Land-Use Model

for
Lake Bellaire, Clam Lake, and Torch Lake Watersheds

built by

Limno-Tech, Inc., Ann Arbor, Michigan,
Excellence in Environmental Solutions Since 1975

for

Three Lakes Association

as part of a

2006 M-DEQ Grant

Clean Michigan Initiative

Land-Use Model

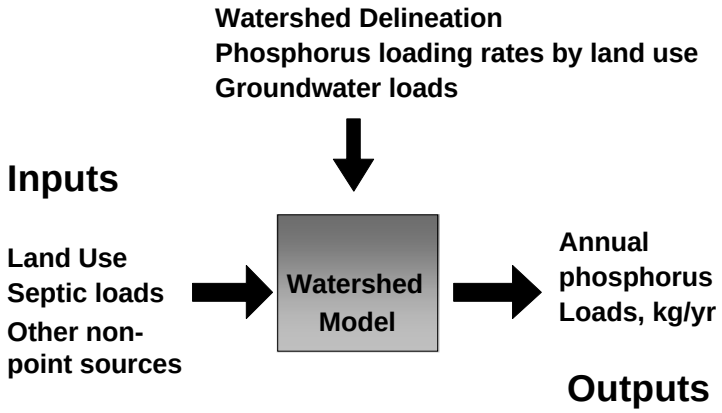
Lake Bellaire, Clam Lake, and Torch Lake Watersheds
January 15, 2007

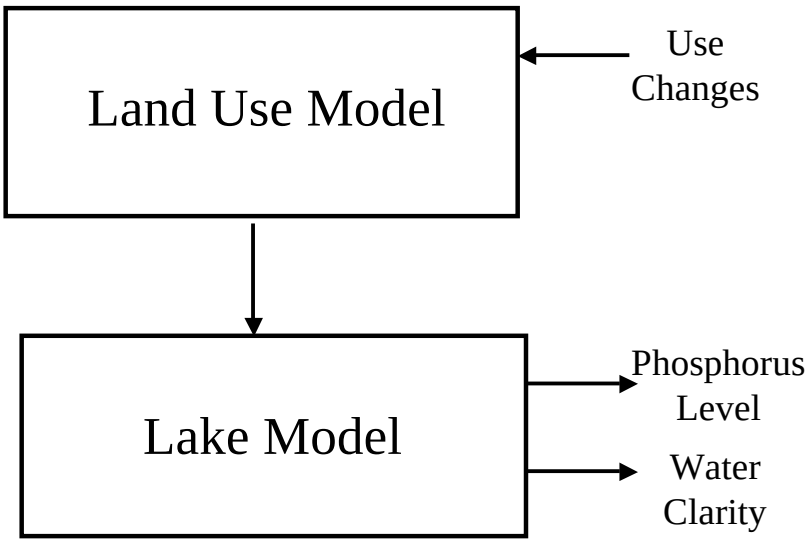
- **Purpose:** To estimate changes in phosphorus loadings based as land uses propose to change…

- **Population** expected to double in the next 25 years

- **Phosphorus loadings**, key input to new water quality models

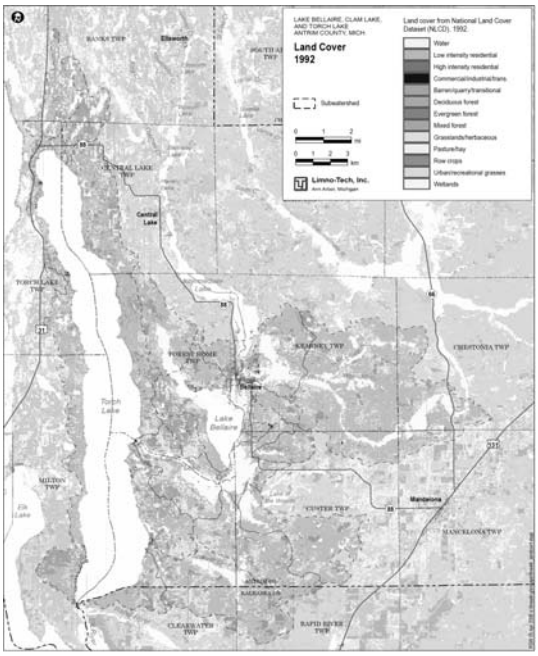
Watershed modeling overview





Study area land cover

Land cover	Percent
Forest	60
Grassland/ herbaceous	17
Wetlands/ water	12
Cropland	11
Developed lands	<0.5
Urban/ recreational grasses	<0.5



Watershed Sizes
(land only)

Lake Bellaire (land area only) 29,471 acres

Clam Lake (land area only) 17,902 acres

Three Lakes (Bellaire, Clam, Torch) 29,184 acres

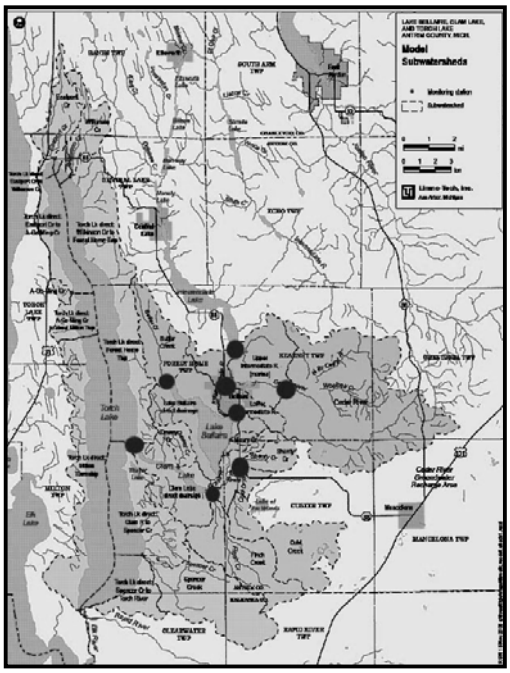
76,557 acres

Elk River Chain of Lakes (500 sq. miles) 330,000 acres

Study areas

and

Sampling locations



Phosphorus Loading Coefficients

Land Use	Phosphorus (kg/acre-yr)
• **High Density Development**	**0.283**
→ **About 5.6 dwellings per acre**	
• **Low Density Development**	**0.223**
→ **One house per acre**	
• **Golf Course**	**0.186**
• **Cropland**	**0.061**
• **Pasture**	**0.053**
• **Forest**	**0.045**

Phosphorus Monitoring Subwatersheds

Lake Bellaire	**Phosphorus Loads, 2006**
• Intermediate River below Intermediate Lake	372 kg P/yr
• Cedar River, at Burrel Road	1,116
• Intermediate River, at Bellaire Highway Bridge	571
• Lower Intermediate River, at entrance to Lake Bellaire	176
• Butler Creek	186
• Maury Creek	32
• Lake Bellaire shoreline (estimated)	426
Total	2,508

Clam Lake	
• Upper Grass River, at Knapp dock	
• Shanty Creek	101
• Cold Creek	497
• Finch Creek	267
• Lower Grass River, at Grass River Nat'l Area dock	160
• Dewey Creek	67
• Clam Lake shoreline (estimated)	282
Total	1,374

Applications of Land-Use Model

Forecast Phosphorus Loadings
25-Year Growth, 2006 to 2031
(population doubling)

Scenario #1: Schuss Mtn-Shanty Creek Area

→ 12 square miles (7,680 acres)

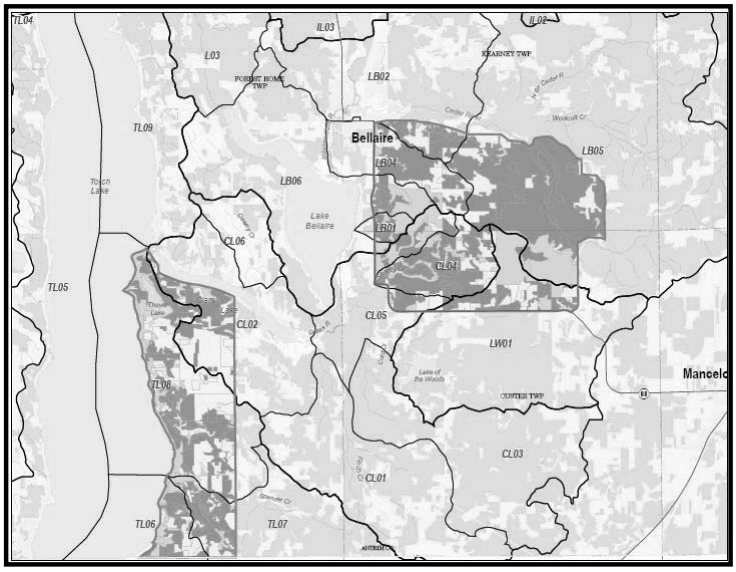
→ 6.5% forest to High Density Housing

→ 6.5% forest to Low Density Housing

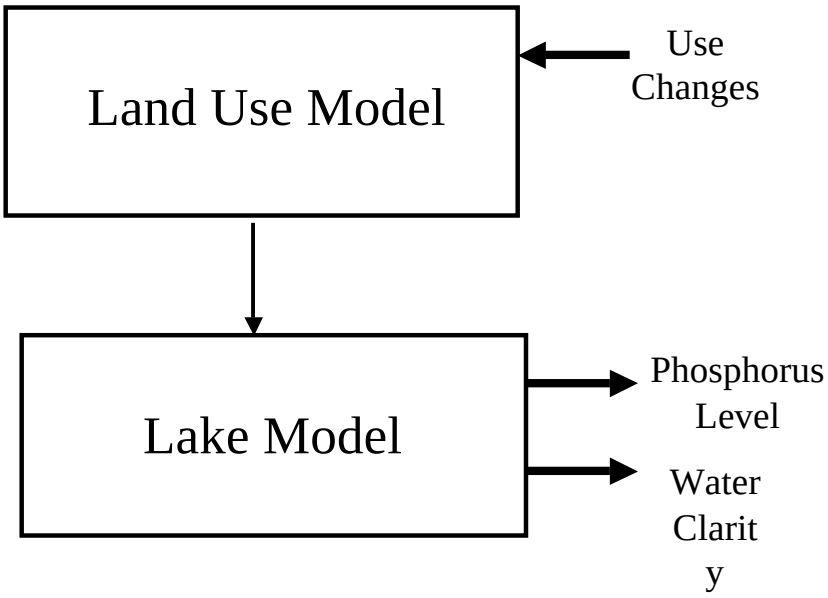
All new dwellings sewered, 80% P removal +298 kg

All new dwellings septic systems: +741 kg

Schuss Mtn. - Shanty Ck. Scenario



Demo of Land Use Model



Best Management Practices (BMP)

Techniques to reduce phosphorus run-off

- **Retention & Detention Basins**
- **Infiltration Trenches**
- **Landscaped Swales**
- **Stormwater & Natural Wetlands**
- **Buffer Strips**

Properly designed and installed BMP can reduce phosphorus loading up to 50%

Local Units of Government
Possible Phosphorus-related Actions

- Master Plans: specific language on water quality
- Require phosphorus estimates in major site plans
- Require septic inspections on sale of property
- Require action on exceeding phosphorus levels
- Establish overlay ordinances, permit requirements
- Establish multi-jurisdictional districts, P.A. 264

Local Units of Government (continued)
Possible Phosphorus-related Actions

- Inventory township's property, BMP needs

  (BMP = Best Management Practices to reduce phosphorus run off)

  → Re-enforce bridge abutment erosion

  → Detention of run off from parks

  → Stream shoreline erosion controls

- Other actions to reduce phosphorus

  → Restrict phosphorus in lawn and agricultural fertilizers

  → Restrict use of phosphorus dish detergents

  → Restrict septage use on farmland