

Using GIS to Model the Impact of Open Space on the Location of Residential Development and Property Values

Richard Ready
Penn State University

Research Questions

- Are houses surrounded by open space worth more than houses surrounded by other land uses?
 - What are the most desirable and undesirable land uses?
 - How far do the impacts extend?
- If yes, could this help explain "leapfrog" development?
 - Do new developments tend to occur in areas with highest expected property values?
 - Do new developments tend to occur in areas with more open space?

Property Value Model

Approach

- Statistical regression between house price and surrounding land use, controlling for other factors

Data Needs

- Sales price, location and structural characteristics of residential properties
- Land use map
- Location of other factors affecting property values
 - Local disamenities
 - Commuting Distances
 - School District, Zoning, etc.

Residential Location Model

Approach

- Compare properties that did subdivide to properties that did not, to identify factors increasing probability of development

Data Needs

- Location and characteristics of parcels that subdivided
- Location and characteristics of parcels that did not subdivide
- Spatial location of all other factors affecting potential property values
 - Surrounding land use, after development
 - Proximity to local disamenities
 - All other factors included in property value model

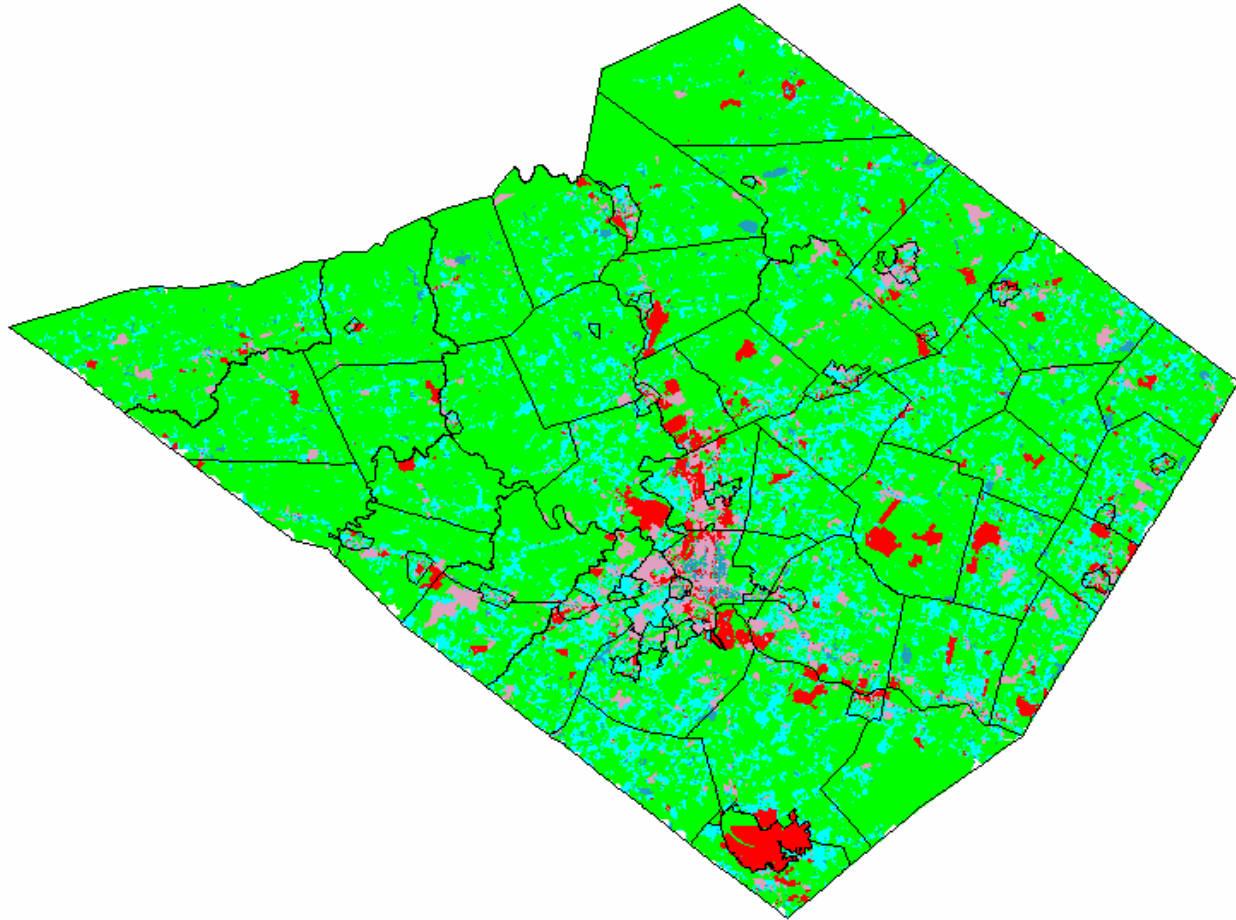
Property Value Model - Data Sources

- Parcel Map
 - Maintained by Office of the Assessment
 - Complete parcel boundary map – use centroid as location of house
 - CAMA file contains structural information, sale price and date, school district
 - Some information on land use/land cover
- NLCD (1992)
- DEM
- Soils Maps

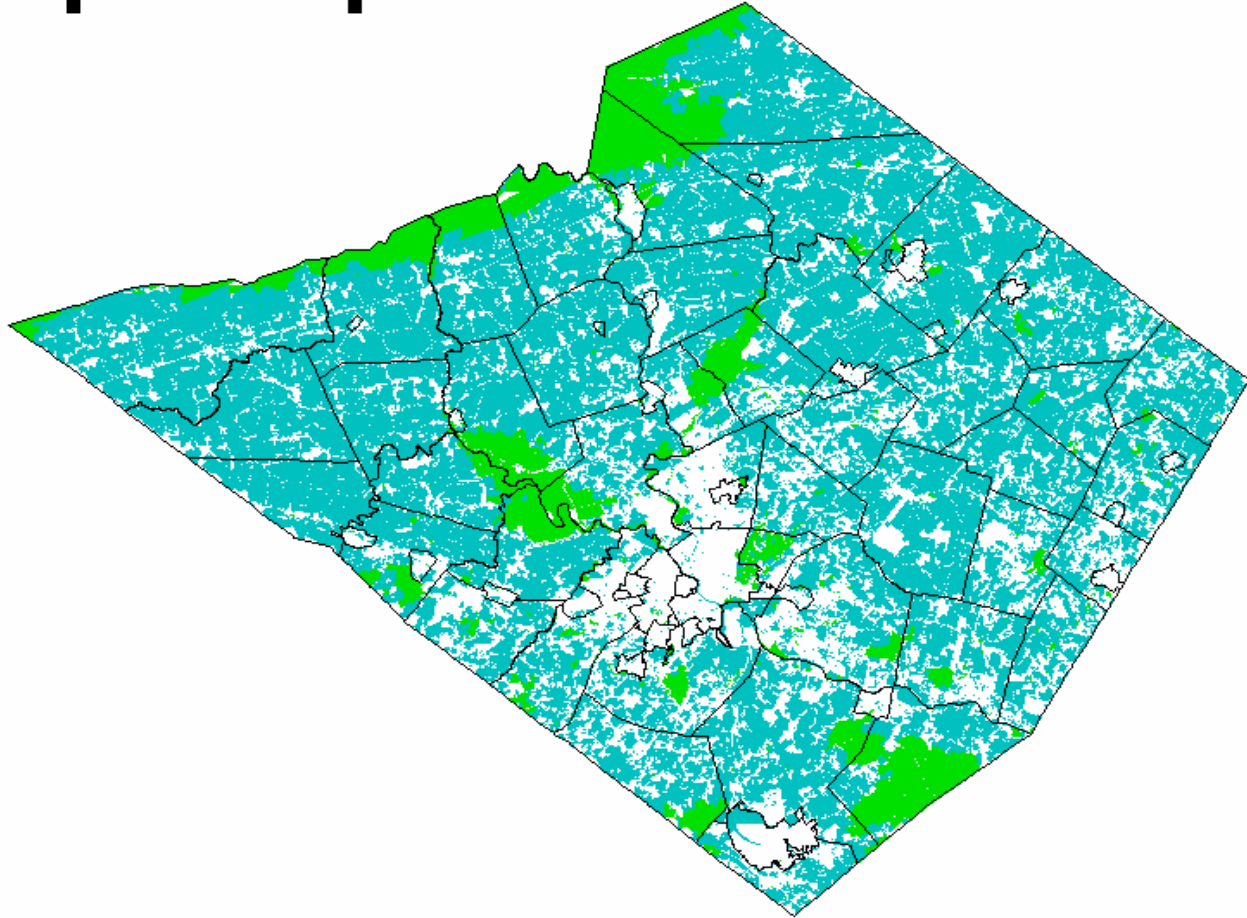
Property Value Model – Themes Developed

- Land Use Map
 - For each parcel, assign to 1 of 12 classes
 - Based largely on assessor's use codes
 - Rely on other clues when use code uninformative
- Open Space Maps
 - Government Ownership
 - Land Cover
 - Eased vs Noneased
 - Vacant developable

Land Use



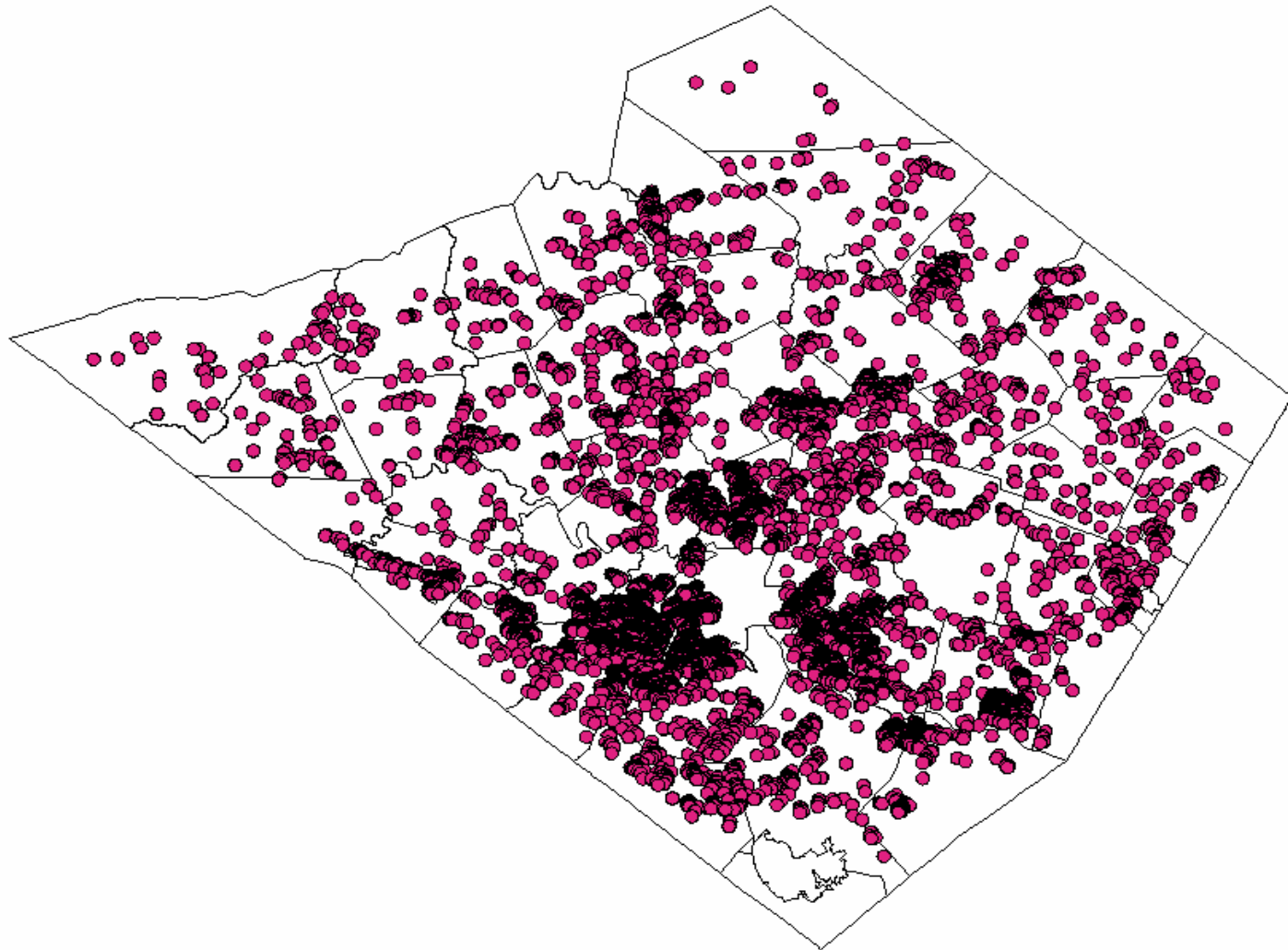
Open Space - Govt Owned



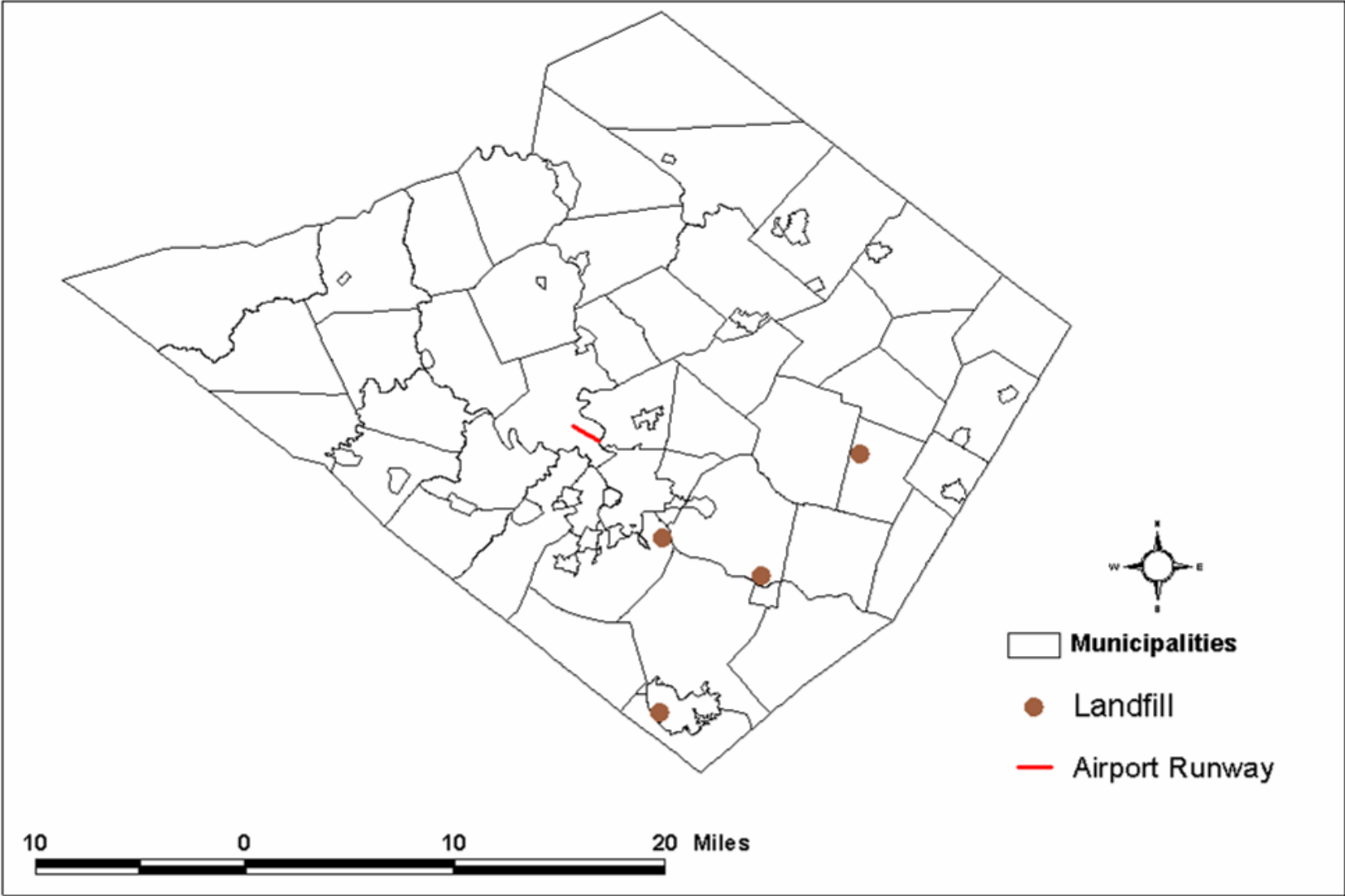
Property Value Model – Themes Developed

- Local Disamenities
 - Landfills, Airport, Sewage Treatment Plants, Mushroom Production Facilities, Large Animal Production Facilities
- Residential Sale Database
 - 8,090 sales
 - Structural and locational variables
 - Used buffering to measure land use within 400 meters and within 1600 meters of house
 - Land use, Ownshership, Land cover, Elevation, Slope, Soils
 - Measured distance from each house to each local disamenity

Residential Sales - 400m Buffers



Location of Landfills and Regional Airport



House Characteristics

| <u>Characteristic</u> | <u>% Impact</u> | <u>Confidence</u> |
|--------------------------|-----------------|-------------------|
| Living Area (sq ft) | 0.023 | ** |
| Lot Size (acres) | -1.800 | ** |
| ln(Lot Size) | 12.759 | ** |
| # Bedrooms | 3.325 | ** |
| # Bathrooms | 6.668 | ** |
| Basement | 4.965 | ** |
| Finished Attic | -1.754 | ** |
| Brick Exterior | 7.354 | ** |
| Stone Exterior | 11.319 | ** |
| Masonry Exterior | 4.966 | ** |
| Central Air Cond | 5.050 | ** |
| Physical Condition (1-5) | -5.851 | ** |
| Year Built | 0.342 | ** |
| Year Sold | -1.216 | ** |

Location Characteristics

| <u>Characteristic</u> | <u>% Impact</u> | <u>Confidence</u> |
|-------------------------|-----------------|-------------------|
| Dist to Reading (km) | 0.103 | ** |
| Dist to Allentown (km) | -0.161 | ** |
| Dist to Phil. (km) | -0.270 | ** |
| PSSA average score | 0.075 | ** |
| Public Sewer | 0.488 | |
| Public Water | 2.340 | ** |
| Slope (degrees) | -0.258 | ** |
| Elevation (m) | -0.002 | |
| Elev. vs Surr. Area (m) | 0.115 | ** |
| Ag Zoning | -1.116 | |
| Effective Ag Zoning | -1.835 | |
| Industrial/Commercial | -0.791 | |
| MultiUse/Village | 2.525 | ** |
| Conservation Zoning | -1.495 | |

Land Use – 400m

| <u>Characteristic</u> | <u>% Impact</u> | <u>Confidence</u> |
|-------------------------|-----------------|-------------------|
| Open Space | | |
| Forested | 0.2763 | ** |
| Pasture/Crops/Grass | 0.2374 | ** |
| Govt Owned | 0.2812 | ** |
| Eased Cropland/Pasture | 0.1622 | ** |
| Vacant | -0.0900 | |
| Residential | | |
| Small Lot (0.1-0.2 ac) | 0.0285 | |
| Medium Lot (0.2-0.5 ac) | 0.1929 | ** |
| Large Lot (0.5-1.5 ac) | 0.2407 | ** |
| XLarge Lot (1.5-5 ac) | 0.2144 | ** |
| MultiFamily/Other | 0.0381 | |
| Commercial | 0.1094 | |

Land Use – 400 to 1600m

| <u>Land Use</u> | <u>% Impact</u> | <u>Confidence</u> |
|-------------------------|-----------------|-------------------|
| Open Space | | |
| Forested | -0.0080 | ** |
| Pasture/Crops/Grass | 0.0005 | |
| Govt Owned | 0.0123 | ** |
| Eased Cropland/Pasture | 0.0109 | ** |
| Vacant | -0.0020 | |
| Residential | | |
| Small Lot (0.1-0.2 ac) | 0.0086 | ** |
| Medium Lot (0.2-0.5 ac) | 0.0032 | |
| Large Lot (0.5-1.5 ac) | 0.0292 | ** |
| XLarge Lot (1.5-5 ac) | 0.0305 | ** |
| MultiFamily/Other | 0.0130 | * |
| Commercial | 0.0327 | ** |

Impact of Open Space Loss

- If 10 acres of cropland is developed, then property values of houses within $\frac{1}{4}$ mile will decrease on average by

New Land Use

Small-lot residential

Multi-unit residential

Large-lot residential

Commercial

Industrial

% Decrease

2.1%

2.0%

no sig. impact

1.3%

2.4%

Potential Local Disamenities

| <u>Facility</u> | % Impact on House Price | | | |
|-----------------------------|-------------------------|------|-------|-------|
| | 500m | 800m | 1200m | 2400m |
| Landfill | -12.4 | -6.9 | -3.8 | -0.8 |
| Airport Runway | -0.3 | -0.2 | -0.1 | |
| Mushroom Prod. Facility | -0.8 | -0.4 | -0.1 | |
| Large-scale Animal Facility | -6.4 | -4.1 | -1.6 | |

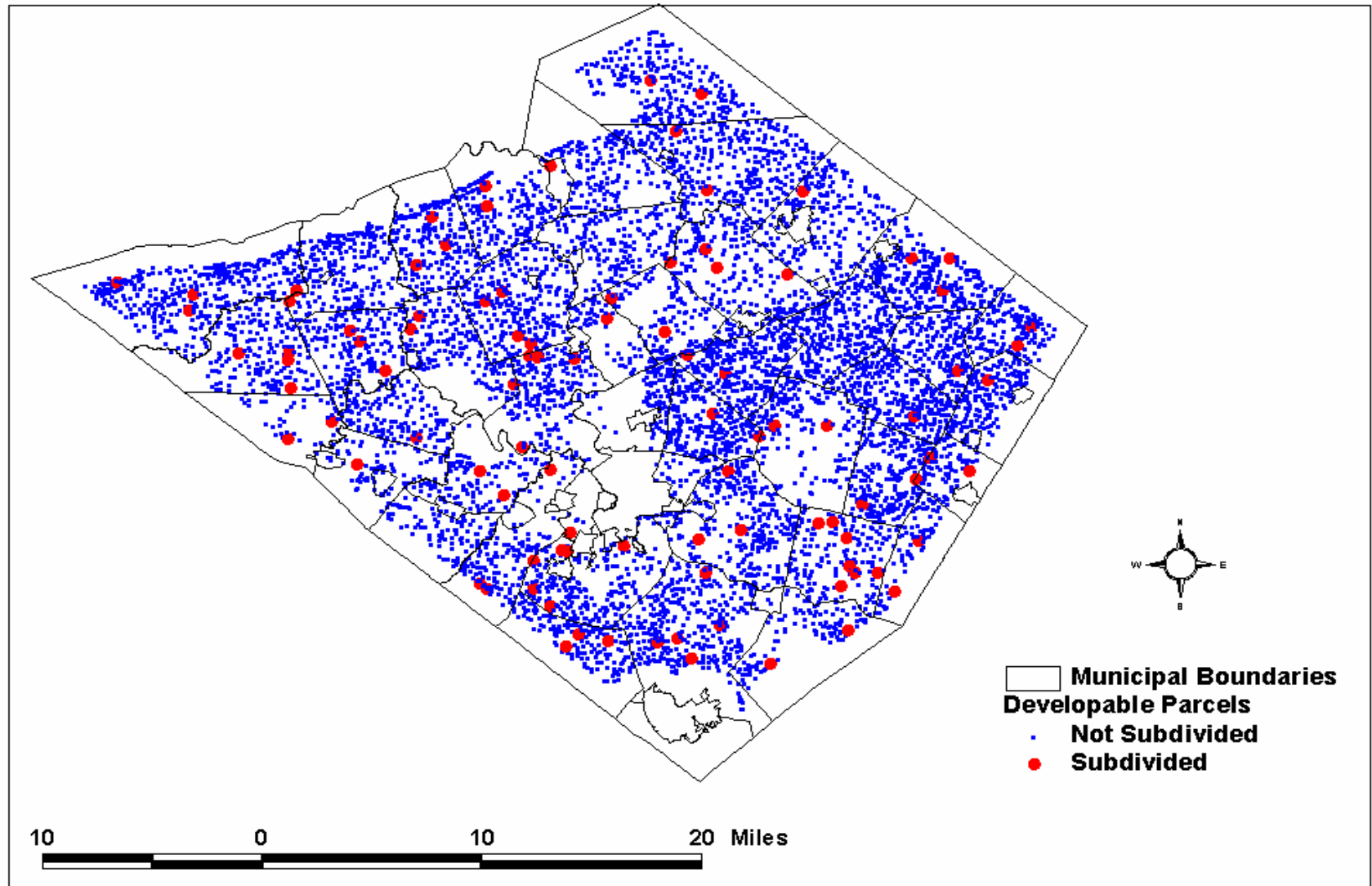
Sewage Treatment Plants – n.s.

High Traffic Roads – proximity is a disamenity to 100m, then amenity

Residential Conversion Analysis – Themes Developed

- Location of subdivision requests
 - Based on Property Identification Number (PIN)
 - Compared 1996 parcel map to 2002 parcel map to develop mother-daughter relationships
 - PIN information often missing in subdivision file
- Location of all parcels that did not subdivide
- Predicted property value on all potentially subdividable parcels
 - Based on location, surrounding land use

Location of New Subdivisions



Residential Conversion Analysis – General Results

- Potential property value had little impact on location of new development
- No tendency to locate in areas with more open space
 - Except, some preference for proximity to government-owned open space
- Tendency to located near existing residential land
- Lower probability of development in areas with Effective Ag Zoning
- Parcels at higher elevation less likely to develop

Making The Data You Already Keep More Useful

- Assessment (Parcel) Data
 - Dont throw away information
 - Dynamic GIS (time series data inside GIS)
 - Land Use for tax-exempt parcels
- Subdivision
 - PIN/location data for every subdivision
 - Mother/daughter relationships
 - Keep information on date of subdivision, parent parcel in parcel map

Unexpected Payoffs from GIS

- Data collected for one purpose (assessment, planning, zoning) can turn out to be useful in unintended ways
- Invest a little extra to store information you already have
- Looking for new counties in which to conduct similar analyses (inside or outside PA)