

Long-Range Spatial Load Forecasting



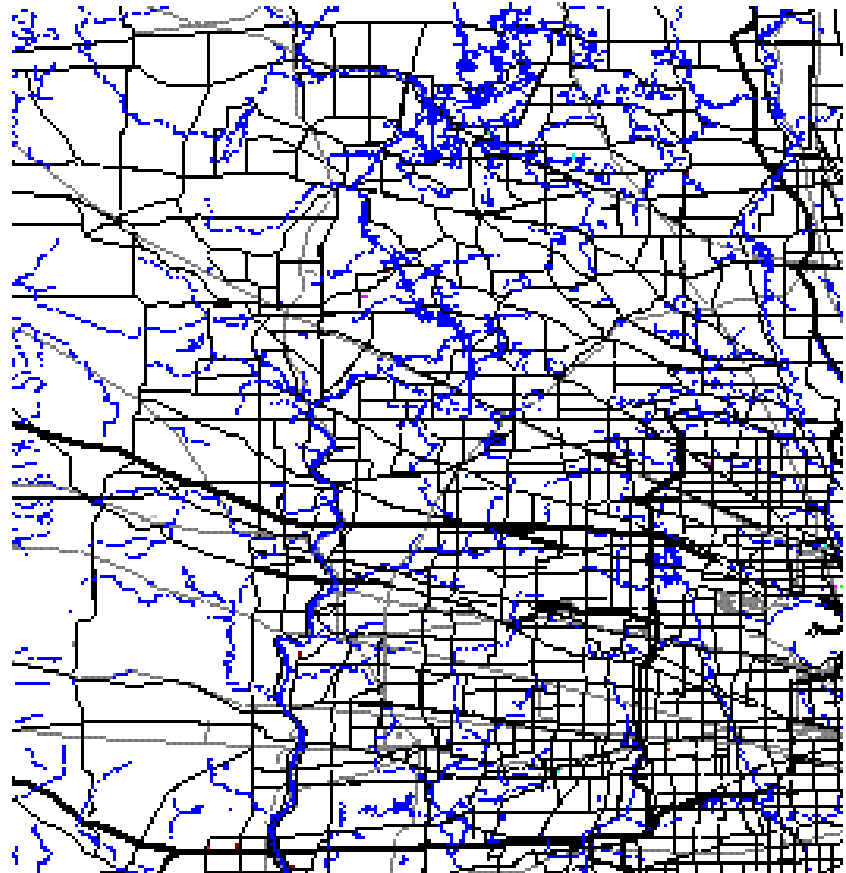
Spatial Forecasting

- Locational forecasts of load growth by assigning load to available land.
- Determines spatial characteristics of long range load growth.
- Most accurate applied to undeveloped land.
- Overall forecast tied to corporate econometric energy / demand forecast.

Infrastructure

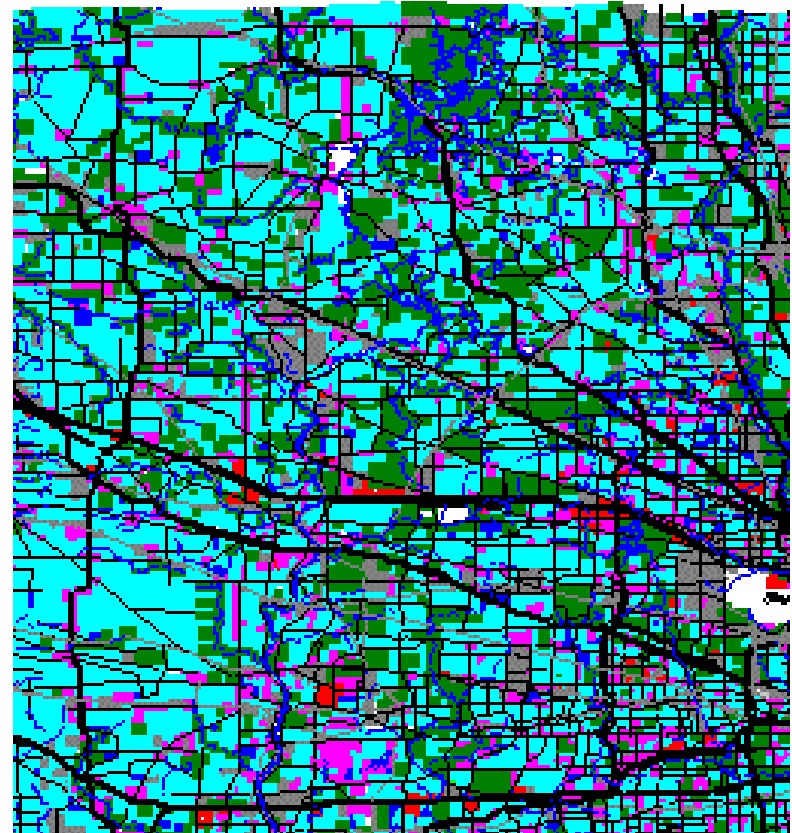
- Interstates / highways
 - Major Roadways
 - Railroads
 - Waterways
-
- Longitude / latitude coordinate based

Can be imported from GIS databases, or from commercially-available databases



Land Use Definition

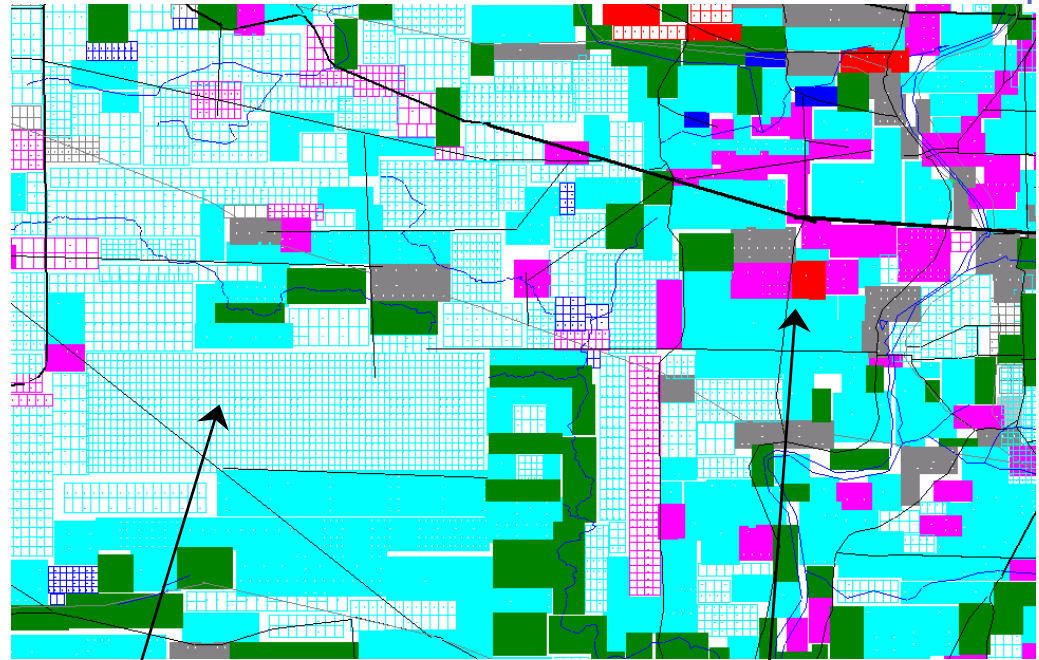
- Three main classes:
 - Residential
 - Commercial
 - Industrial
- Other classes also available
- Can be based on:
 - Land-use databases
 - Satellite Imagery
 - Planner's knowledge and maps



Land Use Definition Detail

Existing development is designated according to land use type.

Undeveloped areas are designated according to zoning / development plans.



Future Development
(Outline Only)

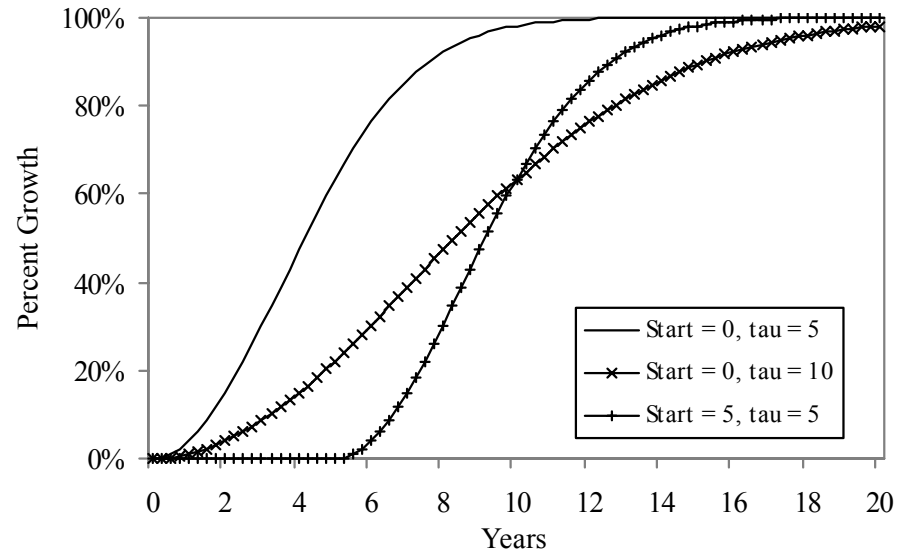
Existing Development
(Solid)

Spatial Forecasting

- Precedence of load growth in available areas determined by proximity to:
 - Infrastructure
 - Interstates / Highways
 - Major Roadways
 - Railroads
 - Waterways
 - Surrounding Development
 - Residential
 - Commercial
 - Industrial

Growth of Small Areas

- Governed by S-curve characteristics
- In each year, growth of small areas constrained by overall growth in the study area



$$L(t) = 0 \quad \text{for } t < t_0$$

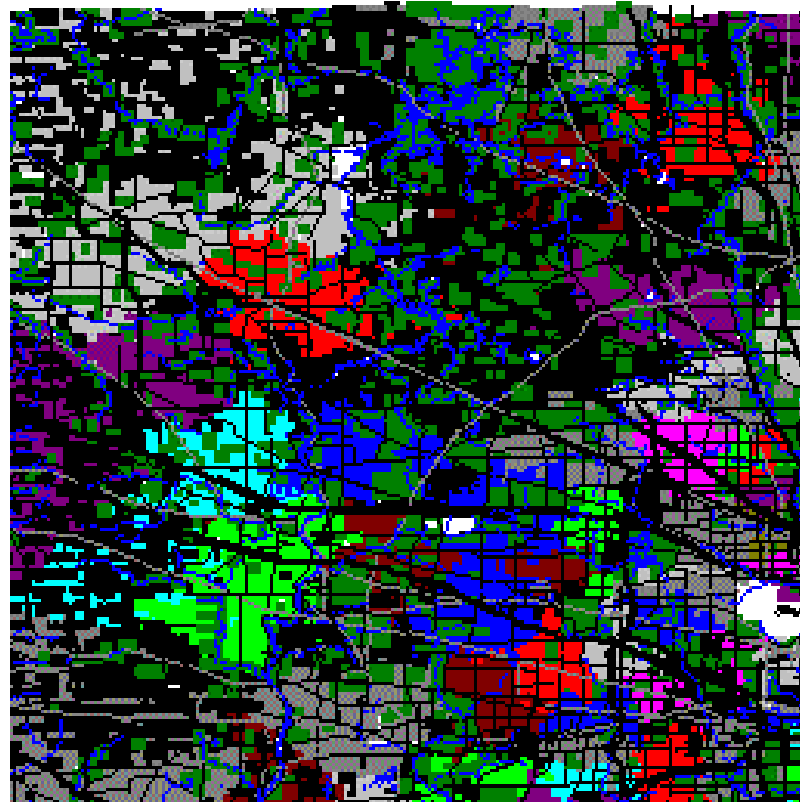
$$L(t) = L_{\max} \left(1 - e^{-\left(\frac{t-t_0}{\tau}\right)^2} \right) \quad \text{for } t > t_0$$

Spatial Forecast Calibration

- The spatial forecast is calibrated to known weather-adjusted load levels in Year 0 using:
 - Substation Area Definition
 - Areas served by each substation defined
 - Load areas calibrated to non-coincident peak load
 - TLM (Transformer Load Management) Data
 - Optional
 - 0.5 x 0.5 mile areas, for example
 - Load areas calibrated to peak load in each area

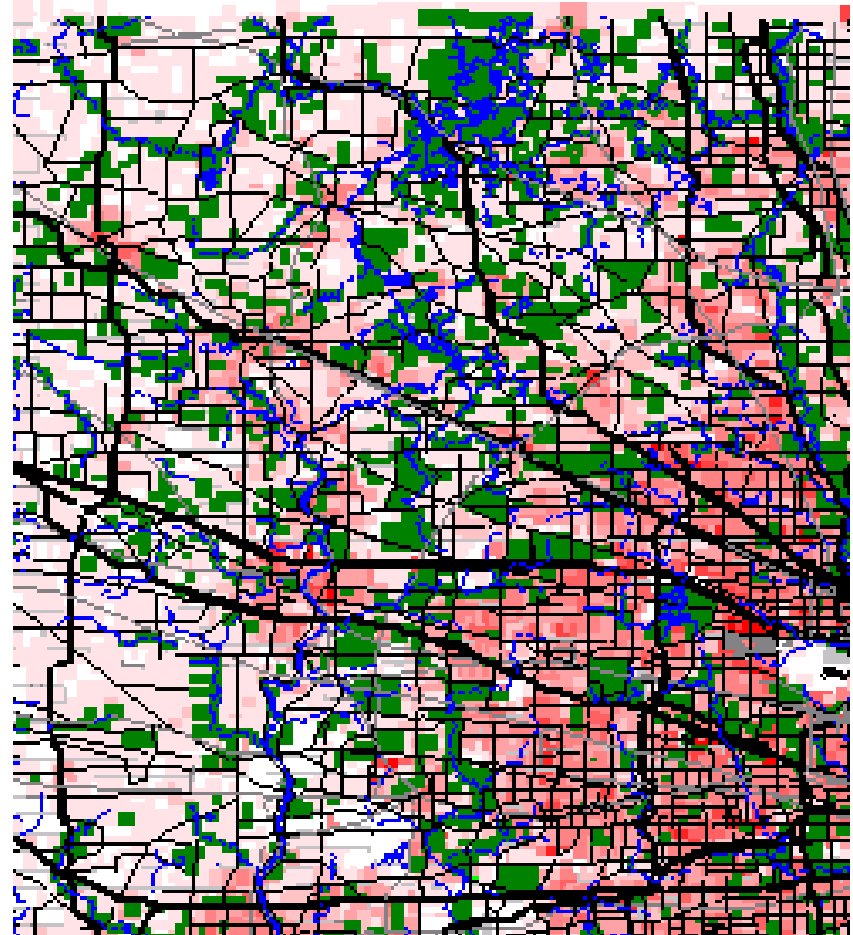
Substation Area Definition

- Substation service areas defined based on “predominant” station serving each TLM area.



TLM Load Density

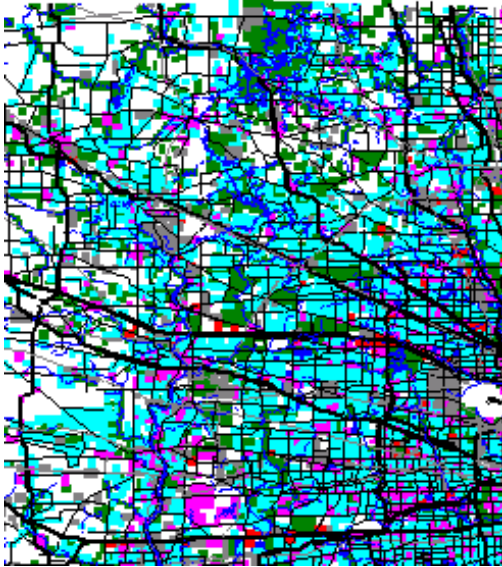
- TLM load density by quarter square mile areas, for example
- TLM data allows density calibration to experienced load level



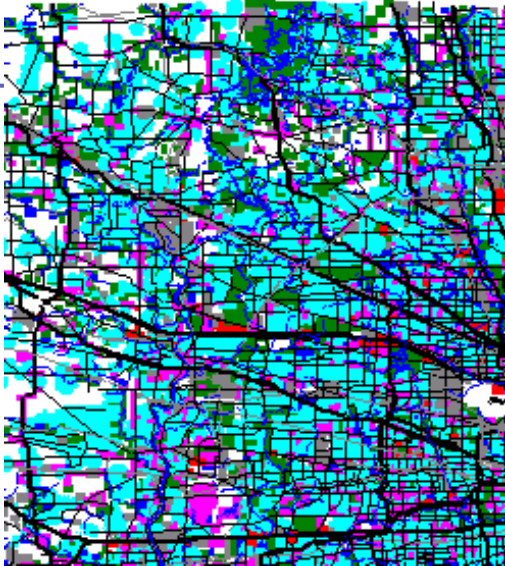
Forecast Results

Forecast provides a yearly, “stepped” evaluation of the spatial load growth.

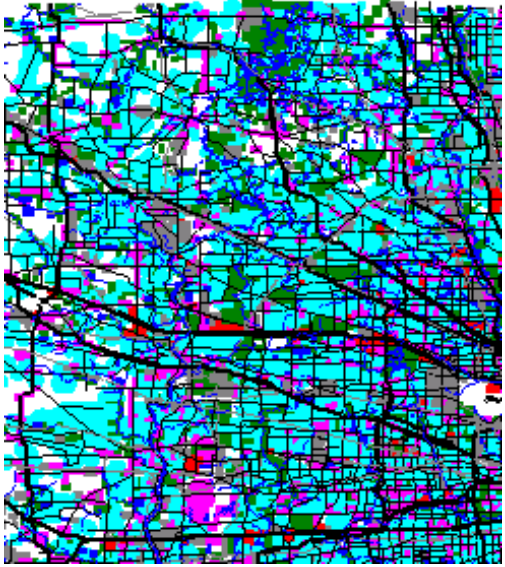
Year 0



Year 10



Year 20



Spatial Forecast Results

- Forecast results show spatial distribution and magnitude of load growth.
- Results available in visual (map display) format and tabular format
- Results can be “rolled up” by:
 - Substation
 - District
 - Land Use Classification

Spatial Forecast Caveats

- Most accurate when substantial vacant land is available for development. (Relatively inaccurate in redevelopment areas, e.g., CBDs, gentrification areas.)
- Best applied to determine long range trends. (Initial growth rates from short-term substation load forecasts.)
- Load growth allocations based on overall econometric forecast.

Spatial Forecast Accuracy

- A four year old forecast was recently reviewed for accuracy and found to provide accuracy within 4% for multiple (6-8) substation areas.
- The the review considered:
 - Major load transfers
 - Differences in forecast/actual weather conditions
 - Deviations in large spot loads
- Multiple substation areas were used since there was significant discretion in new load substation connections

Spatial Forecast Accuracy

- The four year old forecast review also considered deviation between the econometric system-wide load growth forecast and the actual system-wide load growth over the prior four years.
- Accounting for these differences showed the forecast was:
 - 2.5% accurate in all but two of the multiple substation areas
 - 5% accurate on a per substation basis for approximately 85% of the substations.