



CAPTURING QUARRY IMAGES BY DRONE TO GENERATE LARGE 3D MAPS

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May 12, 2017

New Drone Technology

- Drone Types
- Imagery Types
- Flight Planning
- Post Processing
- Data Output Uses

Public Service Announcement

- This is commercial work
- Register your drone
- Get a Part 107 UAS license
- Get familiar with the rules
- Stay out of restricted areas

Drone Types

1

- Quad copter

2

- Rotary

3

- Fixed Wing

Rotary Types

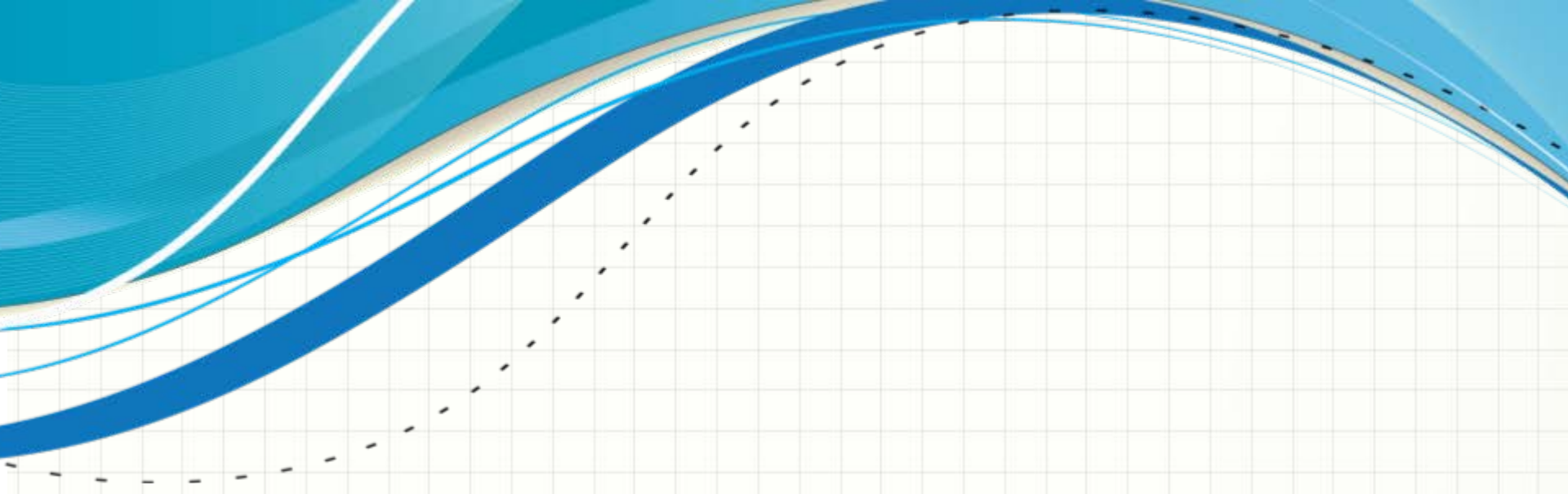
- Kespary
- DJI
- Multi rotor



Fixed Wing

- SenseFly eBee
- Topcon





AERIAL IMAGERY

Imagery Types

1

- Still Photos

2

- Video

3

- LiDAR

Still Photos

- 5 -10 MB in size
- Must be post-processed
- Geo-located



Video

- Public Relations
- Web Sites

LiDAR

- Heavy now for most inexpensive drones
- Digital terrain maps
- Useful in wooded areas





FLIGHT PLANNING

Flight Planning

1

- Ground Resolution

2

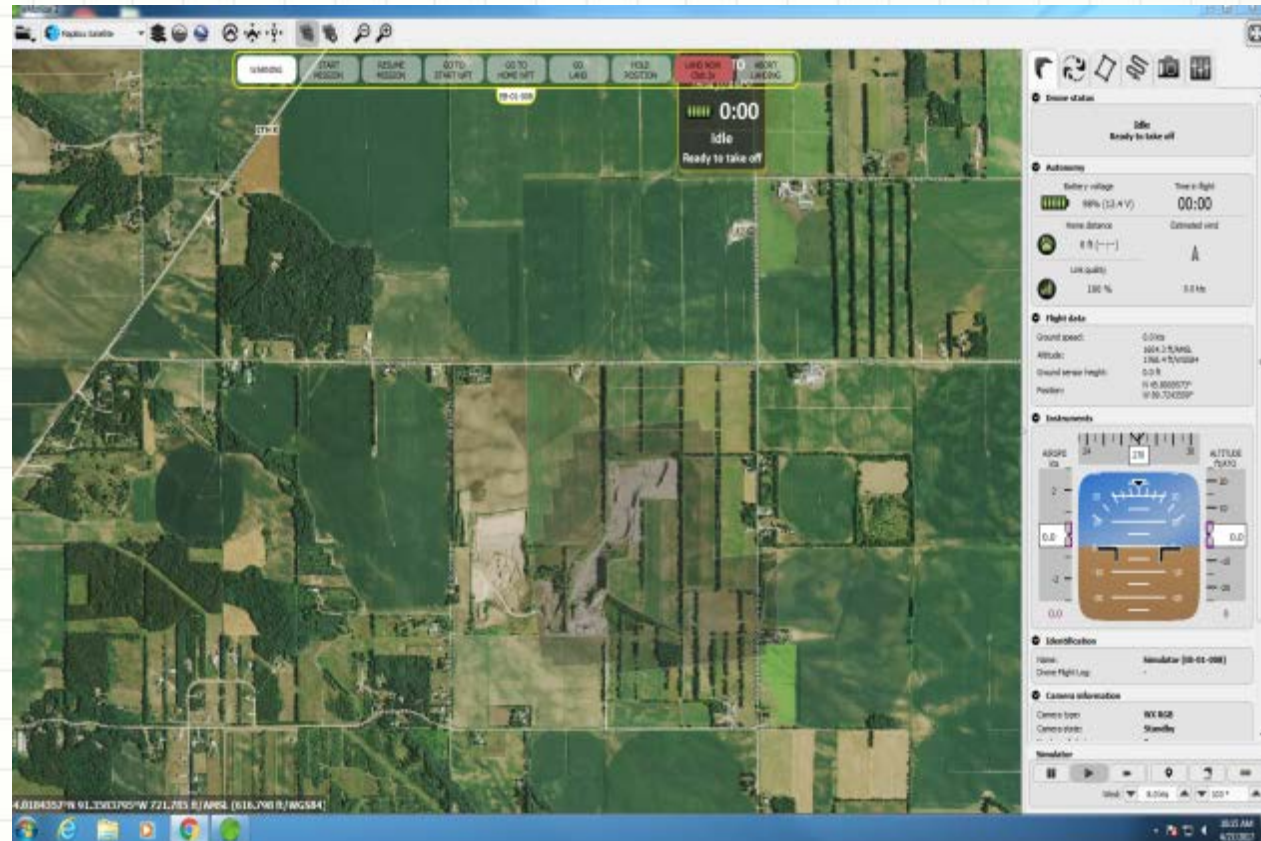
- Positional Accuracy

3

- Coordinate Systems

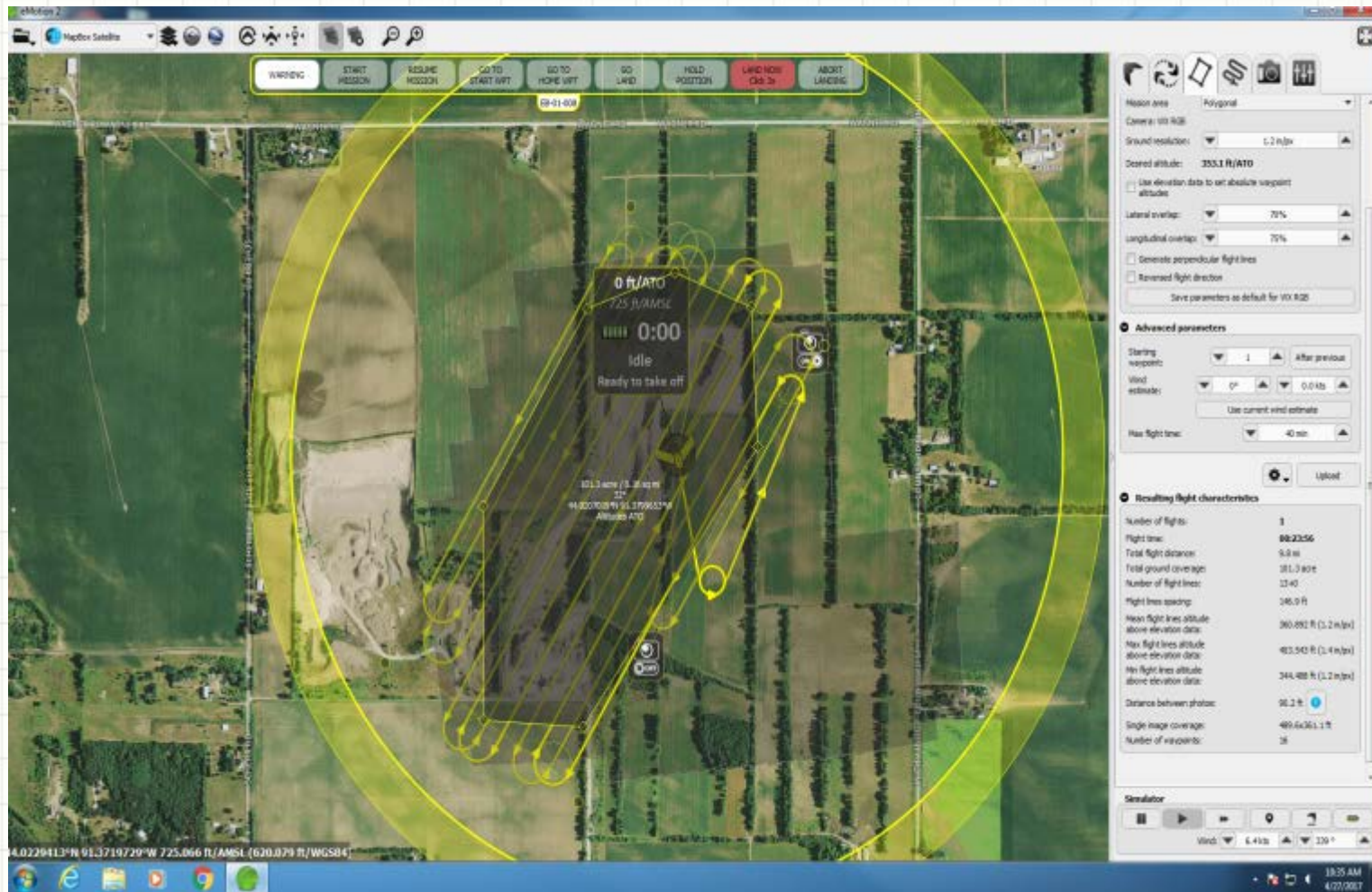
Flight Planning Software

- Kespary
- Drone Deploy
- eMotion



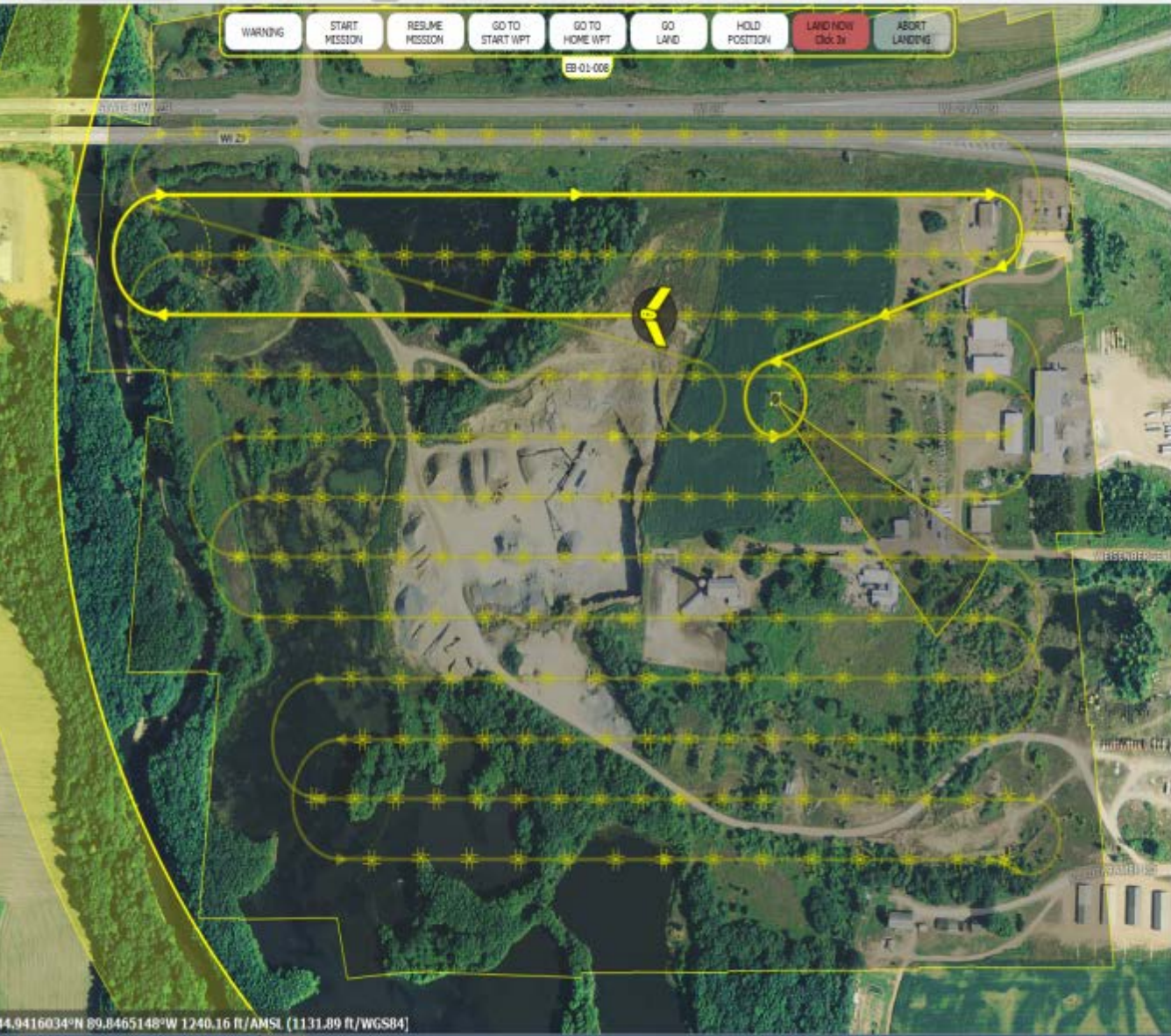
Ground Resolution

- Drone altitude
- Image overlap
- Image quality



WARNING START MISSION RESUME MISSION GO TO START WPT GO TO HOME WPT GO LAND HOLD POSITION LAND NOW (Ctrl.Z) ABORT LANDING

EB-01-008



14.9416034°N 89.8465148°W 1240.16 ft/AMSL (1131.89 ft/WGS84)



Drone status

Taking photo #193

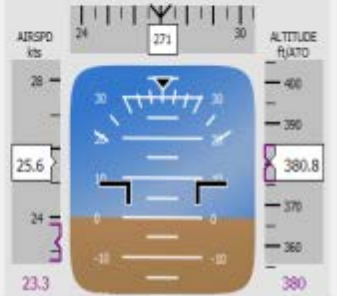
Autonomy

Battery voltage	51% (11.0 V)	Time in flight	17:06
Home distance	436 ft (80:09)	Estimated wind	
Link quality	100 %		5.6 kts

Flight data

Ground speed:	20.4 kts
Altitude:	3640.6 ft(AMSL) 1533.1 ft(WGS84)
Ground sensor height:	390.4 ft
Position:	N 44.9429027° W 89.8528890°

Instruments



Identification

Name:	Simulator (EB-01-008)
Drone Flight Log:	1

Camera information

Camera type:	WX RGB
Camera state:	On

Simulator

Wind: 5.6 kts 296 °



Out in the field!

Positional Accuracy

- Ground sampling distance
- Ground control points
- Surveyed on ground using existing control

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https://www.ngs.noaa.gov/cgi-bin/ds_mark.pl?PidBox=DJ4665
File Edit View Favorites Tools Help
Suggested Sites North Korea warns of ... ESRI Online my senseFly TwistedSifter Business Insider Aviation Weather WI-SCO Well
DJ4665
DJ4665:          North      East      Units Scale Factor Converg.
DJ4665:SPC WI C - 124,990.106  615,073.059  MT  0.99994172  +0 08 05.3
DJ4665:SPC WI C - 410,071.71  2,017,952.19  sFT 0.99994172  +0 08 05.3
DJ4665:UTM 16   - 4,982,124.169  278,449.126  MT  1.00020361  -1 59 08.1
DJ4665
DJ4665!          - Elev Factor x Scale Factor = Combined Factor
DJ4665!SPC WI C - 0.99994296 x 0.99994172 = 0.99988469
DJ4665!UTM 16   - 0.99994296 x 1.00020361 = 1.00014656
DJ4665
DJ4665 U.S. NATIONAL GRID SPATIAL ADDRESS: 16TBQ7844982124(NAD 83)
DJ4665
DJ4665          SUPERSEDED SURVEY CONTROL
DJ4665
DJ4665 NAD 83(2007)- 44 57 28.81669(N)  089 48 32.25426(W) AD(2002.00) 1
DJ4665 ELLIP H (07/29/08) 363.825 (m)  GP(2002.00) 3 1
DJ4665 NAVD 88      397.80 (m)  1305.1 (f) LEVELING 3
DJ4665 NAVD 88 (07/08/08) 397.799 (m)  1305.11 (f) SUPERSEDED 2 1
DJ4665
DJ4665.SuperseDED values are not recommended for survey control.
DJ4665
DJ4665.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
DJ4665.See file dsdata.pdf to determine how the superseded data were derived.
DJ4665
DJ4665 MARKER: DD = SURVEY DISK
DJ4665_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
DJ4665_STAMPING: MARATHON CITY GPS 2005
DJ4665_MARK LOGO: WIDT
DJ4665_PROJECTION: FLUSH
DJ4665_MAGNETIC: R = STEEL ROD IMBEDDED IN MONUMENT
DJ4665_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
DJ4665_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
DJ4665-SATELLITE: SATELLITE OBSERVATIONS - June 22, 2011
DJ4665
DJ4665 HISTORY - Date Condition Report By
DJ4665 HISTORY - 2004 MONUMENTED WIDT
DJ4665 HISTORY - 20070103 GOOD WIDT
DJ4665 HISTORY - 20110622 GOOD WIDT
DJ4665
DJ4665          STATION DESCRIPTION
DJ4665
DJ4665'DESCRIBED BY WI DEPT OF TRANSP 2007 (EPS)
DJ4665'TO REACH THE STATION FROM THE JUNCTION OF STATE HIGHWAY 29 WITH STATE
DJ4665'HIGHWAY 107 (EXIT 156) ABOUT 1 MI (1.6 KM) NORTH OF THE VILLAGE OF
DJ4665'MARATHON CITY, GO EAST ON STATE HIGHWAY 29 FOR 1.5 MI (2.4 KM) TO
DJ4665'136TH AVENUE ON THE LEFT, TURN LEFT AND GO NORTH ON 136TH AVENUE FOR
DJ4665'0.95 MI (1.5 KM) TO THE STATION ON THE LEFT. THE STATION IS A BRONZE
DJ4665'WISCONSIN DEPARTMENT OF TRANSPORTATION GEODETIC SURVEY CONTROL STATION
DJ4665'DISK SET IN THE TOP OF A 40-CM (16 INCH) DIAMETER CONCRETE POST (2.4 M
DJ4665'DEEP), LOCATED WITHIN THE RIGHT-OF-WAY ABOUT LEVEL WITH THE ROAD
DJ4665'PAVEMENT. THE STATION IS 8.5 M (27.9 FT) WEST OF THE CENTERLINE OF
DJ4665'136TH AVENUE, 81 M (265.7 FT) SOUTH OF THE CENTERLINE OF HIGHLAND
DJ4665'DRIVE, 72 M (236.2 FT) SOUTH-SOUTHWEST OF A METAL POST FOR A --STOP--
DJ4665'SIGN, 39.1 M (128.3 FT) NORTHWEST OF A POWER POLE --2906 33W18-- , AND
DJ4665'1.0 M (3.3 FT) EAST OF A WHITE PLASTIC WITNESS POST. ---NOTE---THIS
DJ4665'STATION HAS NO VISIBLE OBSTRUCTIONS EXTENDING HIGHER THAN 15 DEGREES
DJ4665'ABOVE THE HORIZON.
DJ4665
DJ4665          STATION RECOVERY (2011)
DJ4665
DJ4665'RECOVERY NOTE BY WI DEPT OF TRANSP 2011 (PGL)
DJ4665'RECOVERED IN GOOD CONDITION

*** retrieval complete.
Elapsed Time = 00:00:03
```

ControlFinder

Wisconsin State Cartographer's Office

Map Identify Search Results About

Location Search

(Please enter as complete an address as you can.)

County Search

County:

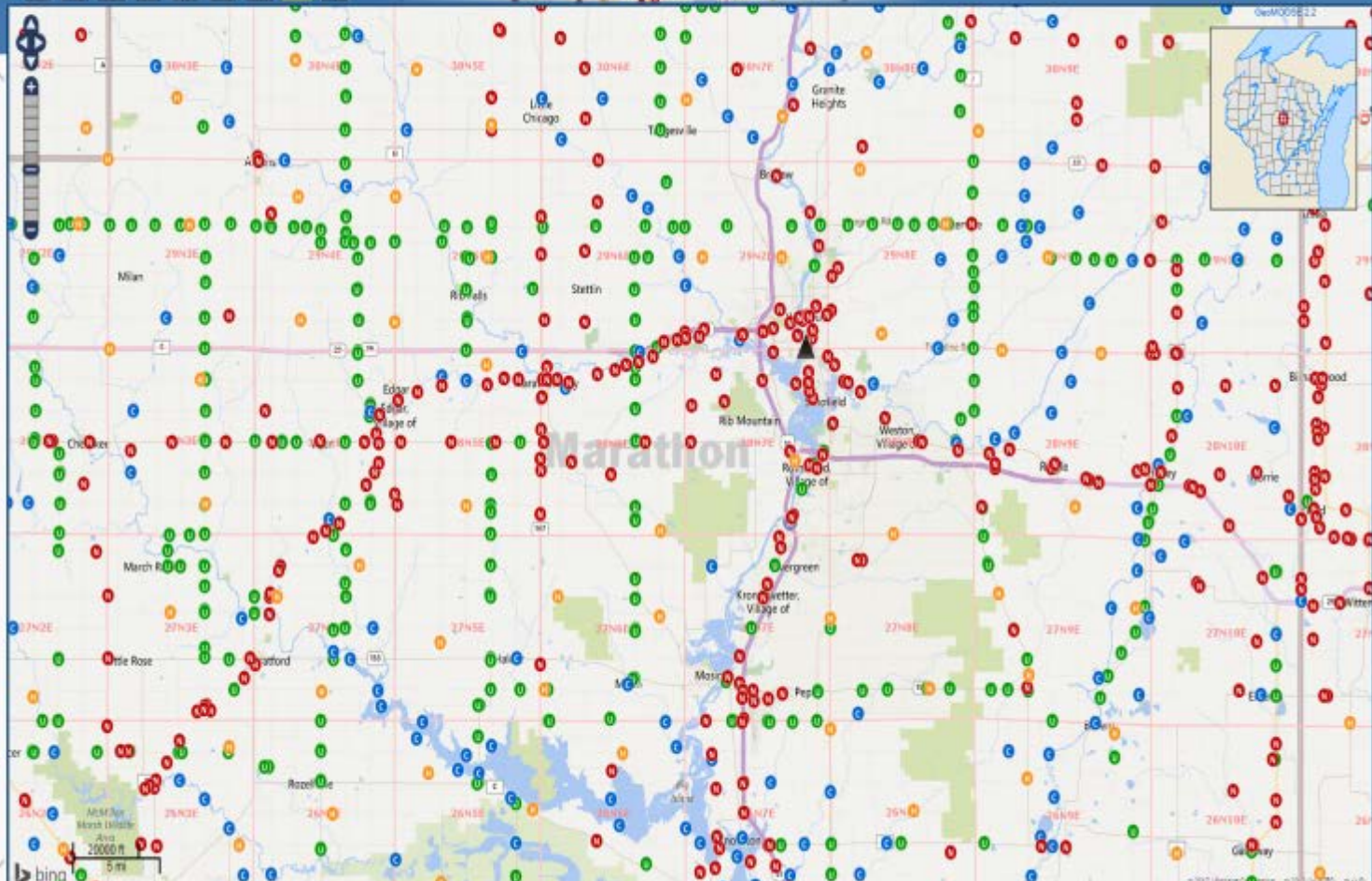
Township/Range/Section Search

Township (1-53):
Range (1-30):
Direction (E or W):
Section (1-36):

Point Search

Field:
Category:
Point ID:

Some features and labels will not display until you zoom in.



NGS Control Points





Temporary Ground control

2 foot by 2 foot, easily visible targets.



Get ready to fly!

Coordinate Systems

- Critical for use in multiple software platforms
- State Plane Coordinates
- Software can typically transform as long as you know Coord. System



POST- PROCESSING

Post-processing

1

- Photogrammetry Software

2

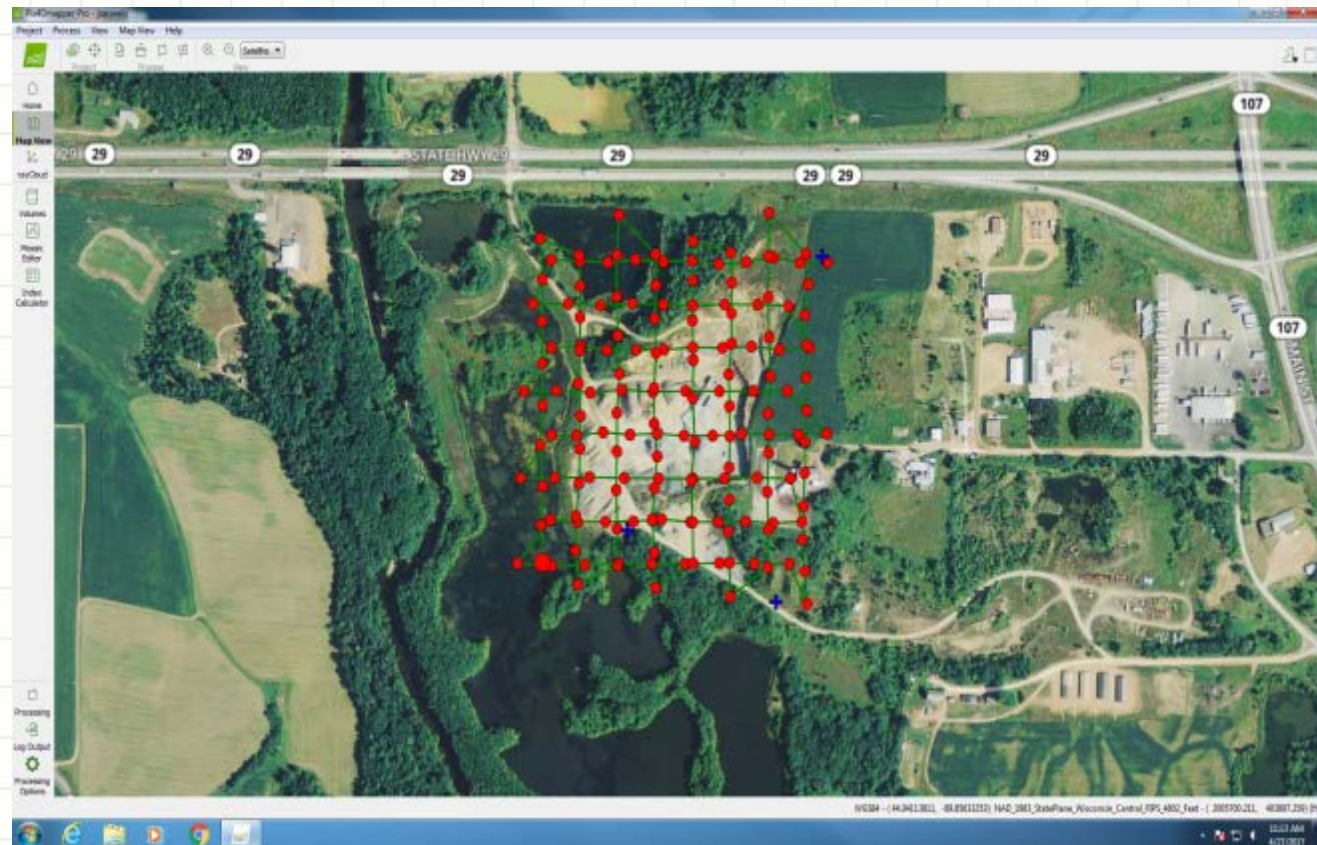
- Outputs

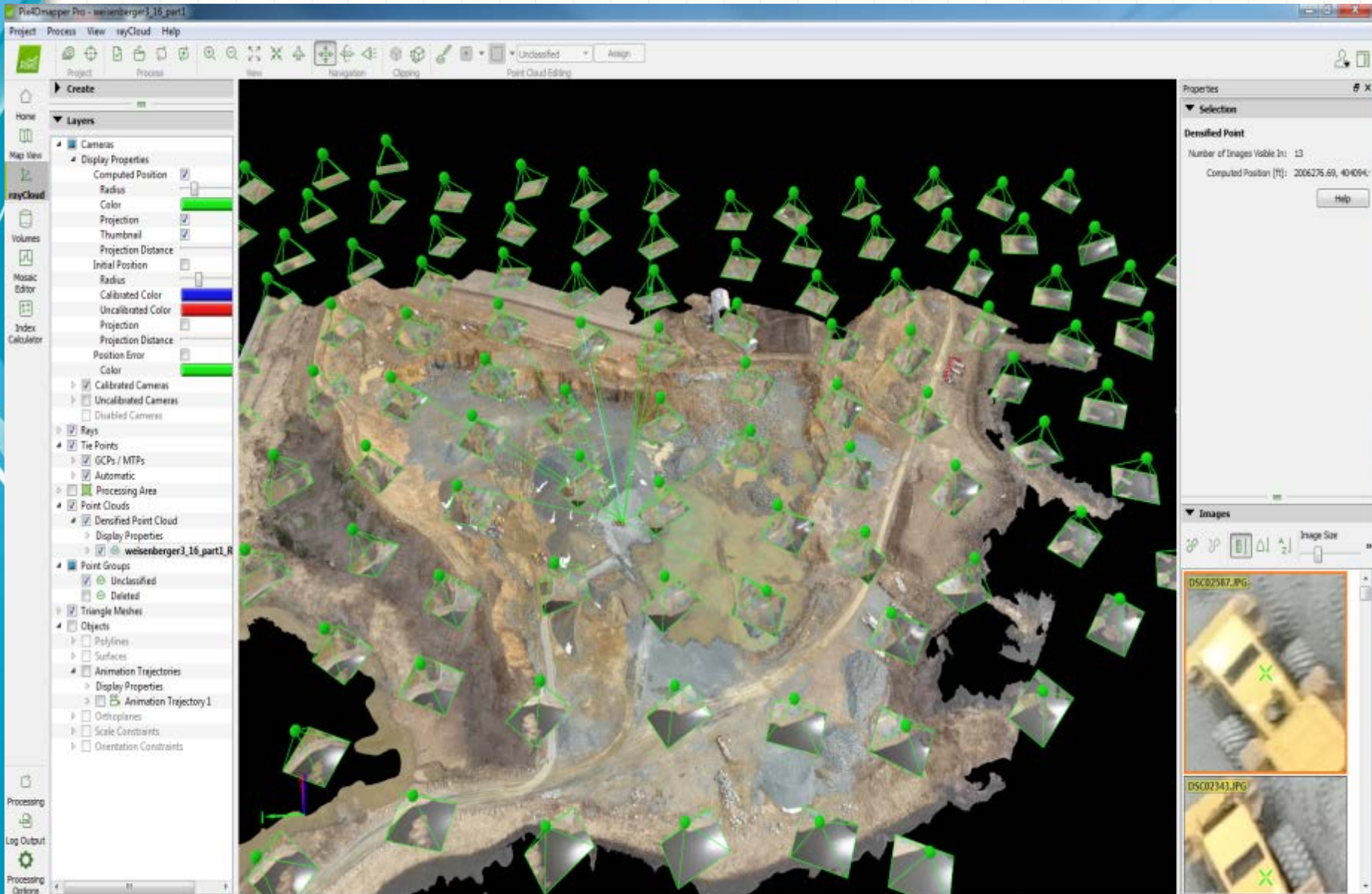
3

- Other 3rd Party Software

Photogrammetry Software

- Cloud based (Kespary, Drone Deploy)
- Local workstation (Pix4D)





Project	nandn81b
Processed	2016-08-16 15:31:56
Camera Model Name(s)	DSC-WX220_4.4_4896x3672 (RGB)
Average Ground Sampling Distance (GSD)	3.17 cm / 1.25 in
Area Covered	0.1228 km ² / 12.2796 ha / 0.0474 sq. mi. / 30.3594 acres

Quality Check



Images	median of 64476 keypoints per image	
Dataset	78 out of 103 images calibrated (75%), all images enabled	
Camera Optimization	0.48% relative difference between initial and optimized internal camera parameters	
Matching	median of 5882.74 matches per calibrated image	
Georeferencing	yes, 4 GCPs (4 3D), mean RMS error = 0.102 ft	

Preview



Pix4D Quality Report

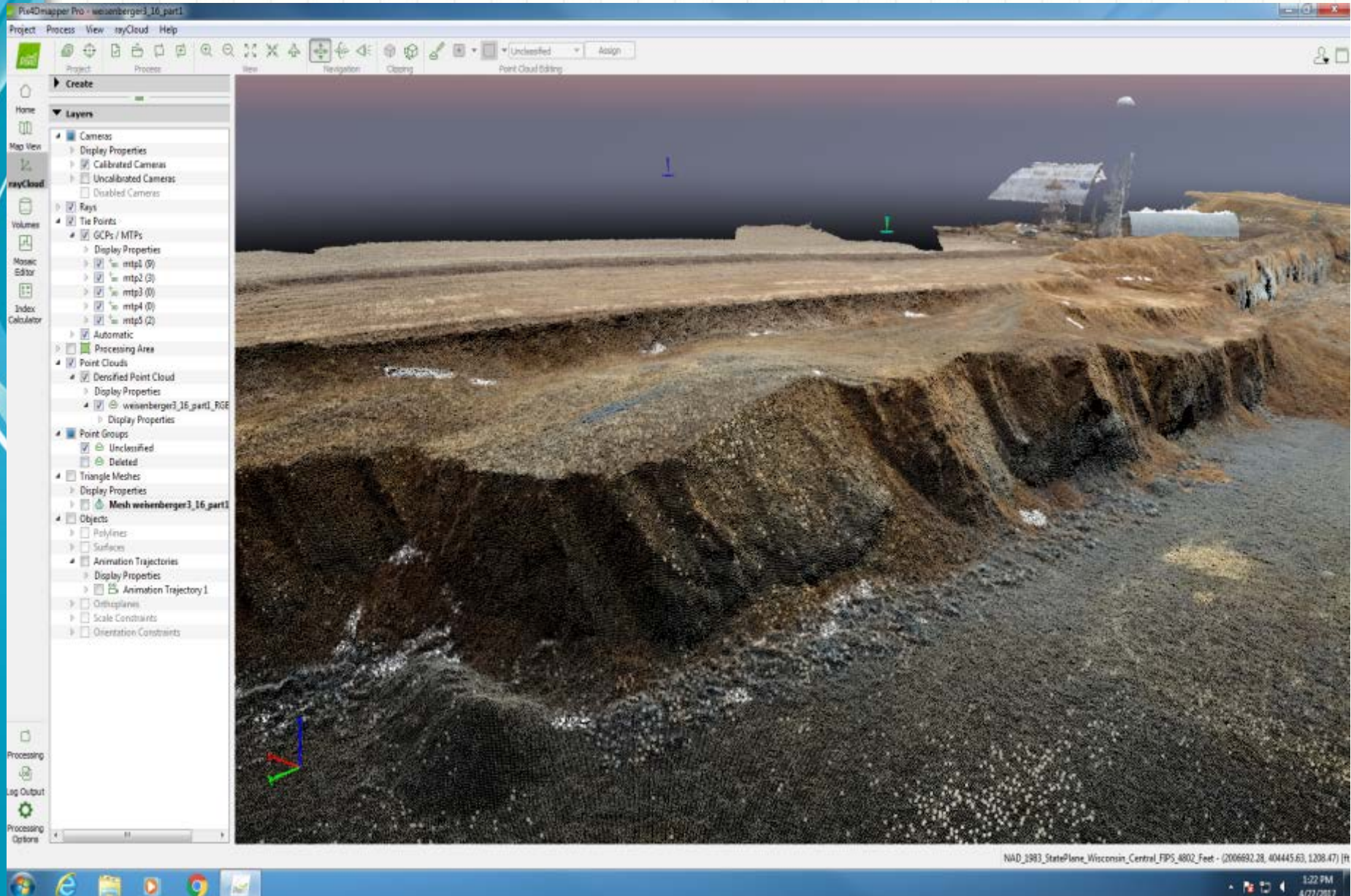
Outputs

- Orthomosaic
- 3D point cloud
- Digital Surface Model (DSM)
- Digital Terrane Model (DTM)
- Contour lines
- 3D textured mesh

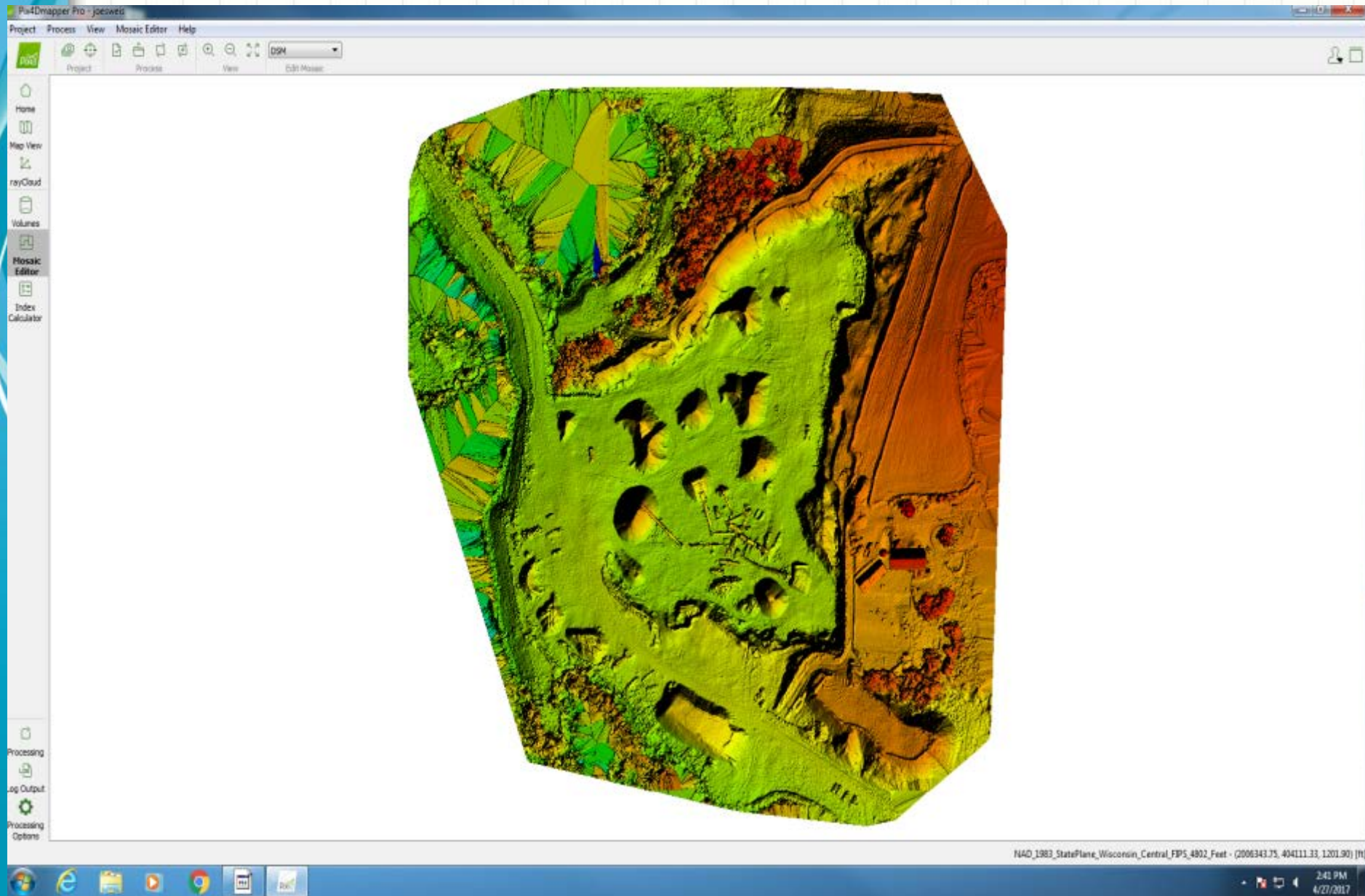
Orthophoto



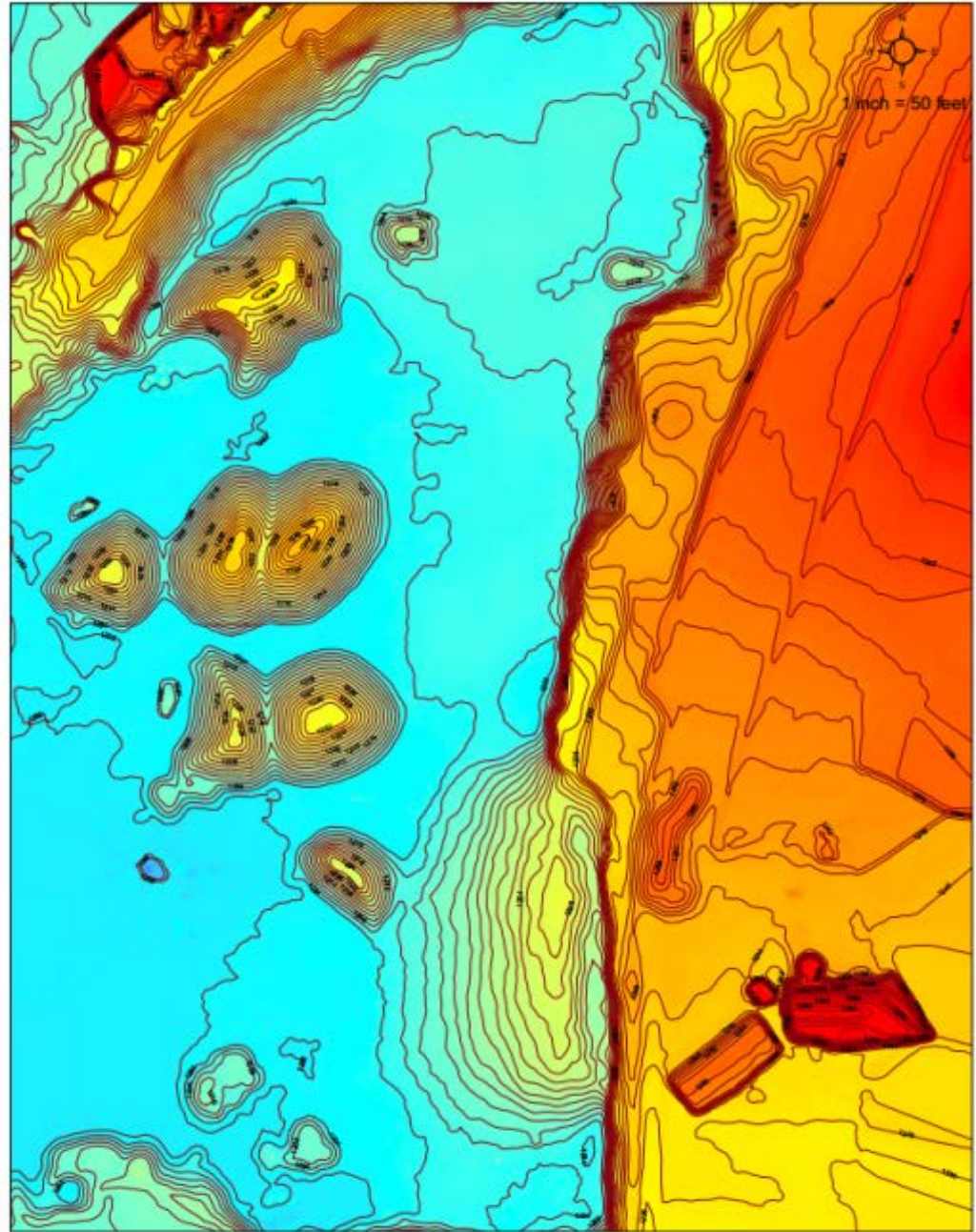
3D Point Cloud



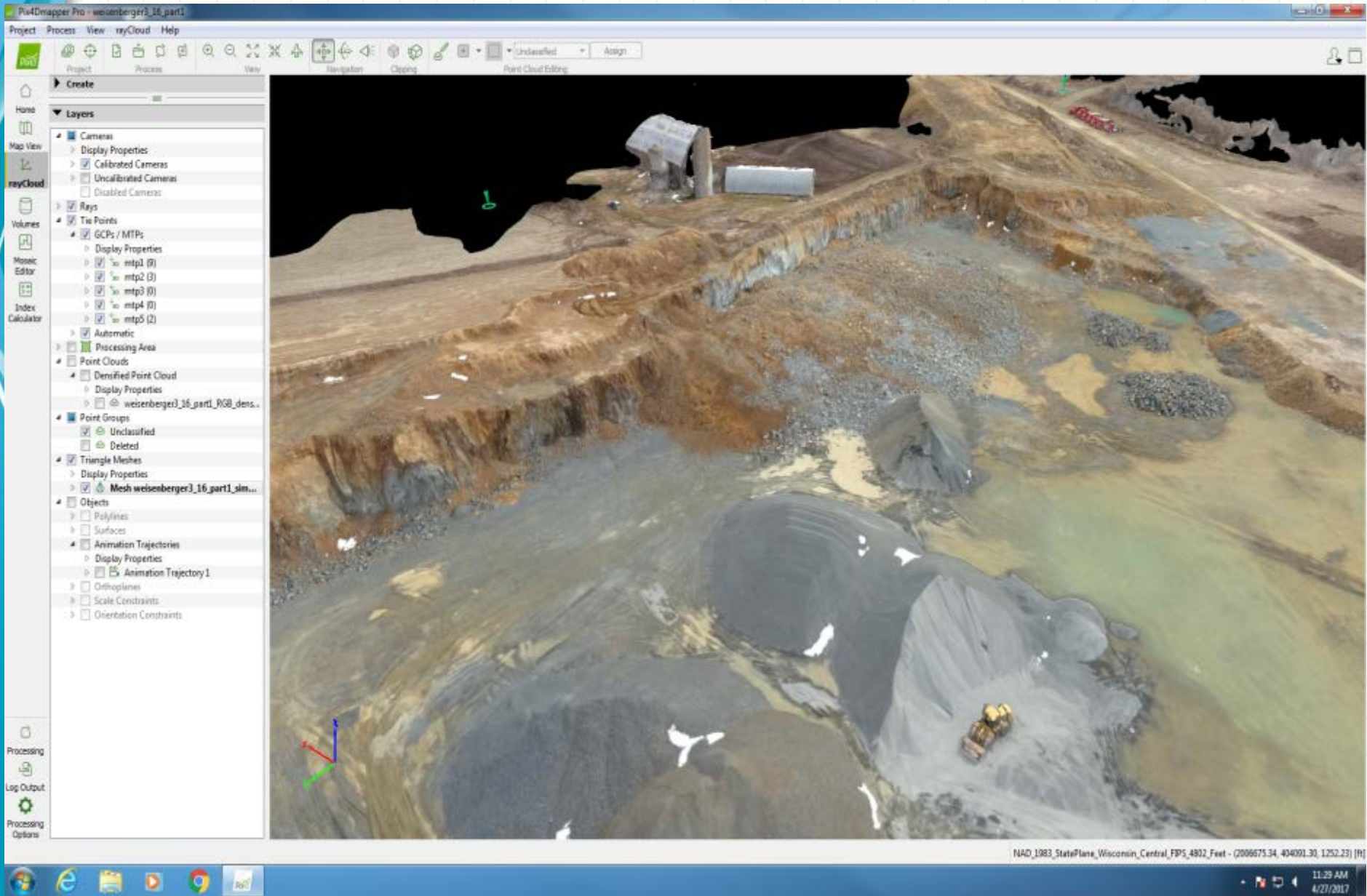
Digital Surface Model



Contours and Digital Terrain Model



3D Textured mesh





OUTPUT USES

Output Uses

1

- Stockpile Volumes

2

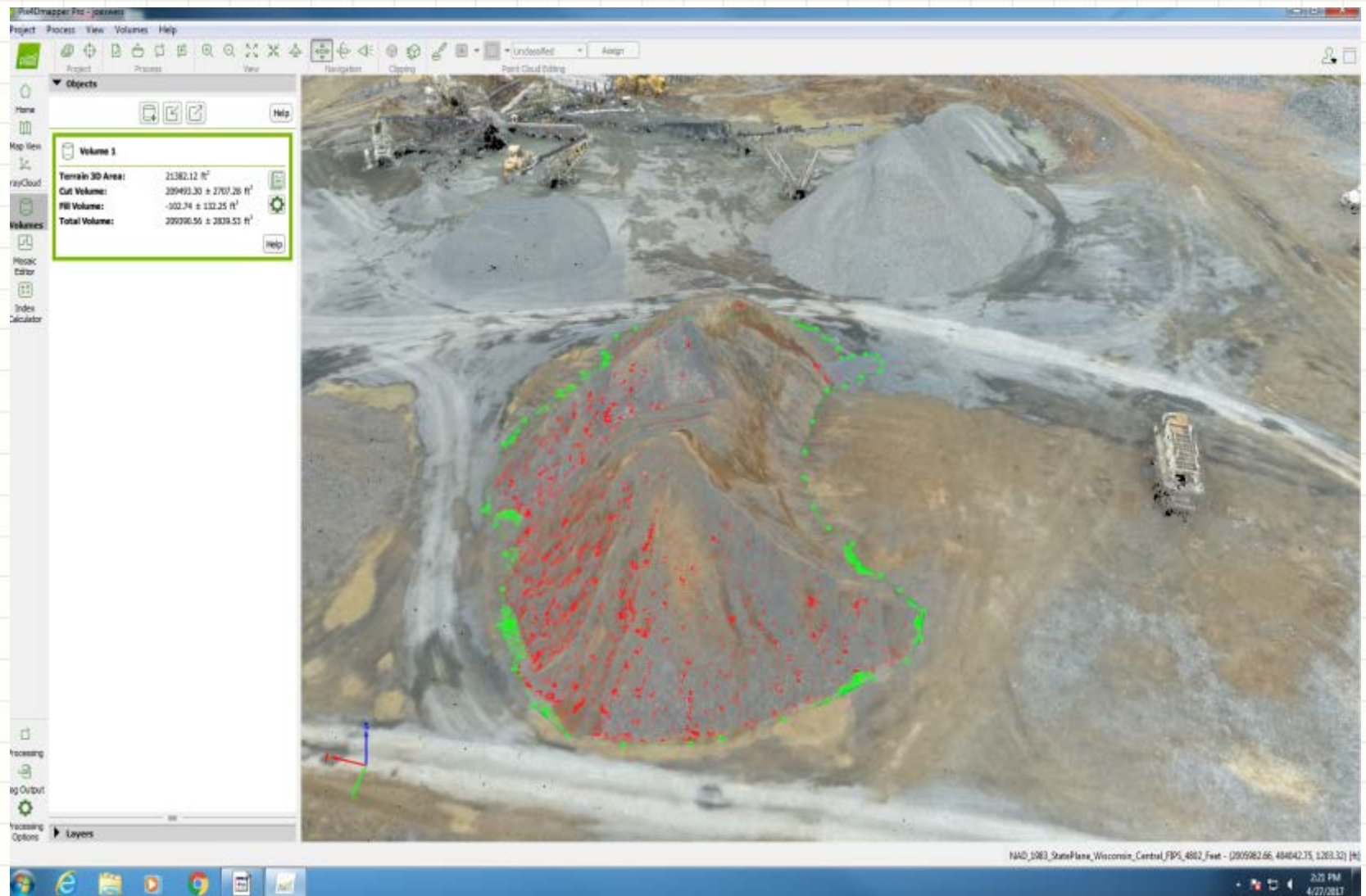
- Mine Planning & Construction

3

- Geographical Information System (GIS)

Stockpile Volumes

- Pix4D
- AutoCAD



Mine Planning & Construction

- AutoCAD Civil3D
- Topcon 3D Office

AutoCAD	
Pix4Dmapper output	Use
Densified Point Cloud (.xyz)	Visualization
Grid DSM (.xyz)	Visualization
Orthomosaic (GeoTIFF)	Distance and area measurements 2D Digitization
3D Textured Mesh (.fbx, .dxf)	Visualization
Contour lines (.dxf)	Visualization Editing
3D Digitized objects (.shp, .dxf)	Visualization Editing

Path: Densified Point Cloud (.xyz): ...\\project_name\2_densification\point_cloud\project_name_densified_point_cloud

Path: Grid DSM (.xyz): ...\\project_name\3_dsm_ortho\1_dsm\project_name_dsm

Path: orthomosaic tiles: ...\\project_name\3_dsm_ortho\2_mosaic\tiles

Path: transparent orthomosaic merged file: ...\\project_name\3_dsm_ortho\2_mosaic\project_name_transparent_mosaic_group_name

Path: orthomosaic merged file: ...\\project_name\3_dsm_ortho\2_mosaic\project_name_mosaic_group_name

Path: 3D Textured Mesh: ...\\project_name\2_densification\3d_mesh\project_name_simplified_3d_mesh

Path: Contour lines (.dxf):...\\project_name\3_dsm_ortho\extras\contours\project_name_interval_resolution_minimum_line_size

Path: 3D Digitized objects: user_defined_path/user_defined_file_name

Geographical Information Systems

- ArcMap
- ArcGIS Online

ArcGIS

Pix4Dmapper output	Use
Densified Point Cloud (.las)	Visualization
Grid DSM (.las)	Visualization
Raster DSM (GeoTIFF)	Contour lines generation Distance, area and volume measurements Comparing volumes between two DSMs 3D digitization
Raster DTM (GeoTIFF)	Contour lines generation Distance and areas measurements
Orthomosaic (GeoTIFF)	Distance and area measurements 2D Digitization
Index Map (GeoTIFF)	Visualization Color Editing
Contour lines (.shp, .dxf)	Visualization Editing
3D Digitized objects (.shp, .dxf)	Visualization Editing

ArcGIS Online Homepage

The screenshot shows a web browser window displaying the ArcGIS Online homepage for County Materials Corporation. The browser's address bar shows the URL <https://cmccorporation.maps.arcgis.com/home/index.html>. The page features a navigation menu with links for Home, Gallery, Map, Scene, Groups, My Content, and My Organization. A search bar is visible with the name "James" and a search icon. The main content area is dominated by a large banner for County Materials Corporation, which includes the company logo (a stylized 'G' in a red and black circle) and the text "County Materials Corporation" over a dark background with a globe. Below the banner is a section titled "CMC Location Group" containing four map thumbnails with labels: "Antigo Retail and Manufacturing", "Antigo2016", "Appleton Retail and Manufacturing", and "Astatula Manufacturing". At the bottom of the page, there is a footer with links for Esri.com, ArcGIS Marketplace, Help, Terms of Use, Privacy, Contact Esri, Contact Us, and Report Abuse.

https://cmccorporation.maps.arcgis.com/home/index.html

County Materials Corporati...

Google Search Share More

Suggested Sites Tillerson: 'All options' ... ESRI Online my senseFly TwistedSifter Business Insider Aviation Weather WI-SCO Well Constructors Reports Esri Location Ad Business Analyst MarathonGIS

Home Gallery Map Scene Groups My Content My Organization

James

County Materials Corporation

CMC Location Group

Antigo Retail and Manufacturing

Antigo2016

Appleton Retail and Manufacturing

Astatula Manufacturing

Esri.com | ArcGIS Marketplace | Help | Terms of Use | Privacy | Contact Esri | Contact Us | Report Abuse

Online Facilities Information

The screenshot displays a web-based GIS application interface. At the top, the browser address bar shows the URL: <https://www.marathon.maps.arcgis.com/home/webmap/viewer.html?webmap=379542cc04481fa1c5a16f025ef60>. The page title is "Roberts Manufacturing and Retail". The interface includes a search bar, navigation tools (Home, Add, Edit, Basemap, Analysis), and utility buttons (Save, Share, Print, Directions, Measure, Bookmarks). A search bar on the right contains the text "Find address or place".

The main map area shows an aerial view of an industrial facility. Several buildings are highlighted in light green. A popup window is visible over one of the highlighted buildings, displaying the following information:

- (1 of 2)
- Structures:
- Type metal
- Area 24,633
- Zoom to Get Directions Edit

The map also shows a red boundary line around the facility, a scale bar in the bottom left, and a "POWERED BY esri" logo in the bottom right corner. The footer text reads: "USDA FSA; DigitalGlobe, GeoEye, Microsoft | Product of the Version 1 Statewide Parcel Map Database Project (V1). Created by: The Wisconsin State Cartographer's Office."

Online Parcel Information

The screenshot shows a web browser displaying an online parcel information application. The browser's address bar shows the URL: <https://com.marathonmaps.arcgis.com/home/webmap/viewer.html?webmap=ea9299b06334b4481f8843d42ecace7>. The page title is "Astatula Manufacturing".

The application interface includes a top navigation bar with "Home" and "Astatula Manufacturing". On the right, there are options for "New Map", "Create Presentation", and a user profile for "James". Below the navigation bar, there are utility icons for "Details", "Add", "Basemap", and "Analysis". A search bar on the right contains the text "Find address or place".

The main content area features a map of Astatula, Florida, with several parcels outlined in red. A popup window is open over a specific parcel, displaying the following information:

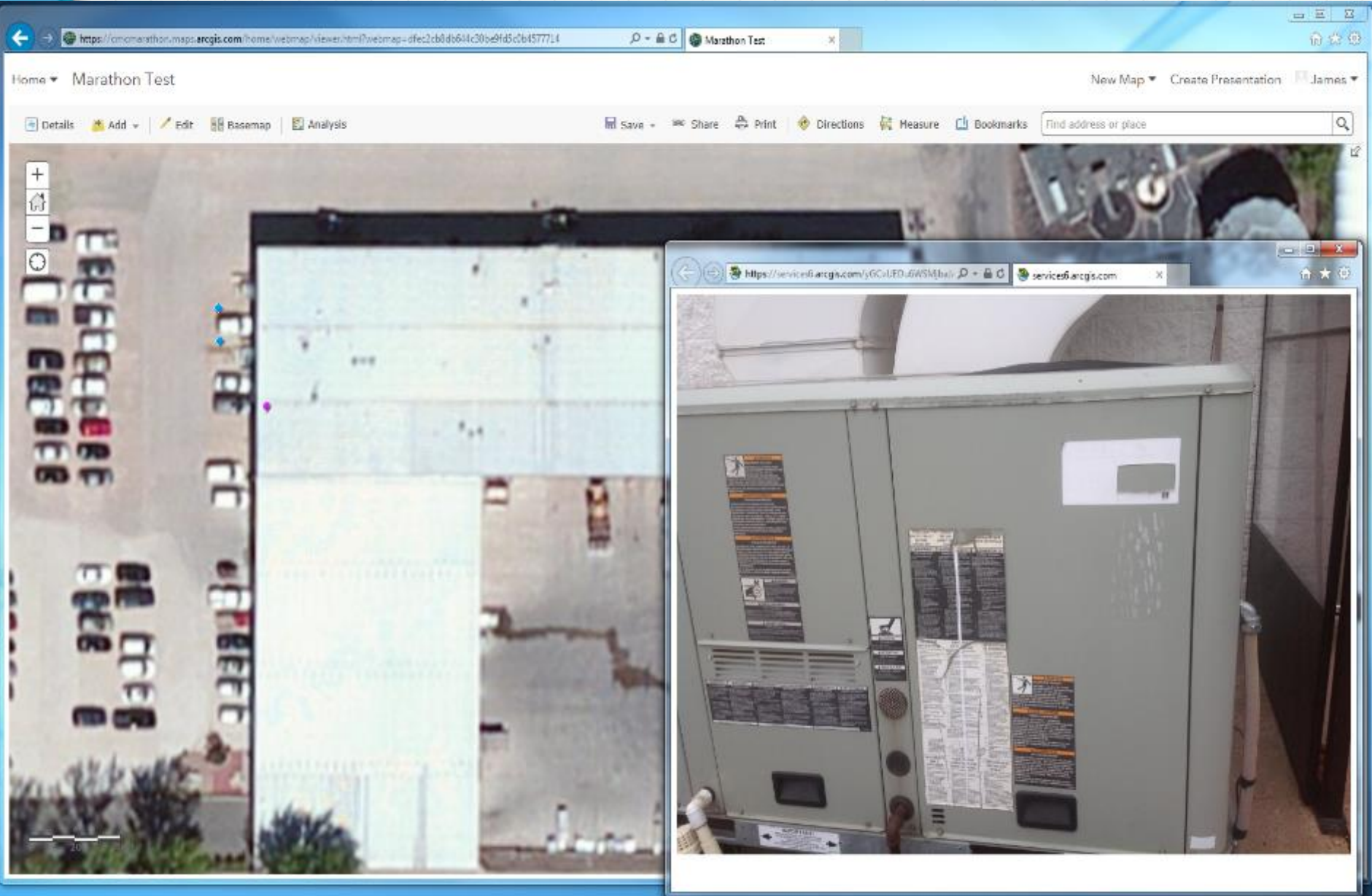
pipearea: COUNTY MATERIALS CORP	
AltKey	1788285
ParcelType	Land Base
ParcelStat	Valid
ParcelNumb	292026130000800005
Section	29
Township	20
Range	26
Subdivide	1300
OwnerName	COUNTY MATERIALS CORP
OwnerAddr	PO BOX 435
OwnerCity	ASTATULA
OwnerState	FL
Zoom to Get Directions	

The map also shows a "Contents" panel on the left with the following items:

- pipeparcels
- FloridaPipe2016
- Imagery with Labels

At the bottom of the page, there is a footer with the text: "Esri.com ArcGIS Marketplace Help Terms of Use Privacy Contact Esri Contact Us Report Abuse". The Esri logo is visible in the bottom right corner.

Location Inventory Using Collector for ArcGIS





3D Movies & Simulations



QUESTIONS?