Introduction to LiDAR in Virginia

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LiDAR

Light Detection And Ranging

LiDAR uses laser pulses to determine distance to an object or surface. Three components are used:

- An aircraft-mounted laser pulse scanner to send/receive data
- Aerial GPS systems to determine precise aircraft positions
- An Inertial Measurement Unit (IMU) to measure aircraft attitude (pitch/yaw/roll).
Figure 2-1. Schematic diagram of airborne lidar performing line scanning resulting in parallel lines of measured points (other scan patterns exist, but this one is fairly common).
Advantages of LiDAR

• Higher resolutions (1m or less data spacing)
• Centimeter vertical accuracies (v. meter vertical accuracies of old topo maps)
• Ability to penetrate vegetation and detect ground surfaces
• Detection of above ground objects (buildings, trees, forest canopy)
Figure 2-4. Multiple returns from single pulse
• Nationwide cost-benefit analysis for LiDAR
• Estimated annual benefits between $1.2 and $12.9 billion, and a C/B ratio of 4.7+
• Recommended QL2 data collected nationwide on an 8-year refresh cycle
## 3DEP in Virginia by the Numbers

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected annual benefits</td>
<td>$10.32 million</td>
</tr>
<tr>
<td>Estimated total cost</td>
<td>$13.50 million</td>
</tr>
<tr>
<td>Payback</td>
<td>1.3 years</td>
</tr>
<tr>
<td>Quality level 1 buy-up estimate</td>
<td>$8.59 million</td>
</tr>
</tbody>
</table>

### Business use and Annual benefits (millions)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Business use</th>
<th>Annual benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Urban and regional planning</td>
<td>$3.03</td>
</tr>
<tr>
<td>2</td>
<td>Natural resources conservation</td>
<td>1.75</td>
</tr>
<tr>
<td>3</td>
<td>Flood risk management</td>
<td>1.53</td>
</tr>
<tr>
<td>4</td>
<td>Agriculture and precision farming</td>
<td>1.11</td>
</tr>
<tr>
<td>5</td>
<td>Resource mining</td>
<td>0.76</td>
</tr>
<tr>
<td>6</td>
<td>Infrastructure and construction management</td>
<td>0.74</td>
</tr>
<tr>
<td>7</td>
<td>Geologic resource assessment and hazard mitigation</td>
<td>0.32</td>
</tr>
<tr>
<td>8</td>
<td>Water supply and quality</td>
<td>0.30</td>
</tr>
<tr>
<td>9</td>
<td>Forest resources management</td>
<td>0.29</td>
</tr>
<tr>
<td>10</td>
<td>Coastal zone management</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>10.33</td>
</tr>
</tbody>
</table>

[Link to State Fact Sheet](www.vita.virginia.gov)
Acquired and Proposed Virginia LiDAR Data

Proposed LiDAR Acquisitions

- FEMA Proposal 2016-2017
- NRCS VDOT Proposal 2016-2017
- Existing LiDAR
## Completed and Funded Projects

<table>
<thead>
<tr>
<th>Year</th>
<th>Sq. Miles</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>4,096</td>
<td>$1,153,683</td>
</tr>
<tr>
<td>2011</td>
<td>5,003</td>
<td>$1,773,083</td>
</tr>
<tr>
<td>2012</td>
<td>2,819</td>
<td>$559,300</td>
</tr>
<tr>
<td>2013</td>
<td>1,147</td>
<td>$379,000</td>
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<tr>
<td>2014</td>
<td>7,054</td>
<td>~$2,200,000</td>
</tr>
<tr>
<td>2015</td>
<td>8,444</td>
<td>~$2,500,000</td>
</tr>
<tr>
<td>total</td>
<td>28,566</td>
<td>~$8,565,000</td>
</tr>
</tbody>
</table>

72% of the Commonwealth

**Funding Partners**
- USGS
- FEMA
- NRCS
- NGA
- DEQ
- DMME
- The Nature Conservancy
- UVA
- ODU
- Page County
- Fairfax County
- HRPDC
- HRSD
LiDAR Data Download

- **3DEP View**
  
  [http://viewer.nationalmap.gov/basic/?basemap=b1&category=ned,nedsrc&title=3DEP%20View](http://viewer.nationalmap.gov/basic/?basemap=b1&category=ned,nedsrc&title=3DEP%20View)

- **Virginia GIS Data Clearinghouse** (under development)
  - State plane coordinates (if available)
  - ESRI compressed format (ZLAS)
  - Faster posting
  - FTP web folders

- **Eastern Shore VA 2015 LiDAR** [http://arcg.is/1Uv1Shl](http://arcg.is/1Uv1Shl)
• Data download demonstration
LiDAR Data

- The native data are delivered as **points** (point clouds) than can be used directly or
- Processed into **surfaces** (DEMVs or TINs)
- Surfaces can be **bare-earth** or **first-reflective surfaces**
- The surfaces can be used to produce **contours** (for cartographic purposes)
Bare-earth DEM

• Raster digital elevation models
• Uses LiDAR points classified as ground and 3D break lines derived from LiDAR
• Produces a “hydro-flattened” representation of the ground surface
• Provide a dense, higher accurate topography
• Can be used to produce contours
• DEM demonstration
• Contours
Point Clouds

- Large collections of 3D elevation points, with x, y, and z, along with additional attributes
- Elevations for the ground, buildings, forest canopy, highway overpasses, and anything else that the laser beam encounters during the survey constitutes point cloud data

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ASPRS LAS Format

1. X, Y, Z coordinates
2. Intensity
3. Return number
4. Number of returns
5. Point classification
6. Edge of flight line
7. RGB
8. GPS time
9. Scan angle
10. Scan direction
Viewing and Using LiDAR Data

- ESRI options
  - DEM rasters
  - LAS datasets for viewing & editing point clouds
  - Terrain datasets
  - Mosaic datasets (on-the-fly rasterization of point clouds)

- LiDAR-specific software
  - LP360
  - MARS
  - TerraSolid
  - Fusion
  - LASTools
• Point cloud demonstration
• LAS Datasets
USGS 3DEP

- Provides an opportunity to partner with USGS to acquire high-quality 3D elevation data
- Can either use the USGS contract or receive a grant
- Match varies with funds availability and interest of other federal partners
- Next opportunity will open July 25 with proposals due October 1
- Public webinars in August

www.vita.virginia.gov

http://dx.doi.org/10.3133/tm11B4
Virginia LIDAR Acquisition Plan

- Adopted in 2014
- Goal of statewide coverage
- Project coordination and data management (VGIN)
- Virginia-specific data requirements
- Data refresh plan (8-Year)
Additional Lidar Specifications

1. Collection areas – whole counties
2. Tiles – VBMP tiling scheme
3. DEM – 2.5 ft cell size
4. Tidal coordination - +/- 2hrs of low tide
5. Datums – most current NAD83, NAVD88, most current geoid
6. Coordinate System – Virginia State Plane
Thank You

John Scrivani

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Feel free to contact me about

- Obtaining and using existing LiDAR
- Partnering for acquiring LiDAR
- General elevation data questions