Elevation Data Quality Assurance Report
Saline Illinois Classified Dataset
April 30, 2012
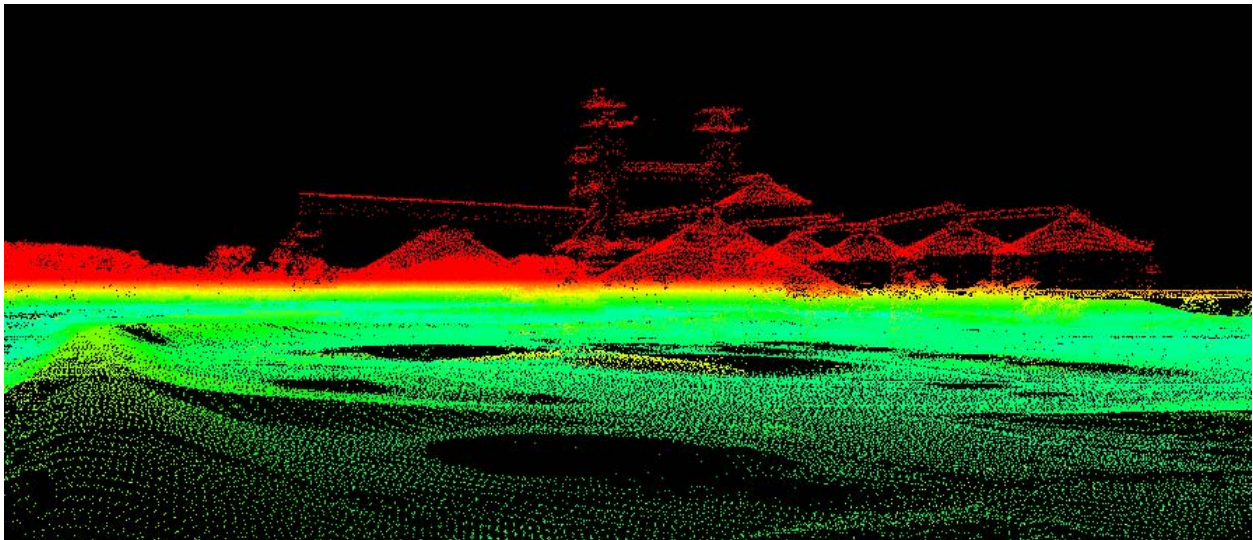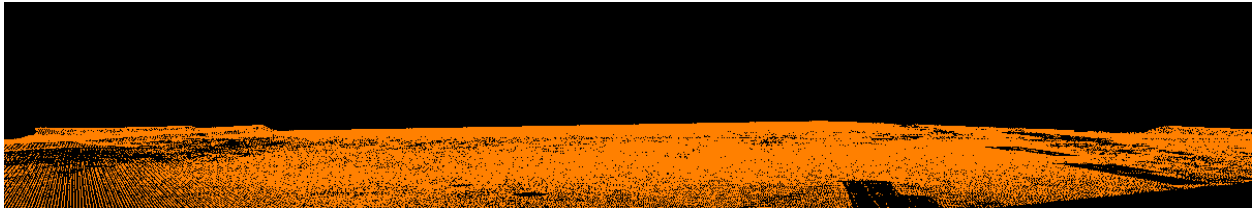
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1. Executive Summary

Under FEMA task order HSFE05-11-J-0009 STARR has completed elevation data post processing for Saline Illinois. The goal of this project is to create a classified bare-earth digital terrain dataset with a vertical accuracy Root Mean Square Error of <18.5cm capable of supporting 2 foot contours.

2. Overview

STARR partner Greenhorne and O'Mara performed an independent quality assurance review on the Classified Point Cloud data. This validates the quality of LiDAR data for use in Risk MAP projects that support the National Flood Insurance Program. This document summarizes the review process and results for Saline Illinois.

Table 1 LiDAR Project Requirements

FEMA Region 5 Saline Illinois LiDAR Post Processing	
Collection/Processing Area	2179 square miles
Breaklines Required	No
Specification Level	Highest
Nominal Pulse Spacing	1 m
DEM Post Spacing	2 m DEM with 2 ft. contour accuracy
Vertical Accuracy, 95% Confidence Level FVA/CVA	24.5 cm/ 36.3 cm
Coordinate System	UTM Zone 16N
Horizontal Datum and Linear Units	NAD 83 Meters
Vertical Datum and Linear Units	NAVD 88 Meters

Table 2 QA Activity and Guideline and Specifications Matrix

QA Activity	PM 61	USGS LiDAR Base Spec v13	ASPRS LAS v1.2	Appendix A	Appendix M
Vendor Submittal	X	X	X		X
Macro Review	X	X		X	
Micro Review	X	X	X	X	
Vertical Accuracy	X	X		X	X

3. LiDAR Data Review

Greenhorne & O'Mara, Inc. utilizes commercial software and proprietary scripts/applications to review LiDAR data. These tools, combined with guidelines and specifications, are incorporated into a standardized quality assurance workflow. The following table summarizes software and proprietary scripts/applications used in the review.

Table 3 Software/Tools used in Quality Assurance Review

Software/Tools	QA Process
ESRI ArcGIS ArcInfo	LiDAR Data Processing
ESRI 3D Analyst Extension	Visual Analysis of LiDAR Data
ESRI Spatial Analyst Extension	Grid Analysis for LiDAR Data
LP360 ArcMap Extension	Visual Analysis of LiDAR Data
SIS Topo Analyst	Vertical Accuracy Quality Assurance
Proprietary Scripts/Applications	Working with LAS files

3.1 Vendor Submittal

All project data has been delivered and is accounted for. The completed Vendor Submittal Quality Assurance checklist is included with the QA Forms delivered with this document.

3.2 Macro Data Review

The macro review is conducted on the full all return and fully classified point cloud datasets. The purpose of this review is to determine whether the dataset was produced in a manner consistent with requirements set forth in the FEMA procedural memorandum. The individual review components are discussed in the following sections.

3.2.1 LiDAR Coverage and Completeness

All LiDAR data processed for the Saline Illinois Project covers the area of interest with a 100m buffer and has an area of approximately 2179 square miles (See Figure 1).   All LiDAR tiles are accounted for and the project datasets have the correct projection and datum information.

3.2.2 LAS Header Review

All LAS files submitted for review have header information that is compliant with ASPRS LAS specifications version 1.2 and 1.3.

The completed LAS Header Quality Assurance checklist is included with the QA Forms delivered with this document.

3.3 Micro Data Review

The following macro reviews were completed on 5% of both the all return and the fully classified point cloud datasets. Tiles selected for review were chosen throughout the project area with a focus on areas of urban development and hydrographic significance (See Figure 2).

- Scan lines removed from bare earth
- Excessive Noise in bare earth
- Elevation Steps
- Gaps/Voids
- Edge matching between tiles
- Artifacts have been removed from bare earth (vegetation, buildings, bridges, etc.)
- Proper definition of roads and drainage patterns
- "Over-smoothed" areas during filtering
- Corn Row Effects
- Mounds and Divots
- Other anomalies

All tiles reviewed meet project requirements for classified LiDAR data and can be used for floodplain mapping activities. The completed Micro Data Review Quality Assurance checklist is included with the QA Forms delivered with this document.

4. Vertical Accuracy Verification

An independent review and verification of submitted CVA survey data with vendor provided LAS files was completed to insure reported vertical accuracy is correct. Survey data points containing field collected GPS elevation values were buffered by 10 meters. LiDAR points contained within the buffered areas are selected and used to create a TIN. The TIN facet z value closest to the x and y control point location is compared to the height of the survey point. The height difference is evaluated statistically and compared to the submitted CVA testing results to insure the vertical accuracy meets project expectations. All CVA survey data submitted for this project has been confirmed to meet project requirements. The report delivered with this document summarizes the results of this assessment.

5. Conclusions

Based upon the submittal verification, acquisition reports, macro/micro reviews and vertical accuracy confirmation, the Saline Illinois dataset meets all applicable project specifications defined in FEMA task order HSFE05-11-J-0009 dated September 8, 2011. This data meets all project requirements for FEMA Risk MAP elevation acquisition and can be used for flood risk analysis.

Approvals

QA Team Lead: **James L. Huffines Date: 4/30/2012**

6. References

Links to guidelines and specifications used in production of the LiDAR datasets:

1. Federal Emergency Management Agency, Procedure Memorandum No. 61 - Standards for Lidar and Other High Quality Digital Topography, http://www.fema.gov/library/viewRecord.do?id=4345
2. U.S. Geological Survey National Geospatial Program, LiDAR Guidelines and Base Specification, Version 13-ILMF 2010, http://lidar.cr.usgs.gov/USGS-NGP%20Lidar%20Guidelines%20and%20Base%20Specification%20v13%28ILMF%29.pdf
3. American Society for Photogrammetry and Remote Sensing, LAS v1.2, http://www.asprs.org/a/society/committees/standards/asprs_las_format_v12.pdf
4. Federal Emergency Management Agency, Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix A: Guidance for Aerial Mapping and Surveying [includes guidance on Light Detection and Ranging Systems (LIDAR)] http://www.fema.gov/library/file;jsessionid=1E39C93AF9CD18EE125B3DFCA5A874B8.Worker2Library?type=publishedFile&file=frm__gsaa.pdf&fileid=2daefcd0-df08-11e0-9bf5-001cc4568fb6
5. Federal Emergency Management Agency, Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix M: data Capture Standards http://www.fema.gov/library/file;jsessionid=1E39C93AF9CD18EE125B3DFCA5A874B8.Worker2Library?type=publishedFile&file=frm__gsam.pdf&fileid=cf85c9b0-df0f-11e0-9bf5-001cc4568fb6
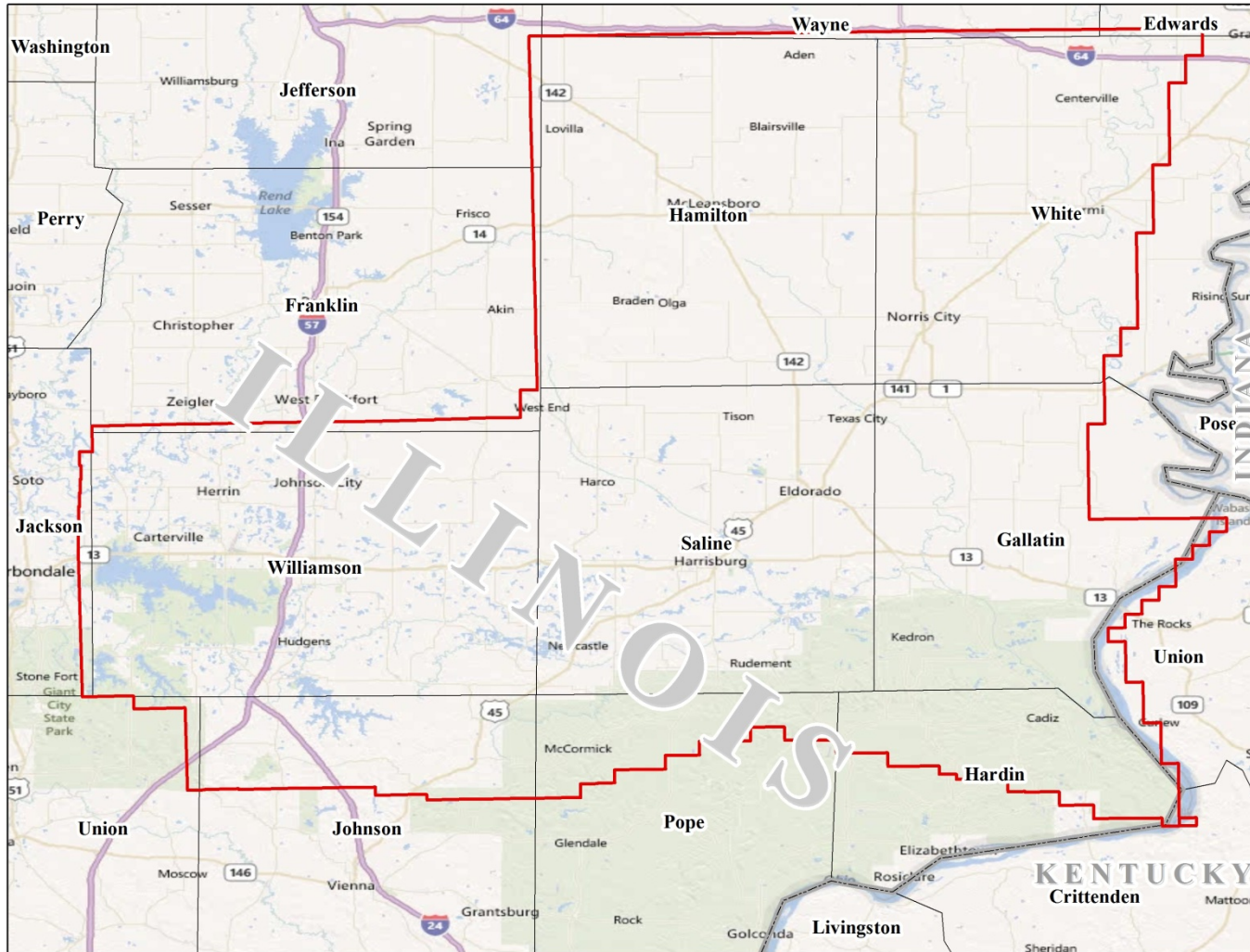
Figure 1 Saline Illinois Project Area

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Figure 2 LiDAR Micro Review