3.2 Urban Projection
Two methods were used to determine the amount of land that was expected to transition to urban over the ten-year period. The first method used historical land cover data. Specifically, the urban transformation number between 1990 and 1999 was calculated using these land cover maps from these two points in time. Future transition numbers were determined by assuming the same number of cells will transition to urban in the next such time interval. More specifically, the number of urban transition based on our 1990 and 1999 land cover maps is 5692 cells, a 13.05% increase from that of 1990. However, by subtracting those cells located in the exclusionary layer, the final estimated transition number for 1990-99 was 4384. Figure 8 shows the real urban change from 1990 to 1999 in red.

The second method to identify transition extent (see User Guide [11]) was calculating the principle index driver (PID) based on the population growth over a time interval for a region. \[ U(t) = \frac{dP}{dt} \times A(t) \]
where \( U \) is the amount of new urban land required in the time interval \( t \), \( P \) is the number of new people in any given area in a given time interval and \( A \) is the per capita requirements for urban land. Unfortunately, this method is most effective with land use change and other data based on municipal boundaries, since the population census is also based on municipal boundaries with different levels (block, track, parcel). For our study area, we were only able to calculate the normalized numbers (e.g. density, percentage) by assuming an even distribution of population within each block. For instance, from 1990 to 2000, the population growth over the...
4. Model Evaluation

The modeled urban projection for 1999 based on 1990’s land cover was overlaid with observed changes in from 1990 and 1999 based on the two-year’s land cover maps. Then, a layer was created with accuracy test information. In this layer, each cell has value ranging from 0 to 3. A designation of “0” means no predicted change and no observed change; “1” means no predicted change but there is observed change; “2” means no observed change but there is predicted change; “3” means predicted change and observed change. In our study area, for the 4500 projected transformed cells, 1552 cells were projected correctly, which gives us a 34.5 % accuracy. Given the history of use of the LTM model, this level of accuracy is considered typical. Accuracies exceeding 45-50 % are considered very unusual and perhaps due to over-fitting (to local circumstances) of the model. However, more detail on local cells, processes, and constraints, would likely improve classifications. Of course, coarser or finer breakdowns of results (groups of cells) might show higher or lower accuracy.

Among the 10-predictor variables, distance to lake, distance to municipal boundary, and distances to highway were the most instructive variables. Distance to lowland was also considered an instructive variable. Distance to stream and aspect were among the least ineffective variables.

Figure 9 shows the predicted future land transformation from non-urban to urban for years 2010 and 2020. Transformed land is concentrated around areas of existing population and development.

A more detailed look at the LTM results should provide useful information relating to future development patterns near the Lake Country Scenic Byway.
Figure 10. West landscape type which includes Detroit Lakes
Western landscapes

- Agrarian plains and communities of the Red River Valley
- Continental divide
- Scattered hardwoods and expansive open space
- Rolling hills and undeveloped terrain
- Smoky Hill State Forest
- Tamarac National Wildlife Refuge (best birding watching in the country)
Figure 11. South landscape type which includes Park Rapids
Southern landscapes

- Transition from open plain to pine forests
- Distinct small town charm
- Quiet, dispersed development and small logging/farming operations
- Interconnected lakes and streams
Land Transformation Model - north
Northern landscapes

• Most unique landscapes
• Itasca State Park preserves the original vegetation
• Headwaters of the Mississippi River
• High percentage of publicly-owned land
Figure 13. East landscape includes the southwest Chippewa National Forest, the City of Walker and Leech Lake
Eastern landscapes

- Small communities have long, loving connection to the water and wood
- Extensive pine forests of the Chippewa National Forest and the Paul Bunyan State Forest
- Some of the largest waters in the state (Leech Lake)
- Strong yet diverse culture