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In association with:
Central Lakes College

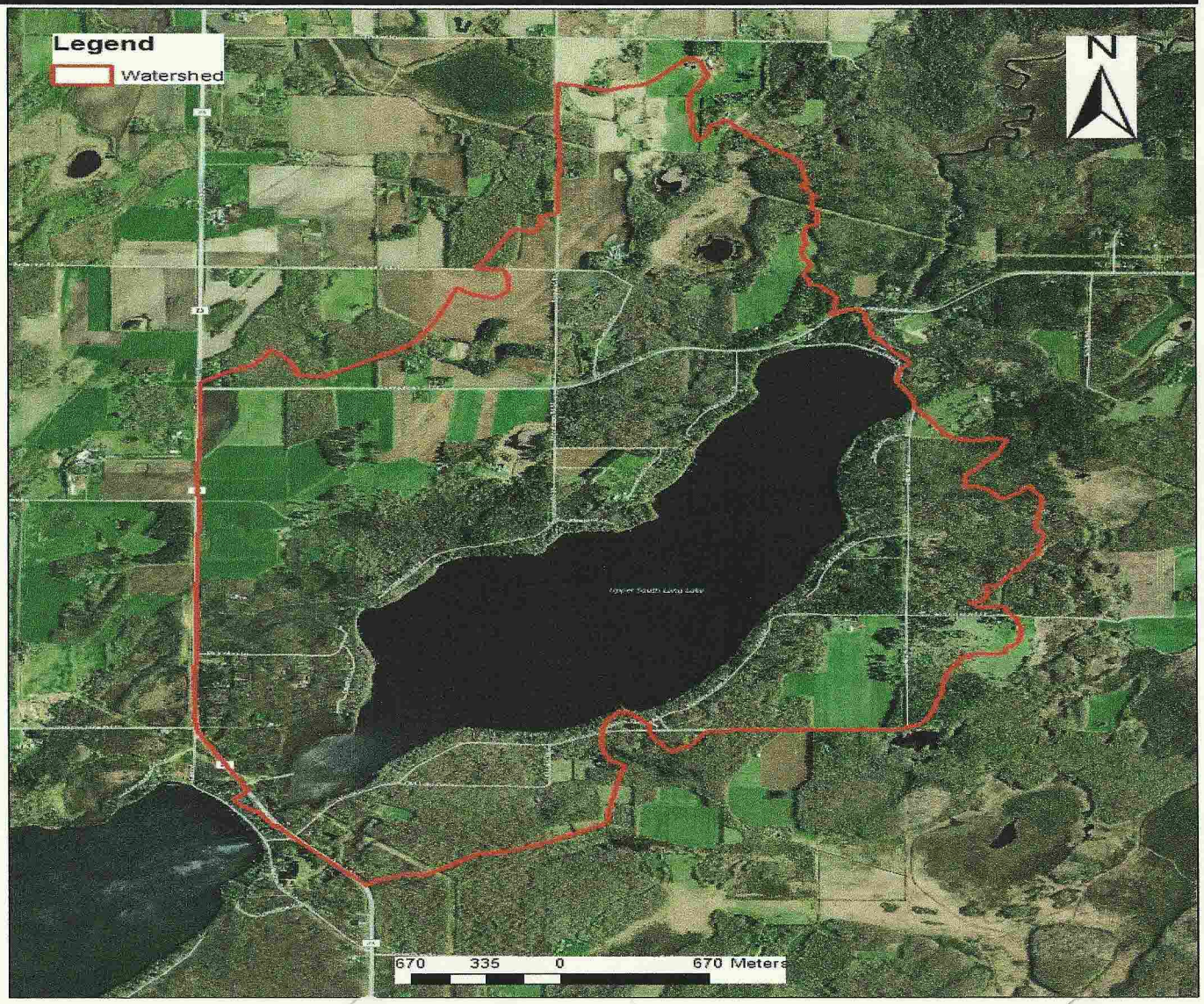
Upper South Long:
Affects of Land Use on Phosphorus Loading

Central Lakes College

Upper South Long Background:

- Main inflow and outflow is the Nokassippi River
- The Upper South Long watershed is 6,477 acres
- Comprised of primarily forest and agriculture
- The lake is classified as general development
- Mostly in private ownership
- Approximately 6 miles southeast of Brainerd

Upper South Long Watershed



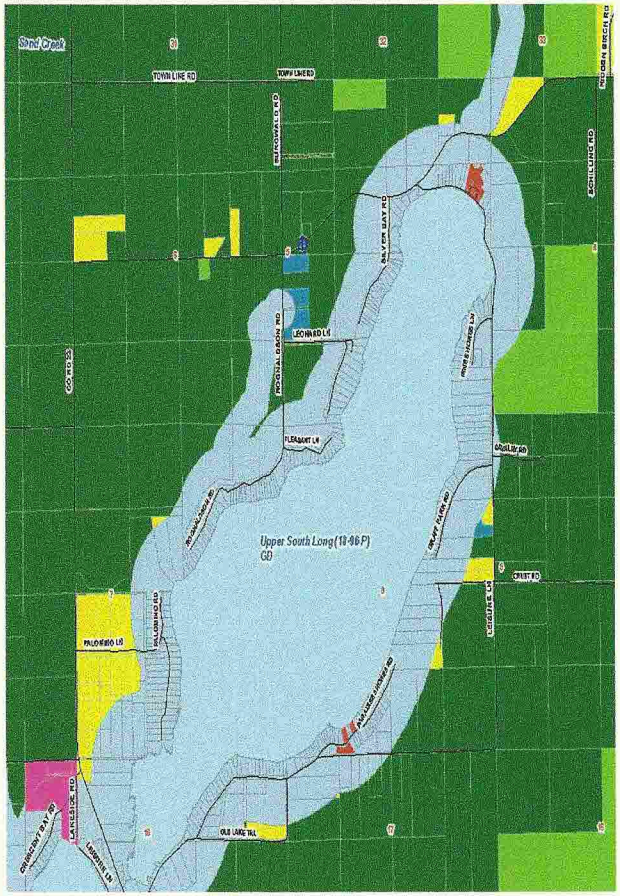
Watershed source: DNR Data Deli
Base map source: ESRI ArcGIS

Area Zoning

- Current zoning in the watershed is made up of primarily forestry/agriculture districts and rural residential-20
- In the proposed plan forested districts in the southern part of the watershed will become rural residential-5, but areas designated rural residential-2.5 in the western areas will become rural residential-5 also
- This will allow more development to take place in the forested regions

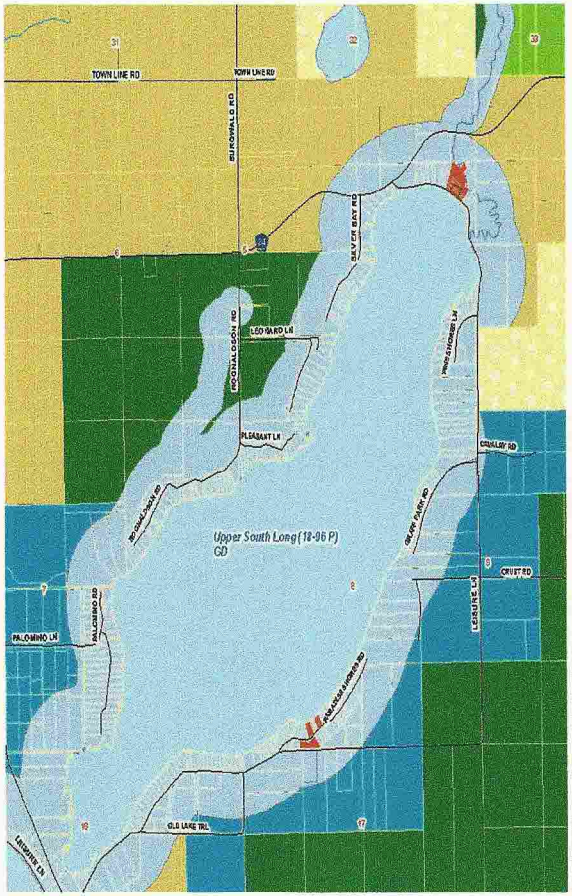
County Zoning

Current:



- Agricultural/Forestry District
- Airport District
- Commercial District 1
- Commercial District 2
- Commerical/Heavy Industrial
- Commerical/Light Industrial D
- Rural Residential - 20
- Rural Residential - 10
- Rural Residential - 5
- Rural Residential - 2.5
- Rural Residential - 1
- Sensitive Shoreland District
- Shoreland District
- Urban Growth District
- Waterfront Commerical

Proposed:

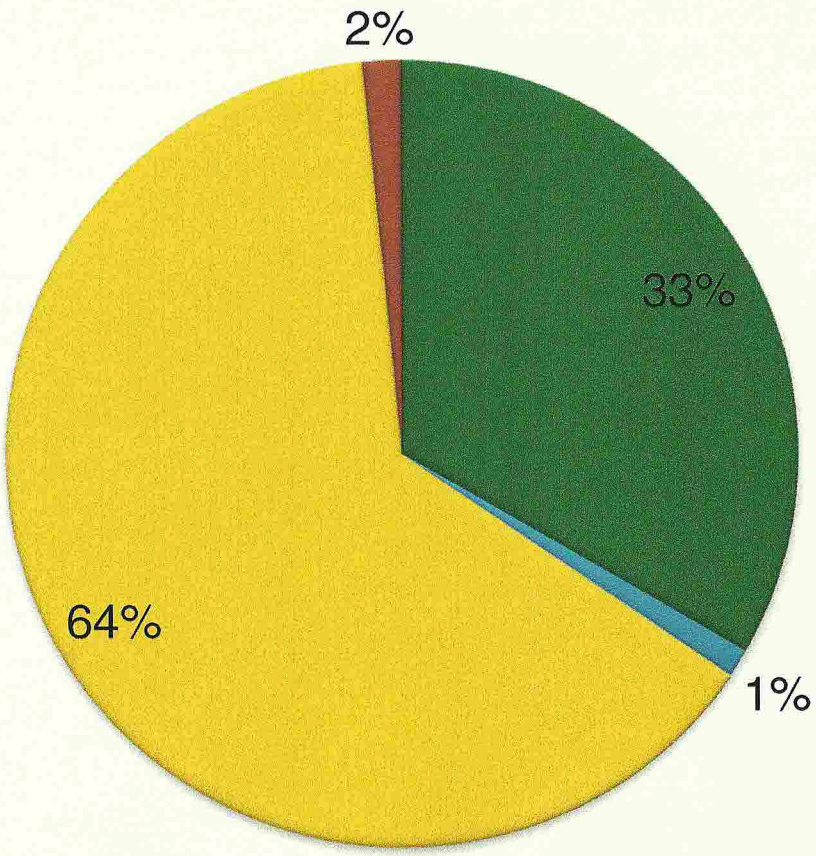


Zoning map source: Crow wing county GIS mapping

Land Use in the Watershed

- Land use throughout the watershed is primarily agriculture and forestry based
- This may change to more residential land use as the proposed zoning is put in place

Watershed Land Use Comparison

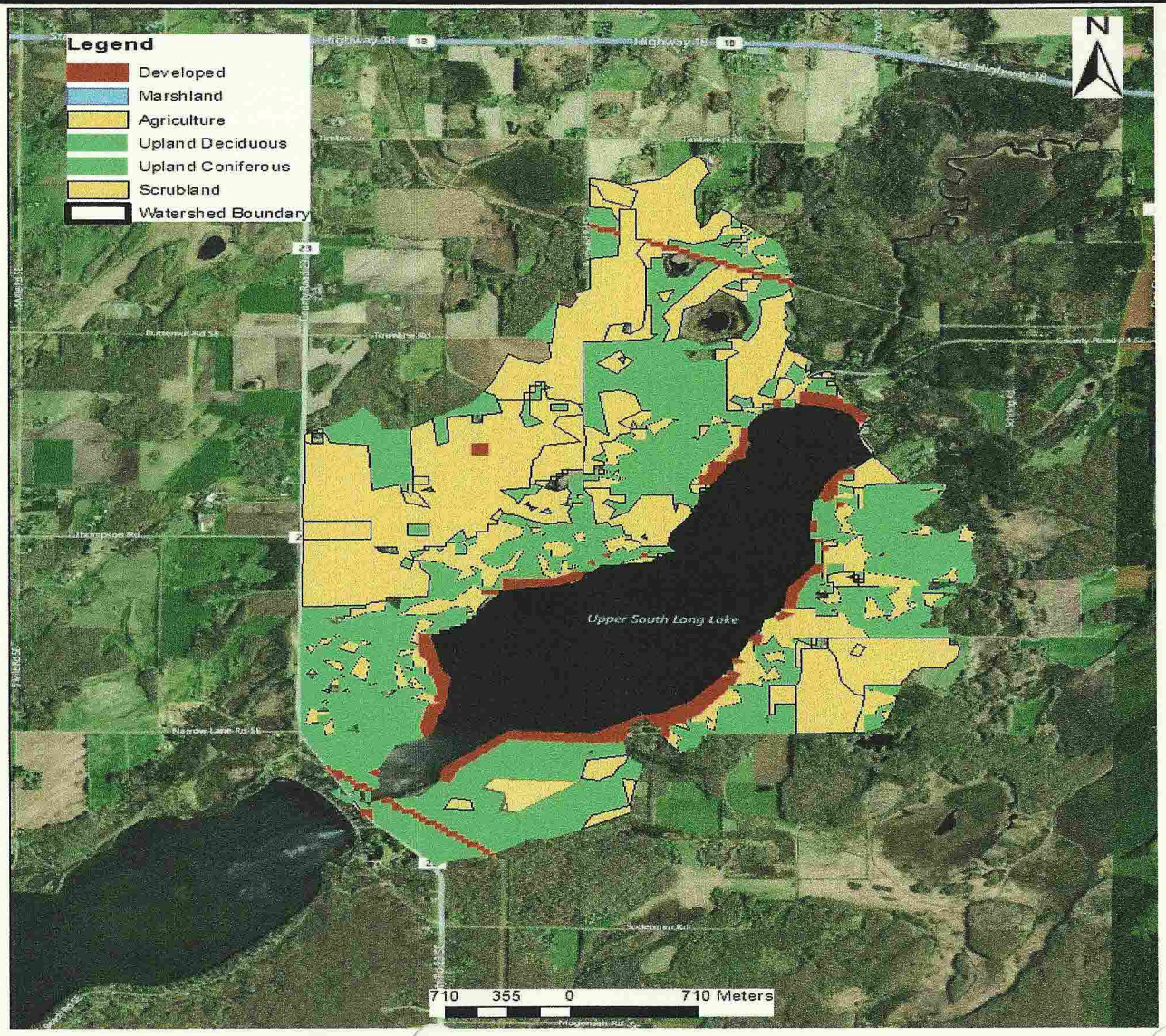


Forested:	2,184 acres
Wetland:	75 acres
Agriculture:	4,178 acres
Developed:	102 acres

- Forested
- Wetland
- Agriculture
- Developed

Land Use source : DNR Data Deli

Current Land Use



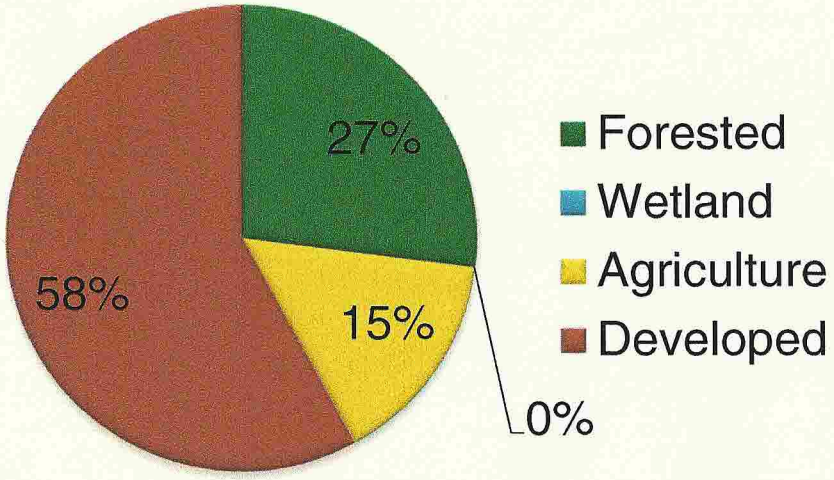
Land Use: DNR Data Deli
Base map: ESRI Arc GIS

Land Use Within Buffer

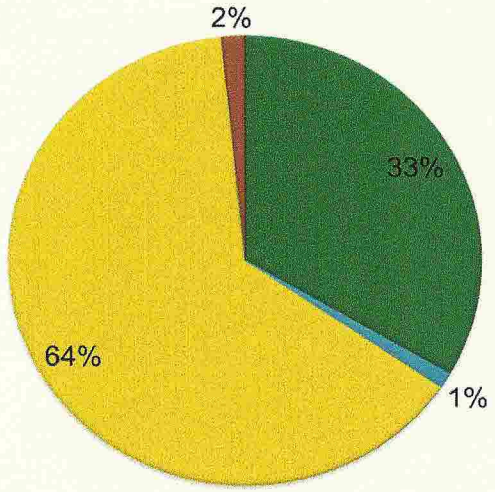
- Buffer area is the area within 300 feet of the ordinary high water line of Upper South Long Lake
- Land use within the buffer changes to being primarily residential and forested
- Under the proposed zoning the amount of residential will be allowed to increase

Buffer Land Use Comparison

BUFFER LAND

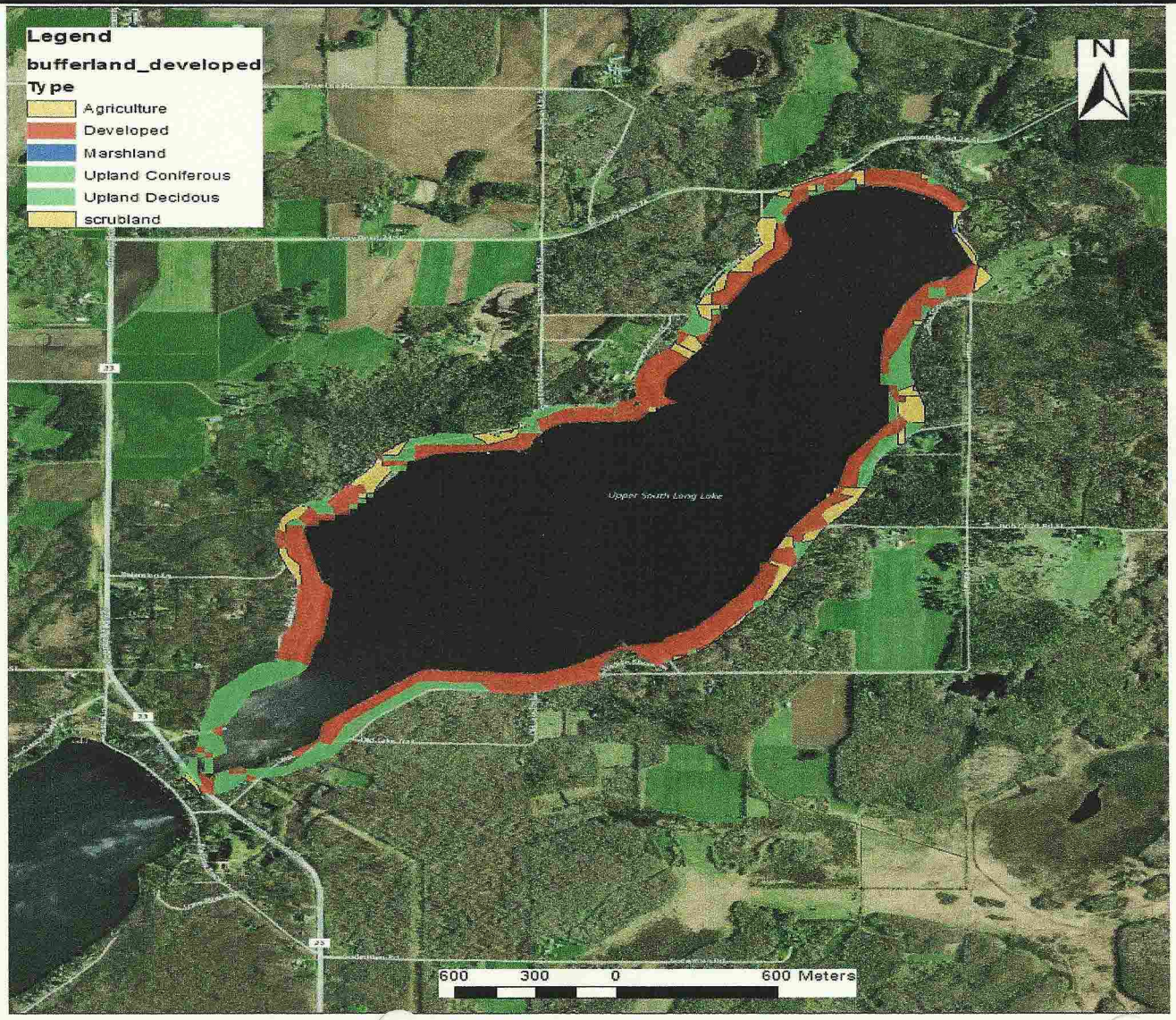


WATERSHED



Land Use source: DNR Data Deli

Land Use in the Buffer



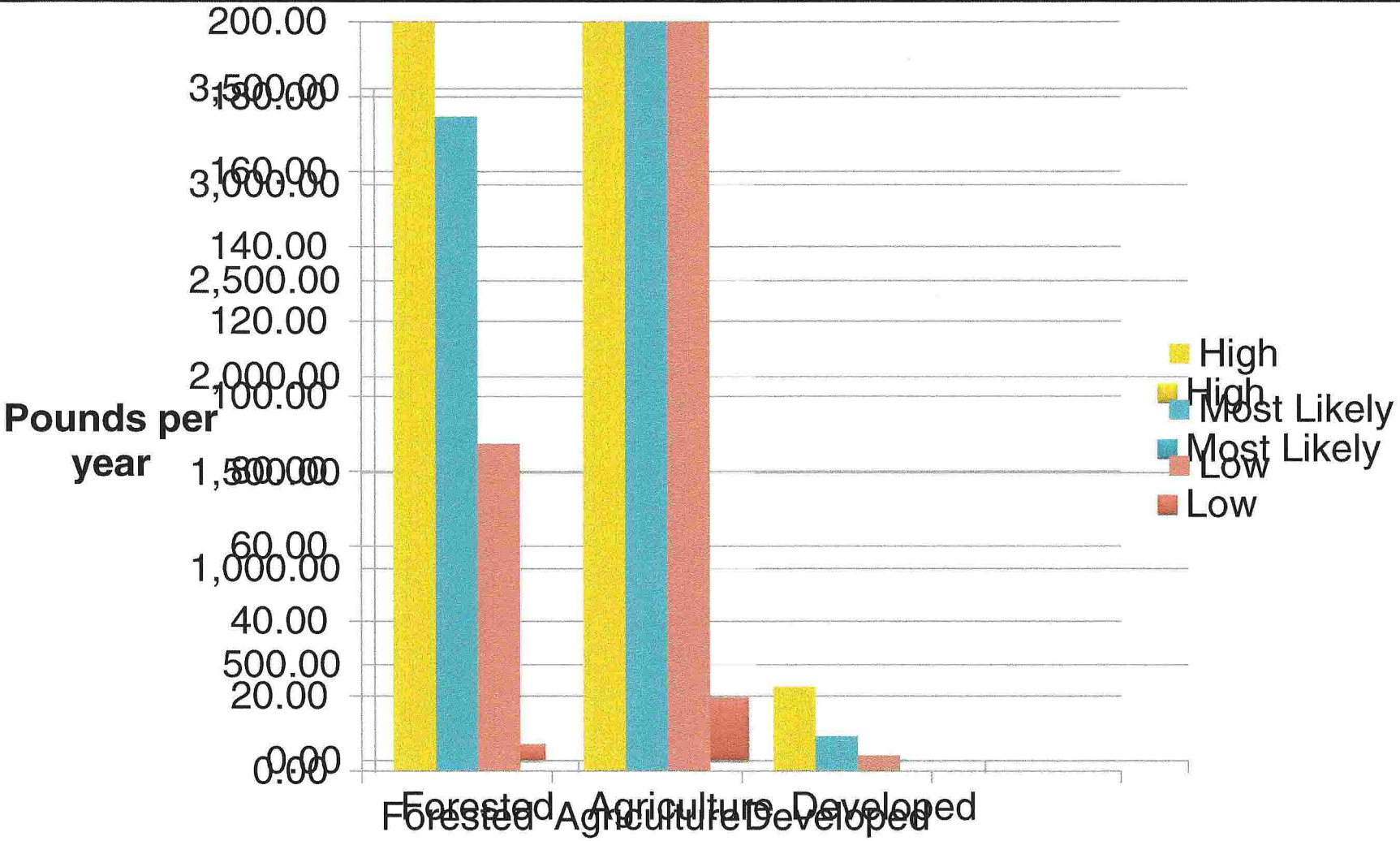
Land Use : DNR Data Deli
Base map: ESRI Arc GIS

Phosphorus Loading for Land Uses

Cover Type	Area (acres)	Phosphorus co-efficient	Phosphorus Loading (pounds per year)
Forested	2,184	0.08	175
Wetland	75	0.1	7.5
Agriculture	4,178	0.3	1253
Developed	102	0.09	9

Land Use Source: DNR Data Deli
Phosphorus Co-efficients source: Minnesota Phosphorus Assessment Tool

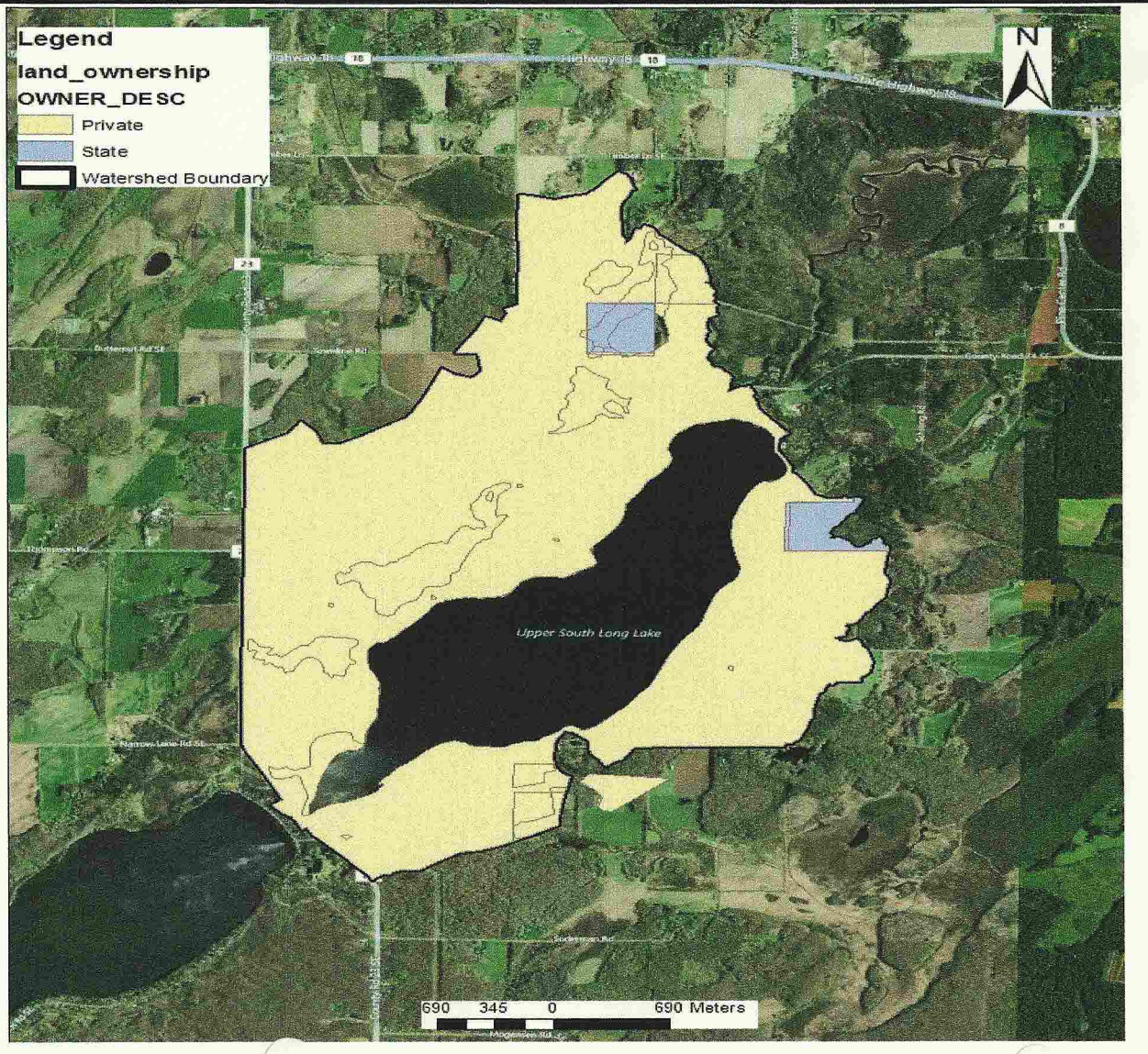
Amounts of Phosphorus Inputs from Land Use Types



Public vs. Private Lands

- Within the watershed the land is almost entirely comprised of private land
- There are some small tracks of public land in the northern and eastern sections of the watershed
- This also will allow for more development to take place in the future

Land Ownership

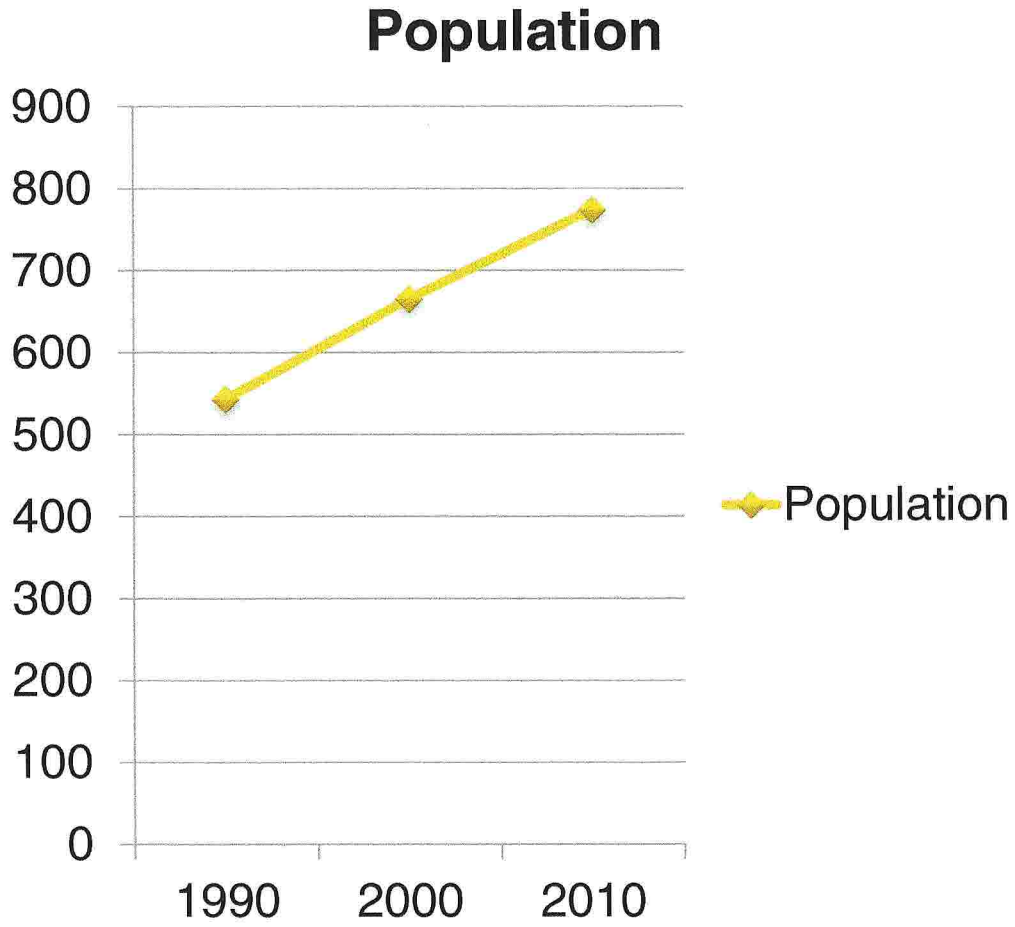


Base map source: ESRI Arc GIS
Ownership Source: DNR Data Deli

Census Data for Maple Grove

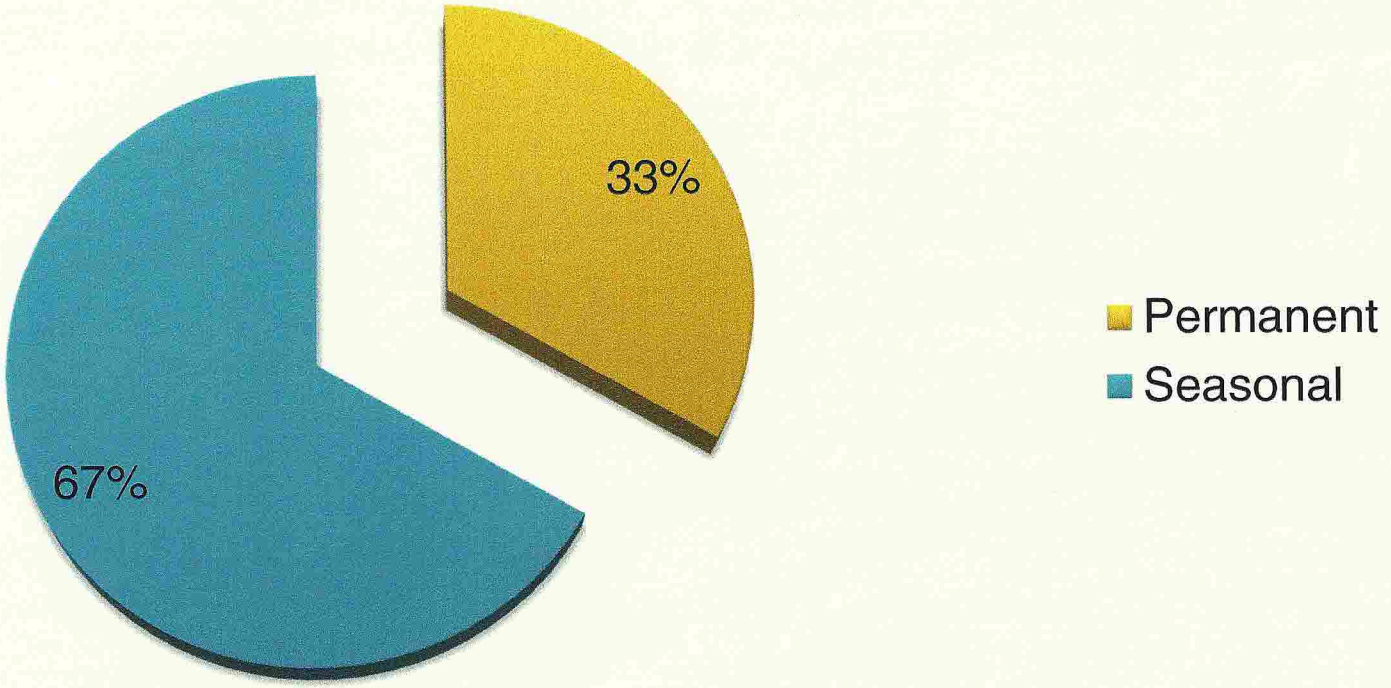
2010 Census:

- 774 people
- 297 Households
- 2.61 people per household



Census Data Source: Department of Administration

Housing Comparison

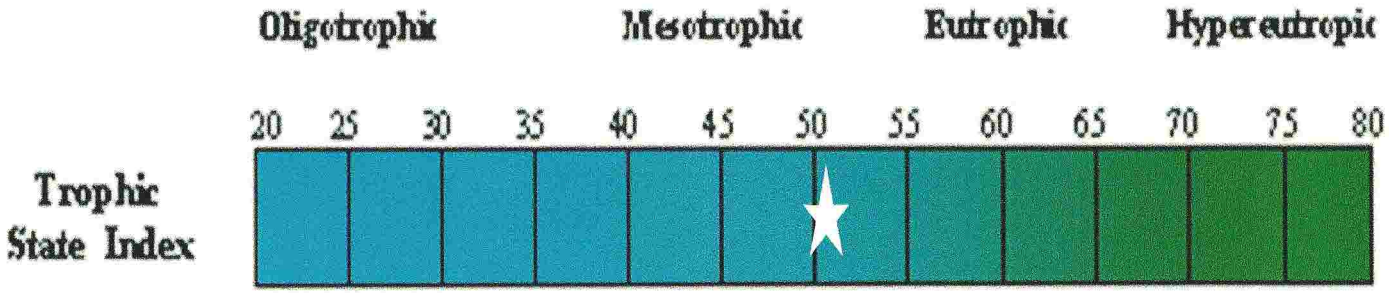


Housing Source: Crow Wing county GIS Mapping

TSI Calculations

- The Trophic Status Index or TSI is a measure of energy in a system
- Higher TSI numbers = greater amounts of available energy
- These numbers also tell us what the trophic status of a lake is such as: eutrophic, mesotrophic, hypereutrophic or oligotrophic

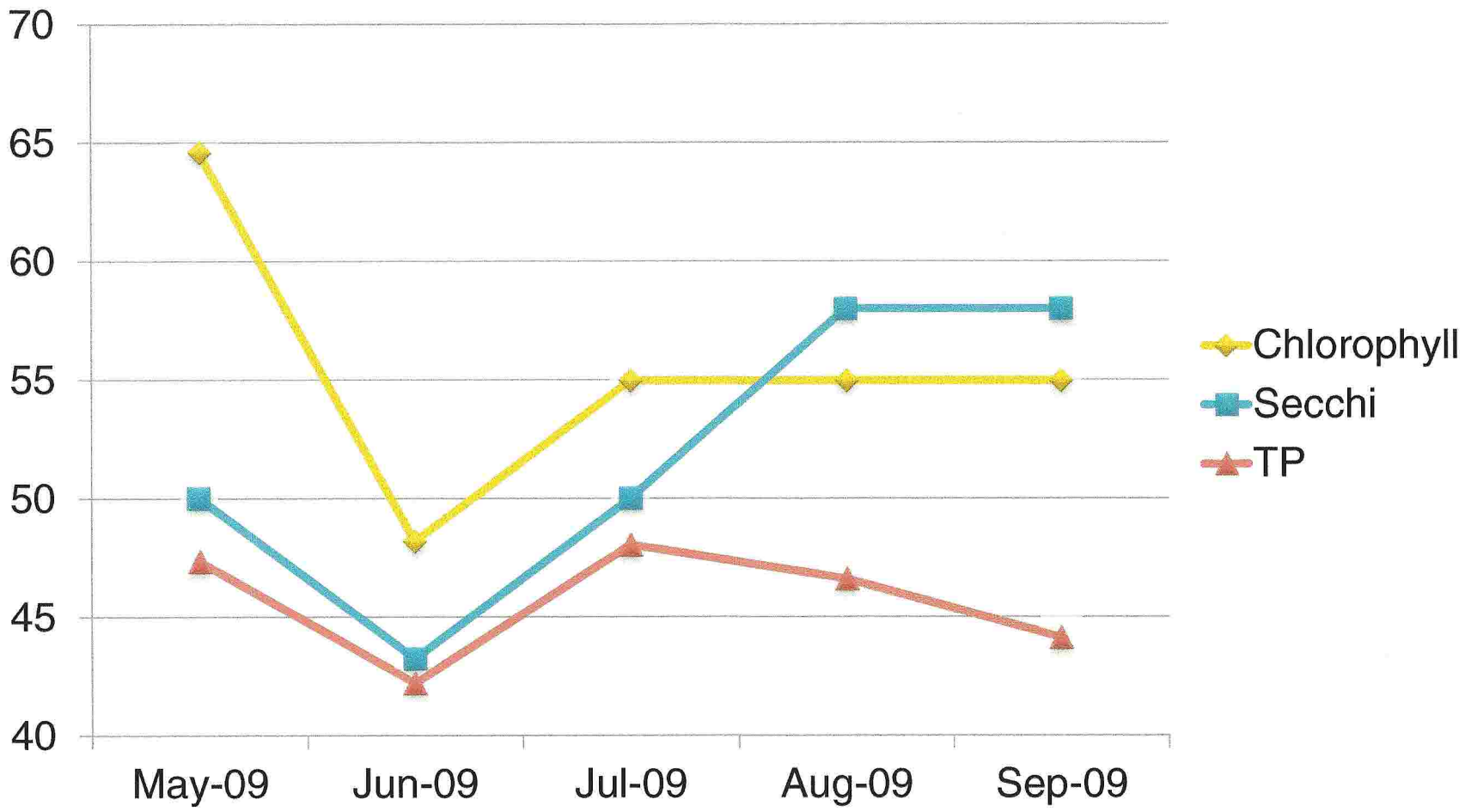
TSI Table Placement



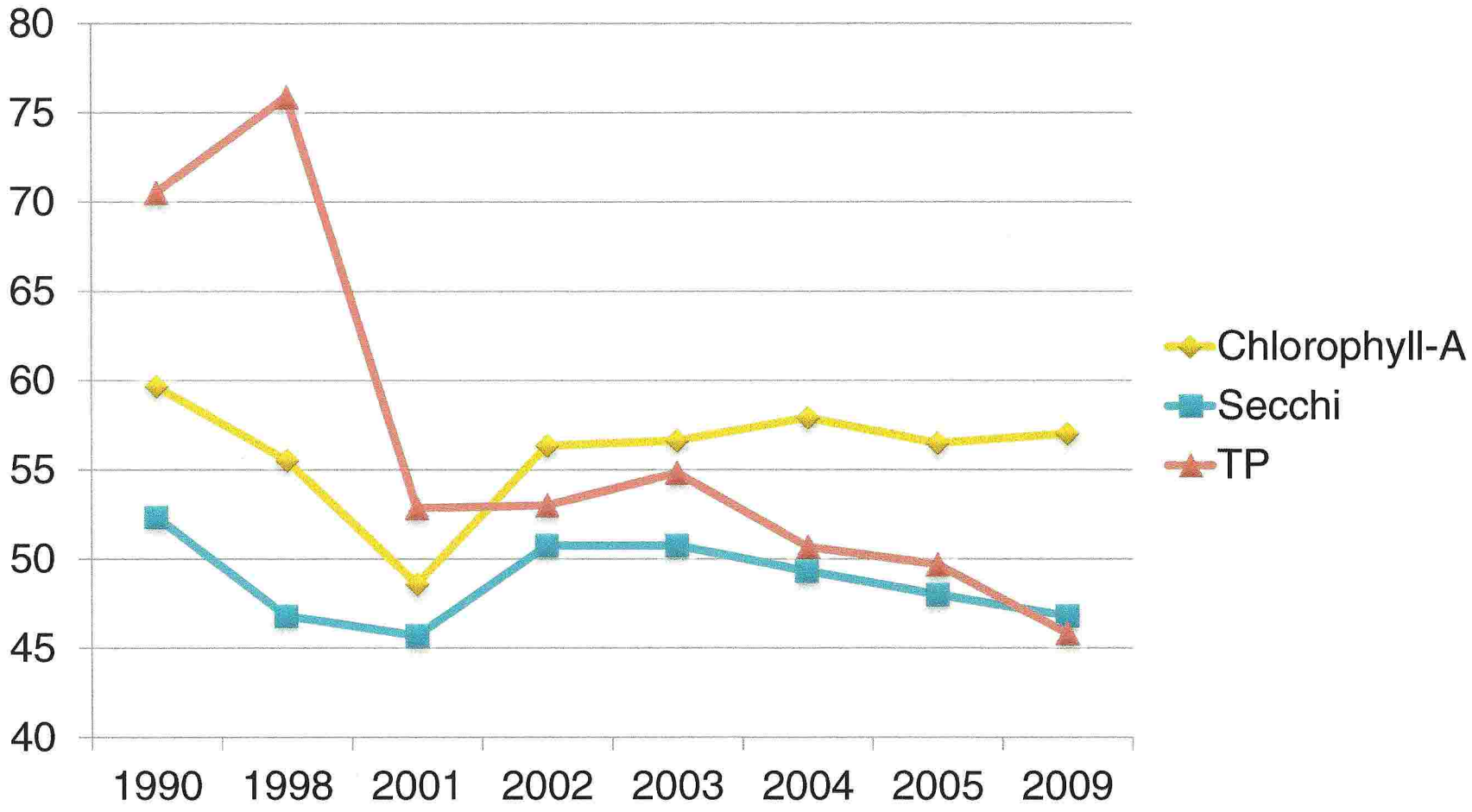
- Upper South Long Lake is midway between mesotrophic and eutrophic

Table Source: http://www.epa.gov/bioiweb1/aquatic/carlson.html

TSI Seasonal Comparison



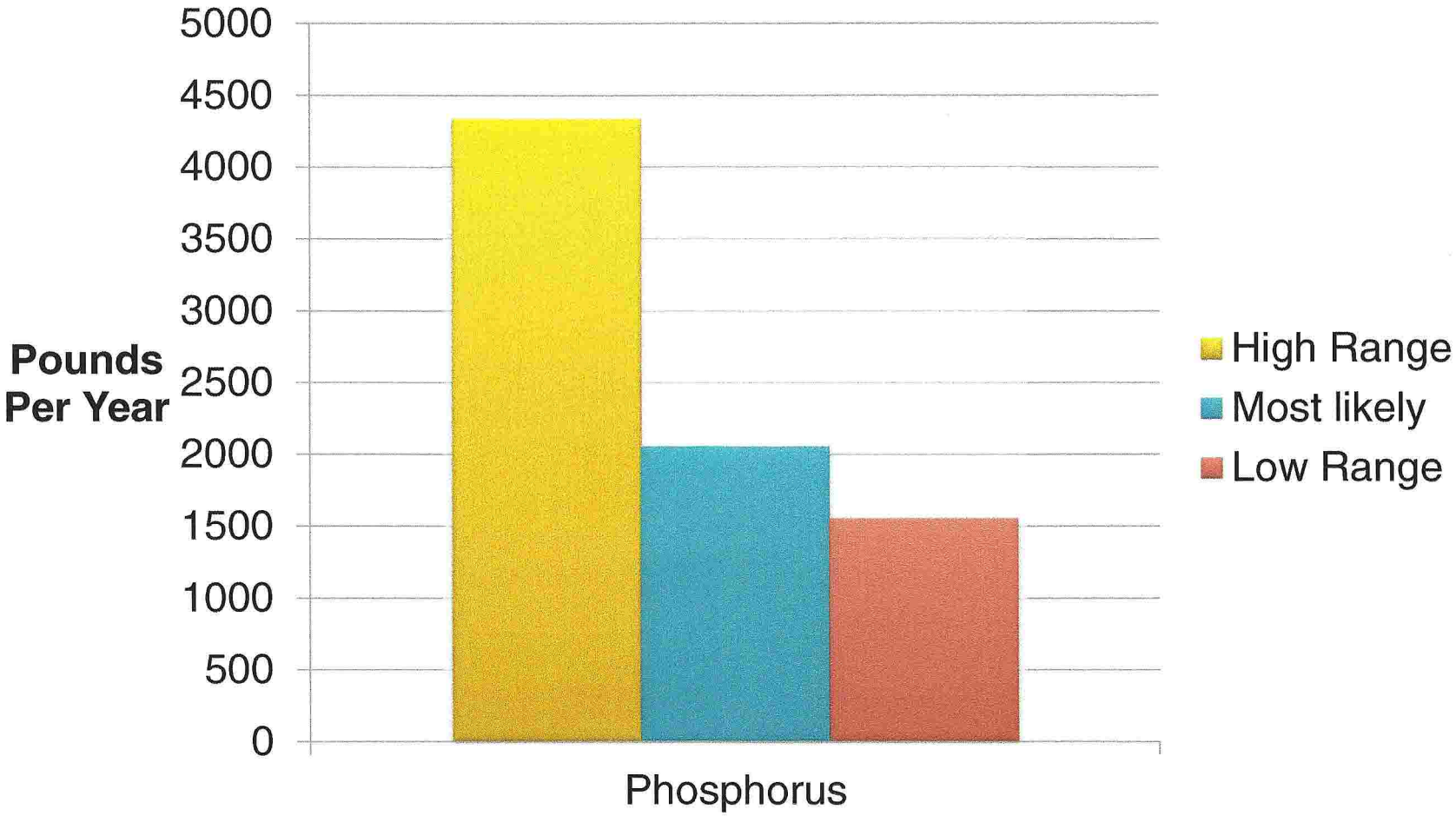
TSI Yearly Comparison



Yearly Inflows of Phosphorus

- Amount of phosphorus inflow is calculated through land cover, phosphorus co-efficient, underlying soils, seasonal vs. residential and people per household
- One pound of phosphorus creates approximately 300-500 pounds of wet algae
- Phosphorus inflows are measured pounds per year

Annual Phosphorus Input from the Watershed



Increased Phosphorus Affects

- Larger and longer algae blooms
- Lowered water clarity
- Thicker weeds
- Lowered dissolved oxygen
- Warmer water temperatures
- Fish die offs

Projections for Phosphorus Inflows

- Projections are calculated on average census growths and future zoning plans
- According to the proposed zoning the area most likely to be developed are the forested areas around the lake and throughout the southern regions of the watershed

Estimated Population Growth for Year 2030

2010

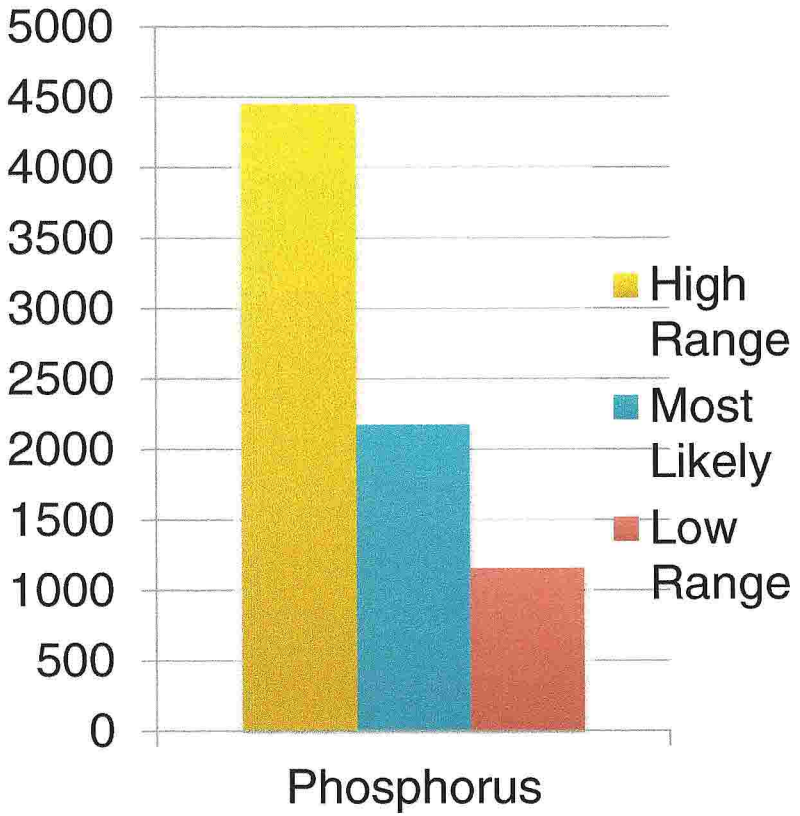
- 774 people
- 297 Households
- 2.61 people per household

2030

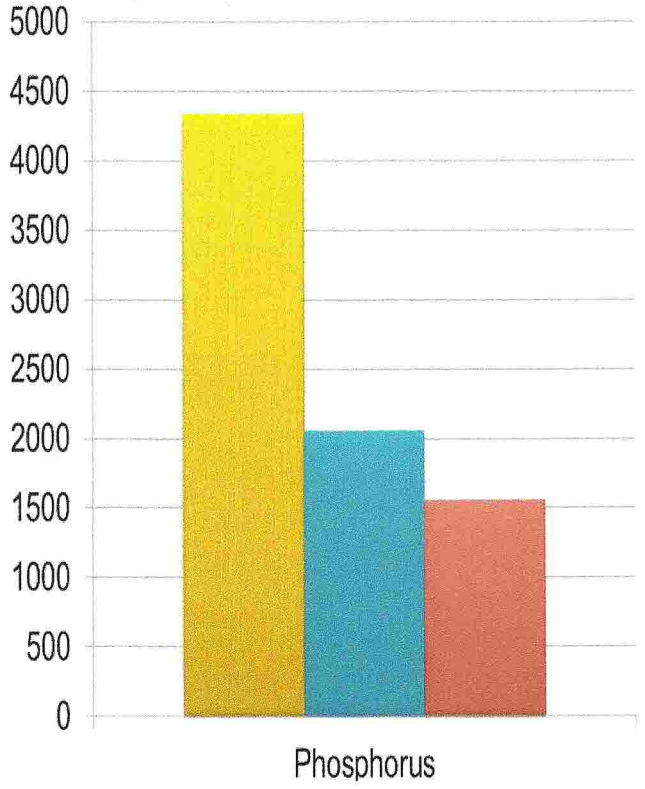
- 1,042 people
- 432 households
- 2.41 people per household
- Approximately 45% increase in households

2030 Projected Phosphorus Inflow

2030

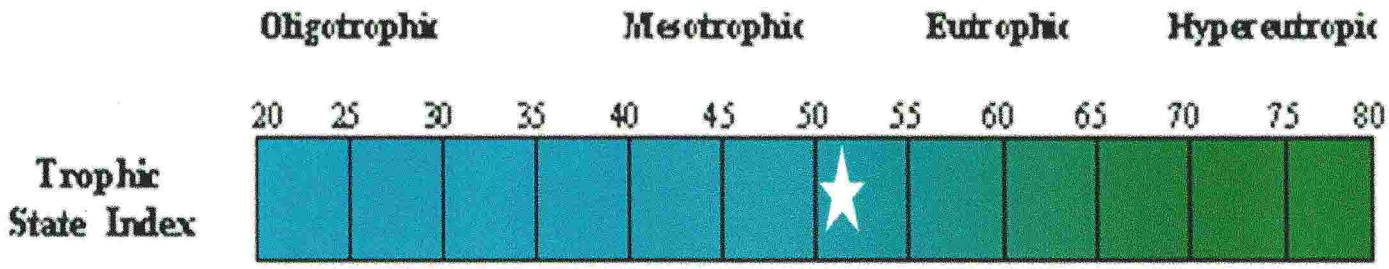


2010



Changes In Phosphorus Loading

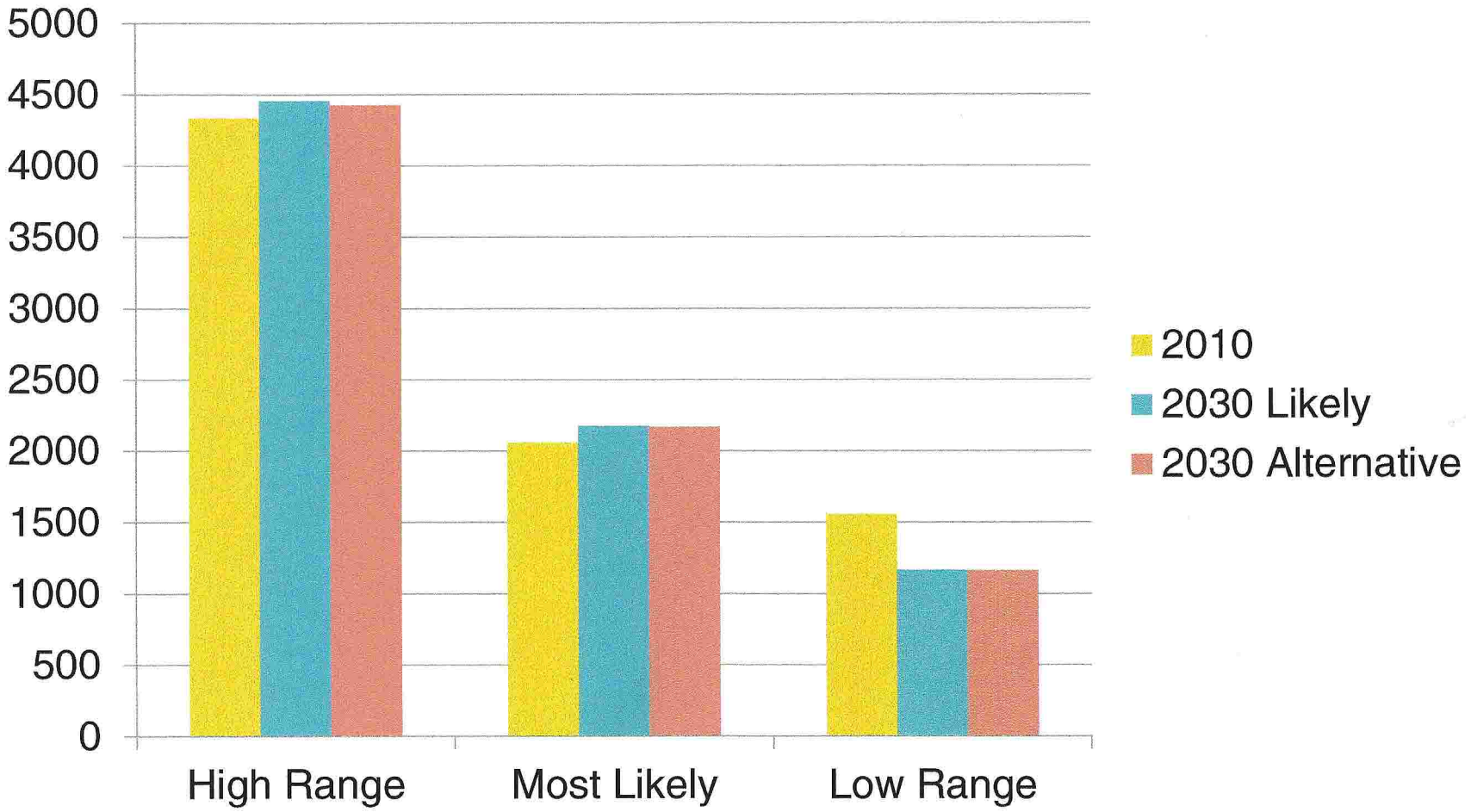
- Increases phosphorus by 118 pounds or 35,298 to 58,830 pounds of wet algae
- Total phosphorus TSI score increase from 51.14 to 51.95 which brings the lake slightly closer towards Eutrophic



Alternatives to Decrease Phosphorus Inflow in the Future

- Change zoning in forested areas back to ten acre minimums and allow rural residential five acre minimum zoning in agriculture areas
- Create conservation easements for the remaining forested areas in the buffer area around the lake

Alternative Comparison



Difference in Phosphorus

- Reduces the most likely phosphorus loading by 10 pounds per year or 3,000 to 5,000 pounds of wet algae
- It would also lower the most likely projected TSI score of 51.95 to 51.88