

Oregon Department of Forestry NW LiDAR Report of Photo Control Survey

The Purpose of this survey was to establish LiDAR verification control in northwestern Oregon for the Oregon Department of Forestry. As part of this project 21 static control points were established throughout the project area and additional kinematic QA/QC observations were taken on over 12 miles of roadway.

GNSS Control Network

For the purpose of this project both horizontal and vertical control was based on nine (9) continuously operating reference stations (CORS) stations. CORS CATH, LWCK, P408, P409, P411, P414, P446 AND SEAS are part of the Oregon Real Time GPS Network (ORGN). NAD83[2011 Epoch 2010] values were established on the P405 processing and adjusting six (6) days of data to the surrounding ORGN CORS.

Global navigation satellite system (GNSS) observations were made between May 10th and June 12, 2015 utilizing Leica GX1230/AX1202GG and Leica ATX1230GG geodetic GNSS receivers.

The three (3) base stations and photo control station 130 were tied to directly to the four (4) CORS stations as well as multiple ties between adjacent base stations. With the exception of Station 112, the 21 control stations was occupied on at least two (2) distinct times with a minimum planned sidereal shift of two (2) hour between the start of observations. Real-time Kinematic (RTK) GNSS observations utilizing the ORGN were acquired at five (5) the stations, 101, 102, 103, 104 and 108. Static GNSS observation of at least 15 minutes were acquired at the remaining station as well as station 108. With the exception of station 112, each station was tied to at least two (2) base stations. Station 112 was destroyed at some point between scheduled observations.

The resulting data was processed and adjusted with Leica Geo Office (LGO) software Suite. The processed base lines were adjusted by least squares methods. Due to the hostile GNSS environment created by the steep forested canyon walls, not all observations were used in the final adjustment. The absolute accuracy of the 17 static GNSS control points was better than 0.10 feet in any direction horizontally and 0.15 feet vertically with a median horizontally accuracy of better than 0.03 feet horizontally and 0.05 feet vertically at 95% confidence. The four (4) RTK stations fell considerably outside of these values but multiple measurements to these points resulted differences that matched the overall accuracies achieved in the network adjustment. The RTK value for station 108 differs from the static value by 0.02 feet horizontally and vertically.

Photo Control Station 101

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,625,478.89

Easting: 512,256.12

Control Orthometric Elevation: 82.89

Panel Orthometric Elevation: Same

Method: RTK GNSS

Control Description: Nothing

Target Description: Post ID

General Location: Clatsop County, OR

Latitude: 46 10' 00.11247"N

Longitude: 123 39' 26.56093"W

Control Ellipsoid Height: 9.18

Combined Factor: 1.000323782





1724 23rd Avenue | Forest Grove OR 97116
T: 503.359.1688 | www.oriongeomatics.com

Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,625,910.58

Easting: 501,883.05

Control Orthometric Elevation: 30.44

Panel Orthometric Elevation: Same

Method: RTK GNSS

Control Description: Nothing

Target Description: Post ID

General Location: Clatsop County, OR

Photo Control Station 102

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 46 10' 00.40827"N

Longitude: 123 41' 54.01963"W

Control Ellipsoid Height: -43.88

Combined Factor: 1.000326366





1724 23rd Avenue | Forest Grove OR 97116
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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,632,392.27

Easting: 529,884.58

Control Orthometric Elevation: 15.06

Panel Orthometric Elevation: Same

Method: RTK GNSS

Control Description: Set Mag Nail

Target Description: Nothing

General Location: Clatsop County, OR

Photo Control Station 103

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 46 11' 14.90284"N

Longitude: 123 35' 20.04943"W

Control Ellipsoid Height: -57.64

Combined Factor: 1.000339318





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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,648,976.03

Easting: 548,070.44

Control Orthometric Elevation: 13.74

Panel Orthometric Elevation: Same

Method: RTK GNSS

Control Description: Set Mag Nail

Target Description: Nothing

General Location: Clatsop County, OR

Photo Control Station 104

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 46 14' 05.11450"N

Longitude: 123 31' 10.49501"W

Control Ellipsoid Height: -57.94

Combined Factor: 1.000367926





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T: 503.359.1688 | www.oriongeomatics.com

Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,590,890.59

Easting: 500,744.29

Control Orthometric Elevation: 259.55

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Set Mag Nail

Target Description: Painted X

General Location: Clatsop County, OR

Photo Control Station 105

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 46 04' 14.62687"N

Longitude: 123 41' 50.81557"W

Control Ellipsoid Height: 186.33

Combined Factor: 1.000260067





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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,579,692.92

Easting: 512,925.62

Control Orthometric Elevation: 897.78

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Set Nail

Target Description: Painted Y

General Location: Clatsop County, OR

Photo Control Station 106

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 46 02' 28.84088"N

Longitude: 123 38' 52.13226"W

Control Ellipsoid Height: 825.67

Combined Factor: 1.000213176





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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,573,655.38

Easting: 583,530.48

Control Orthometric Elevation: 566.66

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Nothing

Target Description: Post ID

General Location: Clatsop County, OR

Photo Control Station 107

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 46 01' 54.82181"N

Longitude: 123 22' 09.12966"W

Control Ellipsoid Height: 496.94

Combined Factor: 1.000223689





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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,617,222.12

Easting: 531,266.84

Control Orthometric Elevation: 136.03

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Set Mag Nail

Target Description: Painted X

General Location: Clatsop County, OR

Photo Control Station 108

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 46 08' 45.81490"N

Longitude: 123 34' 52.33632"W

Control Ellipsoid Height: 63.84

Combined Factor: 1.000309043





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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,533,463.28

Easting: 467,879.68

Control Orthometric Elevation: 250.49

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Set Mag Nail

Target Description: Painted X

General Location: Clatsop County, OR

Photo Control Station 109

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 45 54' 35.41392"N

Longitude: 123 49' 03.54195"W

Control Ellipsoid Height: 177.24

Combined Factor: 1.000174369





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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,481,167.12

Easting: 514,045.99

Control Orthometric Elevation: 295.39

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Nothing

Target Description: Post ID

General Location: Tillamook County, OR

Photo Control Station 110

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 45 46' 17.49320"N

Longitude: 123 37' 43.07071"W

Control Ellipsoid Height: 226.59

Combined Factor: 1.000104447





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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,514,909.79

Easting: 593,789.46

Control Orthometric Elevation: 777.61

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Set Mag Nail

Target Description: Painted X

General Location: Columbia County, OR

Photo Control Station 111

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 45 52' 18.85841"N

Longitude: 123 19' 15.25345"W

Control Ellipsoid Height: 708.52

Combined Factor: 1.000129855



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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,488,609.92

Easting: 598,149.24

Control Orthometric Elevation: 723.50

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Set Nail

Target Description: Cloth X

General Location: Columbia County, OR

Photo Control Station 112

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 45 48' 00.88295"N

Longitude: 123 18' 01.01206"W

Control Ellipsoid Height: 654.42

Combined Factor: 1.000097540





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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,485,898.66

Easting: 576,295.19

Control Orthometric Elevation: 1,429.04

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Set Mag Nail

Target Description: Nothing

General Location: Clatsop County, OR

Photo Control Station 113

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 45 47' 26.66789"N

Longitude: 123 23' 07.89548"W

Control Ellipsoid Height: 1,361.04

Combined Factor: 1.000059269





1724 23rd Avenue | Forest Grove OR 97116
T: 503.359.1688 | www.oriongeomatics.com

Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,454,565.55

Easting: 567,069.85

Control Orthometric Elevation: 1,865.60

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Set Mag Nail

Target Description: Nothing

General Location: Washington County, OR

Photo Control Station 114

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 45 42' 14.34316"N

Longitude: 123 25' 02.27967"W

Control Ellipsoid Height: 1,798.27

Combined Factor: 0.999998533





1724 23rd Avenue | Forest Grove OR 97116
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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,495,729.69

Easting: 688,770.57

Control Orthometric Elevation: 553.65

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Set Mag Nail

Target Description: Post ID

General Location: Columbia County, OR

Photo Control Station 115

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 45 49' 39.70033"N

Longitude: 122 56' 45.66267"W

Control Ellipsoid Height: 480.93

Combined Factor: 1.000119009





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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,511,328.78

Easting: 705,563.11

Control Orthometric Elevation: 382.46

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Nothing

Target Description: Post ID

General Location: Columbia County, OR

Photo Control Station 116

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

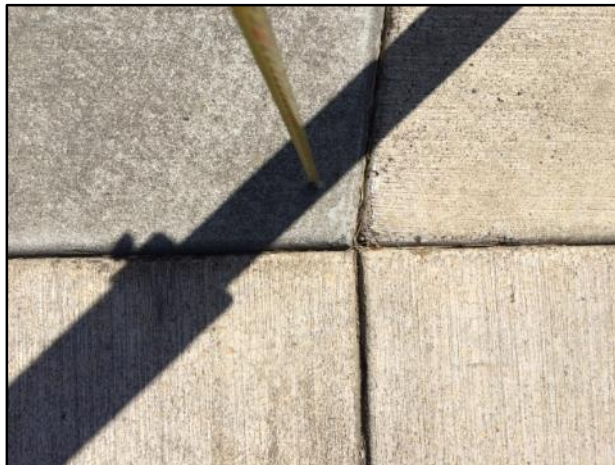
Project No.: 2015-012

Latitude: 45 52' 18.48055"N

Longitude: 122 52' 55.05102"W

Control Ellipsoid Height: 309.63

Combined Factor: 1.000148865





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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,573,749.29

Easting: 690,926.38

Control Orthometric Elevation: 607.57

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Set Mag Nail

Target Description: Nothing

General Location: Columbia County, OR

Photo Control Station 117

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 46 02' 30.05561"N

Longitude: 122 56' 48.05988"W

Control Ellipsoid Height: 536.51

Combined Factor: 1.000227180





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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,575,118.99

Easting: 652,162.42

Control Orthometric Elevation: 316.96

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Set Mag Nail

Target Description: Nothing

General Location: Columbia County, OR

Photo Control Station 118

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 46 02' 31.81266"N

Longitude: 123 05' 57.77092"W

Control Ellipsoid Height: 246.97

Combined Factor: 1.000241287





1724 23rd Avenue | Forest Grove OR 97116
T: 503.359.1688 | www.oriongeomatics.com

Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,540,785.41

Easting: 679,926.81

Control Orthometric Elevation: 905.31

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Set Mag Nail

Target Description: Nothing

General Location: Columbia County, OR

Photo Control Station 119

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 45 57' 01.59799"N

Longitude: 122 59' 09.73336"W

Control Ellipsoid Height: 833.77

Combined Factor: 1.000163967





1724 23rd Avenue | Forest Grove OR 97116
T: 503.359.1688 | www.oriongeomatics.com

Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,520,848.59

Easting: 648,179.90

Control Orthometric Elevation: 1,296.47

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Set Nail

Target Description: Cloth X

General Location: Columbia County, OR

Photo Control Station 120

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 45 53' 35.19217"N

Longitude: 123 06' 29.75423"W

Control Ellipsoid Height: 1,225.39

Combined Factor: 1.000115793





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Date: August 10, 2015

Project: Oregon Dept. of Forestry NW LIDAR

Northing: 1,463,179.35

Easting: 528,317.44

Control Orthometric Elevation: 506.41

Panel Orthometric Elevation: Same

Method: Static GNSS

Control Description: Set Hub

Target Description: Nothing

General Location: Tillamook County, OR

Photo Control Station 121

Horizontal Datum: NAD83[2011 epoch 2010]

Vertical Datum: NAVD88

Geoid Model: Geoid 2012A

Coordinate System: Oregon GIS

Units: International Feet

Project No.: 2015-012

Latitude: 45 43' 25.37290"N

Longitude: 123 34' 12.41868"W

Control Ellipsoid Height: 438.76

Combined Factor: 1.000072344

