

# *Spatial Load Forecasting*

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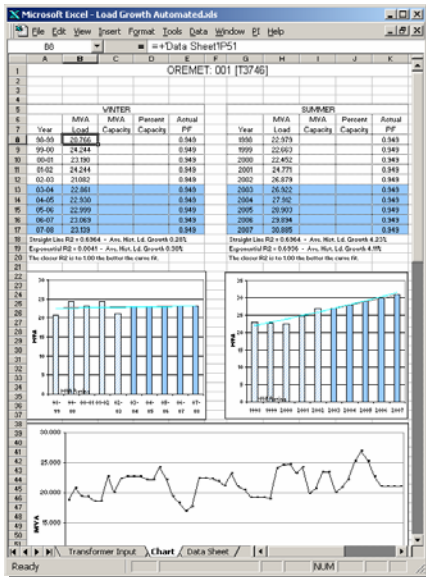
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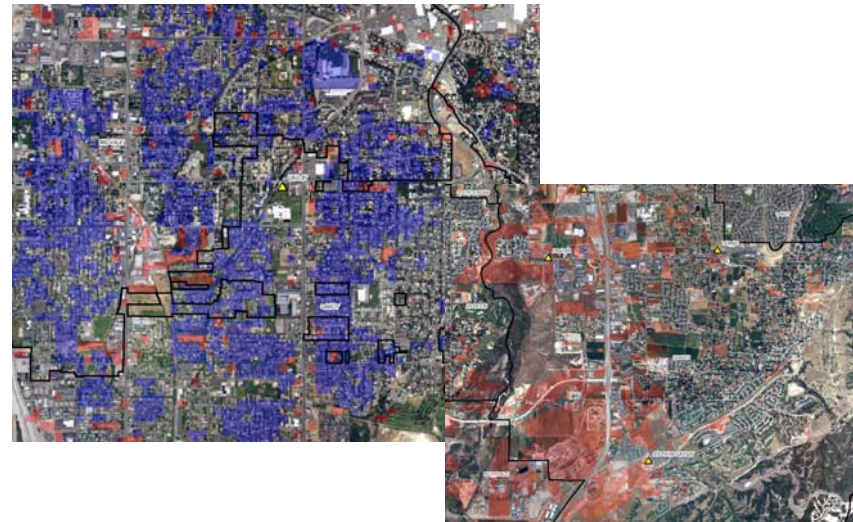
# Load Forecasting

## Before: How Much?



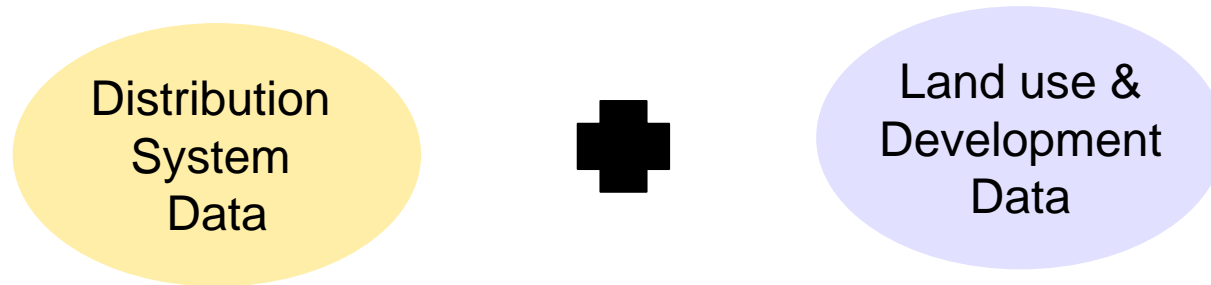
- Trend-analysis based projections
- Planning horizon limited
- Reactive planning, putting out fires

## Now: Where?



- Geographic answers to: Where, When, How much?
- Extends the planning horizon 20 years
- Identifies changing end-use patterns and load centers
- Defendable and cost-effective CAPEX

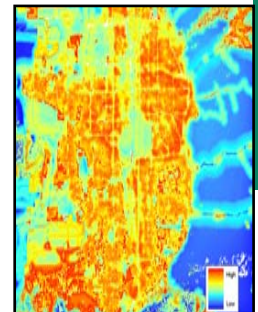
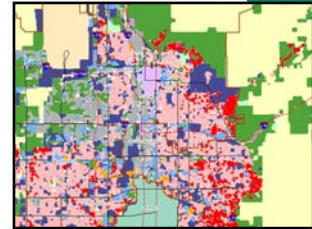
# What Is Spatial Load Forecasting?



- ◆ Forecasts the extent, location, and timeline community development
- ◆ Translates land use into system load
- ◆ Identify where infrastructure investments should be directed
- ◆ Explore the impacts of new initiatives or localized development events
- ◆ Demonstrate the effects of changes in fully developed areas
- ◆ Predict general locale of new substations
- ◆ Challenge the assumptions of planning engineers

# Methodology – *Building a Land use Forecast*

1. Identify load classes - land use represented by typical energy consumption profile
  - Commercial, Industrial, Residential, Low density residential....
2. Build the land use model in GIS - identify current land use, vacant or undevelopable land, zoning, get existing master plans integrated into GIS
3. Use standard principles of growth planning (nearness to roads, hwy, water) and existing development plans to create Suitability Maps
  - Suitability is generated for each class indicating the desirability of land for the development of each class
4. The regional growth is allocated to vacant cells for the forecast
  - Based on current land use, growth rates, growth factors, suitability maps



# Methodology – *Selection of Load Classes*



① Medium Density Residential with central AC (RMAC) – Single family homes

② Medium Density Residential with Evaporative Coolers (RMEV) – Single family



③ Low Density Residential (RL) – Rural housing, large lot subdivisions

④ Residential High Density (RH) – Apartments, Condominiums, Multi-Family



⑤ Commercial Retail (CR) – Strip Malls, Stores, Restaurants, Retail Shopping

⑥ Commercial O&I (COI) – Schools, Churches, Municipality buildings, Office parks



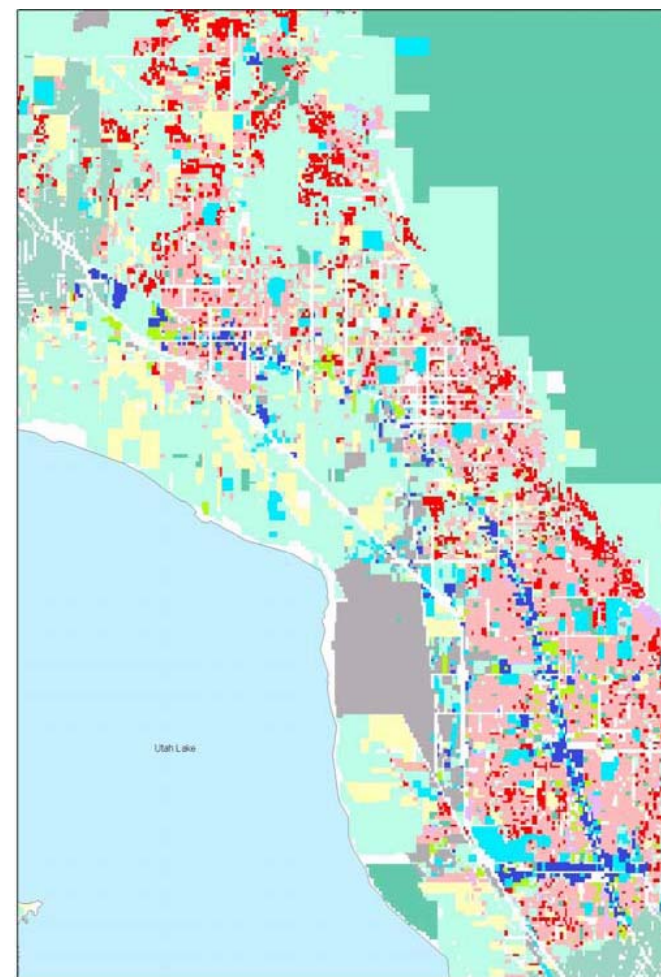
⑦ Light Industrial (LI) – Warehouses, Light-Medium Processes, distribution voltage

⑧ Commercial Business District (CBD) – Salt Lake City Center, large commercial



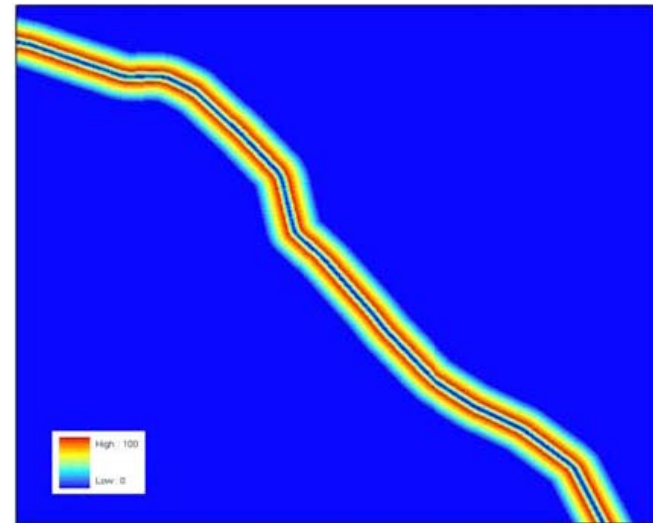
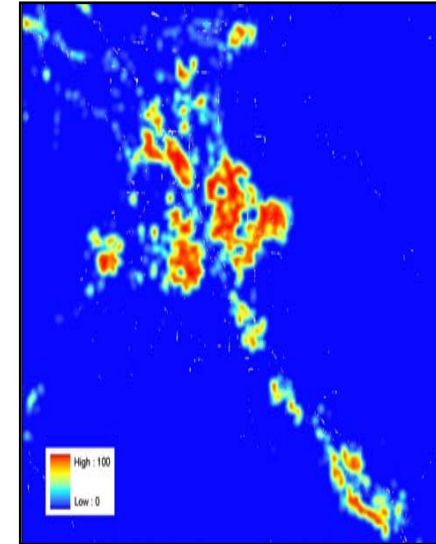
# Building the Land Use Model

- ◆ Reproducing current land use
  - Representing the current/future development environment
- ◆ Identification vacant lands
  - Future vacant lands
- ◆ Non-Developable lands
  - Publicly owned
  - Lake and Reservoirs
  - Slope > 30%
- ◆ Land use affecting forecast
  - Landfills, National Parks, oil fields



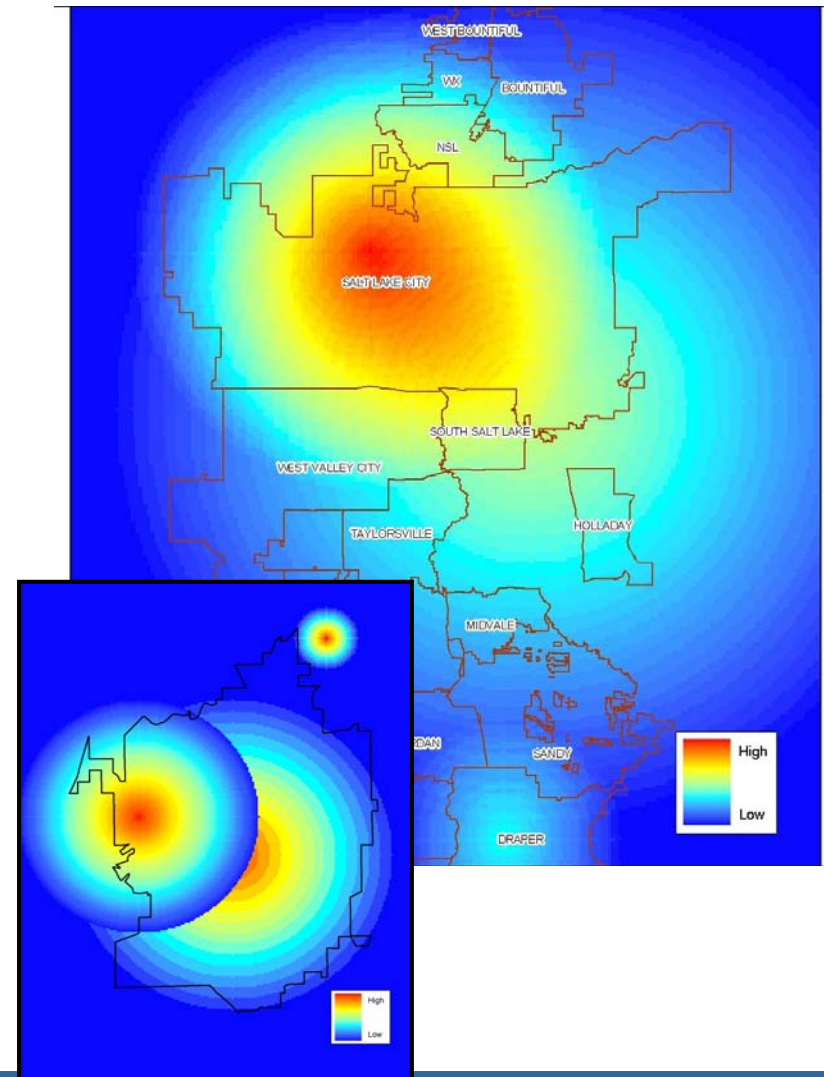
# Factors & Factor Maps

1. Nearness to Highway
2. Nearness to Streets and Major Roads
3. Nearness to Railroads
4. Nearness to Water
5. Nearness to Residential, Commercial, and Industrial lands
6. Nearness to Mountains



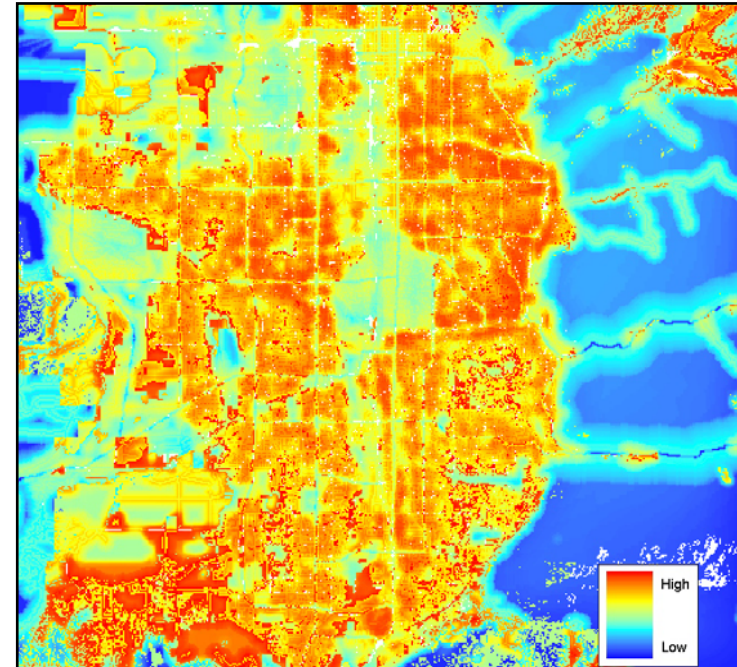
# Urban Poles & Urban Pole Maps

- ◆ Represent the attraction that land use has toward a geographic location.
- ◆ Simulates the importance of an economic, cultural or demographic center
- ◆ Can be used for known planned unit developments or business parks



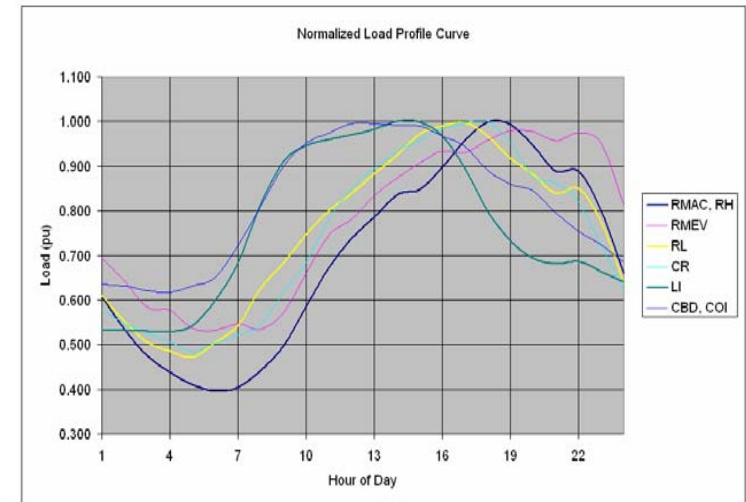
# Preferences & Suitability Maps

- ◆ Factors and urban poles mathematically combined to develop suitability maps for each of the load classes
- ◆ Model uses the highest ranked locations on the suitability maps to assign new growth to that particular area.



# Methodology – *Building a Load Model*

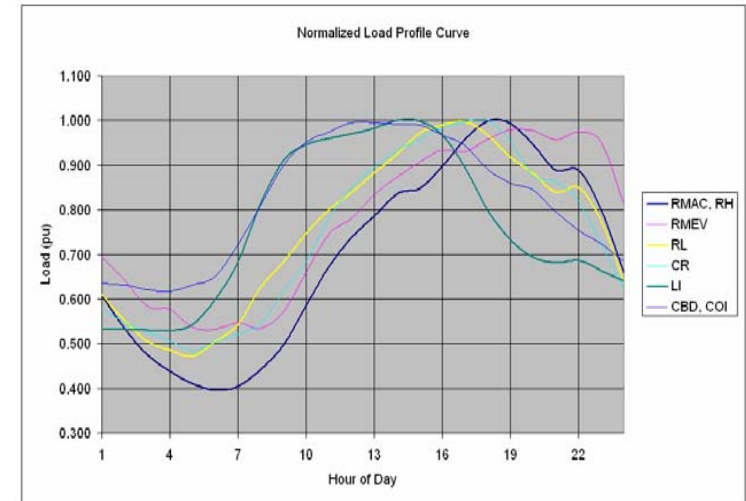
- ◆ Load curves represent the average daily pattern and usage of energy.
- ◆ Load curves are based on the electrical usage of a single land use class.
- ◆ These are used to convert land use or load class to kW/acre
- ◆ **SCADA data and load loggers are used to generate load curve data and to calibrate the calculated load model**





# Methodology – *Calibrating a Load Model*

- ◆ Derived load is calibrated against current actual load first on the system as a whole and then on substation service areas.
- ◆ Reviews are made of land use classes within substation service areas.
- ◆ Spatial adjustments are made to finish calibration of the load model.

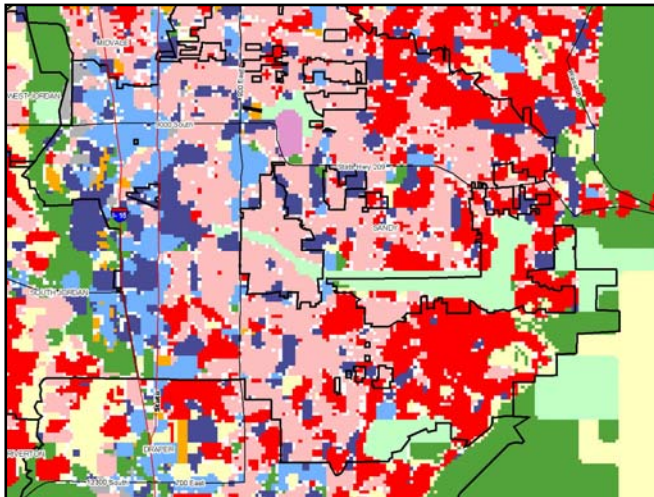


**Final load curves are applied to the forecasted land use acreages to generate a load growth model for each study year.**

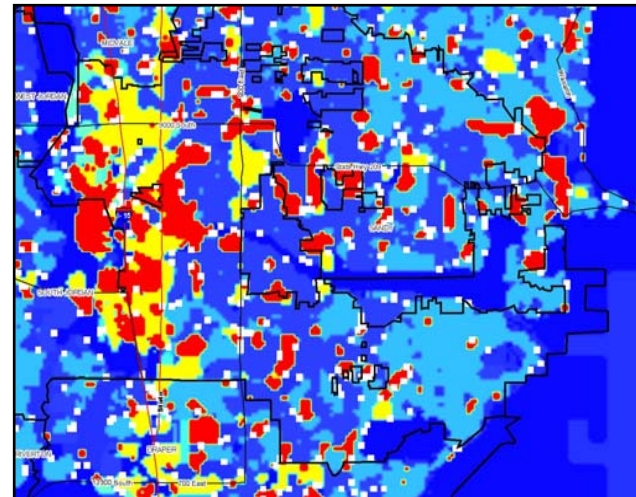
# Generating Substation Forecasts

- ◆ Model generates predicted development
- ◆ New growth converted to MW additions
- ◆ Infrastructure required to meet load demands are predicted

Land use



Land use represented as load

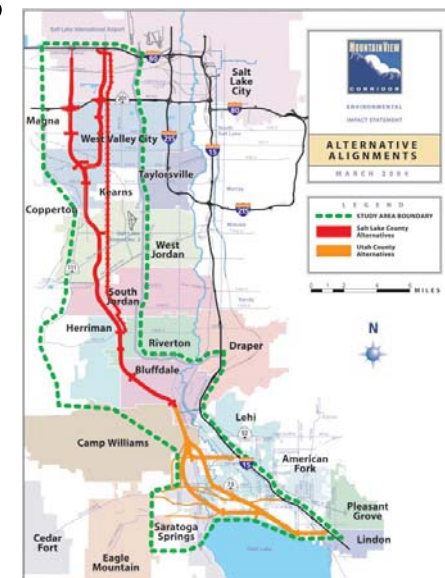
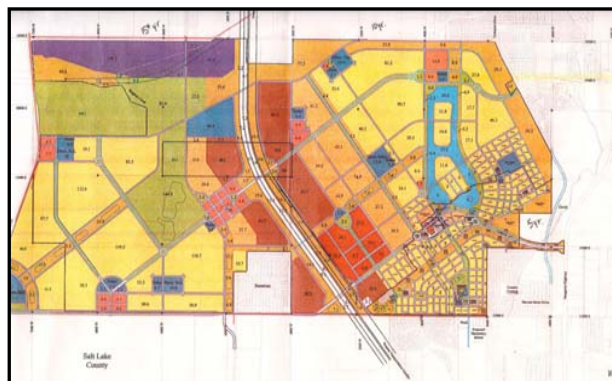


# Growth Rates

- ◆ Two types:
  - New Customers – New Connects
  - Consumption Growth Rate
  
- ◆ S-Curve

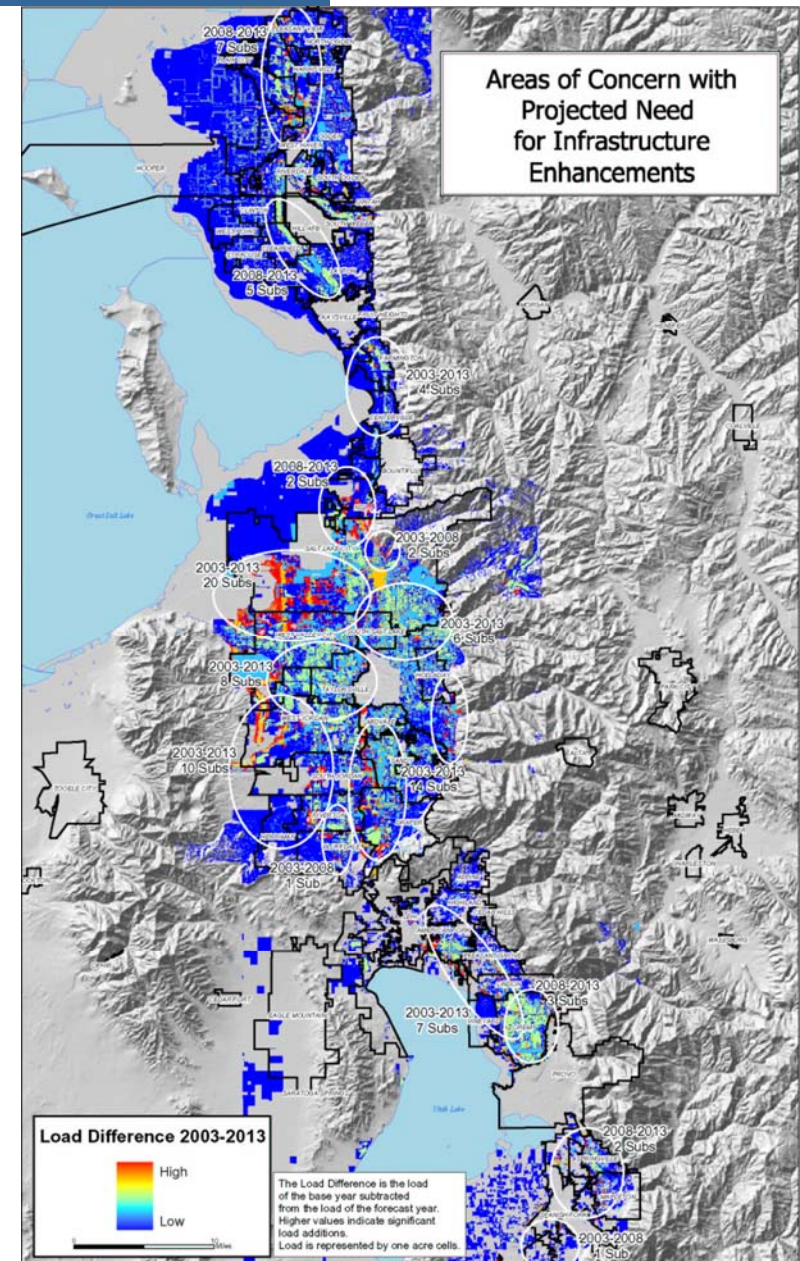
# Changing End Use Patterns & Scenarios

- ◆ Changing End Use Patterns
  - Winter to Summer Peaking
  - Conversion to AC units and Gas Furnaces
  - Created actual simulation of gradual conversion over time
- ◆ Major Land Owner Development Plans
- ◆ Department of Transportation Plans



# Example Results of a Forecast

- ◆ Zone 20 Has The Greatest Infrastructure Requirement 300 – 330 MVA Over The Next 10 Years (1080 – 1140 MVA Over 20 Years)
- ◆ Expected Load Growth Is 5.0% Over The Next 10 Years And 4.4% Over A 20 Year Horizon
- ◆ 2018 Minimum Load Exceeds 2003 Summer Peak



# Why Use It?.....Benefits

- ◆ Predict large load additions in advance
- ◆ Help focus infrastructure additions including where and when
- ◆ Improve Real Estate's negotiations and lead time
- ◆ Visualization of load relative to current infrastructure
- ◆ Prioritization of projects
- ◆ Improved customer relations



## Work Group - Questions

- ◆ Workgroup with ESRI and participating utilities
- ◆ Questions?????