

MAP ACCURACY REPORT
East-Central Minnesota Ortho Project
Multi-Agency Project

Data Contact Person:	Chris Cialek	Department:	MnGEO
Type of Mapping:	Ortho-photo & Stereo Imagery	Contractor:	Surdex Corporation
Independent Testing:	Mn/DOT Photo Unit	Contract Delivery date:	31 December 2010

The purpose of this report is to independently test, for horizontal accuracy the digital ortho quarter quads (DOQQ's) produced by Surdex in both half meter and one foot pixel resolution. Two counties contracted for 6 inch resolution products and those accuracy calculations are not included in this report. Also compressed county mosaics (CCM) were a contract deliverable item and this product was not tested. The DOQQ's are the deliverables which were contracted for by the Minnesota Geospatial Information Office or MnGEO, Department of Administration as part of their association with the Minnesota Department of Natural Resources and the Metropolitan Council. The project area consisted of the following counties: Anoka, Chisago, Carver, Dakota, Hennepin, Isanti, Ramsey, Scott, Sherburne, Washington and Wright. Goodhue and Rice Counties were not collected during the 2010 season due to environmental conditions and were collected in the spring of 2011 as part of the Southern Minnesota Ortho Project. This project consisted of flights flown between the 7th and 17th April 2010, I do not have specific flight data for Goodhue and Rice Counties. The flights were controlled using GPS/IMU equipment onboard the aircraft and supplemented with ground targets. Surdex used three Cessna 441 Conquests with the following tail numbers; N440EH, N441EH and N441FS. The altitude was different for each of the three products, 5,000 feet AGL for the 6 inch pixel resolution, 10,000 feet AGL for the 1 foot pixel resolution and 16,500 feet AGL for the ½ meter product. The aerial cameras used in these missions were Intergraph DMC digital mapping cameras with serial numbers 146 and 149. Surdex used Intergraph Image Station (ISAT) version, 5.0 and 5.1 for the aerial triangulation (AT). A combination of Intergraph PPS version 6.1.1 software was used for the raw data processing and Surdex's own in-house software for all other radiometric/ortho-rectification processes.

The Horizontal Datum used was the North American Datum of 1983 (NAD 83). All products were delivered in either UTM Zone 15 coordinates (meters). The Geoid model used was the GEOID 03.

ORTHOPHOTO

EAST BOUNDING COORDINATE: 92° 14' 31.451" W. Long.
WEST BOUNDING COORDINATE: 94° 19' 04.105" W. Long.
NORTH BOUNDING COORDINATE: 45° 45' 09.565" N. Lat.
SOUTH BOUNDING COORDINATE: 44° 11' 46.052" N. Lat.

Geodetic monumentation used to control this project was published by Mn/DOT and can be found in their geodetic database online at <http://www.dot.state.mn.us/surveying/Geodetics/geodetics.html>. The test data was collected as part of a partnership effort from the 2008 FSA Aerial Imagery Project, where 74 Counties and 9 Mn/DOT District offices participated. The targets covering the project area were repainted but not resurveyed. A general map showing the distribution of these targets is included in this report. Because of a previous agreement with the Aerial Photography Field Office in Salt Lake City; the data sheets showing the statistical analysis was only delivered to MnGEO. The test data itself was collected by various GPS methods including Static, VRS, RTK and Opus Static Solutions.

The horizontal accuracy test done on the ortho-photos were a direct comparison of field surveyed coordinates for the center of the targets that were set previous to flight operations with the closest pixel location that an experienced technician could find. There is a certain amount of personal bias involved in this type of testing, knowing this, when the operator selected a pixel that was outside of the norm, a second technician was asked to see if they could replicate the results. The 6 inch pixel resolution product was not tested as a part of this project.

The contract called for a 0.30 meter (1 foot) ground sample distance (GSD) with a horizontal accuracy of +/- 1.5 meters and the 0.50 meter GSD with an accuracy requirement of +/- 2.4 meters. The technicians identified all targets where the sum of the x and y differences squared is at or above 1.0 meters and these points are double checked. This value was chosen because the horizontal error in any one direction would be just less than 2 pixels. I

felt that this would be the allowable tolerance in the human visual acuity. All test points that had a $dx^2 + dy^2$ value of greater than 2.0 were checked against the 2008 FSA targets to see if a pattern emerged for the purpose of identifying possible survey errors. Dakota County Target No. 2 and Washington County Target No. 3 were identified as having large errors in both data sets, but were not similar in terms of error by direction. It is my recommendation to resurvey these two targets prior to the next data collect.

Additionally, Surdex reported that the DEM used in the ortho-rectification process was a combination of 10 meter USGS/NED data and some photogrammetrically derived data supplied by the client.

The 13 county area was divided up into two zones to give the user a better indication of the accuracy with respect to the two products that were delivered. The contract calls for a 13 county project area but during the available flying season, Goodhue and Rice Counties were not collected due to weather interfering with an extremely short flying season. The contract was revised and the completion date extended out past the spring of 2011.

The NSSDA for the horizontal (r) component or the combined X and Y coordinate for this project are:

<u>Photo Targets</u>	<u>RMSE_r</u>	<u>NSSDA (Horizontal)</u>
13 County Combined	0.775m	1.341m with 111 targets
8 County Core Region (1 Foot)	0.662m	1.146m with 68 targets
Outer Ring Region (1/2 Meter)	0.931m	1.611m with 42 targets

The test data was obtained by various groups ranging from County Engineers, County Surveyors, County GIS Personnel and MnDOT's Metro District Surveyors and their personnel. One hundred eleven (111) targets were used from an original set of targets for the Farm Service Agency imagery collect of 2008. For the 13 county project area only (104) one hundred four targets were used. Six (6) targets were obscured due to reasons stated above. One (1) target was judged to be not acceptable because it was placed in a location where vertical displacement between the ground and the target caused a drastic difference in the horizontal distance.

There are similarities in the distribution of accuracies between the two product deliveries. Although the products are from the same imagery collect, they were actually two different flights based on altitude although the difference in accuracy is rather insignificant. The technician's ability to select the exact center of the target is only slightly improved because of the improved image resolution.

The National Elevation Dataset (NED) contains high resolution data in many portions of the state but not in the greater metropolitan area. The NGA did perform a LiDAR survey for the Republican National Convention in 2008 but it is unknown if that data is included in the NED. Overall, high resolution elevation data should help horizontal accuracy with respect to this type of ortho-photo product. The issue at this time is that the state will be performing a LiDAR collect for the Metro area in the spring of 2011 but that data will be added to the NED based on the schedule determined by USGS.

The tabulated test results, correspondence, related notes and hard copies are attached to this report.

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