Haskell Lake (figure 1) is a 89 acre lake located in the Reservation of the Lake du Flambeau Band of Lake Superior Chippewa Indians (lat/lon: 45° 54' 31" N, 89° 55' 4" W). It is a drainage lake with a maximum depth of 10 feet. Fish include Musky, Panfish, Largemouth Bass, and the majority Northern Pike. The lake's water clarity is low, with high nutrients, and occasional anoxic conditions. Haskell Lake is in the Upper Wisconsin watershed (HUC 07070001) with an inlet on the north end of the lake draining to an outlet on the south end of the lake into Squirrel Lake and eventually on into the Mississippi River.

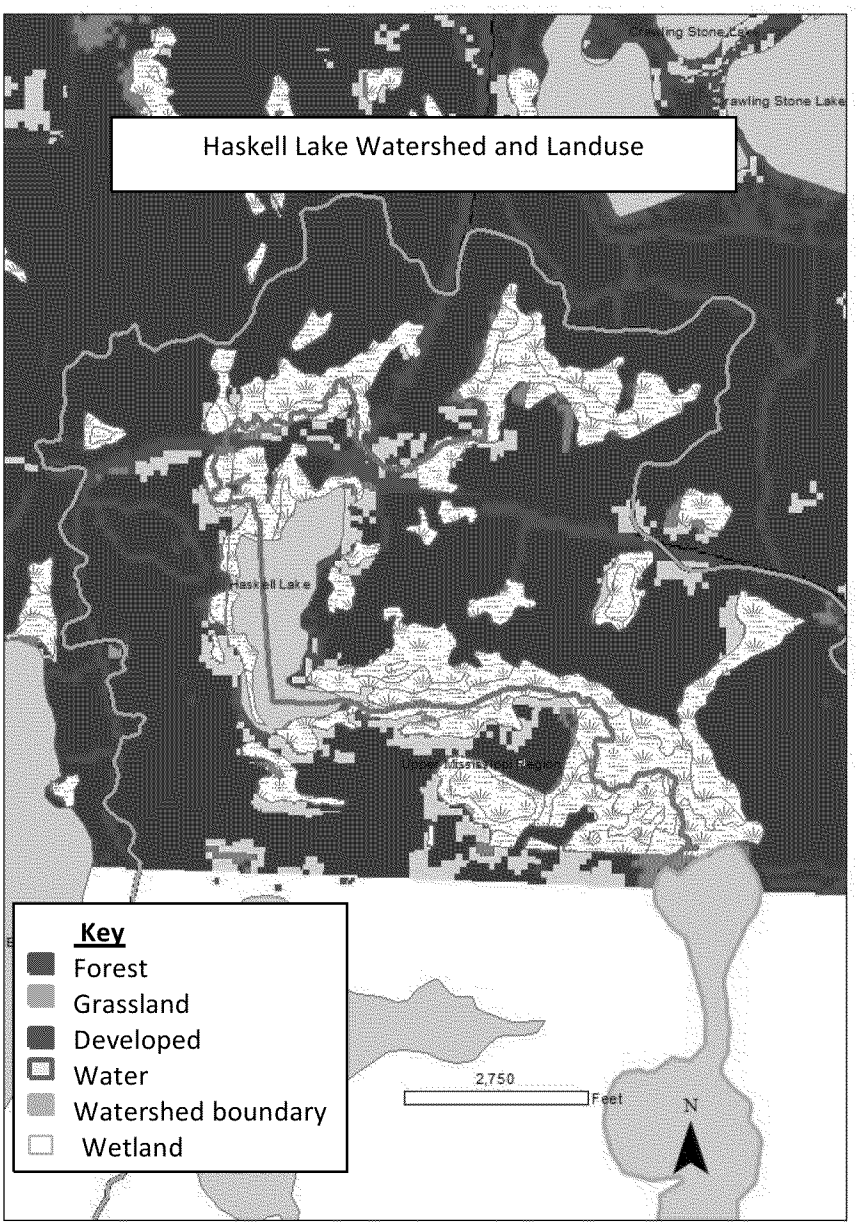

Figure 1: Haskell Lake Watershed and Landuse

Haskell Lake has been examined by the Tribal Natural Resource Water Program in the early 1990s and early 2000s for dissolved oxygen (DO), total phosphorus (TP), pH, and Chlorophyll a as part of the baseline monitoring of the program. Both sampling periods were accomplished under the General Chemistry Quality Assurance Protection Plan approved by EPA. Haskell Lake was also assessed as part of the National Lake Survey in 2007.

Haskell Lake trophic state is eutrophic, meaning high productivity. Trophic state describes a range of biological productivity levels for lakes. Lakes with high nutrient levels, high plant production rates, and an abundance of plant life are termed eutrophic. Eutrophic lakes can be biologically diverse with abundant fish, plants, and wildlife. Yet when excessive nutrient concentrations in lakes result from human activities (such as development within the watershed), the resulting nuisance algae and plant growth, murky water, odor problems and fish kills are beyond the natural trophic expectations. Looking at Table 1, the comparison of Reservation Lakes to Haskell Lake using National Lake Assessment condition criteria to determine good, fair, and poor it is shown that Haskell Lake has good riparian cover (plants on land) but fair literal cover (plants in water), and fair total phosphorus (limiting nutrient for aquatic vegetation). This shows that rooted plants are being inhibited, most likely by turbid water associated with nuisance algae.

Table 1: Comparison of Reservation Lakes to Haskell Lake using National Lake Assessment condition criteria to determine good, fair, and poor

Lake	Human Disturbance	Riparian Cover	Literal Cover	Literal and Riparian Cover	Total Phosphorus
Ike Walton Lake	Medium	Good	Fair	Good	Good
Moss Lake	Medium	Good	Good	Good	Fair
Little Crawling Stone Lake	Medium	Poor	Poor	Poor	Good
Pokegama Lake	Medium	Good	Good	Good	Good
Flambeau Lake	Medium	Good	Good	Fair	Good
Little Trout Lake	Medium	Fair	Good	Good	Good
Wild Rice Lake	Medium	Good	Good	Good	Good
White Sand Lake	Medium	Good	Good	Good	Good
Long Lake	Medium	Fair	Good	Fair	Good
Big Crawling Stone Lake	Medium	Good	Poor	Fair	Good
Fence Lake	High	Good	Poor	Fair	Good
Haskell Lake	Medium	Good	Fair	Fair	Fair

Haskell Lake watershed is dominated with forest land and the shoreline is dominated by wetland (figure 1) leading us to believe that the high nutrients inputs must be from sources other than land use practices. The Tribe is aware of a direct septic discharge originating on the north end of the lake that was stopped in the 1980s. This most likely was one of the causes for the elevated nutrients. Haskell Lake is small shallow lake that is naturally high in nutrients. Shallow, polymictic (mix a lot) lakes display a number of features that set them apart from the more often-studied deeper, dimictic systems (mix in the spring and fall). Frequent mixing of the entire water column and re-suspension of unconsolidated sediments increase internal loading of nutrients from the sediments to water column, maintaining the high nutrient levels even after the external source is discontinued. Moss Lake (table 1) is the lake that is most similar to Haskell Lake in morphology (size and shape), yet the rooted plant community is healthy sustaining clear water, reducing re-suspension, and reducing fish kills.

Haskell Lake is improving in trophic state as nutrients are flushed down to Squirrel Lake through the outlet. In figure 2 the averages of Total Phosphorus and Chlorophyll a are displayed for the periods of early nineties and two thousand. This shows marked improvement in a decade leading us to believe the flushing rate of Haskell Lakes is high. Yet the rate of change has plateaued as less extensive sampling in 2005 showed no significant difference in total phosphorus. In 2012 a fish kill was noted (figure 3) as ice opened in the spring.

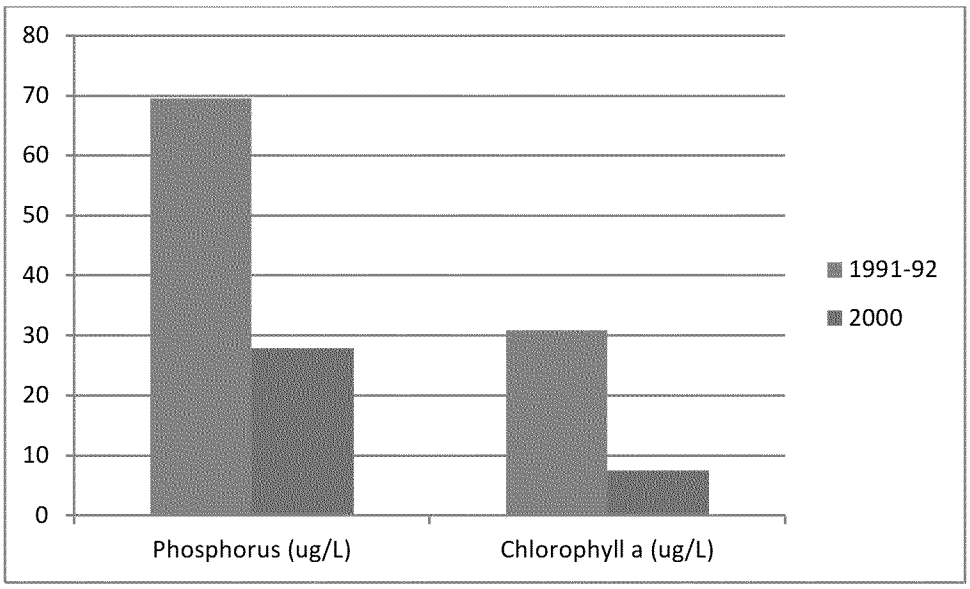

Figure 2: Average Total Phosphorus and Chlorophyll a (algae) during the 1990 and 2000s.

Figure 3: Fish kill on Haskell Lake (3/23/12)

These types of fish kills are indicative of low oxygen levels created by excessive algal growth during the summer, algae dyes back in the winter decaying in the sediments consuming dissolved oxygen. Figure 4 shows the sessional pattern of Haskell Lakes dissolved oxygen (DO) levels. During ice cover oxygen levels drop considerably reducing oxygen availability to the fish for respiration.

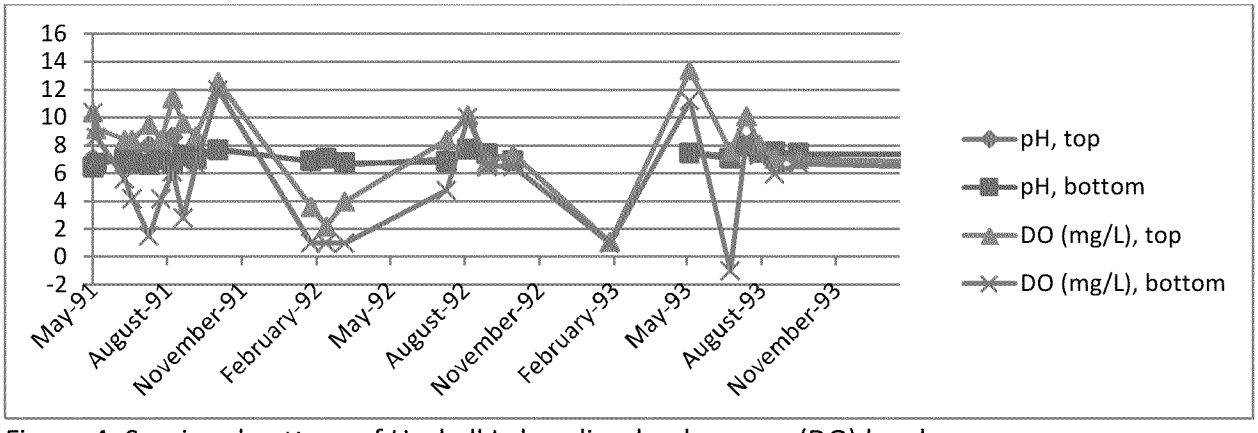

Figure 4: Sessional pattern of Haskell Lakes dissolved oxygen (DO) levels

Other data collected under the National Lake Assessment (2007) is within normal ranges of lakes in this area (Table 2). Haskell Lake has not been studied extensively over the years and could use additional resources for non-trophic state indicators.

Chlorine	Sulfate	Calcium	Magnesium	Potassium	Sodium
CL_PPM	SO4_PPM	CA_PPM	MG_PPM	K_PPM	NA_PPM
9.305	2.57	14.37	4.651	0.466	4.258

In 2000, the State of Wisconsin illegally permitted a discharge of treated water from a groundwater remediation project under the Wisconsin Pollutant Discharge Elimination System General Permit. Wisconsin is not the legal permitting authority on the Reservation as under the Clean Water Act US Environmental Protection Agency is the permitting authority. This permit was then not brought to the Tribal Water Resource Programs attention so that follow up sampling could be conducted to insure benzene, total BTEX, polyncuclear aromatic hydrocarbons, naphthalene, lead, and daily flow met water quality standards. The monitoring records as required under the permit have also not been furnished by the WI DNR at this time. Haskell Lakes has also been impacted by perchlorate from a site located on the tributary to the lake.

Haskell Lake is at the headwaters of the Upper Wisconsin watershed, likely receiving the majority of its water from groundwater sources. Studies indicate that water flushes through the system quickly, yet more work needs to be done to truly understand the hydrology. Trophic state is progressing from hypo-eutrophic to eutrophic and shows signs of improvement, yet it is still impaired buy internal loading of nutrients and the aquatic plants have not recovered from septic pollution. Metals would be important to studied in future work especially in fish flesh as they can bio-accumulate over the years.