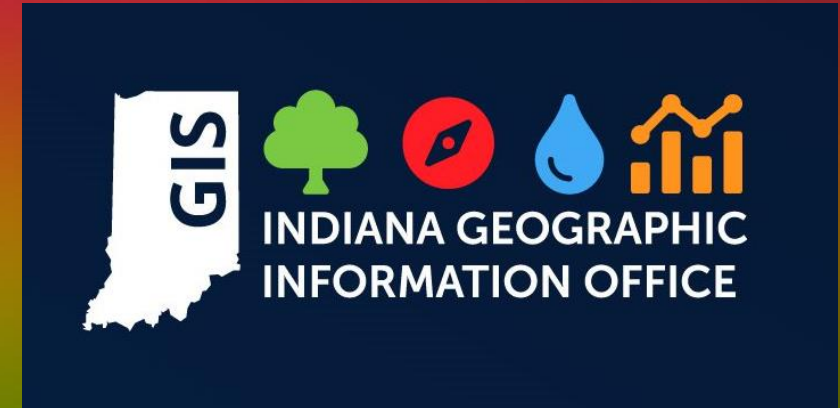




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**INDIANA GEOGRAPHIC
INFORMATION OFFICE**

Indiana Office of Technology Geographic Information Office

2021 - 2024 Indiana Orthoimagery Program – Overview and Buy-ups

January 7, 2022 11:00 pm EST

**Shaun Scholer - Point of Contact, (POC)
GIS Program Director**

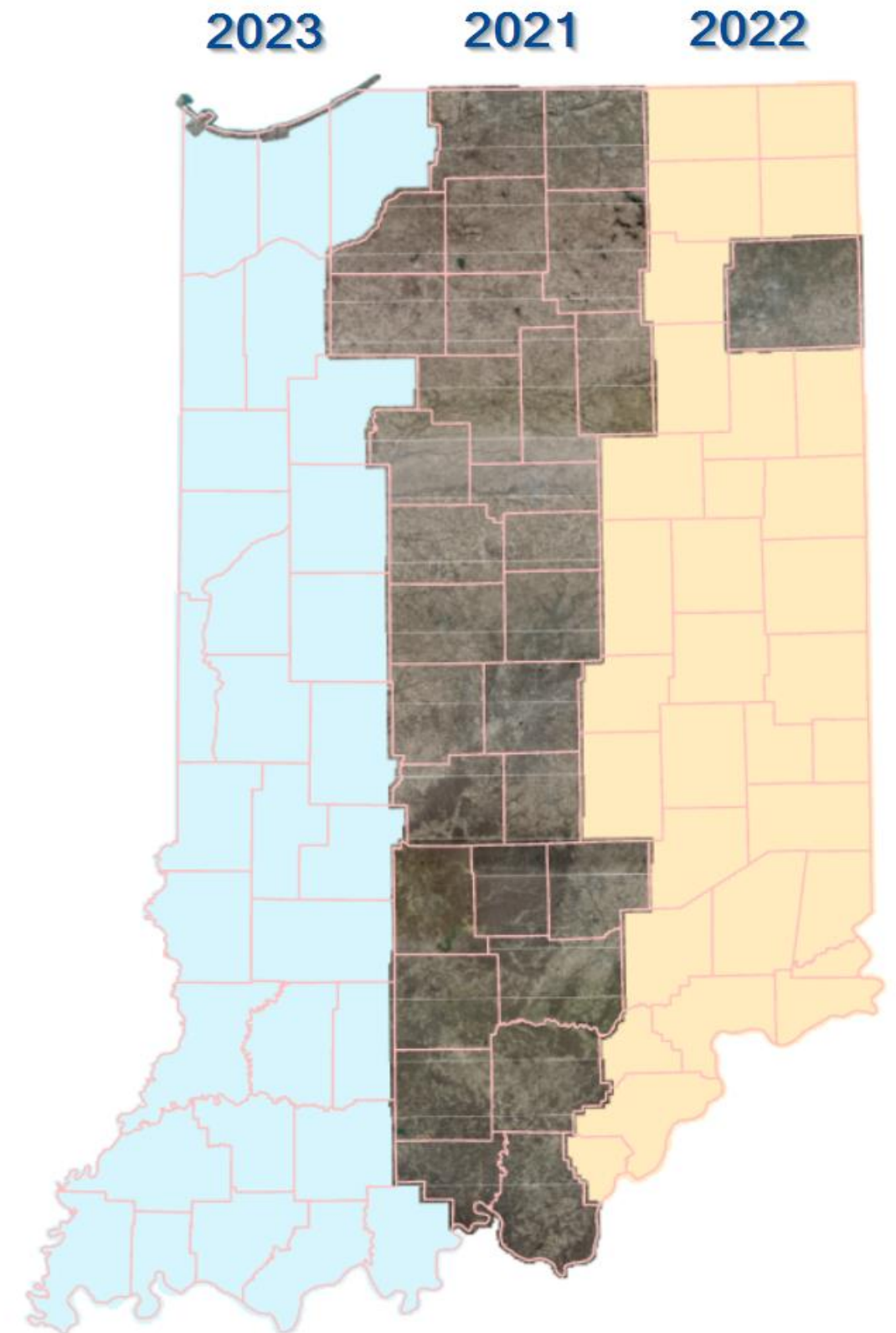
**Megan Compton, MPA
Indiana Geographic Information Officer**

**Shawn Benham, PMP
Project Manager**

**Brad Arshat, CP, EIT
Director, Strategic Accounts**

Indiana Statewide Programs

- **2021-2024 Ortho – 6”**
- 2016-2019 Ortho – 1’
- 2011-2014 Ortho – 1’
- 2005-2006 Ortho - 1’



Indiana Statewide Program Management

- Administered through Indiana Geographic Information Office (GIO)

ALL Inquires



Shaun Scholer

Indiana Geographic Information Office



Sanborn





Indiana Statewide Program - Funding

- Indiana Office of Technology (IOT)
- Indiana Department of Transportation (INDOT)
- Additional Partnerships





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Indiana Statewide Program - Specification

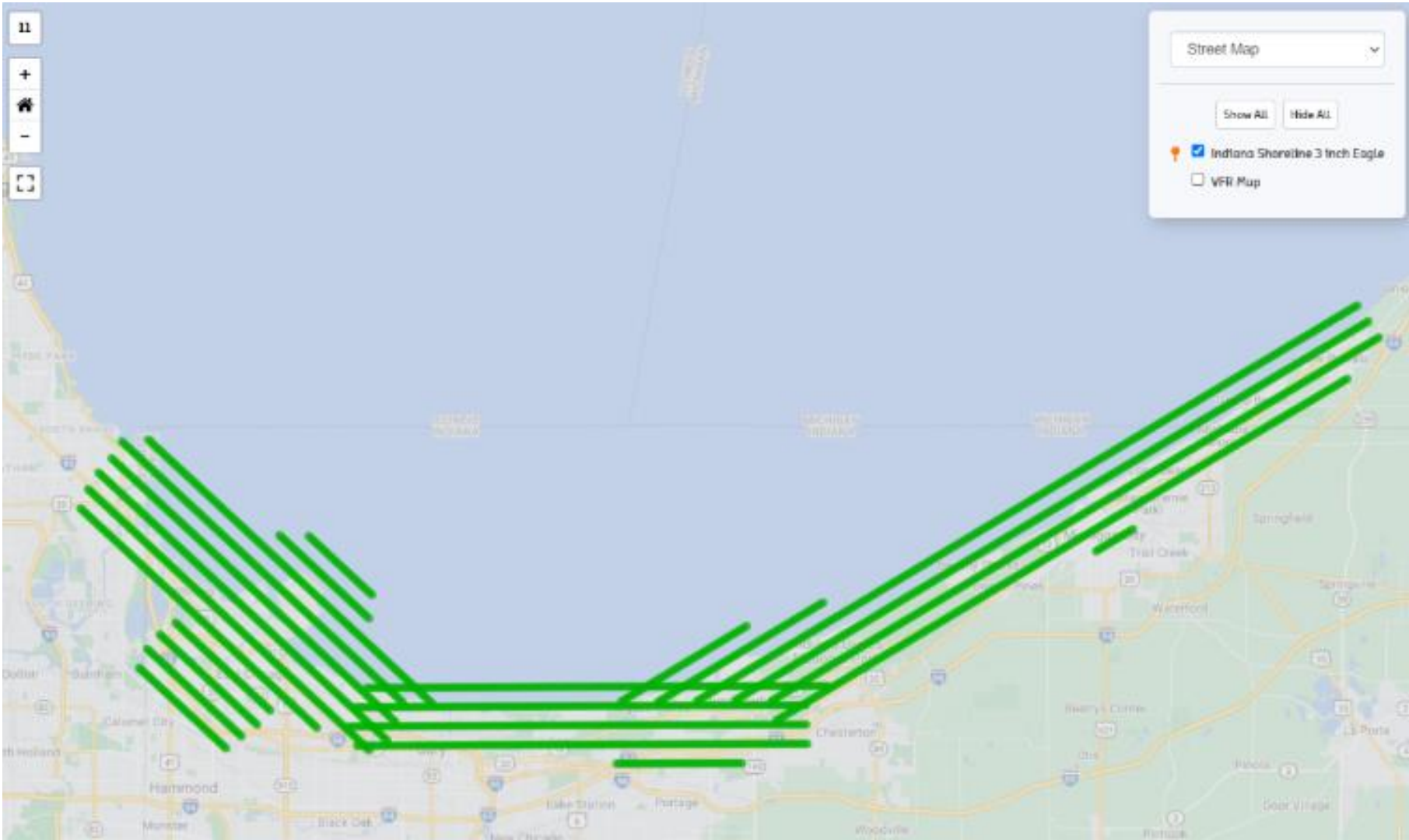
- **Base Products**
 - 6-inch (15-cm) Pixel Resolution
 - Tile 4 -Band (R,G,B, NIR) Imagery
 - GeoTIFF Uncompressed
 - ECW & MrSID compressed
 - County Mosaic MrSID 3-Band



INDIANA GEOGRAPHIC
INFORMATION OFFICE

Project Planning

- Sanborn - Flight Analyst
 - Project Layout
 - Track Daily Progress



Tier I Flight Capture

February 25th – April 13th

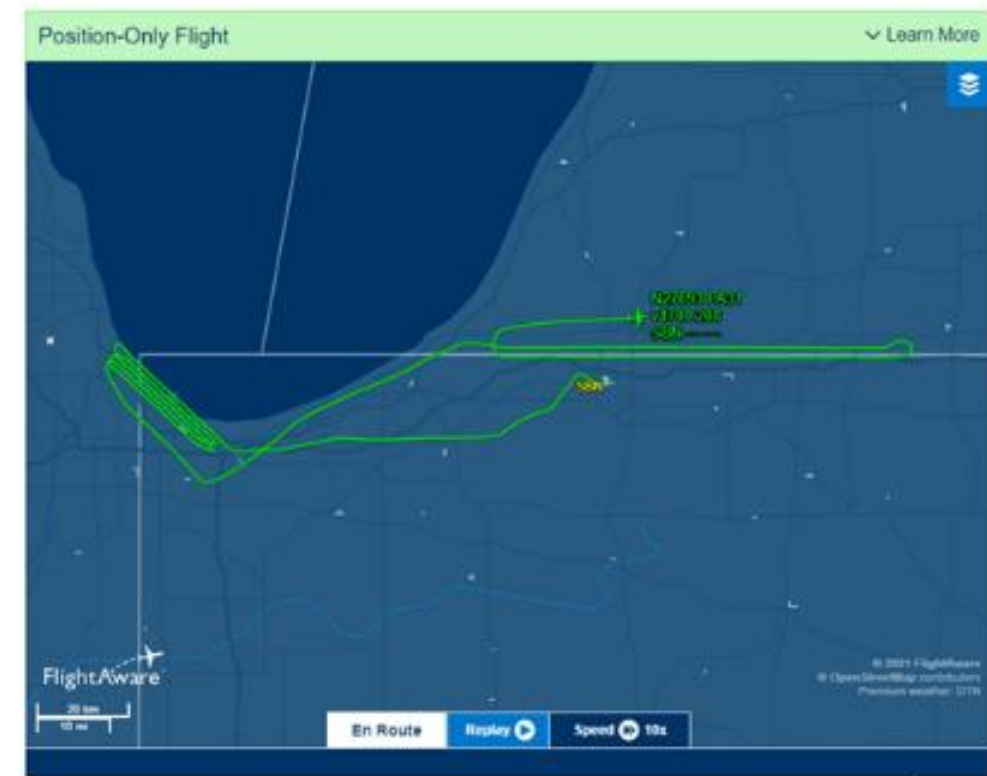
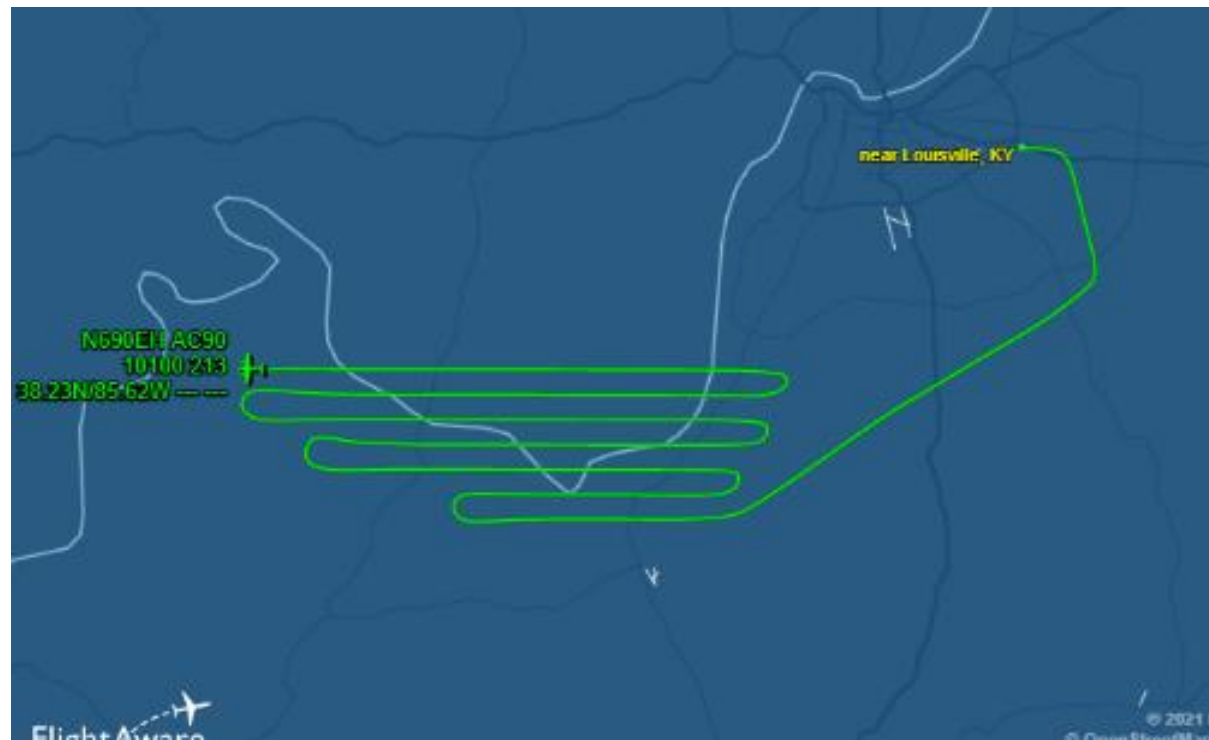
Piper
Navajo



Rockwell
Twin Commander

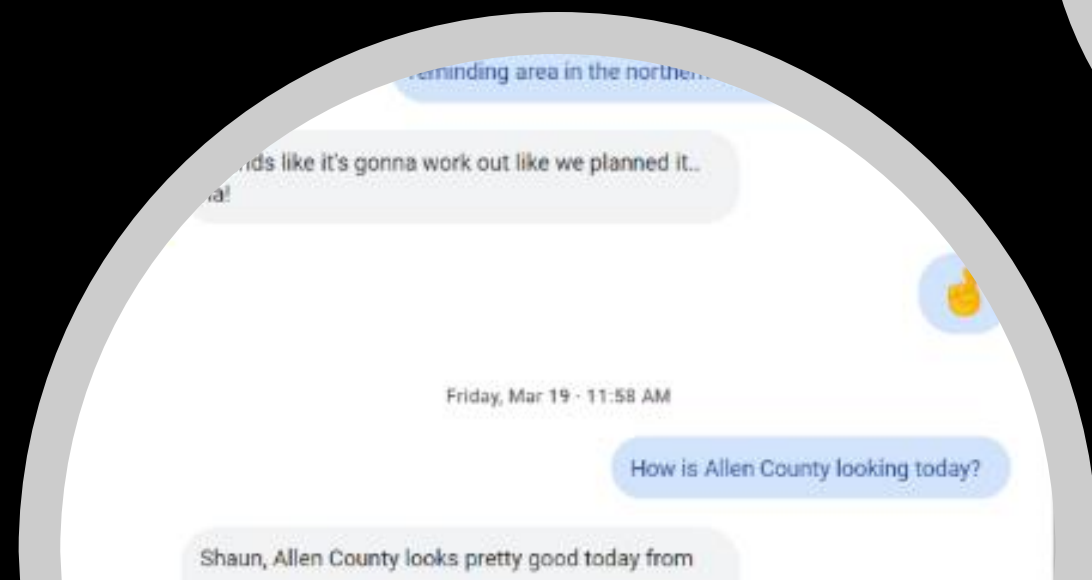
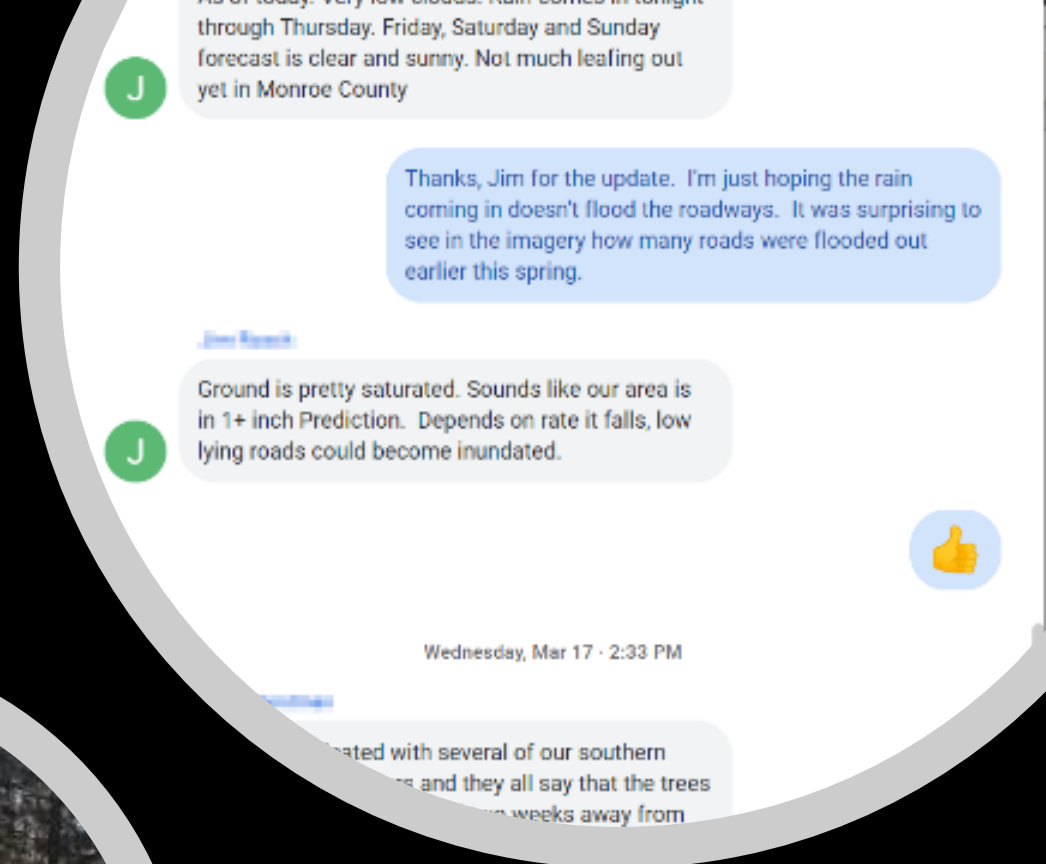


Piper
Apache



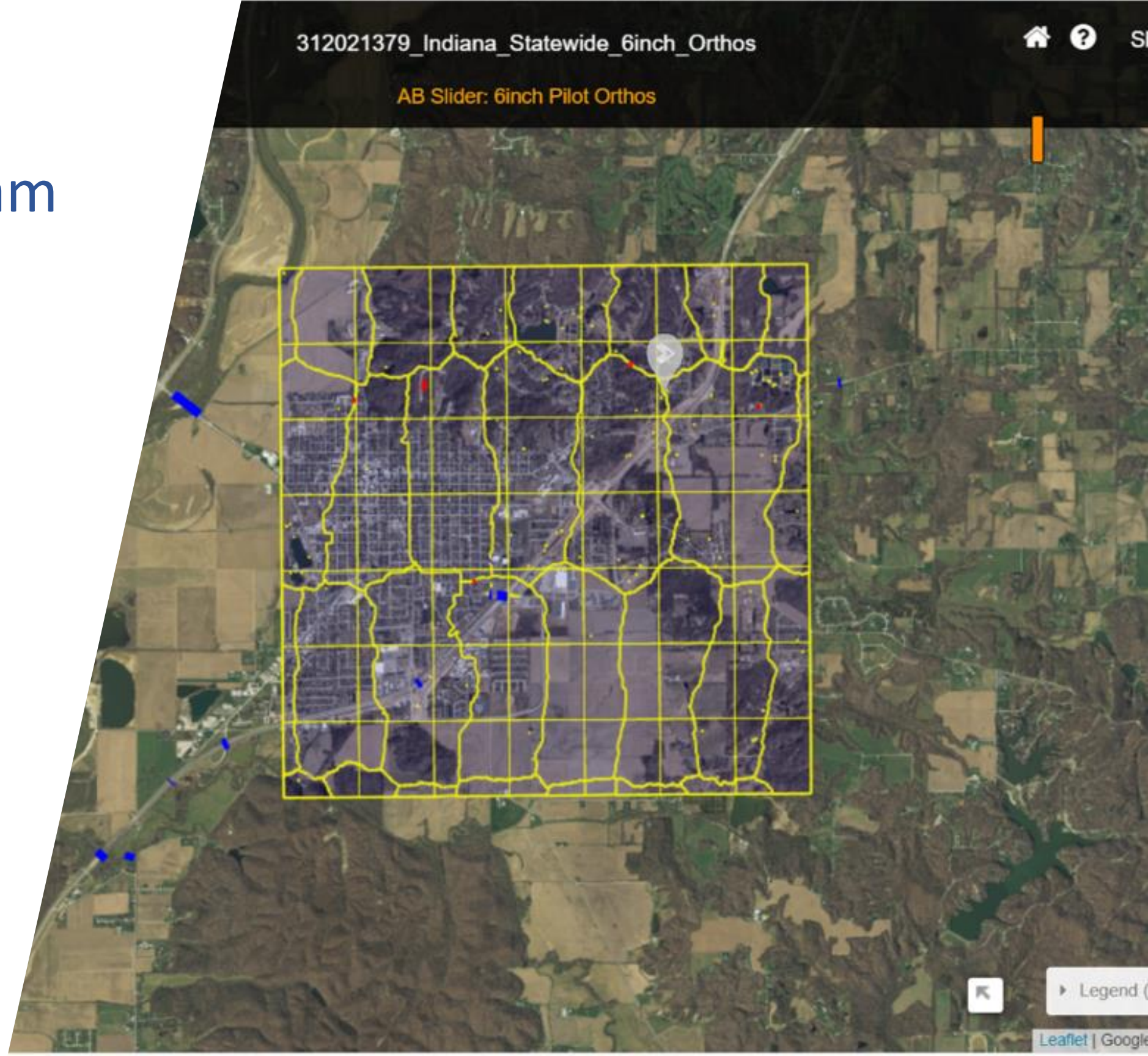
Boots on the Ground

- DNR Employees
- GIS Vendor Employee
- County GIS Managers
- County 911 Director
- County IT Director



Orthophotography QC INDOT Aerial Surveys Team

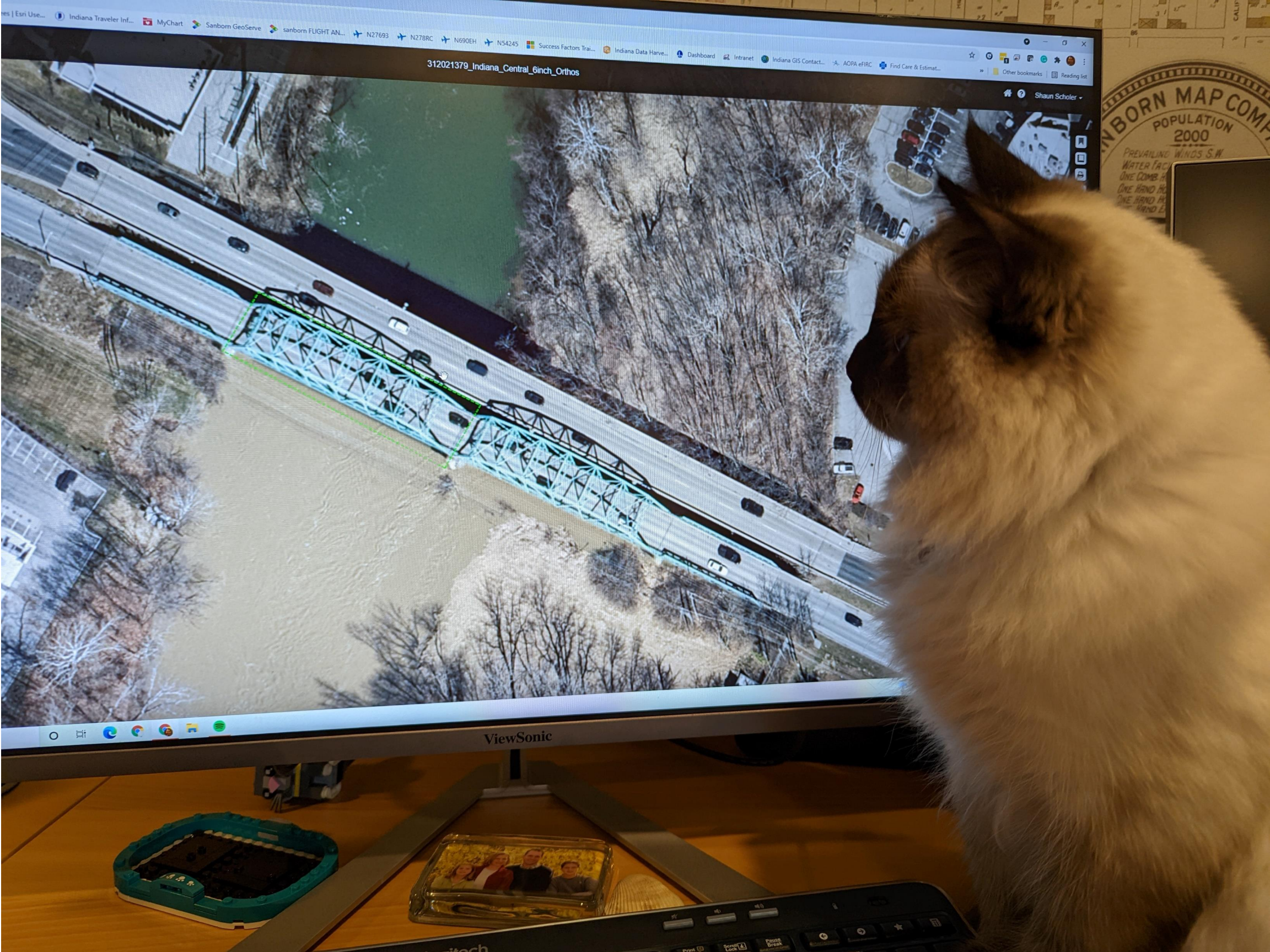
- Eric Banschbach
- Jennifer Waymon
- Jonathan Schiemann
- Mark Shambaugh



Imagery QC



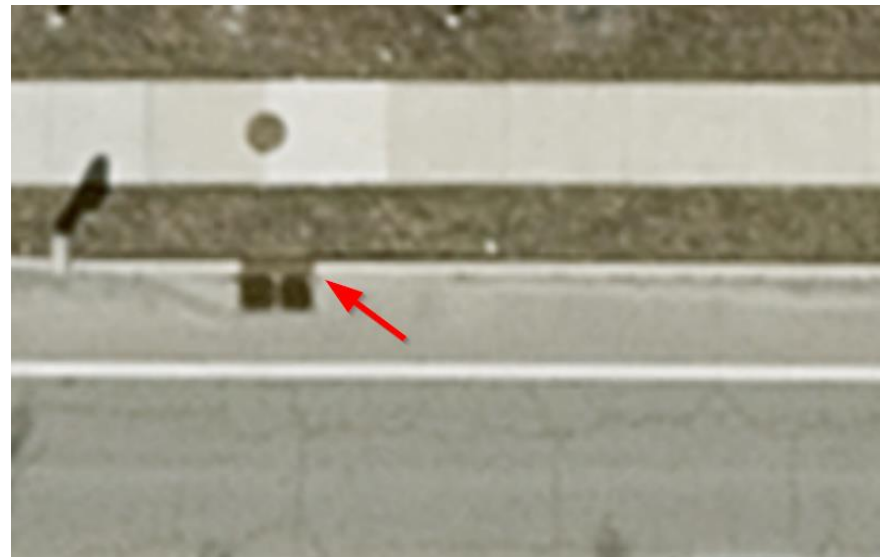
Additional Review





Surveyed Orthophoto Photo Identifiable Points

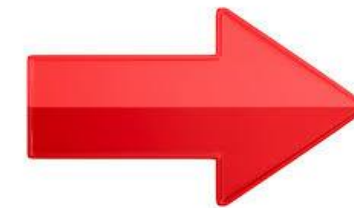
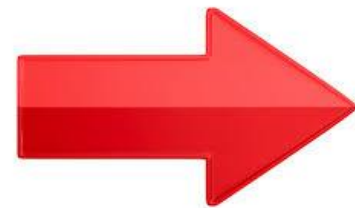
- Edge of pavement
- Well defined sidewalk corners
- Well defined pavement markings





Indiana Statewide Program – Distribution

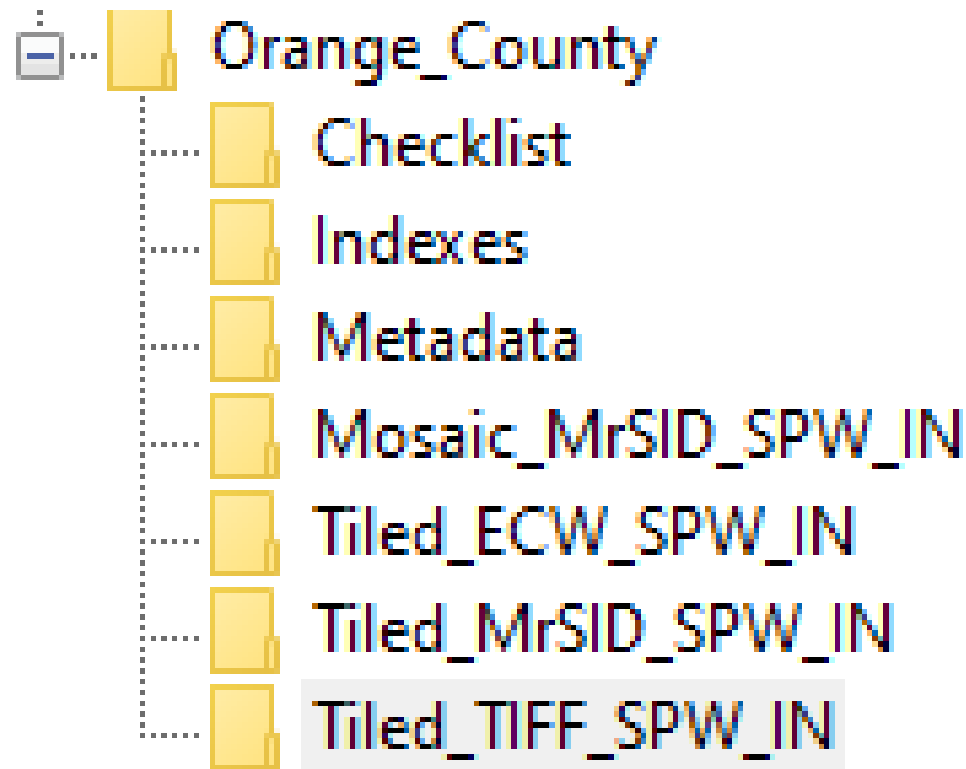
- Sanborn FTP Service
- Survey followed with instructions on how to login and download imagery.





Indiana Statewide Program – Products

File Structure



Checklist

General Quality Checks

	Yes	No	Comments
Do the deliverable files match the specifications in Table 1?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Is the projection information correct? <i>NAD_1983_HARN_StatePlane_Indiana_West_FIPS_1302_Feet</i>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Do the files display <u>properly</u> and in the correct projection?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Does the delivery contain the correct number of files? Tiled GeoTIFF: 2098 Tiled ECW: 2098 Tiled MrSID: 2098	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Does the image name attribute match the Tile Index?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Are the <u>geotiff</u> files the correct size?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Is the ISO 9001:2015 Quality Review Form complete?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

Image tile grid & Photo centers with date stamp

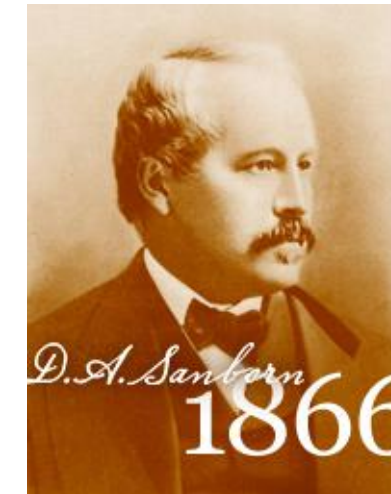


All Compressed products are compressed at 20:1 (nearly lossless)



Sanborn Company Overview

- Founded in 1866
- Full service, dedicated geospatial solution provider
- 125 employees in 4 locations nationwide
- Quality-oriented company and culture
 - Corporate Quality Management System derived from ISO principles





Chronology of Service Offerings	
Service	Offered Since
Ground Surveys	1866
Aerial Photography	1966
Photogrammetric Mapping	1966
Digital Photogrammetric Mapping	1979
Digital Terrain Modeling	1984
Digital Orthophotography	1988
Lidar	1998
Digital Vertical Aerial Imagery	2004
Digital Oblique Aerial Imagery	2011
UAS Operations	2013
HD Mapping	2014
24 Hour Emergency Response	2016
Large Area UAS Processing	2017
Proprietary Oblique Camera	2018

Recent State-Level Mapping Programs

- New York
- Virginia
- Maryland
- Connecticut
- Michigan
- Arkansas
- North Carolina
- Louisiana
- Vermont



Sanborn Overview – Comprehensive Geospatial Solutions

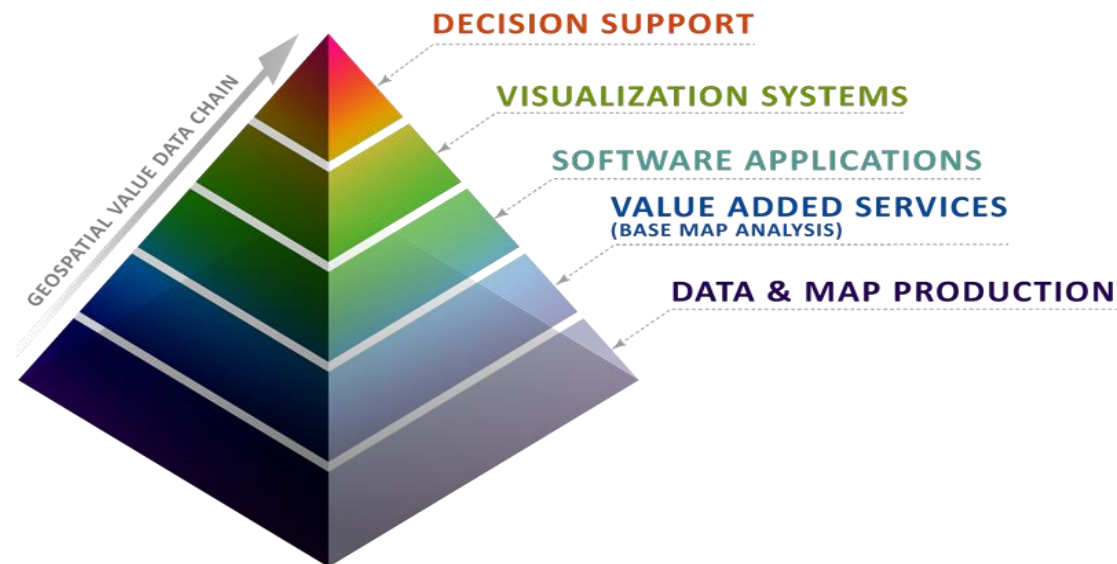
- **Data Map Production**
 - LiDAR, Digital Oblique & Orthoimagery, Photogrammetric, Topographical Maps
- **Value-Added Services**
 - Land use and land cover analyses
 - Change detection
 - Other imagery analysis services/viewers

Decision Support Systems

- Wildfire Management
- Forestry and Ecosystem Management
- Emergency Response

Visualization Systems

- 2D
 - 3D
 - Prism 4D
 - Common Operating Picture
- ## Software Applications
- GIS Software Development
 - Cloud Services
 - Portals and Distribution Tools





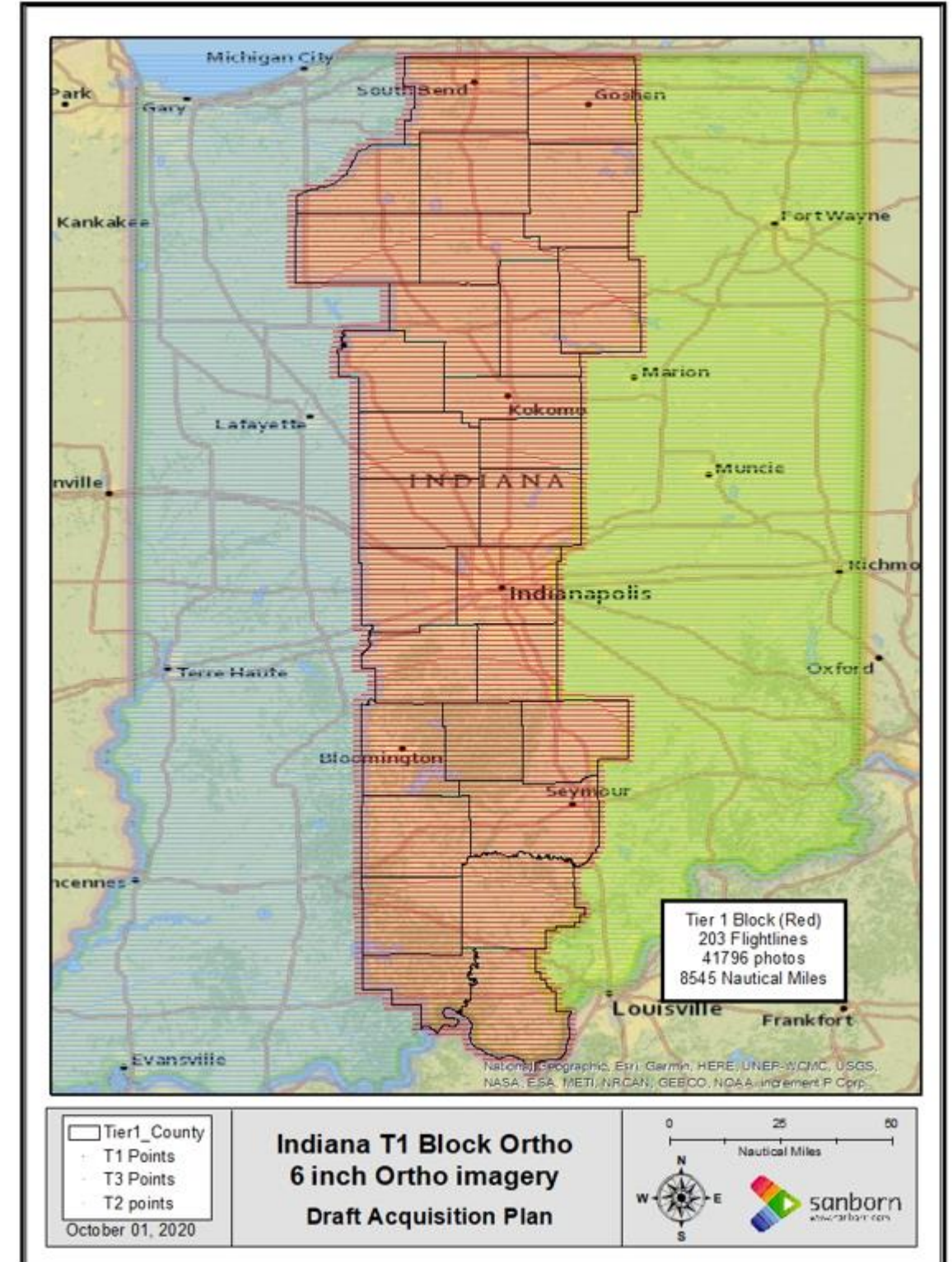
- Central portion of Indiana
- Total Project Area ~ 11,783 mi²
- 6-inch spatial resolution
- 4-band RGBN, 8-bits per channel
- Accuracy of 2-pixels (12-inches) RMSE, 29-inches at 95% confidence
- Geo-referencing - Indiana State Plane East or West zone: NAD83/HARN, US Survey Feet (EPSG Codes 2967 [east] or 2968 [west])
- Tiled and County-area delivery
- Spring, snow-free, flood-free, leaf-off conditions
- Initial delivery 9-30-21. Final, post-IOT QC process delivery 11-11-21



Draft Imagery Acquisition Specifications

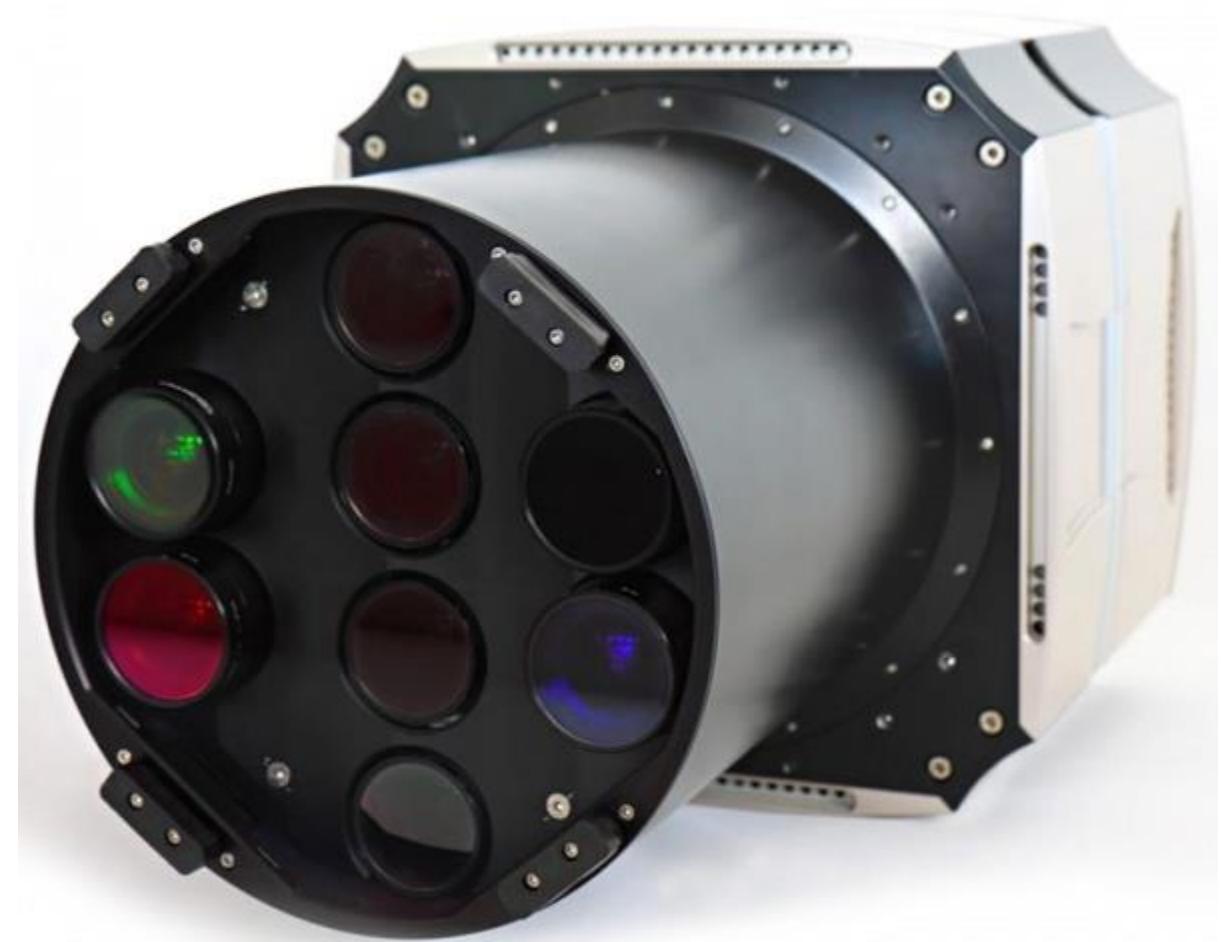
GSD	6-inch (15 cm)
Proposed Sensor	Vexcel Imaging UltraCam Eagle
Focal Length	100 mm
Acquisition Altitude	9,464' AGL
Aircraft Speed	175 kts
Std. Side lap	30%*
Std. End lap	80%*
Sensor Platform	Multi-Engine Fixed-Wing Aircraft
Radiometry	4-band, 14-bit per channel RGB/NIR
Acquisition Date	Spring of each Acquisition Year
Acquisition Time	~10am – 3pm
Sun Angle	30 degrees or greater
Conditions	Snow free, leaf off, no clouds, cloud shadows, or other ground obscuring conditions covering more than 5% of any image. Water bodies within natural banks.

* Areas of dense urban development, or where true or near true orthophotography is required, will be flown at higher overlap (80% forward overlap and 60% side overlap) to minimize radial displacement of buildings and warping of elevated highway structures such as interchanges, bridges, and overpasses. Areas flown at 6-inch spatial resolution or higher will be acquired with minimum 80% forward overlap.



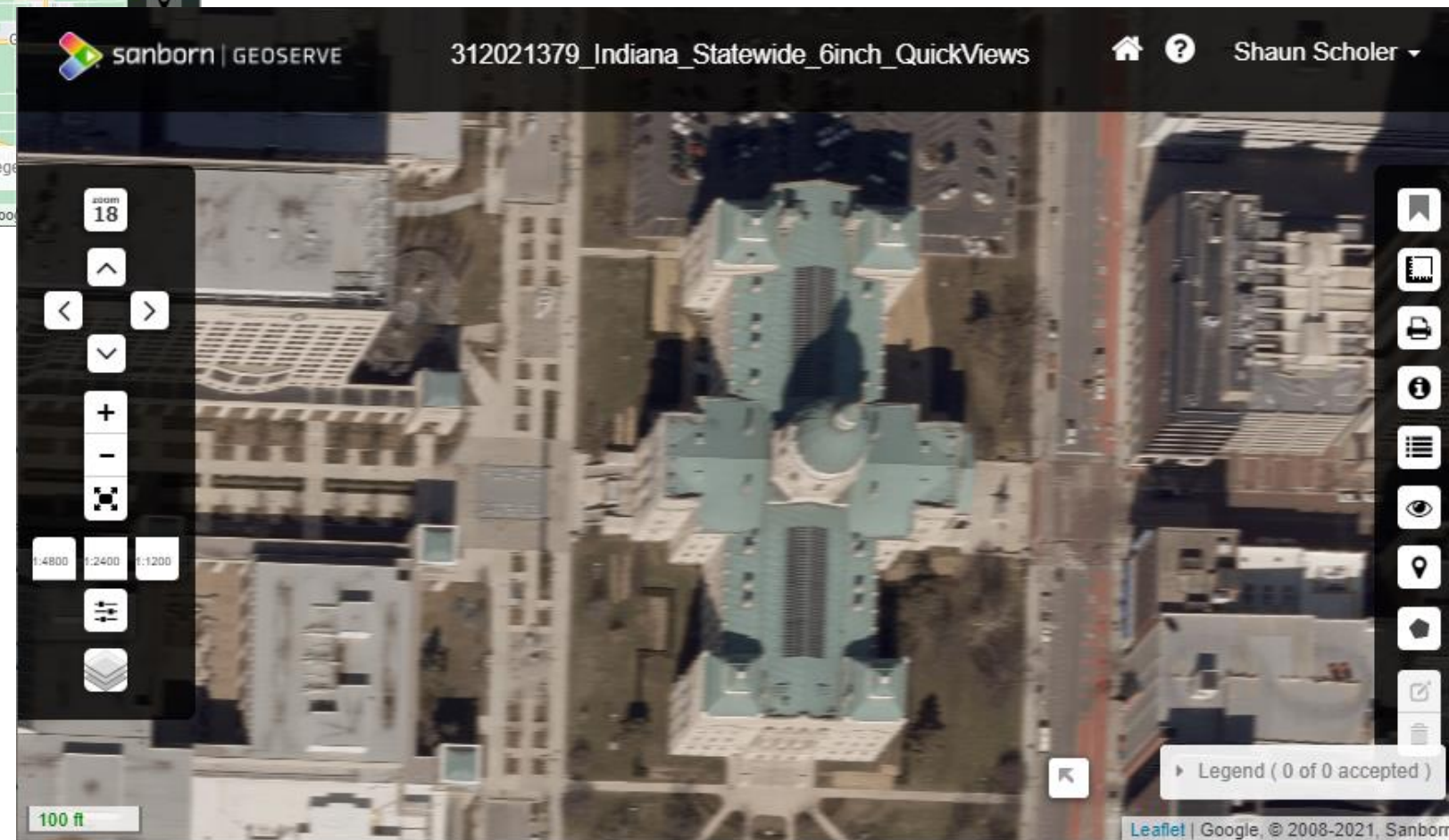
The UltraCam Eagle Digital Aerial Camera

- Acquisition for the program is based on the Vexcel Imaging UltraCam Eagle digital aerial camera with a 100mm lens system.
- 260 megapixels (20,010 x 13,080 pixel CCD)
- 4-band RGB/NIR collected at 16 bits per channel
- Interfaced to airborne GPS and IMU subsystems for sensor position & orientation
- Gyro-stabilized camera mounts
- 56 aircraft and 7 UltraCam Eagle cameras available through the Sanborn team. Three (3) cameras needed for annual acquisition tiers.



Early Review of Raw Imagery

- Sanborn's browser-based Image QC™ application provides the ability to review and comment on imagery within 10 days of acquisition.
- Log-in access, as granted by the State



- Imagery is geo-referenced only. No color-balancing or other corrections performed at this point.
- WMTS access also possible



Technical Approach Summary for Orthoimagery



- Flight Planning
- Control Planning
- Existing State control
- Existing State Lidar DEM

Data Acquisition

- Ground Control
- UltraCam Eagle Large Format Camera
- RGB/NIR Imagery Acquisition
- AGPS/IMU Support
- "Quick View" client access to raw imagery



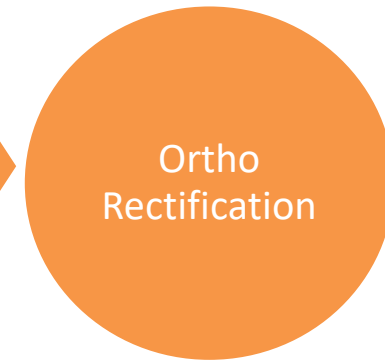
Aerial Triangulation

- Photo matching
- Rigorous least squares adjustment
- Accuracy Verification
- PILOT PROJECT!



DEM Preparation

- Editing/updating of State's existing LiDAR DEM



- Cubic convolution rectification
- Create seam lines
- Correct bridge distortion
- Color balance
- Deliverables and Metadata
- Rigorous QC with review Indiana DOT. Process any needed corrections



6-inch



3-inch



Lessons Learned

- **Timely availability of quickview imagery aids in decision making for reflights**
 - Flooding
 - Snow
- **East/West flight line design proved valuable**
 - When snow fell in northern areas, collected reflights/other lines in south
- **Refinements to QC process will be implemented for Tier 2**
 - Continue with delivery by blocks
 - Review common QC calls with staff prior to production
 - Seams through rooflines
 - Pixelation at bridge/road edges





Annual Projected Milestones

Projected Milestones	
Activity	Completion Date
Project Kickoff, Flight/Control Planning Complete	January
Paneling and/or survey of ground control	February - March
Imagery Acquisition	Early February - Early March, weather and ground conditions pending
imagery Quickview via Image Analyst	Online 10 days from completion of acquisition
Pilot Product Delivery to State for Review	~May 7
Imagery Production	May – September
Orthoimagery Delivery via WMTS, and Online QC Analyst	Complete by September 30
QC/Review Period per County	30-days from Delivery



Buy-up Overview

- **Options Impacting Spring Airborne Data Acquisition**
 - Higher-resolution orthophotography
 - True orthophotography
 - Airborne LiDAR
 - Oblique Imagery
- **Options with No Impact to Airborne Data Acquisition**
 - Planimetric mapping – New or updating
 - Land cover/land use/impervious surfaces mapping
 - Contours
 - 3D buildings and infrastructure modeling
 - Other derivative data sets

High Resolution Orthophotography

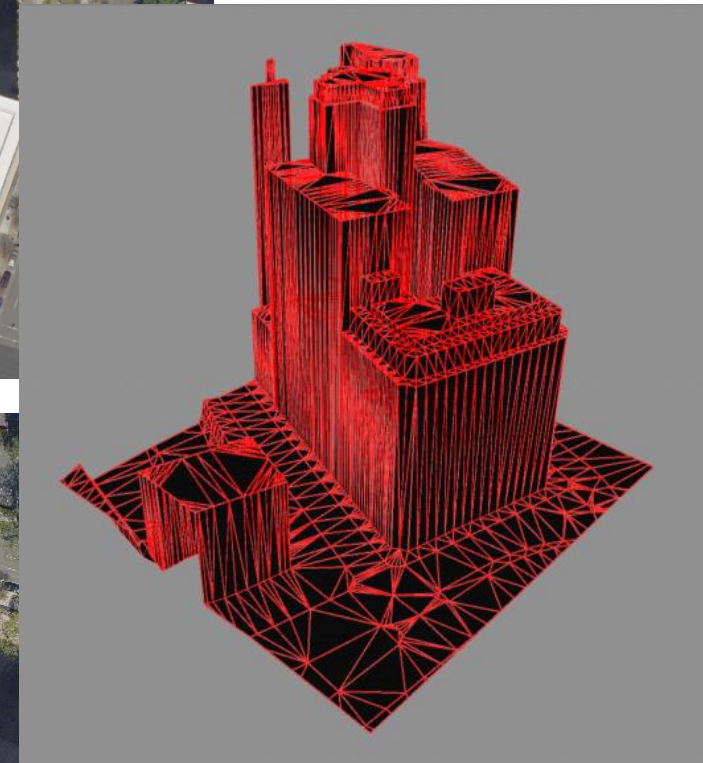
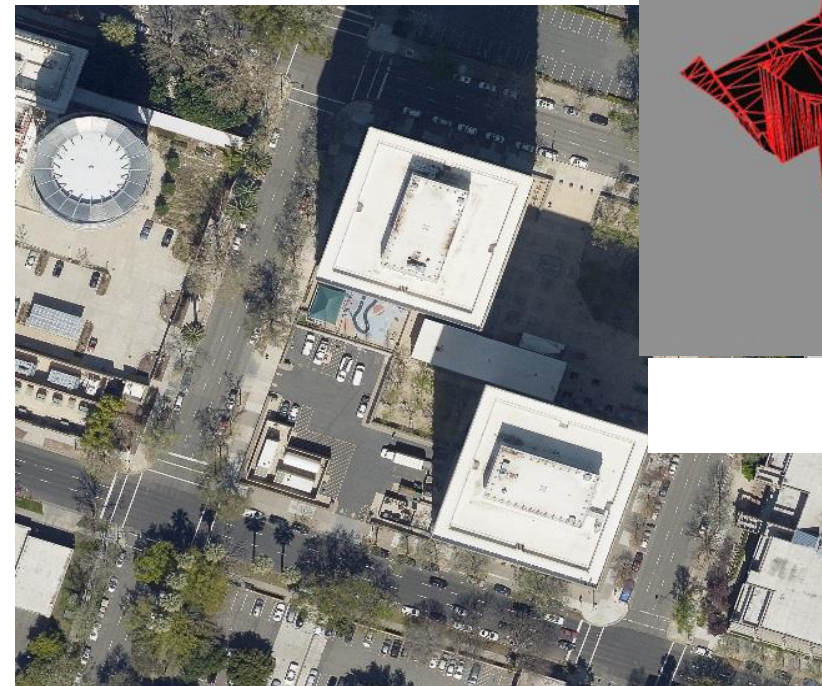


- 3-inch spatial resolution
- 4-band RGB/NIR, 8-bit per channel
- Requires additional flying, control, and enhanced DEM accuracy
- Benefits include:
 - Higher accuracy
 - Ability to see and extract smaller features
 - Ability to support additional applications such as engineering design, traffic & transportation (pavement condition, lane striping, parking studies), utility mapping, vegetation identification, code enforcement, assessment, and logistical planning.



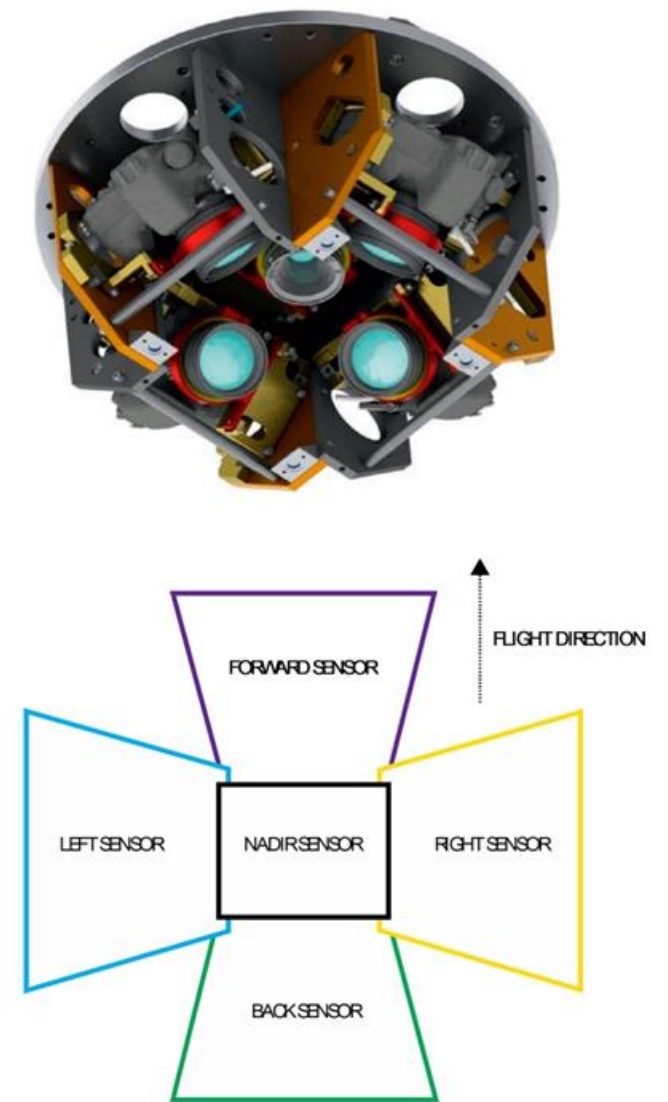
True Orthophotography

- A consideration in urban cores with tall buildings, generally >5 stories
- Orthorectifies buildings, not just the terrain surface – eliminates “building lean”
- In addition to putting each building in true map position, it helps expose otherwise hidden “urban canyons”.
- Requires supplemental high-overlap imagery, and high sun-angle acquisition time
- Requires 3D modeling of buildings



Oblique Imagery

- Full-color imagery provides complete 5-view coverage your chosen project area
 - 4 oblique views (45 degrees) + 1 vertical
 - Vertical image is 4-band RGB/NIR
- Available resolutions from 2 inches to 12 inches+
- 2- to 3-pixel accuracy
- Licensed product, but:
 - No usage, sharing or deployment restrictions
 - No “per seat” costs
 - Right to use never expires

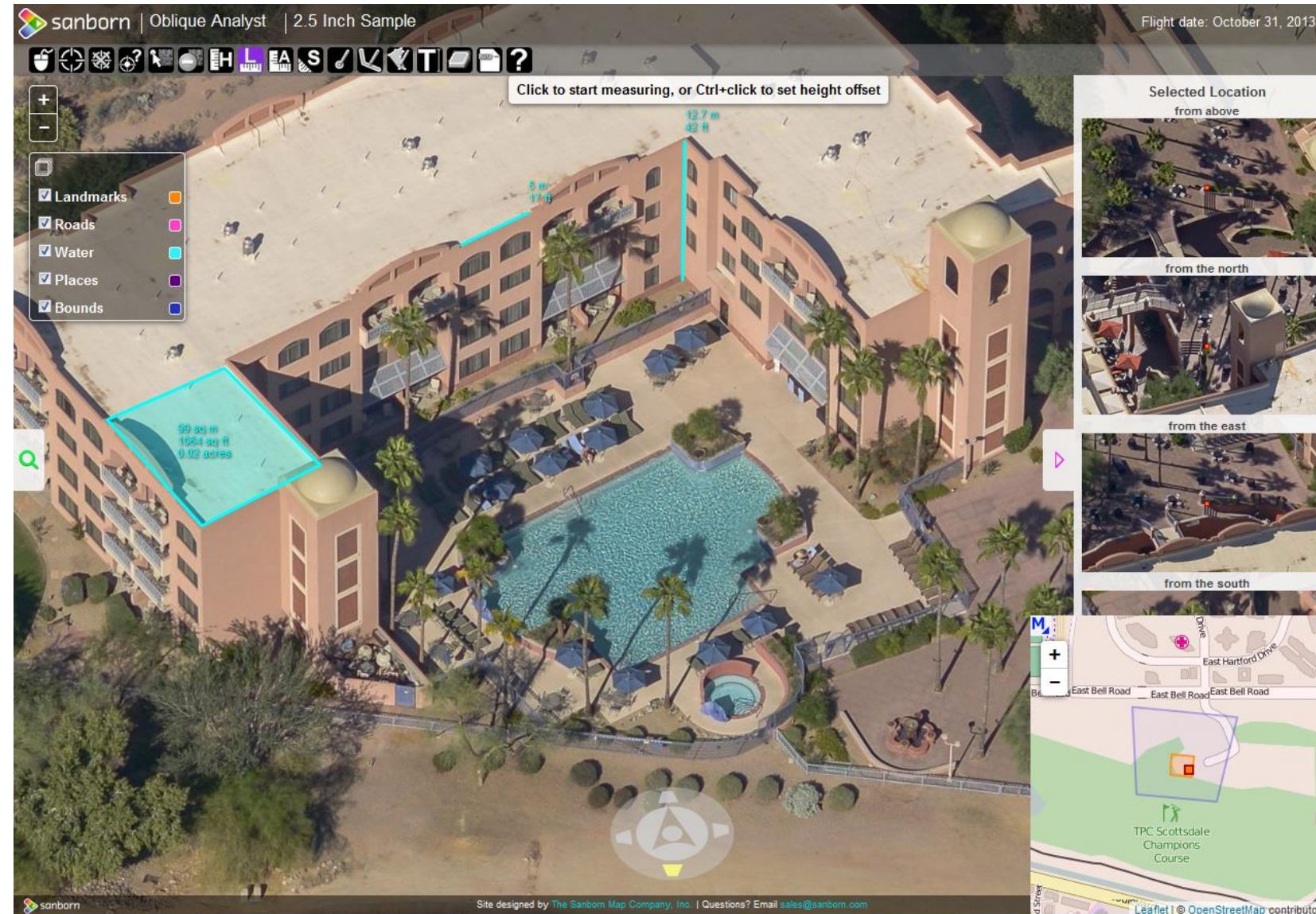




Sanborn Oblique Analyst®

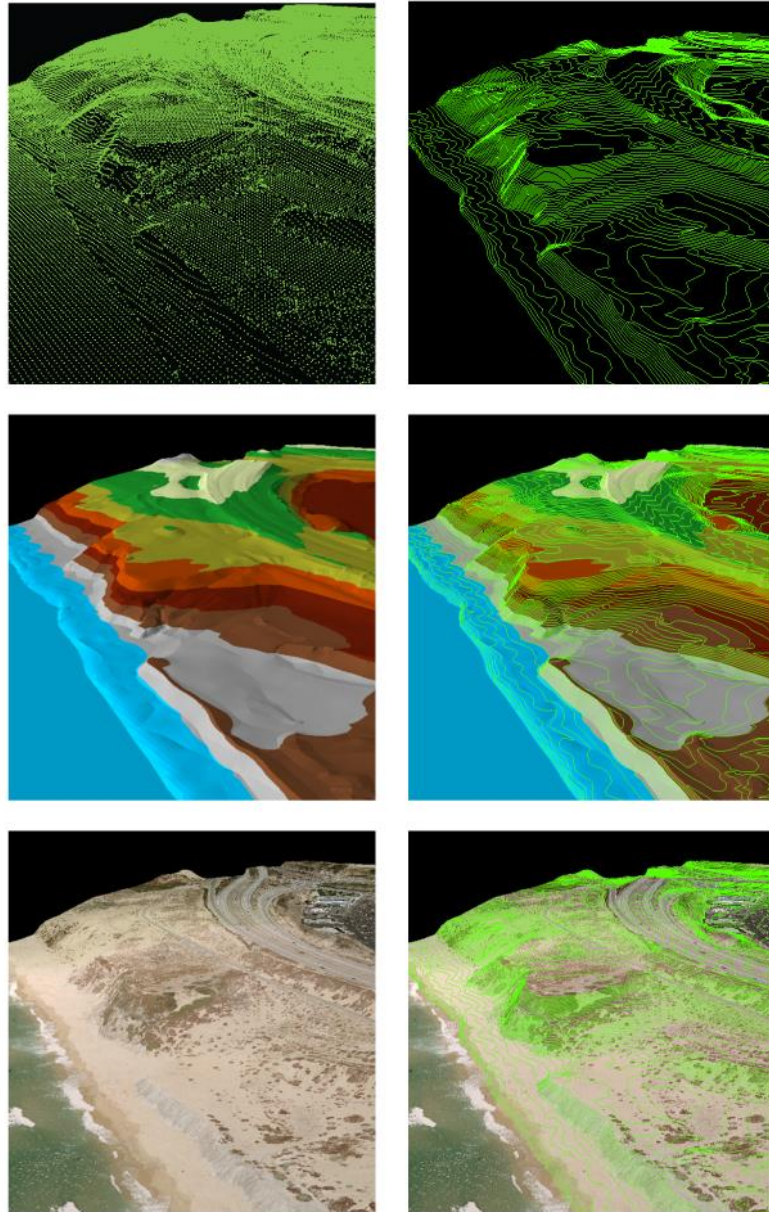
Capabilities include:

- Search by address
- Search by Parcel ID Number
- Pan, zoom
- Set a location
- Show coordinates
- Measure Height
- Measure Length
- Measure Area
- Measure Slope
- Draw (add) Point
- Draw (add) Line
- Draw (add) Polygon
- Draw (add) Text
- Erase Drawings
- Clear Location
- Create PDF
- Ingest shapefiles
- Help Documentation



Sanborn Oblique Analyst® Demo Link:
<https://oblique.sanborn.com/Hennepin/>

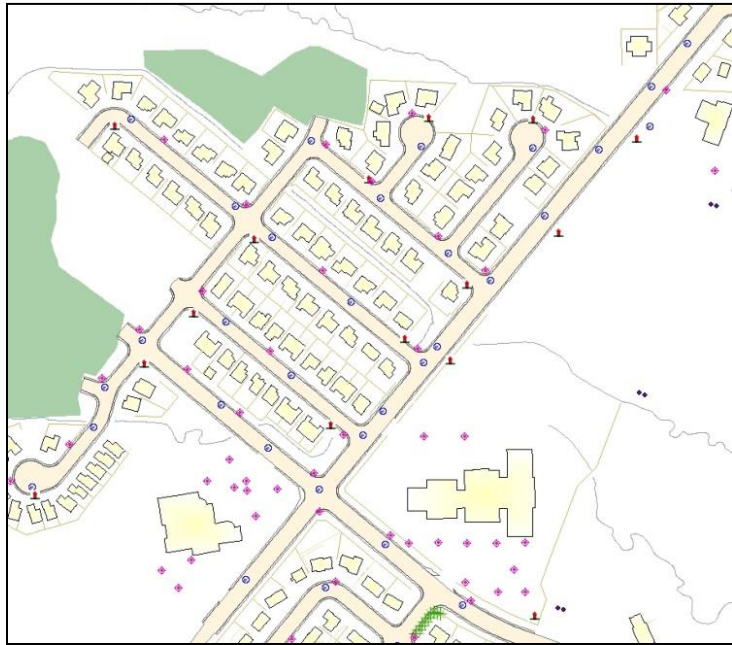
Airborne LiDAR



- Fully compliant with USGS-National Geospatial Program (NGP) per current LiDAR Base Specification v2.1
- Quality Level 2 (2 pts/m²) or Quality Level 1 (8 pts/m²)
- Note that spatial accuracy of QL-2 and QL-1 lidar is the same.
- Delivery of raw point cloud, classified point cloud, hydro-flattened DEM.
- Supports creation of 1-foot contours
- Other enhancements and derivative data sets can be produced – enhanced classification, hydro-enforcement, DSM's, contours, etc.

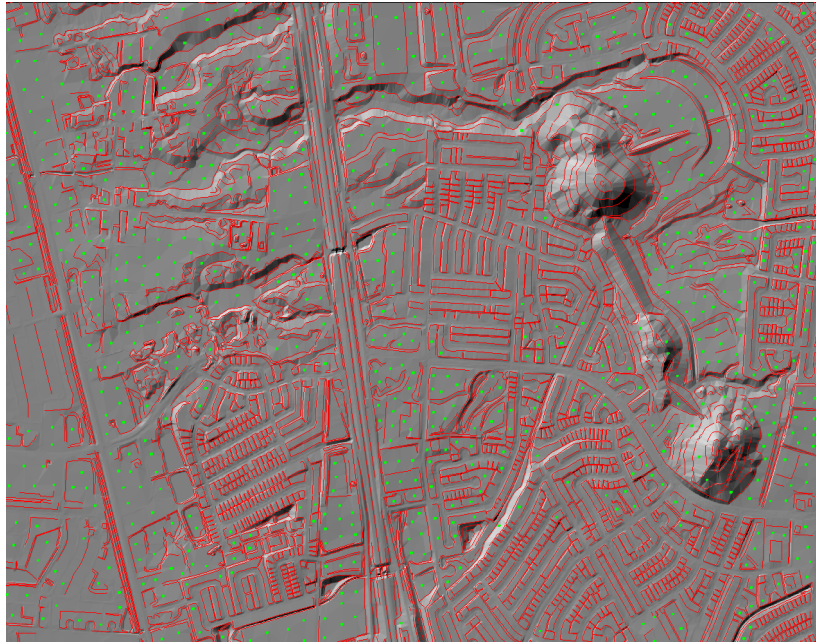


Planimetric Mapping

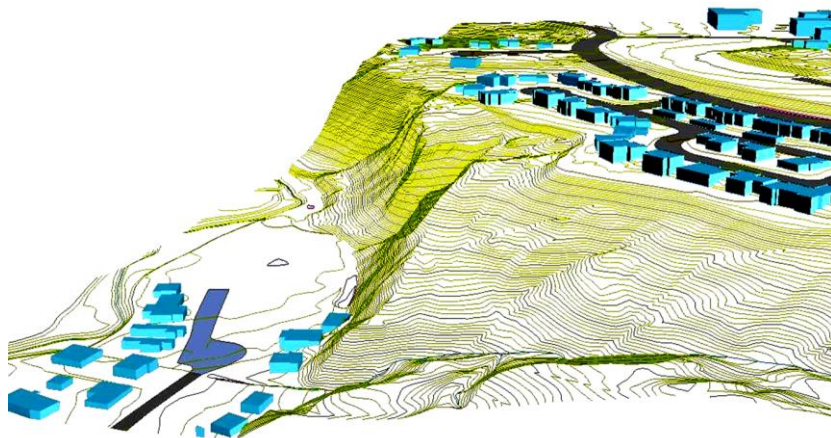


- Vector mapping of visible features
- Fully customizable data sets – can be complete mapping or selected features only, e.g. buildings
- Formatted to your geodatabase design specifications
- All feature data extraction performed using stereo-photogrammetric techniques – no “heads up digitizing” from orthos
- Additional classification such as pervious/impervious can be performed
- GIS or CAD data formats, 2D or 3D
- Old data sets are often cheaper to replace than to update
 - Searching for changes takes a lot of time
 - Specs of legacy data are often unknown
- Pricing is highly scope and feature density dependent – custom quotes will be provided

Contour Development



- Can be derived from lidar or imagery-derived DEM's
- Breakline enhancement performed as required
- Created at the desired interval (1-foot, 2-foot)
- ASPRS accuracy
- Fully attributed or layered to discriminate index contour, index depression contour, obscured index contour, obscured index depression contour, intermediate contour, intermediate depression contour, obscured intermediate contour, obscured intermediate depression contour, and hidden contour.
- GIS and CAD data formats





Pricing – Orthoimagery Buy-ups

3-inch Spatial Resolution Orthoimagery			
Area	Price/mi ²	State Contribution	Actual Buy-up Price/mi ²
At least 10,000 mi ²	\$175.00	\$51.39	\$123.61
At least 2,000 mi ²	\$205.00	\$51.39	\$153.61
At least 400 mi ²	\$250.00	\$51.39	\$198.61
At least 36 mi ²	\$424.00	\$51.39	\$372.61
Out of cycle, at least 400 mi ²	\$265.00	NA	NA
Out of cycle, at least 36 mi ²	\$434.00	NA	NA

6-inch Spatial Resolution Orthoimagery	
Area	Price/mi ²
Out of cycle, at least 400 mi ²	\$ 85.00

True Orthophotography – 6-inch Resolution	
Area	Price/mi ²
At least 400 mi ²	\$ 350.00
At least 36 mi ²	\$ 850.00
At least 5 mi ²	\$ 1,700.00

Sample Calculations

Case #1: Assume 500 mi² county, 3-inch resolution orthoimagery upgrade

From pricing table, cost for areas from 400 to 1,999 mi² is \$250/mi²

State covers cost of baseline imagery (\$51.39/mi²)

$$\text{Cost} = (\$250/\text{mi}^2 - \$51.39/\text{mi}^2) \times 500 \text{ mi}^2 = \$99,305$$

Pricing – Lidar Buy-ups

Lidar – Quality Level 2 (QL-2) 2 points per square meter	
Area	Price/mi ²
At least 40,000 mi ²	\$ 152.00
At least 5,000 mi ²	\$ 140.00
At least 400 mi ²	\$ 205.00

Lidar – Quality Level 1 (QL-1) 8 points per square meter	
Area	Price/mi ²
At least 40,000 mi ²	\$ 165.00
At least 5,000 mi ²	\$ 170.00
At least 400 mi ²	\$ 275.00



Pricing – Contour Buy-ups

Contours		
Area	1-Foot Price/mi ²	2-Foot Price/mi ²
At least 40,000 mi ²	\$85.24	\$42.63
At least 5,000 mi ²	\$85.42	\$42.81
At least 400 mi ²	\$87.80	\$45.19

Pricing – Oblique Imagery Buy-ups

6-inch Spatial Resolution Oblique Imagery*	
Area	Price/mi ²
At least 40,000 mi ²	\$85.00
At least 10,000 mi ²	\$95.00
At least 2,000 mi ²	\$105.00
At least 400 mi ²	\$150.00
At least 36 mi ²	\$400.00
At least 5 mi ²	\$5,747.01

*Other spatial resolutions, 2-inch to 12-inch, by custom quote

By Custom Quotation

- Planimetric Mapping – New or Updating
- Land cover/land use/impervious surfaces Mapping
- Change detection
- Lidar enhancements and derivative products
- 3D Building and infrastructure modeling
- Cloud hosting
- Other relevant requested products and services

Price Quotations, Ordering, Contracting

1 - Contact **Shaun Scholer**

Email: sscholer@iot.in.gov

Phone: 317-414-0889

2 - Define Area of Interest and Scope of Work

- Shapefile for boundary or tile grids are preferred. Include any required buffer areas
- Sanborn will provide any needed technical information, price quotation

3 – Contract for buy-ups and ancillary products

- Direct contract with Sanborn contract, from state pre-agreed contract
- Acquisition-dependent buy-ups must be confirmed no later than 2-15-2022
- Other buy-ups can be ordered any time

Project Team

Shaun Scholer (GIO)

GIS Program Director

Cell: 317-414-0889

Email: sscholer@iot.in.gov

Megan Compton (GIO)

Geographic Information Officer

Office: 317-234-5889

Email: mcompton@iot.in.gov

Shawn Benham (Sanborn)

Project Manager

Cell: 719.502.1296

Email: sbenham@sanborn.com

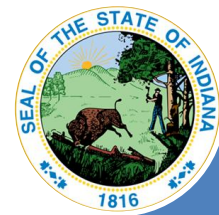
Brad Arshat (Sanborn)

Price Quotations, Technical Information,
Contracts Liaison

Cell: 443-603-7725

Email: barshat@sanborn.com

Thank you for your Time



Acquisition and
Production Experience



Highly Qualified Human
Resources



State of the Art Sensor
Technology



Robust Software and IT
Infrastructure



ISO Certified
Production Processes



Proven Project
Management



Successful Project
History





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Stay Informed

Indiana Geographic Information Council (IGIC)

Orthophotography/LIDAR Committee

4th Tuesday of every month

Tuesday, February 23 at 11 a.m