6.0 Conclusions and Recommendations

Water quality data in the WHCL and results of water quality improvement projects in the WHCL were examined as part of the development of this WQMP. The findings of this WQMP are summarized below.

- Much of the WHCL watershed is urbanized and most urbanization occurred in the years before modern stormwater treatment rules were in place.
- Historic phosphorus loading into the WHCL via point and nonpoint sources has resulted in long term phosphorus accumulation in sediments in some lakes and subsequent internal phosphorus loading.
- Until/unless the "legacy" sediment phosphorus is appropriately addressed, water quality improvement projects that address stormwater loading and other external loadings will have little success.
- Development of the watershed has included replacement of natural infiltration areas with impervious surfaces such as roads and buildings.
- Most of the WHCL lake water levels are lower in elevation (by about five feet) than historical data indicate.
- Lower dry season lake levels in ridge lakes can be associated with degraded water quality, perhaps due to increased re-suspension of nutrient-enriched sediments.
- Lower wet season lake levels in valley lakes can be associated with a hydrologic disconnect between the lakes and their adjacent swamp shoreline.
- Tannin levels in valley lakes are more important when compared with ridge lakes due to their influence on chlorophyll *a* levels.
- Traditional large-scale stormwater retrofit projects have reduced external nutrient loads and improved water quality in the WHCL, however, further reductions in external nutrients loads are still necessary.
- Whole-lake alum treatment appears to be a potential means of improving water quality in lakes in the WHCL.
- Sediment removal projects have been successful in some lakes (Hollingsworth and Trafford) but it may not work for extremely hypereutrophic lakes (e.g. Banana Lake).
- Water quality restoration projects other than sediment removal and/or inactivation that may offer additional water quality improvements in some of the lakes in the WHCL include:

Stormwater infiltration areas can be used to reduce direct runoff of stormwater and associated nutrients into lakes and increase surface water infiltration into the ground water.

Forested wetland rehydration in valley lakes can increase lake water color and subsequently reduce availability of sunlight for phytoplankton productivity.

SAV can improve water quality in lakes in the WHCL and Hydrilla eradication efforts may adversely impact water quality.

FTWs can provide nutrient removal through aboveground plant biomass production.

EAV establishment will slow the flow of stormwater runoff into lakes and increase the filtration and assimilation of nutrients in the water column.

Whole-lake aeration may be a useful tool for water quality improvement for smaller lakes in the WHCL by increasing oxygen in the water column and displace phytoplankton to water depths where they are less productive.

Based on these findings, several recommendations have been developed as part of the WHCL WQMP and can be grouped into recommendations for ridge and valley lakes.

Ridge and Valley Lakes Recommendations

- Additional alkalinity data are necessary to develop a more locally-appropriate threshold value for clear alkaline lakes and a subsequent NNC assessment.
- Maximize native submerged aquatic vegetation communities, in coordination with efforts to control *Hydrilla*, maintain native SAV cover over 30 percent of the lake bottom, and establish EAV along 50 to 75 percent of the shoreline.
- Evaluate legacy phosphorus fluxes from sediments into the water column and time until sediment-water column phosphorus flux reaches steady state.

Ridge Lake Recommendations

- Calculate appropriate targets for TP and TN using the EPA (2010) guidance, after re-classifying most low color lakes into their appropriate category of clear and alkaline based on the use of a 164 µmhos/cm threshold for specific conductance.
- Implement sediment inactivation or sediment removal projects to minimize internal nutrient loads for lakes with documented prior point source impacts.
- Maximize surficial aquifer recharge using dry retention basins such as rain gardens and decrease the impervious areas in the watershed to increase ground water storage and maximize dry season lake levels via ground water discharge to the lakes.

Valley Lake Recommendations

- Calculate appropriate targets for TP and TN using the EPA (2010) guidance.
- Use a target color level of 50 PCU or higher or base target on historic color levels.
- Increase the hydrologic connection between lakes and swamp shoreline to a minimum of 10 to 20 percent of the shoreline to function as a wet season tannin source.

More detailed analysis of the costs of such projects, and project details, will be developed as part of project feasibility studies. The projects listed in Section 5 would supplement efforts to minimize stormwater runoff and maximize ground water recharge, as outlined in the Sustainable Water Resources Management Plan for the Peace Creek Watershed and City of Winter Haven (PBS&J 2009). Projects to increase surface water infiltration to the surficial aquifer would benefit water quality by increasing lake levels in the dry season via infiltration and eventual discharge from the surficial aquifer, and reducing stormwater pollutant loads via treatment processes of a typical dry retention pond. These types of appropriately located SIAs can be used in conjunction with large, regional stormwater treatment systems to reduce phosphorus loadings to lakes.

Sediment inactivation and/or removal projects would focus on lakes with documented prior point source impacts; such prior impacts appear to be capable of severely impacting water quality via internal loading processes.

Hydrilla control efforts should be better coordinated with other ongoing and/or planned lake management activities to minimize the potential of implementing projects with conflicting purposes. For all lakes, particularly low color lakes, an interim goal of maintaining at least 30 percent cover of the lake bottom with desirable SAV and/or 50 to 75 percent of the lake edge with EAV would be appropriate.

Lake aeration projects would focus on the smallest lakes within the WHCL, with emphasis placed on monitoring system responses both in terms of water quality and also monitoring of sediment composition.

For all water quality restoration projects, continued long-term and multi-parameter water quality monitoring programs are critical. While water quality monitoring programs may not receive the publicity and public awareness of large restoration projects, they are the only sources of information that can be relied upon to determine whether or not various restoration projects have performed successfully and whether additional projects should be considered.

Economic and Recreation Considerations

The City of Winter Haven will use the data, analyses, rankings, and recommendations developed for this WQMP to make decisions regarding selection and implementation of projects for the WHCL. Although quantitatively ranking the lakes based on factors other than water quality is beyond the scope of this WQMP, the City of Winter Haven cannot overlook the recreational and economic value of the WHCL in making these decisions. For example, Lakes Howard, May, Shipp, Lulu, and Eloise may be considered of greater importance because of previously implemented water quality improvement projects and relatively high recreation use.

Clean lakes maintain lakeshore property values, contribute to the economic status of entire communities, provide lower cost drinking water, and offer intrinsic, aesthetic value for recreation. Defining the value of lakes can provide a means of evaluating the risk of degrading water quality and the cost of protecting our lakes in perspective. Sorting through restoration projects that compete for scarce funding means that having information about the use and passive use values of the restoration project can aid decision-makers in selecting restoration projects that provide the greatest benefits to society as a whole (Loomis 2008).

Monitoring

Importantly, water quality monitoring should continue in all lakes to provide a means of evaluating lake status in terms in terms of impairment or improvements. Success or failure of restoration projects cannot be evaluated in the absence of water quality monitoring. Alkalinity data should be collected for all lakes in the WHCL to adequately classify lakes based on the EPA NNC alkalinity/acidity designation.