GIS-Generated Street Tree Inventory Pilot Study

Prepared for:

MSGIC Meeting

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21 July 2017

Agenda

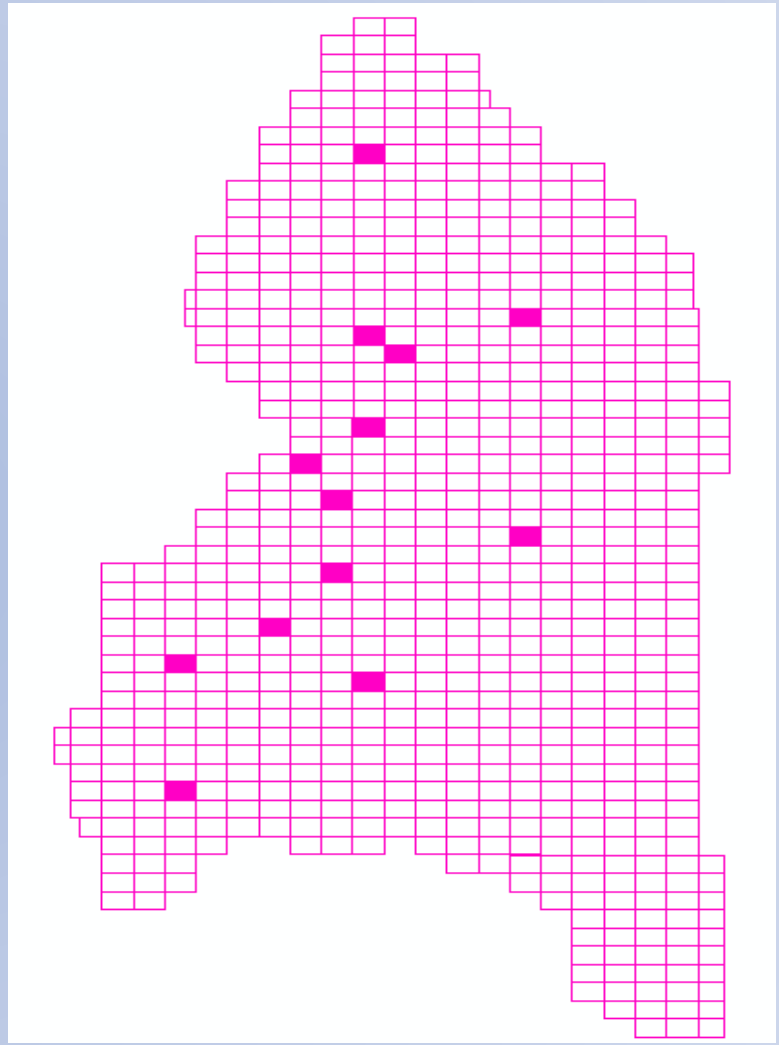
- Purpose of Street Tree Inventory Pilot Study
- Evaluation of Methods to Collect Inventory
- Creation of the LiDAR Model
- Field Verification of Findings
- Regression Model for Accuracy
- Results/Conclusion
- Next Steps

Purpose of Inventory

- Prince George's County Department of Public Works and Transportation, Office of Highway Maintenance Responsible for Trees in Right of Way
  - Operations and Budget Planning
  - Tree Replacement Programs – Right Tree Right Place
  - Stormwater Credit
  - Assist in Planning for Field-Verified Tree Inventory by Arborist

Methods for Collecting Inventory

- Canopy of the ROW
- Heads Up Digitizing from Aerial Image
- LiDAR Model



Canopy of the ROW

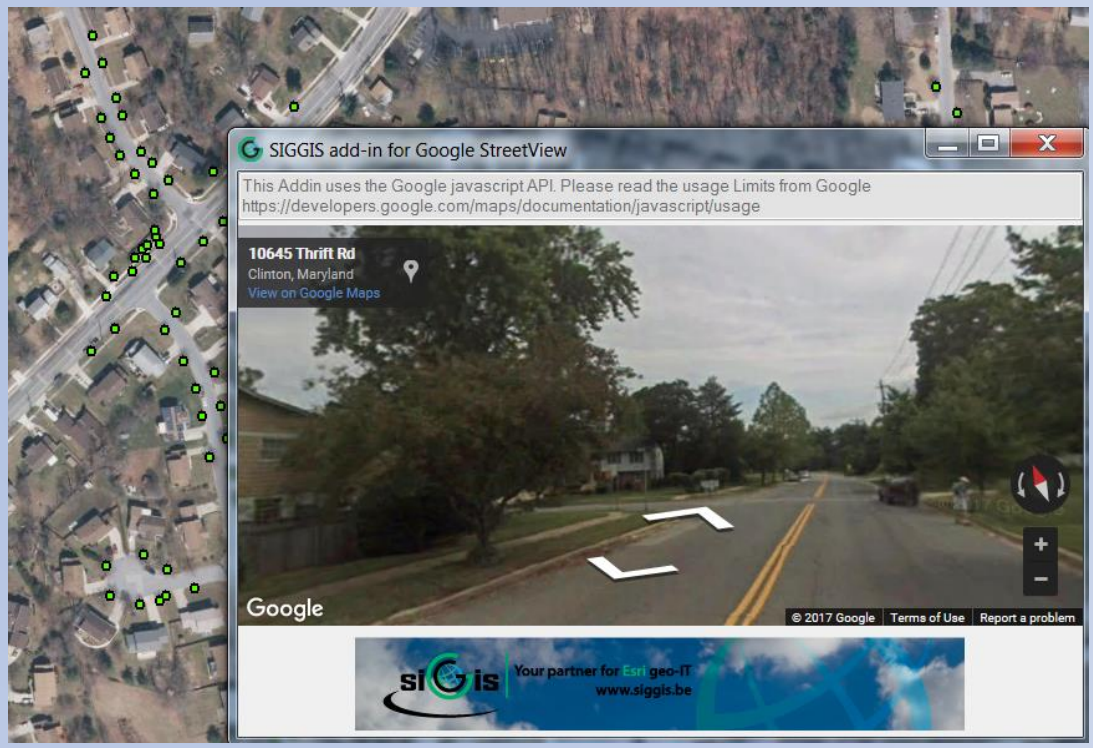
Canopy of the ROW

Canopy of the ROW

- Insufficient Results
- Explored other Options
  - Heads Up Digitizing
  - LiDAR Model
  - Field Verification

Heads Up Digitizing

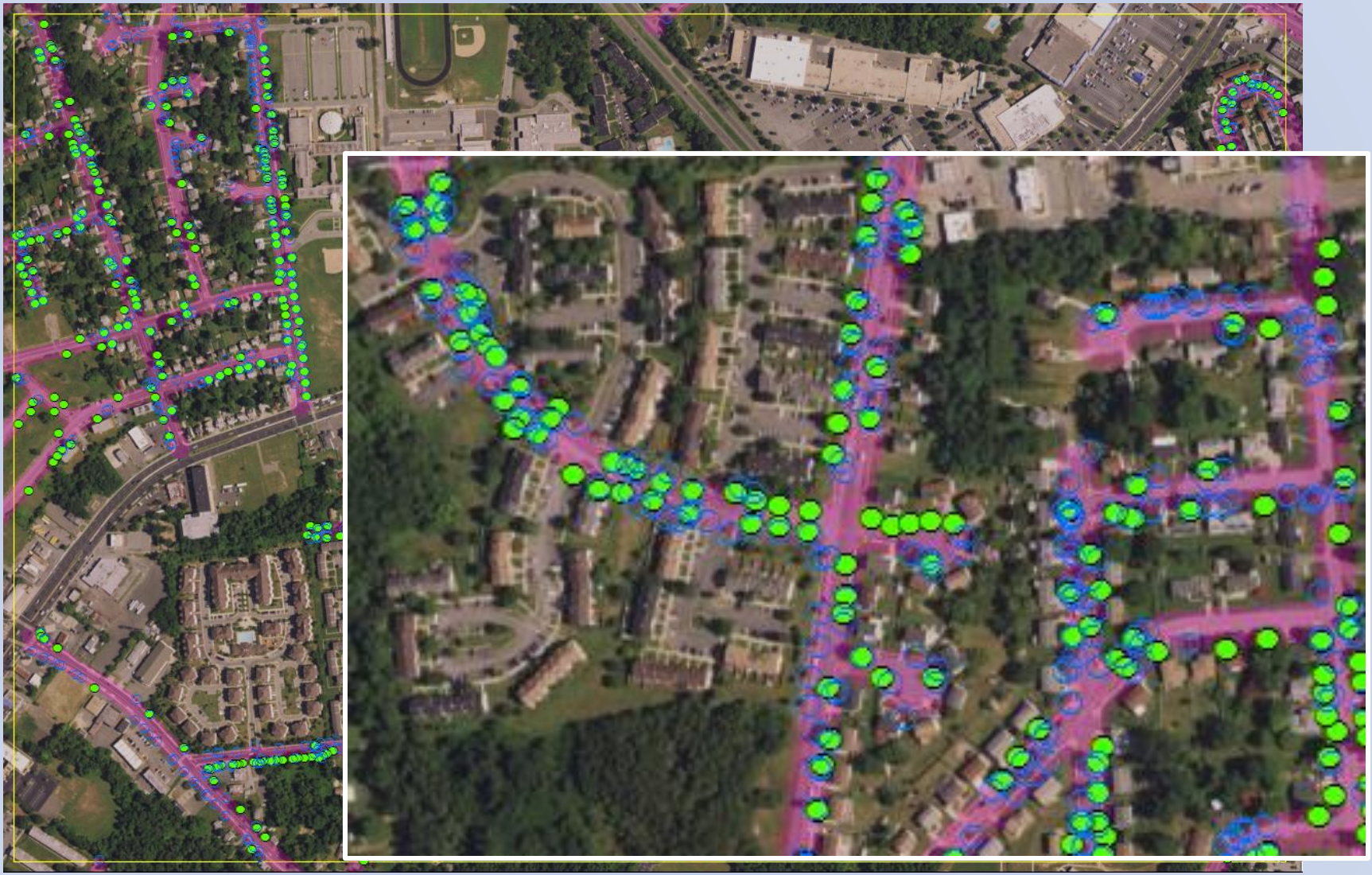
- Heads Up Digitized 13 Grids
- ArcMap – Placing a Point on Every Tree in the ROW
- Imagery
  - NAIP: 2015
  - USGUS EROS: 2014
  - Street View



Heads Up Digitizing

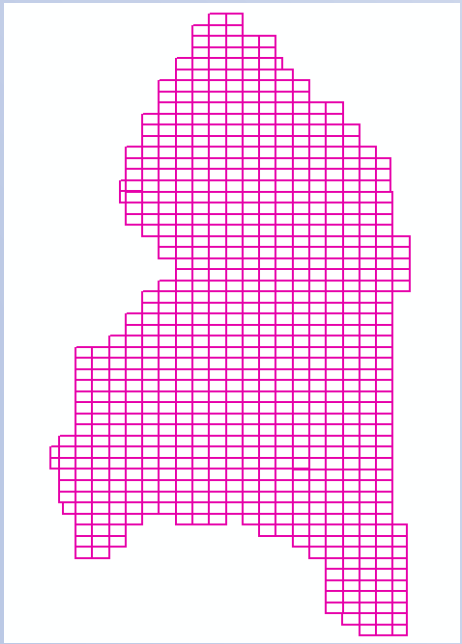
LiDAR

Heads Up Digitized Vs. LiDAR



Preparing LiDAR and Ensuring Data Integrity

- Received 2014 Classified LiDAR (Leaf Off)
  - Unassigned
  - Ground
  - Noise
- 3D Sampling Tools (Esri Toolbox for Managing LiDAR Data)
  - Check LAS-Examine LAS Files for Errors (Data Integrity)
    - 747 Files Processed
    - 0 Problem Files Detected
  - LAS File Extent As Polygon
    - Footprint (747) to Create Grids
  - Create LAS Datasets
    - Coordinate System
    - Compute Statistics
- LAS Dataset statistics
  - Point Count
  - Point Spacing (Approximately 2ft)
  - Z-min
  - Z-max



Check_LAS_Log - Notepad

File Edit Format View Help

```
Esri CheckLAS (v1.0.1) Report
=============================================

Input:                  E:\PG LAS 2014\Classified
Output:                 E:\PG LAS 2014\Classified\Check_LAS_Log.txt
Sub-folders:            NO
Scan points:            NO

Start time:             07:50:50 (2017/04/25)
Elapsed time:           17.400 seconds.

Files Processed:        747
Points scanned:         0
Problem files detected: 0
=============================================
```

NAIP Imagery

- National Agriculture Imagery Program (NAIP) Imagery
  - ArcGIS Online
  - 4 Band Imagery
  - High Resolution 1m or Better
  - 2010-2015 Imagery
  - Color Infrared (CIR)
  - Healthy Vegetation is Red

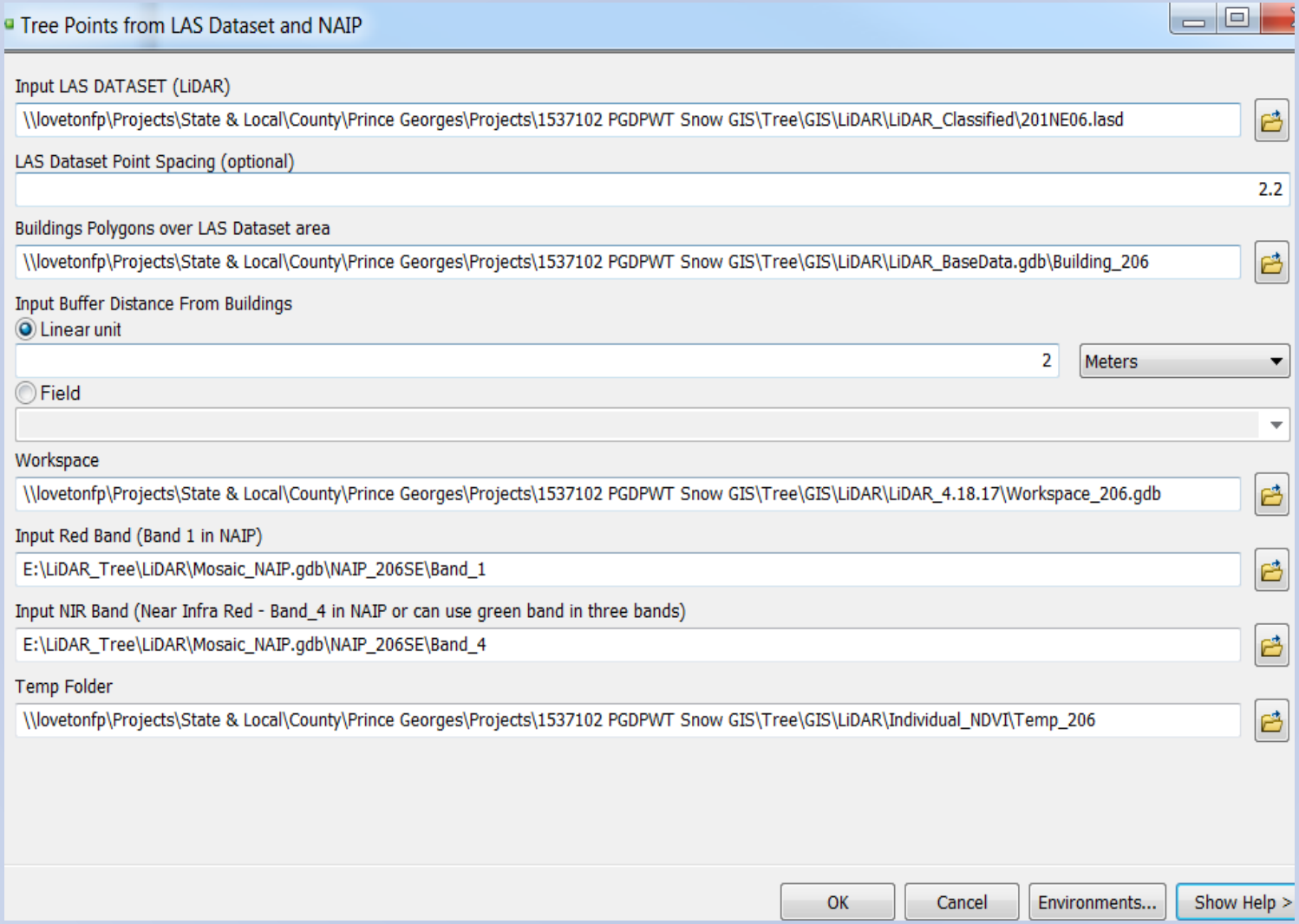
LiDAR Model

- Trees from LiDAR Tool Created September 11, 2015 by Esri modified by EA
- Model Parameters
  - LAS Dataset
  - Z Image (Raster)
  - Building Feature Class
  - NAIP Imagery
- LAS Dataset
  - Convert LAS Point Statistics to Raster
- Z Image
  - Creates Z Range: Distance Between First and Last Return of the LiDAR
  - Sinks Z Range: Sinks with a Negated Z Range are the High Points
  - Flow Accumulation: Amount of Pixels that Flow into the Sinks Determines Diameter/Radius
  - Raster to Polygon
  - Feature to Point
  - Slope
  - Focal statistics
  - Z Range Slope
  - Add Slope to Points (Suggest if it is a high point)

LiDAR Model

- Building Feature Class (2014)
  - Insert Buffer Distance from Building (6ft)
  - Use Feature to Point from to Erase Points within Buffer
  - Export All High Points to Workspace Geodatabase
- NAIP Imagery
  - Input Red Band and Near Infrared Band
    - Red Band: Plus NDVI
    - Near Infrared: Minus NDVI
  - Output NDVI Raster
  - Add Vegetation to High Points
  - Extract High Points with Vegetation (Trees!)
- Intersect Tree Feature Class with County ROW Feature Class Points

LiDAR Model

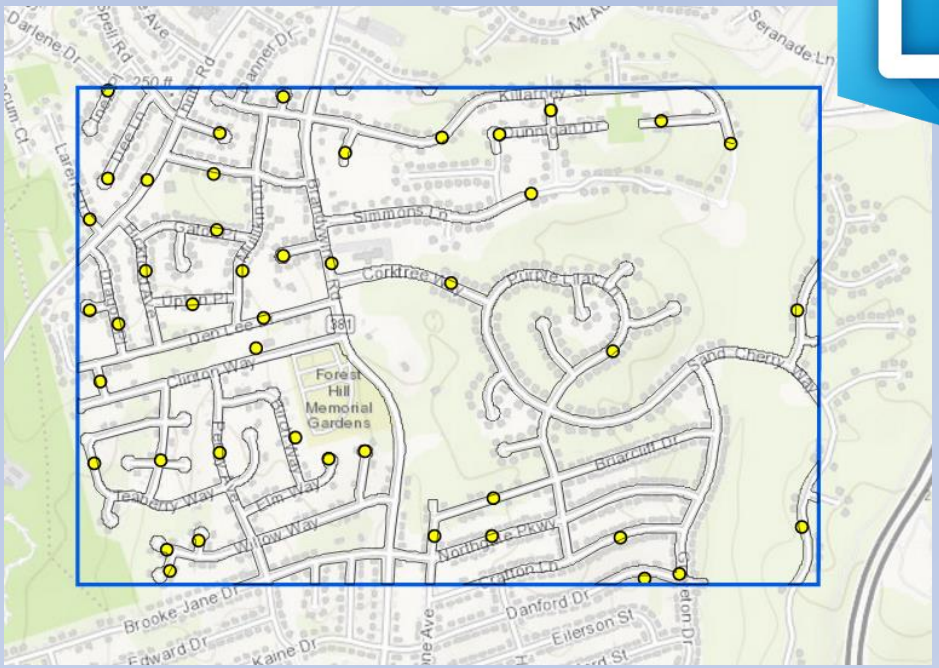

Tree Points from LAS Dataset and NAIP
Input LAS DATASET (LiDAR)
\\lovetonfp\Projects\State & Local\County\Prince Georges\Projects\1537102 PGDPWT Snow GIS\Tree\GIS\LiDAR\LiDAR_Classified\201NE06.lasd
LAS Dataset Point Spacing (optional)
2.2
Buildings Polygons over LAS Dataset area
\\lovetonfp\Projects\State & Local\County\Prince Georges\Projects\1537102 PGDPWT Snow GIS\Tree\GIS\LiDAR\LiDAR_BaseData.gdb\Building_206
Input Buffer Distance From Buildings
Linear unit
2
Meters
Field
Workspace
\\lovetonfp\Projects\State & Local\County\Prince Georges\Projects\1537102 PGDPWT Snow GIS\Tree\GIS\LiDAR\LiDAR_4.18.17\Workspace_206.gdb
Input Red Band (Band 1 in NAIP)
E:\LiDAR_Tree\LiDAR\Mosaic_NAIP.gdb\NAIP_206SE\Band_1
Input NIR Band (Near Infra Red - Band_4 in NAIP or can use green band in three bands)
E:\LiDAR_Tree\LiDAR\Mosaic_NAIP.gdb\NAIP_206SE\Band_4
Temp Folder
\\lovetonfp\Projects\State & Local\County\Prince Georges\Projects\1537102 PGDPWT Snow GIS\Tree\GIS\LiDAR\Individual_NDVI\Temp_206
OK
Cancel
Environments...
Show Help >

Key Considerations and Lessons Learned

- Z Range: Distance Between the First and Last Return of the LiDAR
- DEM Created from LAS to Show How High Things are when LiDAR can Pass Through
- NAIP Imagery with NDVI, Height, and Slop to Determine if Point is Tree
- Canopy Layer can be Created
- LAS Files
  - Point Spacing Must be Correct
- Buffer the Buildings
  - Buffer Current Feature Class at Least 6ft
- Extract NAIP Imagery by Mask using Footprints
  - Must be 4-Band Imagery
- Local Computer Vs. Server
- Ensure All Necessary Licenses are Acquired

Field Verification

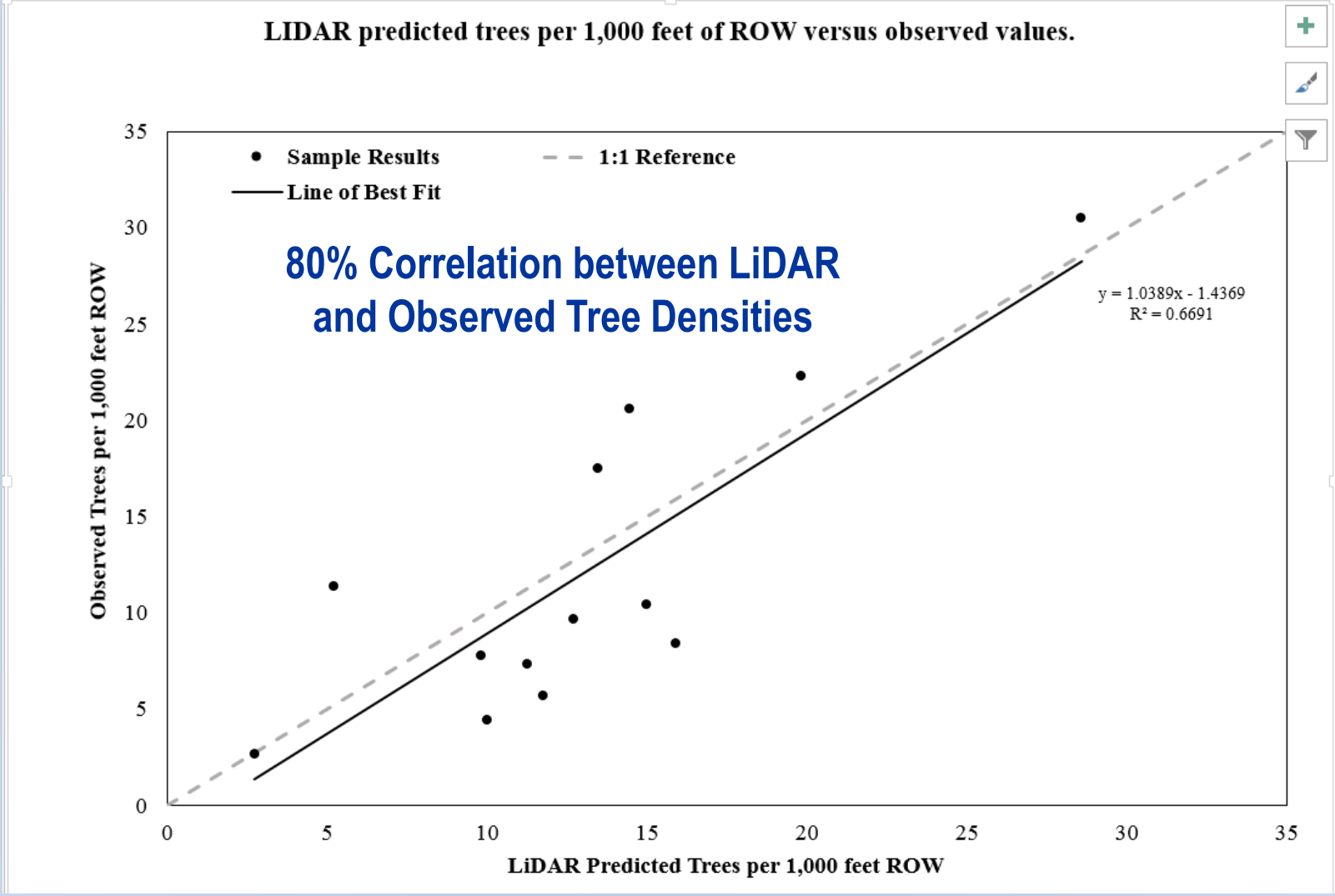
- Field Verified 13 Grids
- ArcGIS Collector App – Count Every Tree in the ROW
  - County ROW Feature Class
  - 13 Grids Created from the LiDAR
  - Point Feature Class



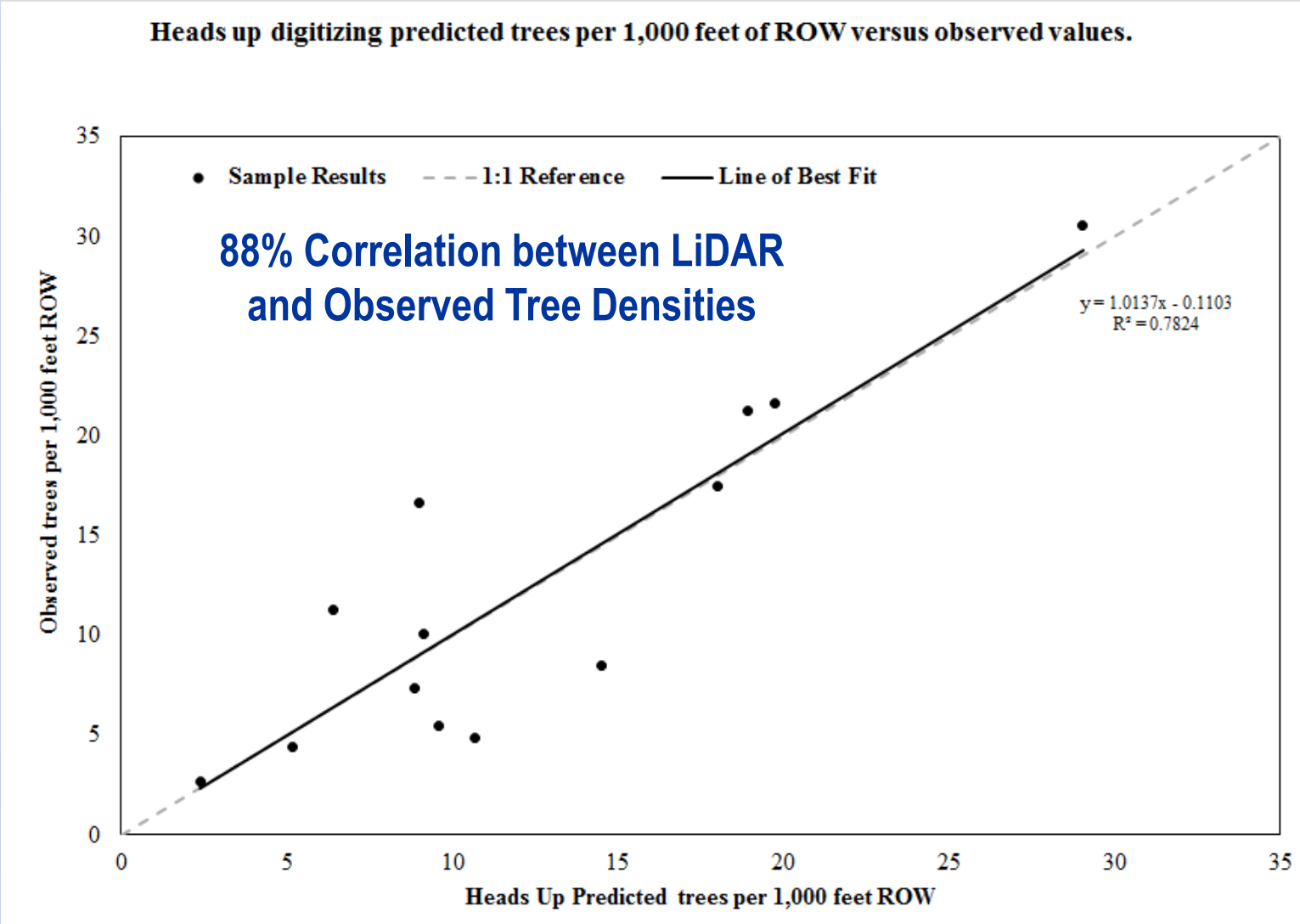
Regression Model for Accuracy

- **Regression Analysis to Assess Agreement Between Model and Field Results**
  - **LiDAR Vs. Field Verification**
  - **Heads up Digitizing Vs. Field Verification**

LiDAR vs. Field



Heads Up Digitizing vs. Field



Results

Grid	LiDAR		Field Work		Heads Up Digitizing	
	Trees	Time (mins : secs)	Trees	Time (hours : mins)	Trees	Time (hours : mins)
201NE06	577	1:42	255	1:10	298	3:25
202SE04	143	1:38	141	1:29	125	2:40
204SE05	639	1:30	338	3:00	384	3:01
205NE07	88	1:38	192	:50	108	2:15
206NE06	632	1:26	500	:55	689	3:02
206SE11	524	1:26	590	:55	500	2:35
207NE11	817	1:38	872	:46	830	3:45
208SE05	650	1:50	425	1:40	510	4:15
211SE03	396	1:48	191	1:00	307	3:50
213SE01	394	1:50	561	1:15	538	3:05
214SE06	873	1:46	1134	1:59	1166	3:05
216NE06	451	1:26	314	2:00	271	2:12
220SW01	289	1:31	220	:40	329	2:05

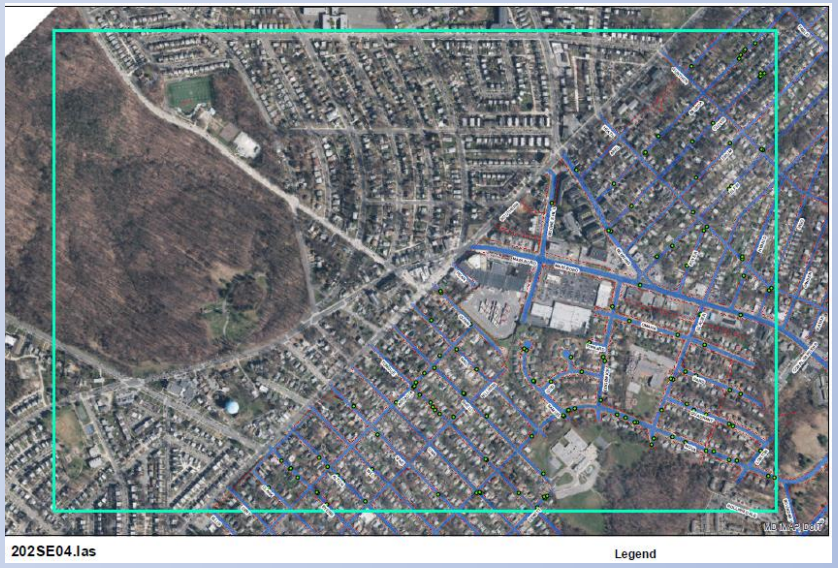
132%

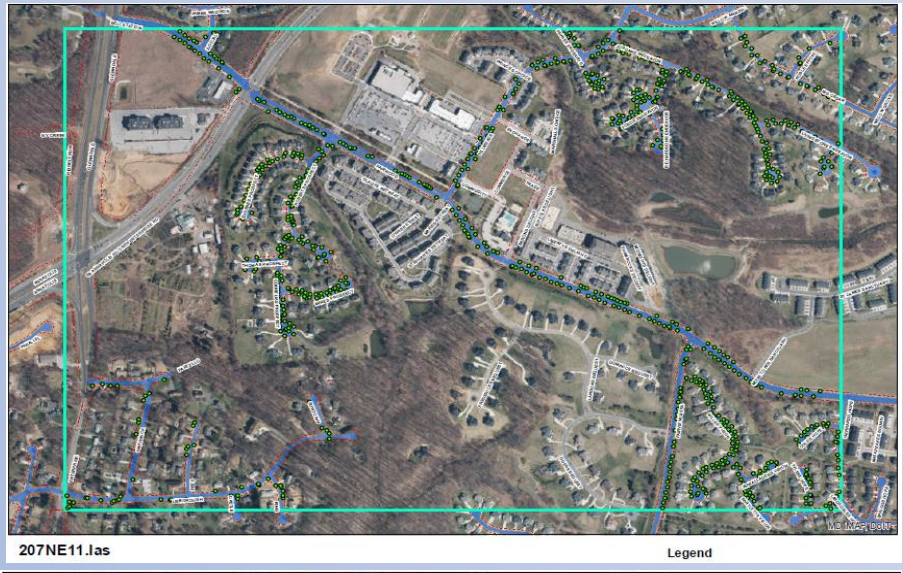
1%

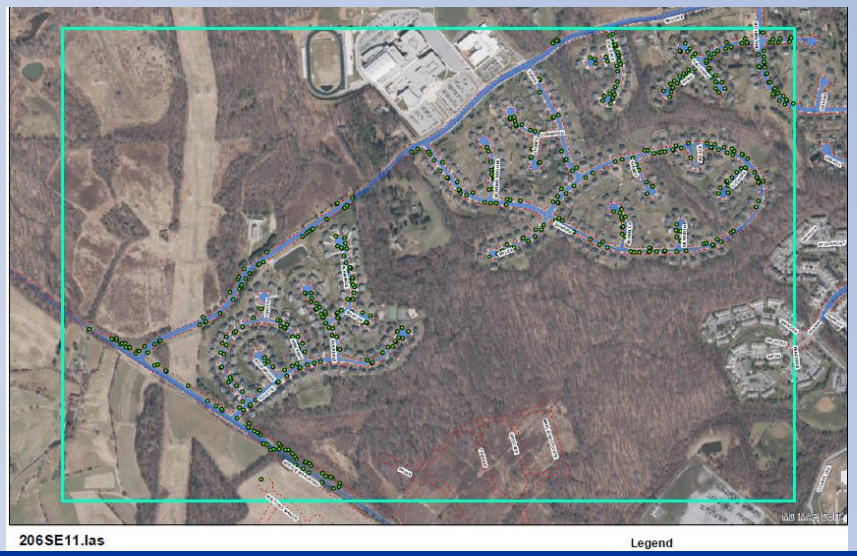
61%

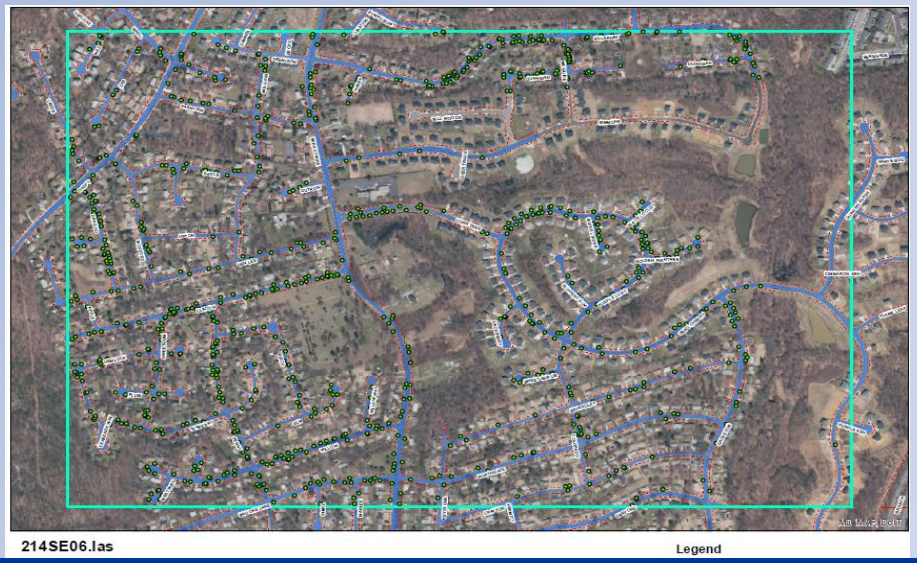
3%

High Correlation



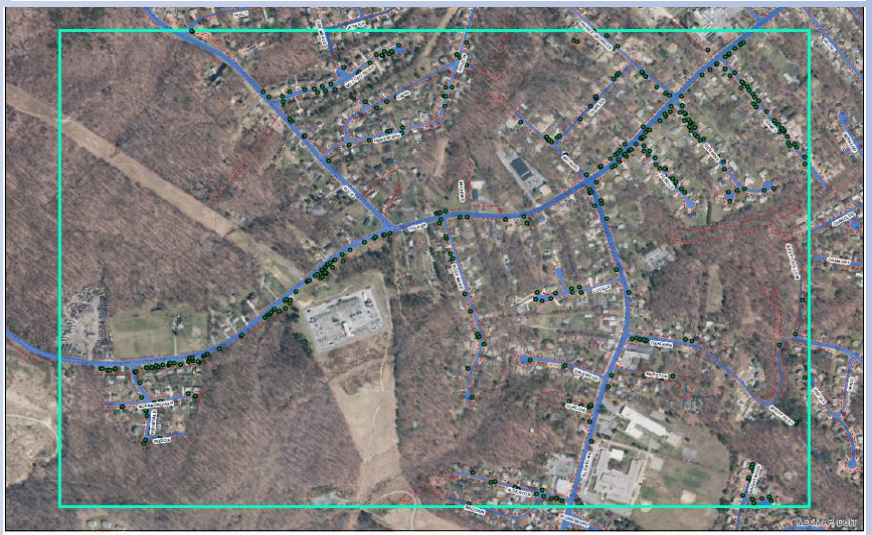




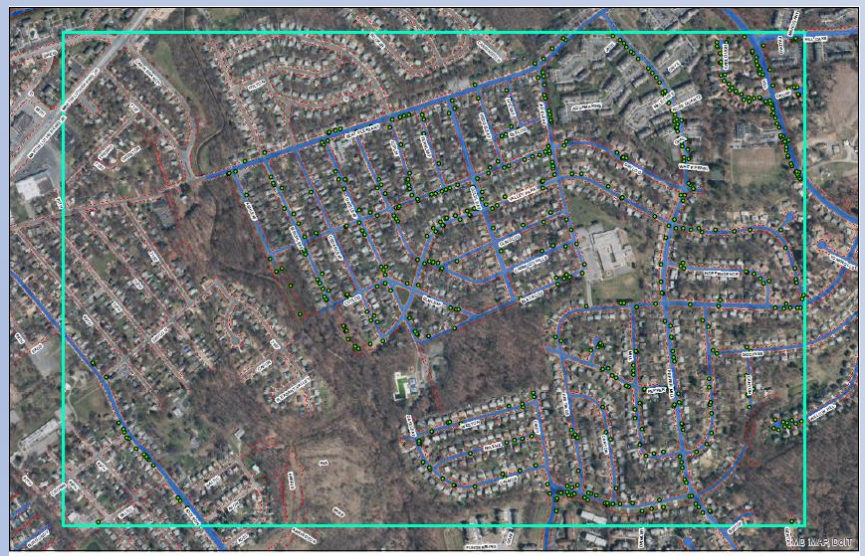


Low Correlation

204SE05.las Legend



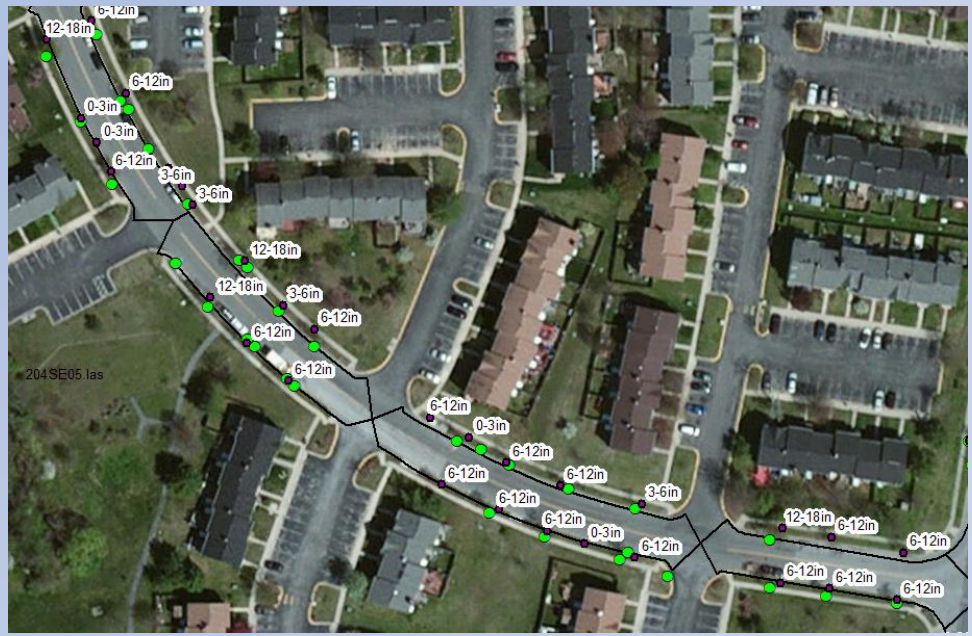
211SE03.las Legend



201NE06.las Legend

Next Steps

- **Apply Model to Whole County**
  - Modify Model for Batch Imagery
  - Compare Results to Arborist Field-Verified Inventory
- **Land Use Correlation**
- **Compare 2009 LiDAR to LiDAR 2014**
  - Improve Stormwater Baseline



Questions?

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