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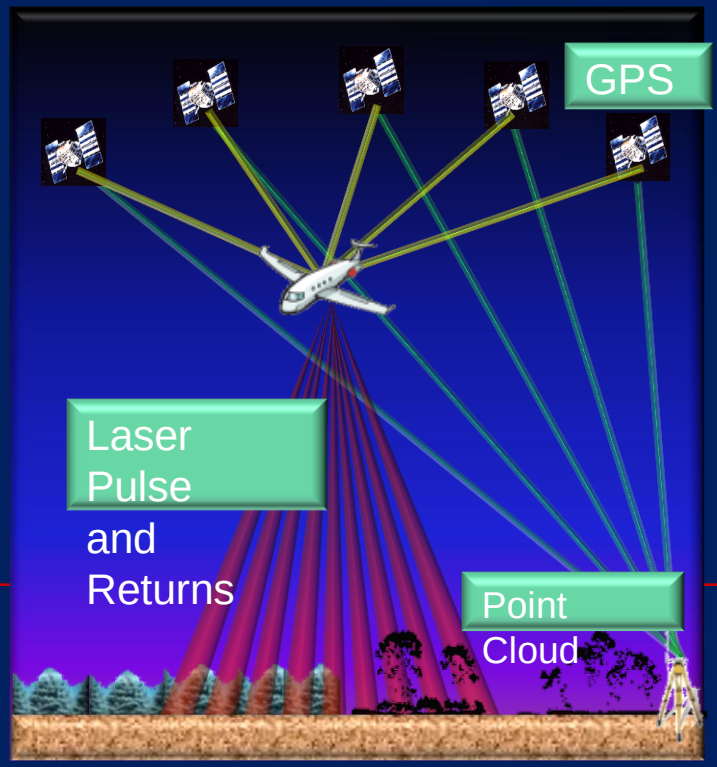
3-D Elevation Program (3DEP)

(Lidar for the Nation)

Charley Hickman - USGS
East Lakes ASPRS & AAG 2013
University of Toledo



USGS
U.S. Department of the Interior
U.S. Geological Survey

Charles Hickman

Geographer - U.S. Geological Survey

National Map Liaison to Ohio, Michigan, and Kentucky

6480 Doubletree Avenue Columbus, Ohio 43229 USA

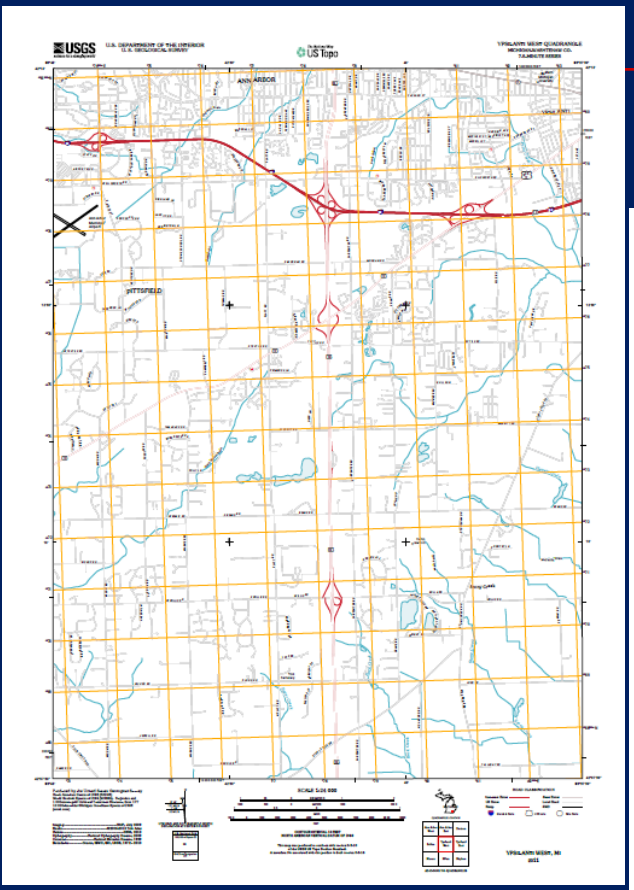
chickman@usgs.gov (614) 430-7768

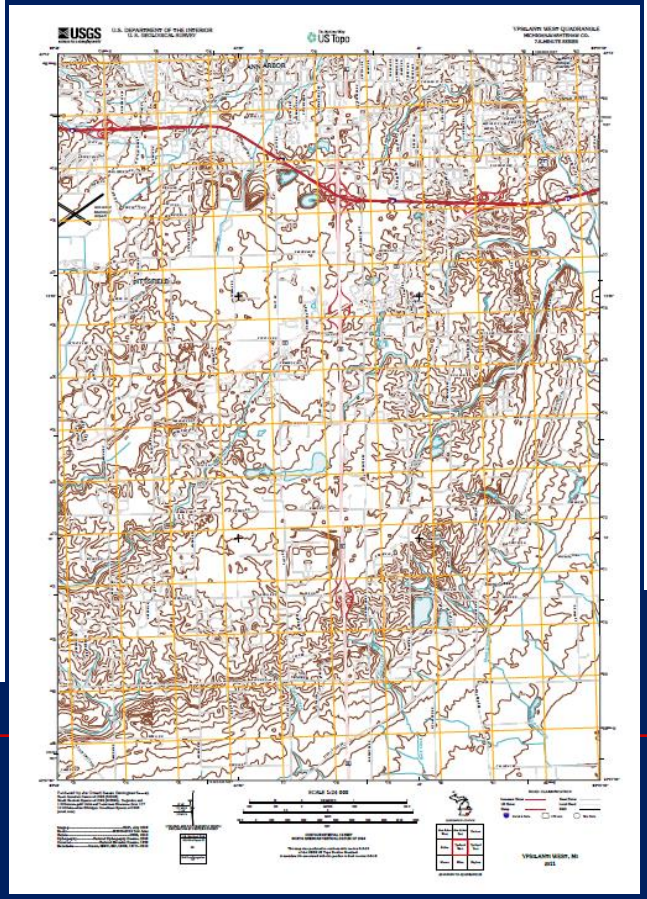
http://nationalmap.gov/3DEP/

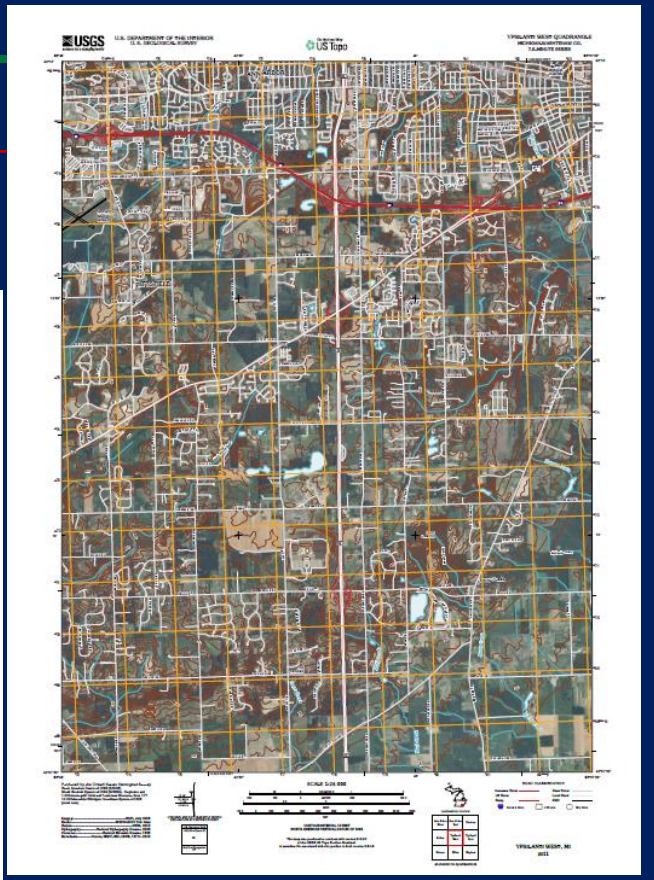
http://nationalmap.gov

- **Ask USGS**
- **Email: ask@usgs.gov,**
- **Phone 1-888-ASK-USGS**
- **Web http://www.usgs.gov**

New US Topo Maps
Ypsilanti West 2011







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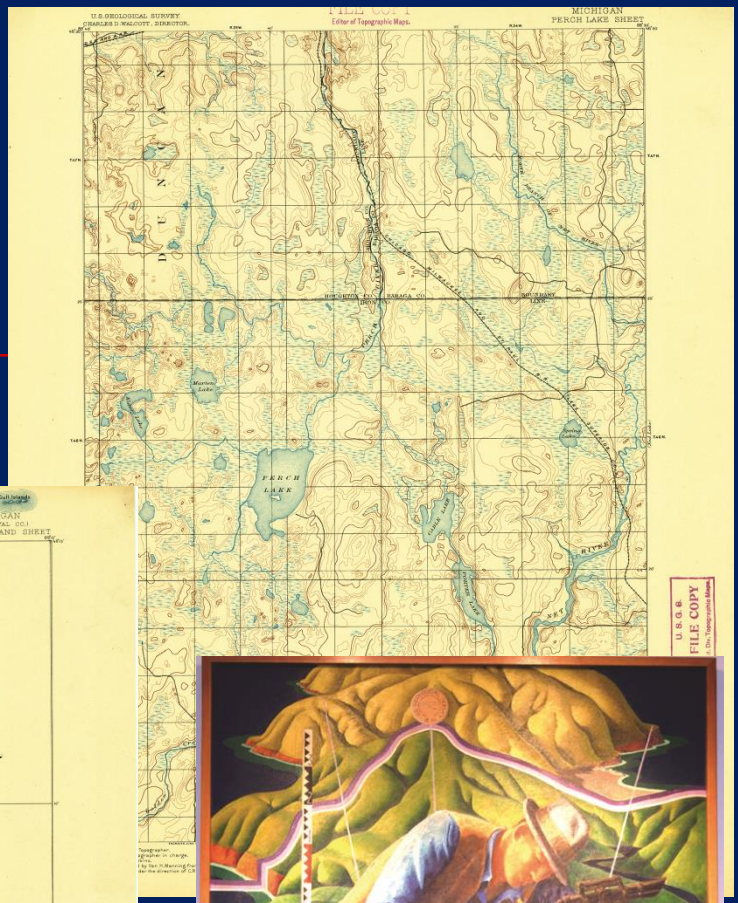
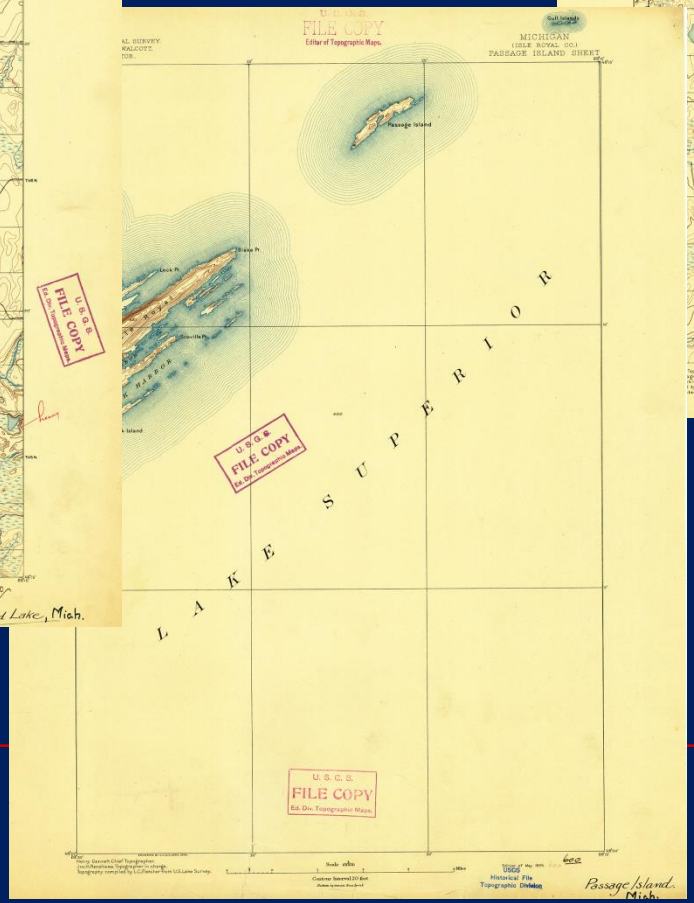
Michigan's Oldest Maps

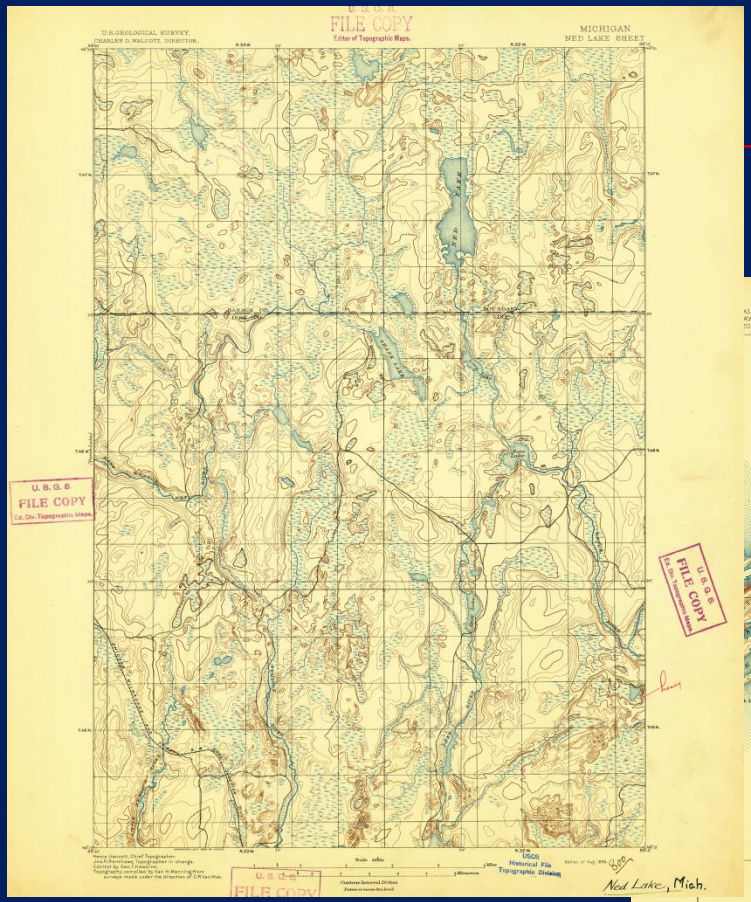
Published 1895 1:62,500

Perch Lake



Passage Island



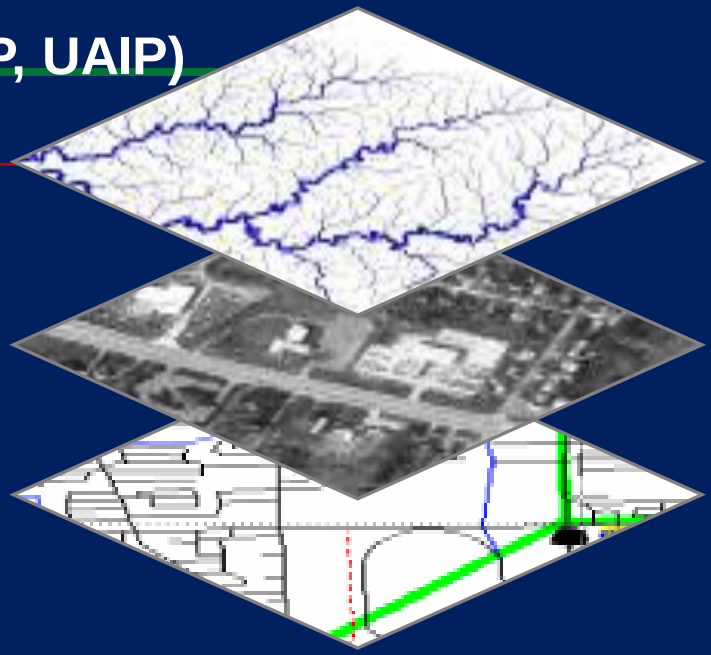


Ned Lake

USGS

The National Map: Data Themes

- **Imagery** (aerial photography, NAIP, UAIP)
- **Elevation** (NED)
- **Transportation**
- **Hydrography** (NHD & WBD)
- **Structures** (buildings)
- **Boundaries** (gov & admin)
- **Land cover** (NLCD)
- **Geographic names** (GNIS)



Other types of geographic information can be added within the viewer or brought in with National Map data into a Geographic Information System to create specific types of maps or map views.

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Goal of 3DEP

USGS NGP has introduced the 3DEP initiative, the goal of which is to systematically collect enhanced elevation data in the form of high-quality lidar data over the conterminous United States (CONUS), Hawaii, and the U.S. territories.

Ifsar data will be collected over Alaska, where cloud cover and remote locations preclude the use of lidar over much of the State.

The 3DEP initiative will result in higher resolution and more accurate data as well as new products in the future.

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http://nationalmap.gov/3DEP/

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The National Map

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3D Elevation Program (3DEP)

The National Map Home >> 3D Elevation Program (3DEP)

3DEP Resources

The 3DEP Elevation Program - Summary of Program Direction (USGS Fact Sheet 2012-3089)

National Enhanced Elevation Assessment (NEEA)

3DEP Executive Forum

Alaska Mapping Roundtable

3DEP '*In the News*'

Remapping Coastal Areas Damaged by Hurricane Sandy

3DEP State Fact Sheets

Idaho

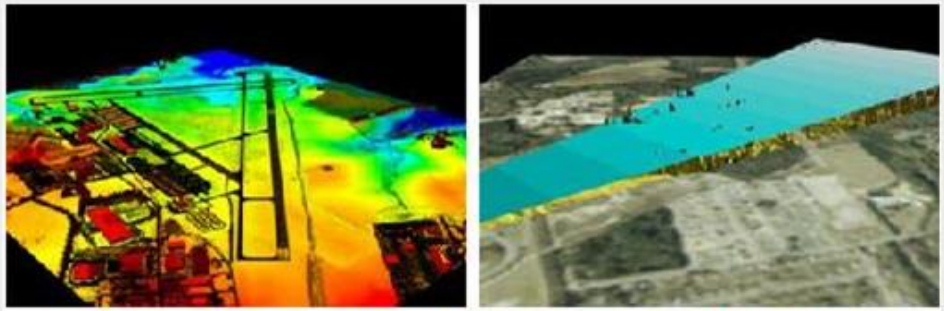
Rhode Island

Virginia

Washington

Wisconsin

Introduction and Goals



Lidar is used to detect potential obstacles that present hazards to air navigation.

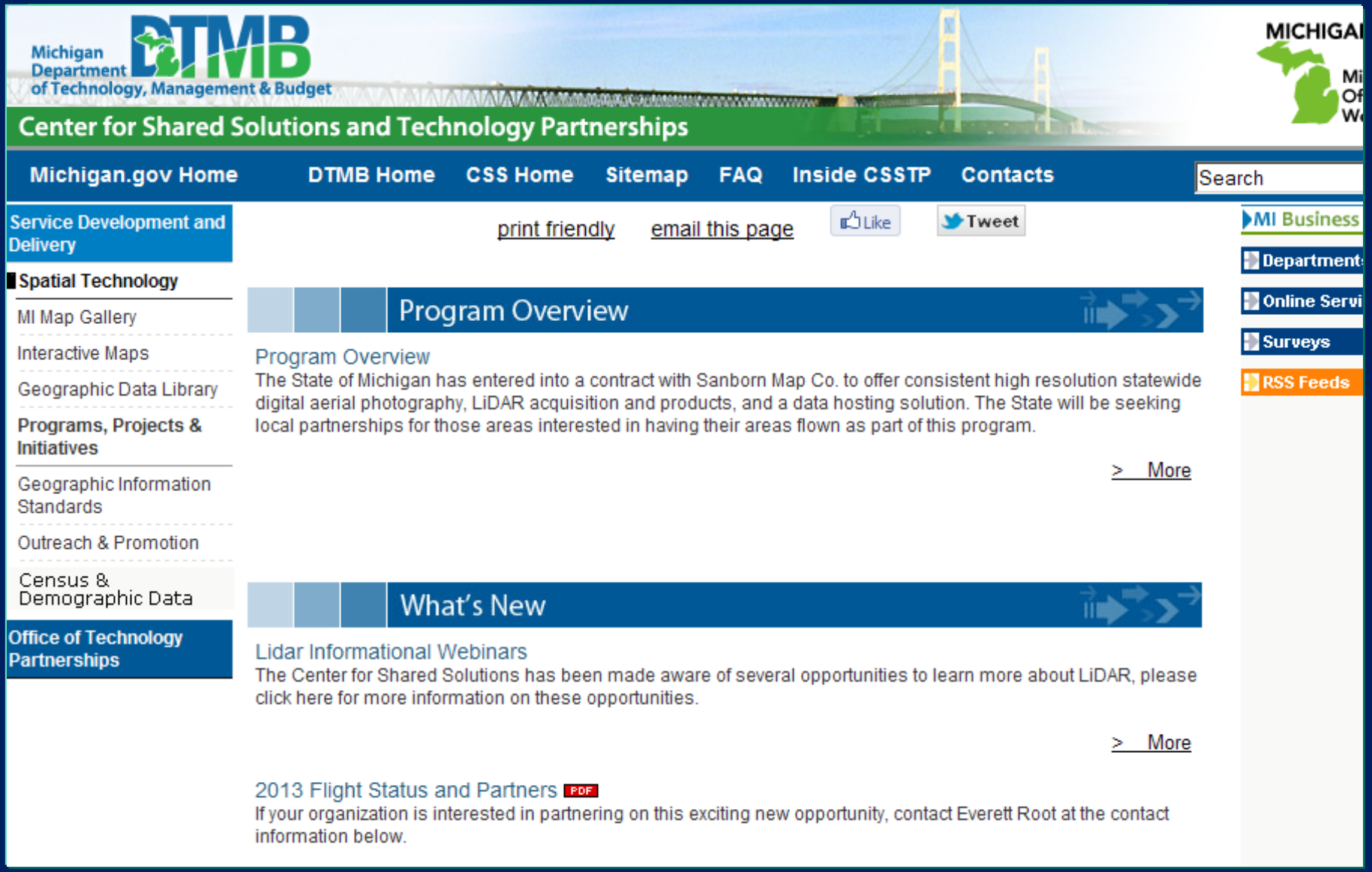
Applications - A Few Examples

3DEP will provide expanded benefits to a range of Federal, State, local, and private improved elevation data include:

- The Federal Emergency Management Agency (FEMA) expects that a nationa time needed to update its flood maps. These enhanced data could provide si customers of the National Flood Insurance Program. For example, updated in homeowners more quickly.

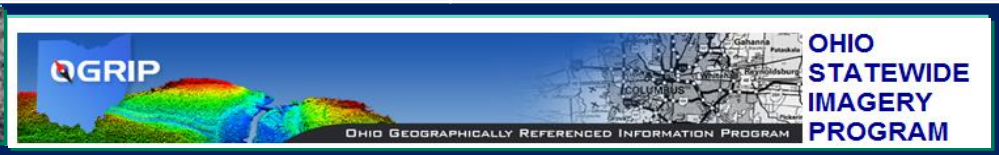
Michigan Statewide Aerial Imagery and Lidar Program

http://www.michigan.gov/cgi/0,4548,7-158-52927_53037_12699_63834---,00.html
http://www.michigan.gov/documents/cgi/MI_GISUG_Presentation_410737_7.pdf



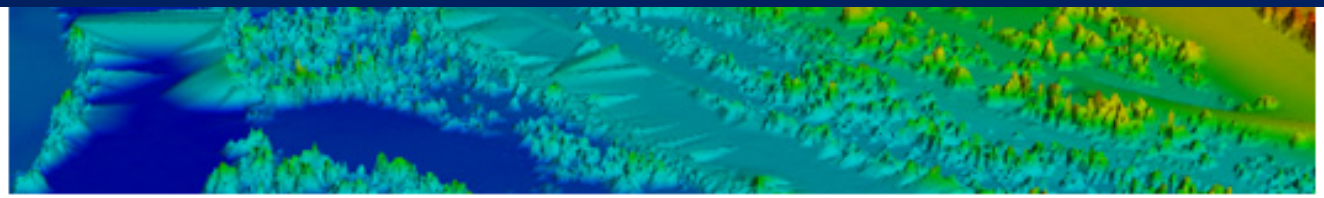
State LiDAR Programs

State	Agency Leading Effort	Funding Source	Primary Applications Cited
Louisiana	LA Oil Spill Coordination Office	FEMA and State match (50/50)	Floodplain insurance mapping
Iowa	Department of Natural Resources	State Agriculture and Natural Resources Fund	Conservation farming, road surveys
Minnesota	Council on GIS	State Conservation Legacy – Clean Water	Support clean water projects
North Carolina	Office of Budget, Div. of Emergency Mgmt.	State, FEMA and other agencies	Floodplain insurance mapping
South Carolina	Department of Natural Resources	Federal, state, local consortium	Map bare earth, structures, vegetation
Ohio	Office of Information Technology	Federal, state, local consortium	Orthorectify imagery
Pennsylvania	Department of Conservation	State appropriation	Accurate bare earth elevation model
Oregon	Dept. of Geology and Mineral Industries	Federal, state, local consortium	Map landslides, faults, road construction



NEEA – National Enhanced Elevation Assessment

Is a national effort needed? What should it look like?



Final Report of the National Enhanced Elevation Assessment

Revised March 29, 2012

The National Enhanced Elevation Assessment (NEEA) was performed to document national requirements for improved elevation data, estimate the benefits and costs of meeting these requirements, and evaluate multiple national enhanced program implementation scenarios. The study was sponsored by member agencies of the National Digital Elevation Program and was completed December 2011. Study participants included 34 federal agencies, 50 states, and selected local governments and tribes, as well as private and not-for-profit organizations. An analysis of the results showed that an improved national program has the potential to generate $1.2-billion to $13-billion in new benefits each year once fully operational. The report was developed by Dewberry under contract to the USGS. The findings build on similar results documented by the National Research Council, federal agencies, and numerous state reports. Questions regarding the report should be directed to Greg Snyder, USGS, at gsnyder@usgs.gov.

Downloads

- NEEA Final Report
- Appendix A: NED Release Notes
- Appendix B: Federal Agency Functional Activities
- Appendix C: State, Territory & Local Functional Activities
- Appendix D: Nongovernmental Functional Activities
- Appendix E: Business Use Requirements & Benefits
- Appendix F: Benefit Cost Analysis Process
- Appendix G: Technology Trends & Risk Considerations
- Appendix H: IT Infrastructure
- Appendix I: USGS LiDAR Guidelines & Base Specs
- Appendix J: Online Questionnaire

Report posted to www.dewberry.com at the request of the USGS.

Michigan Input to NEEA

- **Sam Quon** (City of Lansing, and Ingham County)
- **Mike Sobocinski** (Michigan State Police, hazard mitigation)
- **Mike Toth** (MDOT, lead on elevation)

- Flood map analysis and loss estimates for properties in flood prone areas
- Forest fire susceptibility and identification of structures in wildland interface areas
- Preliminary design and planning

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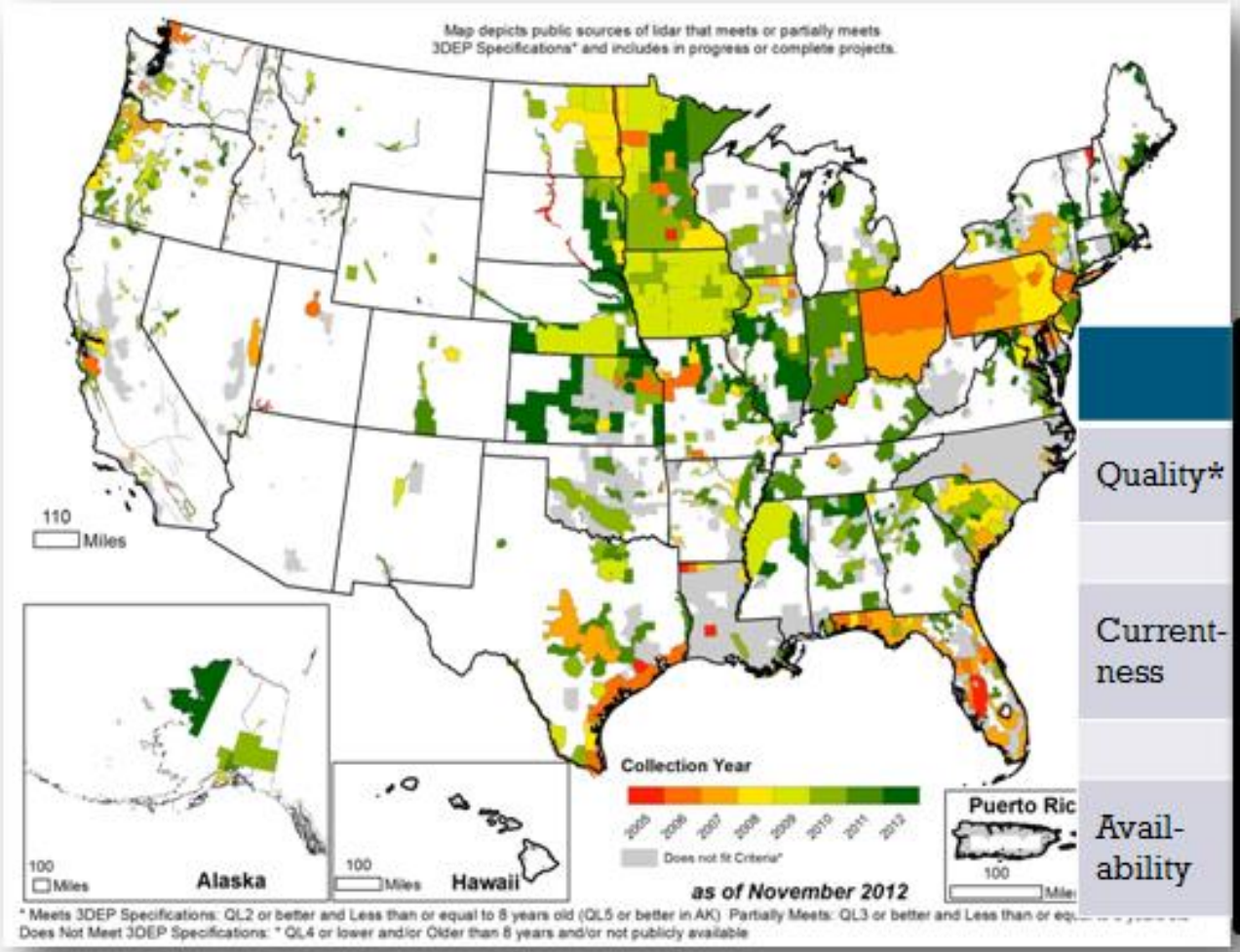
+ 2012 Inventory Update

Data that "meet or partially meet" 3DEP specifications



	Meet	Partially Meet	Do Not Meet
Quality*	QL2 or better	QL3	QL4 or lower
	AND		OR
Current-ness	Less than or equal to 8 years old		Older than 8 years
	AND		OR
Avail-ability	Publicly available		Not publicly available

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* Except Alaska where data meet 3DEP specifications at QL5 or better

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

New National Elevation Inventory

During the first week of August 2012, the U.S. Interagency Elevation Inventory (USIEI) was released to the public for the first time. A collborative effort between the National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), and Federal Emergency Management Agency (FEMA), the USIEI is an online inventory tool

National Enhanced Elevation Assessment

At a Glance

- Sponsored by the National Digital Elevation Program (NDEP) and funded by USGS, NGA, FEMA, NRCS and NOAA to:
  - Document national requirements for improved elevation data from technologies such as LiDAR and IfSAR
  - Estimate the benefits and costs of meeting these requirements
  - Evaluate multiple national enhanced program scenarios for government consideration
- 602 mission-critical activities that require enhanced elevation data were identified by:
  - 34 Federal agencies and 50 states
  - A sampling of local governments, tribes, private and not-for profit organizations
- **A national program has the potential to generate $1.2 billion to $13 billion in new benefits each year**

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National Enhanced Elevation Program

Strategic Goals for 3DEP

- Directed, national approach to meet critical business uses for precision elevation data
- Standardized quality products collected once and meeting multiple Federal and State mission needs
- Consistent measurements across projects for reliable science
- Readily accessible data in useful formats
- Use of leading edge technology
- Balancing requirements, benefits and costs

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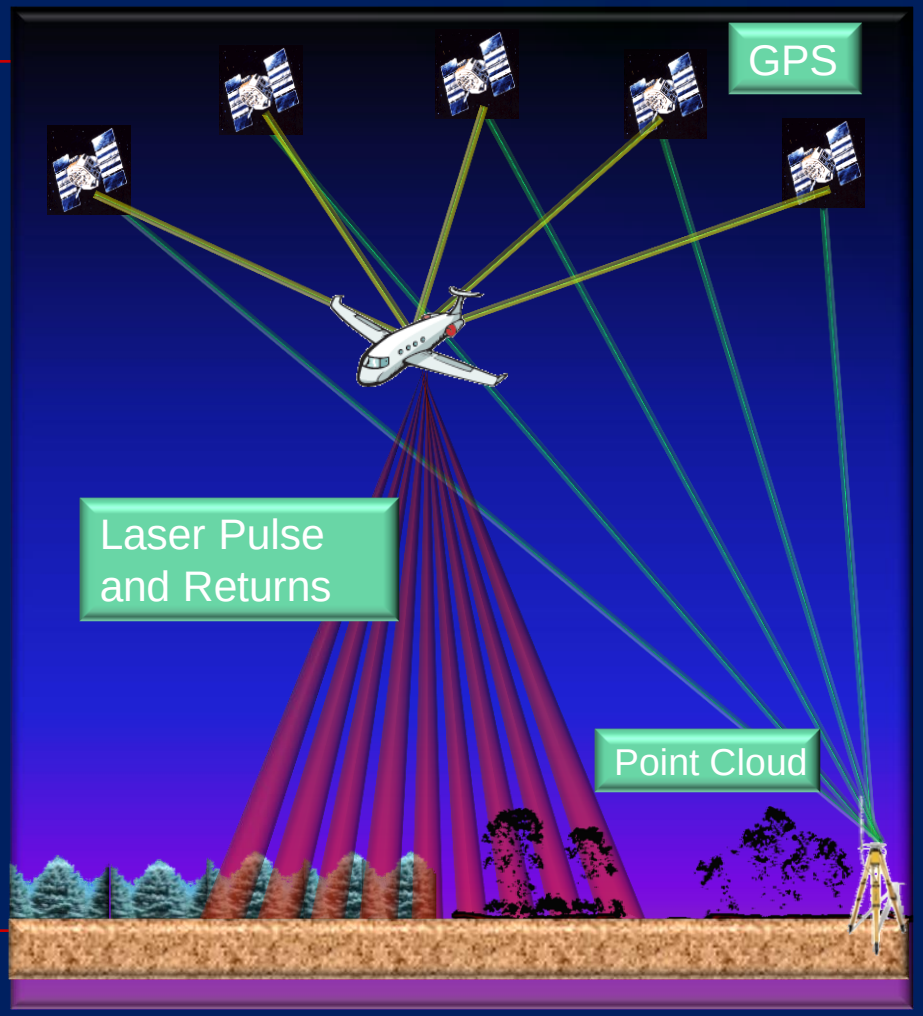
Technology of Choice - LiDAR

- Light detection and ranging (LiDAR)
- System with a laser and detector (range), scanning mirror (laser direction), GPS (location), and IMU (orientation)
- Output 300,000+ laser pulses per second
- Record laser reflection information
- Billions of recorded points create 3-dimensional representation of bare earth, vegetation and structures at centimeter-level accuracy
- Many forms of “elevation” can be derived



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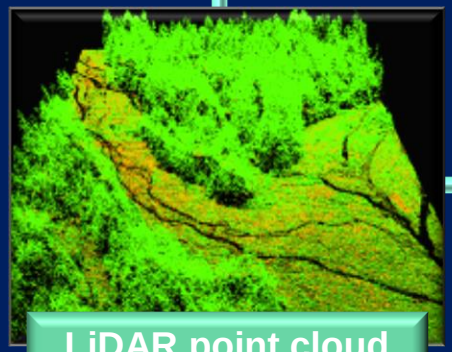
LiDAR Point Cloud and Derived Elevation Products

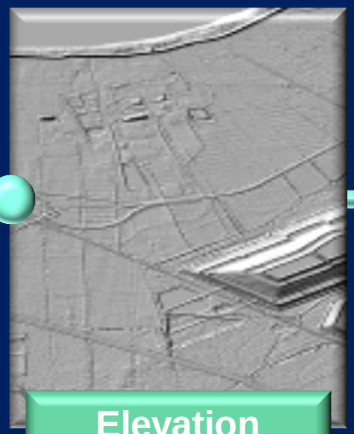
Supports Data Development and Geospatial Data Integration



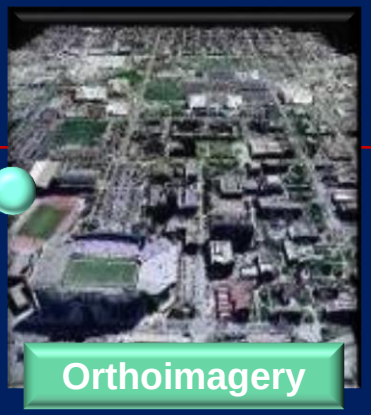
LiDAR point cloud

Land Cover

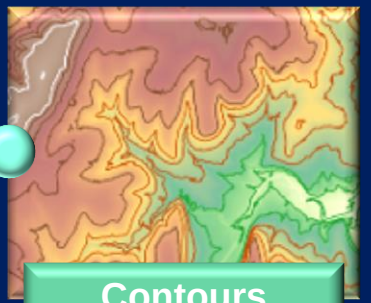
Structures



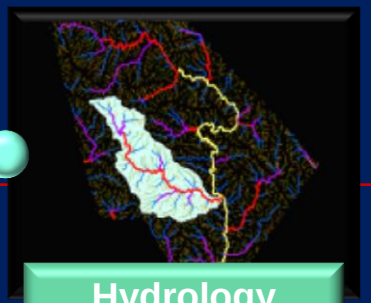
Elevation



Orthoimagery



Contours



Hydrology

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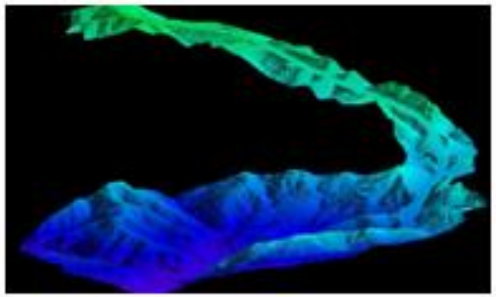
+ Example Business Uses

Precision Farming



Land Navigation and Safety

Geologic Resources and Hazards Mitigation

Natural Resource Conservation

Infrastructure Management

Flood Risk Mitigation

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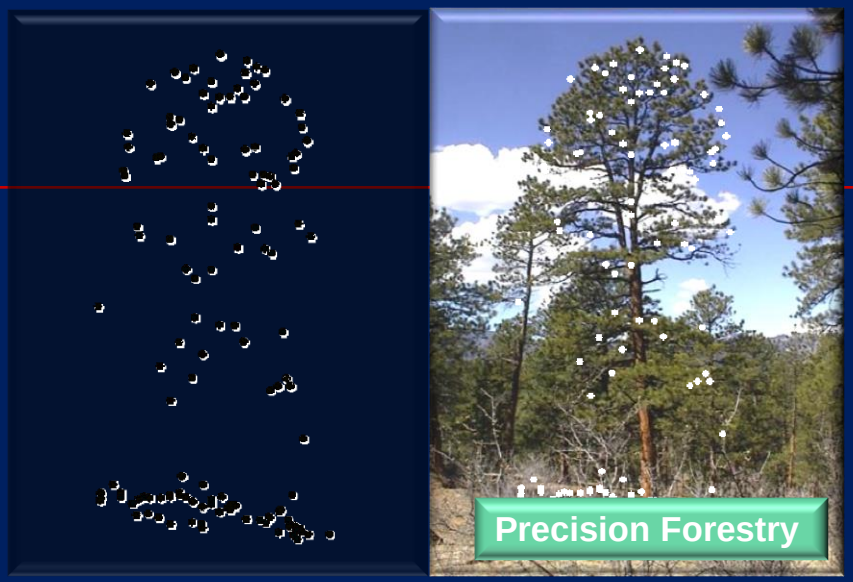
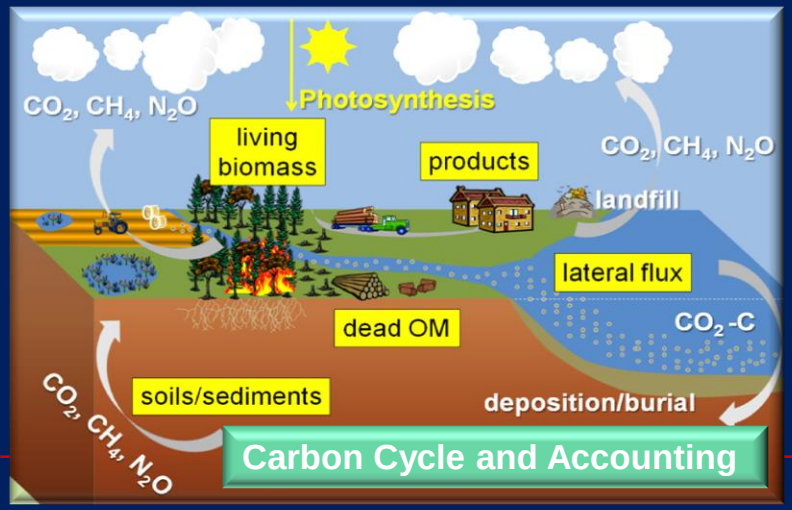
Advanced Geospatial Applications for LiDAR and Derived Datasets





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How many functional activities?

- 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
- Mapping confined urban channels vs natural streams
- In the creation of seamless topo/bathy products
- Integration into the National Elevation Dataset
- Derivation of stream channel characteristics
- Mapping and monitoring coastal hazards
- Identify small hydrologic features (ditches, tile drain)
- 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
- Jokulhaup monitoring
- Fault-rupture mapping
- Monitoring sea level rise
- Natural Hazards
- Identifying landslide-prone areas
- Creating topographic maps
- Glacier changes
- Carbon sequestration assessments
- Homeland security scenarios

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+ Benefits for Top Business Uses

Rank		Annual Benefits	
		Conservative	Potential
1	Flood Risk Management	$295M	$502M
2	Infrastructure and Construction Management	$206M	$942M
3	Natural Resources Conservation	$159M	$335M
4	Agriculture and Precision Farming	$122M	$2,011M
5	Water Supply and Quality	$85M	$156M
6	Wildfire Management, Planning and Response	$76M	$159M
7	Geologic Resource Assessment and Hazard Mitigation	$52M	$1,067M
8	Forest Resources Management	$44M	$62M
9	River and Stream Resource Management	$38M	$87M
10	Aviation Navigation and Safety	$35M	$56M
:			
20	Land Navigation and Safety	$0.2M	$7,125M
	Total for all Business Uses (1 – 27)	**$1.2B**	**$13B**

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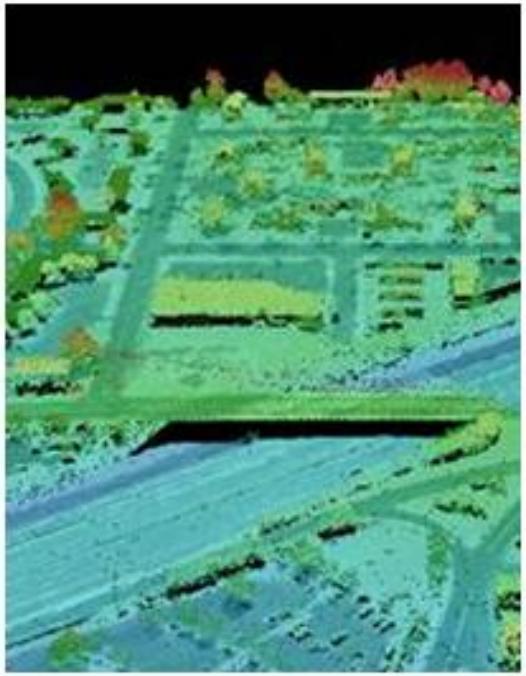
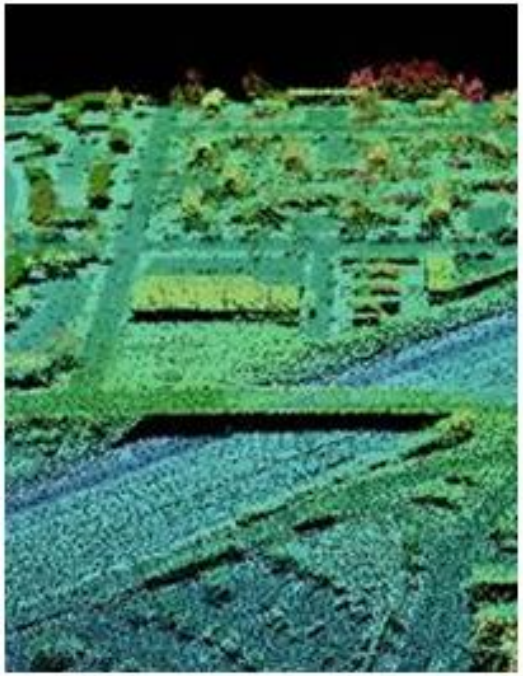
+ LiDAR at Three Quality Levels

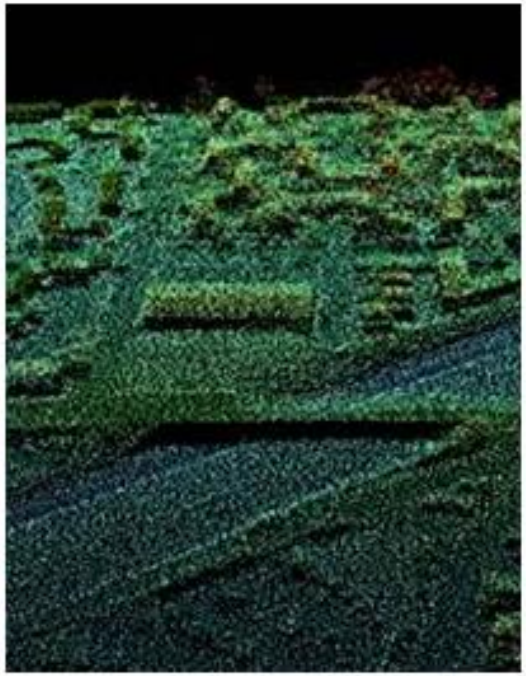
Simulated Quality Levels based on resampled QL1 data



0.35 meter point spacing (QL1)



0.7 meter point spacing (QL2)



1.4 meter point spacing (QL3)

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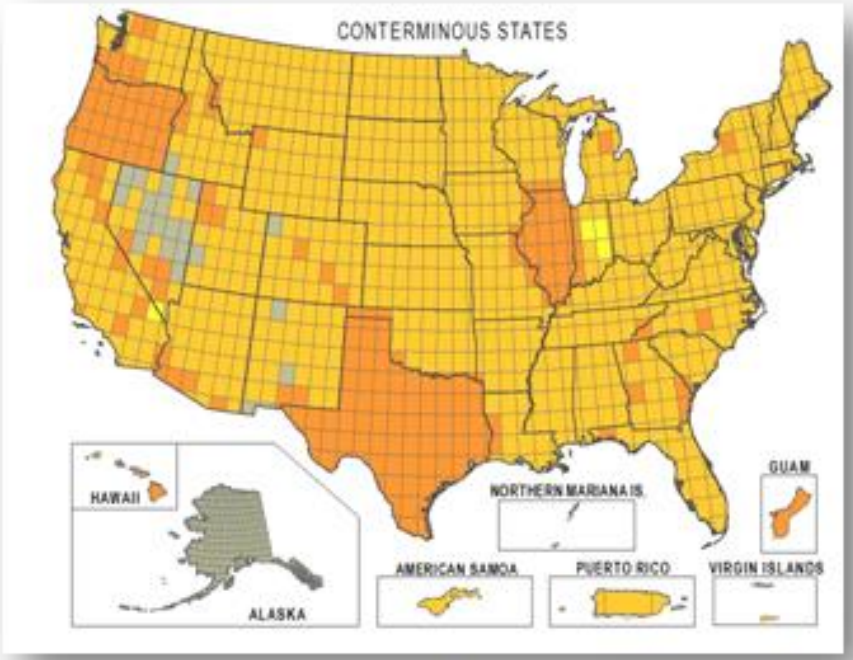
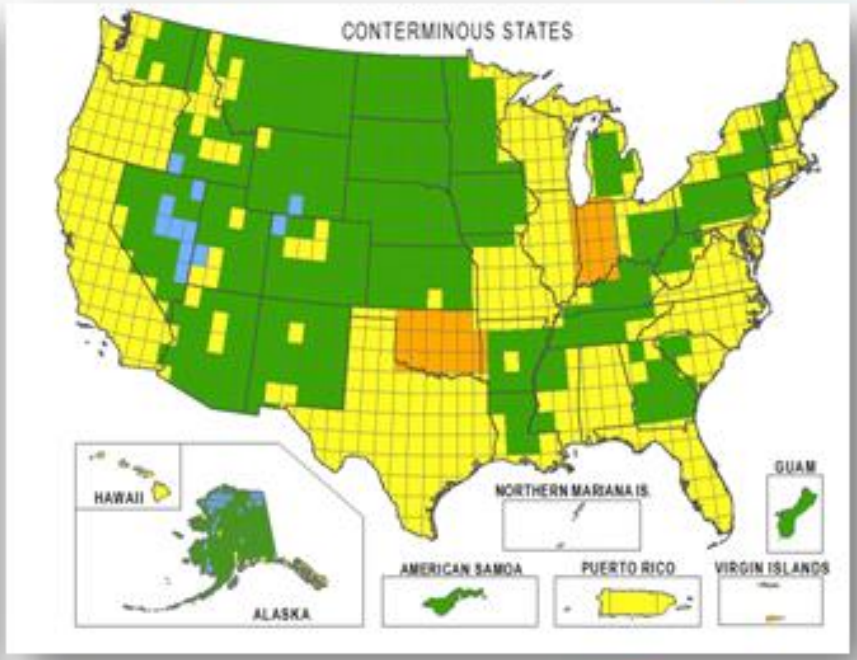
NEEA Program Implementation Scenario

Highest Net Benefits for all Requirements including Federal, State and Nongovernmental – Study Scenario 4



Quality Levels

- Quality Level 1
- Quality Level 2
- Quality Level 3
- Quality Level 4
- Quality Level 5



Update Frequencies

- Annual
- 2 - 3 years
- 4 - 5 years
- 6 -10 years
- > 10 years

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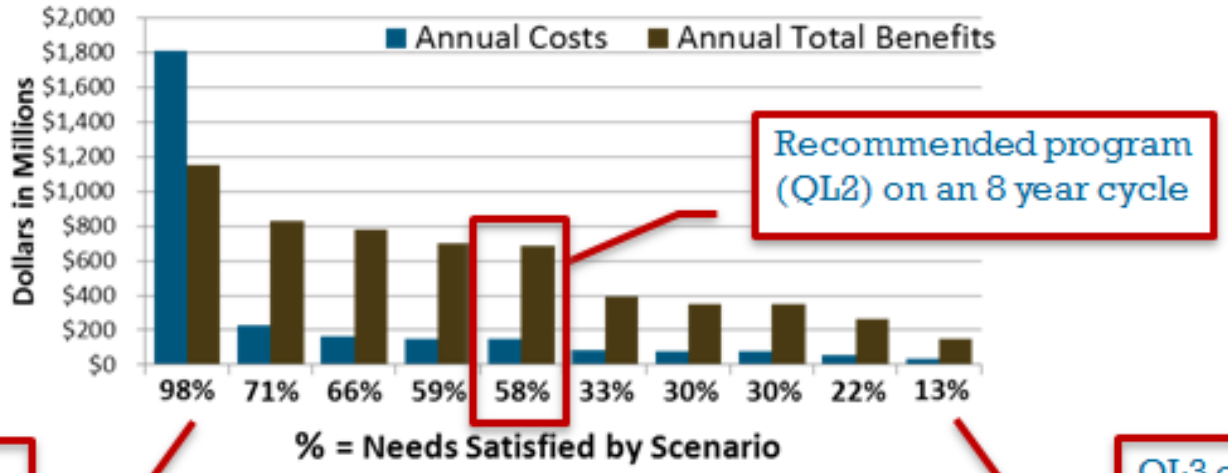
National Program Recommendation

Multiple Scenarios Considered

- Avg. Annual Costs: $146M
- Avg. Annual Benefits: $690M
- Avg. Annual Net Benefits: $544M
- Benefit Cost Ratio - 4.7:1
- Total Benefits Satisfied: 58%



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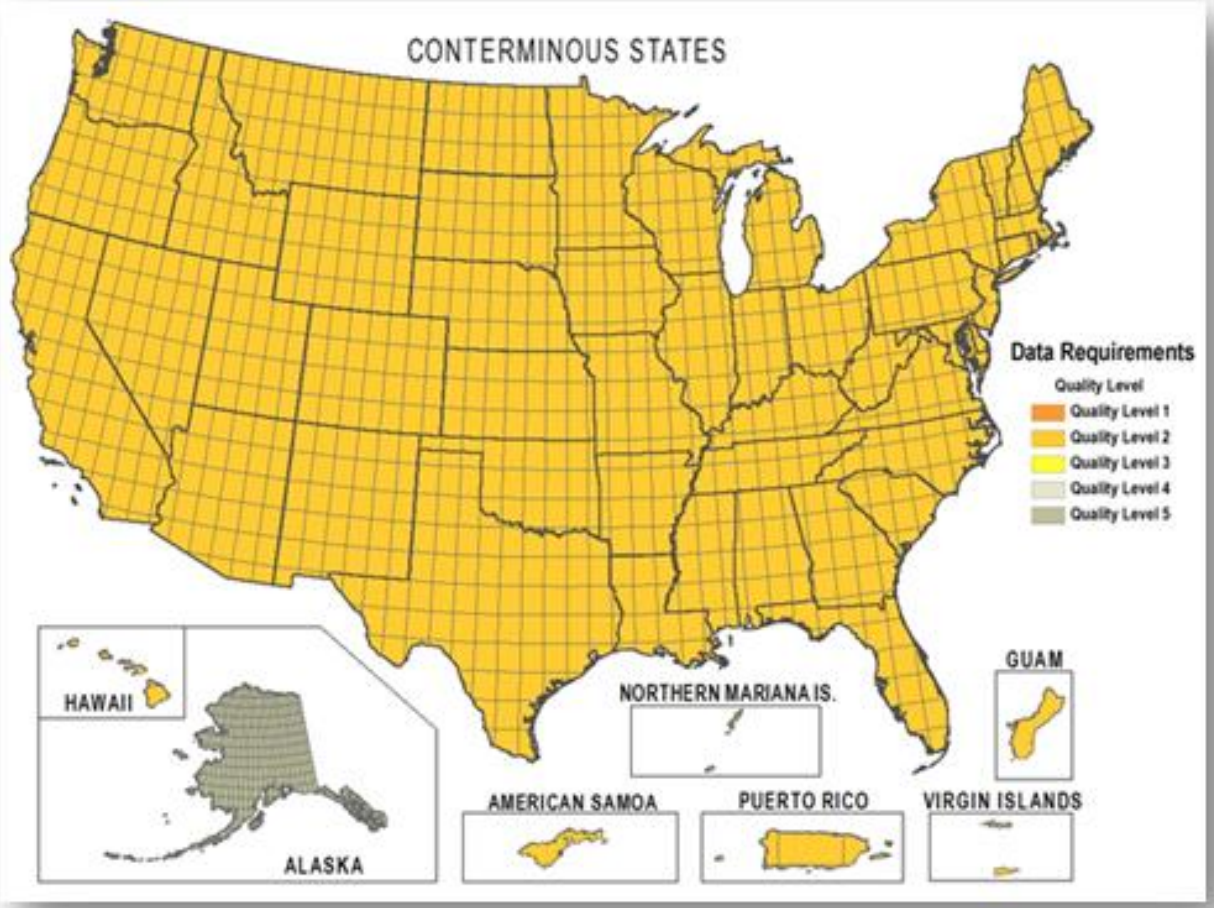
+ Terrestrial Elevation

Target State – 3DEP



- Evaluated 10 alternatives
  - Benefit to cost – 4.7:1
  - Total benefits - $690 million/year
- Publically accessible
- Partnership approach
- Multiple data products and services
- Operational in January 2015
- Complete one cycle of data collection by 2023

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3DEP Endorsements

- **National Geospatial Advisory Committee (NGAC), April, 2012** - "The NGAC endorses a national elevation program (i.e., 3D Elevation Program, or 3DEP) as described in the National Enhanced Elevation Assessment conducted by the U.S. Geological Survey (USGS). The NGAC encourages the USGS, the Department of the Interior, and Federal partner agencies to refine, adopt, and implement this program in partnership with other levels of government, academia, and the private sector."
- **National States Geographic Information Council (NSGIC)** – Endorsed by membership in April, 2012. Endorsement supports the recommended program and requests that there be advanced planning and buy up opportunities
- **National Digital Elevation Program (NDEP) Committee** – Endorsed by member agencies in December, 2012
- **Management Association for Private Photogrammetric Surveyors (MAPPS)** – Endorsed by membership in January, 2013
- Other endorsements expected

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3DEP . . .

- $9,000,000 in proposed FY14 budget
- MAP 21 and FEMA and lidar
- 2015 through 2022 for 3DEP
- Hydro enforcement

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+ 3DEP-Related Funding Increases

FY13 and FY14

FY14 President's 3DEP Budget

- +$9M to USGS National Geospatial Program
- + $1M for Alaska to USGS National Geospatial Program
- +$2M for coastal elevation to USGS Natural Hazards/Coastal Marine Program
- +$750k for ecosystem data to USGS National Geospatial Program
- +$7M to NOAA
- +$500K to NPS for Alaska ifsar

Hurricane Sandy Supplemental

- +$3.1M approved, additional $4M requested
- Other agencies?

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3DEP Acquisition Planning

Next Steps

- Revise the acquisition approach with input from the 3DEP Executive Forum and NDEP
- Establish a Broad Agency Announcement or other contract mechanism to streamline partnership development
- USGS Geospatial Liaisons work with state and local partners to facilitate move to new planning strategy
- Trial run of some steps (compiling agency requirements and plans against criteria) in FY14
- Initiate 3 year planning in FY14
- Implement new approach for FY15 (beginning in April, 2014)

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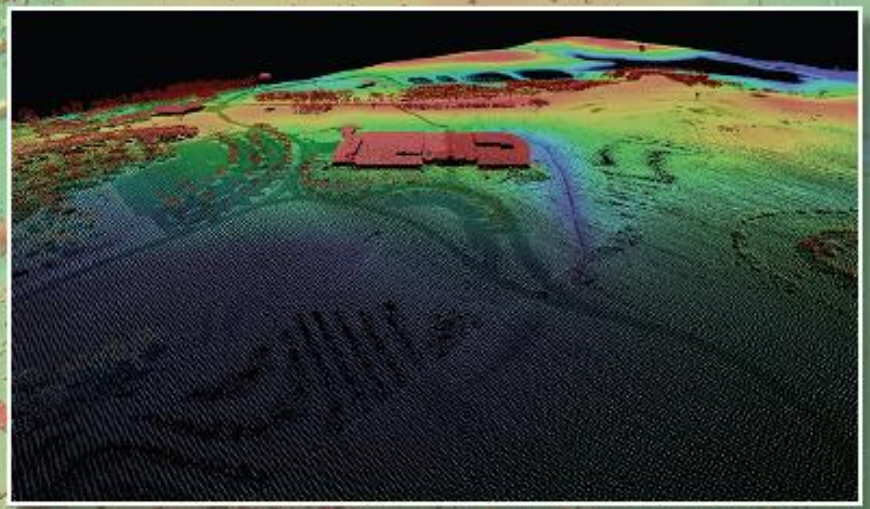
National Geospatial Program

Lidar Base Specification Version 1.0

Chapter 4 of
Section B, U.S. Geological Survey Standards
Book 11, Collection and Delineation of Spatial Data



Techniques and Methods 11–B4

U.S. Department of the Interior
U.S. Geological Survey

asprs
THE IMAGING & GEOSPATIAL INFORMATION SOCIETY

LAS SPECIFICATION

VERSION 1.4 – R13

15 July 2013

Approved:
November 2011

Published by:
The American Society for Photogrammetry & Remote Sensing
5410 Grosvenor Lane, Suite 210
Bethesda, Maryland 20814-2160
Voice: 301-493-0290
Fax: 301-493-0208

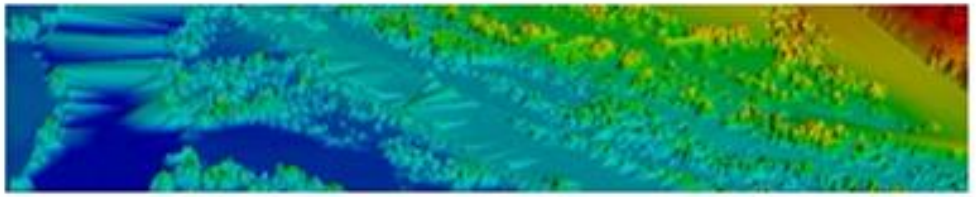
3DEP . . .

- Large areas – at least full counties
- Complete a state
- Public domain
- Flat water . . .

USGS

+ 3DEP Resources

- NEEA Report
- 3DEP webpage
- USGS Fact Sheets
  - NEEA at a glance
  - 3D Elevation Program
- Resources in work
  - State information sheets
  - Journal articles



Final Report of the National Enhanced Elevation Assessment

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Charles Hickman

Geographer - U.S. Geological Survey

National Map Liaison to Ohio, Michigan, and Kentucky

6480 Doubletree Avenue Columbus, Ohio 43229 USA

chickman@usgs.gov (614) 430-7768

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- Ask USGS
- Email: ask@usgs.gov, nationalmap@usgs.gov ustopo@usgs.gov,
- Phone 1-888-ASK-USGS
- Web http://www.usgs.gov