

# AERIAL TRIANGULATION REPORT



## INDIANA STATEWIDE IMAGERY PROGRAM INDIANA OFFICE OF TECHNOLOGY

### TIER 2 - BLOCK 8

Woolpert Project Number: 72134  
July 2012



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### INDIANA STATEWIDE IMAGERY PROGRAM

### WOOLPERT PROJECT #72134

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# AERIAL TRIANGULATION REPORT

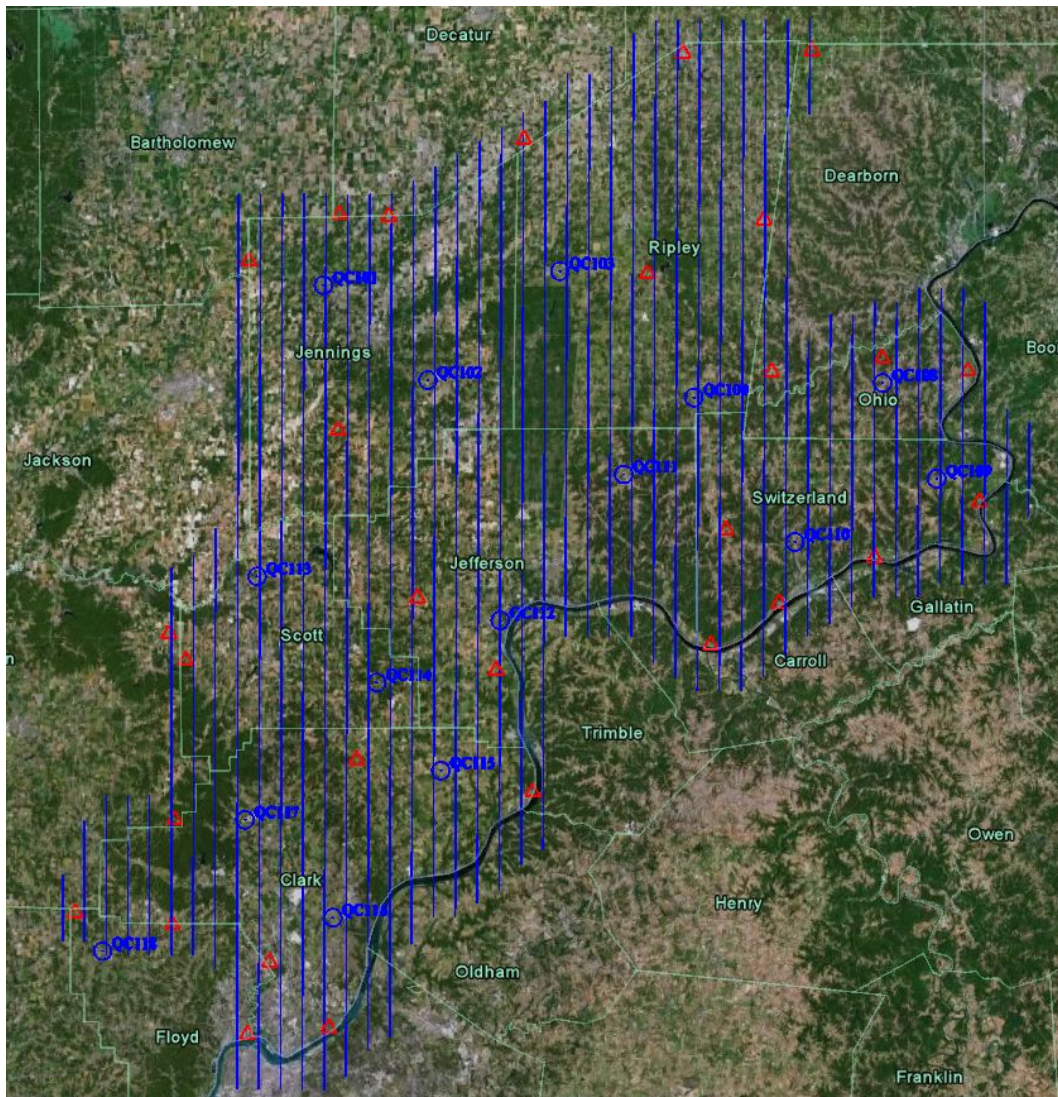
## INTRODUCTION

This report contains an outline of the photogrammetric aerial triangulation (AT) process that supported the 2012 Indiana Statewide Imagery Program for Tier 2 - Block 8, under the direction of the Indiana Office of Technology.

## PROJECT AREA

The project area is defined within this report as Indiana Statewide Tier 2 - Block 8, and visually shown below:

### INDIANA STATEWIDE TIER 2 - BLOCK 8



## PURPOSE OF AERIAL TRIANGULATION

Aerial triangulation is a method of ground control extension or densification performed mathematically and in conjunction with a limited number of ground control points, Airborne GPS data, and inertial measurement data to control aerial imagery such that it may be utilized to measure 3D information about features on or above the ground.

## DATES OF IMAGE ACQUISITION

Aerial imagery was acquired using the Leica ADS51 digital sensors. A total of four (4) missions were completed for the entire project Tier as follows:

Julian Day	Imagery Flights	Sensor(s)	Date
49	40-43	110	February 18, 2012
51	17-30	110	February 20, 2012
57	1-16	110	February 26, 2012
58	31-39, 44-46	110	February 27, 2012

## SENSOR DESCRIPTION

All data was acquired using the Leica ADS52 digital sensor, serial number 110. Both the FCIR and RGB bands were acquired simultaneously. The maximum acquisition ground sampling distance was 0.98-foot with the final deliverable pixels being produced at 1.0 -foot.

The band configurations are as outlined:

Sensor #110		
Calibration Date: September 17, 2007		
BLUE NADIR	NIR NADIR	PANF02
GREEN NADIR	PANB14	RED B16
RED NADIR	PANF27	GREEN B16
BLUE B16	NIR B16	

## PROCESSING SOFTWARE

The software utilized for the digital image processing and aerial triangulation, developed by Leica GeoSystems, was XPro version 5.0.

## PROCESSING METHODOLOGY

Indiana Statewide Tier 2 - Block 8 was created using Leica's XPro software and is based on project specifications, control point locations and a suitable number of lines for the block. Indiana Statewide Tier 2 - Block 8 contains a good distribution of control points within its boundaries.

Every band for the required flight lines is added to the project applying the processed position and orientation data. This creates metadata files and an orientation data file for each band giving the imagery its raw position and orientation.

The aerial triangulation process uses only the Level 0 panchromatic imagery bands PANB14, PANF27, and PANF02 which are created by XPro. The aerial triangulation process is similar to conventional operations, where the Level 0 panchromatic imagery is passed through Automatic Point Measurement, the resulting tie points and ground control is adjusted using CAP-A and ORIMA software. Blunders are removed and the block is analyzed for weak network areas, and if required, manual points are added. The final adjustment output consists of precise orientation data files for each band, calibration parameters and metadata. The imagery can now be rectified to a DEM which removes any relief displacement which may be present. During this processing stage, we can set the required ground sampling distance (GSD), 8 bit or 16 bit imagery, and apply a tonal curve. The ortho-rectified imagery is commonly referred to as Level 2 imagery.

## GROUND CONTROL USED IN TRIANGULATION

Ground Control Used in Triangulation			
Point ID	X ft	Y ft	Z ft
201	321535.8	1110827	470.038
202	398841.4	1199293	470.886
203	465918.2	1254552	483.128
204	527543	1287332	476.471
205	566832.6	1308049	471.472
206	562342.8	1356742	486.704
208	530133.2	1361597	747.385
209	488486.9	1356439	891.536
210	485381.6	1413072	1004.469
211	503105.4	1476373	960.927
216	454567.2	1475352	966.277
217	394674.2	1443094	896.54
218	343540.9	1414250	758.147
219	355040.7	1271688	753.111
220	471575.1	1297429	880.059
221	441562.5	1392992	968.393
222	324729.2	1334211	671.857
223	332063.5	1211068	698.571
224	299038.5	1135191	458.31
265	290645.4	1108184	436.824
267	262078.9	1148949	908.093
296	384885.6	1244790	795.293
297	267034.3	1248087	620.221

Ground Control Used in Triangulation			
Point ID	X ft	Y ft	Z ft
298	491677.3	1270166	480.405
4	260537.1	1257925	567.199
5	262816.7	1188314	788.654
6	224954.4	1153203	837.788
45	324734.3	1414927	734.243
47	290517.4	1397471	646.416

## AT BLOCK STATISTICAL DATA

Control Point Residuals			
Point ID	X ft	Y ft	Z ft
201	321535.8	1110827	470.038
202	398841.4	1199293	470.886
203	465918.2	1254552	483.128
204	527543	1287332	476.471
205	566832.6	1308049	471.472
206	562342.8	1356742	486.704
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6	224954.4	1153203	837.788
45	324734.3	1414927	734.243
47	290517.4	1397471	646.416
48	281268.3	1291418	562.05

## SUMMARY

The final RMSE (Root Mean Square Error) residuals on the ground control points are as follows:

	X	Y	Z
RMS	0.001578	0.002	0.000289
RMS P	0.002547		

The RMSE P values fall well within the industry and National Map Accuracy Standards for DOI mapping at 1"=200' scale.

## QC RESULTS

The Indiana Statewide Tier 2 - Block 8 QC Point Horizontal Accuracy Static Worksheet listed below shows quality-controlled point checks and analysis.

Point number	Point description	x (Survey)	x (AT)	diff in x	(diff in x) <sup>2</sup>	y (Survey)	y (AT)	diff in y	(diff in y) <sup>2</sup>	(diff in x) <sup>2</sup> + (diff in y) <sup>2</sup>
"QC101"	target	318895.745	318895.6967	0.048	0.002	1388487.125	1388487.451	-0.326	0.106	0.109
"QC102"	target	358675.895	358676.1057	-0.211	0.044	1353057.202	1353057.131	0.071	0.005	0.049
"QC103"	target	408494.448	408494.2882	0.160	0.026	1393829.068	1393829.105	-0.037	0.001	0.027
"QC104"	target	459277.139	459277.3495	-0.211	0.044	1346729.252	1346729.2	0.052	0.003	0.047
"QC108"	target	530369.322	530369.1744	0.148	0.022	1352332.229	1352332.179	0.050	0.002	0.024
"QC109"	target	550785.402	550785.7286	-0.327	0.107	1316675.095	1316675.199	-0.104	0.011	0.117
"QC110"	target	497523.456	497523.4798	-0.024	0.001	1292940.141	1292940.115	0.026	0.001	0.001
"QC111"	target	432901.118	432900.9996	0.118	0.014	1317992.219	1317992.463	-0.244	0.060	0.074
"QC112"	target	386402.848	386402.9832	-0.135	0.018	1263341.169	1263340.983	0.186	0.035	0.053
"QC113"	target	294117.804	294117.6303	0.174	0.030	1279471.135	1279471.111	0.024	0.001	0.031
"QC114"	target	339696.31	339696.1838	0.126	0.016	1239951.436	1239951.021	0.415	0.172	0.188
"QC115"	target	363973.419	363973.5359	-0.117	0.014	1207134.536	1207134.509	0.027	0.001	0.014
"QC116"	target	323088.698	323088.7296	-0.032	0.001	1151943.637	1151943.618	0.019	0.000	0.001
"QC117"	target	289636.404	289636.4083	-0.004	0.000	1188402.686	1188402.531	0.155	0.024	0.024
"QC118"	target	235420.226	235420.2879	-0.062	0.004	1138933.103	1138933.199	-0.096	0.009	0.013
									sum	0.772
									Average	0.051
									RMSE	0.227
									NSSDA	0.393