



May 13, 2022

**Survey Report** of  
Additional LiDAR Calibration & Quality  
Control Points

USGS Contract: G16PC00016

MO\_WESTCENTRALMISSOURI\_2018\_D19

USGS Task Order: 140G0219F0061

Presented to:



Presented By:



# CONTENTS OF REPORT

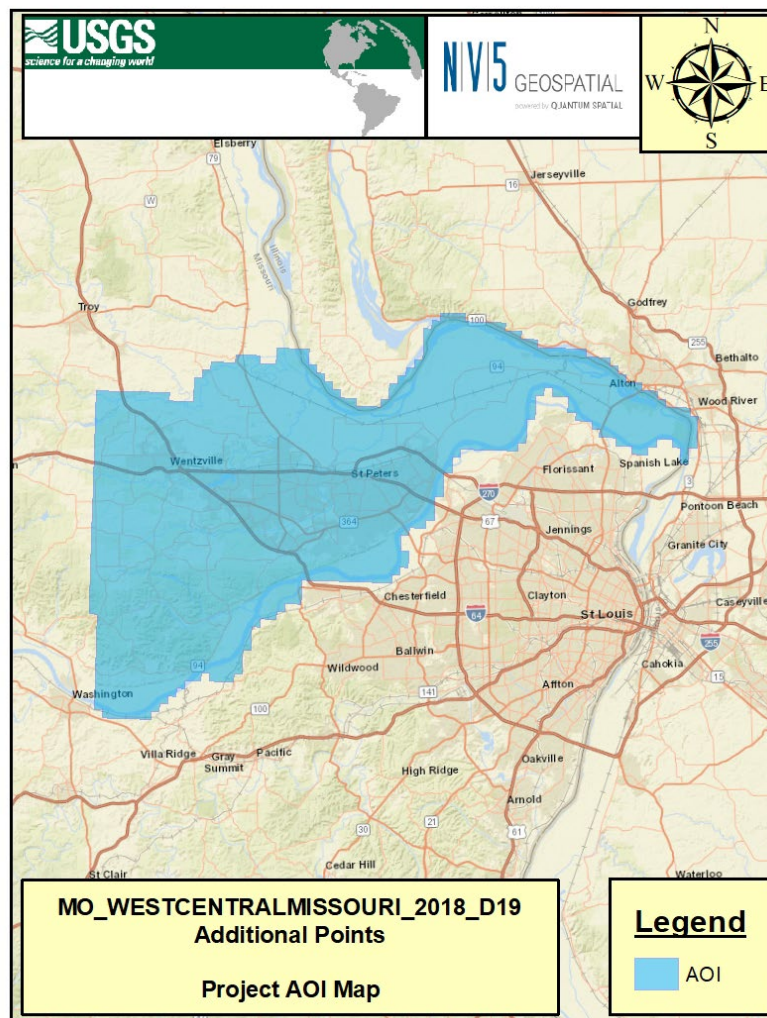
<b>PROJECT PROCEDURE SUMMARY.....</b>	<b>1</b>
<b>AREA OF INTEREST &amp; POINT LOCATION MAP.....</b>	<b>4</b>
<b>NVA-VVA POINTS.....</b>	<b>5</b>
<b>FINAL POINT COORDINATES.....</b>	<b>6</b>
<b>NVA-VVA POINTS.....</b>	<b>7</b>
<b>LOCATION &amp; ACCURACY DATA SHEETS.....</b>	<b>8</b>
<b>NVA-VVA POINTS.....</b>	<b>9</b>
<b>SURVEY CERTIFICATION.....</b>	<b>14</b>

## Introduction

NV5 Geospatial, Inc. was contracted by USGS under task order 140G0219F0061 to survey LiDAR calibration and quality control points in support of the MO\_WESTCENTRALMISSOURI\_2018\_D19 project. The project consisted of 8,093 square miles in 13 counties of Missouri. This is the report of the technical approach used and detail of five additional points surveyed in the area of St Charles County. The ground survey was subcontracted to FGS-Surveyors.

## Project Area

The Project Area, shown in the figure below, resided in St Charles County, MO.



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## Technical Approach to Land Cover Validation Point Selection

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Referencing ASPRS Positional Accuracy Standards for Digital Geospatial Data (Edition 1, Version 1.0, - November, 2014) table C.1 Recommended Number of Checkpoints based on Area, NV5 Geospatial determined that an additional 3 Non-Vegetated Vertical Accuracy (NVA) and 2 Vegetated Vertical Accuracy (VVA) points beyond the original dataset were required for the project area.

To ensure that checkpoints were distributed generally proportionate among the various vegetated land cover types, NV5 Geospatial used existing USGS Land Cover data to divide both the NVA and VVA categories among the various types, calculating the approximate number of required points in each representative type proportionate to the total project area.

Proposed point locations are selected with this distribution methodology in mind; however, access to the entire AOI limited the distribution.

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## Survey Accuracy Requirements

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Given that the survey accuracy of calibration and quality control check points should be 3 times more accurate than the required accuracy of the data set, NV5 Geospatial requires that calibration and NVA points are better than 3 centimeters RMSE, both horizontally and vertically, and that VVA points be better than 5 centimeters RMSE, both horizontally and vertically. The surveyed accuracy of each point must be determined through redundant measurements and/or network adjustment using procedures and methodologies that reliably and consistently result in the aforementioned accuracies.

Due to variances in reference control accuracy and adjustment, NV5 Geospatial requires that the survey methodology used be explained, so that it can be repeated if necessary.

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## Field Survey Methodology

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Date Range: November 4, 2021

**Equipment Used:**

Field crews used Trimble R12 dual frequency GNSS receivers as rovers.

**GNSS Methodology:**

Crews performed this survey using the Missouri MODOT RTN. The project was then calibrated in Trimble Business Center using the NGS and OPUS values for existing ground control.

All the GNSS and conventional information was downloaded, processed, and analyzed using Trimble Business Center processing software. A network was formed and adjusted.

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**Overall Project Accuracy Statement**

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All point coordinates have been reported in the North American Datum of 1983 (2011). Missouri State Plane coordinates in Meters horizontally. Elevations are relative to the North American Vertical Datum of 1988 (NAVD 88) which were derived using the Geoid 18 model and are reported in Meters.

**NVA Points**

Average Horizontal RMSE is 0.007 m.

Average Elevation RMSE is 0.013 m.

Average 3 dimensional RMSE is 0.014 m.

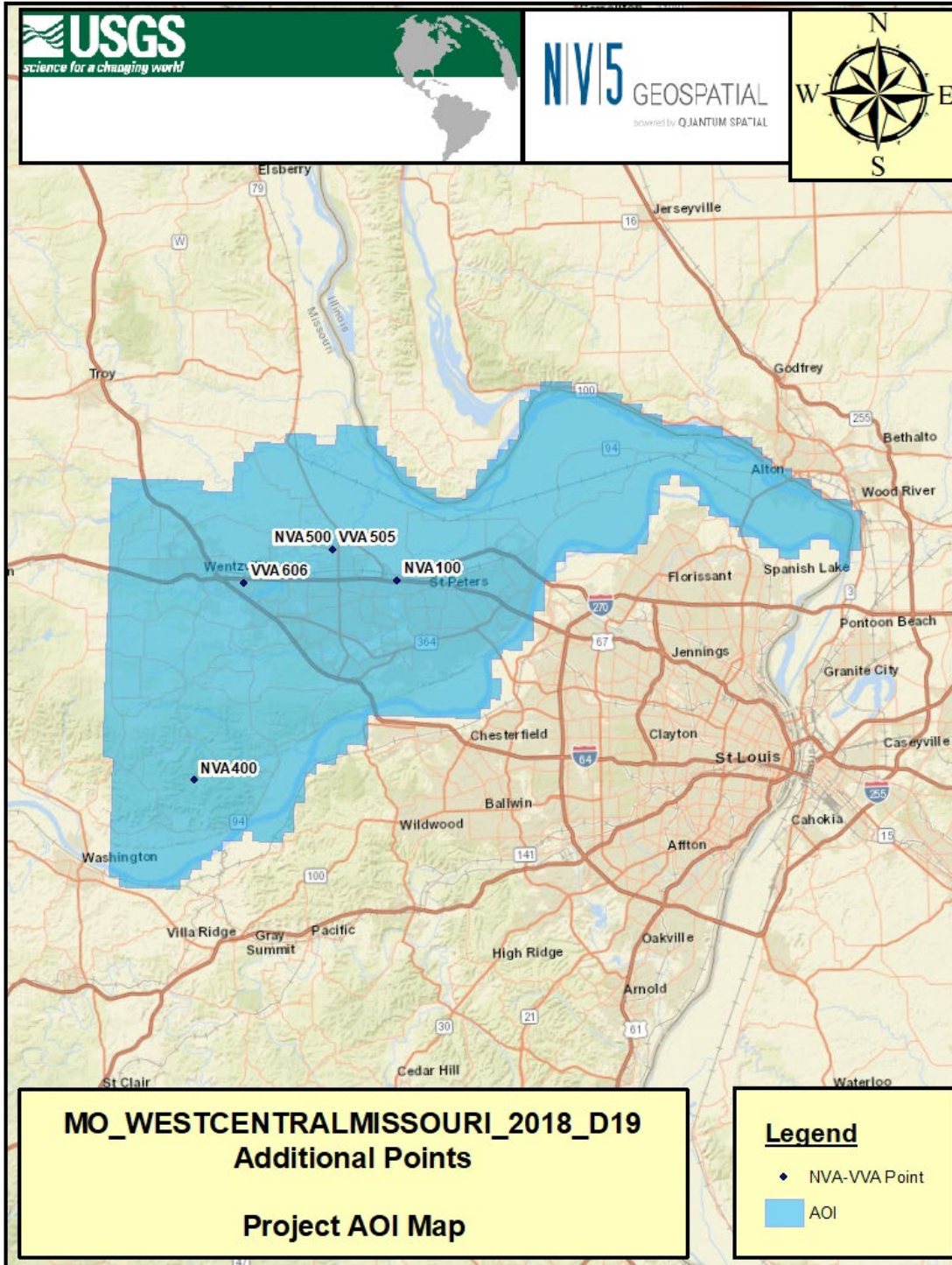
**VVA Points**

Average Horizontal RMSE is 0.009 m.

Average Elevation RMSE is 0.018 m.

Average 3 dimensional RMSE is 0.020 m.

## **PROJECT AOI & POINT LOCATION MAP**



## **FINAL POINT COORDINATES**



## **NVA-VVA POINT COORDINATES**

Horizontal Datum - NAD83(2011)  
Universal Transverse Mercator – ZONE 15  
Vertical Datum - NAVD 88  
Geoid - GEOID18  
Units – Meter

Point ID	Northing (m)	Easting (m)	Elev. (m)
NVA 100	4297301.836	705558.566	135.948
NVA 400	4277424.200	685278.295	164.515
NVA 500	4300353.856	699067.165	142.140
VVA 505	4300353.212	699053.808	141.563
VVA 606	4297039.249	690299.839	174.459

## **LOCATION AND ACCURACY DATA SHEETS**

Point ID	NVA 100
Project No.	39313
Project Name	USGS-WestCentral-MO
State	Missouri
County	St. Charles
Quad	O'Fallon

	Aerial Target
X	LiDAR Ground Control
	LiDAR QC Point
	New Control
	Photo ID
	Published Control

Coordinate System	
	UTM 15N
	NAD83(2011)
	NAVD88
	GEOID18
	Meters

Northing	Easting	Elevation
4297301.836	705558.566	135.948

Operator	B. Estes
Receiver Model	Trimble R-12
Receiver S/N	782
Antenna Height	2.000 m

Date (MM-DD-YYYY)	11-04-2021
RMSE Hz	0.007 m
RMSE Z	0.015 m
GPS Method	RTK

**PHOTOS**



Point ID	NVA 400
Project No.	39313
Project Name	USGS-WestCentral-MO
State	Missouri
County	St. Charles
Quad	Defiance

	Aerial Target
X	LiDAR Ground Control
	LiDAR QC Point
	New Control
	Photo ID
	Published Control

Coordinate System	
	UTM 15N
	NAD83(2011)
	NAVD88
	GEOID18
	Meters

Northing	Easting	Elevation
4277424.200	685278.295	164.515

Operator	B. Estes
Receiver Model	Trimble R-12
Receiver S/N	782
Antenna Height	2.000 m

Date (MM-DD-YYYY)	11-04-2021
RMSE Hz	0.006 m
RMSE Z	0.009 m
GPS Method	RTK

**PHOTOS**



Point ID	NVA 500
Project No.	39313
Project Name	USGS-WestCentral-MO
State	Missouri
County	St. Charles
Quad	O'Fallon

	Aerial Target
X	LiDAR Ground Control
	LiDAR QC Point
	New Control
	Photo ID
	Published Control

Coordinate System	
	UTM 15N
	NAD83(2011)
	NAVD88
	GEOID18
	Meters

Northing	Easting	Elevation
4300353.856	699067.165	142.140

Operator	B. Estes
Receiver Model	Trimble R-12
Receiver S/N	782
Antenna Height	2.000 m

Date (MM-DD-YYYY)	11-04-2021
RMSE Hz	0.007 m
RMSE Z	0.014 m
GPS Method	RTK

**PHOTOS**



Point ID	VVA 505
Project No.	39313
Project Name	USGS-WestCentral-MO
State	Missouri
County	St. Charles
Quad	O'Fallon

	Aerial Target
	LiDAR Ground Control
X	LiDAR QC Point
	New Control
	Photo ID
	Published Control

Coordinate System	
UTM 15N	
NAD83(2011)	
NAVD88	
GEOID18	
Meters	

Northing	Easting	Elevation
4300353.212	699053.808	141.563

Operator	B. Estes
Receiver Model	Trimble R-12
Receiver S/N	782
Antenna Height	2.000 m

Date (MM-DD-YYYY)	11-04-2021
RMSE Hz	0.007 m
RMSE Z	0.014 m
GPS Method	RTK

**PHOTOS**



Point ID	VVA 606
Project No.	39313
Project Name	USGS-WestCentral-MO
State	Missouri
County	St. Charles
Quad	Wentzville

	Aerial Target
	LiDAR Ground Control
X	LiDAR QC Point
	New Control
	Photo ID
	Published Control

Coordinate System	
	UTM 15N
	NAD83(2011)
	NAVD88
	GEOID18
	Meters

Northing	Easting	Elevation
4297039.249	690299.839	174.459

Operator	B. Estes
Receiver Model	Trimble R-12
Receiver S/N	782
Antenna Height	2.000 m

Date (MM-DD-YYYY)	11-04-2021
RMSE Hz	0.010 m
RMSE Z	0.022 m
GPS Method	RTK

**PHOTOS**



### Surveyor's Certificate

I, Steven J. Hyde, being a Licensed Professional Land Surveyor in the State of Missouri, hereby certify to the best of my professional knowledge and belief that the survey methodologies and results shown on the attached report for the State portion of the report titled Survey Report of Additional LIDAR Calibration & Quality Control Points, USGS Contract: G16PC00016, MO\_WESTCENTRALMISSOURI\_2018\_D19, dated May 13, 2022, were performed and obtained utilizing commonly acceptable survey standards, practices and procedures. The survey portion of this project was accomplished on November 04, 2021.

I have reviewed the accuracy statements as part of my oversight and found them to meet the National Standards for Spatial Accuracy (NSSDA) shown.

  
Steven J. Hyde  
Professional Land Surveyor #2016000164

