4.10. Lake Howard

Background

Physical and chemical characteristics specific to Lake Howard are presented here in the context of relevant regulatory criteria and requirements (Table 4-19). Lake Howard (WBID 1521F) is located in the Southern Chain of the WHCL and is hydrologically connected to lakes Cannon and May via constructed navigable canals (Photo 4-11, Figure 4-38). In 2005, Lake Howard was declared verified impaired based on elevated TSI values (>60). A TMDL was adopted for the Southern Chain of the WHCL, including Lake Howard (FDEP 2007), and Lake Howard was subsequently delisted from impairment by FDEP in 2010. Based on the modeled external TP load to Lake Howard, a 62.5 percent reduction in TP load (193 kg TP/year) is required to comply with the TSI criteria of 60 (FDEP 2007). The TP, TN, and chlorophyll *a* geometric mean for Lake Howard for the period of 1997 to 2007 and corresponding EPA NNC water quality targets are listed in Table 4-19. To comply with the NNC, concentration reductions of 23 percent for TP, 22 percent for TN, and 41 percent for chlorophyll *a* are required.

A summary of water quality statistics for Lake Howard is presented in Table 4-20. In 1977, point source discharges to Lake Howard from the Jan-Phyl Village WWTF were eliminated followed by overflow discharge termination in 1980. These point source discharges resulted in the annual addition of approximately 689 kg TP to the lake as well as lake sediment accumulation. While the effluent discharges have been eliminated, the discharges resulted in nutrient and sediment accumulation in the lake bottom. An inverse relationship between lake levels and chlorophyll *a* concentrations may suggest sediment resuspension resulting in a decline in water quality. Recognizing water quality problems for the lake, the City of Winter Haven and the District implemented a habitat/stormwater retrofit project and alum injection (Photo 4-12). Projects and predicted load reductions are summarized in Table 4-21. Based on TP load reduction estimates for projects constructed on Lake Howard (263 kg/year), it appears that required TP load reductions (193 kg/year) have already been accomplished (Figure 4-40). Unfortunately, chlorophyll *a* levels in the lake following completion of stormwater retrofits in 2000 and 2001 provided no clear evidence of improvement in water quality. Chlorophyll *a* levels in Lake Howard seem to reflect a delayed, but real, response to point source load eliminations in the 1980s, but not after the 2000 and 2001 stormwater retrofits. The lowest chlorophyll *a* values exceed 20 µg/liter, indicating that TSI_{CHLA} values less than or equal to 60 (which would require chlorophyll *a* levels to be below 20 µg/L) were not reached. An increase in TP levels in Lake Howard after an initial decrease during the months after completion of the large regional stormwater treatment projects was also observed. This increase in TP coincided with herbicide applications for *Hydrilla* eradication over approximately half of Lake Howard (Polk County, personal communication). *Hydrilla* eradication efforts in Lake Howard appear to have compromised or offset some of the benefits, at least to chlorophyll *a* concentrations and TP levels, of the prior stormwater treatment projects.

The median chlorophyll *a*, TN and TP concentrations continue to exceed the NNC targets provided by EPA for Lake Howard. Chlorophyll *a* concentrations in Lake Howard fluctuate but remain elevated above 20 µg/L (Figure 4-41). A statistically significant decline in chlorophyll *a* concentrations from 1983 to 2007 was observed (seasonal Kendall-Tau, p=0.092). The

combination of the elimination of point source discharges and stormwater treatment projects has resulted in improved water quality when compared to the previous water quality conditions. Improvements in water quality within Lake Howard could result in benefit farther downstream.

The Lake Howard watershed is 1,153 acres in size and includes 948 acres (82 percent) of developed lands compared to 205 acres (18 percent) of undeveloped lands. The 2000-2007 median color value (15 PCU) was below 40 PCU indicating the lake is a clear (non colored) lake and specific conductivity data indicate the lake is alkaline. The lake area, perimeter, water depth, and volume statistics are based on a water level elevation of 132 feet in August 2005. Bathymetry data are available for Lake Howard for the August 2005 water level elevation (Figure 4-39). A water level of 130.0 feet was reported in August 2010, reflecting a 2.0 feet decrease in water elevation when compared to 2005. The subsequent changes in overall surface area, water depth, and volume of the lake should be considered during the development and implementation of water quality restoration projects.

Water Quality Restoration Project Selection and Priorities

Based on Lake Howard water quality and the surrounding watershed characteristics, four potential water quality restoration projects were identified using the WHCL WQMP decision key (Figure 4-42). The decision key presents the factors on which yes/no decisions were based and used to identify and select water quality improvement projects. Projects to address water quality, nutrient and sediment loading, and reduced lake levels are proposed. The projects are listed in order of priority, based on expected water quality improvements. A detailed discussion of the potential water quality restoration implications for each project can be found in Section 3.0.

- Project 1: Sediment Removal/Inactivation
- Project 2: Stormwater Infiltration Areas (SIAs)
- Project 3: SAV Planting/Management or FTWs
- Project 4: EAV Planting/Management

Table 4-19. Physical, chemical, and regulatory characteristics of Lake Haines.

Physical			
Location in chain	Southern	**High infiltration soils (acres)**	655 (57 percent)
Relation to other lakes	Intermediate	**Developed land (acres)**	948 (82 percent)
Watershed area (acres)	1,153	**Undeveloped land (acres)**	205 (18 percent)
Lake area (acres)*	641	**Median water depth (feet)***	11.5
Perimeter (feet)*	21,459	**Maximum water depth (feet)***	18.7
Surface area: lake volume ratio*	0.16	**Volume (acre-feet)***	6,968
Watershed to surface area ratio*	1.80		
Water Chemistry			
Locally-derived: acidic or alkaline	Alkaline	**Clear or colored**	Clear
Geometric mean chlorophyll *a* (µg/L)	34	**NNC chlorophyll *a* target (µg/L)**	20
Geometric mean TN (mg/L)	1.27	**NNC TN target (mg/L)**	1.00
Geometric mean TP (mg/L)	0.039	**NNC TP target (mg/L)**	0.030
Regulatory Data			
Impaired	Yes	**TMDL status**	Required†
Chlorophyll *a* trend	Decreasing**	**TP concentration reduction required**	23 percent

*at a water level elevation of 132 feet
**presented in section 5.0
† TMDL adopted

Photo 4-11. View of Lake Howard from southwestern rim.

Table 4-20. Lake Howard water quality summary for 1997 to 2007.

Parameter	N	Minimum	Median	Maximum
Chlorophyll *a* (µg/L)	44	1	32	78
Color (PCU)	28	5	15	52
Conductivity (µmhos/cm)	26	188	215	300
Dissolved oxygen (mg/L)	26	6.97	8.85	11.6
pH	26	6.87	8.18	9.07
Secchi depth (feet)	47	1.0	2	2.7
Total nitrogen (mg/L)	46	0.48	1.41	2.67
Total phosphorus (mg/L)	42	0.002	0.041	0.109

Figure 4-38. Lake Howard and associated watershed.

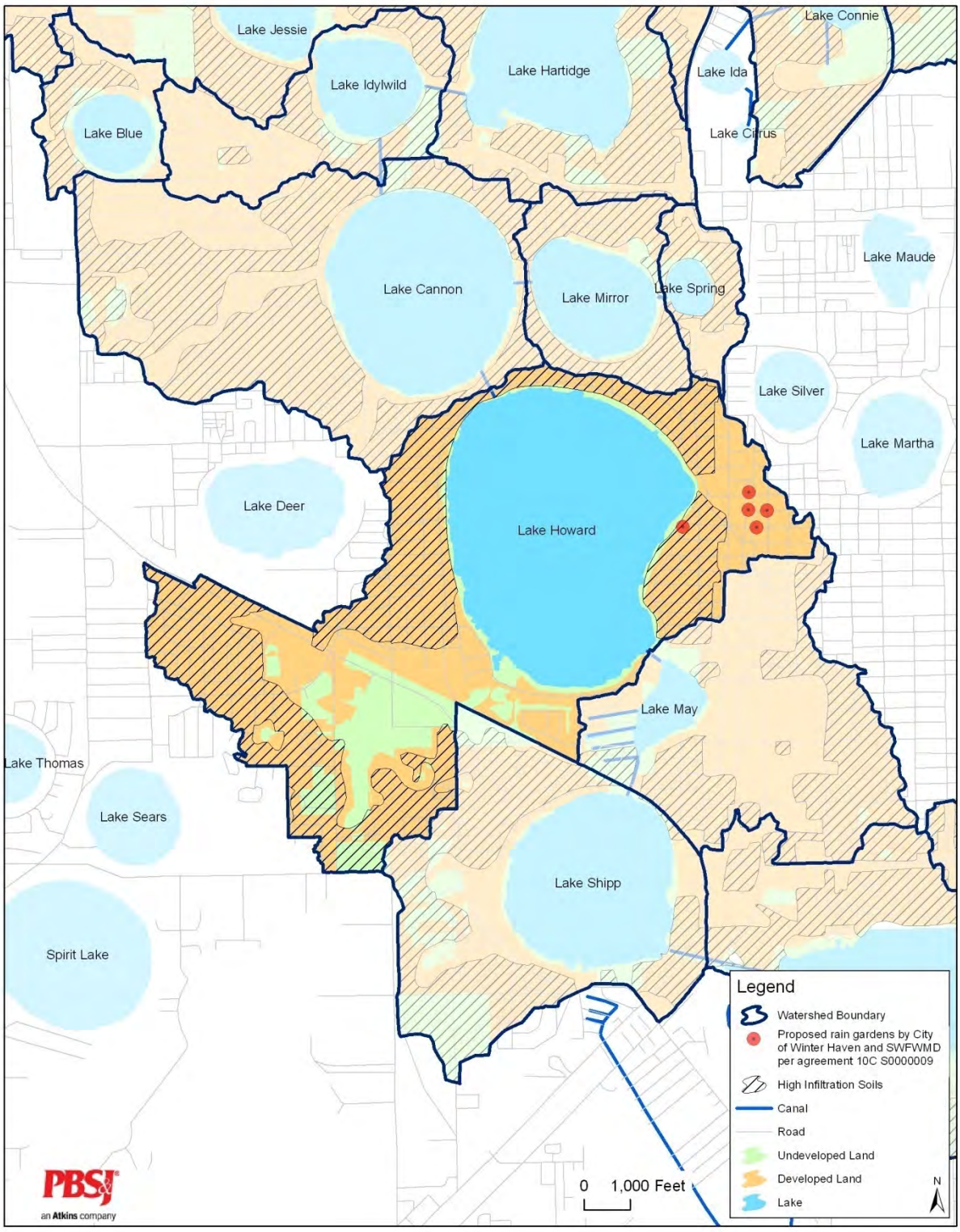


Photo 4-12. South Lake Howard wet detention stormwater treatment project.

Table 4-21. Estimated Lake Howard TP reductions due to projects and required under the TMDL.

Project	Year Completed	Contributing Drainage Area (acres)	Projects	TP Reduction (kg/year)
Lake Howard Habitat/Stormwater Retrofit Project	2001	578	Wetland treatment/wet detention	181
Lake Howard Alum Injection Project	2000	175	Alum injection	82
Total		753	NA	263 (estimated)
TMDL TP Reduction Required (kg/year)				193 (required)

NA=not applicable

Figure 4-39. Lake Howard bathymetry (August 2005) at water level elevation = 132 feet (Polk County Water Atlas).

Figure 4-40. Lake Howard chlorophyll *a* concentrations and *Hydrilla* treatment history using available data from 1983 to 2007.

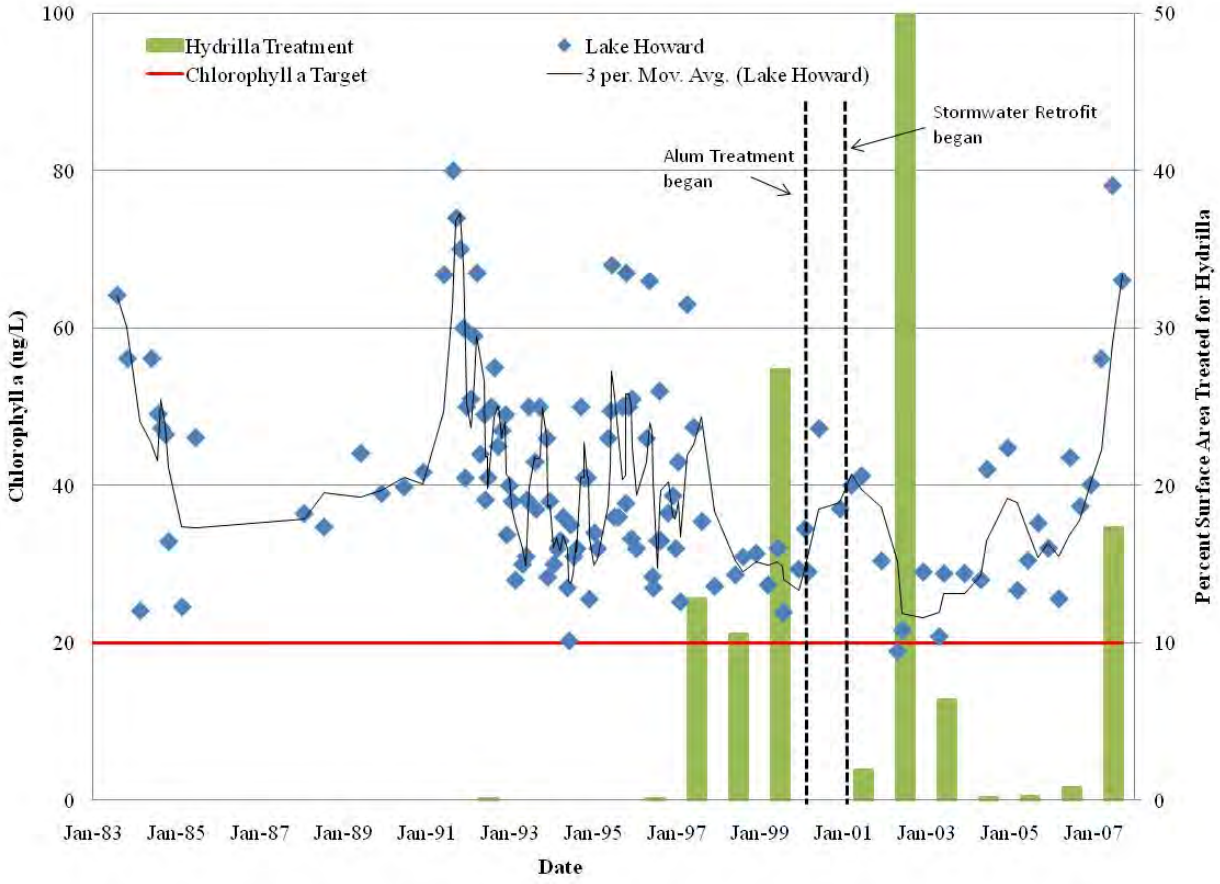


Figure 4-41. Lake Howard total phosphorus concentrations and *Hydrilla* treatment history using available data from 1983 to 2007.

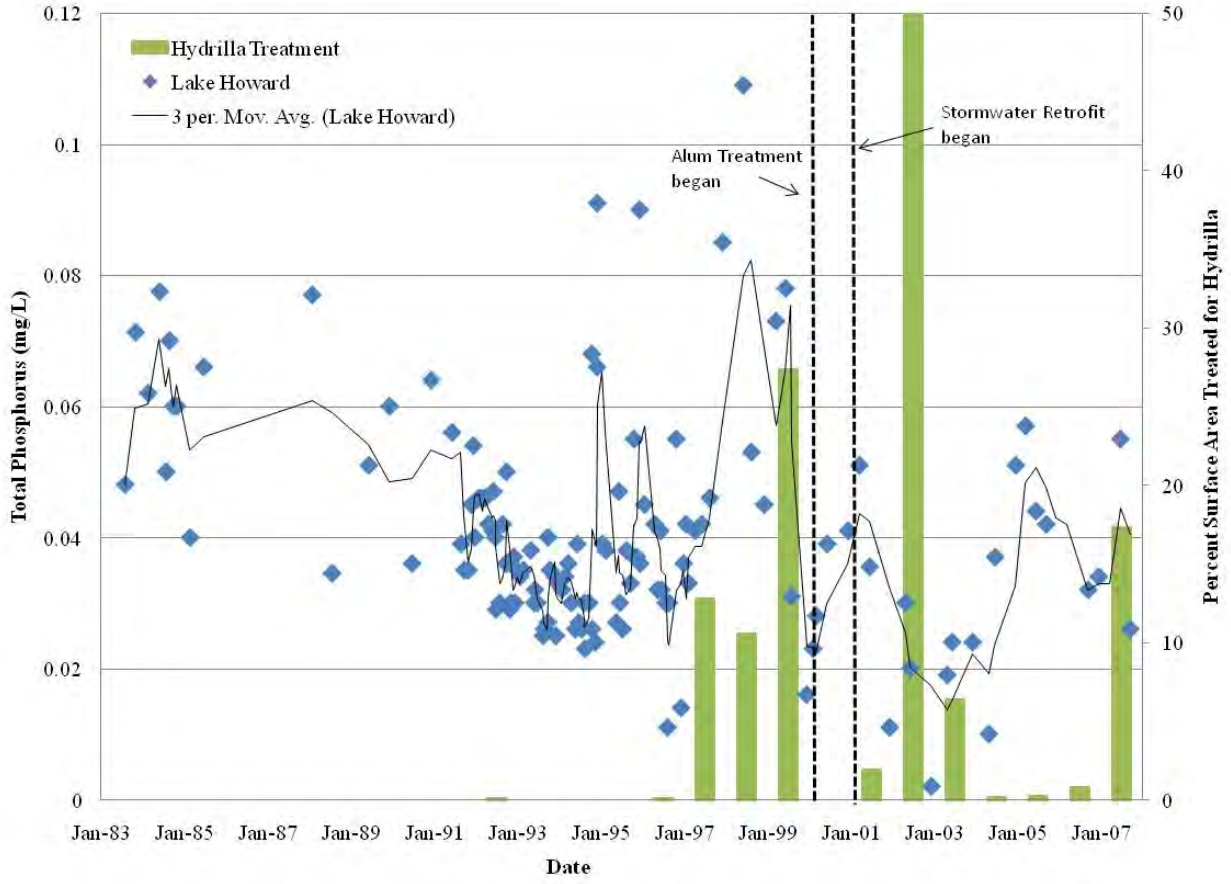
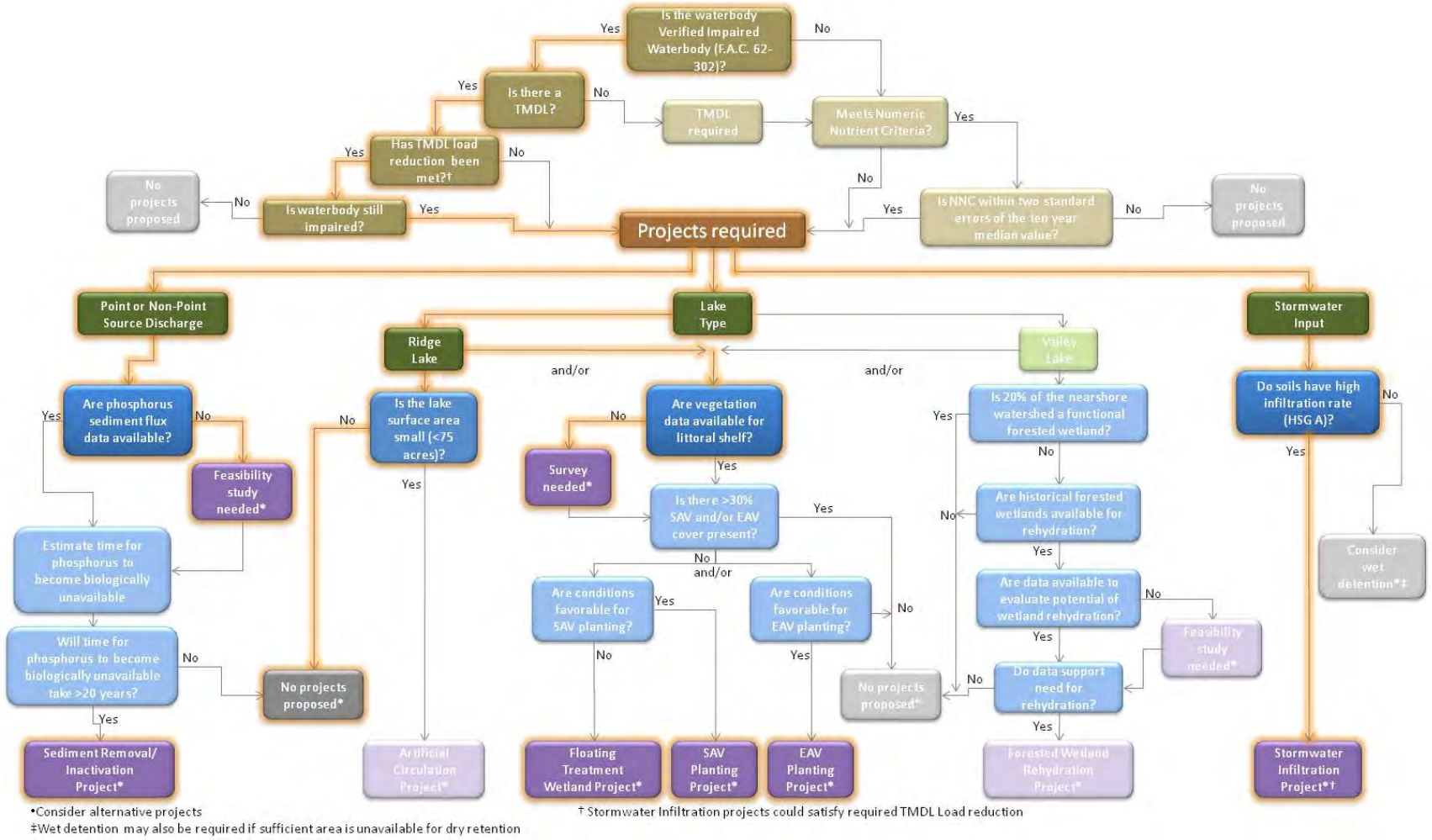


Figure 4-42. Lake Howard decision key: highlighted path shows decision process.



Project 1: Sediment Removal/inactivation

Historical point source discharges to Lake Howard from the Jan Phyl Village WWTF will require further evaluation of the potential internal phosphorus load from the lake bottom sediments. Presently, sufficient data are not available to evaluate the internal phosphorus load and calculate the phosphorus decay rate and the time at which the phosphorus will ultimately become biologically unavailable in the lake sediments. A feasibility study is required to determine whether sediment removal/inactivation is necessary to reduce internal phosphorus loads to the lake.

Cost Estimate: $10,000.

Project 2: Stormwater Infiltration Areas (SIAs)

The Lake Howard watershed has approximately 655 acres (57 percent of the watershed) classified as high infiltration soils. A TMDL has been established for Lake Howard, and as such, the SIA design should be focused on satisfying the TMDL requirements. SIA projects would need to encompass approximately 8 percent (87 acres) of the watershed in order to accomplish an annual 193 kg reduction in TP loads to Lake Howard. Acres of SIA estimated to meet the TP NNC was 38 (3 percent of the watershed) for a 23 percent phosphorus reduction in Lake Howard to meet its NNC. Fifty-seven percent of the watershed is characterized by high infiltration soils; therefore, it may be feasible to satisfy the TMDL load reductions through SIA implementation.

Presently, the City of Winter Haven has preliminarily identified six rain garden projects within the contributing drainage basin for Lake Howard as part of SWFWMD funded agreement. The rain gardens' sizes range from 200 to 2,500 feet^2 providing treatment to 5,200 to 15,000 feet^2. A brief description of each project is identified below as provided by the City of Winter Haven.

Site 1: Southeast corner of 3rd Street NW and Ave. C NW:

Type of Project:	Storm Inlet and perforated pipe (French Drain)
Objective:	To capture and percolate the runoff coming down the south side of Ave. C NW before crossing 3rd Street. This would help to reduce the ponding that occurs along Ave. C NW west of 3rd Street NW.
Drainage Area:	11,000 SF
Perforated Pipe:	55 L.F. of 18 inch pipe surrounded by 1 foot thick stone layer.
Treatment Volume:	530 CF (Provided)
Cost Estimate:	$ 7,600

Site 2: Southeast corner of 3rd Street NW and Ave. C NW:

Type of Project:	Storm Inlet and perforated pipe (French Drain)
Objective:	To capture and percolate the runoff coming down the south side of Ave. C NW before crossing 3rd Street. This will help to reduce the ponding that occurs along Ave. C NW west of 3rd Street NW.
Drainage Area:	11,000 SF
Perforated Pipe:	55 L.F. of 18 inch pipe surrounded by 1 foot thick stone layer.
Treatment Volume:	530 CF (Provided)
Cost Estimate:	$ 7,600

Site 3: West of 4th Street NW, southeast corner of Patterson Park:

Type of Project:	Rain Garden
Objective:	To capture and percolate the runoff coming down the west side of 4th Street NW. The runoff from the road can be easily diverted into the depressional area/rain garden at this location as the general area is lower than the edge of pavement elevation.
Drainage Area:	5200 SF
Rain Garden:	750 SF
Treatment Volume:	540 CF (Provided)
Cost Estimate:	$ 4,175

Site 4: West of 4th Street NW and Ave. C NW at Joyce Davis Park:

Type of Project:	Rain Garden
Objective:	To capture and percolate the runoff coming down Ave. C NW and the west side of 4th Street NW. The runoff from the adjacent roads can be easily diverted into the depressional area/rain garden at this location as the general area is lower than the edge of pavement elevation.
Drainage Area:	9,600 SF
Rain Garden:	1,200 SF
Treatment Volume:	860 CF (Provided)
Cost Estimate:	$ 6,550

Site 5: Winter Haven Public Library parking lot along Ave. B NW:

Type of Project:	Rain Garden
Objective:	To capture and percolate the runoff coming down the roof of the building and the adjacent parking area. The runoff can be easily diverted into the depressional area/rain garden at this location by providing curb cuts and concrete flumes at several locations along the existing Type “D” curb.
Drainage Area:	15,000 SF

Rain Garden:	2,500 SF
Treatment Volume:	625 CF (Provided)
Cost Estimate:	$ 5,800

Site 17: Southeast corner of Lake Howard Dr. NW and Ave. B NW:

Type of Project:	Storm Inlet and perforated pipe (French Drain)
Objective:	To capture and percolate the runoff coming down the south side of Ave. B NW before flowing down the road to Lake Howard. In addition to increasing the percolation/infiltration into the ground, this would provide treatment of the runoff thus improving the water quality of the lake.
Drainage Area:	6,000 SF
Perforated Pipe:	100 L.F. of 18 inch pipe surrounded by 1 foot thick stone layer.
Treatment Volume:	950 CF (Provided)
Cost Estimate:	$ 7,450

Cost Estimate: The City of Winter Haven has preliminarily identified 45 locations throughout the City to implement rain garden or perforated pipe systems. The cost estimate for these projects ranged from $2,200 to $20,000. The treatment volume ranged from 150 to 3,200 feet^3.

Project 3: SAV Planting or FTWs

SAV Planting

In Lake Howard, *Hydrilla* eradication occurs frequently attributing to the continued degradation in water quality. A survey of existing SAV cover in Lake Howard is recommended due to the lack of sufficient data to calculate percent lake cover. Based on the results of the SAV survey, conclusions regarding SAV planting can be determined. If SAV cover is less than 30 percent, lake conditions should be evaluated to assess if additional SAV is viable based on the soil condition, water clarity and water depth. *Hydrilla* harvesting may be required for successful establishment of selected SAV plants.

The 1997-2007 median secchi depth in Lake Howard (2.0 feet) indicated that SAV planting should not occur in water depths greater than 2 feet. The maximum planting effort could result in vegetation cover of approximately 3 percent of the lake bottom (20 acres).

The calculated area for planting is based upon current bathymetry data. Due to the extensive organic material located in Lake Howard, it is recommended that SAV planting be performed after sediment removal/inactivation, if completed. If sediment removal is completed, the planting area would need to be recalculated using updated bathymetry data.

Cost Estimate: $105,000 (estimate based on previous purchase and installation cost of $0.90 per plant provided by EarthBalance®, additional funds included for maintenance)

FTWs

If the feasibility study indicates that more than 30 percent of Lake Howard has SAV cover, FTW may be considered. The installation of floating mats with appropriate aquatic vegetation would be expected to assimilate nutrients from the water column.

Project 4: EAV Planting

A survey of existing shoreline vegetation surrounding Lake Howard is recommended due to the lack of sufficient data at this time. Based on the results of the shoreline survey, conclusions regarding emergent aquatic or woody vegetation planting can be determined. If limited shoreline vegetation is present, shoreline conditions should be evaluated to assess if vegetation planting is viable based on the soil conditions, slope, water level and inundation frequency and wave disturbance.