

Analyzing Flood Damages in North Dakota

An aerial photograph showing a residential neighborhood in Minot, North Dakota, completely inundated with floodwater. The water is a dark, murky brown color. Numerous houses with various roof colors (brown, grey, white) are visible, mostly with only their roofs and upper floors above water. Many green trees are scattered throughout the flooded area. In the upper center, a large, multi-story brick school building with a central entrance and many windows stands on a slightly elevated area, surrounded by green lawns and trees. To the left of the school, there is a large, empty, light-colored paved area, possibly a parking lot or a dry riverbed. The overall scene depicts significant flooding damage to a community.

Analyzing the extent of flooding impacts using a site specific analysis and user generated depth grids

Jesse Rozelle
Risk Analyst/Regional GIS Coordinator
FEMA Region VIII

Minot, North Dakota – June 28th, 2011

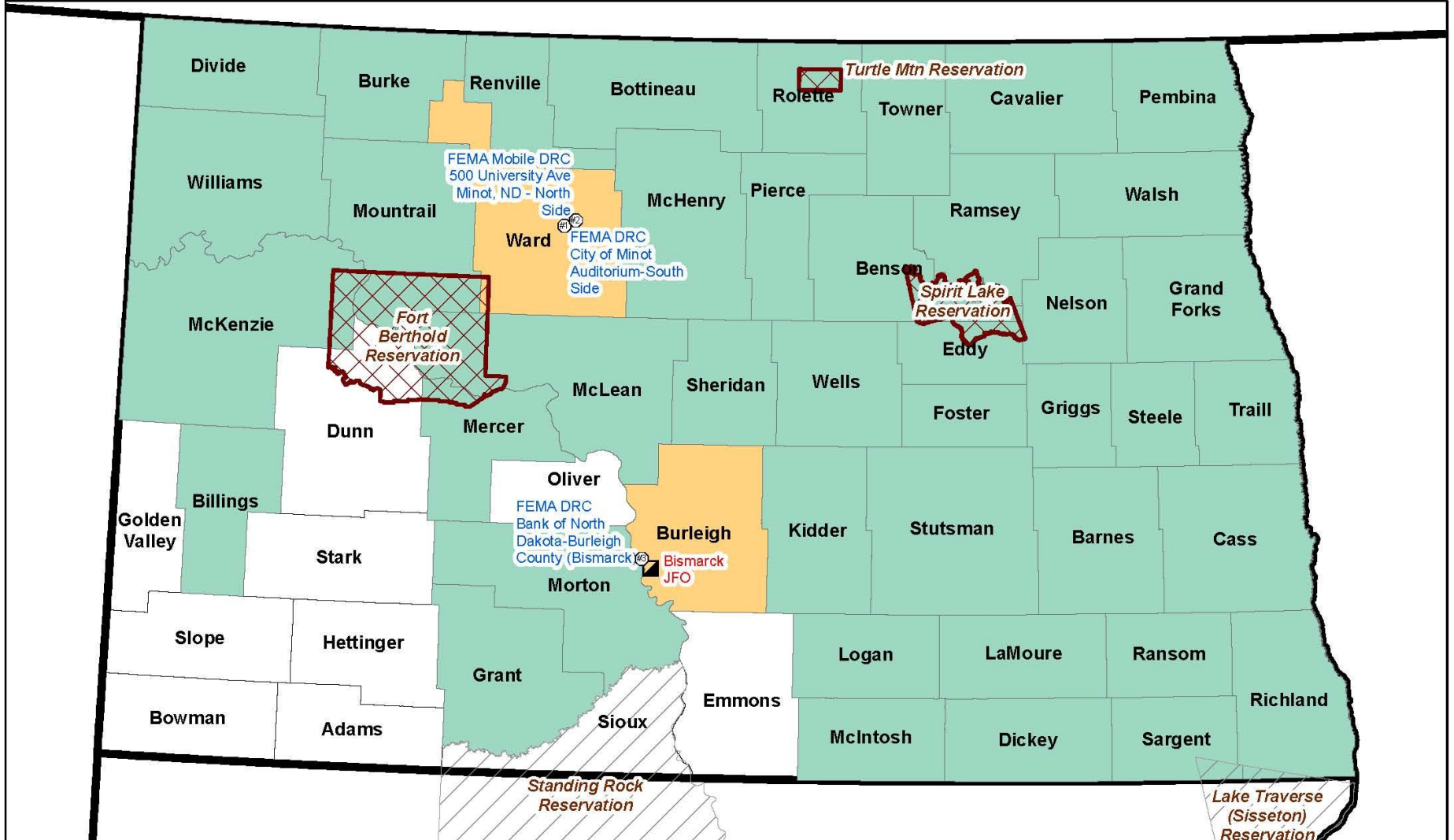
Photo courtesy of Pictometry



FEMA

FEMA-1981-DR-ND

Amendment No. 4 – June 24, 2011



Designated Counties and Tribal Nations

- IA and PA
- PA
- Designated Tribal Nations
- Bismarck JFO
- DRCs

Location of ISB: Ellsworth AFB Rapid City, SD

All counties and Indian Tribes in the State of North Dakota are eligible to apply for assistance under the Hazard Mitigation Grant Program

Name: smcnabb

Date Created: 06/25/2011

Source: HSIP Gold & FEMA Region VIII data

50

Miles



Extensive Flooding in Minot, North Dakota – Rapid Turnaround Damage Assessment Needed

Accomplished using the following:

- USGS High Water Mark Collections**
- Pictometry Oblique Aerial Imagery**
- New Light/ImageCAT Damage Assessment**

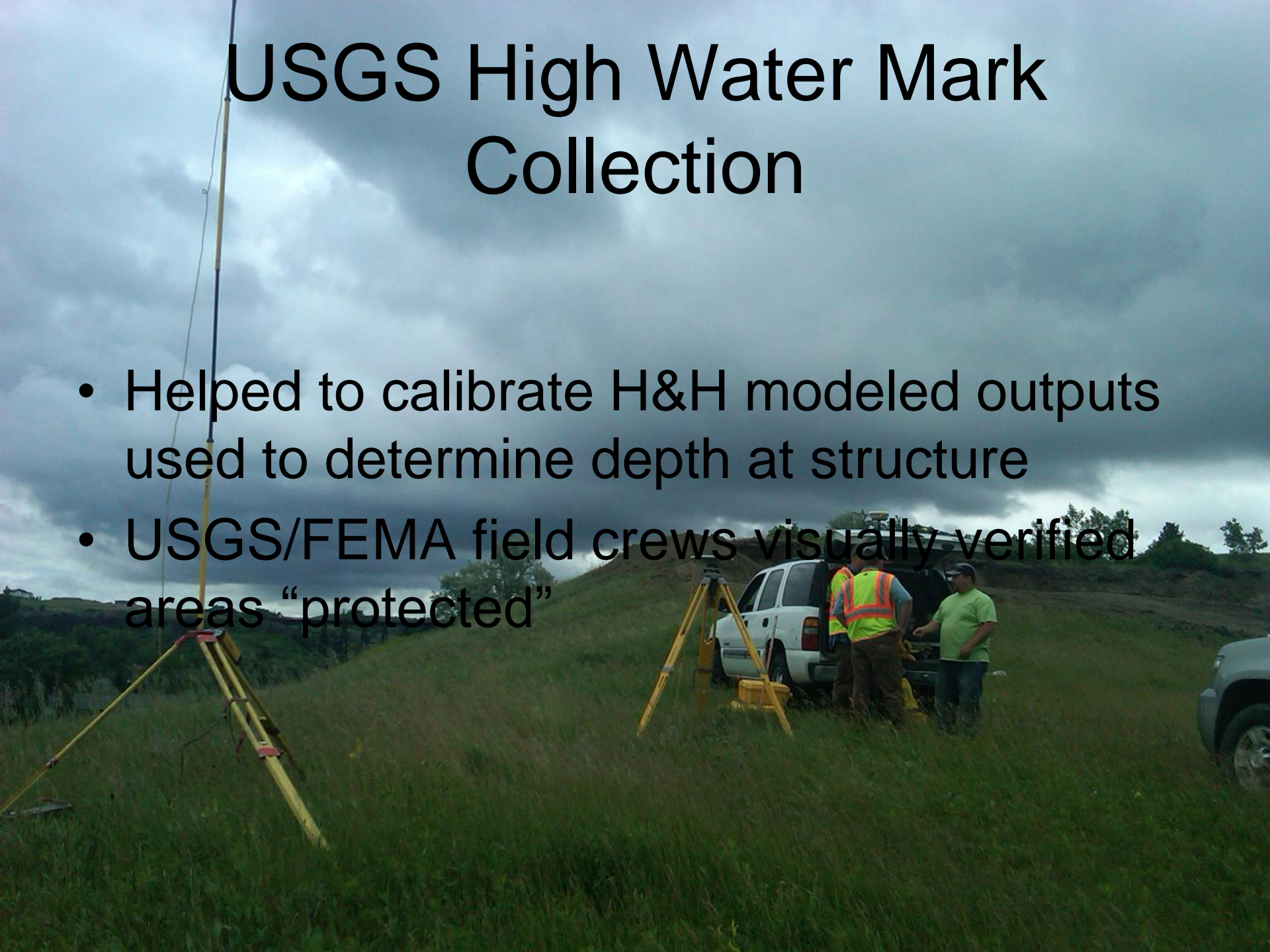
Results:

Number of Structures Impacted

HAZUS Site Specific Derived Financial Impacts

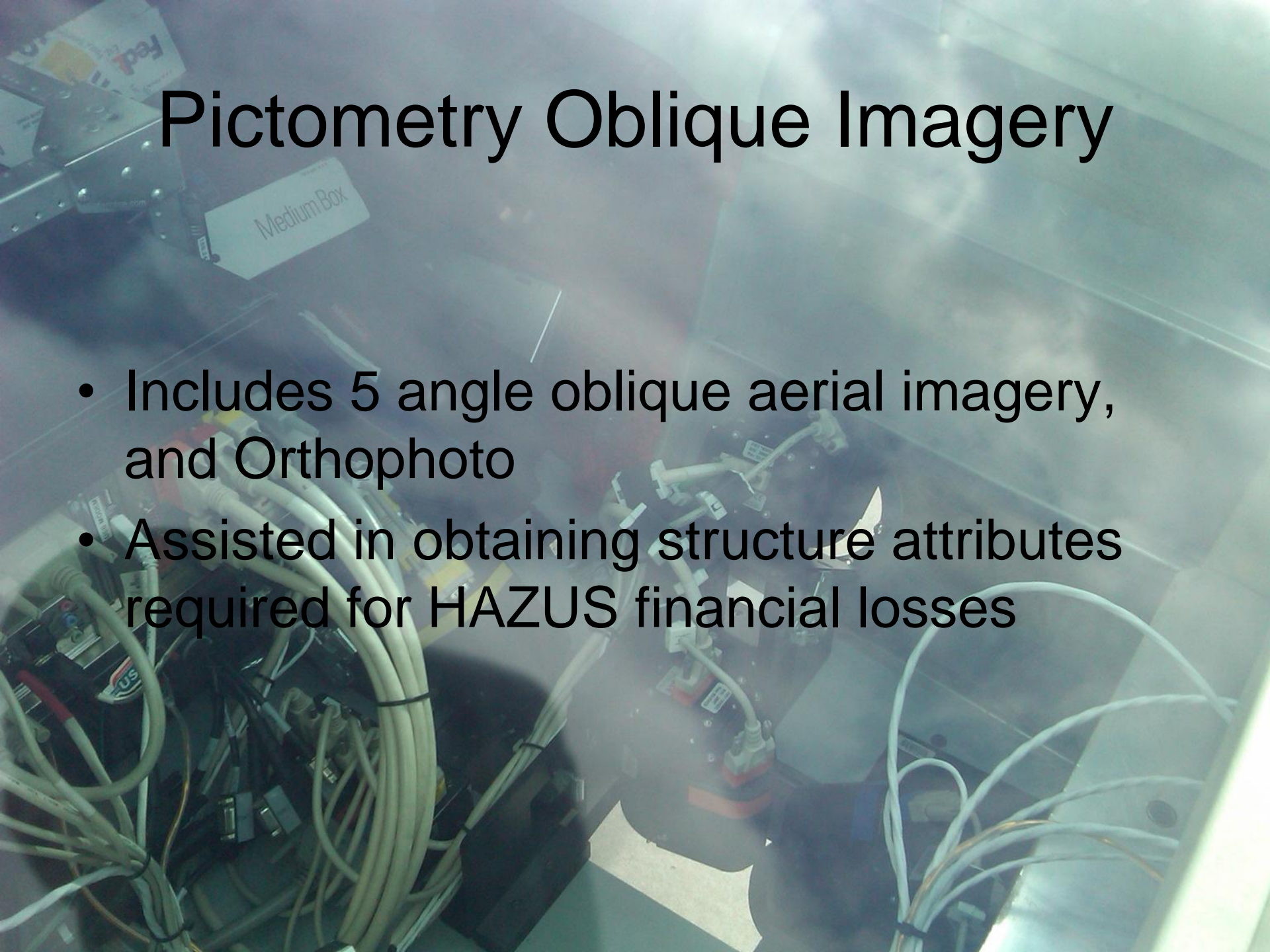
USGS High Water Mark Collection

- Helped to calibrate H&H modeled outputs used to determine depth at structure
- USGS/FEMA field crews visually verified areas “protected”



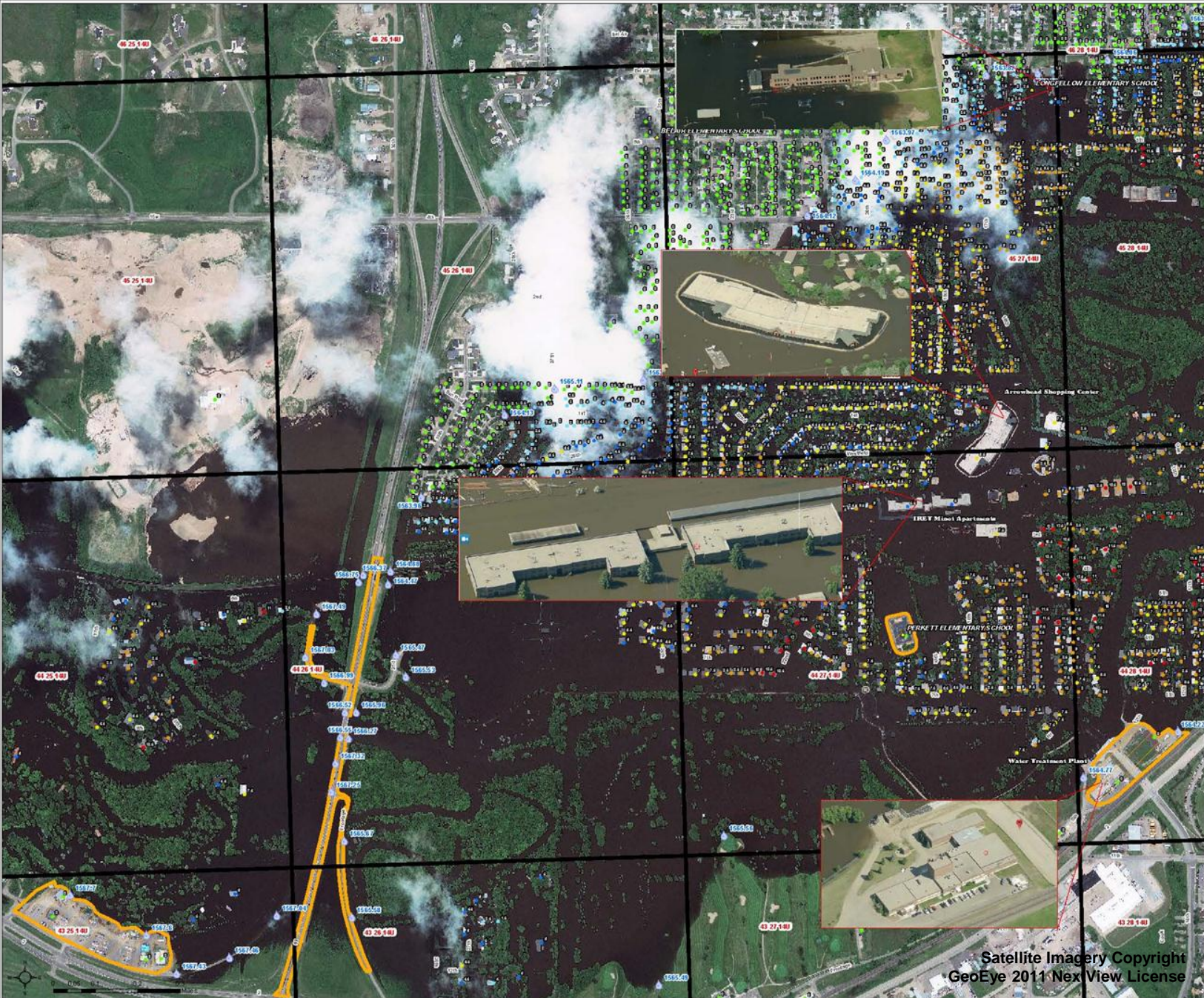
Pictometry Oblique Imagery

- Includes 5 angle oblique aerial imagery, and Orthophoto
- Assisted in obtaining structure attributes required for HAZUS financial losses



West Minot, ND: River Extent and Depth of Water at Structure

Interim Map
July 5, 2011



Depth of Water (ft)	Structures Impacted	Damage Level
0.3 - 2	156	Affected
2 - 6	799	Minor
6 - 10	2376	Major
> 10	591	Destroyed

Estimated depth in feet relative to ground surface, damage descriptions are generalized and vary by building type and flood duration.



Data Layer/Map Description(s):

Flood extents and depths were obtained from USACE/Honston Eng.

Areas protected/dry were confirmed on the ground by FEMA/USGS field survey. Depths at structure represent modeled depths from USACE/Honston Eng. 24hr data. High Water Marks Obtained by USGS Satellite Imagery acquired Saturday June 25, 2011.

These graphics are the best available estimates of highly uncertain conditions. There is an inherent margin for error, and the user is cautioned to allow for this. The user assumes all risks related to the use of this data.

Map Legend:

- Hospitals
- Colleges and Universities
- Sports Complex
- Law Enforcement Locations
- Schools
- High Water Marks (NAVD '88)
- US National Grid
- Confirmed Protected Areas (FEMA/USGS Field Survey)

Structures Affected - 4,165

*in Current Extent based on Imagery Analysis of 2010 NAIP

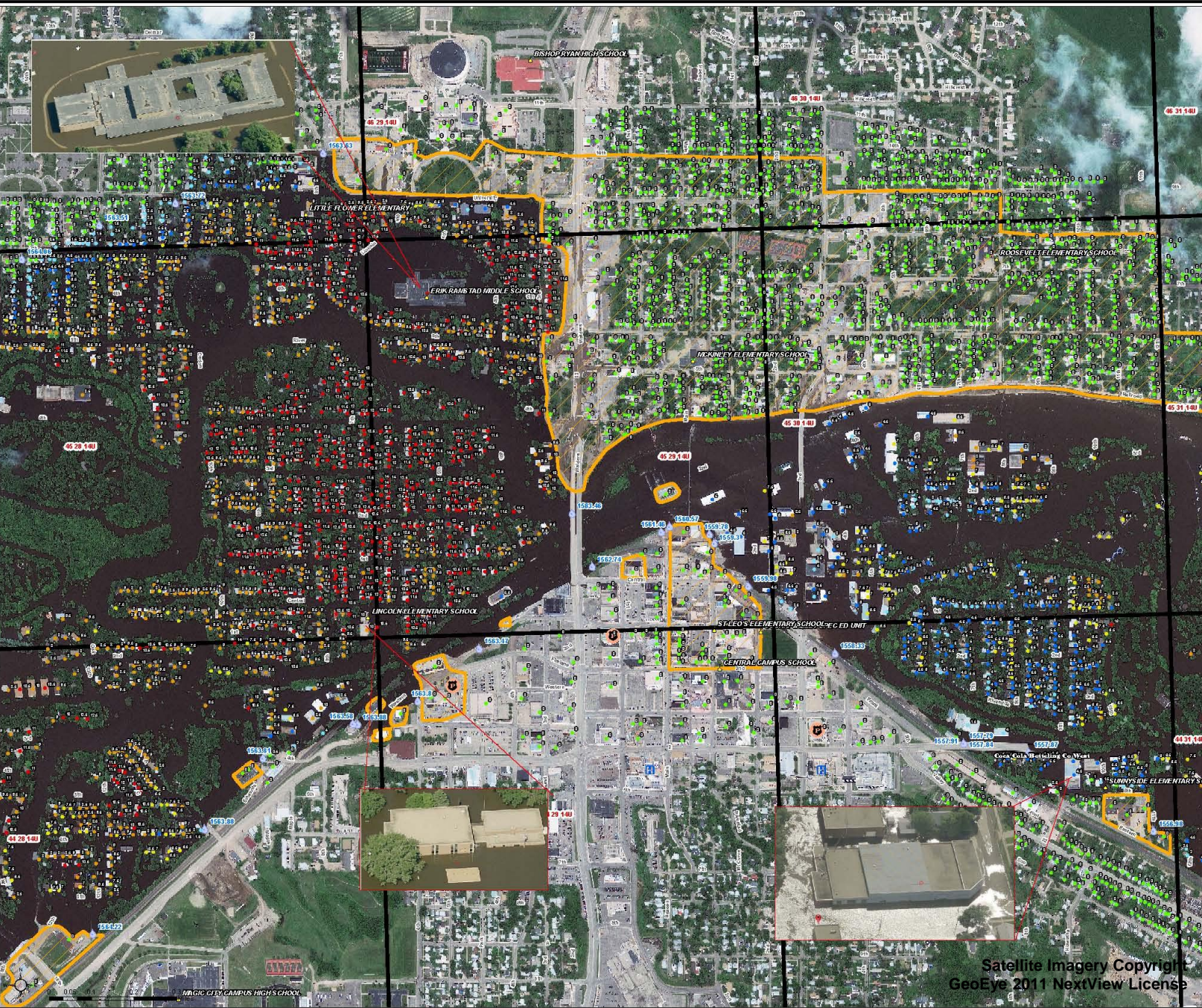
- ### Water Depth at Structure
- 0 - 1 ft
 - 1 - 4 ft
 - 4 - 6 ft
 - 6 - 7 ft
 - 7 - 10 ft
 - > 10 ft

Satellite Imagery Copyright
GeoEye 2011 Nex View License

This Report / Document is the property of FEMA. It is to be used for informational purposes only. It is not to be used for any other purpose. It is not to be used for any other purpose. It is not to be used for any other purpose.

Central Minot, ND: River Extent and Depth of Water at Structure

Interim Report
July 5, 2011



Depth of Water (ft)	Structures Impacted	Damage Level
0.3 - 2	156	Affected
2 - 6	799	Minor
6 - 10	2376	Major
> 10	591	Destroyed

Estimated depth in feet relative to ground surface, damage descriptions are generalized and vary by building type and flood duration.



Data Layer/Map Description(s):

Flood extents and depths were obtained from USACE/Honston Eng. Areas protected/dry were confirmed on the ground by FEMA/USGS field survey. Depths at structure represent modeled depths from USACE/Honston Eng. 24k data. High Water Marks Obtained by USGS Satellite Imagery acquired Saturday June 25, 2011.

These properties are the best available estimates of highly uncertain conditions. There is no warranty made for errors, and the user is cautioned to allow for this. The user assumes all risks related to the use of this data.

The presence of this data is provided this data "as is" and no warranty is made regarding the data or its use, including without limitation any implied warranty of merchantability or fitness for a particular purpose. In no event will the presence of this data be liable to you or to any third party for any direct, indirect, incidental, consequential, special or exemplary damages or lost profit resulting from any use or misuse of this data.

Map Legend:

- Hospitals
- Colleges and Universities
- Sports Complex
- Law Enforcement Locations
- Schools
- High Water Marks (NAVD '88)
- US National Grid
- Confirmed Protected Areas (FEMA/USGS Field Survey)

Structures Affected - 4,165

1" Current Extent based on Imagery Analysis of 2010 NAIP.

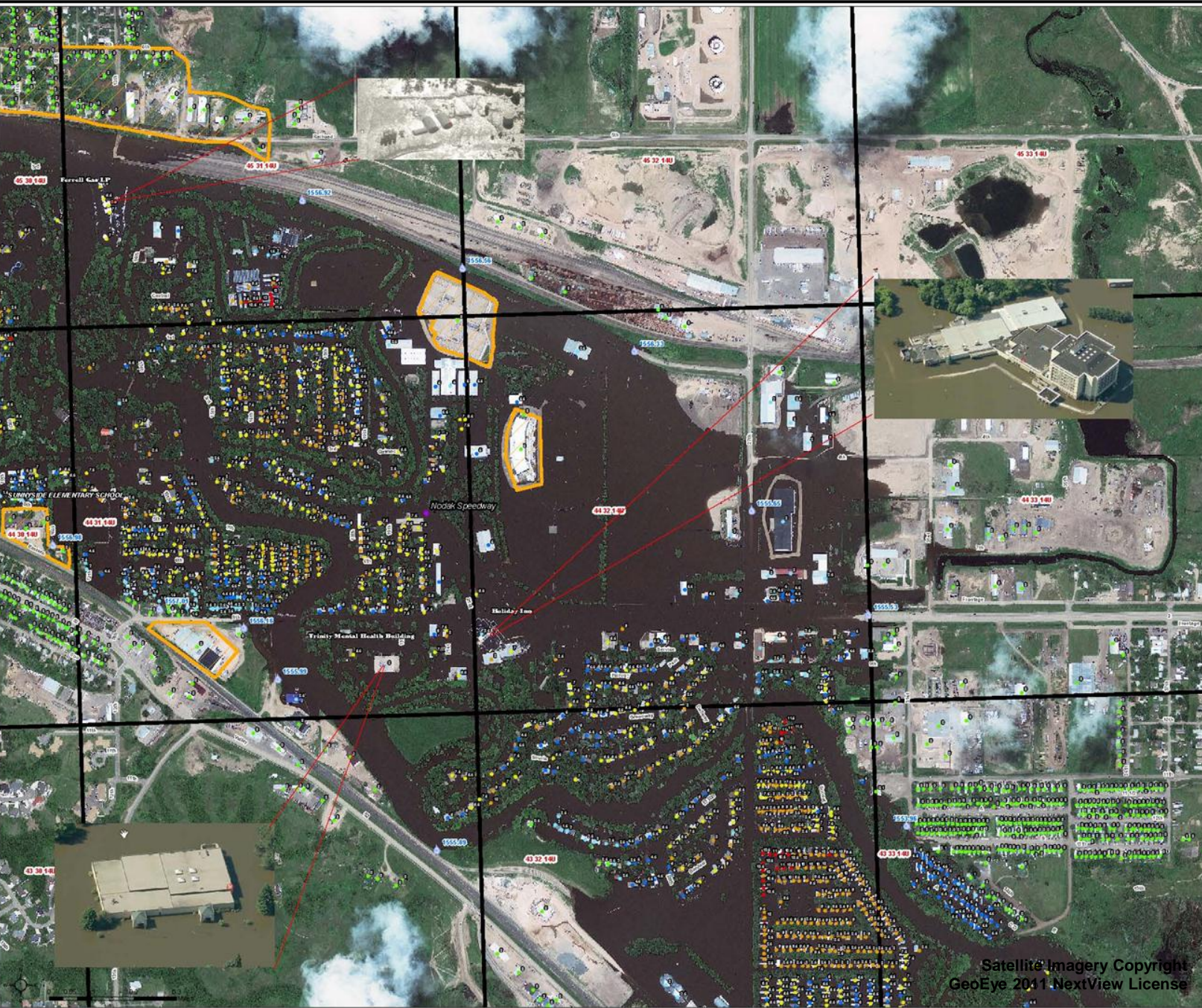
Water Depth at Structure

- 0 - 1 ft
- 1 - 4 ft
- 4 - 6 ft
- 6 - 7 ft
- 7 - 10 ft
- > 10 ft

Satellite Imagery Copyright
GeoEye 2011 NextView License

East (a) Minot, ND: River Extent and Depth of Water at Structure

Interim Map
July 5, 2011



Depth of Water (ft)	Structures Impacted	Damage Level
0.3 - 2	156	Affected
2 - 6	799	Minor
6 - 10	2376	Major
> 10	591	Destroyed

Estimated depth in feet relative to ground surface, damage descriptions are generalized and vary by building type and flood duration.



Data Layer/Map Description(s):
Flood extents and depths were obtained from USACE/Honston Eng.
Areas protected/dry were confirmed on the ground by FEMA/USGS field survey. Depths at structure represent modeled depths from USACE/Honston Eng. 24hr data. High Water Marks Obtained by USGS Satellite Imagery acquired Saturday June 25, 2011.
These projections are the best available estimates of highly uncertain conditions. There is an unknown margin for error, and the user is cautioned to allow for this. The user assumes all risks related to the use of this data.
The producer of this data is providing this data "as is" and provides no warranty, expressed or implied, regarding the data or its use, including but not limited to any implied warranties of merchantability or fitness for a particular purpose. In no event will the producer of this data be liable to you or to any third party for any direct, indirect, incidental, consequential, special or exemplary damages or lost profits resulting from any use or misuse of this data.

- Map Legend:**
- Hospitals
 - Colleges and Universities
 - Sports Complex
 - Law Enforcement Locations
 - Schools
 - High Water Marks (NAVD '88)
 - US National Grid
 - Confirmed Protected Areas (FEMA/USGS Field Survey)

Structures Affected - 4,165
*in Current Extent based on Imagery Analysis of 2010 NAIP

- Water Depth at Structure**
- 0 - 1 ft
 - 1 - 4 ft
 - 4 - 6 ft
 - 6 - 7 ft
 - 7 - 10 ft
 - > 10 ft

Satellite Imagery Copyright
GeoEye 2011 NextView License

Source: FEMA, USACE, USGS, NOAA, and other sources. This map is for informational purposes only and is not for navigation. It is not a warranty of any kind.

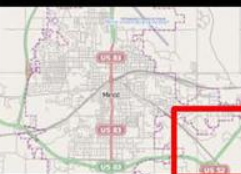
East (b) Minot, ND: River Extent and Depth of Water at Structure

Interim Map
July 5, 2011



Depth of Water (ft)	Structures Impacted	Damage Level
0.3 - 2	156	Affected
2 - 6	799	Minor
6 - 10	2376	Major
> 10	591	Destroyed

Estimated depth in feet relative to ground surface, damage descriptions are generalized and vary by building type and flood duration.



Data Layer/
Map Description(s):

Flood extents and depths were obtained from USACE/Honston Eng.

Areas protected/dry were confirmed on the ground by FEMA/USGS field survey. Depths at structure represent modeled depths from USACE/Honston Eng. 24hr data. High Water Marks Obtained by USGS Satellite Imagery acquired Saturday June 25, 2011.

These projections are the best available estimates of highly uncertain conditions. There is an inherent margin for error, and the user is cautioned to use this. The user assumes all risk related to the use of this data.

The presence of this data is provided "as is" and no warranty is made, expressed or implied, regarding the data or its use, including but not limited to any implied warranties of merchantability or fitness for a particular purpose. In no event will the presence of this data be liable to you or any third party for any direct, indirect, incidental, consequential, special or exemplary damages or lost profits resulting from any use or misuse of this data.

Map Legend:

- Hospitals
- Colleges and Universities
- Sports Complex
- Law Enforcement Locations
- Schools
- High Water Marks (NAVD '88)
- US National Grid
- Confirmed Protected Areas (FEMA/USGS Field Survey)

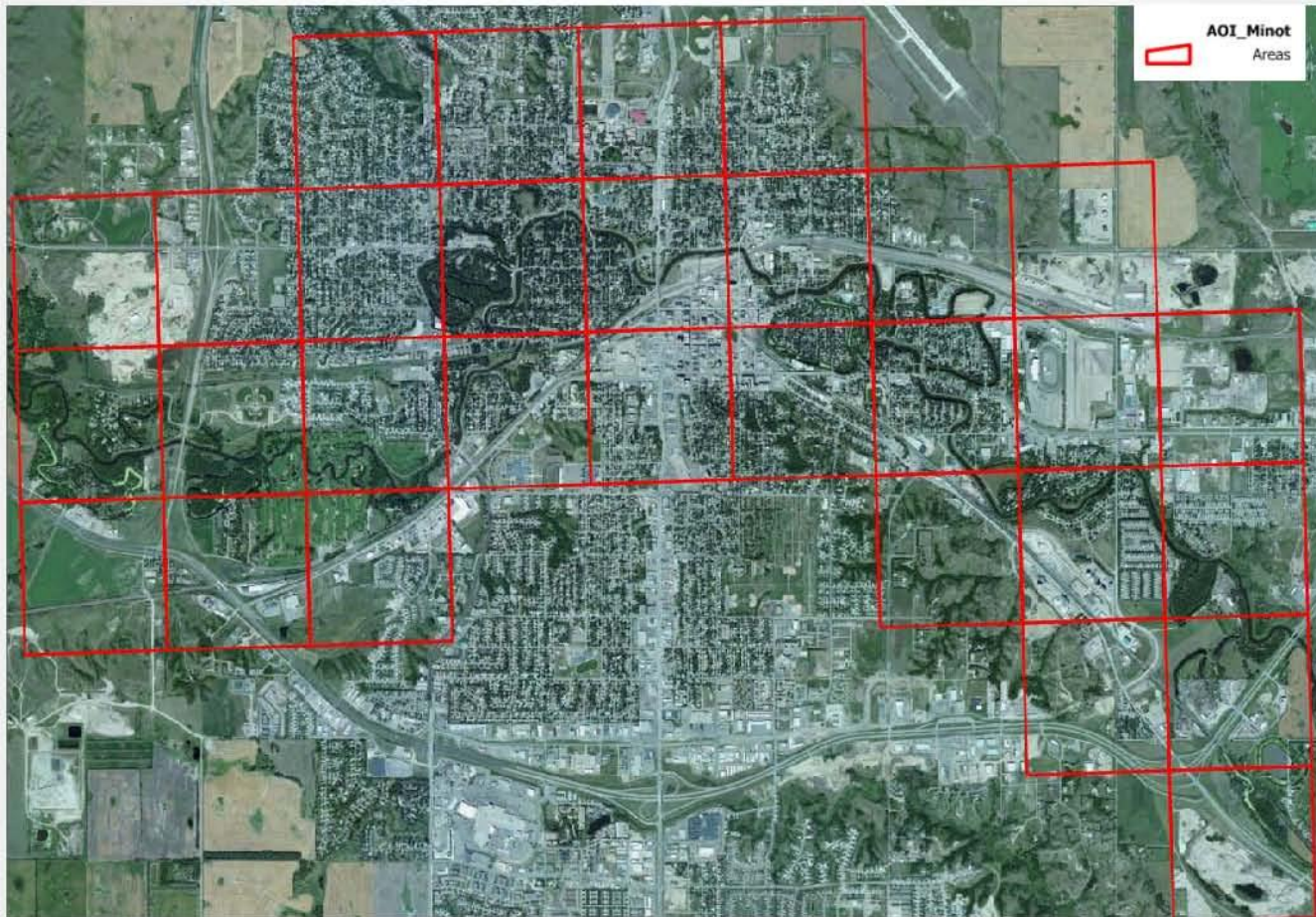
Structures Affected - 4,165
*In Current Extent based on Imagery Analysis of 2010 NAIP

- Water Depth at Structure
- 0 - 1 ft
 - 1 - 4 ft
 - 4 - 6 ft
 - 6 - 7 ft
 - 7 - 10 ft
 - > 10 ft

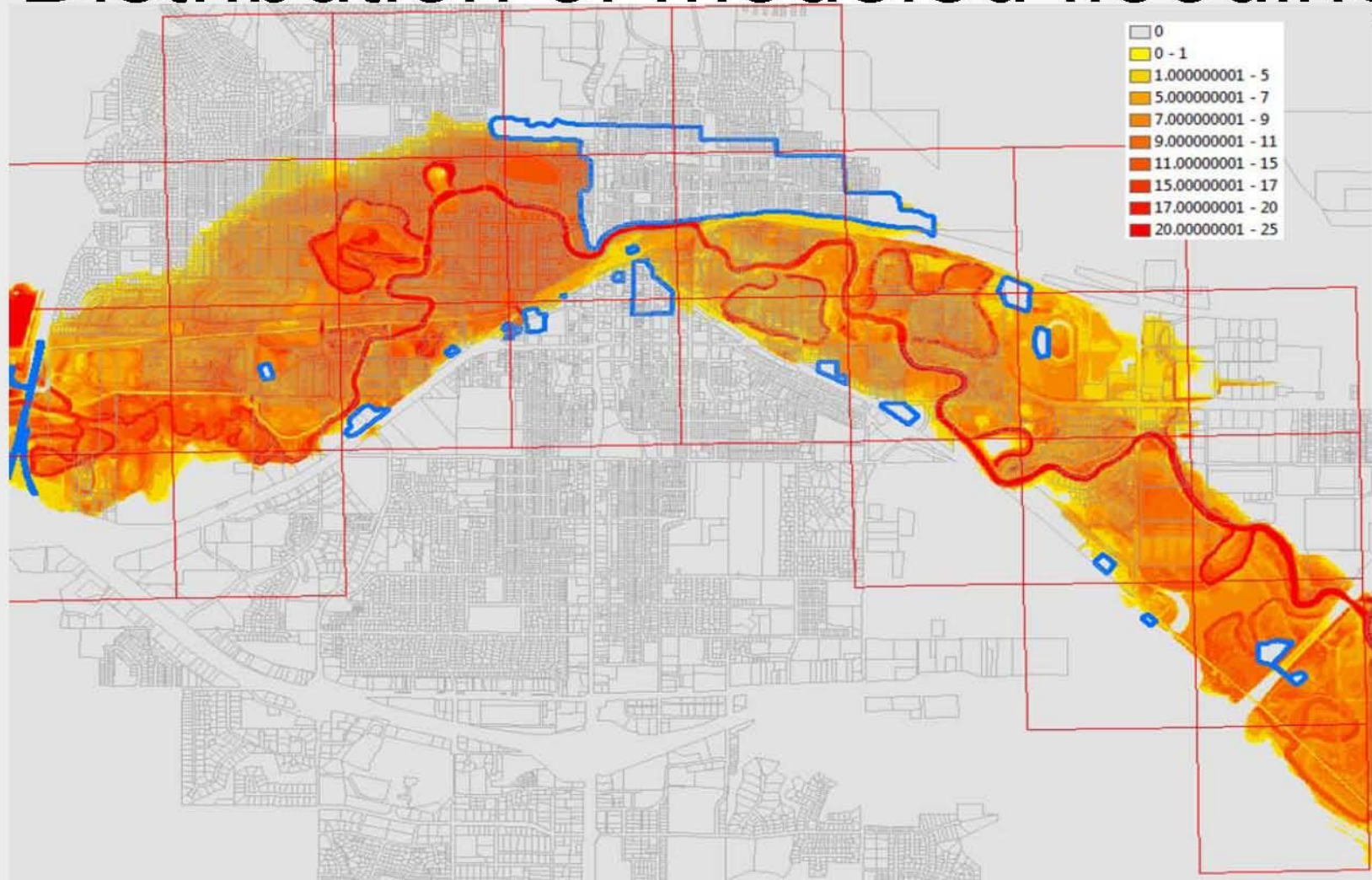
Satellite Imagery Copyright
GeoEye 2011 NextView License

This Report / Document is for informational purposes only. It is not intended for use in any legal proceeding. The user assumes all risk related to the use of this data.

AOI- National grids in red (Minot, ND)



Distribution of modeled flooding



ImageCat, Inc.™

New Light Technologies

Inventors of Risk Management Technologies

Exposure Development

- Rapid online product development to support widespread interpretation
- Detailed protocol developed
- Heavy use of Google Earth, Pictometry, and Bing to make determinations

Exposure Development: Occupancy

- Analysts used Google earth, parcel data, imagery interpretation
- Largely residential



Exposure Development: Basements

- Engineering-based protocol with design considerations
- Manufactured Housing: Defined as at grade
- Options: Basement, At Grade, Crawl Space, Unable to determine
- Google Earth used when imagery not clear.



Exposure Development: Number of Stories

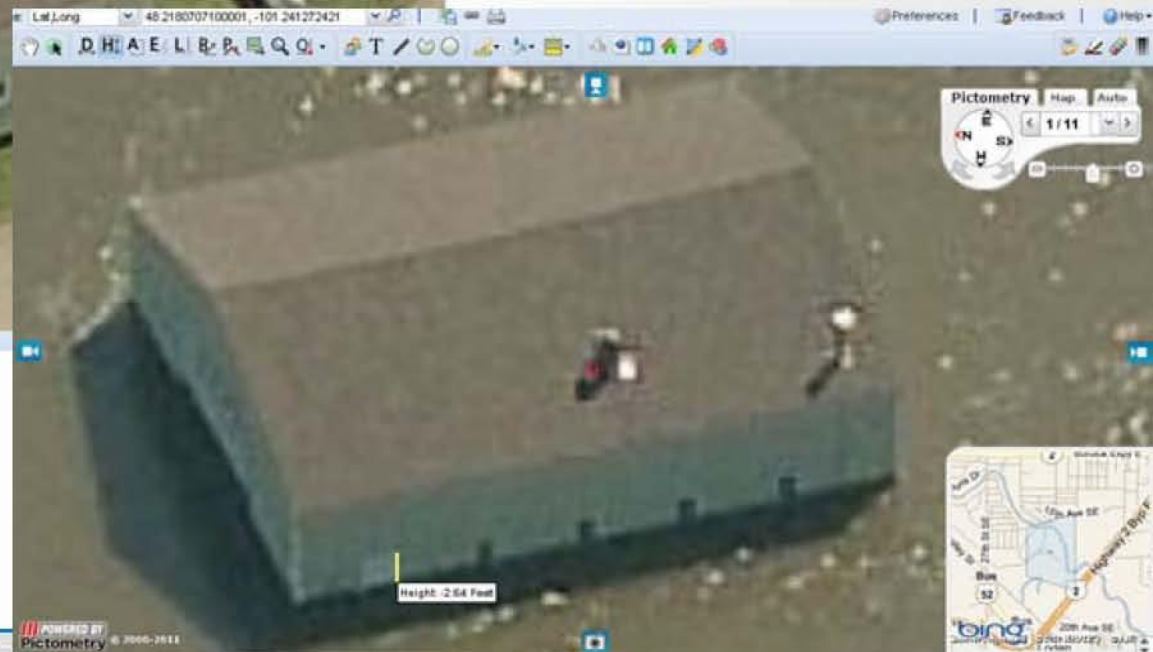
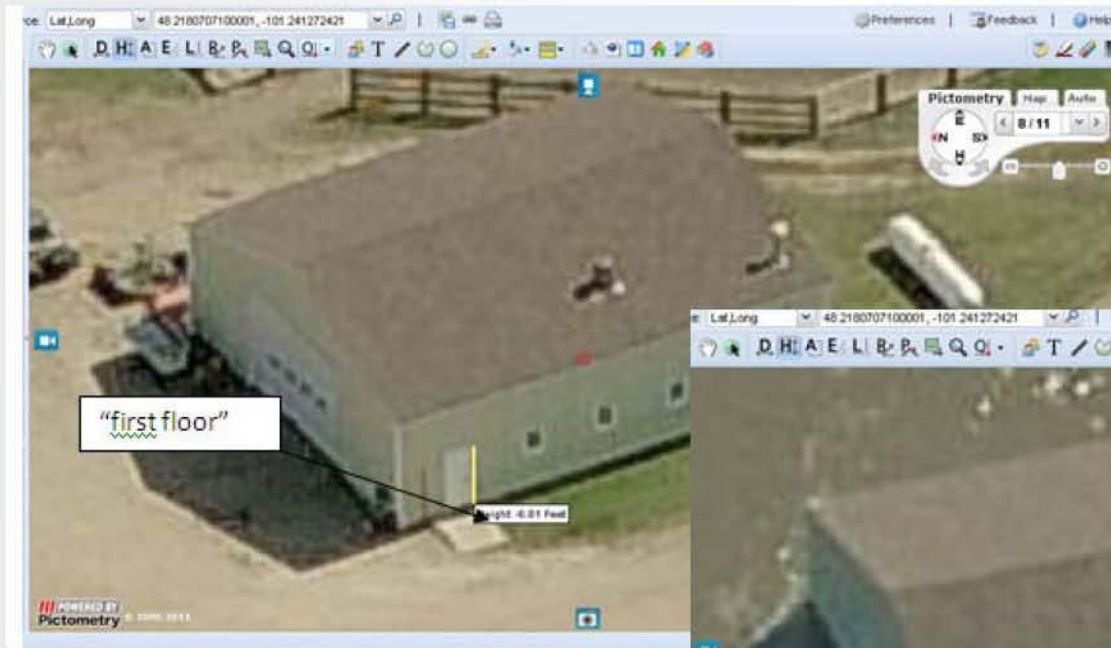
- 2-story or 1-story with basement determinations made with guidance from assessor data, livability considerations
- Depth of flooding measured in conjunction with assessment



Flood Depth protocol

- Analysts measured from a visual cue to first floor elevation in before imagery, and from visual cue to flood elevation in after imagery
- Results had to be assessed with building design considerations
- Results at short distances, with roof overhangs, or in difficult terrain not deemed reliable

Example from Pictometry interface



Prioritization

- Prioritization in assessment given to Oak Park area of town
- 12 key structures identified for in depth analysis

Priority Structures

	Facility	Address	Parcel ID
1	Ramstad Middle School	501 Lincoln Ave Minot, ND 58703	MI142590800040
2	Lincoln Elementary School	1 7th St SW Minot ND 58701	MI233720300000
3	Longfellow Elementary School	600 16th St Minot, ND 58703	MI142760002760
4	Holiday Inn	2200 Burdick Expy E Minot, ND 58701	MI19B280000010
5	Trinity Mental Health building	1900 8th Ave SE Minot, ND 58701	MI192882520280
6	Arrowhead Shopping Center	1600 2nd Ave SW Minot, ND 58701	MI222920200021
7	Ferrell Gas LP	1200 3RD Ave NE Minot, ND 58703	MI247960000020
8	Coca Cola Bottling Co West	405 9th St SE Minot, ND	MI243970100110
9	Water treatment plant	905 16th St SW Minot, ND	MI239530300330
10	IRET Minot Apartments	1805 2nd Ave SW Minot, ND	MI222910860000



Example: Holiday Inn

Building ID: 4

Facility: Holiday Inn

Address: 2200 Burdick Expy E, Minot, ND 58701

Parcel: MI19B280000010

HAZUS occupancy: COM 8, COM 8, RES 4

Description: 7 story hotel with a connection ballroom, indoor pool and entertainment casino area. The hotel appears to be constructed of reinforced concrete with steel framing in the larger open areas.

Square Footage: 1)hotel 109,203 2)warehouse 12,460 3)casino 22,425. Total 144,088

Water depth at first floor: 2-5 feet



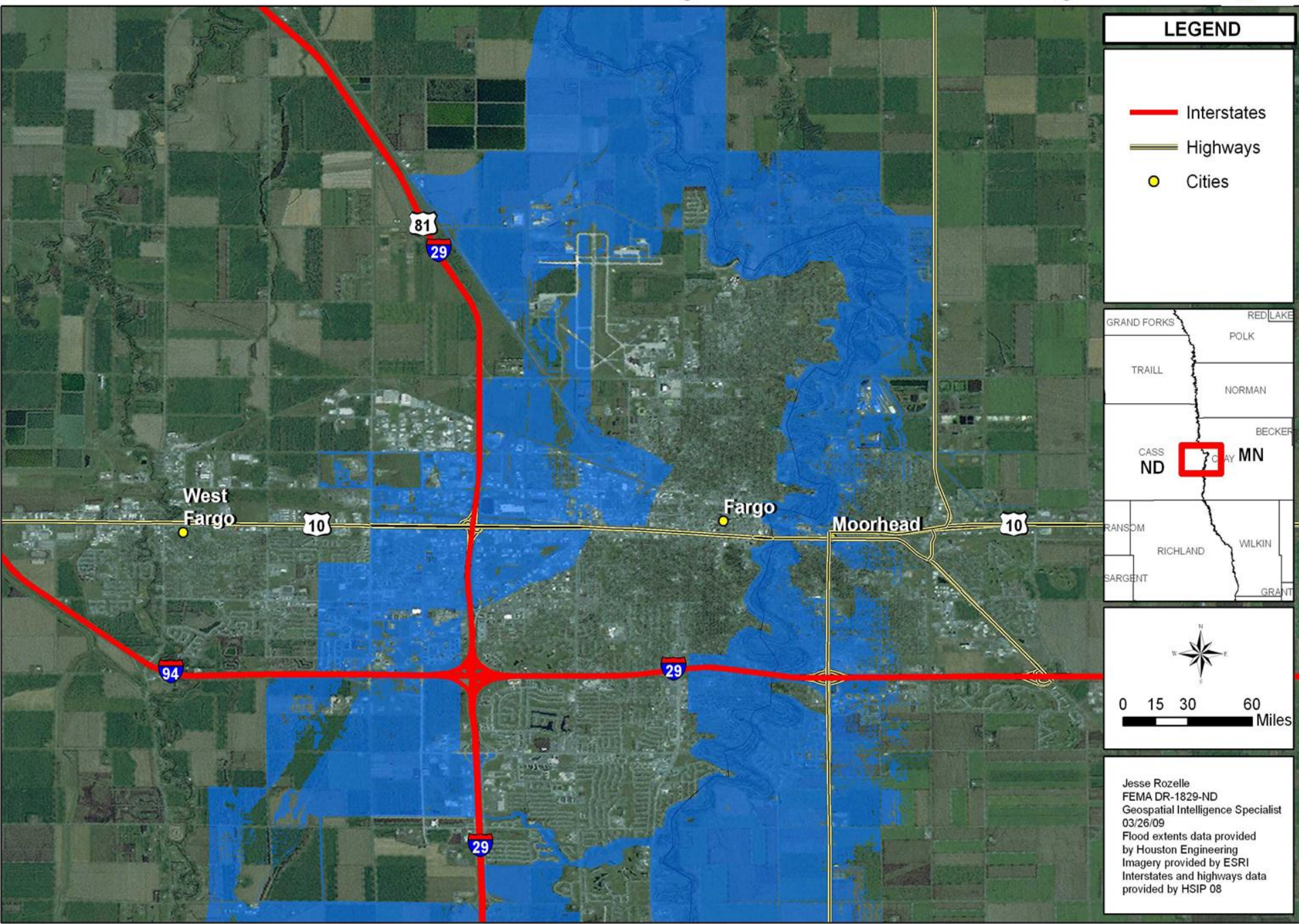
[illegible][illegible]

A Comparison: Site Specific vs. Aggregated Flood Loss Modeling Approach

Case Study – Fargo, ND



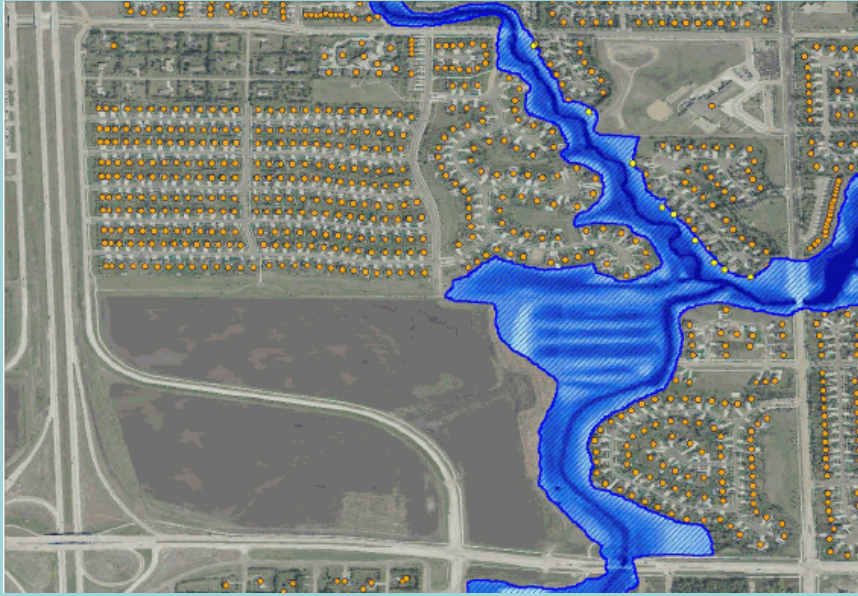
Predicted Extent of Flooding From 43 Ft. Flood Stage



Scenario	Flood Related Building Damage (buildings only) - Census Block Analysis	Flood Related Building Damage (buildings only) - Site Specific Analysis	Level I Area Weighting Approach Overestimation
2010 37 foot crest, closest to actual event	\$69,016,000	\$968,919	\$68,047,081
2010 37 foot crest, if flood protection measures had failed	\$81,561,000	\$2,835,323	\$78,725,677
2009 41 foot crest, closest to actual event	\$87,024,000	\$1,894,676	\$85,129,324
2009 41 foot crest, if flood protection measures had failed	\$374,937,000	\$232,863,548	\$142,073,452

User Defined Assessors Inventory - Dollar Exposure Total (bldg. values only, does not account for contents)	\$5,923,485,360	\$5.9B
HAZUS Census Block Inventory - Dollar Exposure Total (bldg. values only, does not account for contents)	\$7,476,342,000	\$7.47B

Site Specific Loss Approach (8 structures affected)



Area Weighting Estimation – Assumes Uniform distribution of Structures



Aggregated Flood Losses Approach – Possible Reasons for Overestimation of Losses

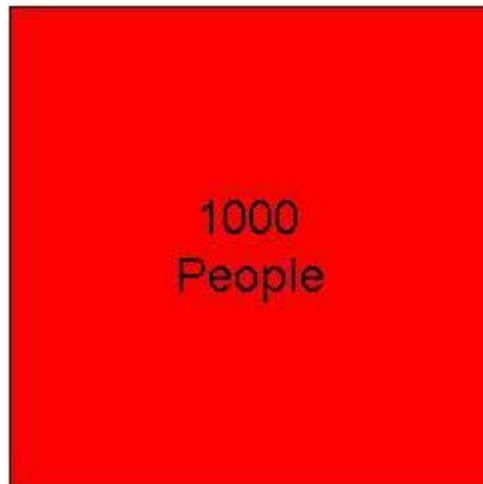
Many homes are at higher elevations than the street or surrounding areas



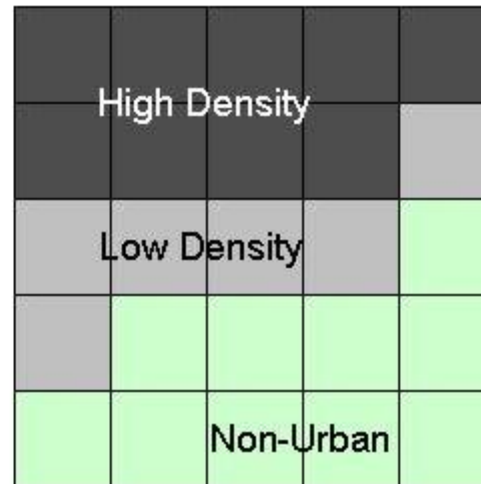
Dasymetric Mapping

- General Definition: Redistributes data from one spatial unit to a new spatial geography using an ancillary data source
- Components:

Census Block



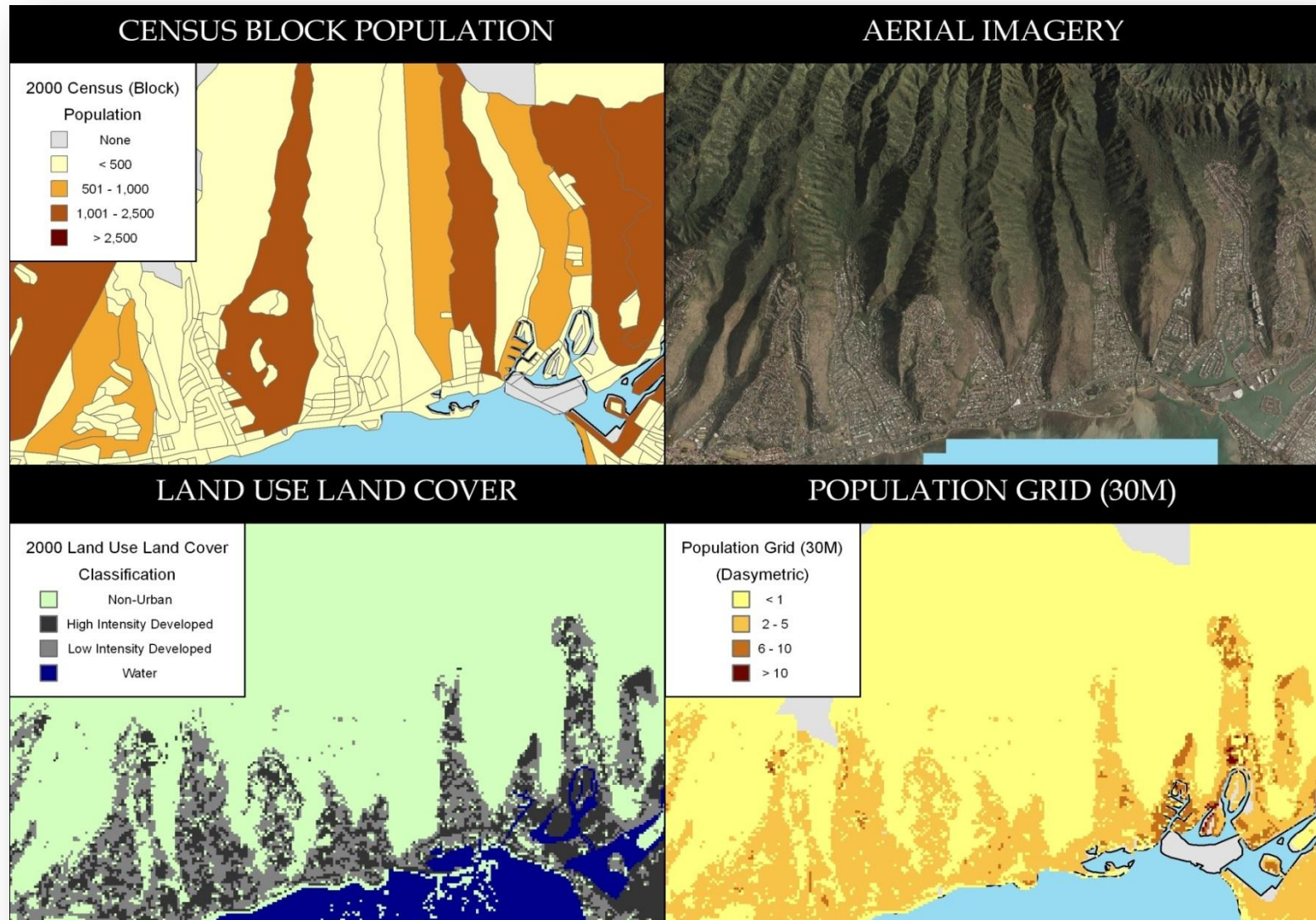
Land Use Land Cover



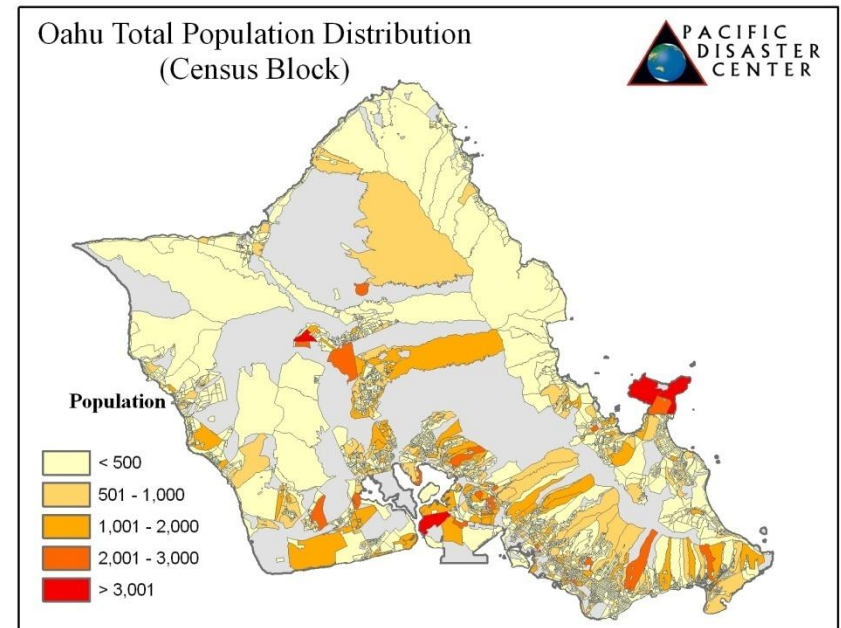
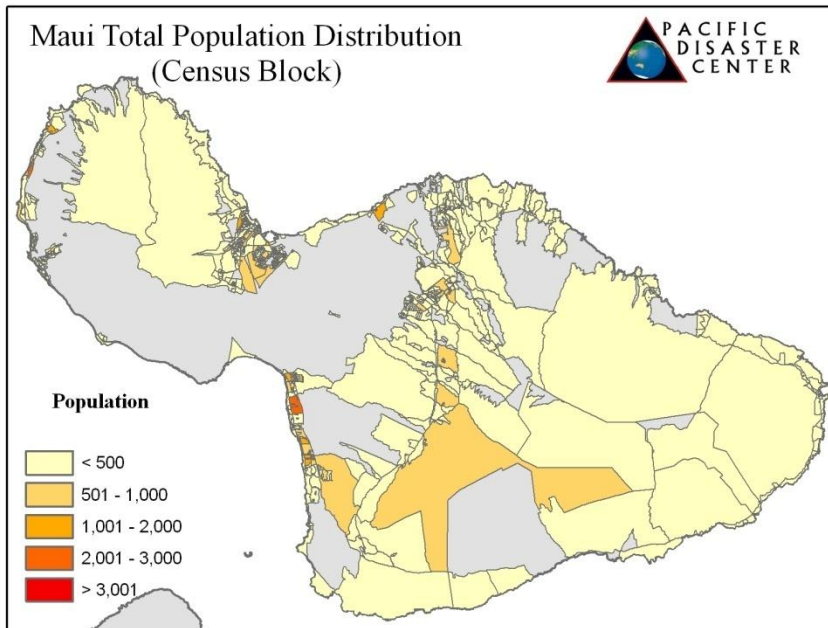
Population Grid

72	72	72	72	72
72	72	72	72	57
57	57	57	57	.02
57	.02	.02	.02	.02
.02	.02	.02	.02	.02

Dasymetric Mapping

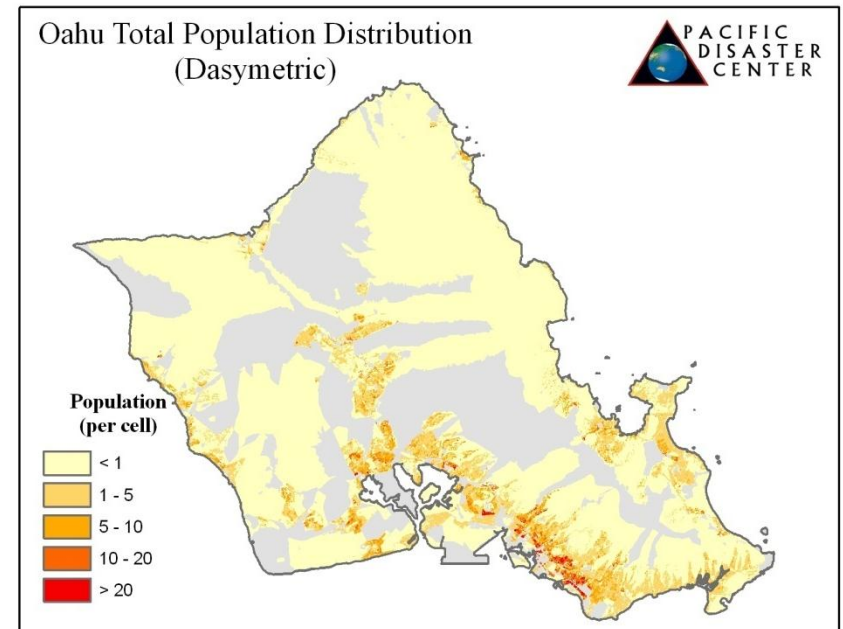
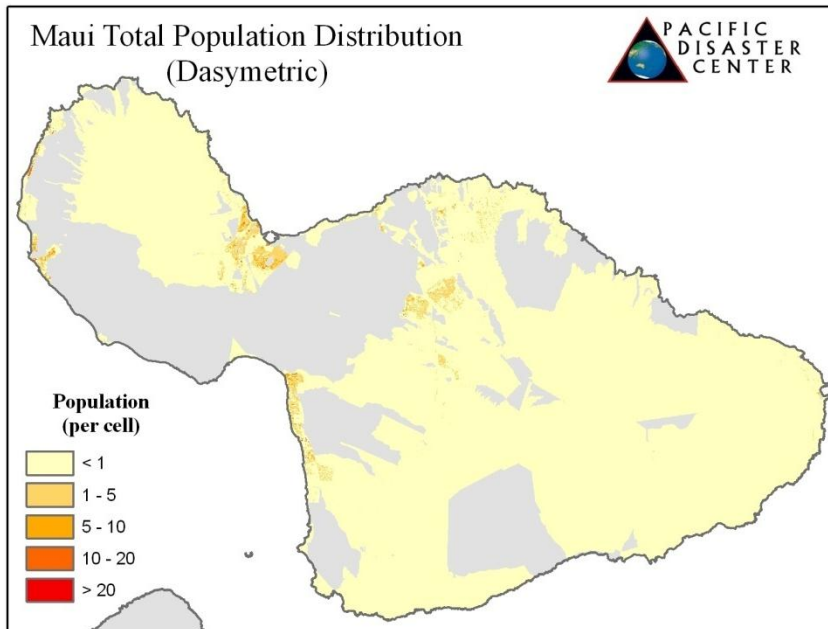


Dasymetric Mapping



Dasymetric Mapping

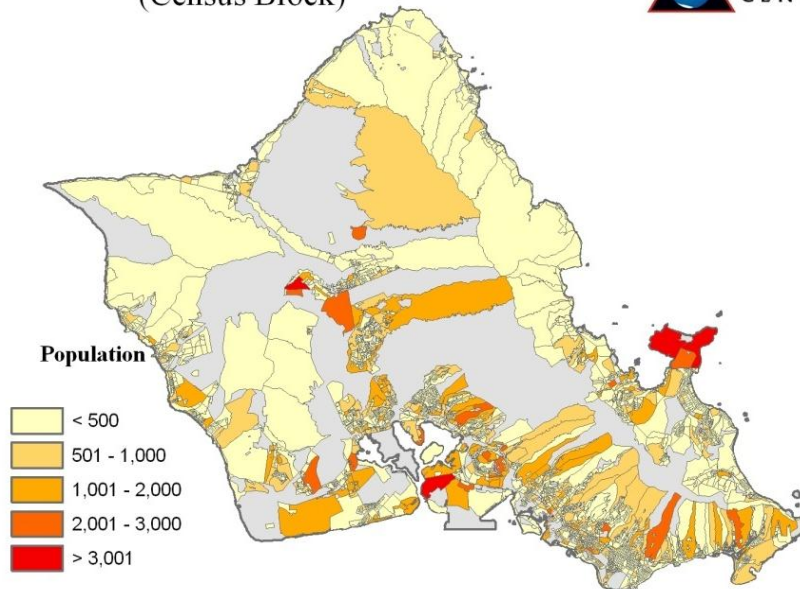
- Population Distribution (Dasymetric)



Dasymetric Mapping

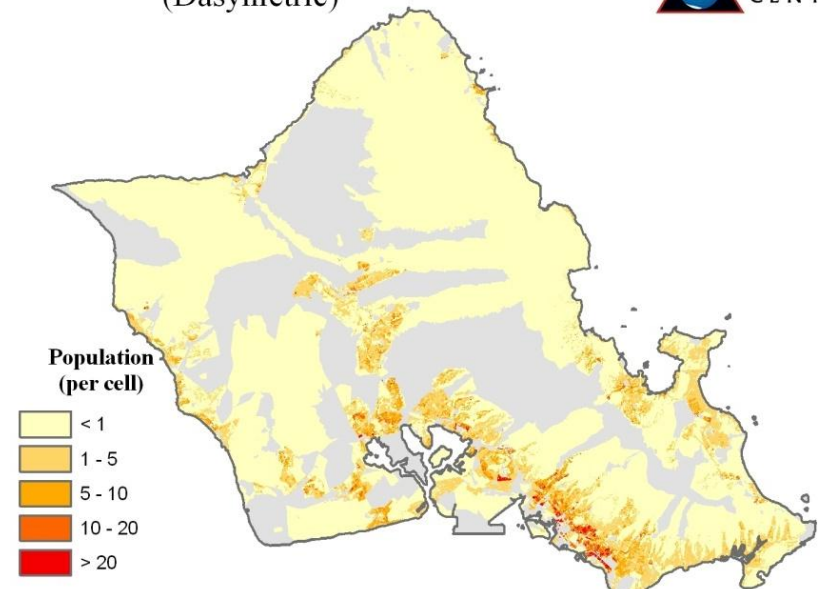


Oahu Total Population Distribution
(Census Block)



Census Block

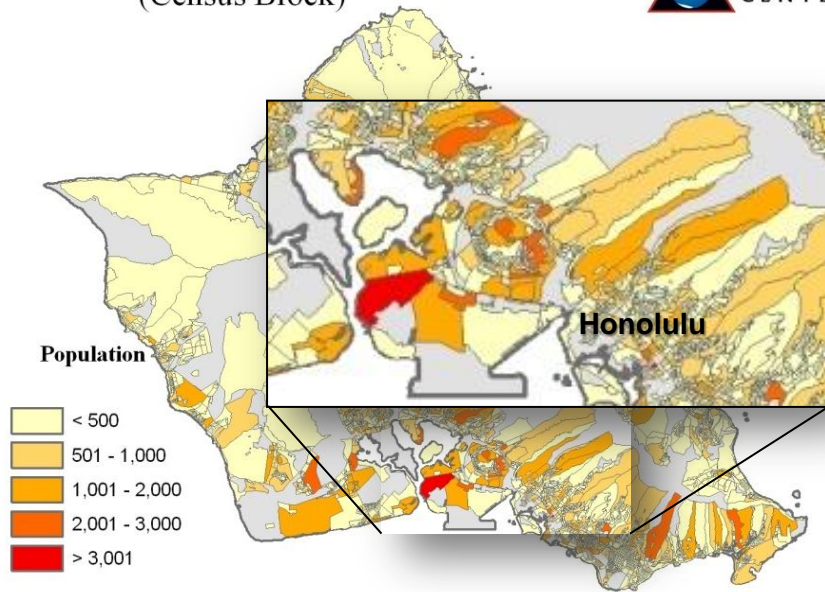
Oahu Total Population Distribution
(Dasymetric)



Dasymetric Distribution

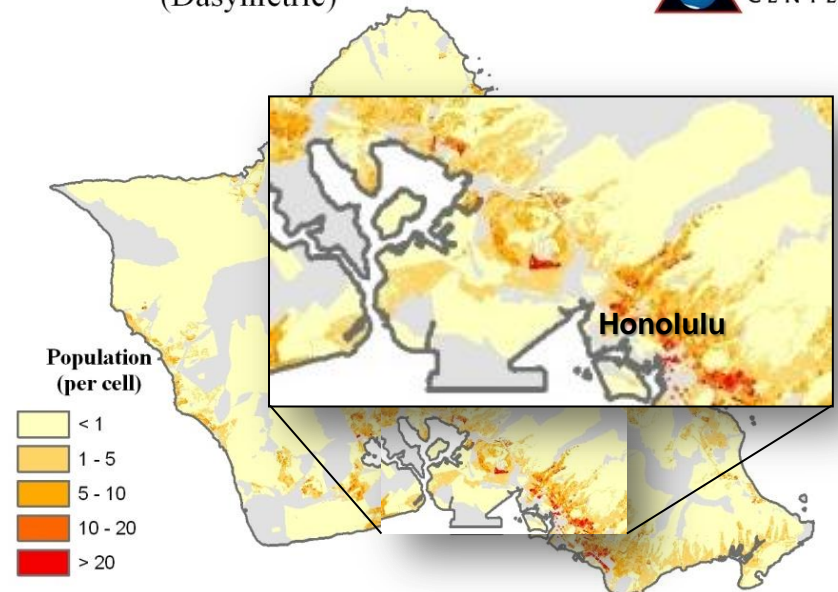
Dasymetric Mapping

Oahu Total Population Distribution
(Census Block)



Census Block

Oahu Total Population Distribution
(Dasymetric)

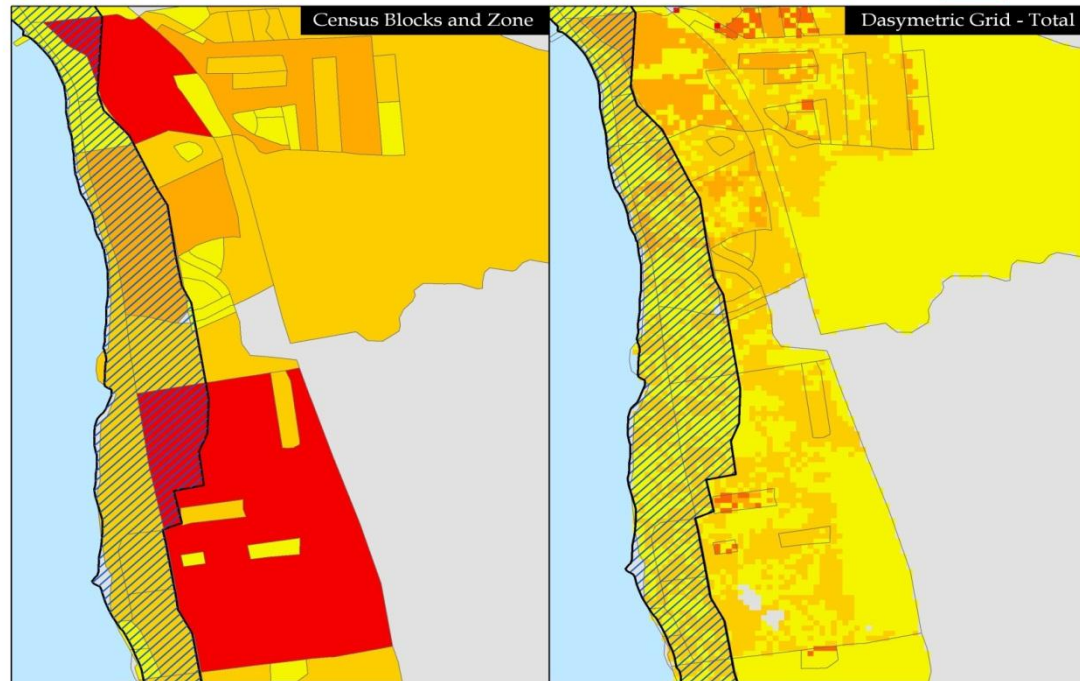


Dasymetric Distribution

Dasymetric Mapping



Tsunami Evacuation Zone 64: Kamaole Beach Park to Kealia (Maui)



Questions?

