

Mud Lake Lakeshed Assessment

The lakeshed vitals table identifies where to focus organizational and management efforts for each lake. Criteria were developed using limnological concepts to determine the effect to lake water quality.

Lakeshed Vitals		Rating
Major Basin	Upper Mississippi River	descriptive
Major Watershed	Leech Lake River	descriptive
Minor Watershed	8034	descriptive
Lakeshed	Leech River (803401)	descriptive
Ecoregion	Northern Lakes and Forests	descriptive
Lake Area	1,420 acres	descriptive
Miles of Shoreline	8.17	descriptive
Miles of Stream	18.56	descriptive
Miles of Road	10.3	descriptive
Lake Max Depth	5 ft.	descriptive
Lake Mean Depth	NA	NA
Water Residence Time	NA	NA
Municipalities	None	+
Sewage Management	None – No residences on lake	+
Public Drainage Ditches	None	+
Lake Management Plan	None	x
Lake Vegetation Survey/Plan	None	x
Forestry Practices	None	+
Development Classification	Natural Environment	+
Shoreline Development Index	1.5	+
Total Lakeshed to Lake Area Ratio (total lakeshed includes lake area)	11.4:1	x
Public Lake Accesses	3	x
Inlets	3 – Leech Lake River, Snake Creek, Unnamed	x
Outlets	1 – Leech Lake River	x
Feedlots	None	+
Agriculture Zoning	758 acres > 200 ft. from lake	x
Public Land : Private Land	11:1	+
Wetland Coverage	61%	+
Lake Transparency Trend	NA	NA
Exotic Species	None	+

Rating Key:

- + beneficial to the lake
- possibly detrimental to the lake
- x warrants attention

Lakeshed



Understanding a lakeshed requires the understanding of basic hydrology. A watershed is the area of land that drains into a surface water body such as a stream, river, or lake and contributes to the recharge of groundwater. There are three categories of watersheds: 1) basins, 2) major watersheds, and 3) minor watersheds.

Mud Lake is found within the **Upper Mississippi River Basin**, which includes the **Leech Lake River Major Watershed** as one of its sixteen major watersheds. The basin covers 20,000 square miles, while the Leech Lake River Watershed covers 1,335 square miles (approximately 854,349 acres). Mud Lake falls within **minor watershed 8034**, one of the 75 minor watersheds that comprise the Leech Lake River Major Watershed.

Within this watershed hierarchy, lakesheds also exist. A lakeshed is defined simply as the land area that drains to a lake. While some lakes may have only one or two minor watersheds draining into them, others may be connected to a large number of minor watersheds, reflecting a larger drainage area via stream or river networks. Mud Lake falls within the **Leech River (803401) lakeshed**, covering 16,134 acres (includes lake area). Even though Mud Lake receives water from minor watershed 8037 via the Leech Lake River, for the purpose of this assessment it is decided that only the immediate lakeshed be inventoried and assessed.

Mud Lake Lakeshed Water Quality Protection Strategy

Each lakeshed has a different makeup of public and private lands. Looking in more detail at the makeup of these lands can give insight on where to focus protection efforts. The protected lands (easements, wetlands, public land) are the future water quality infrastructure for the lake. Developed land and agriculture have the highest phosphorus runoff coefficients, so this land should be minimized for water quality protection.

Although the majority of Mud Lake's lakeshed is made up of public land, private forested uplands can be the focus of development and protection efforts in the lakeshed.

	Private (8%)					2%	Public (90%)		
	Developed	Agriculture	Forested Uplands	Other	Wetlands	Open Water	County	State	Federal
Land Use (%)	1%	2%	4%	0%	1%	2%	0%	74%	16%
Runoff Coefficient Lbs of phosphorus/acre/year	0.45 - 1.5	0.26 - 0.9	0.09		0.09		0.09	0.09	0.09
Description	Focused on Shoreland	Cropland	Focus of development and protection efforts	Open, pasture, grassland, shrubland	Protected				
Potential Phase 3 Discussion Items	Shoreline restoration	Restore wetlands; CRP	Forest stewardship planning, 3 rd party certification, SFIA, local woodland cooperatives		Protected by Wetland Conservation Act		County Tax Forfeit Lands	State Forest	National Forest

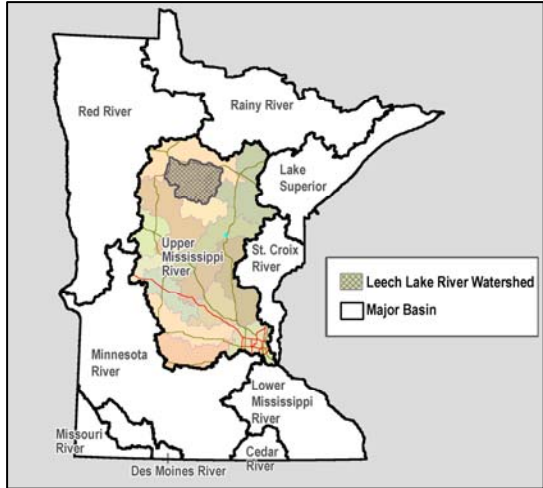


Figure 1. Upper Mississippi Basin and the Leech Lake River Watershed.

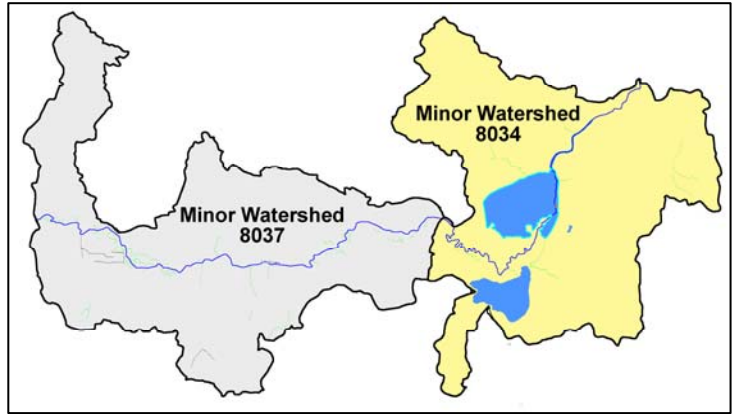


Figure 2. Minor Watersheds 8034 & 8037 contribute water to Mud Lake.

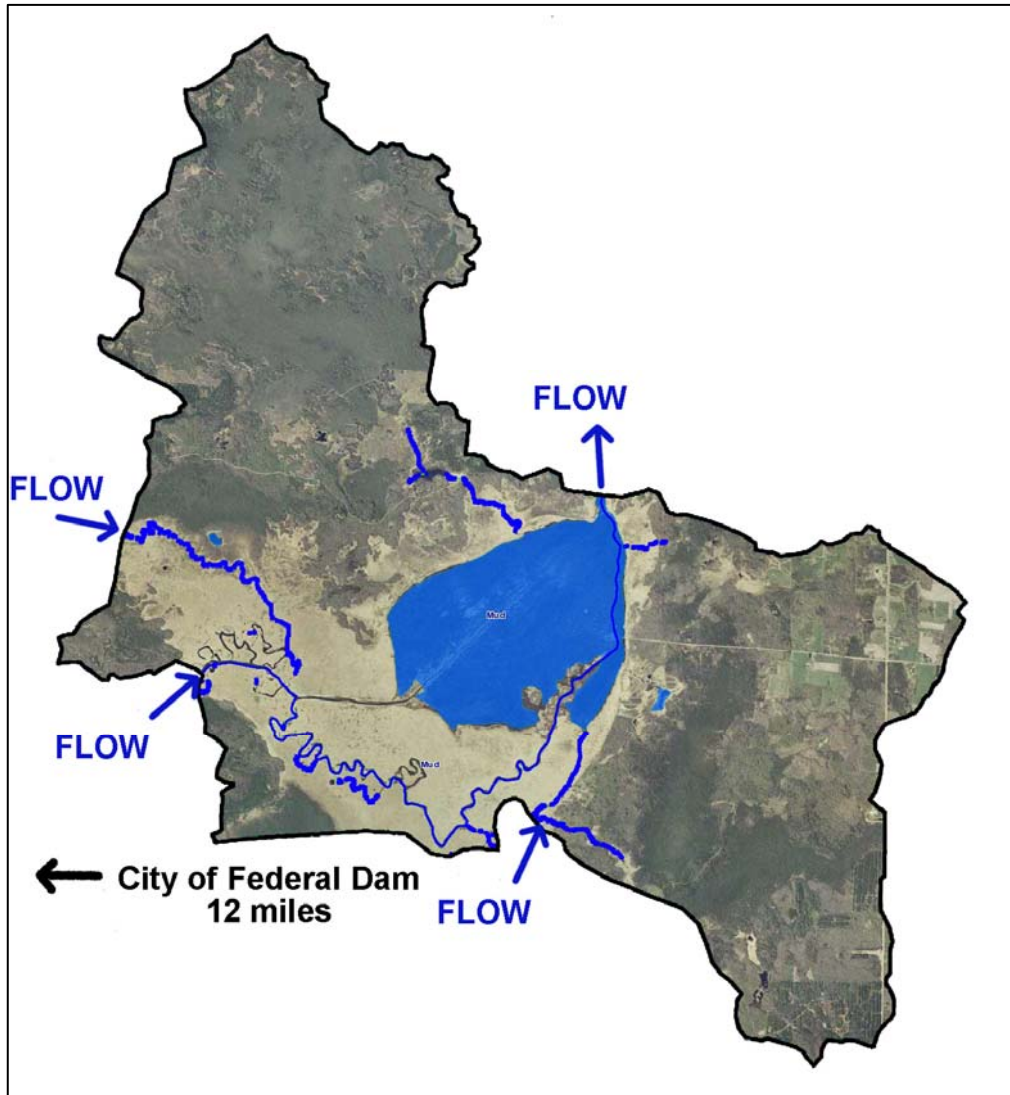


Figure 3. The Leech River (803401) Lakeshed (Aerial Imagery 2008 1M).

Land Cover / Land Use

The activities that occur on the land within the lakeshed can greatly impact a lake. Land use planning helps ensure the use of land resources in an organized fashion so that the needs of the present and future generations can be best addressed. The basic purpose of land use planning is to ensure that each area of land will be used in a manner that provides maximum social benefits without degradation of the land resource.

Changes in land use, and ultimately land cover, impact the hydrology of a lakeshed. Land cover is also directly related to the land's ability to absorb and store water rather than cause it to flow overland (gathering nutrients and sediment as it moves) towards the lowest point, typically the lake. Impervious intensity describes the land's inability to absorb water, the higher the %

impervious intensity the more area that water cannot penetrate into the soils. Monitoring the changes in land use can assist in future planning procedures to address the needs of future generations.

Phosphorus export, which is the main cause of lake eutrophication, depends on the type of land cover occurring in the lakeshed. Figure 5 depicts Mud Lake's lakeshed land cover.

The University of Minnesota has online records of land cover statistics from years 1990 and 2000 (<http://land.umn.edu>). Table 1 describes Mud Lake's lakeshed land cover statistics and percent change from 1990 to 2000. Due to the many factors that influence demographics, one cannot determine with certainty the projected statistics over the next 10, 20, 30+ years, but one can see the transition within the lakeshed from agriculture, forest, and water acreages to grass/shrub/wetland and urban acreages. The largest change in percentage is the decrease in water cover (88.6%); however, in acreage, grass/shrub/wetland cover has increased the most (1,626 acres). In addition, the impervious intensity has increased, which has implications for storm water runoff into the lake. The increase in impervious intensity is consistent with the increase in urban acreage.

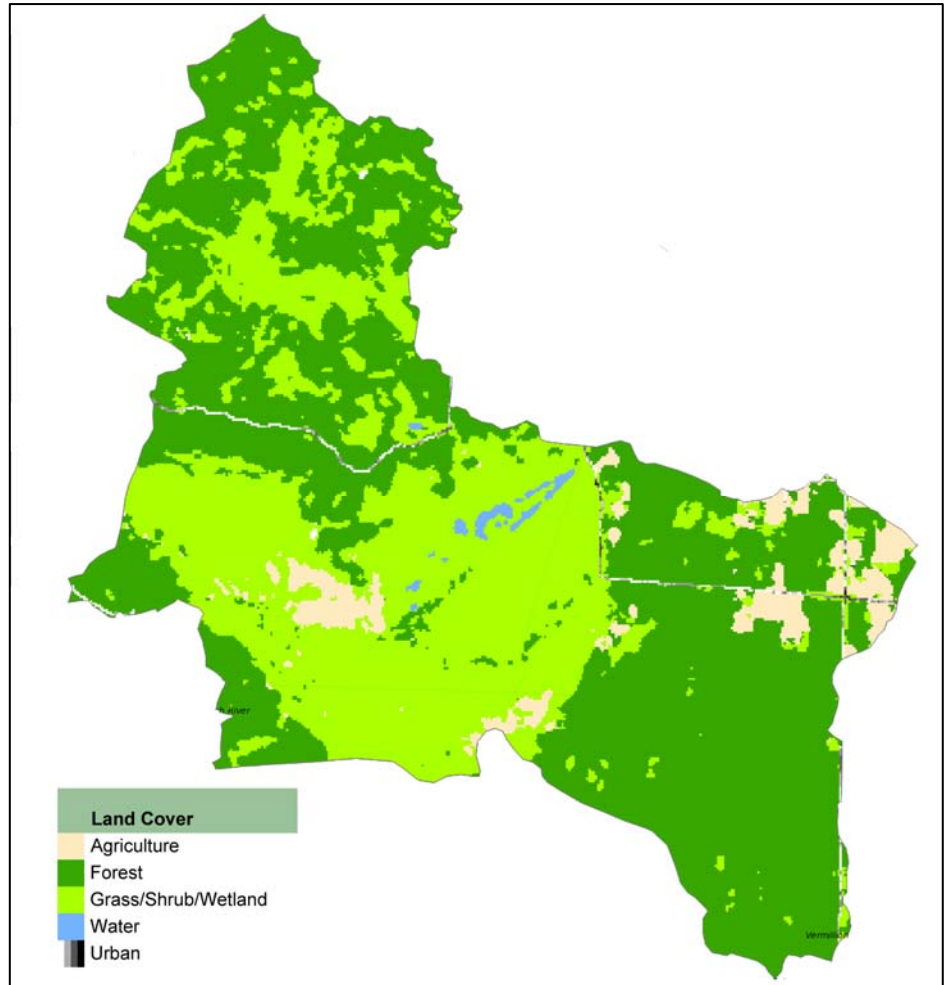


Figure 5. The Leech River (803401) lakeshed land cover (<http://land.umn.edu>).

Table 1. Mud Lake's lakeshed land cover statistics and % change from 1990 to 2000 (<http://land.umn.edu>).

Land Cover	1990		2000		% Change 1990 to 2000
	Acres	Percent	Acres	Percent	
Agriculture	888	5.5	738	4.57	16.9 % Decrease
Forest	9,848	61.04	8,985	55.69	8.8 % Decrease
Grass/Shrub/Wetland	4,566	28.3	6,192	38.38	35.6 % Increase
Water	694	4.3	79	0.49	88.6 % Decrease
Urban	142	0.88	144	0.89	1.4 % Increase
Impervious Intensity %					
0	16,067	99.56	16,056	99.49	0.1 % Decrease
1-10	30	0.19	32	0.2	6.7 % Increase
11-25	26	0.16	29	0.18	11.5 % Increase
26-40	11	0.07	14	0.09	27.3 % Increase
41-60	5	0.03	5	0.03	No Change
61-80	0	0	1	0.01	100 % Increase
81-100	0	0	1	0.01	100 % Increase
Total Area	16,134		16,134		
Total Impervious Area (Percent Impervious Area Excludes Water Area)	11	0.07	15	0.09	36.4 % Increase

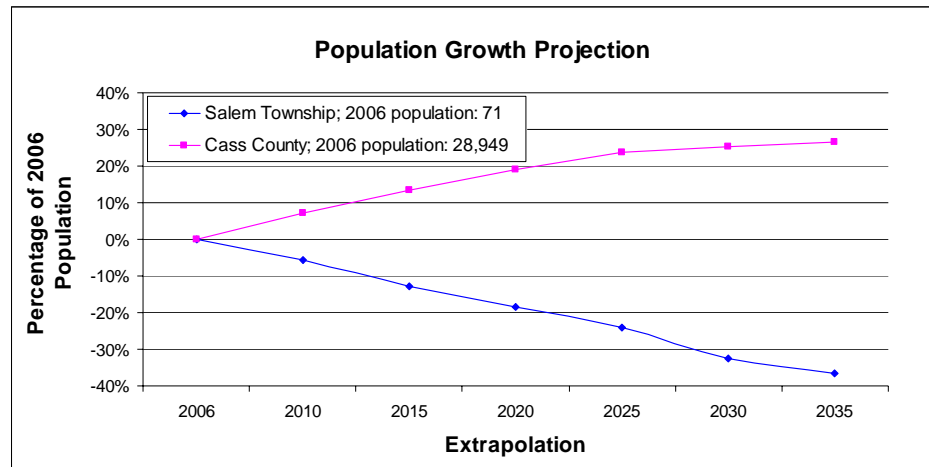
Demographics

Mud Lake is classified as a natural environment lake. Natural environment lakes usually have less than 150 total acres, less than 60 acres per mile of shoreline, and less than three dwellings per mile of shoreline. They may have some winter kill of fish; may have shallow, swampy shoreline; and are less than 15 feet deep.

The Minnesota Department of Administration Geographic and Demographic Analysis Division extrapolated future population in 5-year increments out to 2035. These projections are shown in Figure 6 below. Cass County as a whole has a higher, positive extrapolated growth projection than Salem Township, which has a negative extrapolated growth projection.



Figure 6. Population growth projection for the townships around Mud Lake and Cass County. Figure excludes one unorganized township that lacks individual population data (source: <http://www.demography.state.mn.us/resource.html?id=19332>).



Status of the Fishery

No information available.