possible that Lake Owasso could be listed on the MPCA's 303(d) Impaired Waters list and a Total Maximum Daily Load (TMDL) study would be required to address the sources of impairment. This can be a costly and time-consuming process. Therefore, the conclusions and recommendations of this UAA will be extremely useful in aiding the GLWMO, City of Shoreview, and City of Roseville with the implementation of watershed and lake BMPs that improve lake water quality and reduce the likelihood of Lake Owasso being listed on the 303(d) Impaired Waters list.

The following summary describes the main conclusions of this UAA that allowed for a diagnosis of the water quality issues in Lake Owasso and identification of the activities and projects that would help the lake continue to meet or improve its water quality goals in the future.

1. Water quality data collected in Lake Owasso for 2007 and 2008 would classify Lake Owasso as a eutrophic lake. Because data was collected in 2 sampling locations within the lake, the spatial variability of water quality in Lake Owasso was observed and water quality does vary through out the lake. The trend analysis for Lake Owasso using the past 10 years of water quality data (1998 through 2008) found that there has not been a significant change in total phosphorus concentrations over the past 10 years while there was a statistically significant increase in the Chlorophyll *a* concentration over the same time period. Additionally, there was a significant decrease in Secchi depth.

2. The MNLEAP model estimated the total phosphorus concentration in a minimally-impacted lake similar to Lake Owasso to be 40 µg/L (±15 µg/L), similar to the range of water quality observed in the lake. For the Vighi and Chiaudani model and the MPCA's diatom analysis, which are predictors of natural background phosphorus concentrations (no impact from anthropogenic sources), suggested that Lake Owasso's natural background phosphorus concentration would fall

within the range of 18 to 22 μg/L. Comparison of these predicted values to observed water quality in the lake indicates that Lake Owasso's water quality falls within the expected range for a minimally-impacted lake with similar characteristic, but the background levels indicate that there is potential for water quality improvement.

3. Sediment cores collected and analyzed in 2007 indicated that the average intenal loading rate from sediment release for the whole lake was 0.5 mg/m^2/day with a maximum expected loading rate of 2.9 mg/m^2/d in the deepest sediment core collected. Although some internal loading from the sediments is likely, when compared to internal loading rates for lakes across the Twin Cities metro area, the maximum expected loading rate in Lake Owasso is significantly less than the average observed across the metro (6.3 mg/m^2/day).

4. A macrophyte survey completed in late-May 2007 quantified the distribution and density of Curlyleaf pondweed throughout Lake Owasso. This macrophyte, which dies-back in early summer, can act as a significant source of phosphorus in a lake system, as is the case with Lake Owasso. In 2007, approximately 52% of the lake was covered by Curlyleaf pondweed. Review of historic macrophyte surveys and other reports about Lake Owasso indicate that Curlyleaf pondweed has been present in the lake as far back as 1981.

5. Relationships between the three key water quality parameters (total phosphorus, chlorophyll *a*, and Secchi depth) were evaluated. There is not a strong relationship observed between cholorphyll *a* and total phosphorus concentrations, showing a similar relationship to what was observed during earlier studies. The relationship in Lake Owasso suggests that the algae concentrations in Lake Owasso are not directly controlled by total phosphorus and are impacted by zooplankton grazing, to some extent. A direct relationship between Secchi depth and total phosphorus was developed to be used predictively. The variability in the data used to develop this relationship suggest that the Secchi depths predicted by this relationship should not be taken as absolute values but rather general indicators of the clarity that can be expected.

6. Review of temperature depth profiles in Lake Owasso at both monitoring sites (site 5401 in the north and site 5403 in the south), indicate that both basins thermally stratify during the summer months, with mixing occurring during spring and fall turnover (dimictic lake). Additionally, total phosphorus and dissolved oxygen data at depth, shows that along the bottom of the lake goes anoxic (devoid of oxygen) and phosphorus accumulates within the hypolimnion, being contained below the thermocline. Because water quality data was not collected in the third deep basin

located on the east side of the lake, the Osgood Index was used to estimate the probability of mixing events to occur during summer stratification. This index indicated that this third basin would also be strongly stratified during the summer (dimictic).

Although the deep areas of the lake strongly stratify, much of the lake is relatively shallow, with an average lake depth of less than 11-feet. It is possible for mixing to occur in these shallow areas of the lake as the result of wind and motor boat activity, although it is unclear what role mixing and resuspension in the shallow areas of the lake have on the overall water quality in Lake Owasso. Anecdotal information suggests that turbidity in the lake increases as the result of motor boats in shallow areas of the lake.

7. The 2001 MDNR fishery survey indicates that small numbers of carp are present in Lake Owasso. The activity of carp, and other benthivorous fish, can result in phosphorus loading to the lake. Additionally, carp were observed in the Central Park – West (County Road C) wetland in the spring of 2008. In late summer, there was a fish-kill in the wetlands and dead carp were observed in the area.

8. The water and phosphorus budgets developed for Lake Owasso for the various climatic conditions indicates that the sources of the water and phosphorus loads to the lake are variable. Watershed runoff plays a variable role in total phosphorus loads to the lake depending on the climatic conditions, ranging from 12 to 23 percent of the total load. However, during dry conditions, there are periods where significant portions of the watershed do not discharge during storm events, as was observed in the summers of 2007 and 2008. There also appears to be internal loading from waterbodies and wetlands within the Lake Owasso watershed that contribute to the total phosphorus load to the lake (5 to 9 percent). These loads can possibly be attributed to carp activity or release of total phosphorus from sediments. Internal phosphorus loads from within Lake Owasso (the result of Curlyleaf pondweed die-back,release from lake sediments, wind mixing, roughfish activity) were estimated to range from 50 to 57 percent of the load to the lake. Other sources of total phosphorus to the lake include atmospheric deposition and groundwater.

9. Review of the 2008 runoff water quality monitoring data at the Dale Street monitoring station, just downstream from the City of Roseville Leaf Recycling Center, suggests that the compost area is not a significant source of phosphorus to Lake Owasso. Total phosphorus concentrations observed during storm events are similar to typical urban stormwater runoff concentrations.

Good housekeeping practices at the Leaf Recycling Center site should continue to be promoted, including the maintenance of the vegetated buffers around the perimeter of the site as well as maintenance of a flat grade on the site to minimize stormwater runoff. Additionally, a small sedimentation pond site could be constructed on the site to collect and treat all surface runoff from the site, before discharging to the downstream wetland.

10. In-lake modeling indicates that the control of Curlyleaf pondweed will have the most significant impact on the total phosphorus concentrations and water clarity in Lake Owasso during the summer months, for all climatic conditions. The implementation of a Curlyleaf management plans is recommended to control the growth of this non-native, invasive species in order to limit its contribution to the internal total phosphorus load, and to allow native macrophyte species to reestablish in Lake Owasso. See Section 8.3.1 for more details about the Curlyleaf management plan proposed for Lake Owasso.

11. Runoff from the majority of the Lake Owasso watershed is routed through stormwater pond or natural wetlands prior to discharging to the lake. Therefore the watershed runoff was identified being less important than other sourcse of phosphorus to Lake Owasso. As a result, a variety of structural BMPs in the watershed were shown to have limited impacts on the water clarity of Lake Owasso. However, watershed and in-lake water quality modeling was done evaluating the implementation of infiltration practices throughout the watershed, demonstrating that the BMPs can result in the improvement of water quality in Lake Owasso. Though no one specific project is currently recommended, it is recommended that the GLWMO and the Cities of Roseville and Shoreview continue to promote the implementation of infiltration BMPs throughout the Lake Owasso watershed as opportunities arise as the result of redevelopment and infrastructure improvement projects.

12. Evaluation of the runoff monitoring data, along with the water quality modeling results, indicate that internal loading occurs in several water bodies (Central Park-West wetland (County Road C), Central Park – East wetland (Dale Street), Charlie Ponds (West Owasso)) within the Lake Owasso watershed and contributes a significant portion of the annual phosphorus load to Lake Owasso (5 to 9 percent). Because the specific sources of these “internal” loads are not fully understood at this time, additional monitoring and studies are recommended for several of these water bodies to more completely understand the systems. The focus of these studies will be additional water quality monitoring, quantifying the potential impacts of the sediments on the

phosphorus load, and the observations of carp activity in some of these water bodies. See Section 8.1 for more detailed discussion of the recommended monitoring and studies.