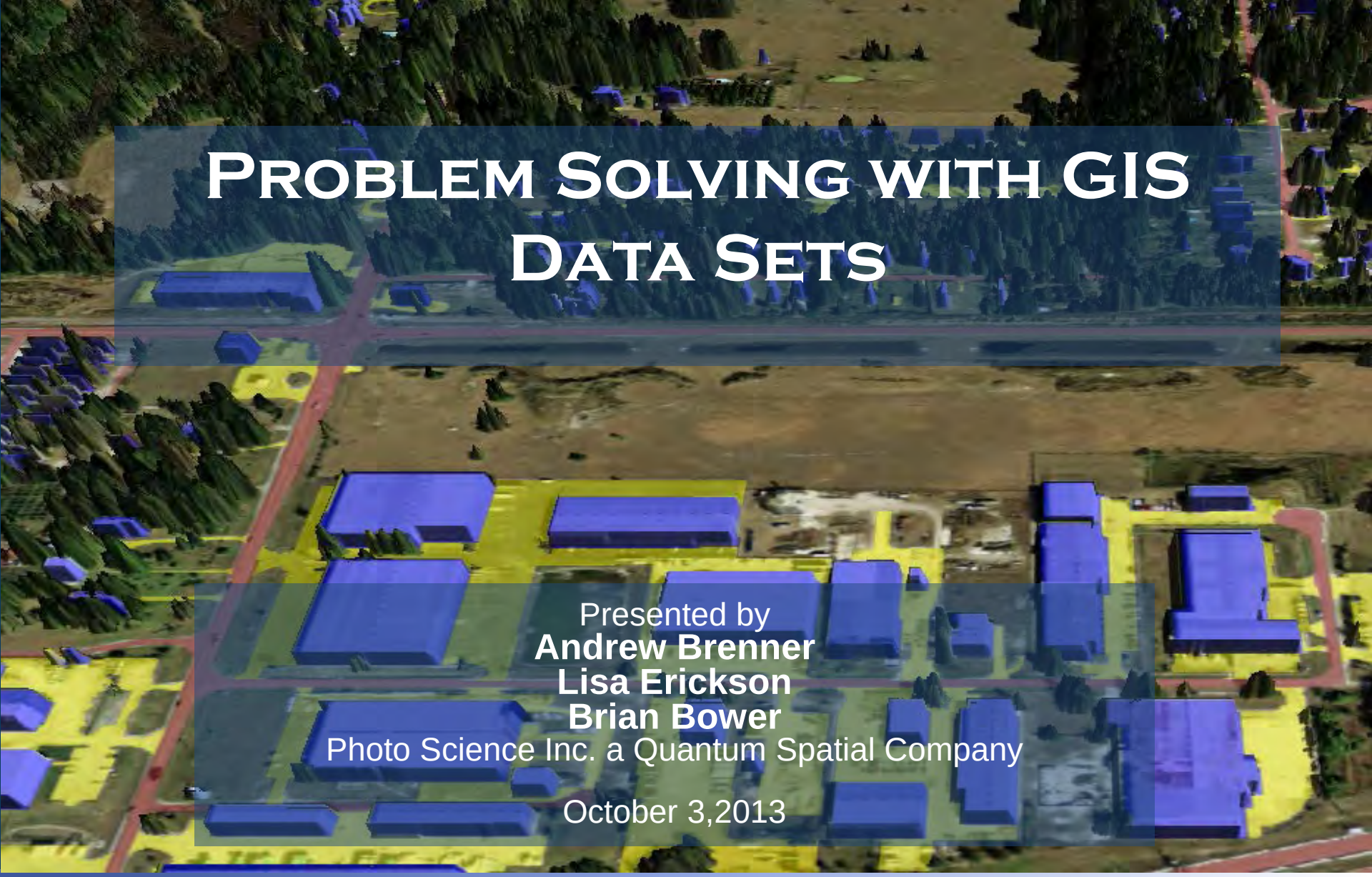

Problem Solving with GIS Data Sets

Presented by
Andrew Brenner
Lisa Erickson
Brian Bower
Photo Science Inc. a Quantum Spatial Company

October 3,2013

Photo Science
Geospatial Solutions

Quantum Spatial

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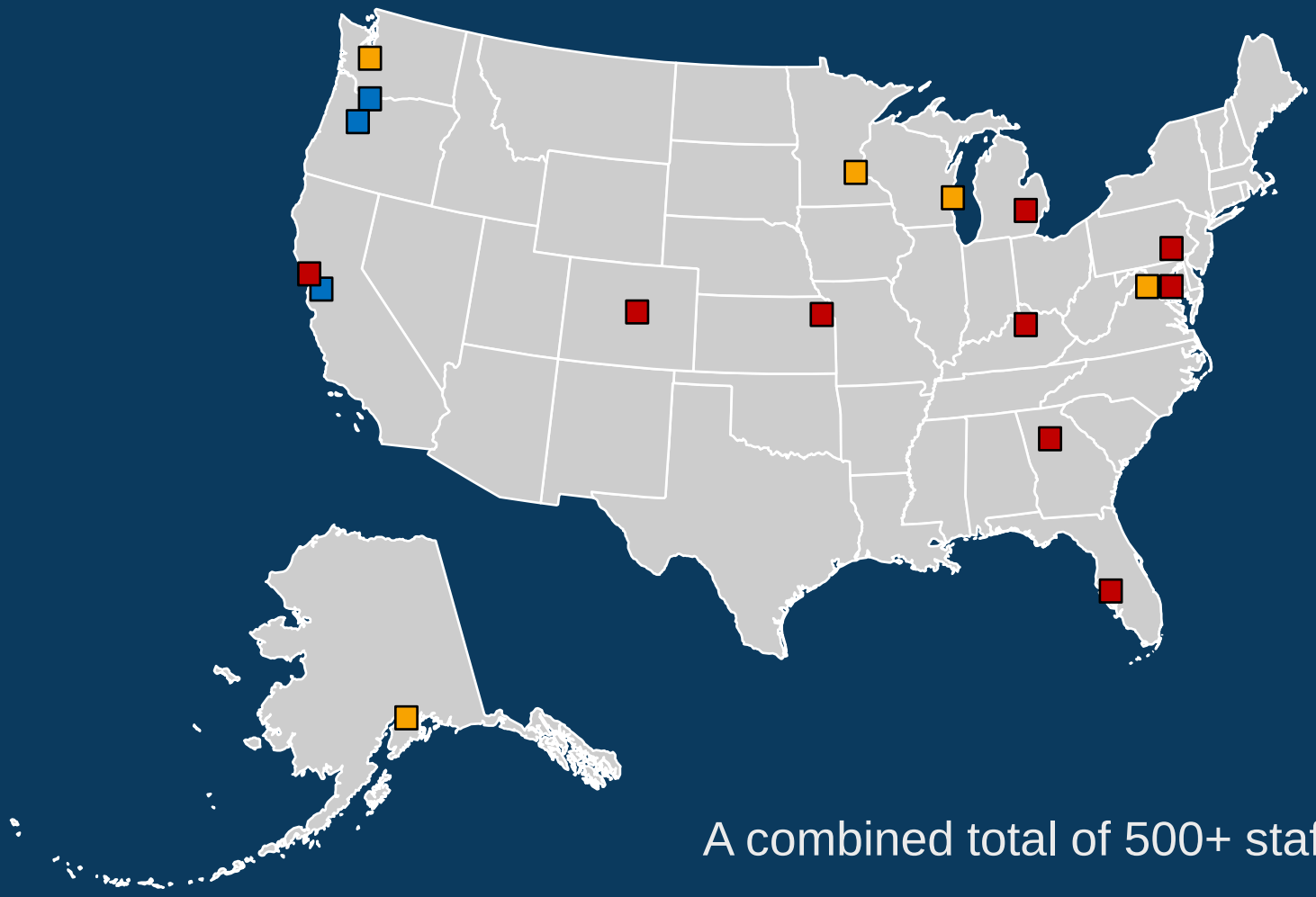
Our Locations



AeroMetric
Sheboygan, WI
Anchorage, AK
Dulles, VA
Minneapolis, MN
Seattle, WA

Photo Science
Lexington, KY
Emeryville, CA
Colorado Springs, CO
St. Petersburg, FL
Norcross, GA
Mission, KS
Chesapeake Beach, MD
Ann Arbor, MI
West Chester, PA

WSI
Portland, OR
Corvallis, OR
Oakland, CA

A combined total of 500+ staff members

Photo Science
Geospatial Solutions

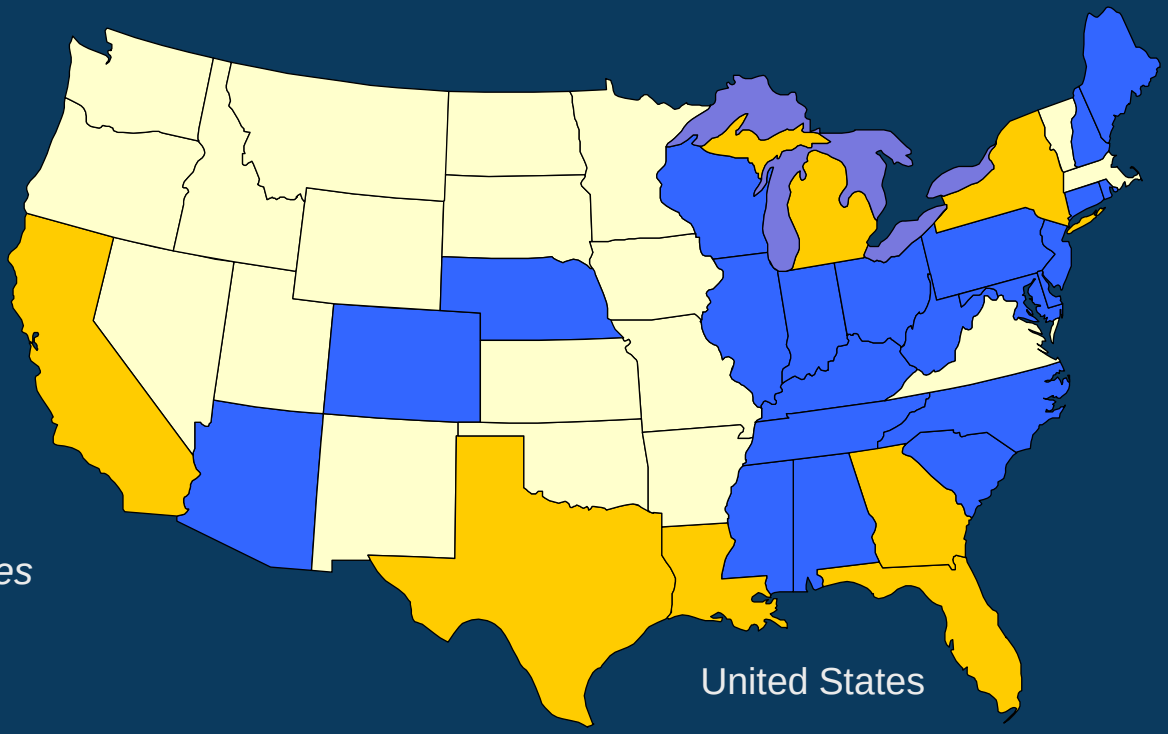
What We Do

Statewide – Digital Orthos

The following illustrates Photo Science's statewide experience for entire states and partial states (exceeding or nearly exceeding 5,000 square miles) for digital ortho imagery.

DO – *Entire States*

DO – *Partial States*
Greater than 5,000 square miles



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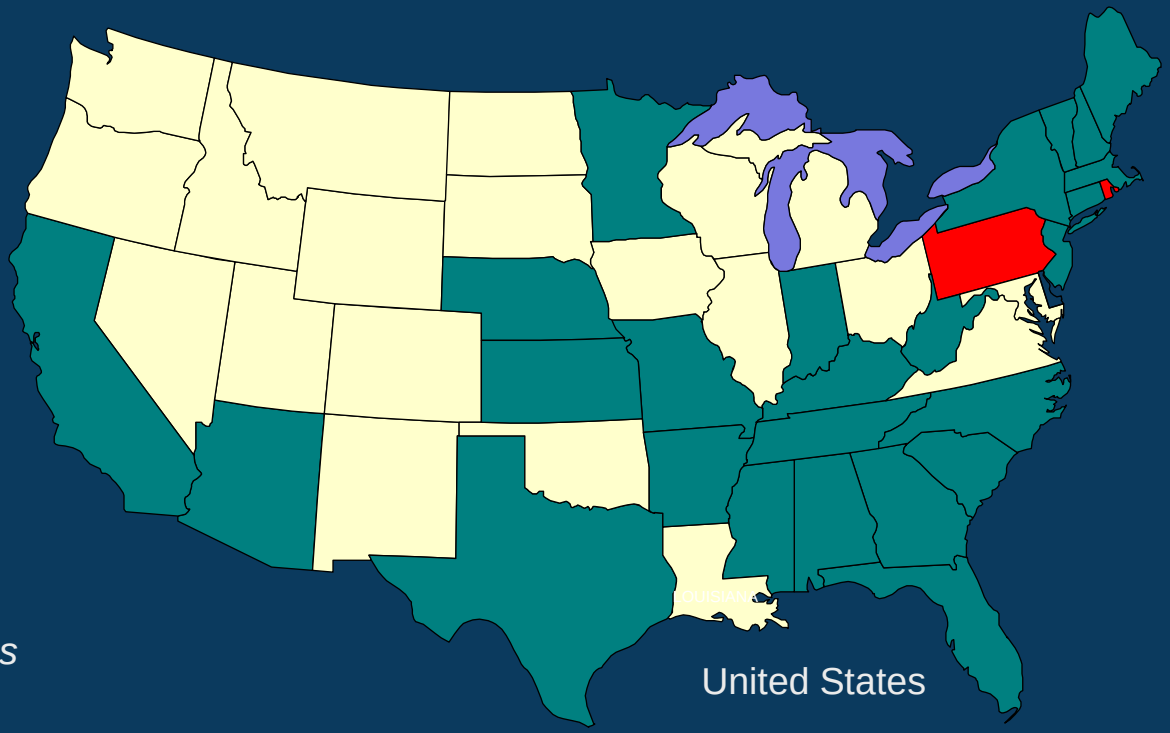
What We Do

Statewide – LiDAR

The following illustrates Photo Science's statewide experience for entire states and partial states (exceeding or nearly exceeding 5,000 square miles) for LiDAR services. *NOTE: Very few states have completed a statewide elevation model using LiDAR.*



LiDAR – *Entire States*

LiDAR – *Partial States*
Greater than 5,000 square miles

Photo Science
Geospatial Solutions

What We Do
Remote Sensing

- Group dedicated to leveraging high resolution imagery and LiDAR data towards solving client needs (solutions)
- Capable of using multiple techniques
  - Photo interpretation
  - Image Classification
- Multispectral, Hyperspectral, LiDAR, Thermal, Radar
- Leverage both Aerial and Satellite
- Erdas, ENVI, eCognition, Feature Analyst

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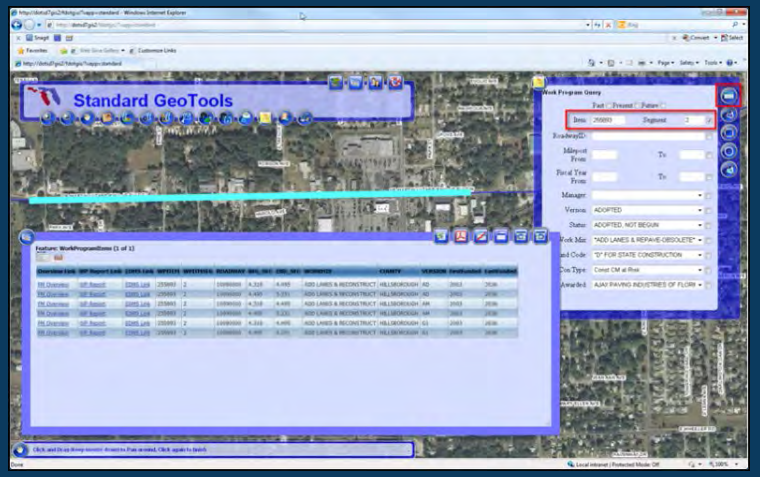
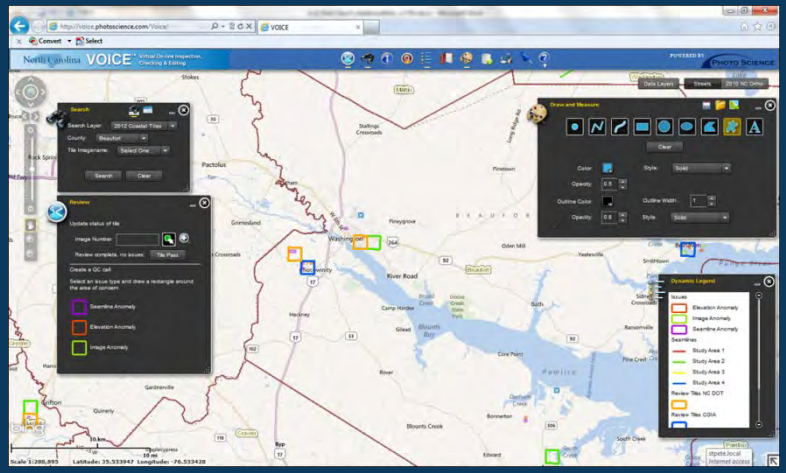
Geospatial Solutions

What We Do
GIS Solutions

- Software as a Service
- Feature extraction
- Data analysis
- Database design
- User needs assessment
- Software design
- Application development





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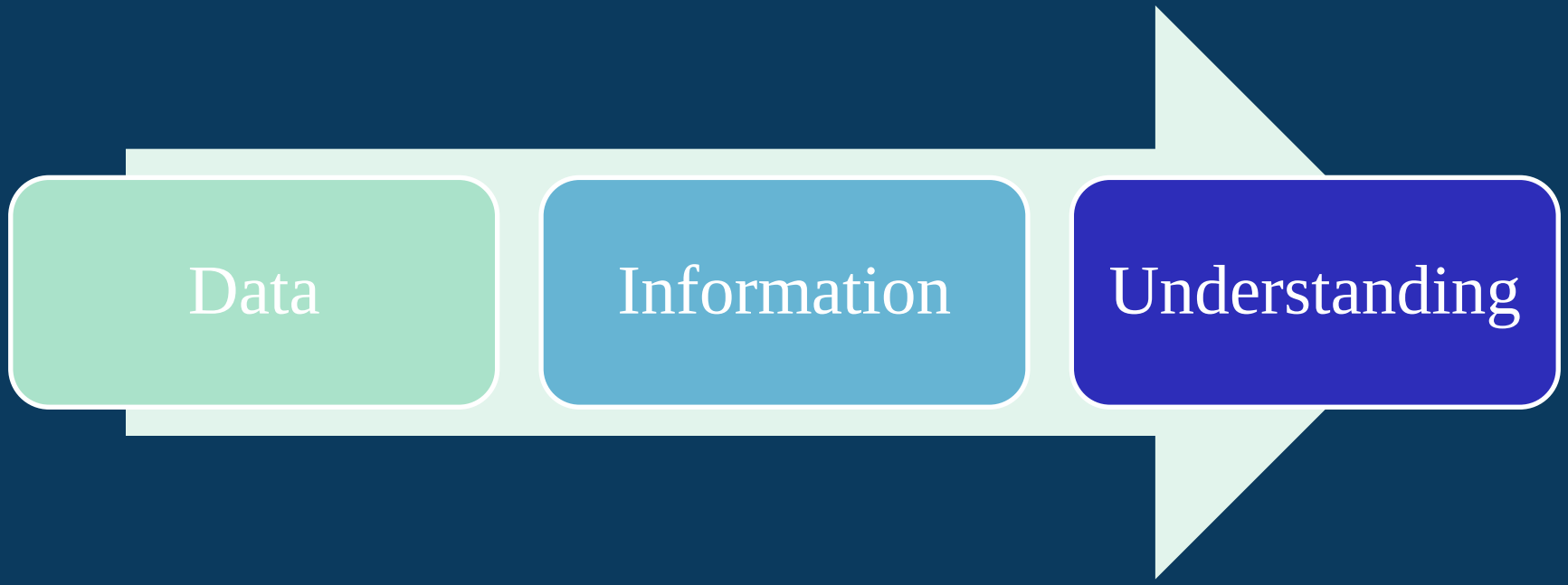
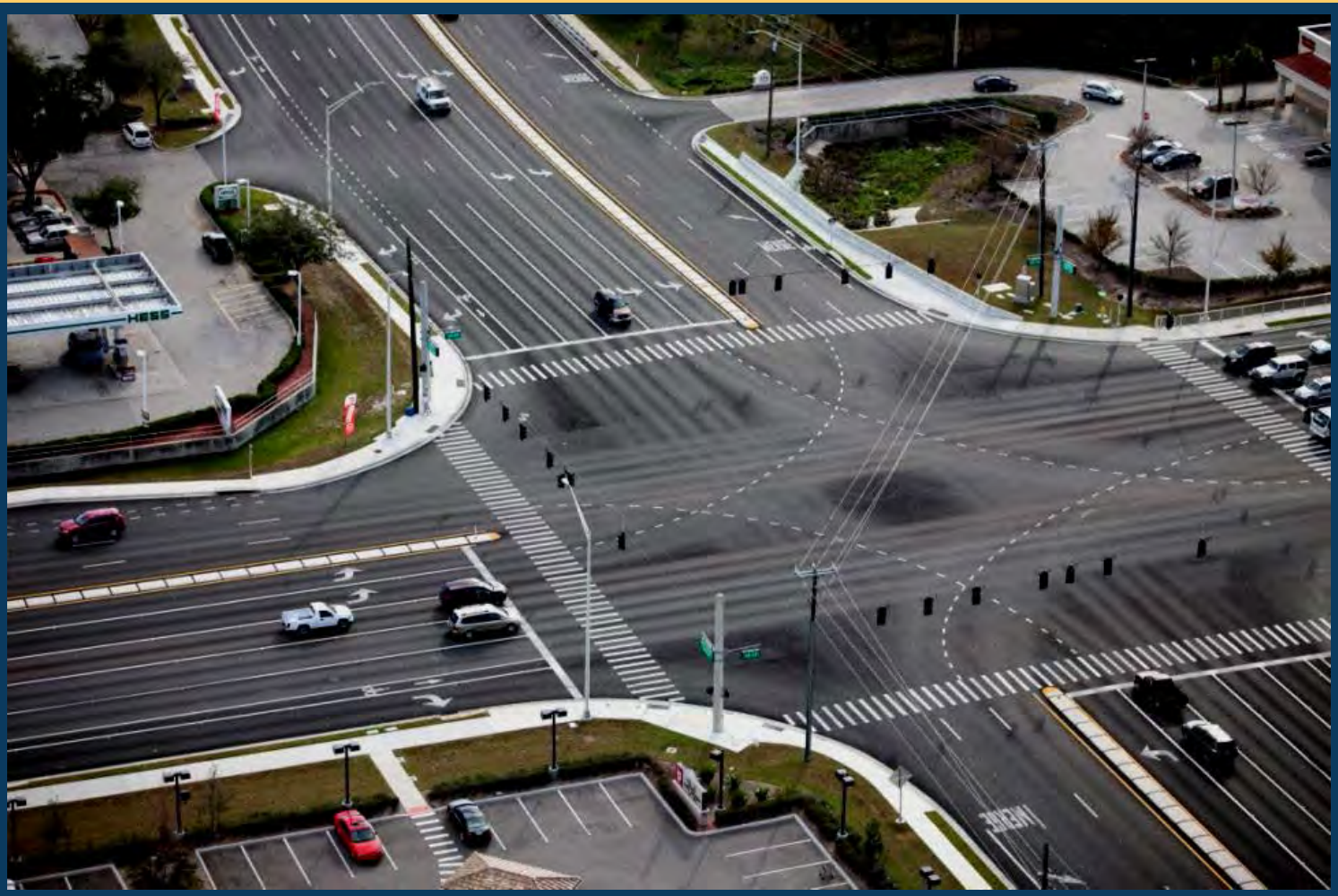
Geospatial Solutions

- **Data** - Numbers, characters, images
- **Information** - Data that is presented within a context that gives it meaning
- **Understanding** - Capacity to apprehend general relations of particulars



Oblique Imagery Collection



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Mobile Mapping

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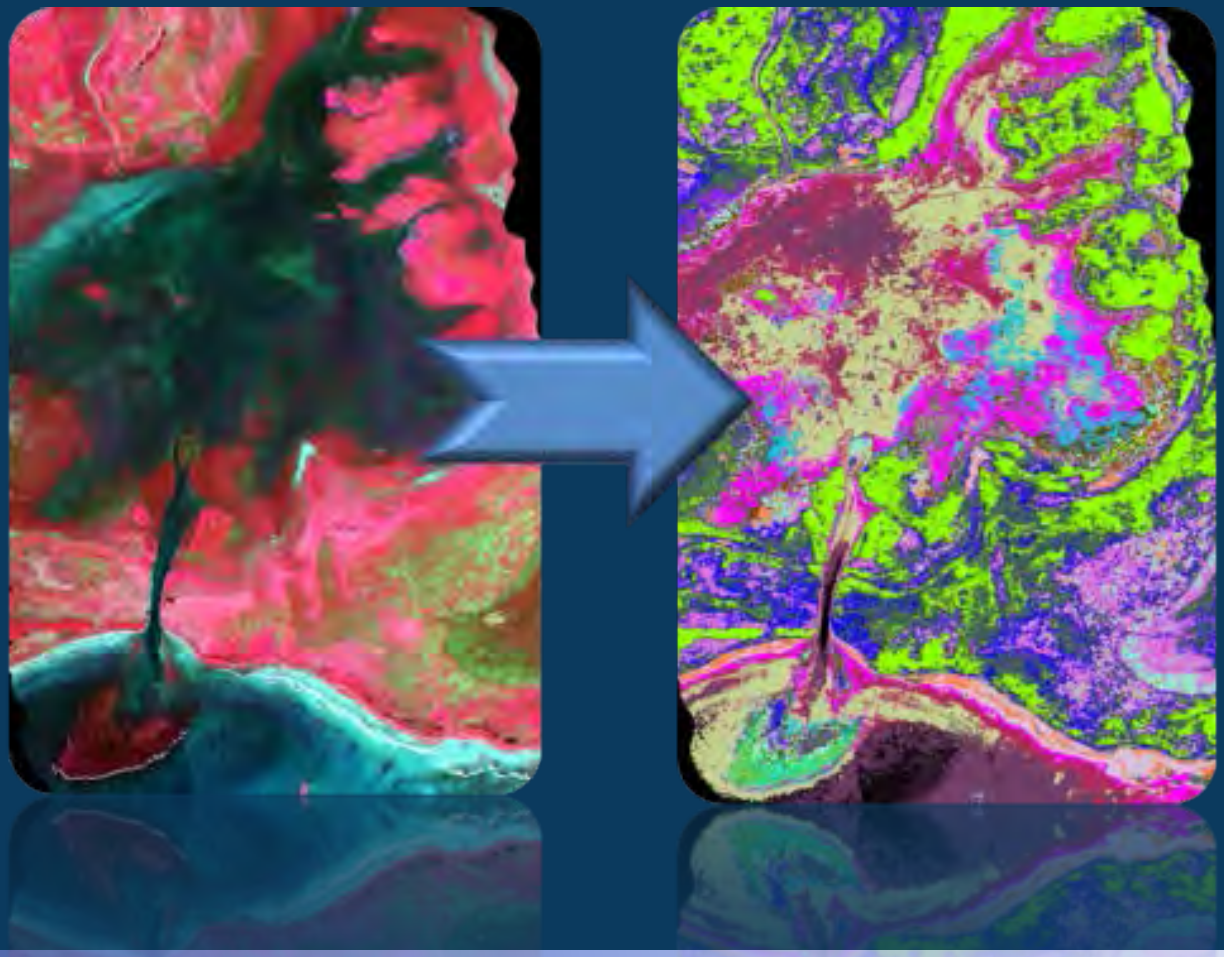
Hyperspectral



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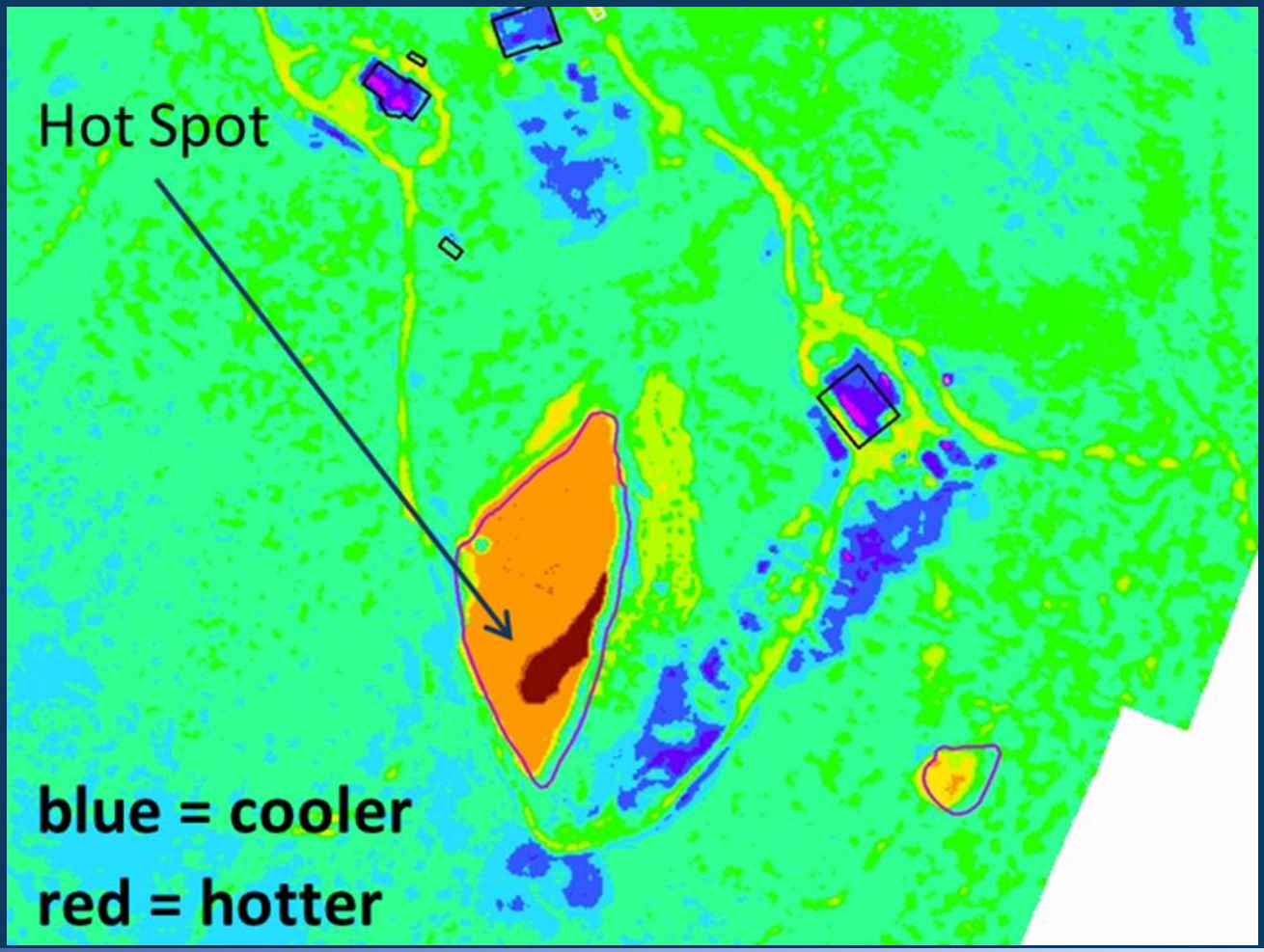
Thermal



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GIS Data

- Historic Land Cover
  - NOAA's Coastal-Change Analysis Program
- Impervious Surfaces
  - Statewide to local scales
  - 3D Buildings
    - Extruded buildings
    - Architectural buildings
- Green Infrastructure
  - The Greening of Detroit
  - Storm water retention

Overview of Historic C-CAP

- What is C-CAP?
- Land cover changes in Lake Michigan Basin 1985 – 2010
- Wider Applications
- C-CAP Land Cover Atlas
- Summary

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NOAA C-CAP Program

- Program began in the 1990s, run by NOAA Coastal Services Center
- Nationally standardized database of land cover and land change in coastal U.S.
- Objective – improve understanding of linkages between coastal wetland habitats, adjacent uplands, and marine resources
- Based on 30 m Landsat imagery (moderate resolution product)
- “Coastal expression” of the USGS National Land Cover Dataset (NLCD)

C-CAP Classes

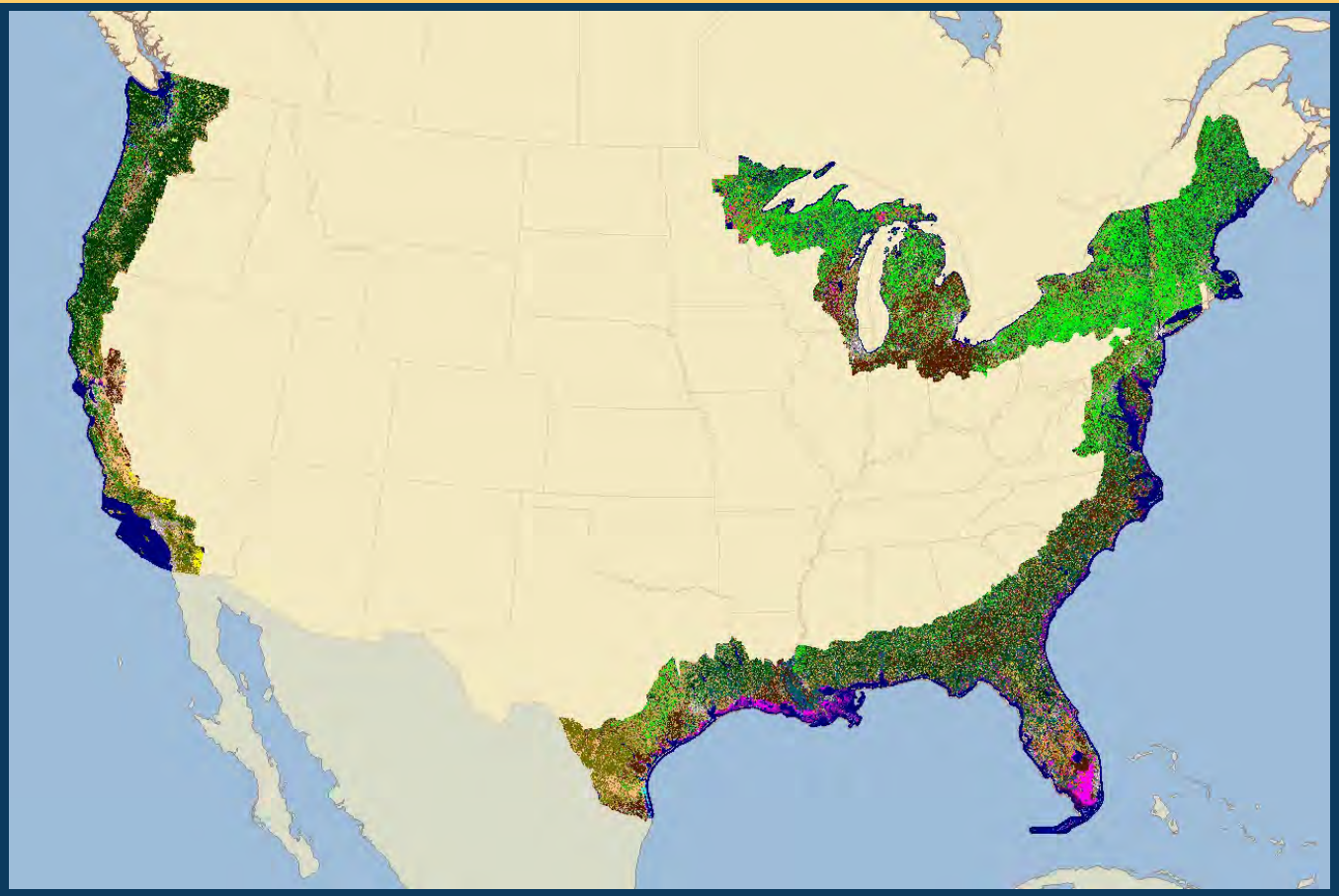
Upland Classes - 14

- Developed, High intensity
- Developed, Medium intensity
- Developed, Low intensity
- Developed, Open space
- Cultivated Crops
- Pasture/Hay
- Grassland/Herbaceous
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Scrub/Shrub
- Bare Land
- Tundra
- Perennial Snow/Ice

Wetland Classes - 10

- Palustrine Forested Wetland
- Palustrine Scrub/Shrub Wetland
- Palustrine Emergent Wetland
- Estuarine Forested Wetland
- Estuarine Scrub/Shrub
- Estuarine Emergent
- Unconsolidated Shore
- Open Water
- Palustrine Aquatic Bed
- Estuarine Aquatic Bed

Where is C-CAP?



Also Hawaii!

2006 C-CAP Land Cover

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Available C-CAP Data: 25+ years

- Base 1996, updated every 5 years (2001, 2006, 2011)
- Most areas in the U.S. have land cover data for eras 1996, 2001, 2006
- A few areas have 1992 era land cover data
  - Some east coast states
  - Washington
  - Some of the Hawaiian islands
- NEW – portions of Great Lakes region will have 1985 and 1992 era data
- 2011 data for Michigan is available now

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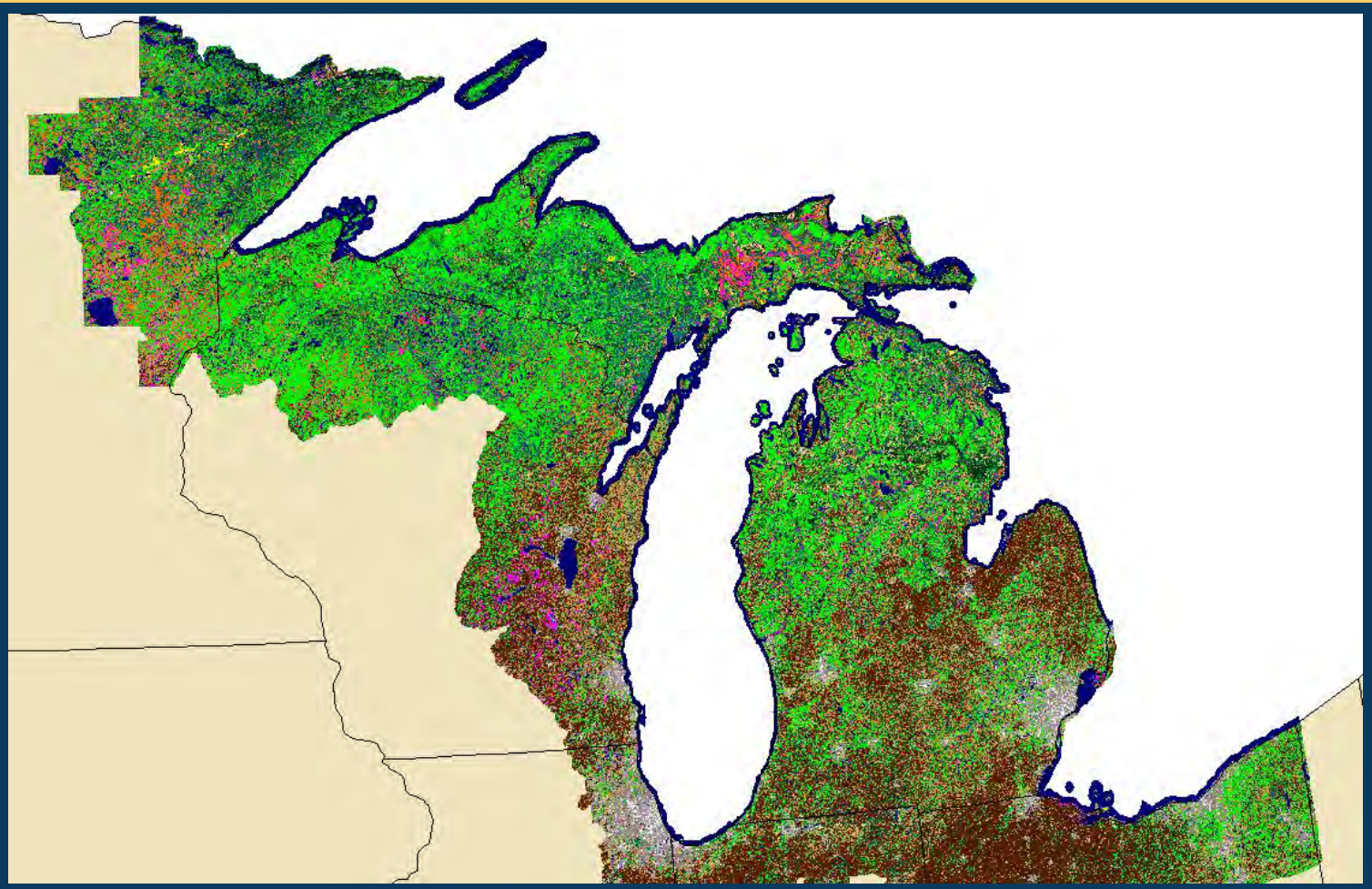
How Are C-CAP Data Used?

- Change analysis – How does the land cover change over time?
- Trend analysis – How are the changes characterized over time?
  - What types of land cover are increasing, decreasing, staying the same?
  - Can future changes be forecast?
- Wide variety of users, local to federal
  - Land use planning
  - Land management
  - Watershed modeling

Michigan C-CAP Mapping



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MIICA Change Analysis

April 28, 2006

March 22, 2010

MIICA Change

June 18, 2007

August 29, 2010

Areas of Change – Clare County, MI

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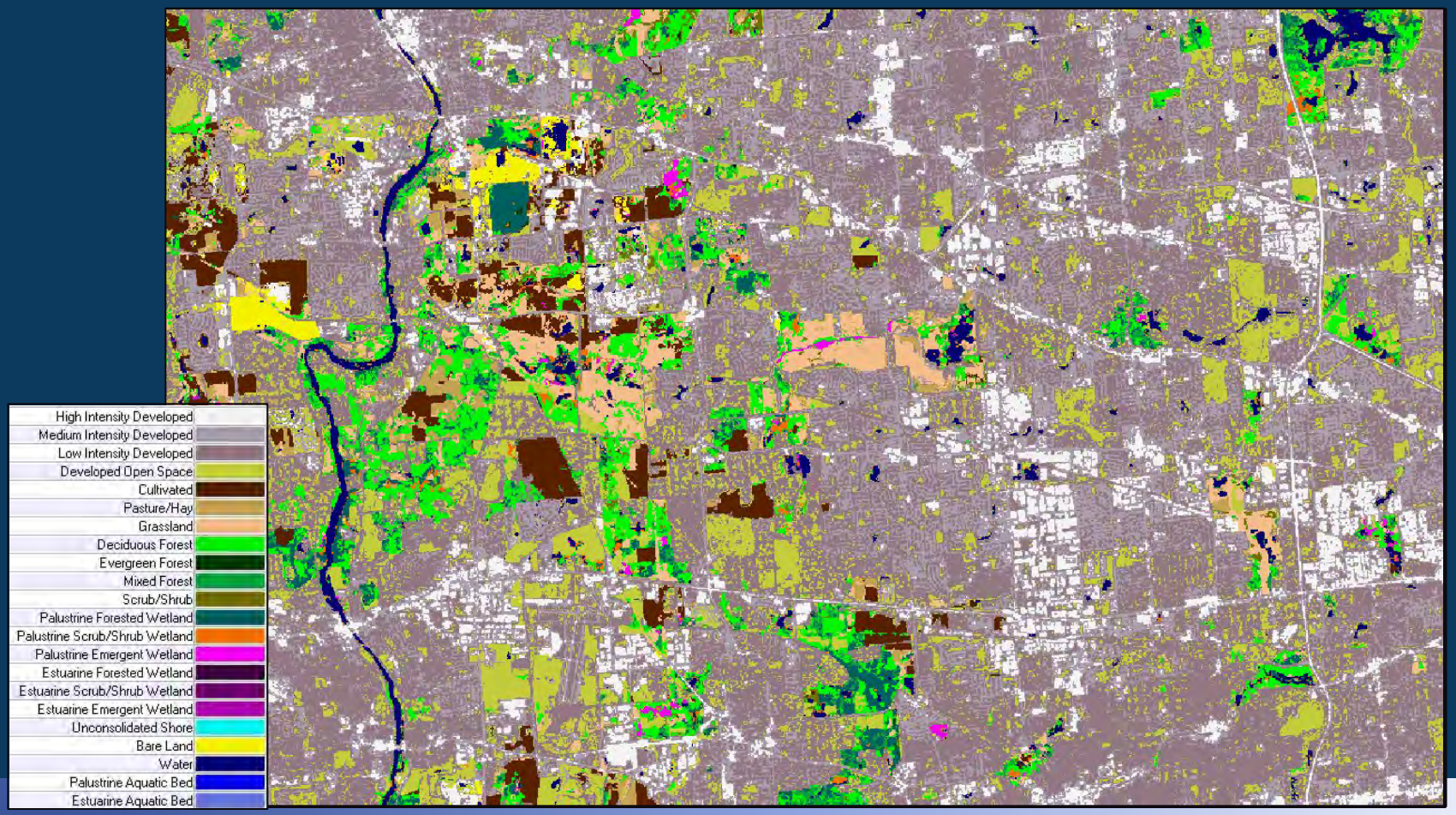
Change Classification



Chicago Suburb Development – 1985 to 2011

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2010 Land Cover

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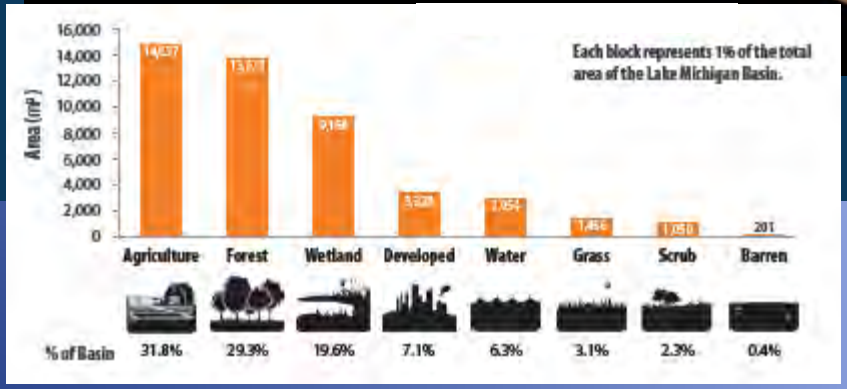
Geospatial Solutions

Land Cover of Watershed



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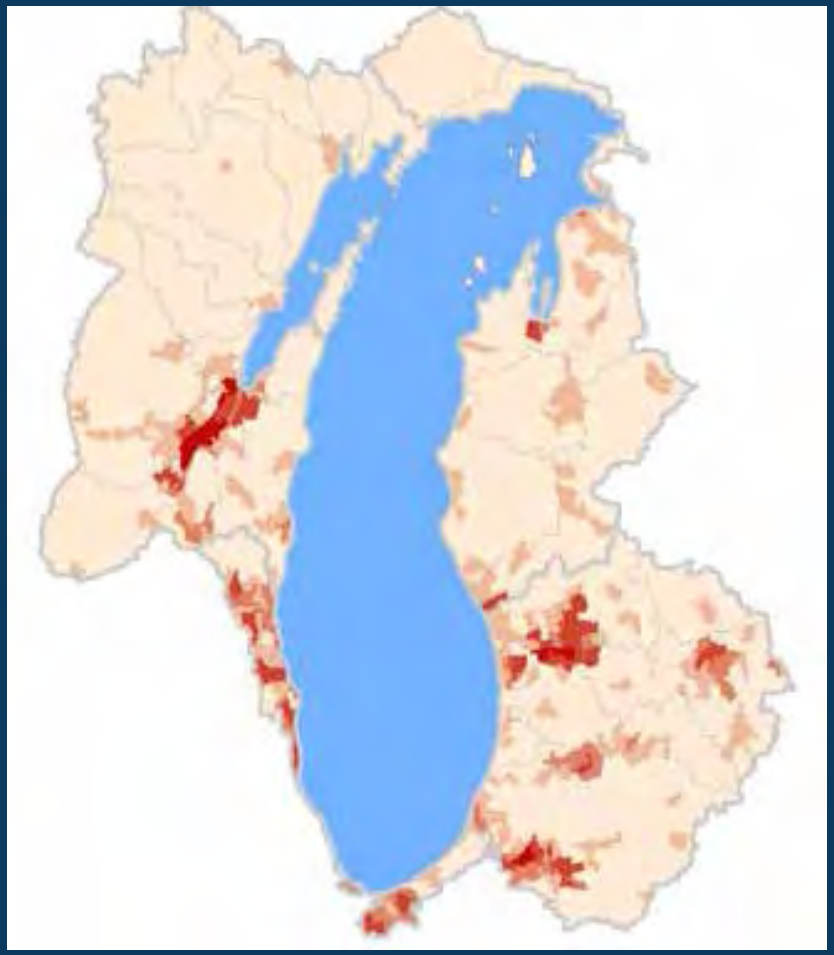
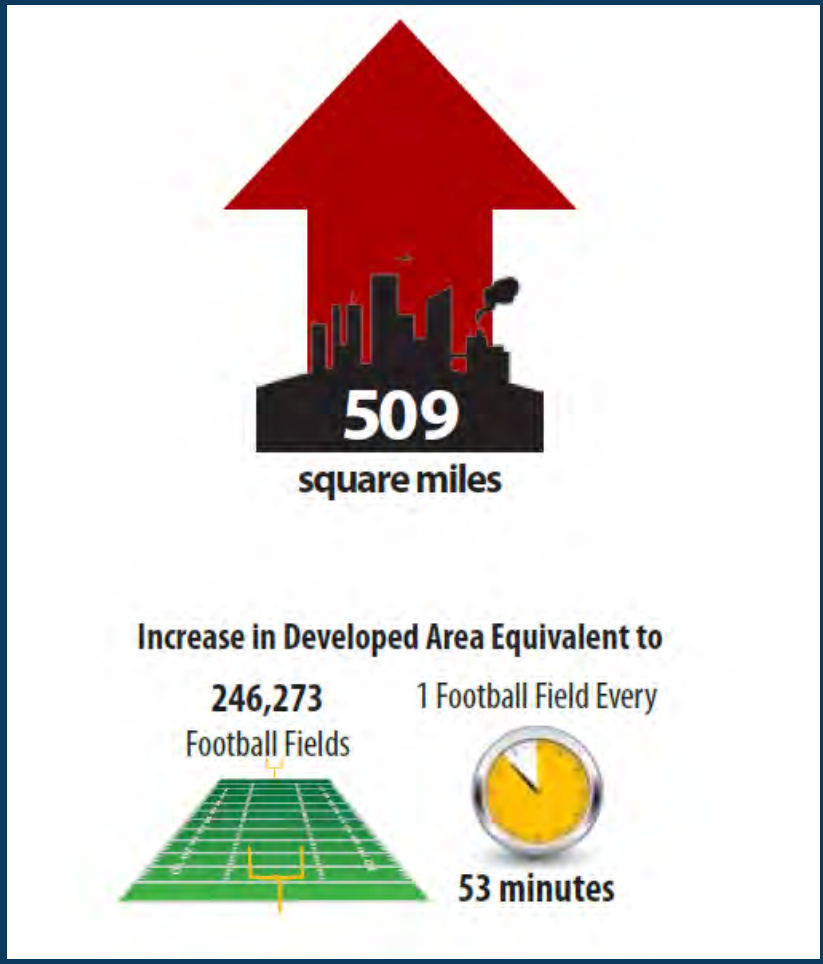
Increase in Developed Area





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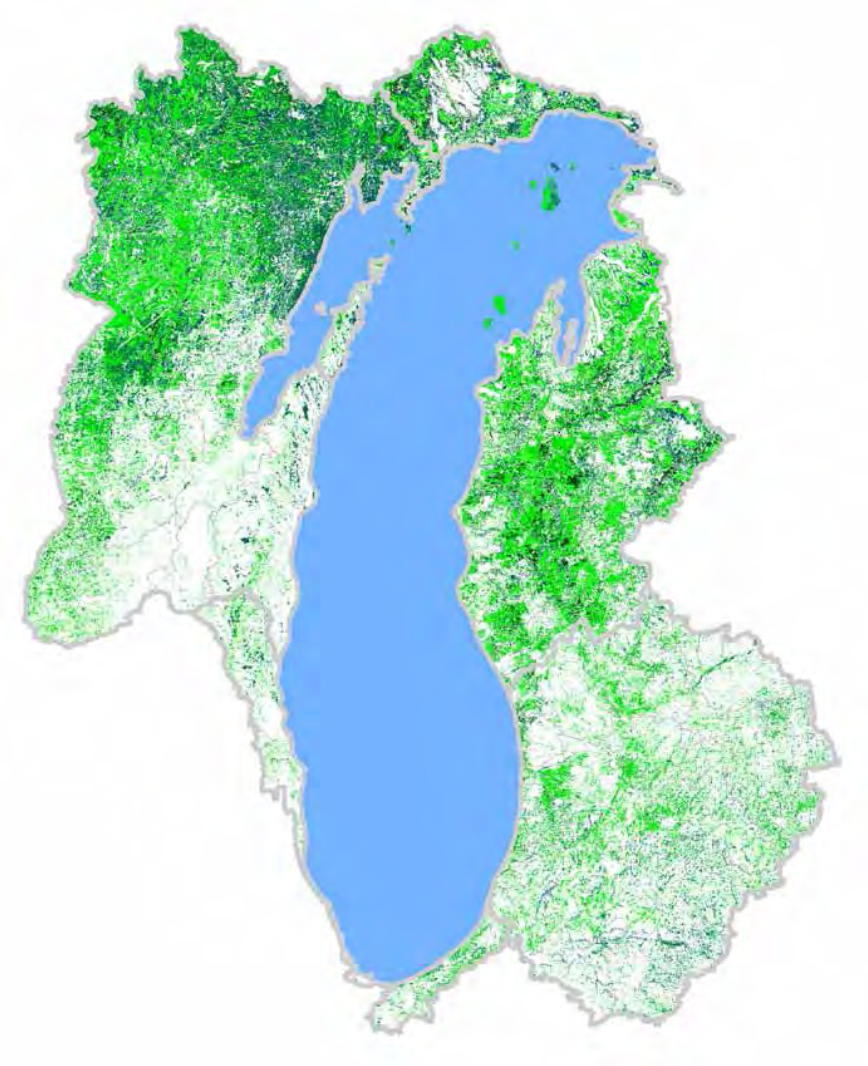
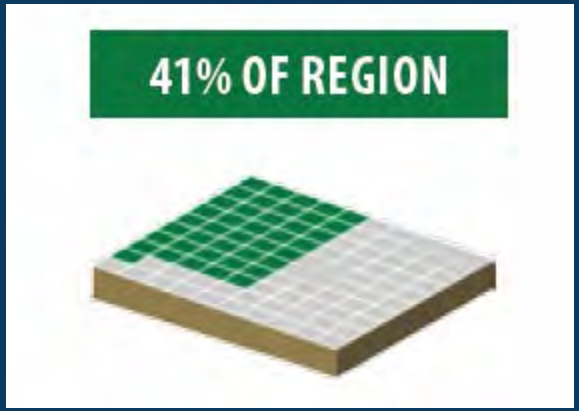
Forest Resources





Deciduous Forest
Mixed Forest
Evergreen Forest
Palustrine Forested Wetland

2010 forest map for the Lake Michigan Basin. This map depicts three upland forest categories and one wetland forest category.

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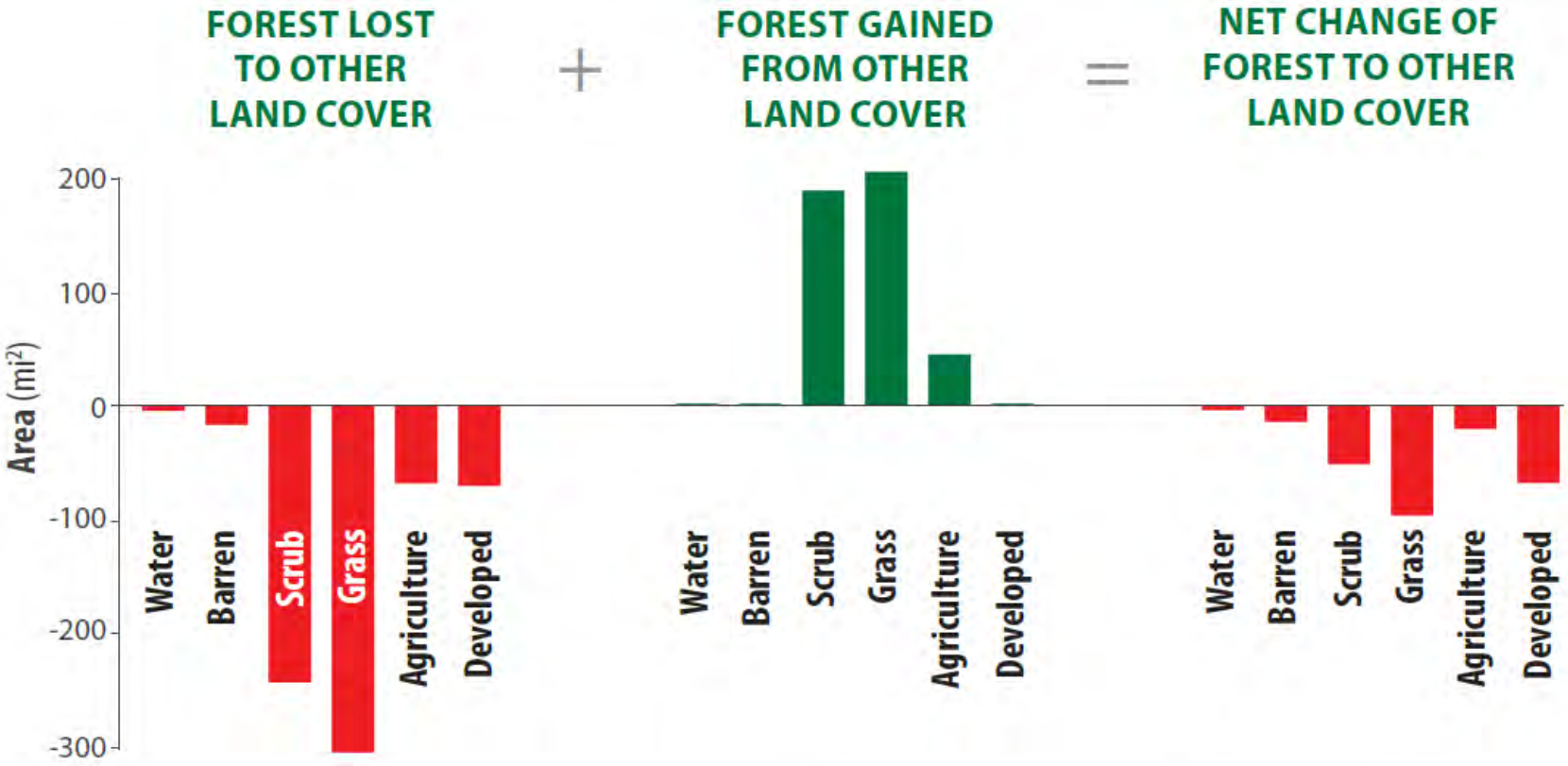
Forest Change



These graphs show the categories of land cover that forests were lost to or gained from, along with the resulting net change between each of these categories and forests between 1985 and 2010.

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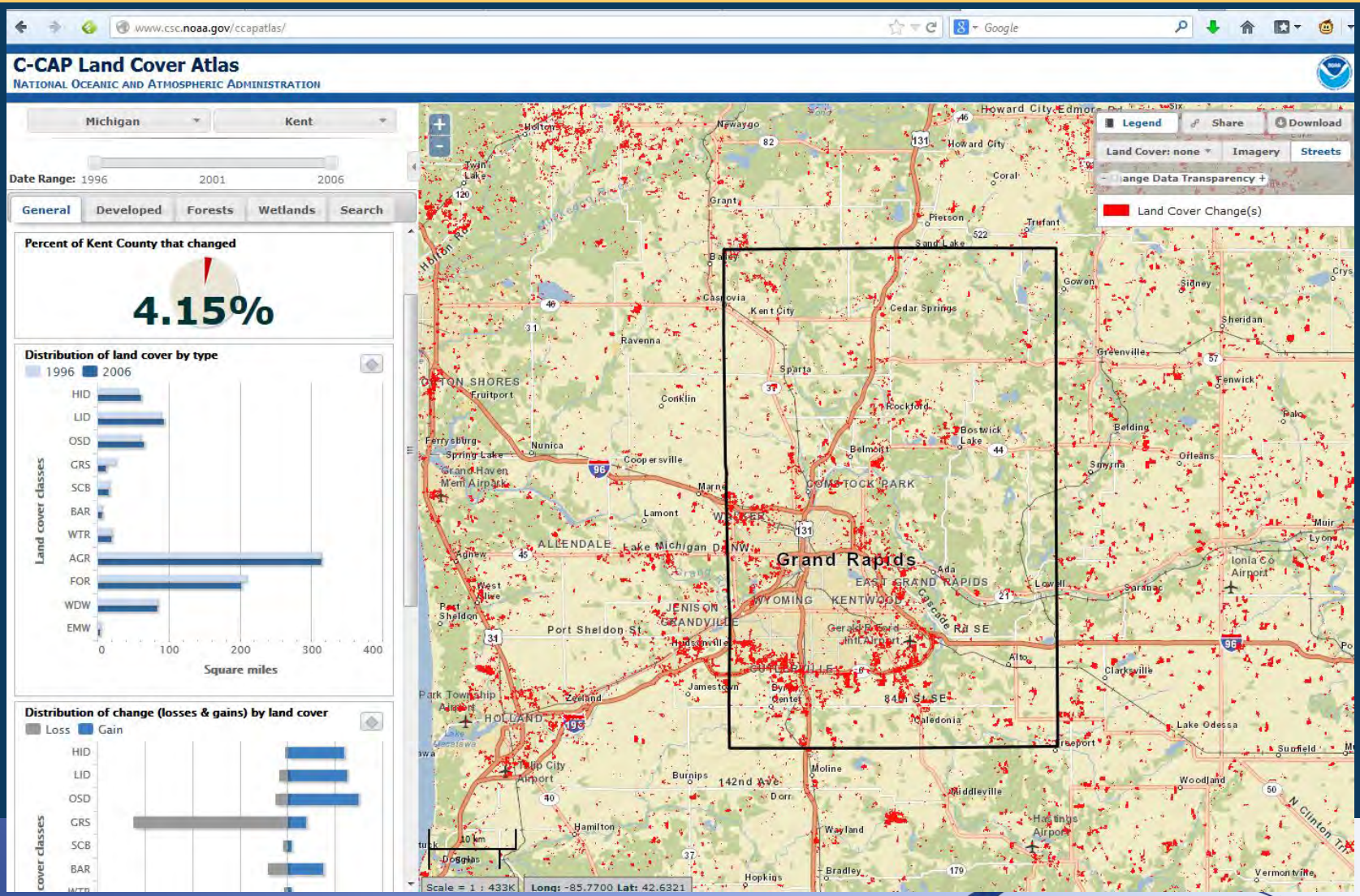
C-CAP Land Cover atlas



http://www.csc.noaa.gov/ccapatlas/

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Value of Data to Planners

- Measure the changes of vegetation and urban development across a watershed
  - Impacts water quality
  - Impacts water quantity (flooding, drought)
- Natural resource management
  - Open space management
    - Wildlife
    - Recreation
    - Hunting and fishing
  - Agricultural preservation and abandonment
  - Forestry trends
- Climatic impacts

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Value of Data to Managers

- Data feed into models of water flow
- Can track impacts of land use policy or lack of policy
- Can track changes in the agricultural and forest economy
- Can support forest inventory and biomass assessments for biomass plants and timber mills
- Can track urban sprawl for a community across its borders

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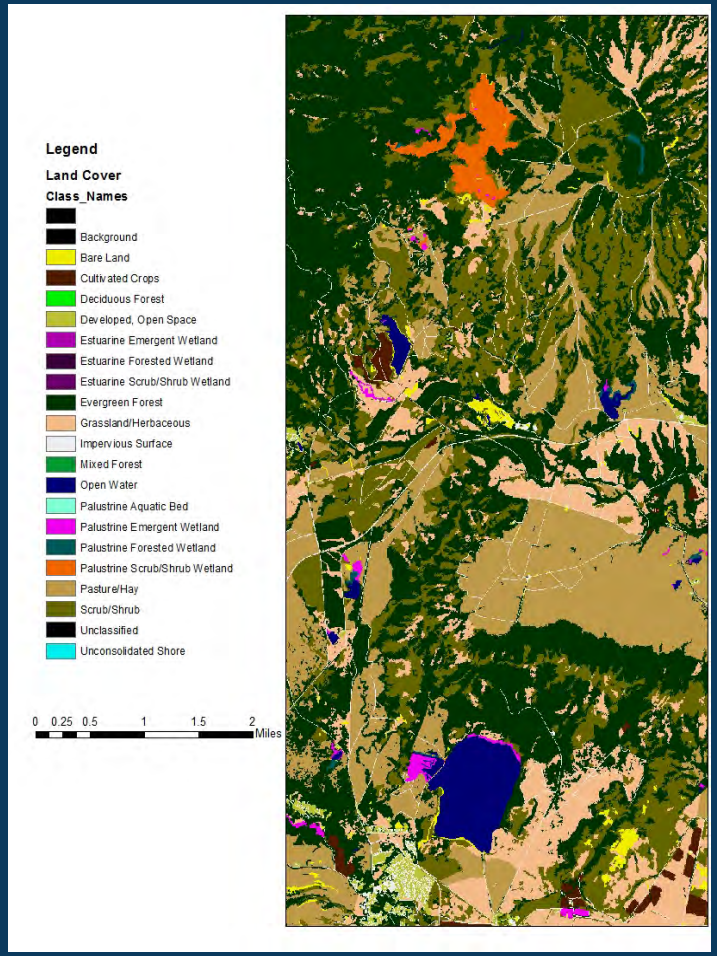
Where to go with data

- Use as is – http://csc.noaa.gov/digitalcoast/
- Add additional dates 1981, 1977 or 2013
- Add additional classes
  - Agricultural crop type
  - Forest type
  - Ecological system
- Add increased spatial resolution, utilize higher resolution NAIP/ortho imagery



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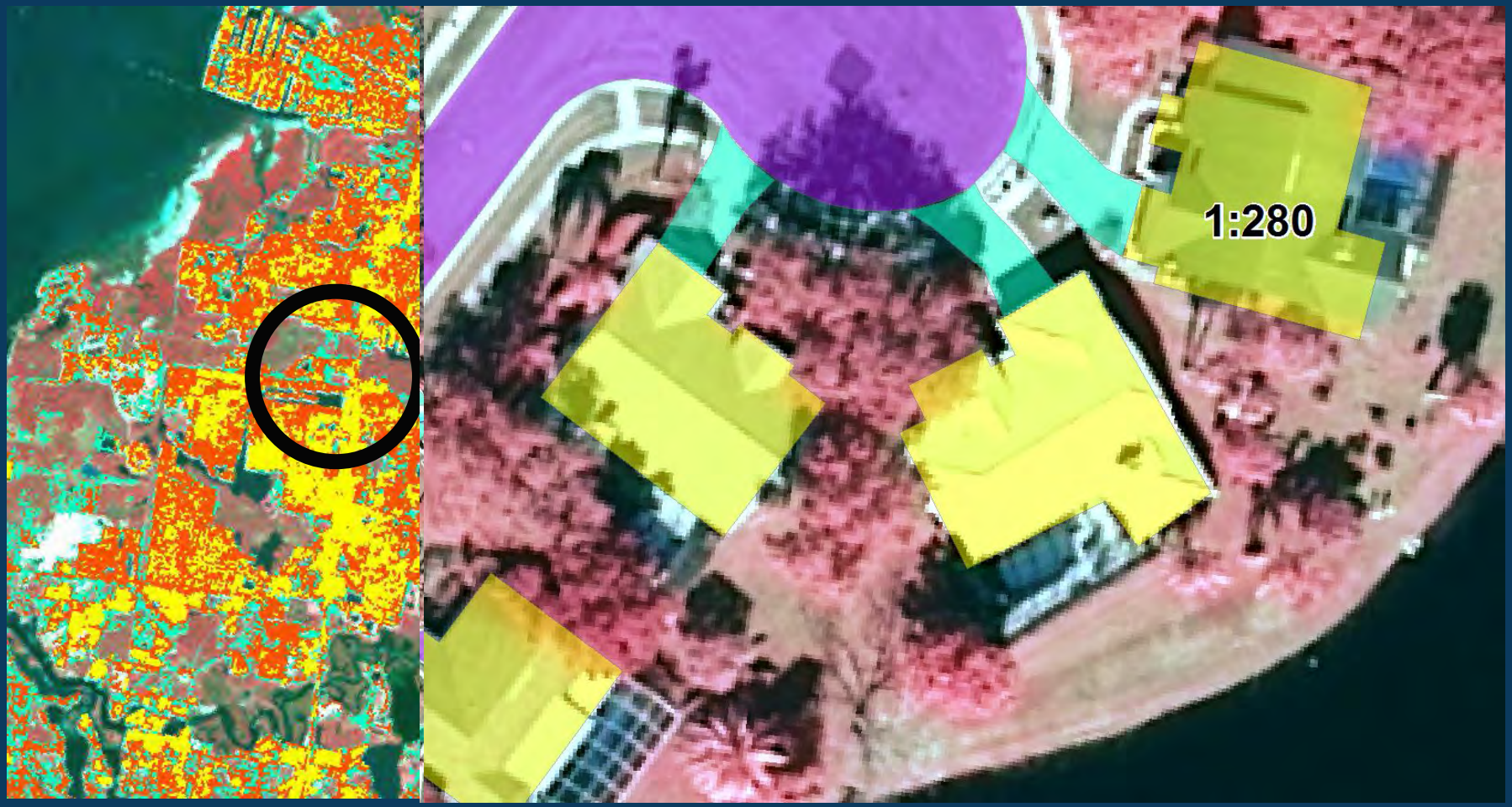
What are Impervious Surfaces?

- NOAA Coastal Services Center High-Resolution Land Cover Project Definition

  "Anthropogenic features such as buildings, parking lots and roads developed from asphalt, concrete or other constructed surfaces which do not allow infiltration from precipitation."

- Some features are up for interpretation
  - Compacted bare soil
  - Two track dirt roads
  - Gravel parking lots
  - Railways
  - Artificial turf
  - Docks

Statewide to Local Scales



Statewide Scale

- 30 – 2.0 meter data
- Less costly to put together than smaller scale data
- Potential uses include
  - Change Detection
  - Trend Analysis
  - Watershed modeling
  - Land Cover/Use Management
  - TMDL and policy development

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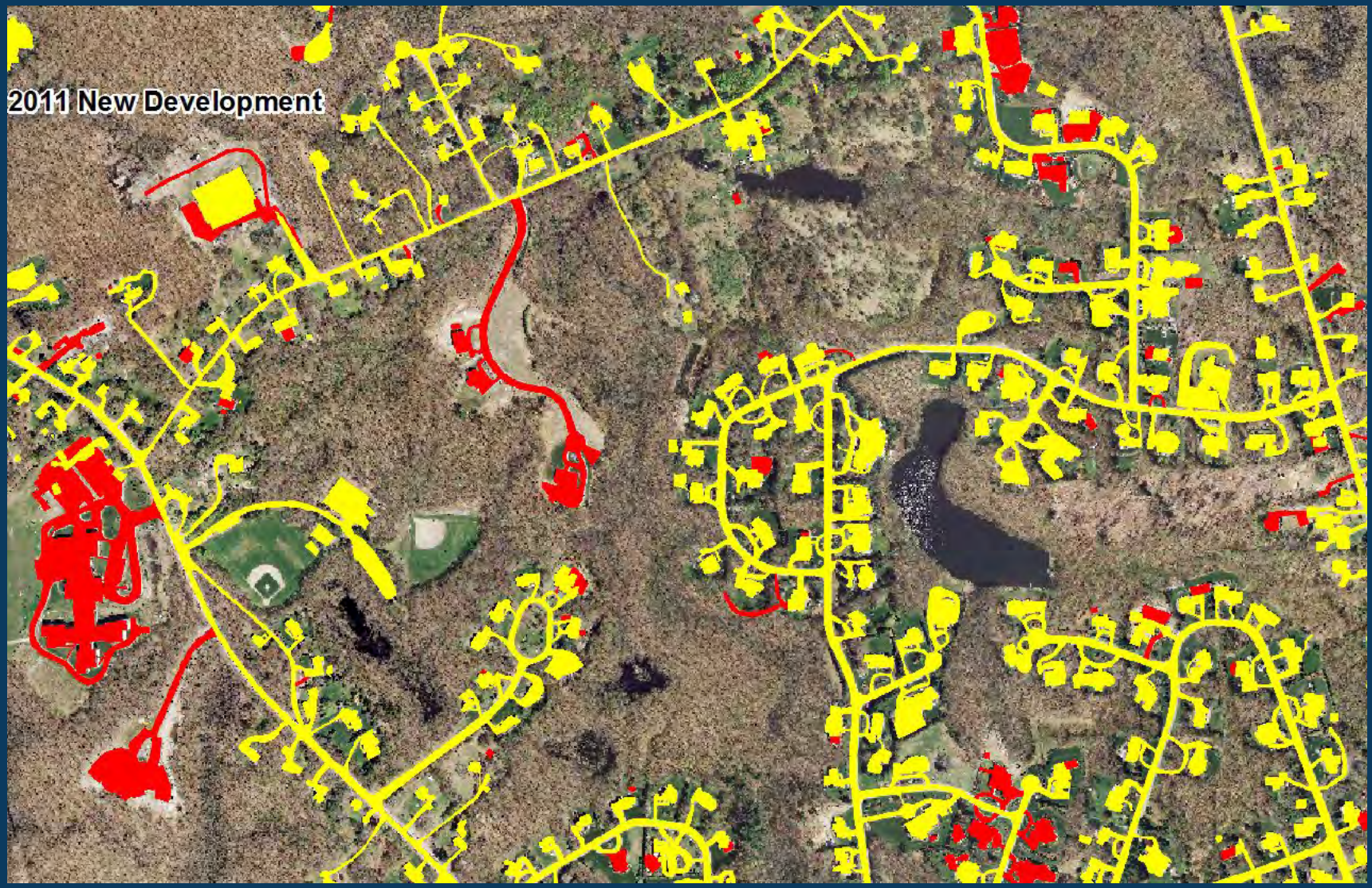
Rhode Island Impervious Data



Local Scale

- 2.0 meter – 0.5 feet and less
- Used for
  - Change detection
  - Trend Analysis
  - Watershed modeling
  - Land Cover/Use Management
  - Monitoring
  - TMDL and policy development
  - Risk assessments by utility companies

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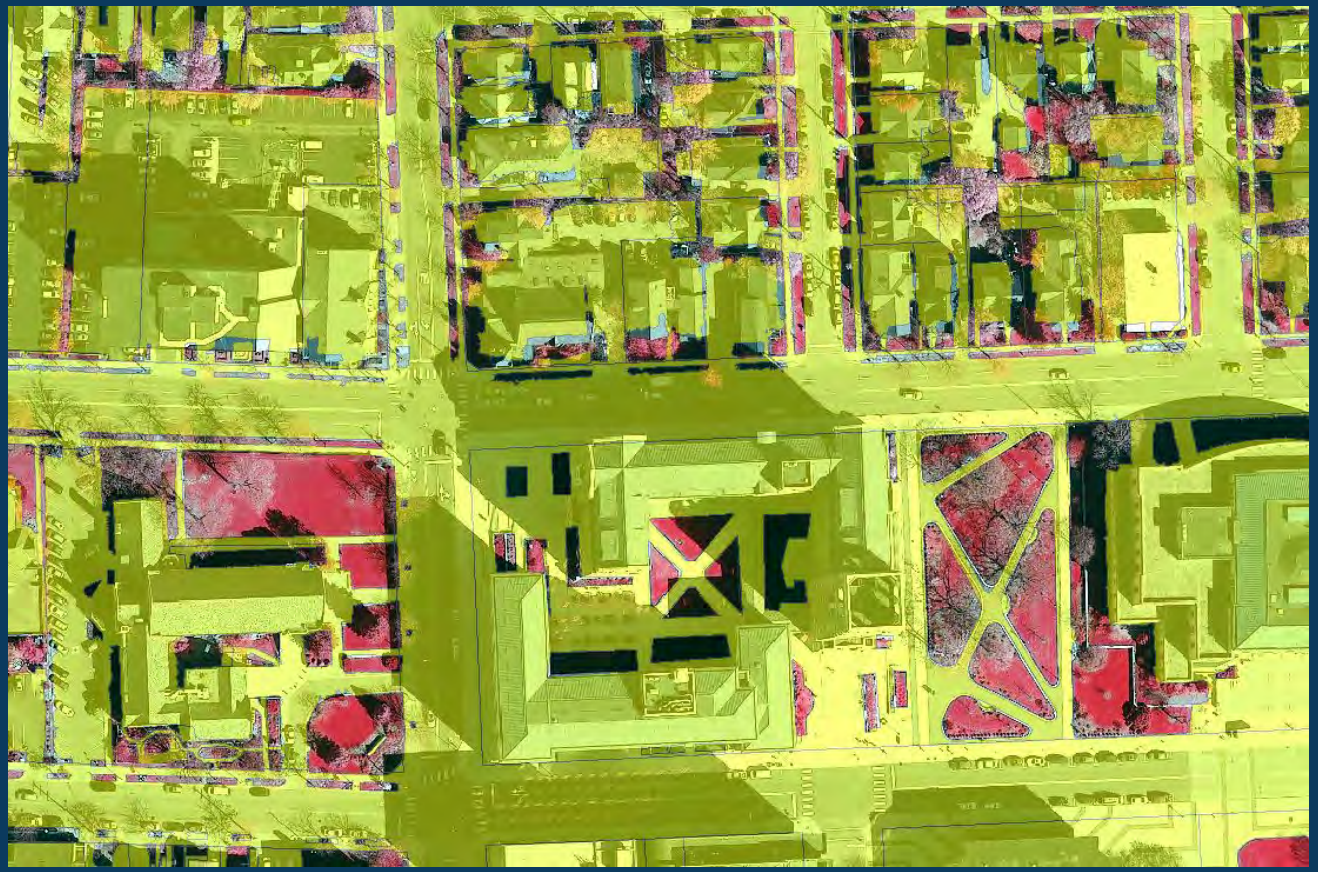
Building Footprints for Risk Assessment

- Unitil Corporation
  - Semi-automated buildings from LiDAR and imagery
  - 225 mi² of New Hampshire

Assessment Level

- 6 inch aerial imagery
- Used for
  - Storm water utility
  - Fee assessment



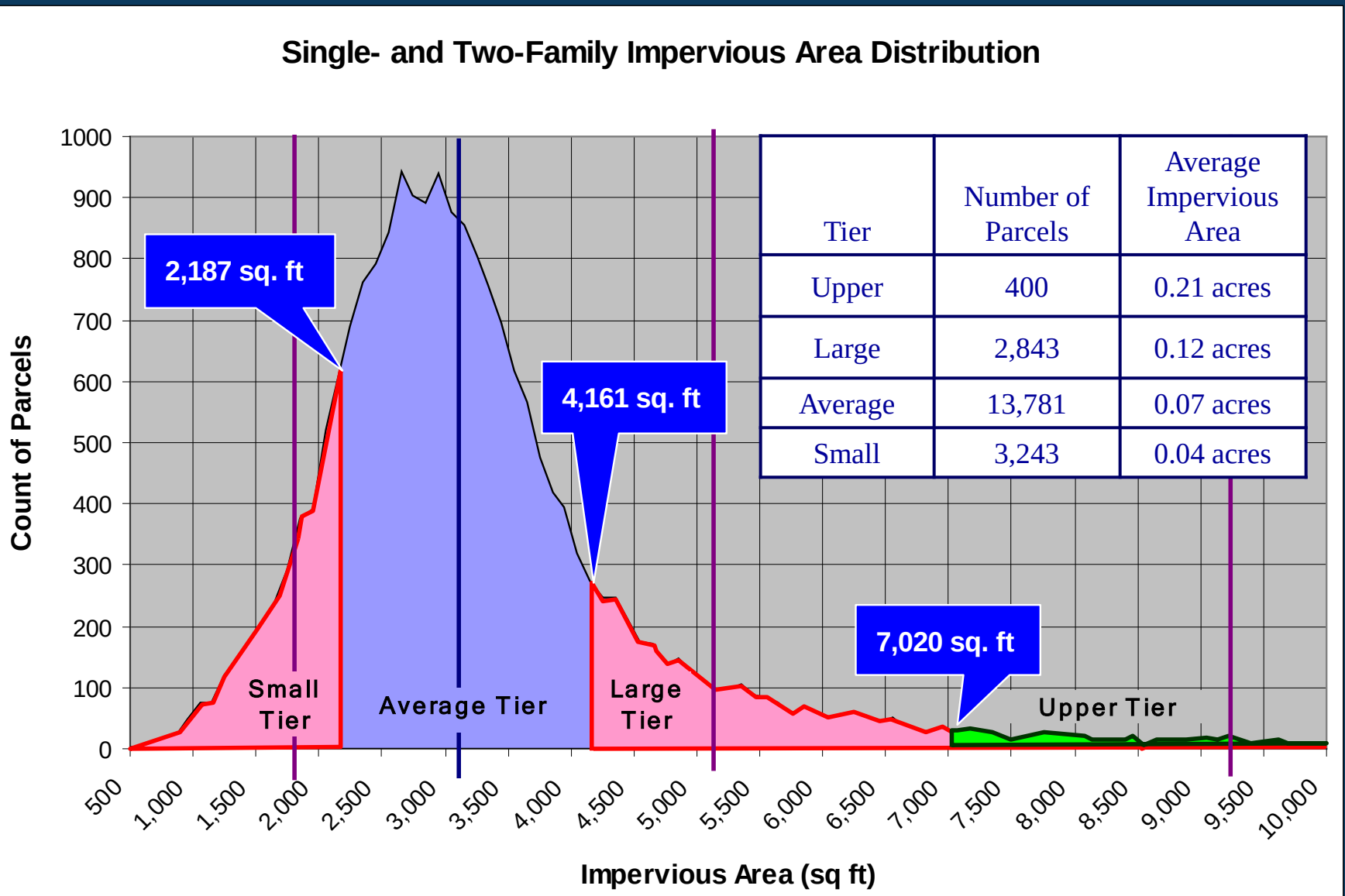
Storm Water Utilities

- Aging storm water infrastructure
- Maintenance and expansion costs
  - Traditionally these costs are built into the water utility rates, general fund costs or taxes
- Rates are generally assessed by type and size of property
  - Indirectly related to use of storm water infrastructure

Why Impervious

- Impervious surfaces
  - primary generator for storm water runoff
  - area is directly related to the volume of runoff from a parcel
- If a property owner is charged for use of the storm water system
  - More equitable
  - Incentivizes the property owners in how runoff is generated leading to better storm water control practices
- A utility fee is not a tax
  - Electric fees are based on usage
  - Water fees are based on usage

Evaluation of Properties



Tier	Number of Parcels	Average Impervious Area
Upper	400	0.21 acres
Large	2,843	0.12 acres
Average	13,781	0.07 acres
Small	3,243	0.04 acres

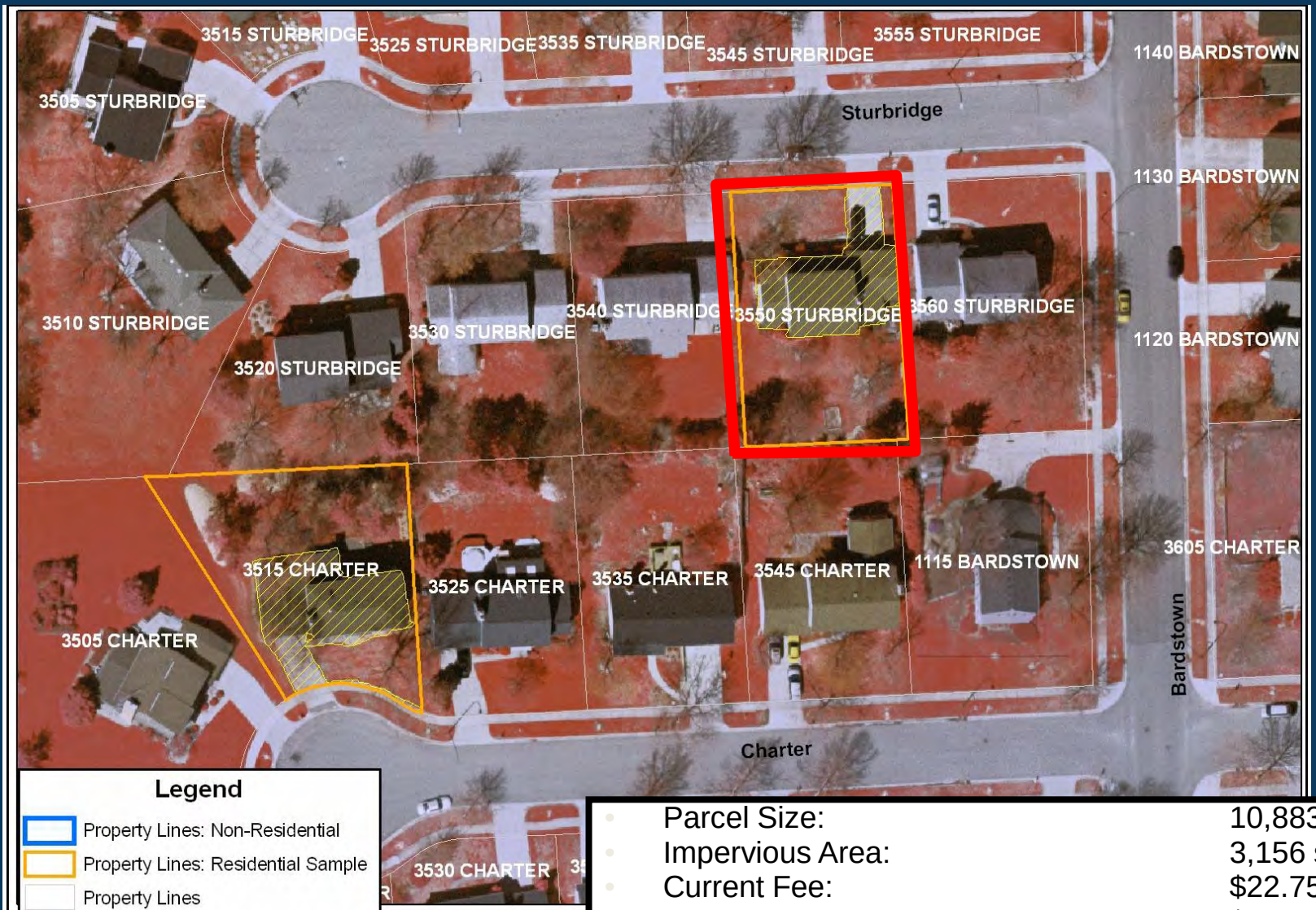
Ann Arbor's Rate Model

- Storm Water Fees:
  - Rates for ALL Residential and Non-Residential Properties
    - $5.92 / quarter / customer PLUS
    - $251.44 / quarter / impervious acre
  - Non-stormwater: $0.27 / quarter / 1000 gal.
  - Reductions for on-time payment
  - Credits recognize on-site stormwater management
- Advantages:
  - Cost recovery proportionate to runoff volume
  - Four residential tiers increase equity and distribution
  - Credit system recognizes stormwater management
  - Allows customers to control use of stormwater service
  - Automates impervious area updates
- Disadvantages:
  - More complex than existing system
  - Additional costs for future updates

Assessment Fees

- Parcel Size: 51820 sq. ft.
- Impervious Area: 9853 sq. ft
- Current Rate Structure: $ 22.75 / quarter
- User Fee Based on Impervious: $ 58.72 / quarter

Assessment Fees



- Parcel Size: 10,883 sq. ft.
- Impervious Area: 3,156 sq. ft
- Current Fee: $22.75 / quarter
- User Fee Based on Impervious: $20.37 / quarter

3D Building Models

- Extruded
- Architectural

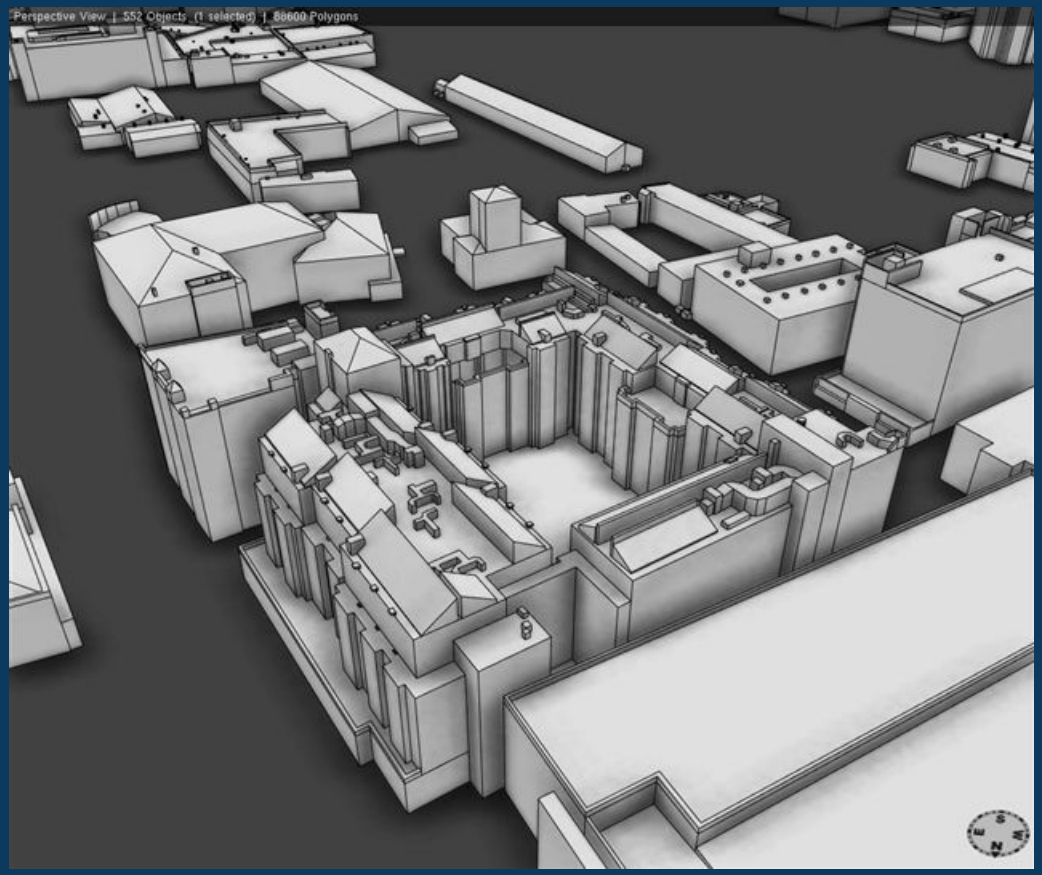
http://opticks.org/confluence/display/~sbmiller/2012/01/12/LiDAR+-+An+expanding+field+to+be+excited+about

Extruded Building Footprints

- Overlay with census data for population density
- Emergency response
- Geocoding
- Visualization

Architectural Building Footprints

- City Planners and Developers
- Sustainability Planners
- Facility managers
- Civil engineers
- Police and security personnel
- Military Personnel



http://www.cybercity3d.com/index.php?option=com_content&view=article&id=121&Itemid=76/

Planning and Zoning

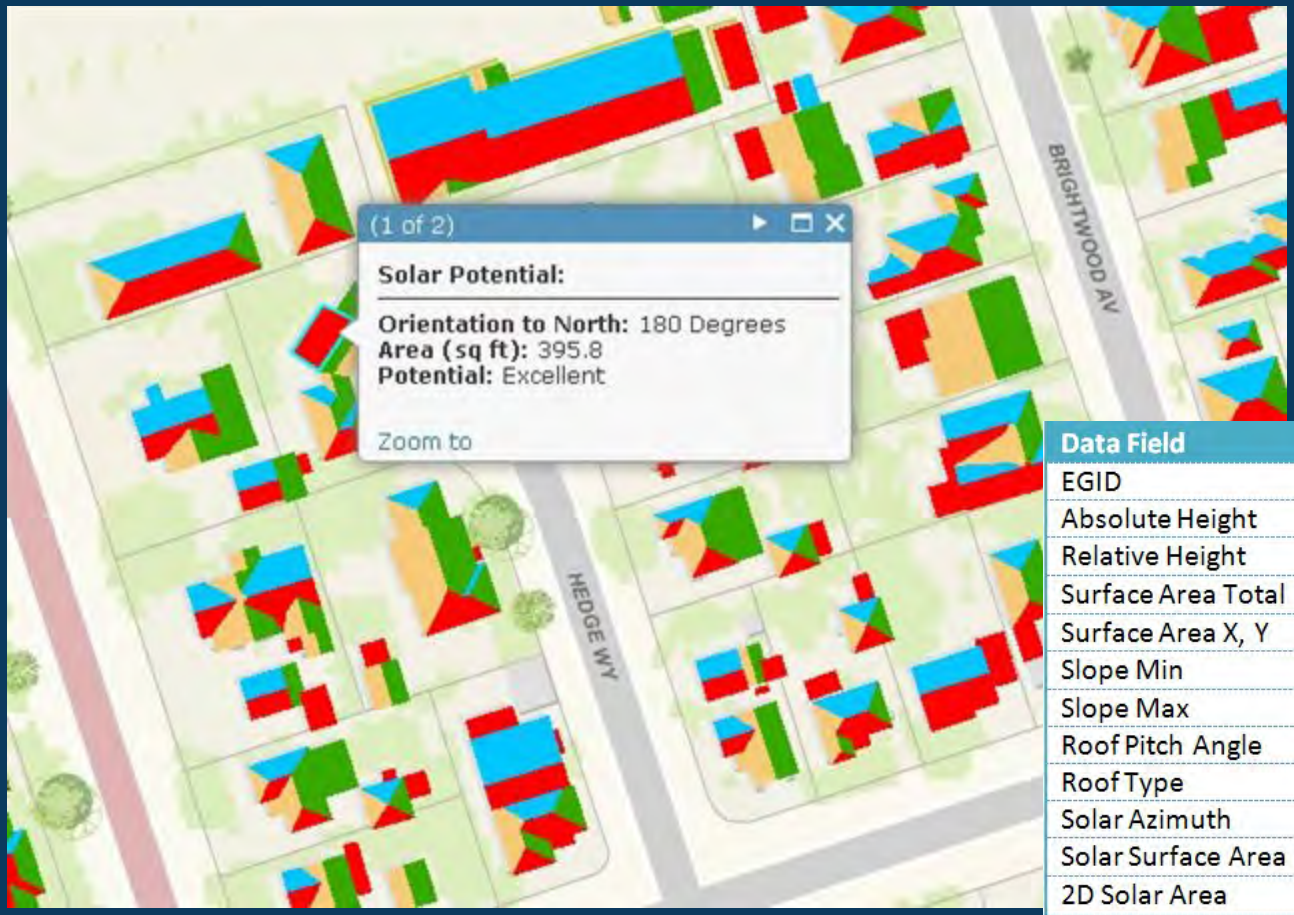
- ESRI's CityEngine
  - 3D city models
  - Store, visualize, analyze 3D data

http://www.esri.com/software/~/media/Files/Pdfs/library/brochures/pdfs/esri-cityengine.pdf

Shadow Study from 3D Models

http://www.cybercity3d.com/

Solar Roof Potential



Data Field	Description
EGID	Building ID number
Absolute Height	Height relative to sea level
Relative Height	Height relative to DTM
Surface Area Total	Total 3D area
Surface Area X, Y	2D polygon total area
Slope Min	Slope of roof polygon minimum
Slope Max	Slope of roof polygon maximum
Roof Pitch Angle	Solar roof slope in degrees
Roof Type	Roof description (Flat, Saddle, etc)
Solar Azimuth	Roof orientation relative to North
Solar Surface Area	Solar roof surface area
2D Solar Area	2D polygon area measurement
Sp Façade	Superstructure façade area
SP Roof	Superstructure roof area

http://proceedings.esri.com/library/userconf/muc12/papers/muc_13.pdf

The greening of Detroit

- Utilizing the potential of non-developed areas
  - Stormwater retention
    - Costs and return on investment with green infrastructure
  - Human health benefits
  - Environmental health benefits

Conclusions

- Historic Data
  - Large scale for broad, regional analysis
  - Changes over time are captured for monitoring
- Impervious data sets provide information at a variety of scales for multiple uses
  - Small scale impervious data
    - Planning, Assessment, Visualization
  - 3D buildings
    - Accurate measurements
    - New applications emerging as technology improves
- Green Infrastructure
  - Implementing land uses for reduced stormwater treatment

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Questions