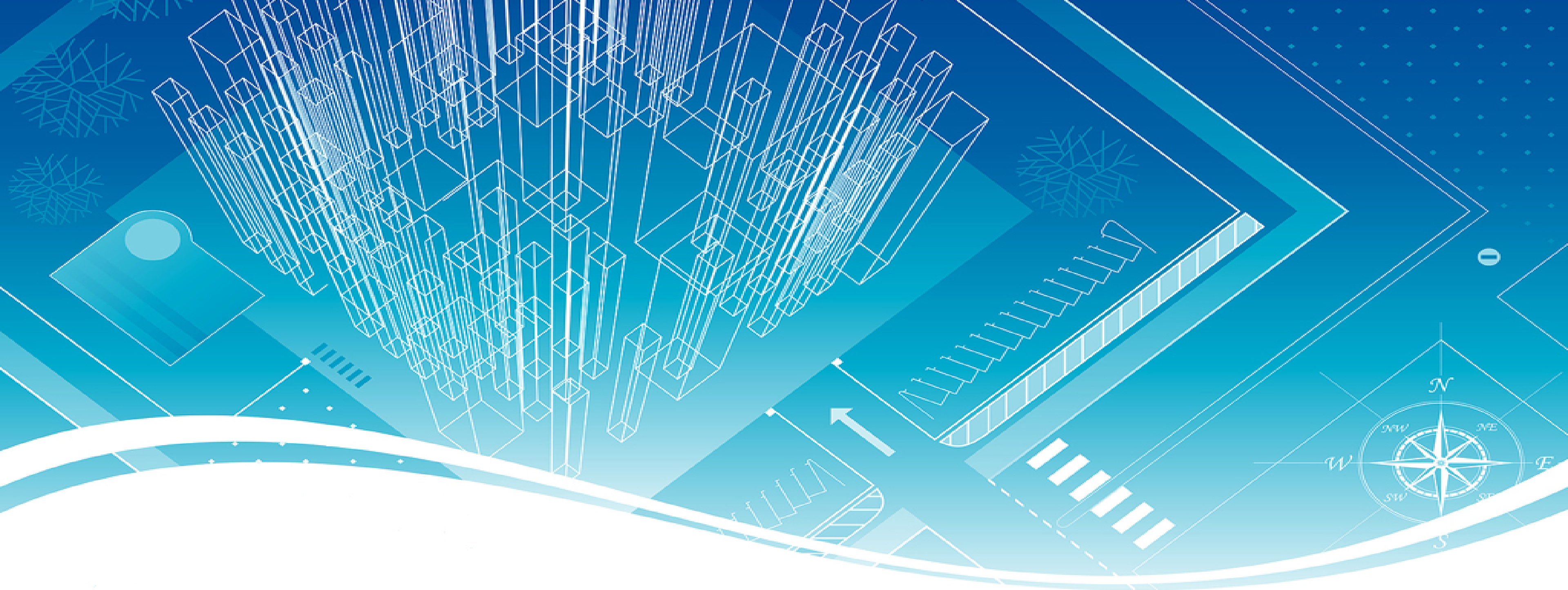

High-Accuracy Data Collection with Collector: Is MSL possible?

Tiffany Puett, GISP

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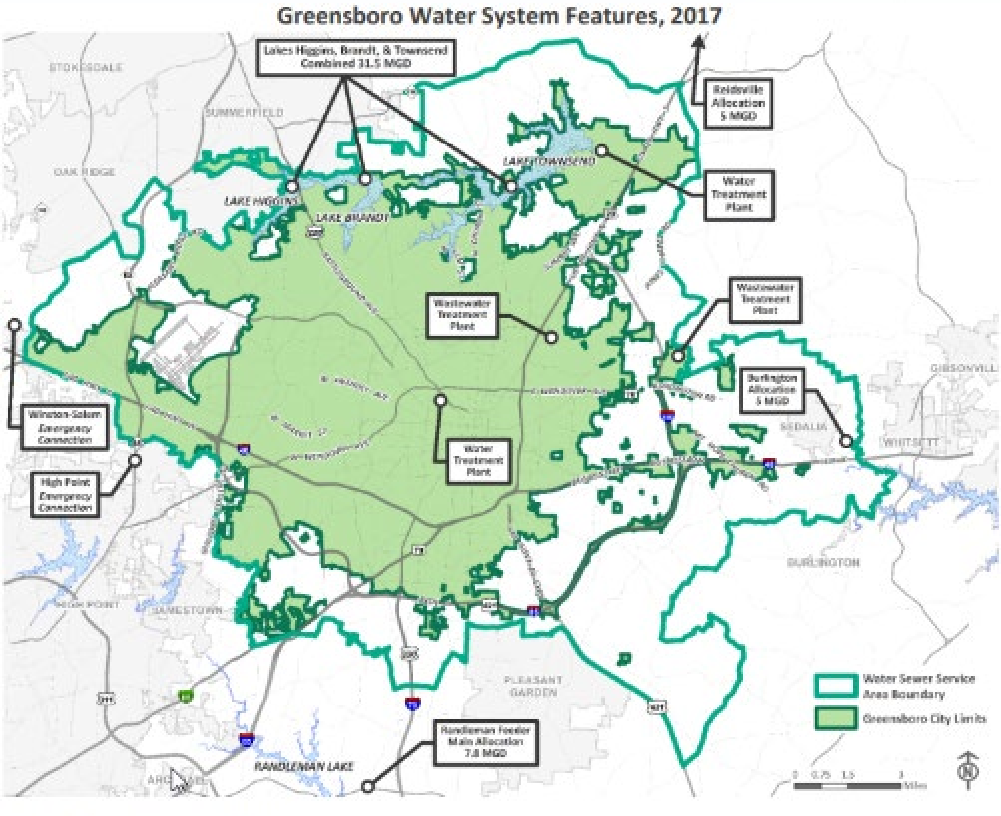
Background: MSL

City of Greensboro Water Resources Case Study

- Need for high-accuracy MSL data collection
- Shift away from older software
- Less dependencies on custom code
- ArcGIS Pro

The City of Greensboro - Water Resources GIS Facts



Source: City of Greensboro, Water Resources

Water

- 1826 Miles of water lines (40+ yr)

Sewer

- 105 Lift Stations (avg age 38+ yr)
- 40,514 Manholes (avg age 46+ yr)
- 1647 Miles of Sewer lines

Stormwater

- 13,382 Manholes
- 42,096 Inlets
- 1915 Miles (Pipes, Channels,Culverts, & Swales)

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The City of Greensboro - Water Resources GIS Facts

- Invest $50 million/yr on system improvements
- Customers generally pay less than top 10 cities
- 254 Sq miles of territory

Municipality	Average Monthly Cost Residential Water/Sewer
Cary	$70.54
High Point	$68.00
Wilmington - Cape Fear Public Utility Authority	$64.49
Raleigh	$62.99
Greenville	$59.13
Charlotte	$54.44
Durham	$54.38
Fayetteville	$54.13
Winston-Salem	$43.39
Greensboro	$42.39

Source: City of Greensboro Water Resources

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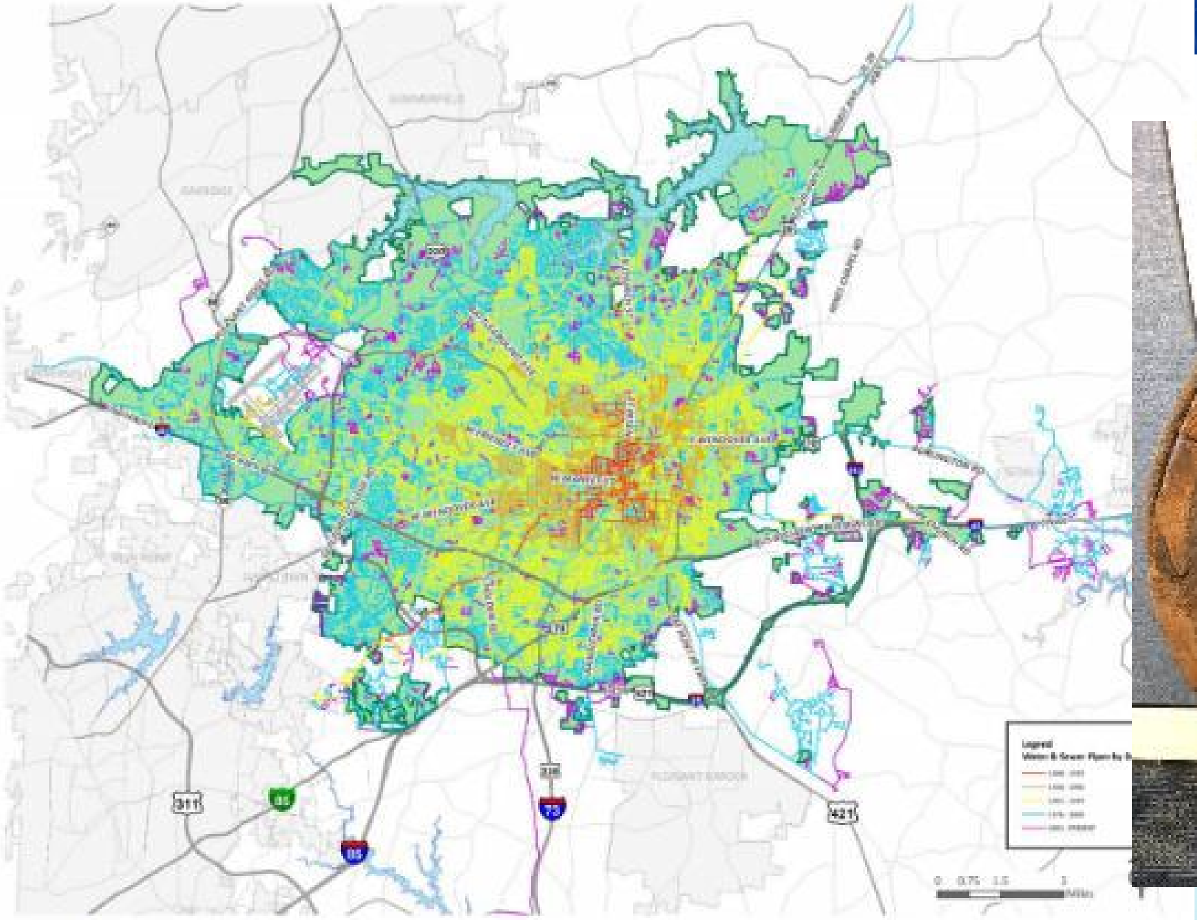
Aging systems

Location and Age of Water and Sewer Pipes, 2017



Source: City of Greensboro, Water Resources

Location, location, location

Existing Development Challenges

Greensboro Coliseum

Storm

- 60 manholes
- 165 inlets
- 248 pipes

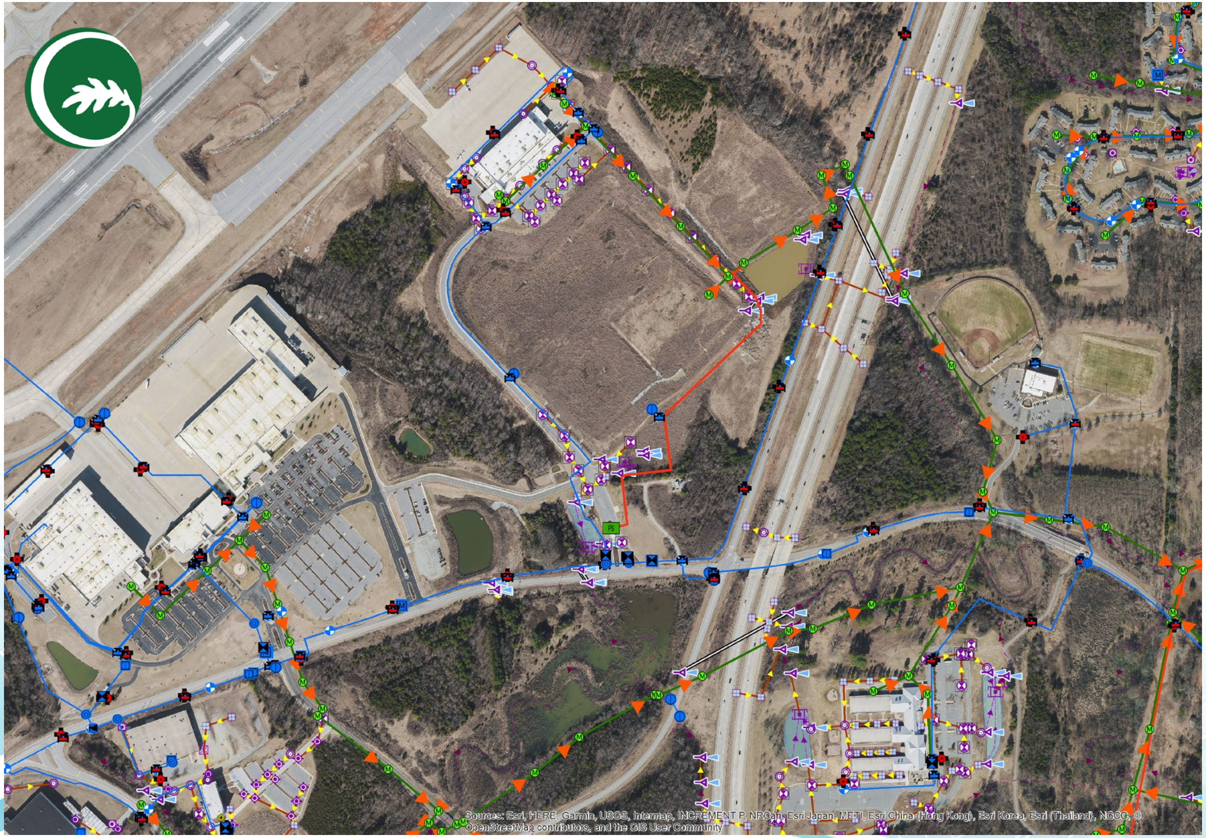
Sewer

- 41 manholes
- 44 gravity mains
- 92 force mains
- 9 cleanouts

Water

- 56 fittings
- 15 hydrants
- 56 valves

Economic Development/Expansion Challenges

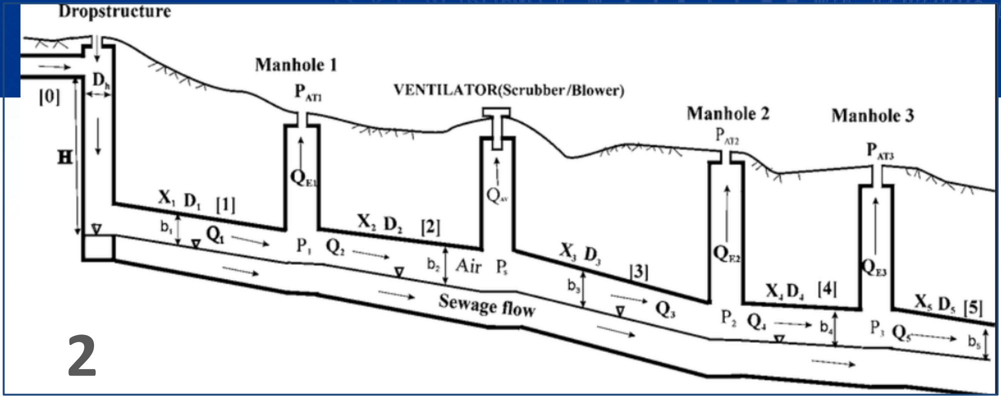


- City grants permits under certain requirements
- Examples: Apartment complexes, manufacturing, population hubs, etc
- Models must be correct!

XYZ: Why?

1

2



- Need for high-accuracy models
- Modeling delivers accurate information for sizing, flow, capacity
- Elevation diagram: RIM elevation!
- All other elevations calculated

- High potential for utility conflicts
- Limited, narrow, congested ROWs
- Deeper installations with less detectible materials
- Inaccurate documentation/information
- Increasingly tight project schedules

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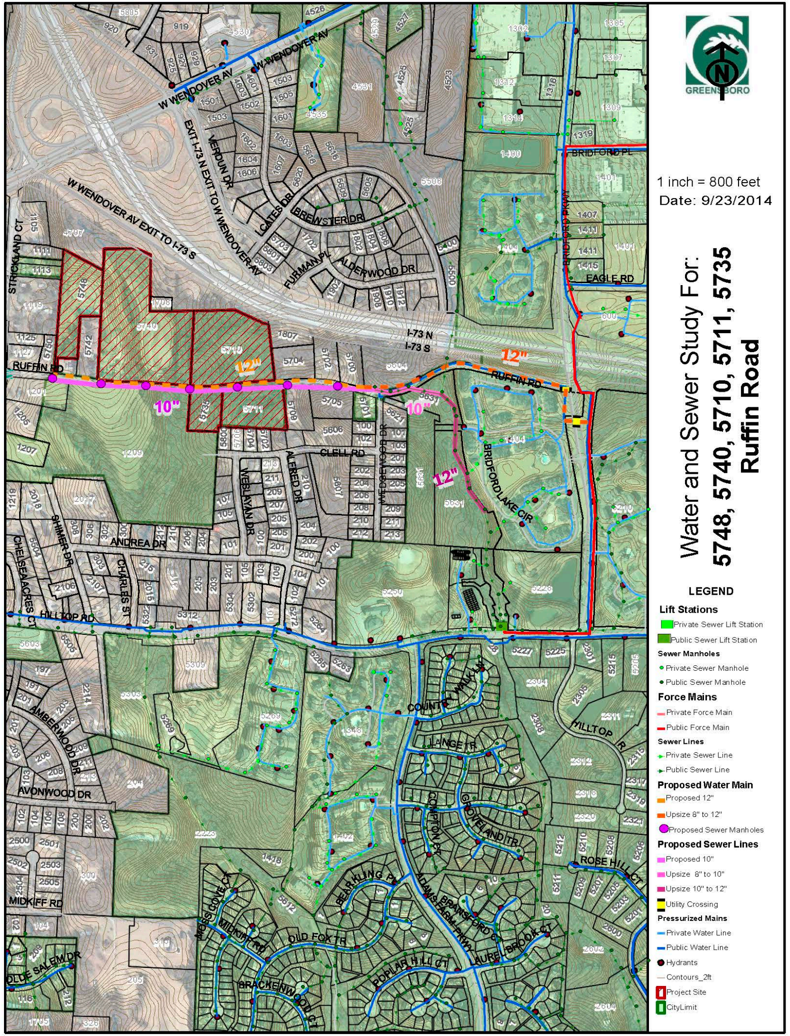
Feasibility Study 2014



- EPA violations are costly
- Lots of associated paperwork
- Prevention is key!!

Earlier Methods…

Trimble Business Center (survey-grade)

- x,y,z collection
- Job Creation on the fly
- Check-in workflow then loading to SDE
- Slow/inefficient

Esri's Collector

- Edits in real-time/fast
- X & Y
- Submeter & CM receiver
- No Geoid/MSL

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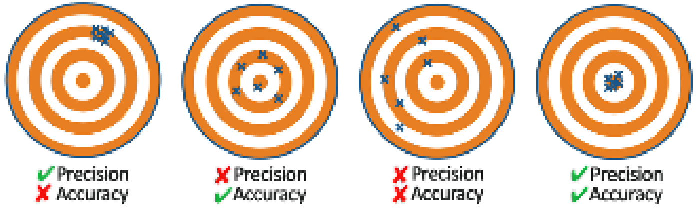
GNSS Field Data Collection Overview

GNSS – Global Navigation Satellite System

Combination of regional satellite systems



GPS-USA

GLONASS-Russia

Galileo-Europe

BeiDou-China

- Trend toward Bring Your Own Device (BYOD)
- Smaller devices, lower cost, higher accuracy & precision
- Shift toward real-time corrections vs post-processing
- Increased need for elevation data

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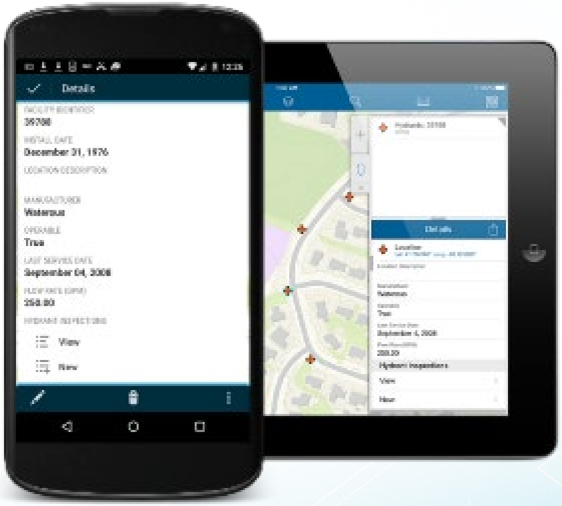
Collector for ArcGIS Benefits

- Support for High-Accuracy GNSS receivers
- Low-cost deployment
- Fully-hosted or server-based feature services
- Fully-supported
- Scalable



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Elevation in Feature Collection

- Elevation is relative
- Good elevation data necessary to represent the system in a GIS
- Fluid flows downhill (gravity)
- Elevation data paired with good topology allows for modeling of a utility network
- 3D analyst requires proper Z values

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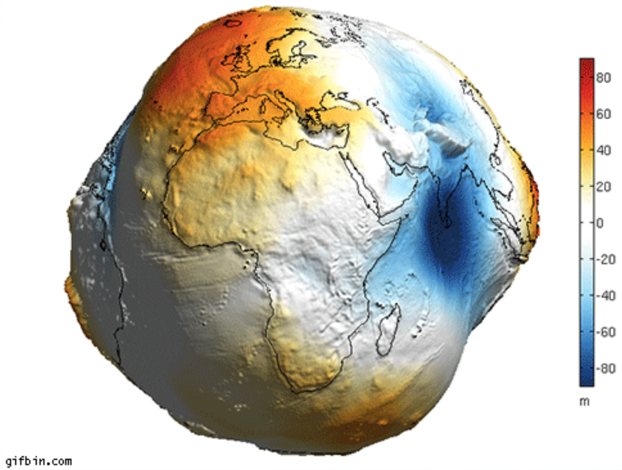
HAE vs MSL

GNSS receivers work on WGS 84

- Raw GNSS elevation measured with respect to ellipsoid, **height above ellipsoid (HAE)**
- The earth is not perfectly "oval."
- An ellipsoid is a mathematical representation of the earth's surface, think oval

Geoid: Orthometric Height=MSL

- Geoid: model of the earth that best fits global Mean Sea Level (MSL)
- Locally calculated (current vertical datum in US: NAVD88)
- **Orthometric height** is for practical purposes "height above sea level"
- MSL=Ellipsoid height - Geoid height



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Collector: No Ortho Heights

Post from GeoNet on 10/8/2014 and most recent comments

Collect Z values (elevation) using Collector App

Idea created by cfeizollahi on Oct 8, 2014

Comment • 11

Reviewed

SCORE
570

57 VOTES UP   0 VOTES DOWN

+48 MORE

In "Geometry Properties", it would be nice to collect Z values whiles using cloud services to store elevation for 3D data. Especially in regards to utilities data collection.

TDB_Consultants_Inc
Mar 15, 2018 11:47 AM

Is it still impossible to collect altitude information within line geometries? Or has this change been implemented? if so, how can we collect altitude information within line geometries? Collector for ArcGIS

Actions   Like • 0

Jessyemert
Apr 4, 2018 8:54 AM

This would be a absolute game changer for underground utilities collection. Especially with the integration of high accuracy receivers (such as the Trimble R2) being paired with Collector.

Actions   Like • 2

EatonCountySS
Apr 30, 2018 12:55 PM

The two biggest shortcomings of using Collector are that it doesn't do elevation or snapping. Considering ancient stuff like arcpad does these just fine, it's a real head-scratcher.

Actions   Like • 0

Esri is Listening!

Major Collector Update

Enhancements to High Accuracy 3D Data Collection

As part of this project, Collector is adding support for direct capture of 3D data. In addition, vertical datum transformations will allow you to transform elevations on the fly, eliminating office workflows usually required to achieve accurate elevations.

Released Q4 of 2018 (iOS)

*Support for High Accuracy 3D Data Collection **NOT CORE** in first release

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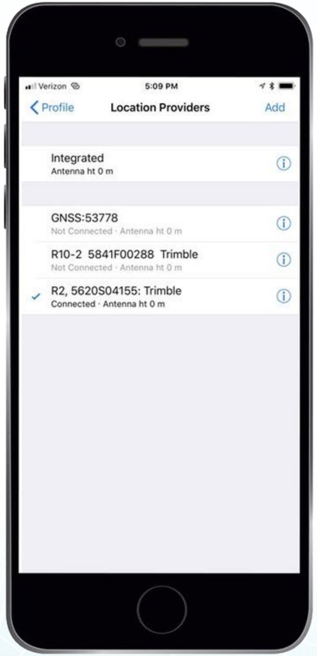
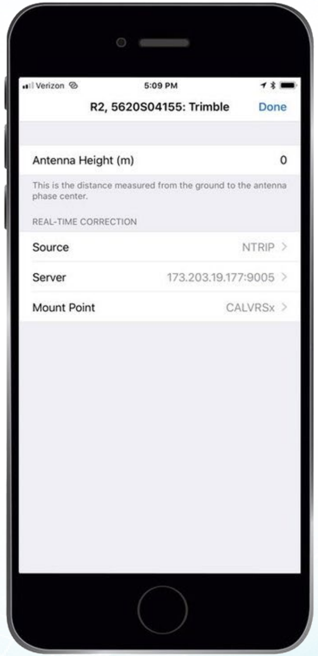
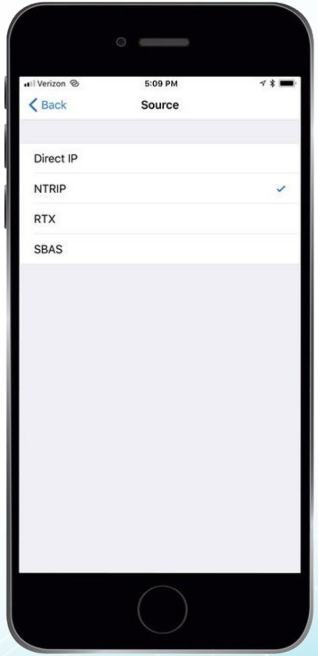
GNSS & Collector Integration

- In app configuration
- Mount points
- Nominal phase







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Manually Speaking…

- Manual 9-step process
- Requires attribute containing HAE values
- Includes multiple datum transformations (horizontal & vertical)
- Output is Z-enabled feature layer (with MSL)

**Duncan-Parnell has only tested in ArcGIS Pro at this time*

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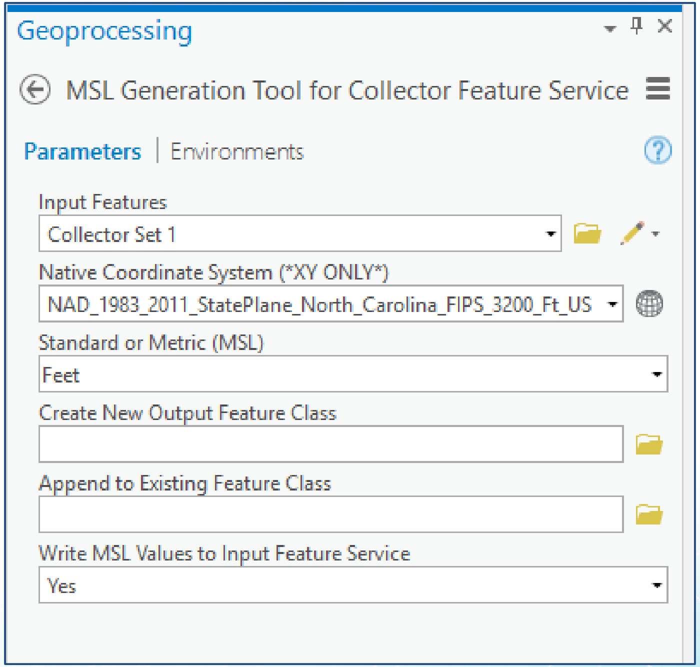
Duncan-Parnell’s Custom MSL Tool

- Automate Processes
- Multiple output options
- Available for ArcGIS Pro
- Supports Hosted Feature Services, Feature classes, SDE
- Flexibility
- Deployed in 5 organizations



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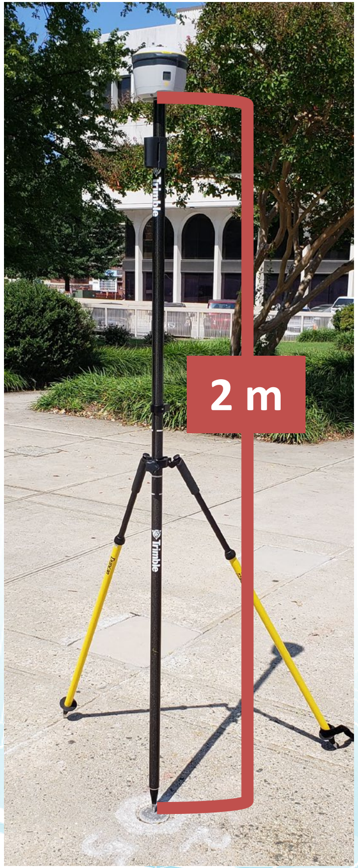
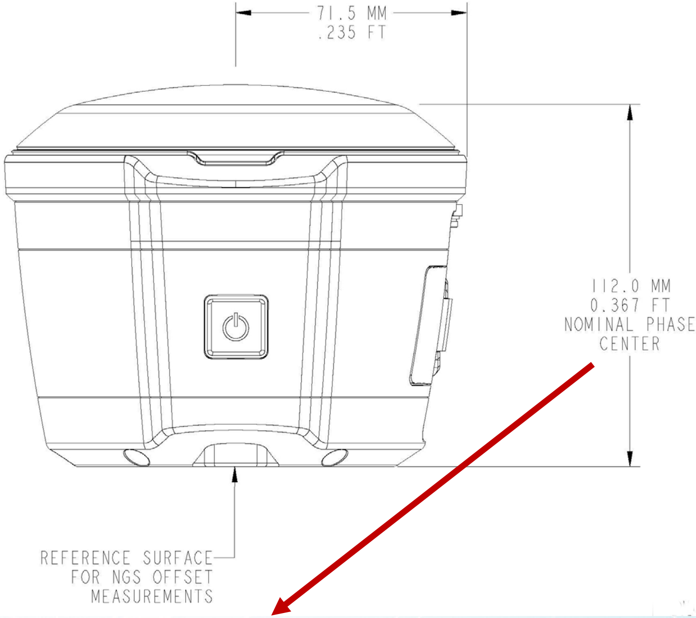
Field Testing – Lessons learned

- Fixed pole height
- Nominal Phase (Collector Classic)
- Obstruction & Multipath
- Location Profile
- Units of measure





Classic Collector Antenna Height:
2.112 meters
6.929 feet

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Field Testing - Results

- 35 points collected on 17 Geodetic Monuments
- Greensboro, Charlotte, Gastonia, Concord
- R2 CM with NC VRS
- Estimated Avg Horizontal Accuracy **1.46cm**
- Estimated Avg Vertical Accuracy **2.45cm**
- **Measured Avg Vertical Accuracy 2.35cm**

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Custom MSL Tool

TOOL DEMO

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Demo Monument

```
= datasheet95, VERSION = 8.12.5.2
 National Geodetic Survey,   Retrieval Date = FEBRUARY 27, 2019
***********************************************************************
 HT_MOD        -  This is a Height Modernization Survey Station.
 DESIGNATION -  BELMONT
 PID           -  DG4172
 STATE/COUNTY-  NC/GASTON
 COUNTRY       -  US
 USGS QUAD     -  MOUNT HOLLY (1993)

                        *CURRENT SURVEY CONTROL
 ______________________________________________________________________
 NAD 83(2011) POSITION- 35 15 06.02279(N) 081 02 58.18011(W)   ADJUSTED
 NAD 83(2011) ELLIP HT-   178.196 (meters)        (06/27/12)   ADJUSTED
 NAD 83(2011) EPOCH   -   2010.00
 NAVD 88 ORTHO HEIGHT -    209.12  (meters)      686.1    (feet) GPS OBS
 ______________________________________________________________________
 NAVD 88 orthometric height was determined with geoid model     GEOID99
 GEOID HEIGHT    -         -30.948 (meters)                     GEOID99
 GEOID HEIGHT    -         -30.923 (meters)                     GEOID12B
 NAD 83(2011) X  -     811,279.285 (meters)                     COMP
```

Point Information:

Ortho Height: 686.1ft

Ellip Height: 584.63 ft

**CM Trimble R2 (NCVRS)*

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Questions?

Tiffany Puett, GISP
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tiffany.puett@duncan.parnell.com