MISSOURI
LiDAR Stakeholders Meeting

East-West Gateway
June 18, 2010

Tim Haithcoat – Missouri GIO

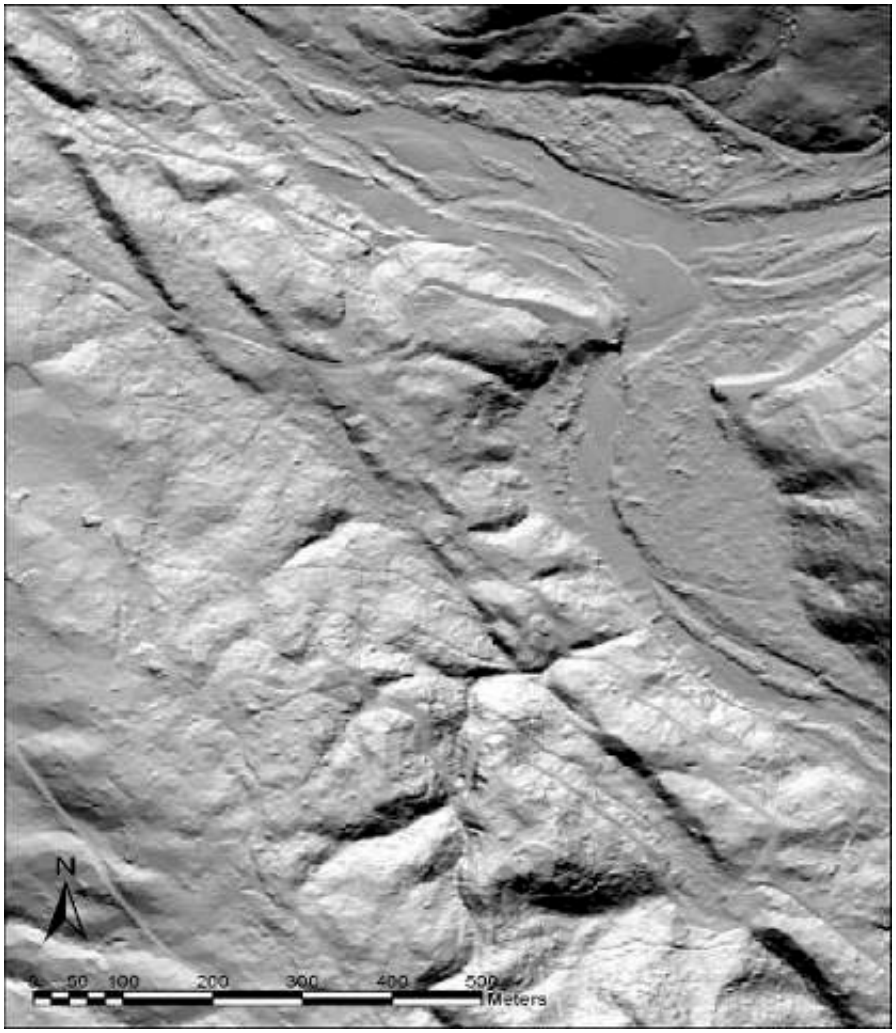
Enhanced Elevation Data…

- Business requirements are changing….fast
- New data collection technologies are dramatically changing how we think about the surface of our planet
- The concept of elevation is changing from a bare earth surface characterization to a 3D model of the landscape including bare earth, built environment, vegetation structure, and other features
- Applications must evolve (quickly) to meet these business requirements
- LiDAR is a revolutionary 3D mapping technology

Lidar Point Cloud Versus Lidar-Derived Products

- Point cloud includes the 3D collection of all LiDAR points (returns)
- Point cloud derivatives are:
  - Bare earth DEM, DSM or other surface
  - Extracted features:
    - Land cover classes
    - Building footprints and 3D models
    - Other infrastructure features (multiple classes)
    - Vegetation characteristics (horizontal and vertical structure, tree heights, canopy volume, closure, etc)
  - Single-band intensity images

Lidar Capabilities – Bare Earth



Carol Prentice, USGS

Figure 1

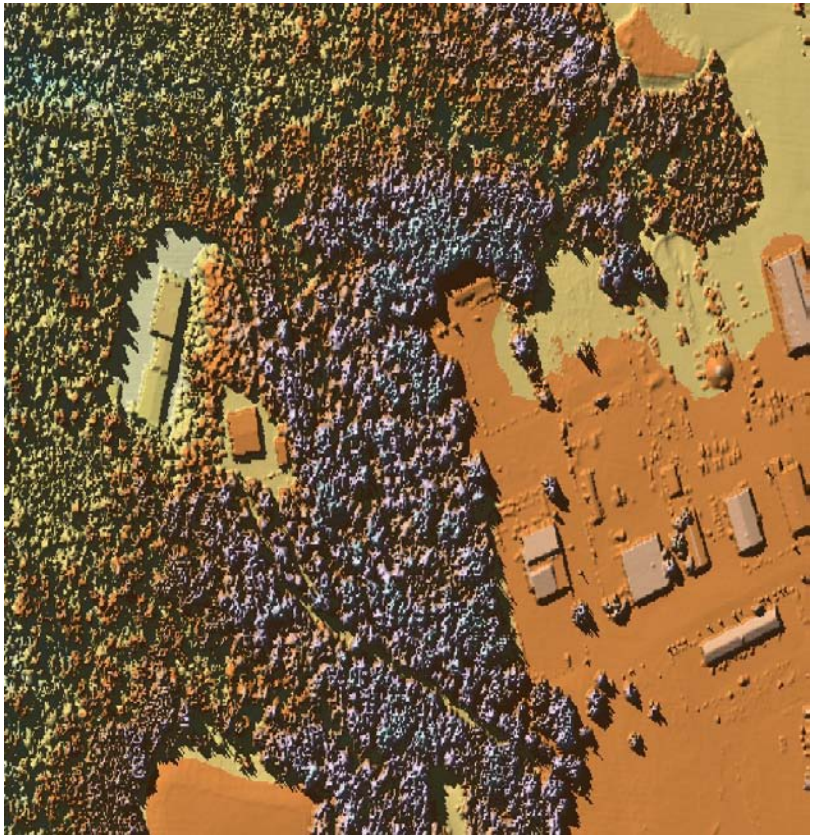


Figure 2

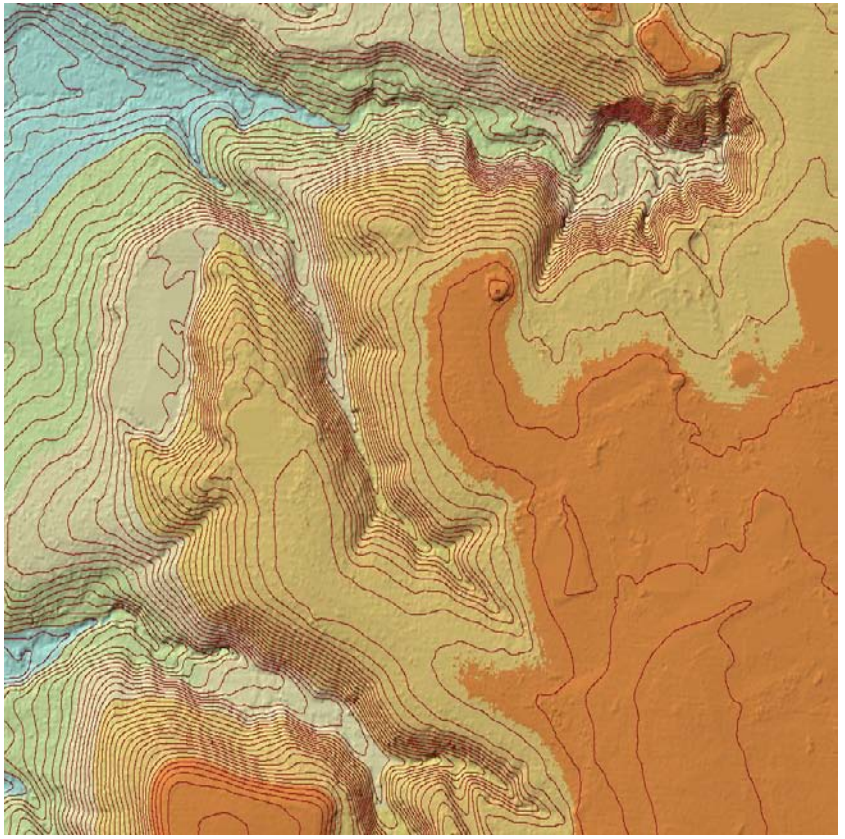
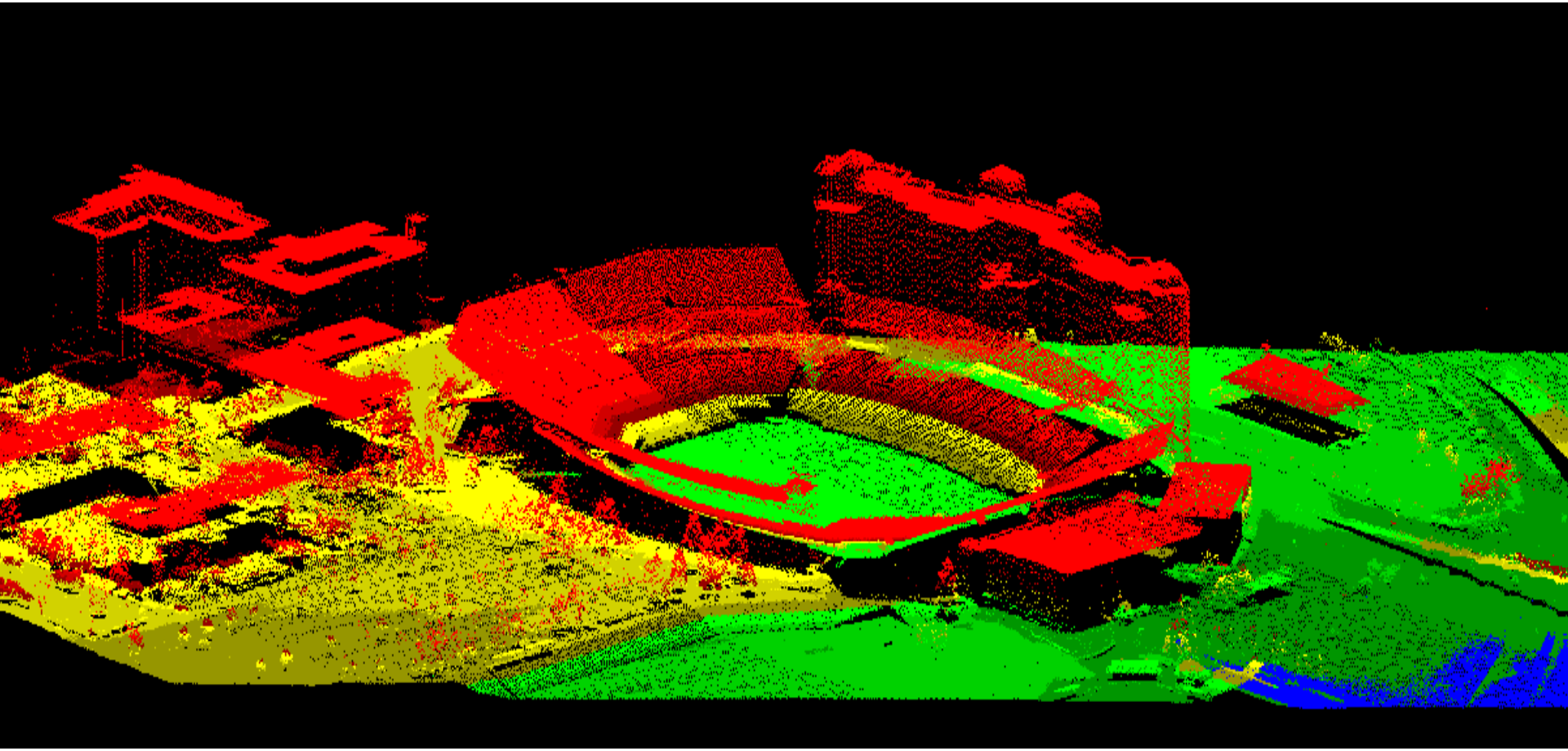


Figure 1 above shows LiDAR first-return mass points, colored by elevation. One can clearly see the buildings and trees. **Figure 2** shows a bare-earth terrain model and contours, derived from the same data after processing to remove the buildings and trees. The ravines present in wooded areas are accurately depicted from the subsequent returns that penetrated the upper tree canopy.

Examples of Point Clouds - Structures

University of Nebraska



USGS study - 2003

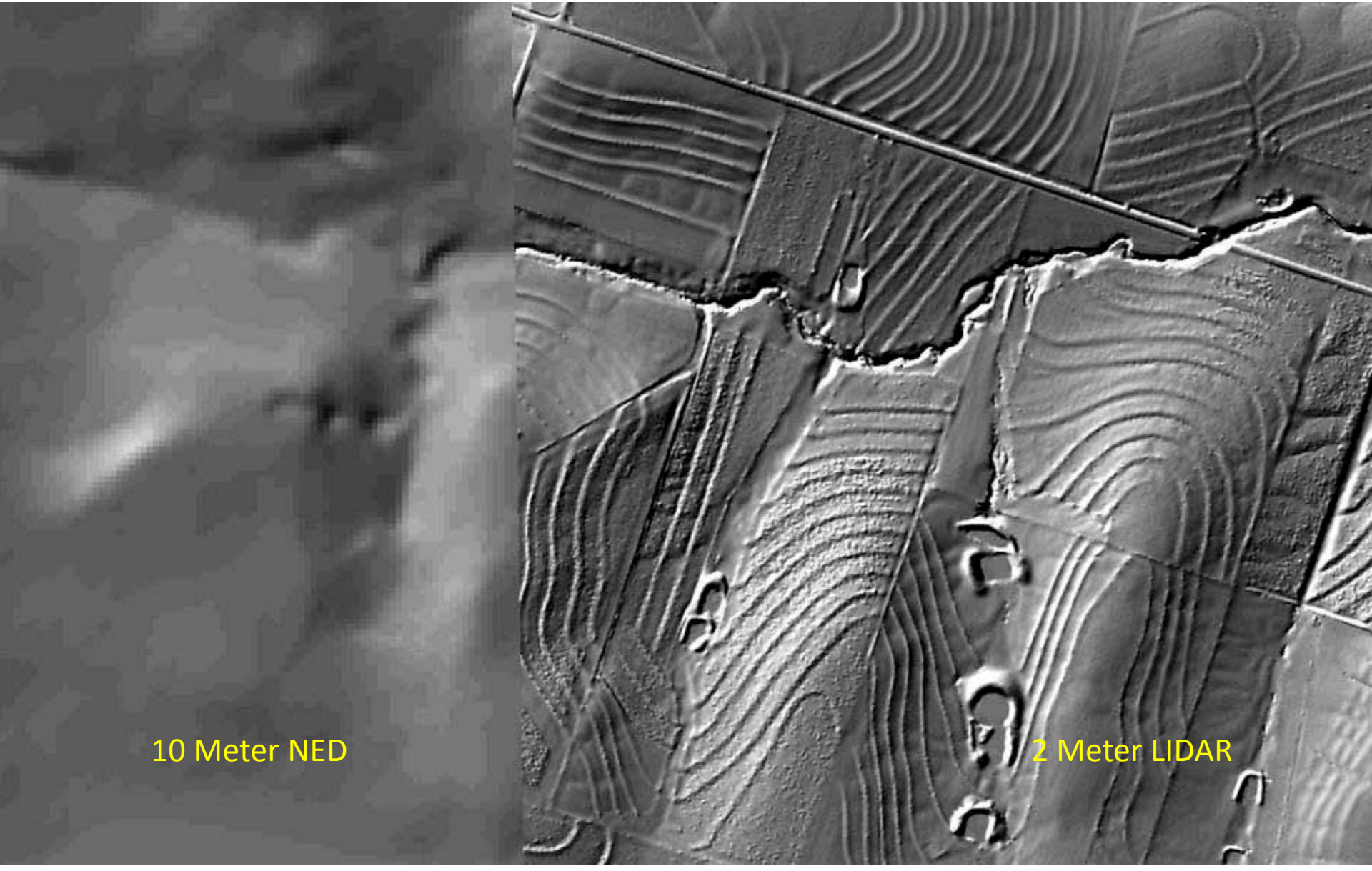
How Many Applications ?

- Mapping urban channels vs natural stream
- In the creation of seamless topo/bathy products
- Integration of elevation data into the NED
- Derivation of stream channel characteristics
- Mapping and monitoring coastal hazards
- ID of small hydrologic features (ditches, tile drain studies)
- Mapping fish habitat
- Characterizing wildlife habitat
- Identification of canopy gaps
- Flood inundation modeling
- Derivative hydrologic profiling
- Disaster response
- Fire science
- High-resolution floodplain mapping
- Characterization of canopy structure
- Defining drainage basins
- Fault-rupture mapping
- Monitoring sea level rise
- Natural Hazards
- Identifying landslide-prone areas
- Creating topographic maps
- Glacier changes
- Carbon sequestration assessments
- Homeland security scenarios
- Delineation of canopy surface and forest metrics
- Determination of watershed characteristics
- Delineation of building structures
- Characterization of urban settings
- Monitoring long-term shoreline change
- Mapping land cover and land use
- Measuring earthquake deformation
- Delineation of volcanic structure
- Monitoring volcano hazards
- Urban mapping
- Powerline mapping
- Hydrologic Modeling
- Bare earth products
- Monitoring debris flows
- Wave height surveys
- Sedimentation into rivers
- Monitoring geomorphic processes
- Identification of ponding areas
- Mapping wetland drainage
- Creation of synthetic drainage networks
- Identifying culverts
- Transportation mapping
- 3-D visualization of buildings
- Volume visualization
- Identifying bird habitats

Why is Better Data Needed?

- Many applications require it!
  - For example, National Elevation Dataset has an RMSE of 2 meters
  - FEMA guidelines for flood hazard mapping require a RMSE of .185meters
- 3D data for above-terrain features (vegetation and built-up) is not being fully utilized
- Recent high resolution LiDAR collections are inconsistent and difficult to integrate

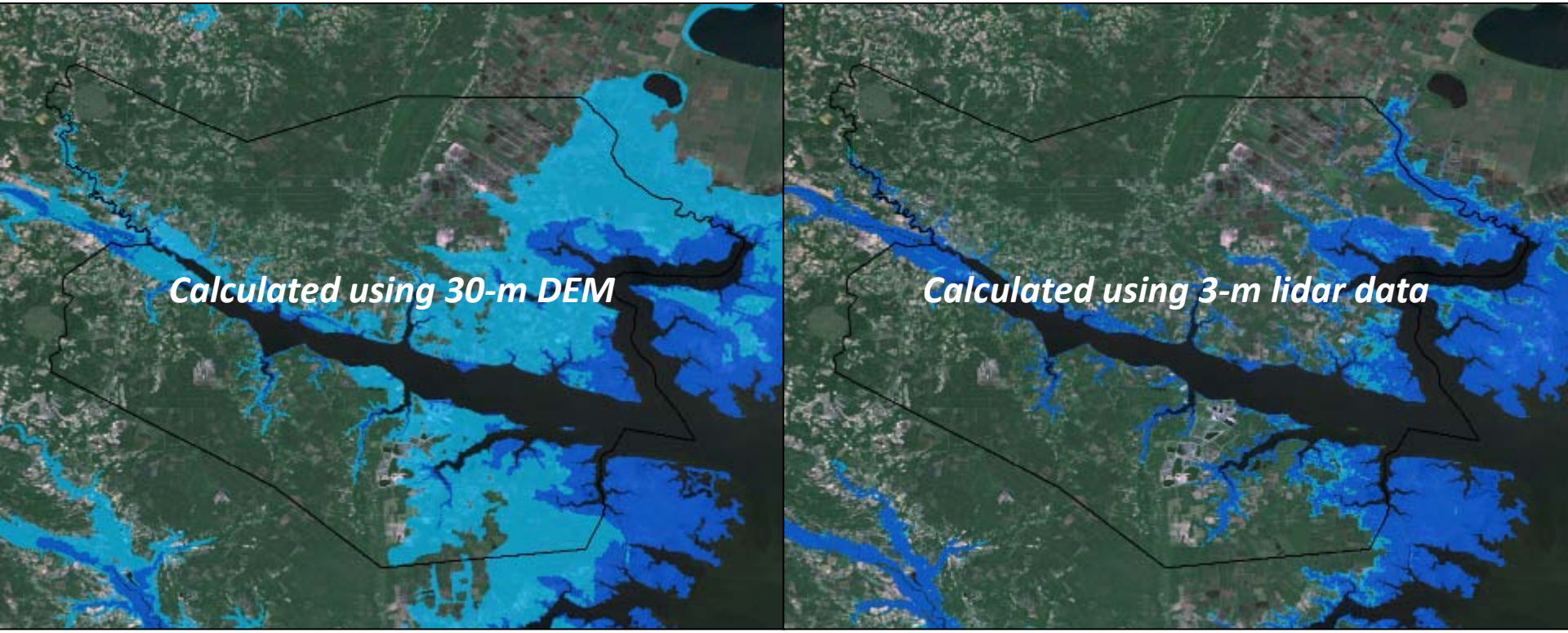
Enhanced Elevation Dataset



Beaufort County, North Carolina

Modeling Flood Inundation:
if Sea-Level Rises 1-Meter

Lighter blue tint is the area of uncertainty

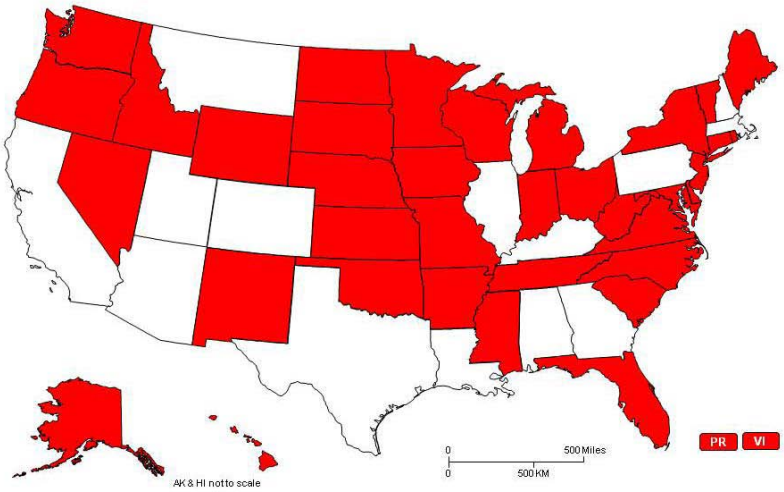


"The principal factor impacting the reliability of the floodplain boundary delineation is the quality of the input digital elevation information"

(National Research Council Committee on Floodplain Mapping Technologies, 2007).

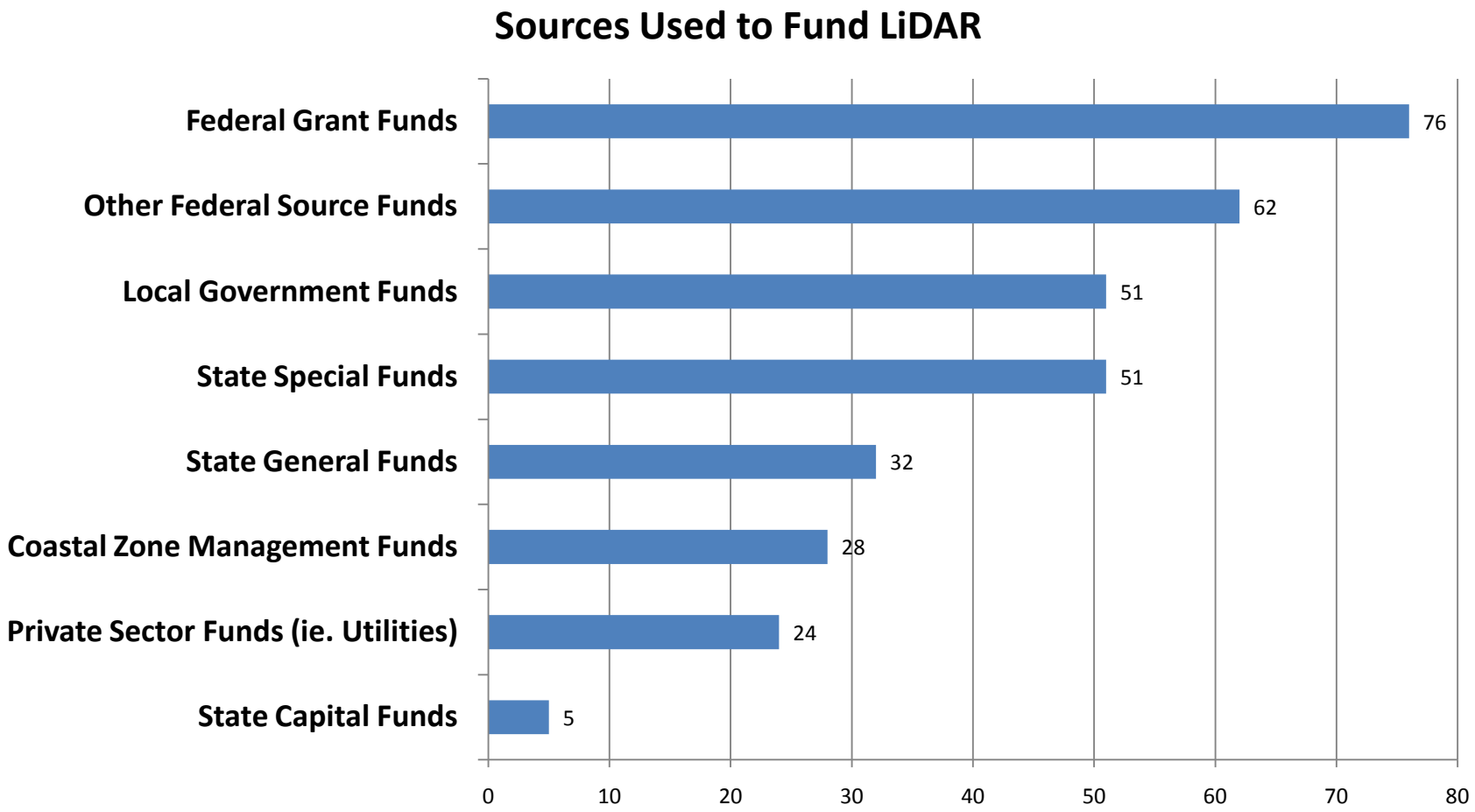
National States Geographic Information Council Survey

Jan 2010



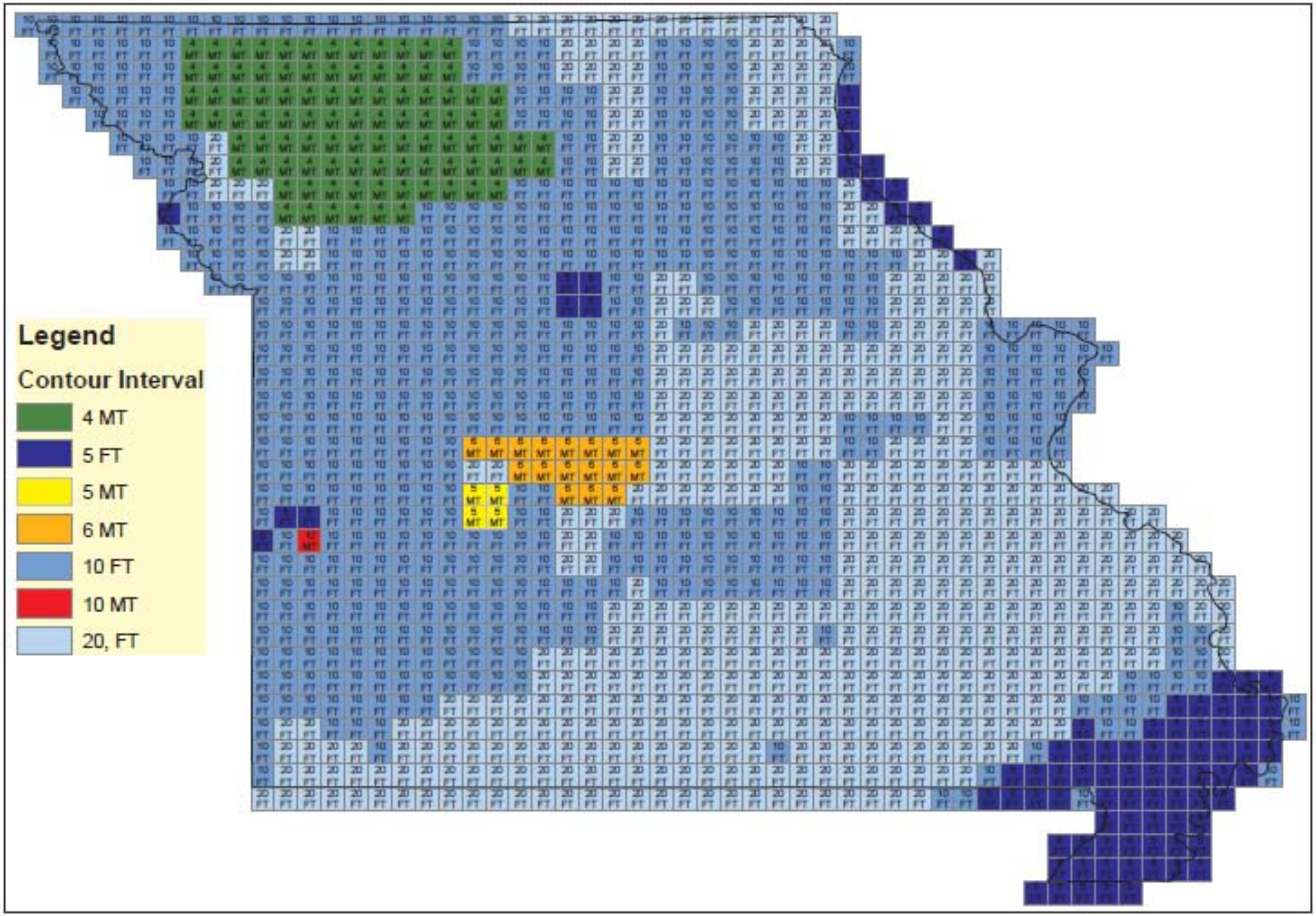
- 41 people from 37 states
- Programs
  - 15 cm vert / 2-ft contours
    - 85% - possibly partner
    - 88% - would meet over 61% of state business requirements
  - 9 cm vert / 1-ft contours
    - 42% - possibly partner
    - Would meet a larger portion of state business needs

National States Geographic Information Council Survey (January 2010)

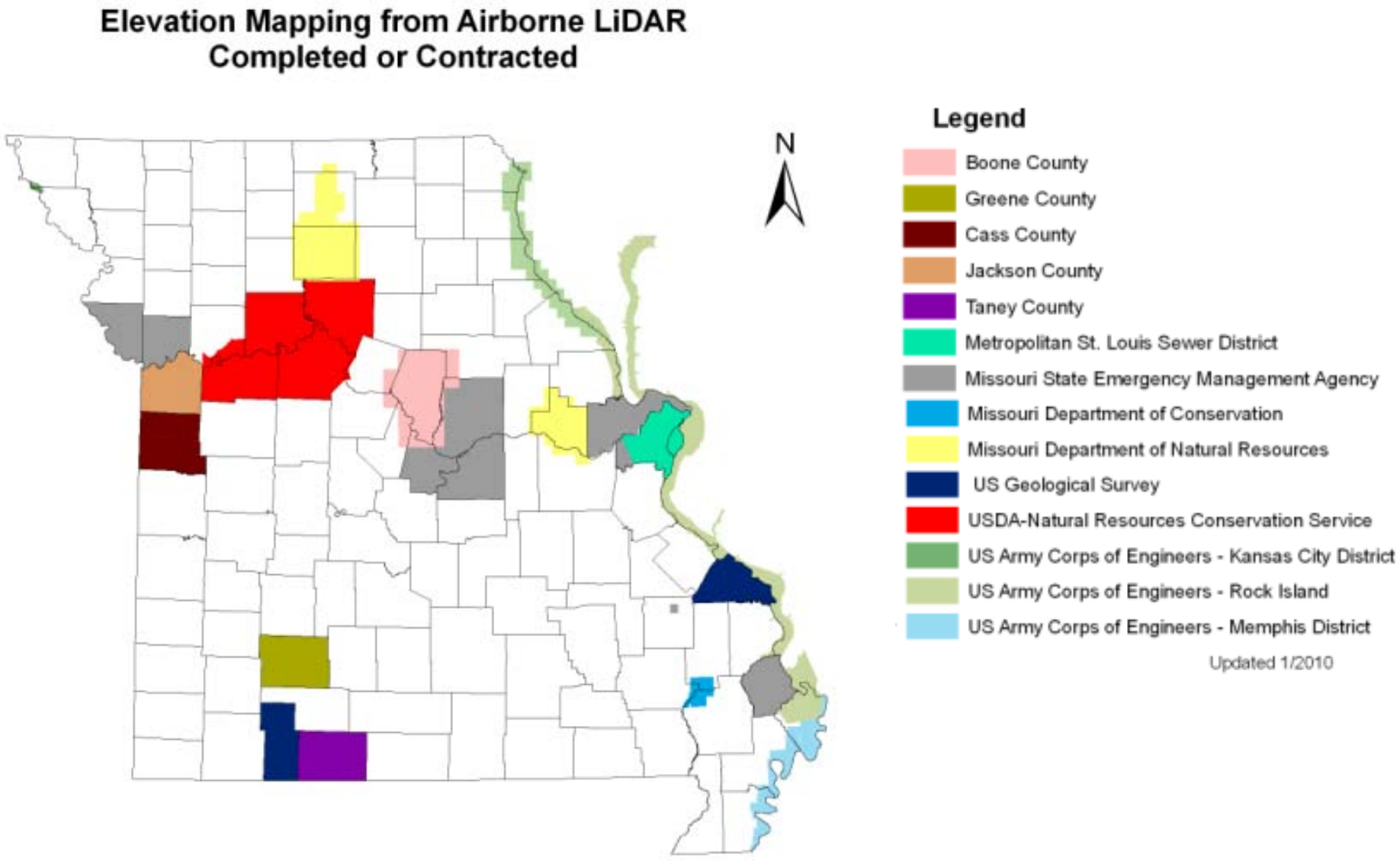


Percentages total more than 100% because data partnerships usually involve funding from multiple sources.

Paper Map Intervals for Missouri



Known State Acquisitions



Geospatial Coordination
FEMA Region VII

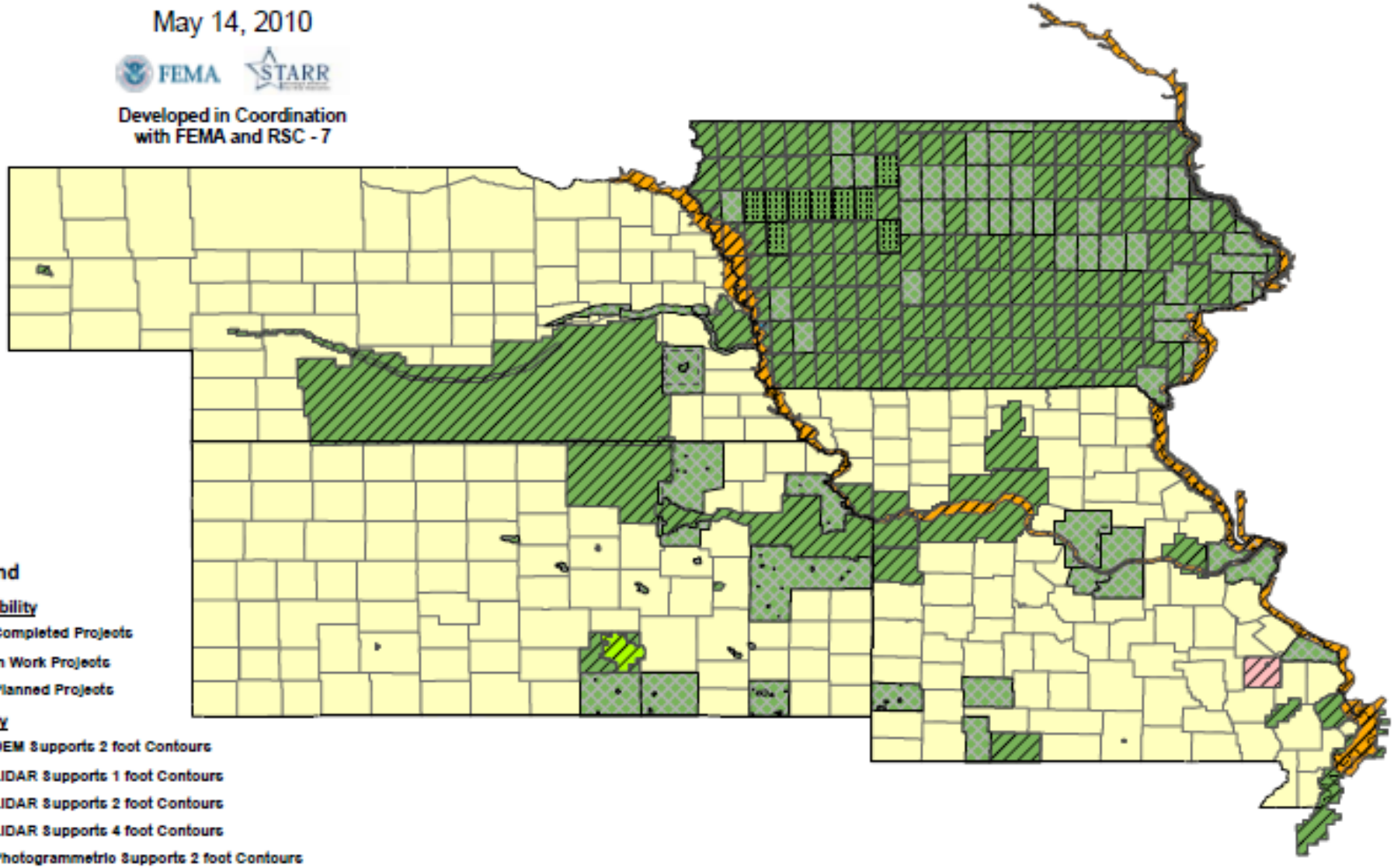
Topographic Inventory
Status Map

May 14, 2010

FEMA STARR

Developed in Coordination
with FEMA and RSC - 7

Basemap Source: ESRI
NOTE: Map scale is not referenced



Legend

Availability

- Completed Projects
- In Work Projects
- Planned Projects

Quality

- DEM Supports 2 foot Contours
- LIDAR Supports 1 foot Contours
- LIDAR Supports 2 foot Contours
- LIDAR Supports 4 foot Contours
- Photogrammetric Supports 2 foot Contours
- Photogrammetric Supports 4 foot Contours

LiDAR Stakeholders

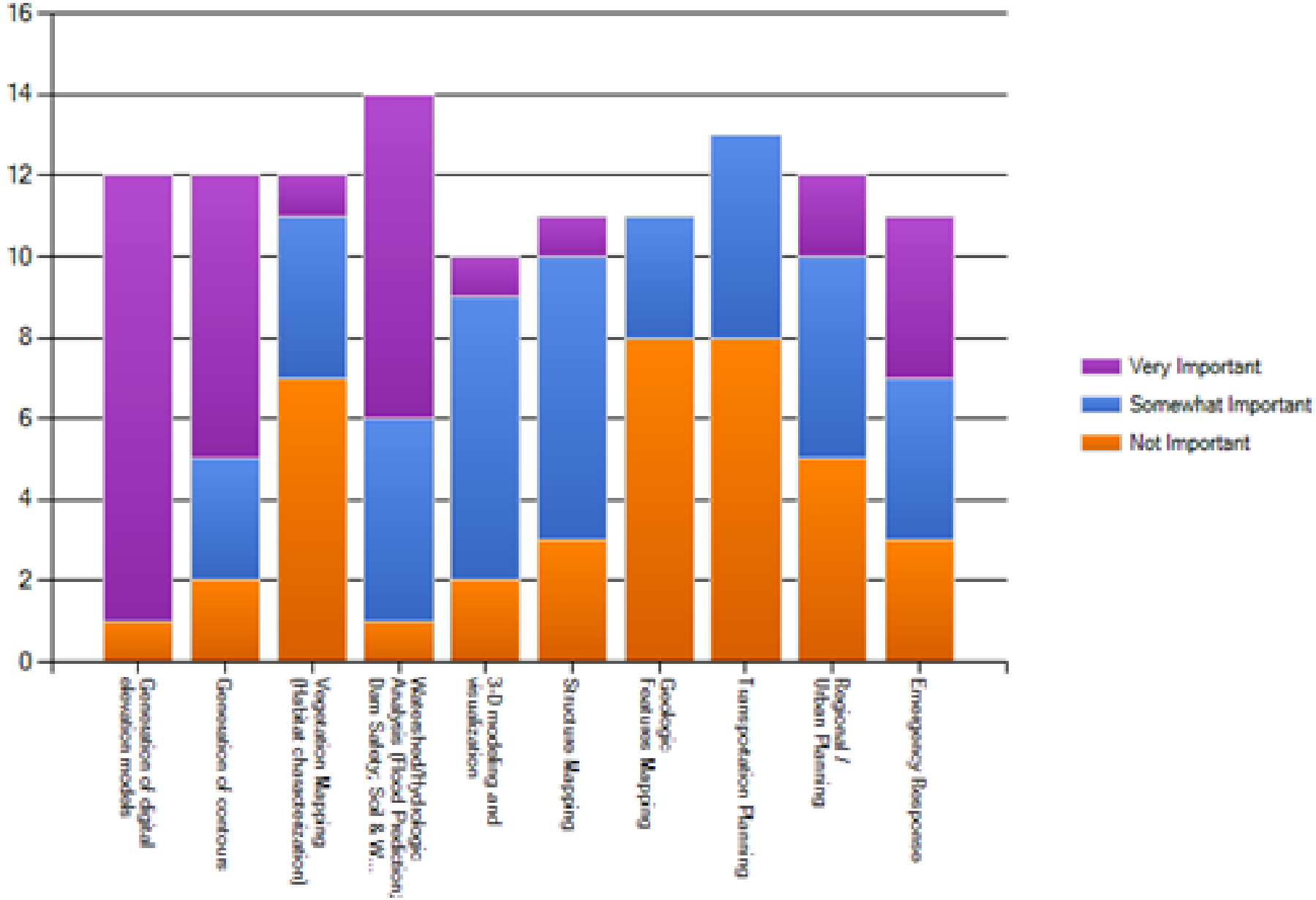
- Federal Agencies (DOI/USGS, FEMA, USDA, NOAA, USACE, DOT, NGA, etc.)
- State of Missouri and its agencies (SEMA, DNR, MDC, MoDOT, etc.)
- Local governments (County, Municipal, Regional, etc.)
- Private Sector (Utilities, Insurance, etc.)
- Other organizations or groups?

Missouri LiDAR Survey

May 2010

- 16 people – small number! Need more!!
- 68% already acquired some LiDAR
- 68% making plans to acquire LiDAR in the next two years
- What Type of Program?
  - 15 cm vert / 2-ft contours
    - 81% - possibly partner (56% very likely)
    - 62% - would meet over 61% of your business requirements; BUT 25% said only 0-20% of needs

Please rank the following business requirements for LiDAR data from your perspective.



Expectations of a State Program

- Cohesive pre-planned statewide effort to map terrain, the built environment, and vegetation structure
- Multi-use / multi-purpose for environment, infrastructure, forestry, hazards, etc.
- Balances requirements, benefits, and costs
- Standards-based to maximize interoperability and multi-use
- Includes partnerships among Federal, State, Local and private organizations
- Offers on-demand derivative products for business uses
- Maximizes commercial sector involvement
- Spawns new markets and user communities
- Relies predominantly, but not exclusively, on LiDAR

Missouri Enhanced Elevation Business Plan

- Being undertaken by MGISAC Data Development Committee to:
  - Develop and refine requirements for a State program to meet priority Federal, State, and local needs within Missouri as well as address national business needs
  - Identify program implementation alternatives and associated benefits and costs

- Quantify answers to key questions:
  - Is it more cost effective for Missouri to manage these activities within the context of a coordinated statewide program?
  - Are there additional state, organization, or agency benefits derived from such a strategy, and what are they?
  - What does the optimized program look like?
  - What group could lead this coordination and what would it look like?
  - What are key technical limitations or innovations that may impact the appropriate timing or strategy for a statewide program?

Missouri Multi-Year Effort

BY THE NUMBERS

- Currently, Federal, State and Local government are acquiring LiDAR with relatively small project areas, generally comprising one county at a higher price per sq mile; range of $250 - $350 / sq mile.
- We have 12,254 square miles (17.5%) either acquired or planned. Assuming acquisition at a minimum of $250 per sq mile (current estimate for Cole, Callaway and Osage Counties for SEMA) – potentially $3,063,500 has already been invested in LiDAR within the state.
- Remains 57,455 sq miles (82.5%) - at $250 / sq mile = **$14,363,750**.
- As much of the cost of LiDAR acquisition is fixed, there are significant cost savings by contracting for large projects which a state-wide plan would provide the focus for.
- Remains 57,455 sq miles - at $170 / sq mile = **$9,767,350.**
- Coordinated contracting through partnering over larger areas has potential **cost savings of $4,596,400 dollars**

For budgeting purposes, a cost of $170 per square mile for LiDAR acquisition has been averaged from informally asking several data providers for regional pricing.

Programmatic Goal and Objectives

Programmatic Goal: *Develop LiDAR data for improved statewide elevation data, and other uses for a multitude of critical applications and risk determination*.

Objectives:

1: Identify elevation program management team who will champion the project

2: Gather core requirements and expectations from stakeholder community

3: Analyze current and near future high resolution elevation data collection efforts to determine the necessary geographic extent of the program

4: Evaluate available technical options and approaches for suitability

5: Develop technical specifications, determine acquisition criteria, and procure services according to scope of work

6: Determine data storage and other management strategies, mechanisms for promoting the availability of the data, its potential applications, and distribution details

7: Request program cost estimates from qualified data providers based on a scope of work

8: Identify and pursue program funding source(s); encumber funds

9: Advertise and make available project deliverables to stakeholders

10: Conduct post-project assessment, including success factors and lessons learned