APPENDIX E —WATER RESOURCE VALUE (WRV) ASSESSMENT

Water Resource Values (WRVs) Assessment

Pursuant to Sections 373.042 and 373.0421, F.S., SJRWMD considered the following 10 environmental values (also called water resource values [WRVs]) identified in rule 62-40.473, F.A.C..

1. Recreation in and on the water
2. Fish and wildlife habitats and the passage of fish
3. Estuarine resources
4. Transfer of detrital material
5. Maintenance of freshwater storage and supply
6. Aesthetic and scenic attributes
7. Filtration and absorption of nutrients and other pollutants
8. Sediment loads
9. Water quality
10. Navigation

These 10 environmental values were evaluated to determine if they are protected by the recommended MFLs condition for each lake. The MFLs condition represents the minimum hydrologic regime necessary to protect all environmental criteria evaluated (i.e., it is based on the most constraining metric at each lake). The P50 lake deficits for Lakes Brooklyn and Geneva equal 1.6 ft, and 0.3 ft, respectively. The MFLs condition timeseries for each lake is based on increasing (i.e., recovering) the current-pumping condition timeseries by these deficits.

The suite of 10 environmental values were evaluated based on the protections afforded by the metrics described in the MFLs determination and based on the difference in exceedance of critical elevations between the no-pumping and MFLs conditions. The latter analysis was aided by the creation of no-pumping and MFLs condition exceedance curves (Figures 1 and 2). For those WRVs metrics evaluated relative to a no-pumping condition exceedance, a significant harm threshold of 15% was used as the maximum allowable change.

1. Recreation in and on the water

The purpose of this environmental value is to protect, from significant change due to water withdrawal, the active use of water resources and associated natural systems for personal activity and enjoyment. These activities typically include, but are not limited to swimming, scuba diving, water skiing, boating, fishing, and hunting. Recreation in and on the water was considered by first evaluating three SWFWMD significant change standards: the Dock-Use Standard; the Basin Connectivity Standard; and the Recreation/Ski Standard (Appendix C.1). None of these were applicable for Lakes Brooklyn and Geneva because they each resulted in a minimum P50 that was either higher than historical median lake levels, or based on extremely low water levels at which the lakes' use for recreation is minimal.

Given that the SWFWMD recreation metrics were not usable for these lakes, two other criteria were developed to ensure protection of this environmental value. One of these metrics, the open water area

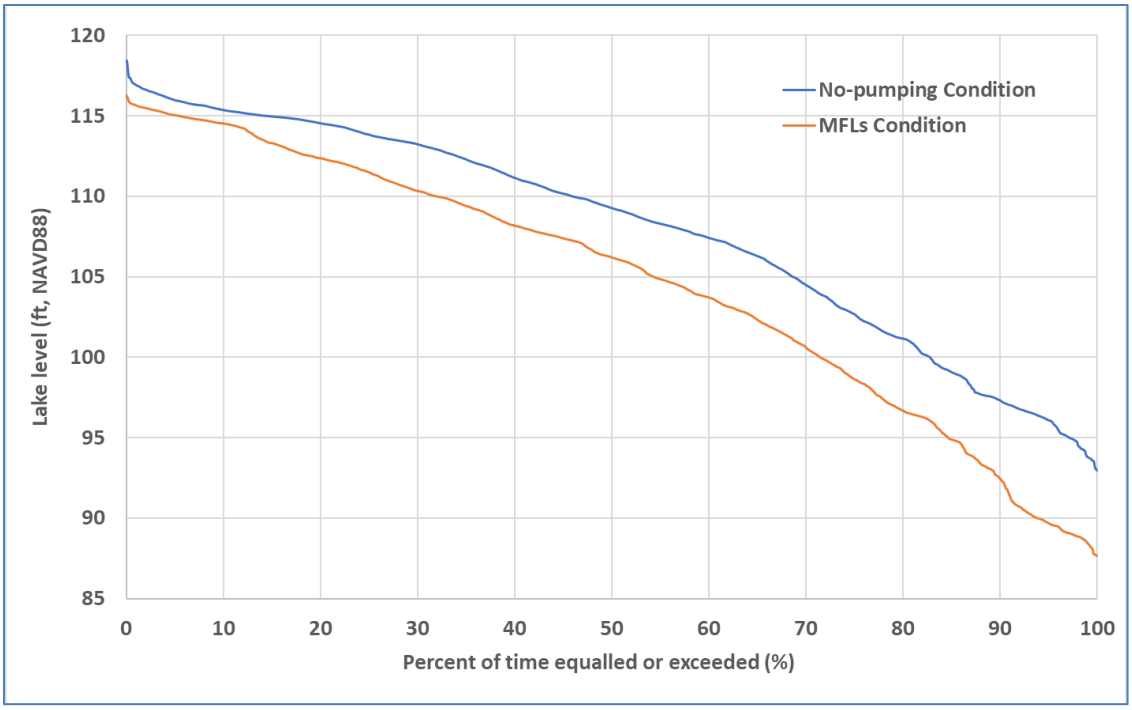

Figure 1. No-pumping Condition and MFLs Condition exceedance curves for Lake Brooklyn, Clay County, Florida

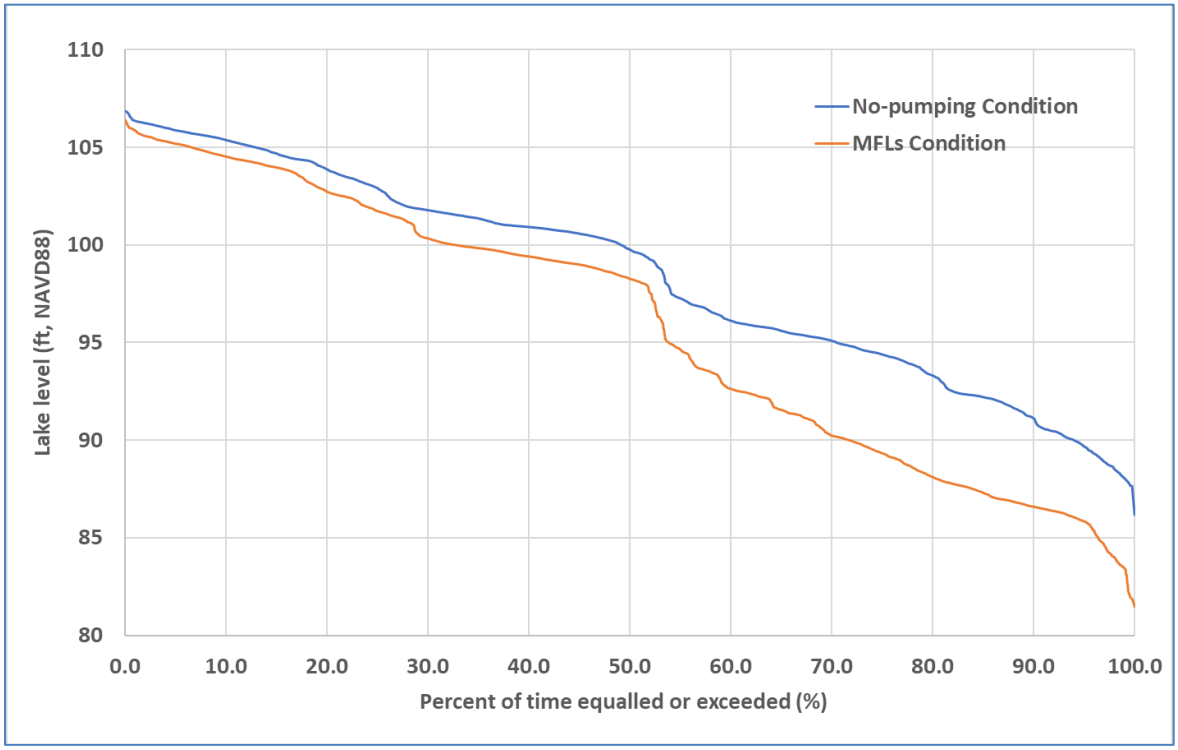

Figure 2. No-pumping Condition and MFLs Condition exceedance curves for Lake Geneva, Clay and Bradford Counties, Florida

metric is the constraint (basis of the MFLs condition) for both lakes. The purpose of this metric is to protect recreational values (e.g., boating, swimming) by providing for open areas free of submerged obstacles (i.e., areas beyond the zone of emergent and floating plants). The second recreational metric, the lake lobe connection metric is less constraining than the open water area metric. Therefore, the MFLs condition will ensure that the exceedance of lake lobe critical elevations is not reduced by more than 15% relative to the no-pumping condition. As such, this WRV is considered protected by the recommended MFLs condition.

2. Fish and wildlife habitat and the passage of fish

The purpose of this environmental value is to protect, from significant change due to water withdrawal, aquatic and wetland environments required by fish and wildlife. Minimum hydrologic requirements necessary to support the life cycles of aquatic, wetland and wetland-dependent species were considered using two metrics. The first metric evaluated was the standard event-based IH criterion. Because the IH was not constraining (i.e., had a large freeboard), it suggests that the hydrology necessary to prevent movement of the upland/wetland boundary is protected by the MFLs condition.

The second way this WRVs was assessed was by developing and evaluating fish and wildlife habitat metrics using the hydroperiod tool. These habitat metrics demonstrated that at both Lakes Brooklyn and Geneva, fish and wildlife habitats in the nearshore environment improve with water level decline (i.e., the lakes develop into shallow wetlands). At Lake Geneva, all habitats evaluated increased in area with declining water level, due to the specific bathymetry of this lake. At Lake Brooklyn all habitats increased in area until a certain elevation is reached, and then they slowly decreased in area.

Because none of the fish and wildlife metrics evaluated were constraining (and in fact had large amounts of freeboard at both lakes) these functions and values are considered protected by the MFLs conditions for both lakes (i.e., the MFLs conditions are based on much more constraining criteria).

3. Estuarine resources

The purpose of this environmental value is to protect, from significant change due to water withdrawal, coastal systems and their associated natural resources that depend on the habitat where oceanic salt water meets freshwater. These resources are not affected by the recommended minimum hydrologic regime at Lakes Brooklyn and Geneva, and therefore this environmental value was not evaluated.

4. Transfer of detrital material

The purpose of this environmental value is to protect, from significant change due to water withdrawal, the production and movement of particulate organic matter and its associated fauna that form the base of invertebrate and fish foodwebs. The hydroperiod tool analyses suggest that for both lakes there will be an increase in average wetland habitat area with water level reduction. As such, there will be an increase in production and transport of organic matter, relative to the no-pumping condition. Therefore, the recommended minimum hydrologic regime will not negatively affect this environmental value for either lake.

5. Maintenance of freshwater storage and supply

The purpose of this environmental value is to protect, from significant change due to water withdrawal, an adequate amount of freshwater for non-consumptive uses and environmental values associated with coastal, estuarine, riverine, spring, aquatic, and wetlands ecology. This environmental

value encompasses all other environmental values identified in Rule 62-40.473 F.A.C.. Because the overall purpose of the MFL is protect environmental resources, and other non-consumptive beneficial uses while also providing for consumptive uses, this environmental value is considered protected if the remaining relevant values are protected.

6. Aesthetic and scenic attributes

The purpose of this environmental value is to protect, from significant change due to water withdrawal, those features of a water body usually associated with passive uses, such as bird-watching, sightseeing, hiking, photography, contemplation, painting and other forms of relaxation.

Aesthetics and scenic attributes were first considered by evaluating the SWFWMD Aesthetics Standard. As described in Appendix C, this standard was not used because the starting point for this minimum P50 is the historical P90 of a lake. Due to the large (~13 ft) difference between the P50 and P90 at Lake Brooklyn, this metric would result in a very low minimum P50, and thus was not used.

The second approach involved evaluating average lake surface area to protect aesthetics and scenic attributes. Maintaining the scenic value of a lake is often not a function of preserving water depth, but rather surface area. Shallow areas across a lake add to the overall coverage with water, reduce exposed areas and add to scenic value. Therefore, preventing significant change to lake surface area will ensure that the amount of exposed shoreline does not increase significantly. Studies have shown that shoreline exposure due to low water levels is perceived as a primary impact to the aesthetic value of lakes (Hoyer et al., 2006, Kashian and Winden 2015), and can negatively affect lakeshore property value (Loomis and Feldman 2003).

The current status assessment of the lake surface area metric, for both Lakes Brooklyn and Geneva, showed that the MFLs condition is more constraining that this metric. Therefore, the MFLs condition will ensure that the lake surface area decreases less than 15% relative to the no-pumping condition. As such, this WRV is considered protected by the recommended MFLs condition for both lakes.

7. Filtration and absorption of nutrients and other pollutants

The purpose of this environmental value is to protect, from significant change due to water withdrawal, the ability of a water body to mitigate the negative effects of elevated nutrients and other pollutants through the process of filtration and absorption (i.e., removal of suspended and dissolved materials) as these substances move through the water column, soil or substrate, and associated organisms.

The processes involved with filtration and uptake of nutrients and other pollutants, are typically associated with flooding and alternating periods of aerobic and anaerobic conditions. Lower water levels may increase the amount of shallow wetland habitat, as suggested by the hydroperiod tool analysis, and thus provide a greater surface area for nutrient uptake.

Based on available data (1986 to 2011; see Water Quality section above for more details) Lakes Brooklyn and Geneva total phosphorus, total nitrogen and chlorophyll a (chl a) are all inversely related to water level, with higher concentrations associated with lower lake levels (Figures 17 through 22 in main report).

The protection of this environmental value was evaluated by examining the exceedance of elevations at both lakes associated with meeting FDEP standards (i.e., elevation thresholds) under the MFLs

condition, relative to the no-pumping condition. Based on the relationship between a given parameter and water level, elevation thresholds were determined, below which TP, TN and chl a increased above state standards. The shift in exceedance of these elevation thresholds from the no-pumping to MFLs conditions were examined to determine if this represents a significant change.

TP increases markedly when Lake Brooklyn water levels fall below the elevation threshold of 100 ft NAVD88 (Figure 18 in main report). For TN and chl a, the elevation thresholds are 92 ft NAVD88 and 93 ft NAVD88, respectively. A comparison of the no-pumping to the MFLs condition shows that the reduction in exceedance of these critical elevations is less than 15% (Figure 3). This change is not considered a significant shift.

Based on available water quality data at Lake Geneva, all parameters are below state standards, and thus no critical elevations are available to conduct this exceedance analysis.

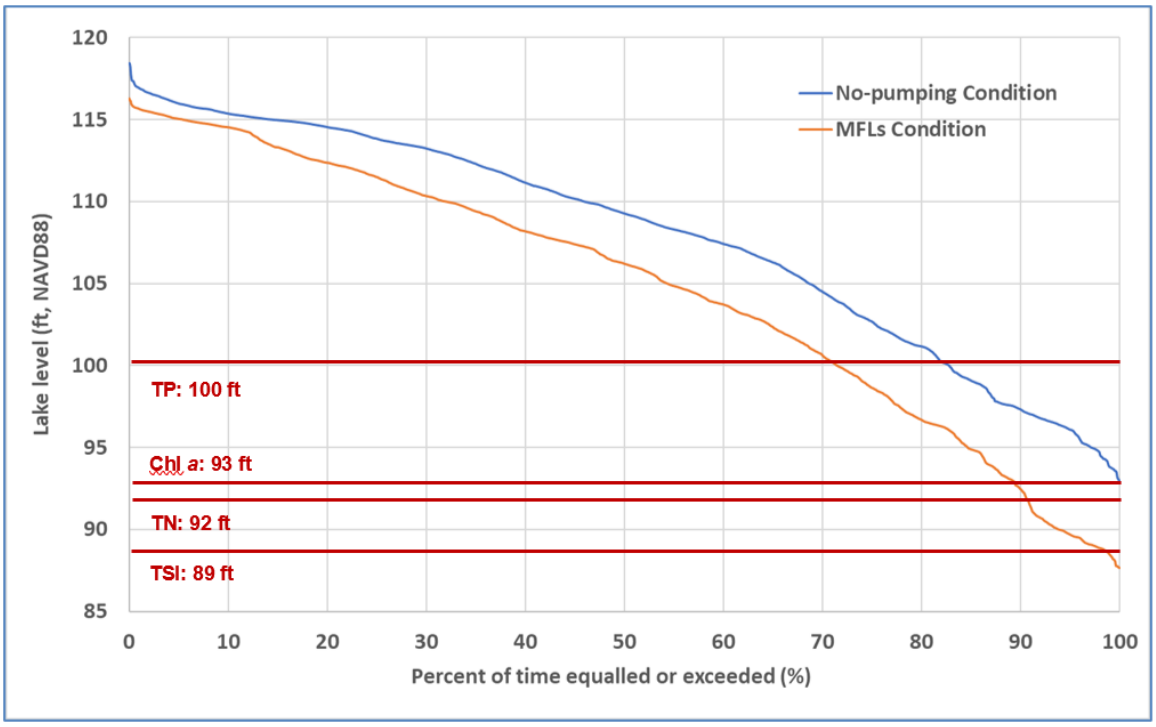

Figure 3. No-pumping and MFLs condition exceedance curves and elevations related to numeric nutrient standards for total phosphorus (TP), total nitrogen (TN), chlorophyll a (chl a) and for trophic state index (TSI) for Lake Brooklyn, Clay County, Florida

Trophic State Index

In addition to directly evaluating TP, TN and chl a, a composite index, the Trophic State Index (TSI), was also calculated for both lakes. The TSI is a rating system for classifying lakes based on biological productivity. TSI is considered an indicator of lake health or integrity, and is calculated using TP, TN and chl a data. Lakes with TSI values less than 60 are rated as "good and fully support uses." For the available period of record (1986 to 2011), and for most elevations, Lake Brooklyn has had TSI values below 60 and is thus considered of good quality based on this index (Figure 4). For this period of record, TSI values for Lake Geneva were all below the 60-point threshold, suggesting good water quality at this lake (Figure 5).

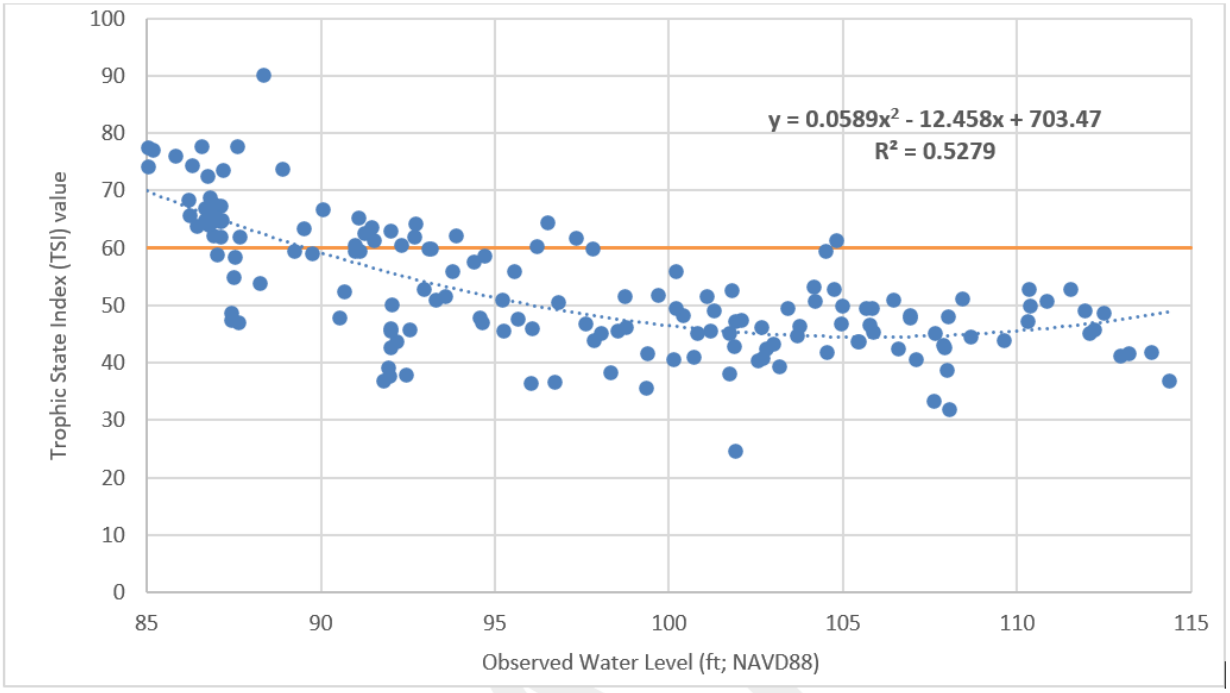

Figure 4. Trophic state index (TSI) versus observed water level at Lake Brooklyn. The orange line depicts the threshold for "good" status (TSI = 60).

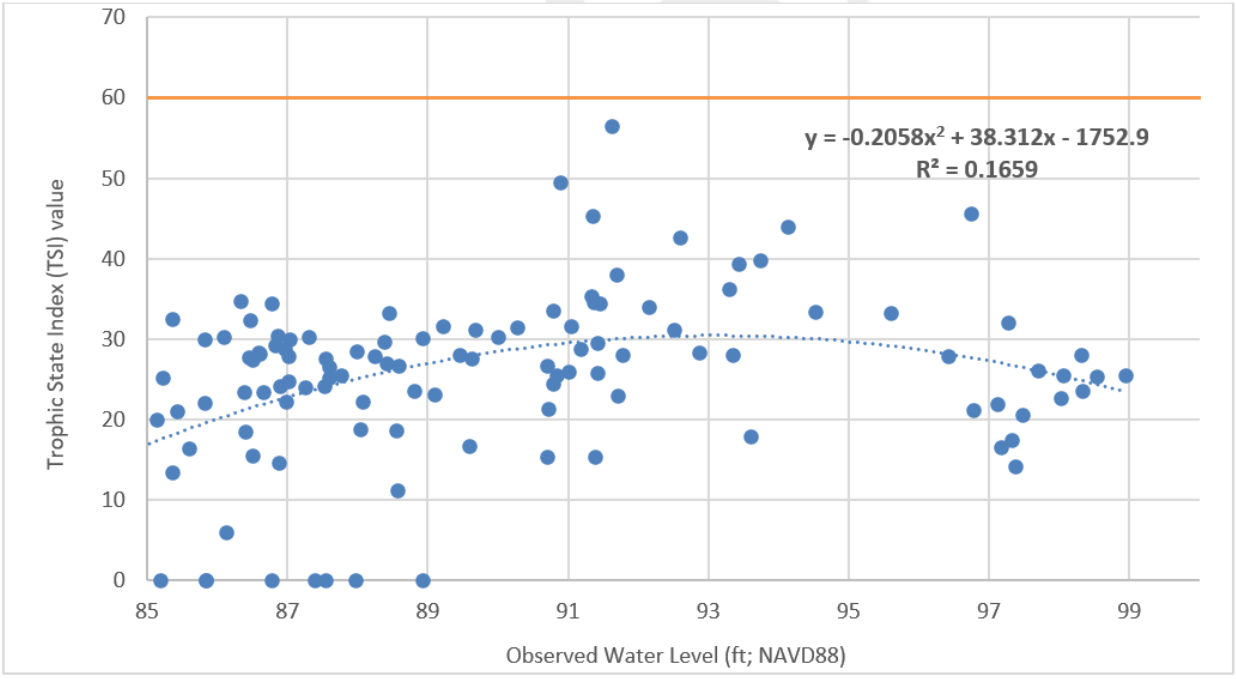

Figure 5. Trophic state index (TSI) versus observed water level at Lake Geneva. The orange line depicts the threshold for "good" status (TSI = 60).

As with the individual parameters evaluated, TSI at Lake Brooklyn showed a significant inverse relationship with water level. At Lake Geneva the relationship between TSI and water level is not as strong and slightly positive.

At Lake Brooklyn there is an elevation threshold of 89 ft NAVD88, below which TSI values increase above the "good" rating of 60. The change in exceedance from the no-pumping to MFLs condition is very small (Figure 3) and so there will be minimal change to TSI values at Lake Brooklyn. At Lake Geneva, all TSI values are below 60. Based on the nutrient and TSI relationships with water level described above, and the small change in exceedance of elevation thresholds between the no-pumping and MFLs conditions, this environmental value is considered protected.

8. Sediment loads

The purpose of this environmental value is to protect, from significant change due to water withdrawal, the ability of a system to transport inorganic sediment. Sediment erosion, entrainment and transport are processes most often associated with flowing systems or very large lakes, and are often dependent upon the velocity of surface water moving through a system. The effects of the recommended minimum hydrologic regime on sediment transport at Lakes Brooklyn and Geneva is considered negligible.

9. Water quality

The purpose of this environmental value is to protect, from significant change due to water withdrawal, the ambient chemical and physical properties of a water body; this environmental value involves constituents not included in definition number 7 (i.e., nutrients and other pollutants).

Relevant chemical and physical properties include pH, dissolved oxygen concentration, total suspended solids, clarity and temperature. Based on available data (Table 3 in main report), these parameters are within normal ranges for clear acidic lakes and there is no evidence to suggest they will be affected by the recommended minimum hydrologic regime. Minimal water clarity (measured as Secchi depth; Lakewatch 2016) data suggest a downward trend, but data are not sufficient to assess the effects of the recommended minimum hydrologic regime on this parameter.

Dissolved oxygen data are also not sufficient to assess the effects of the recommended minimum hydrologic regime. However, given that the MFLs Condition hydrologic regime will be an increase, relative to the current-pumping conditions (i.e., because both lakes are in recovery), this parameter is not thought to be significantly harmed.

Overall, the recommended minimum hydrologic regime will not significantly change the fluctuation range or frequency of high and low events, and thus not significantly affect non-nutrient water quality parameters (see above, value # 7, for discussion of nutrients).

10. Navigation

The purpose of this environmental value is to protect, from significant change due to water withdrawal, the safe passage of watercraft (e.g., boats and ships), which is dependent upon adequate water depth and channel width. The passage of small craft for boating and fishing was evaluated under "Recreation" (i.e., value #1, listed above). Navigation of larger craft will not be affected by the recommended minimum hydrologic regime at Lakes Brooklyn and Geneva, and therefore this environmental value was not evaluated.

The WRVs assessment results indicate that the 7 WRVs relevant to Lakes Brooklyn and Geneva are all protected by the recommended MFLs (Table 1). WRVs 3, 8 and 10 are not applicable to these lakes and thus were not considered in this assessment.

Table 1. Criteria evaluated to determine protection of 62-40.473 environmental values by the recommended MFLs for Lakes Brooklyn and Geneva.

WRV	Criteria	Protected by the MFLs Condition?
Recreation in and on the water	open water area and lake lobe connections	Yes
Fish and wildlife habitats and the passage of fish	wetland / upland boundary; fish and wildlife habitat area	Yes
Estuarine resources	NA	NA
Transfer of detrital material	wetland area protection	Yes
Maintenance of freshwater storage and supply	all other relevant WRVs are protected by the MFLs condition	Yes
Aesthetic and scenic attributes	lake surface area protection	Yes
Filtration and absorption of nutrients and other pollutants	TP, TN, chl-a and TSI assessment	Yes
Sediment loads	NA	NA
Water quality	chemical parameter data sparse but within normal ranges	Yes
Navigation	NA	NA