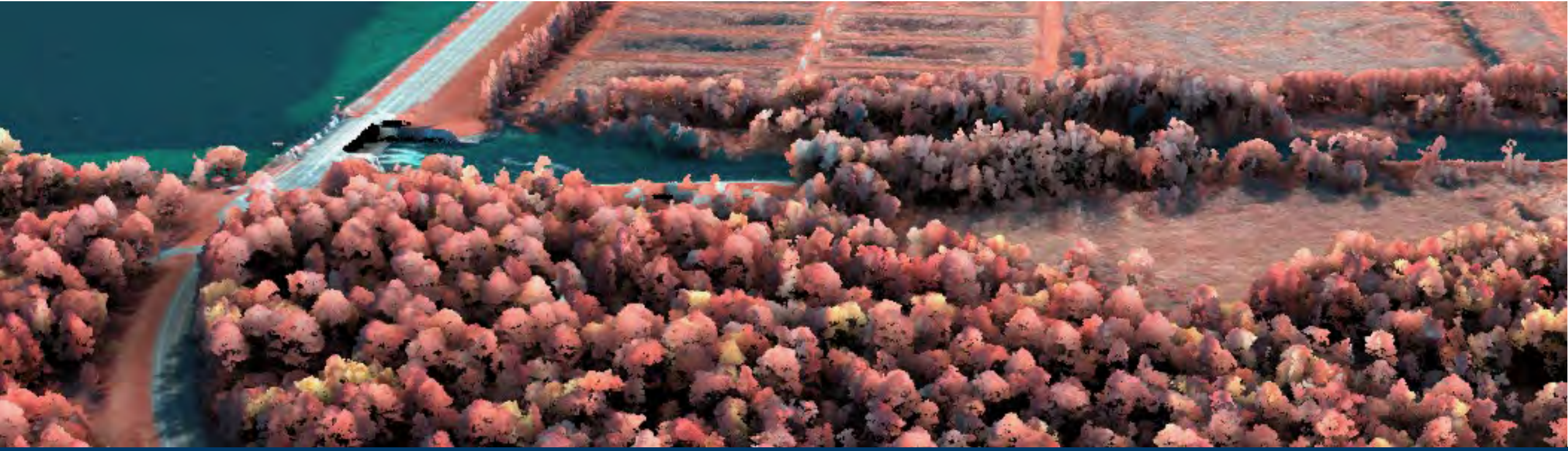


Plot Based Inventory (PBI) – Area Based Estimation for Updating Minnesota's Stand Level Inventory

Jennifer Corcoran, MN DNR Resource Assessment

Operational Lidar Inventory Meeting
April 7, 2021

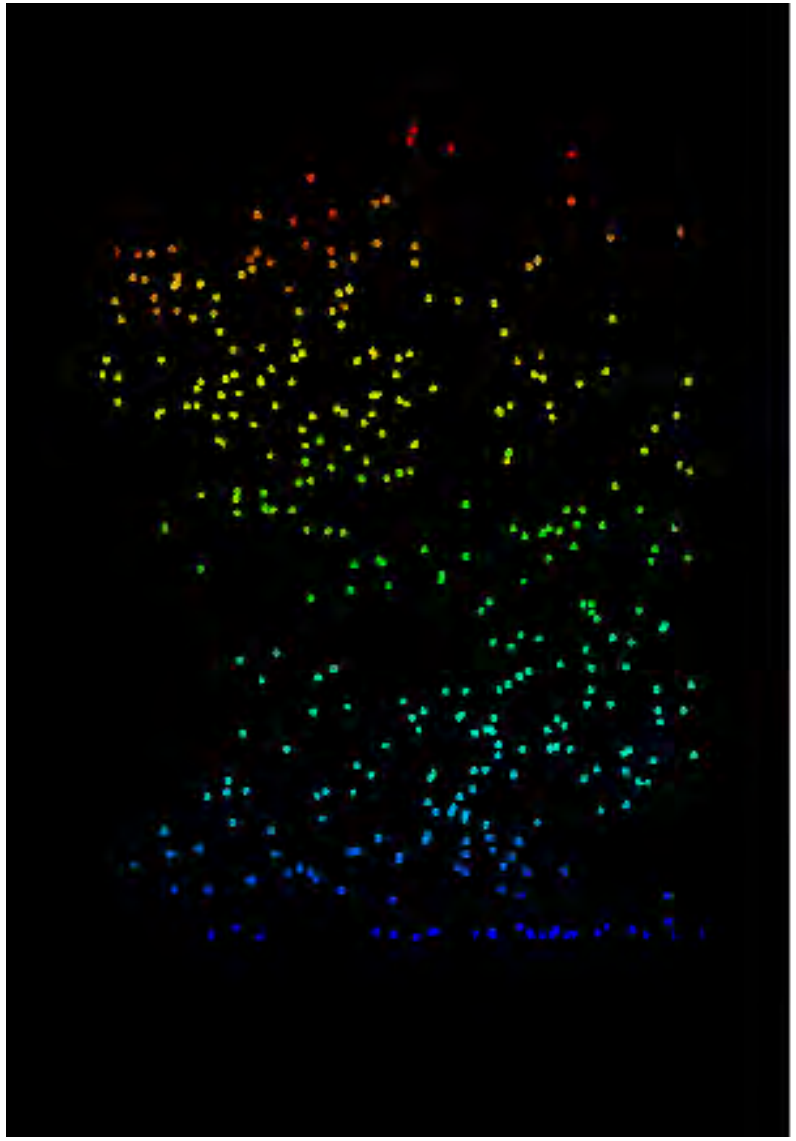
DEPARTMENT OF NATURAL RESOURCES

Goals for today

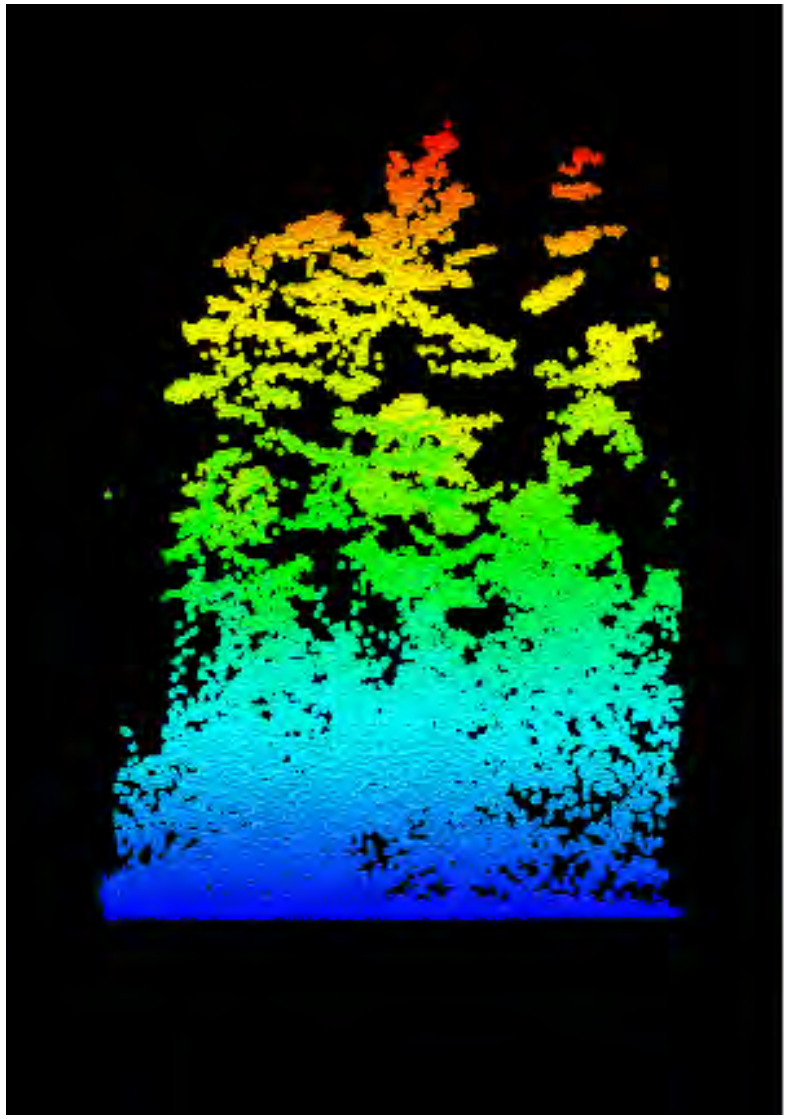
- Share info about Minnesota Lidar Planning efforts
- Update on MNDNR progress in lidar derived forest inventory
- Provide time for questions and discussion

High-density
Lidar

QL3, Low Density Lidar 2011

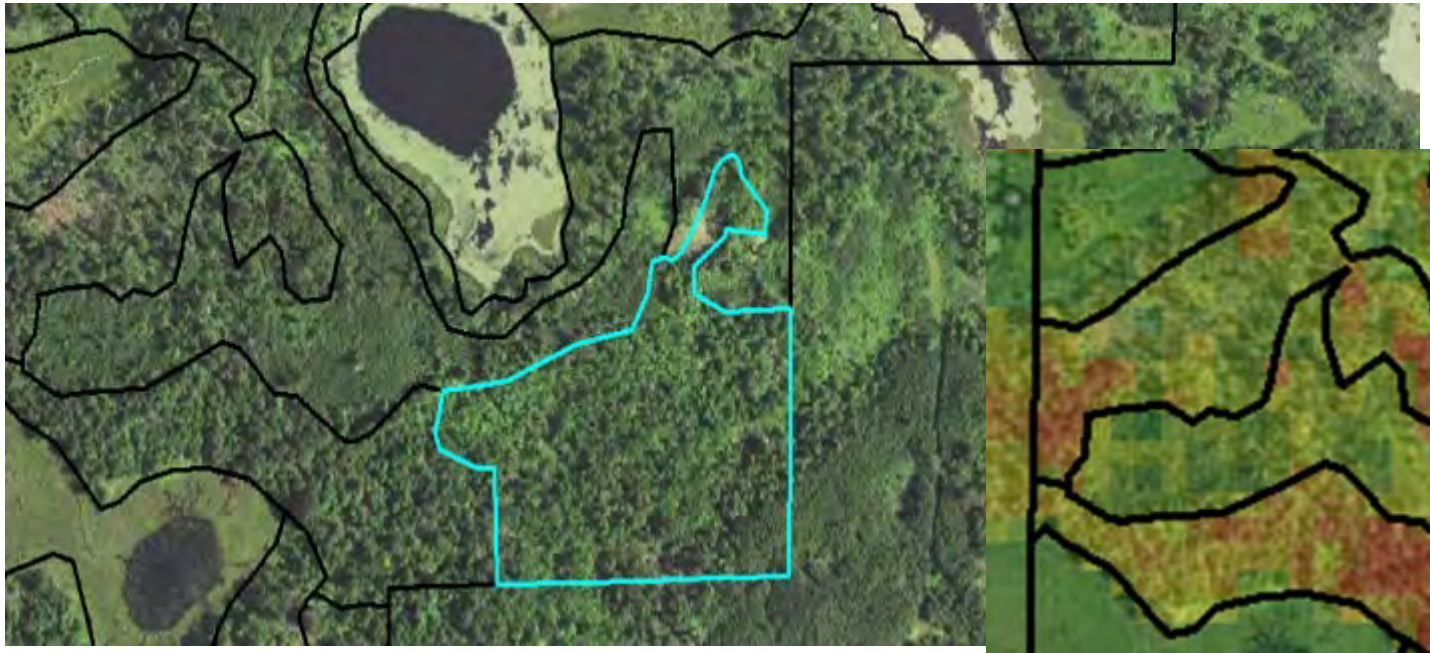


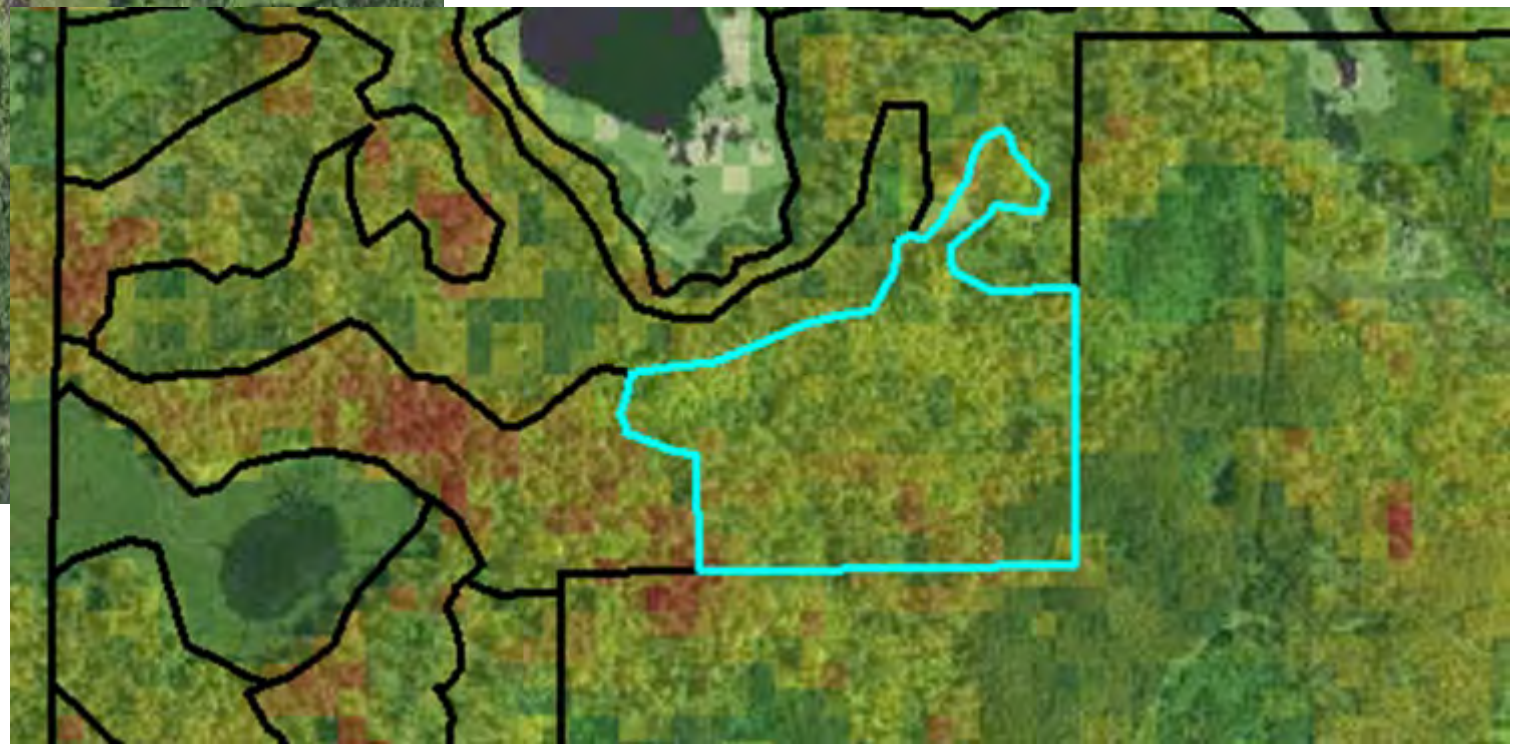
QL1, Linear Lidar 2018



Forest Inventory - The End Goal

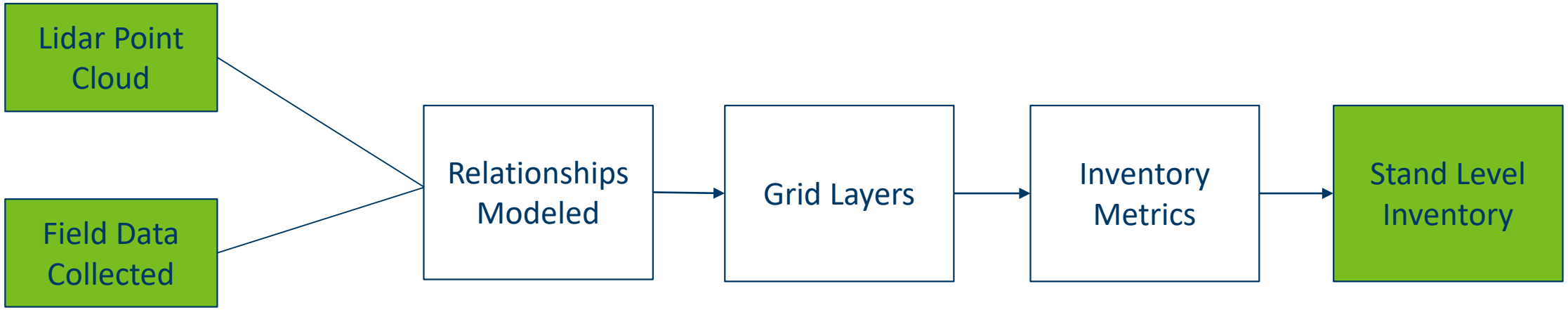
	FID	Shape *	STAND_KEY	MN_CTYPE	SURVEY_YR	STAND_AGE	Field1	STAND_KE_1	Grid_Cell_	AGB_Lbs	BAWHT_Max	BA_Wt_weig	QMD_Inches	BA_SqFT_Pe	Site_Index	TPA	Volume_CuF	Age_2019	Volume_Cor	Stand_Acre
▶	2908	Polygon	5374	1	1992	99	255	5374	164	91711.17	85.33	56.97	11.3	93.36	56.86	152	2230.88	126	28.24	16

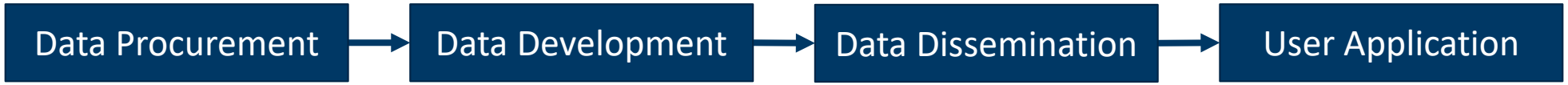


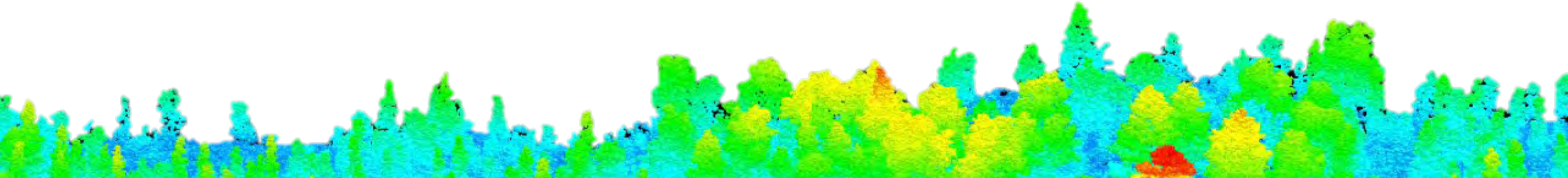


Forestry Inventory - Pulling Elements Together

Lidar is Foundational Data for DNR







Lidar
Collection
Planning

Geospatial Advisory Council - 3D Geomatics Committee

What is the GAC?

- The Minnesota ***Geospatial Advisory Council*** is the coordinating body for the Minnesota geospatial community.
- **Cross-section of organizations** that include counties, cities, universities, business, nonprofit organizations, federal and state agencies, tribal government, and other stakeholder groups.

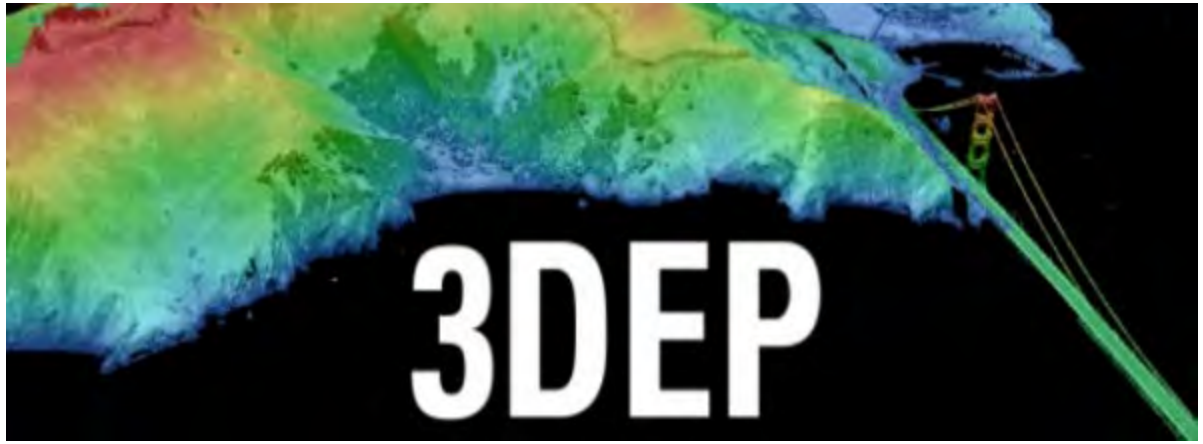
What is the 3D Geomatics Committee?

- The ***3D Geomatics Committee*** (3DGeo) is a committee under GAC that works to identify and promote the need for planning, funding, acquisition, and management of three-dimensional geomatic data and derived products.

USGS 3D Elevation Program (3DEP)

3D Elevation Program (3DEP)

- **Systematically** guiding the collection of 3D elevation data in the form lidar data for the United States, and the U.S. territories
- Goal: elevation dataset for the nation **by 2023**

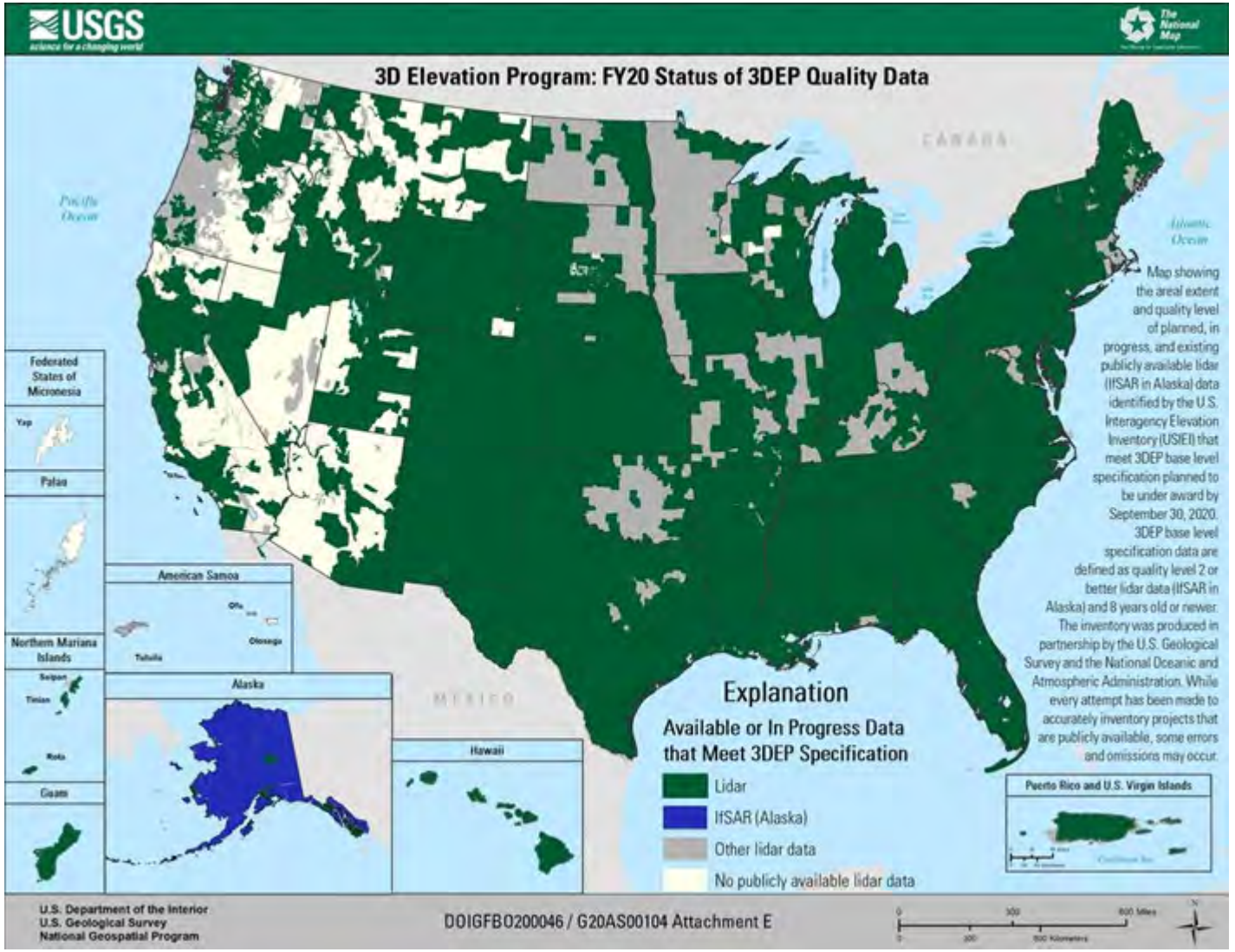


- Acquisition contracts are under two managerial mechanisms
  - GPSC
  - COOP

USGS 3D Elevation Program (3DEP)

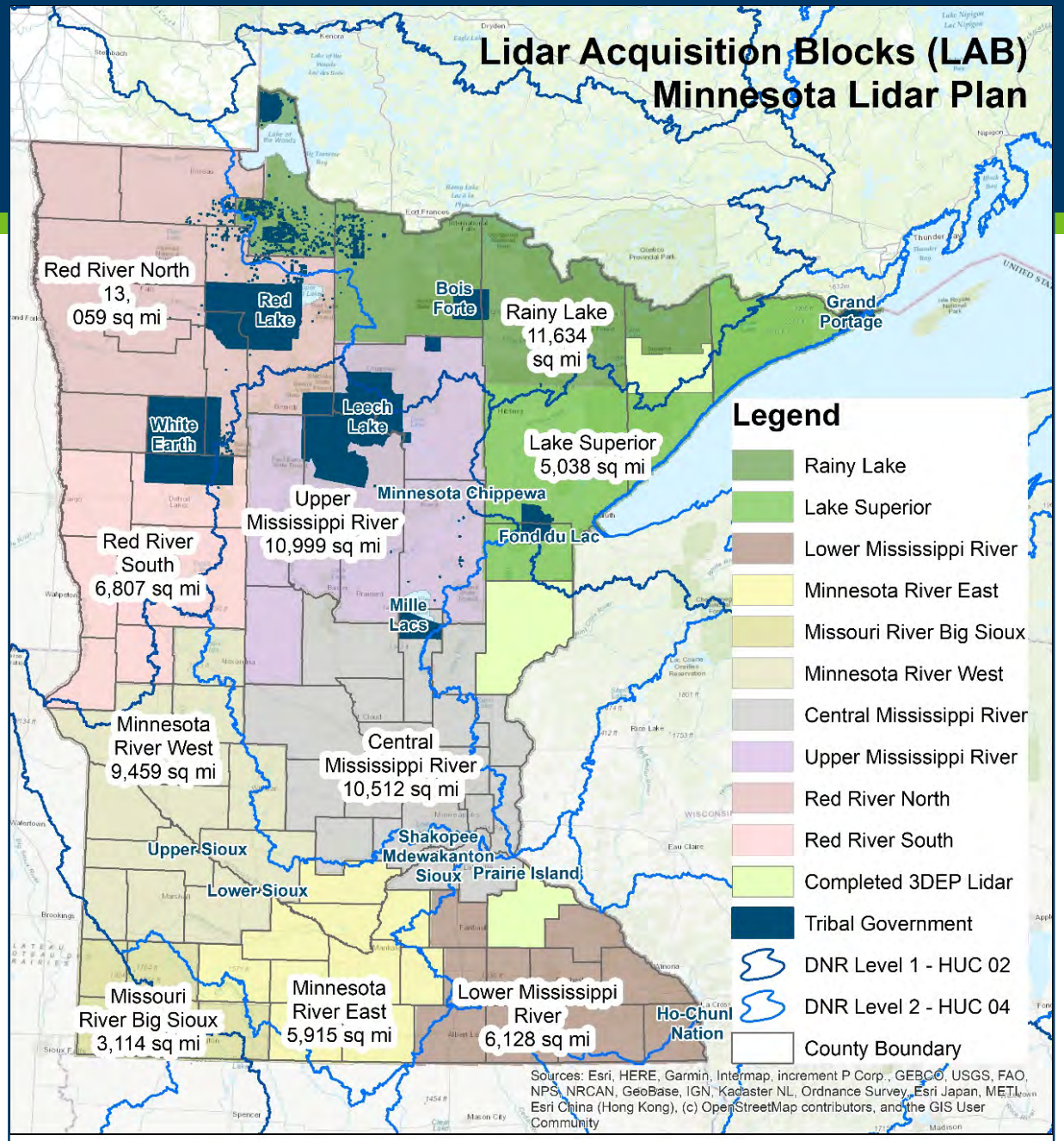
Broad Agency Announcement (BAA)

- **Grant coordinating** mechanism 3DEP
- Guides **partnerships** between the USGS and other Federal agencies with other public and private entities seeking high-quality 3D lidar elevation data acquisition.
- USGS is **cost-sharing** via grant funds for QL2 or greater
- Grants through “BAA” process – **deadlines** are every fall (Oct/Nov)



Minnesota Lidar Plan & Story Map

http://bit.ly/MnLidarPlanStoryMap



Tribal boundaries data source:
MnDOT, US Census Data Sept 2019

0 20 40 80
Miles

Map Date: Nov 16, 2020

Lidar
Derived
Forest
Inventory

Forestry Inventory - pulling elements together

Lidar is Foundational Data for DNR

$$\hat{T}_{y.reg} = N * (\hat{B}\mu_x)$$

$$SE_{\hat{T}_{y.reg}} = \sqrt{N^2 \frac{s^2_{reg}}{n}}$$

Lidar Point Cloud

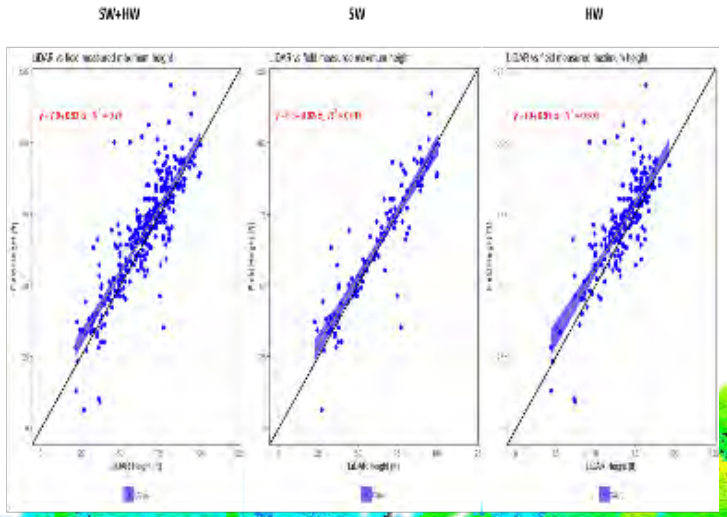
Field Data Collected

Plot Level Relationships Modeled

Area Based Estimations Developed- Grid Layers

Small Area Estimation for Any Area of Interest i.e., Stands

Stand Level Inventory

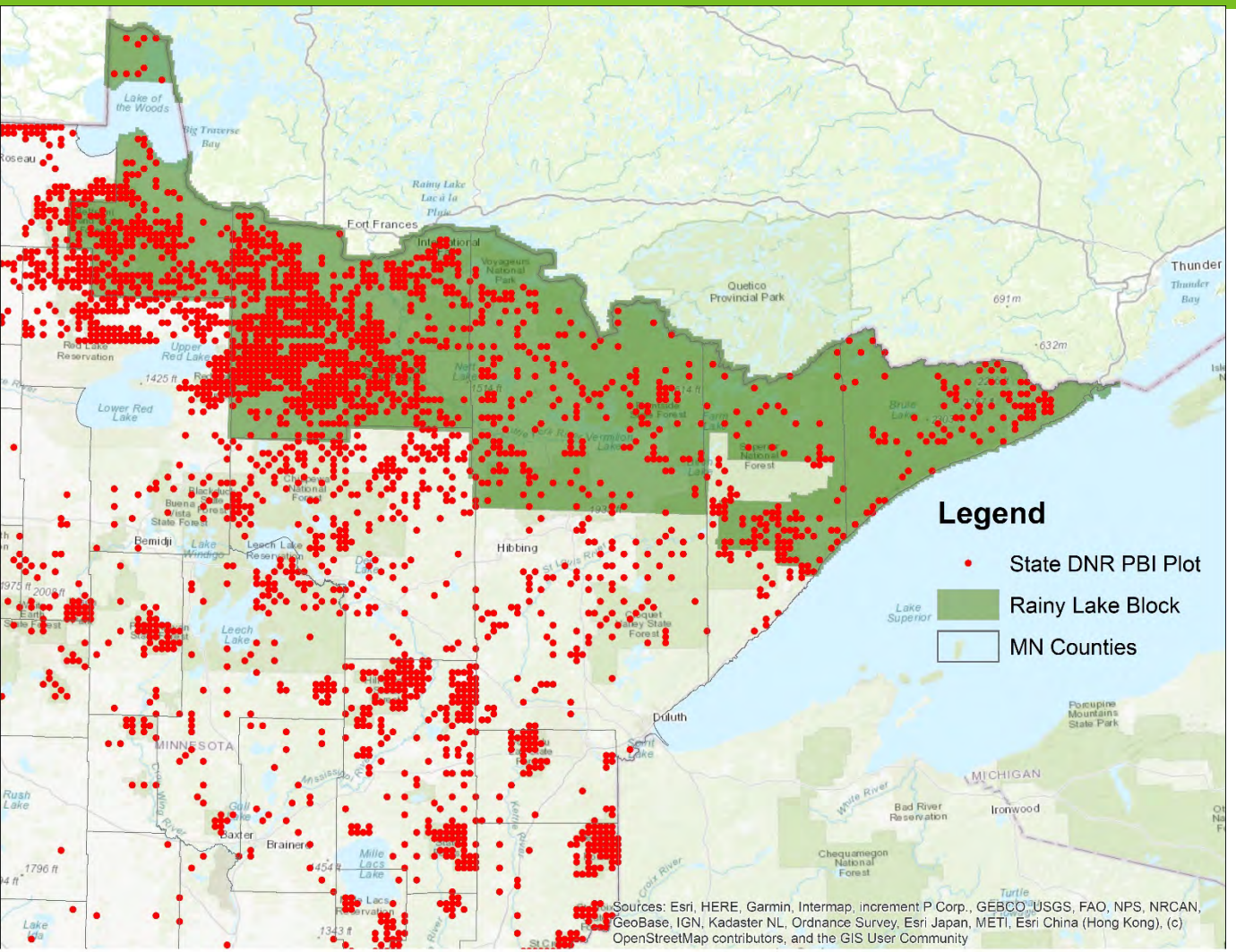


$$\widehat{Var}_{pr}(\hat{\bar{Y}}_m) = \widehat{Var}_p(\hat{\bar{Y}}_m) + \frac{\hat{\sigma}^2_\varepsilon}{N_m}$$

$$\widehat{Var}_{prh}(\hat{\bar{Y}}_m) = \widehat{Var}_p(\hat{\bar{Y}}_m) + \frac{1}{N_m^2}\sum_{i=1}^{N_m}\hat{\sigma}_i^2$$

$$\widehat{Var}_{pr}(\hat{\bar{Y}}_m) = 2*(\widehat{Var}_p(\hat{\bar{Y}}_m) + \frac{\hat{\sigma}^2_\varepsilon}{N_m})$$

New Plot Based Inventory (PBI): Transition Plan



0 15 30 60 Miles

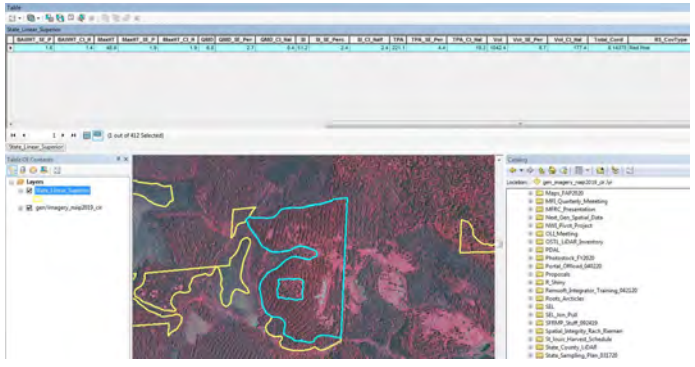
Map Date: February 2, 2021

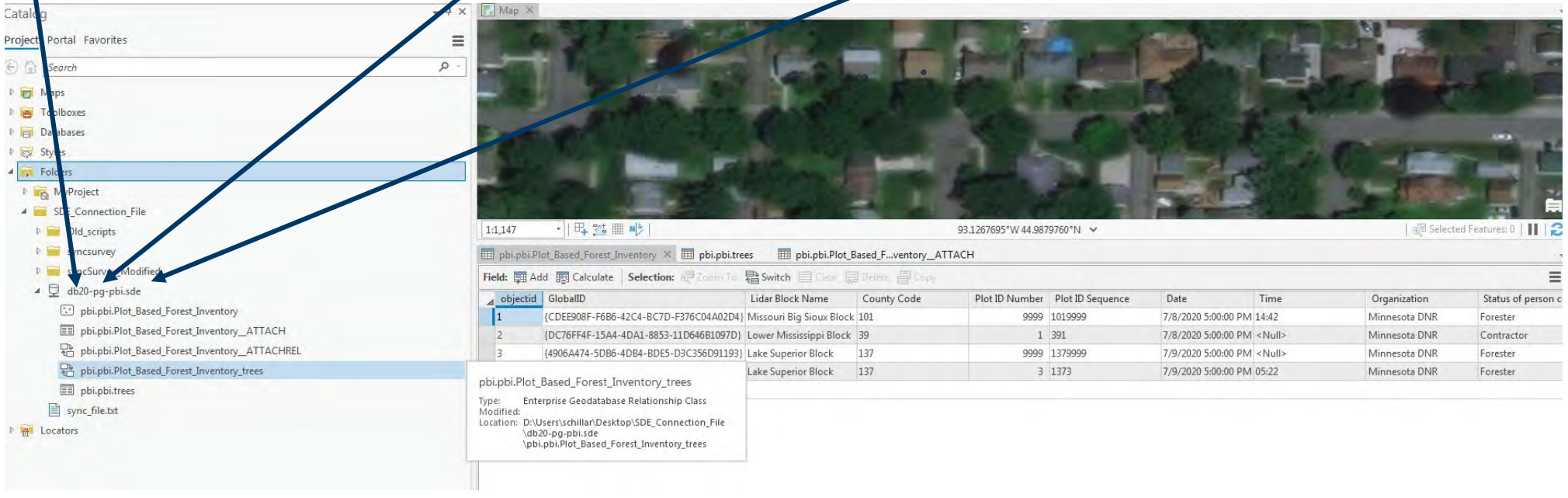
- RA research supports the recommended plot density = 1 plot : 1500 acres forest land
- Cost per Plot = ~$300-$500 (that's only $0.17-$0.29 per acre for field work)

Example: Rainy Lake Block

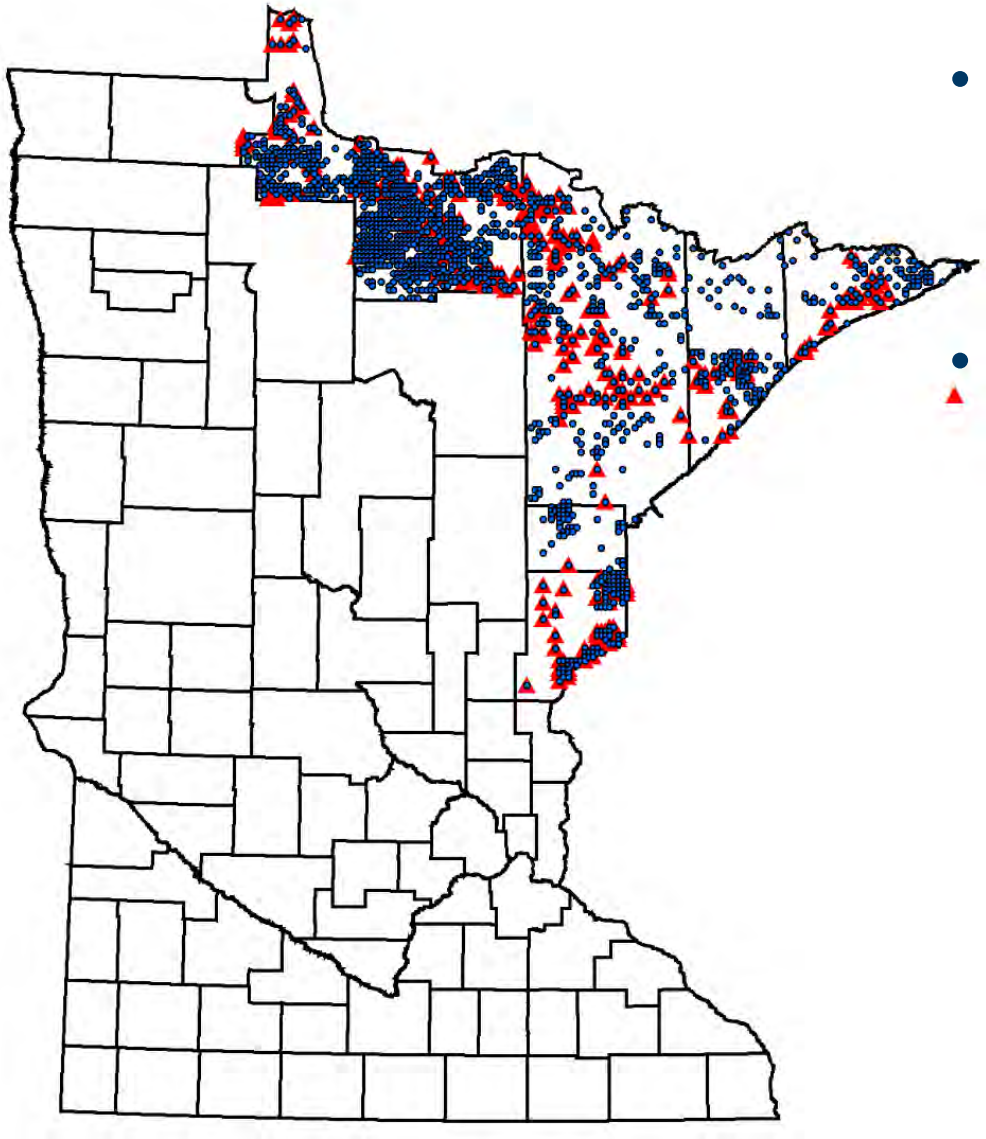
Owner Type	Count	Total Acres
County	9	12,846
NPS	68	120,554
State	1086	1,954,396
Tribal	63	129,679
USFS	606	1,010,723
Other	5	4,923

Streamlining Data Collection

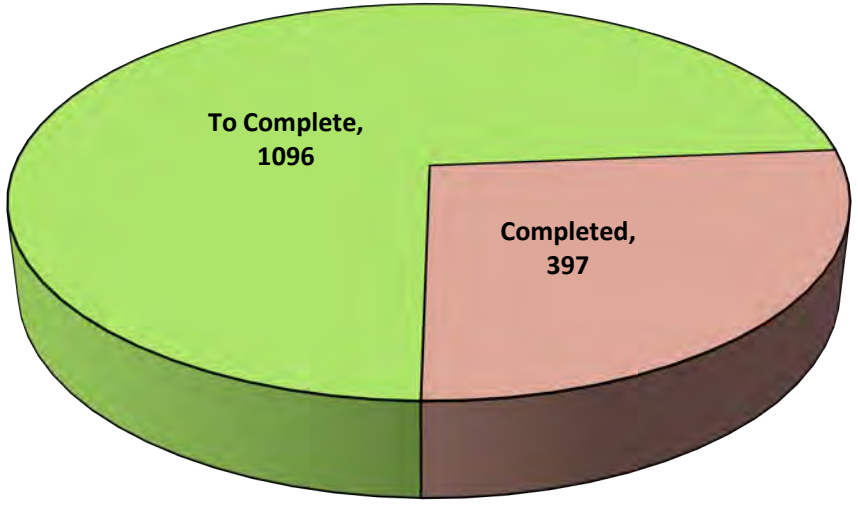




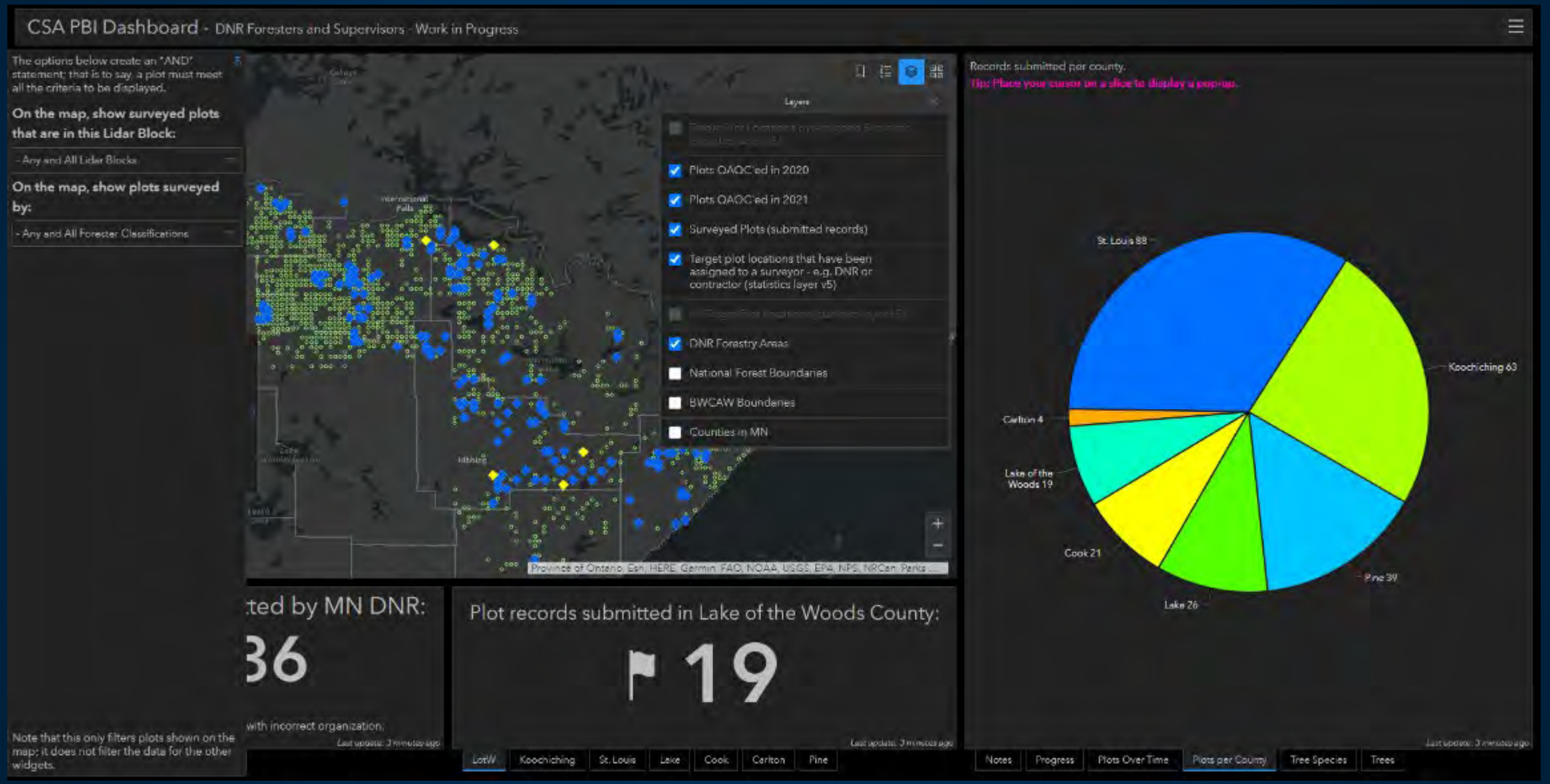
Current Progress of PBI



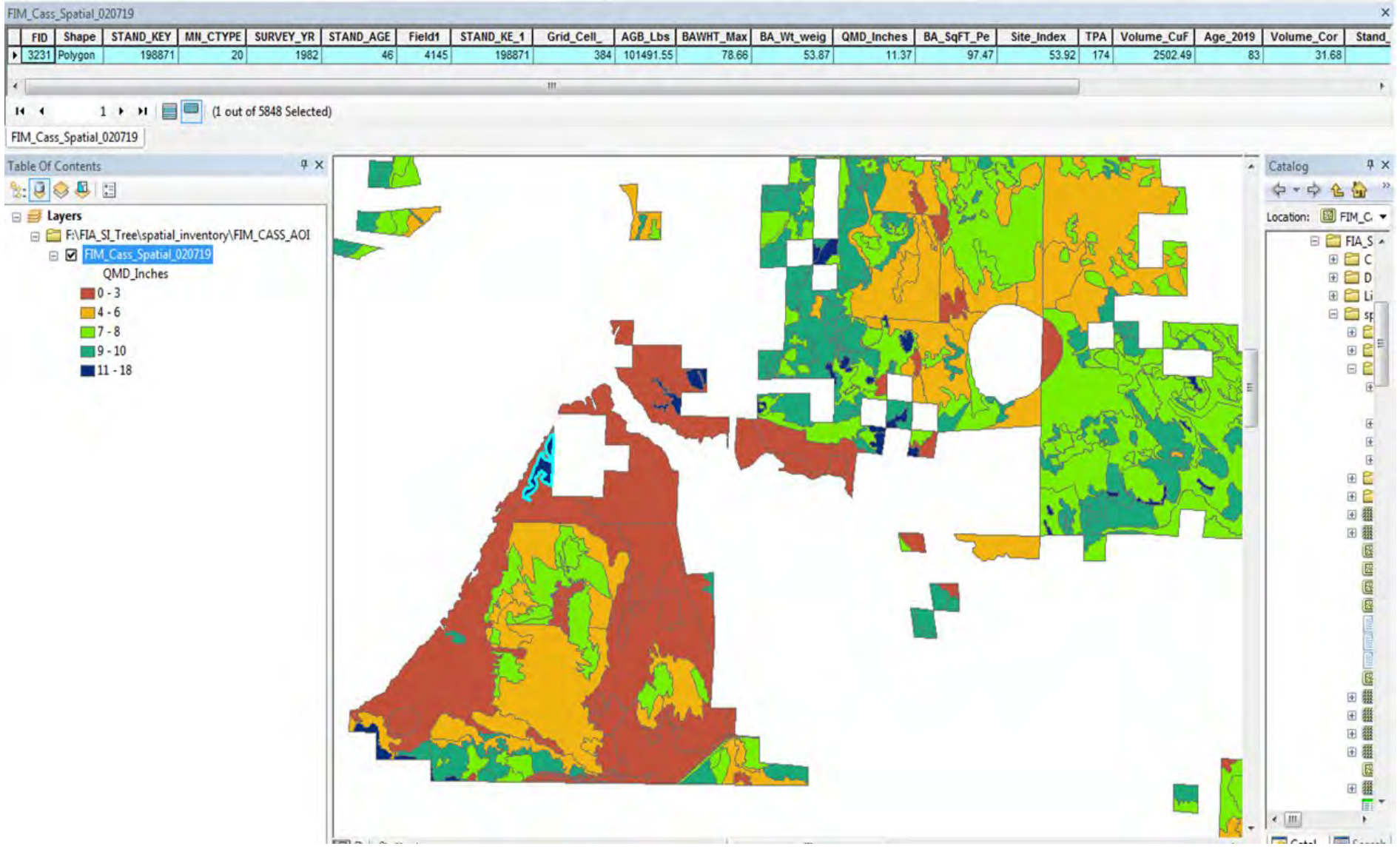
- On State administered land: DNR forestry staff and contractors have completed 397 plots of 1493 plots in Rainy Lake and Lake Superior Blocks, and Pine County.
- Work started in June and will continue through the summer into next winter, rolling into the next Lidar Acquisition Block when completed with these areas.



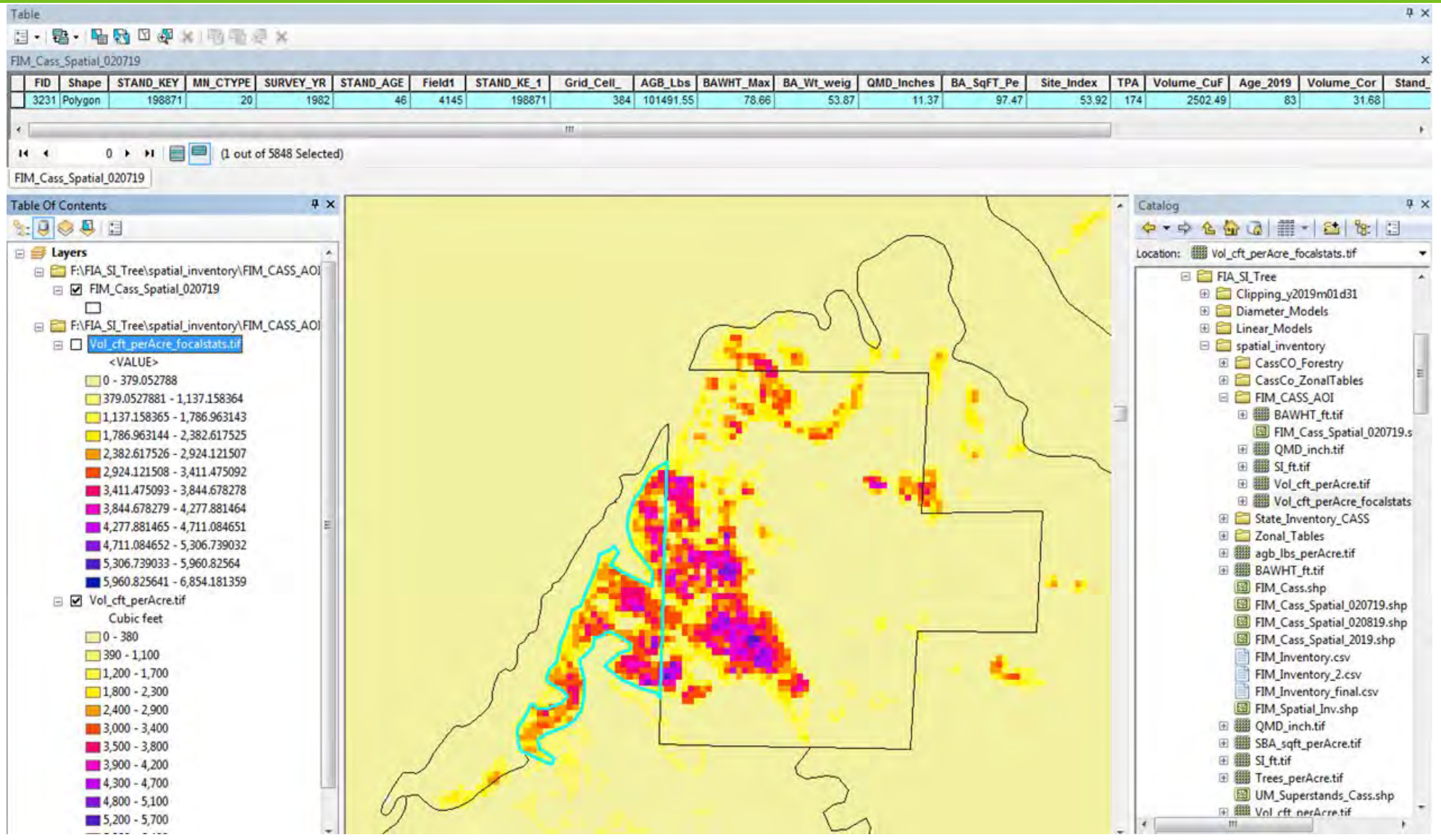
New Forest Inventory - PBI Dashboard



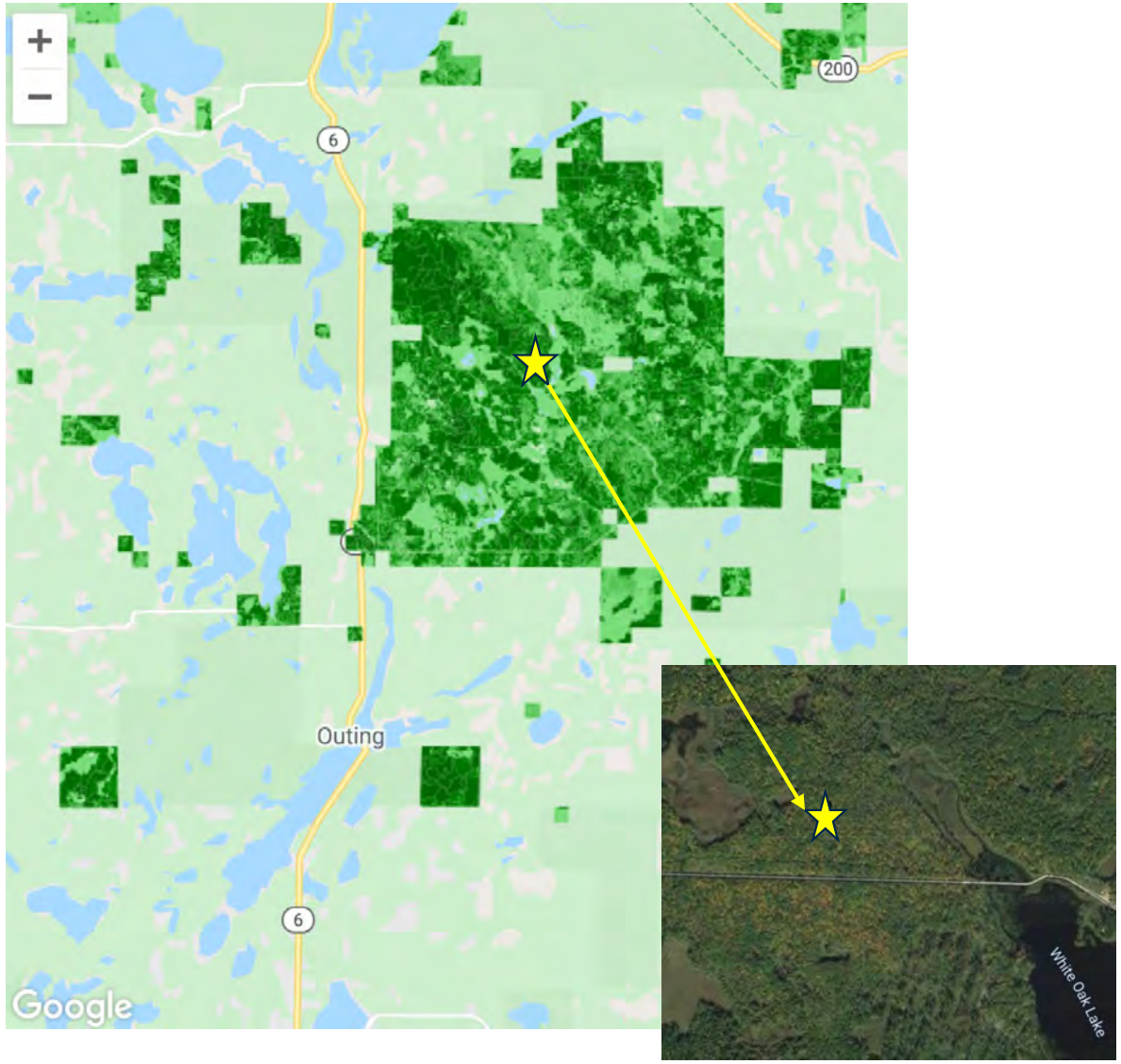
Small Area Estimation - Any Area of Interest

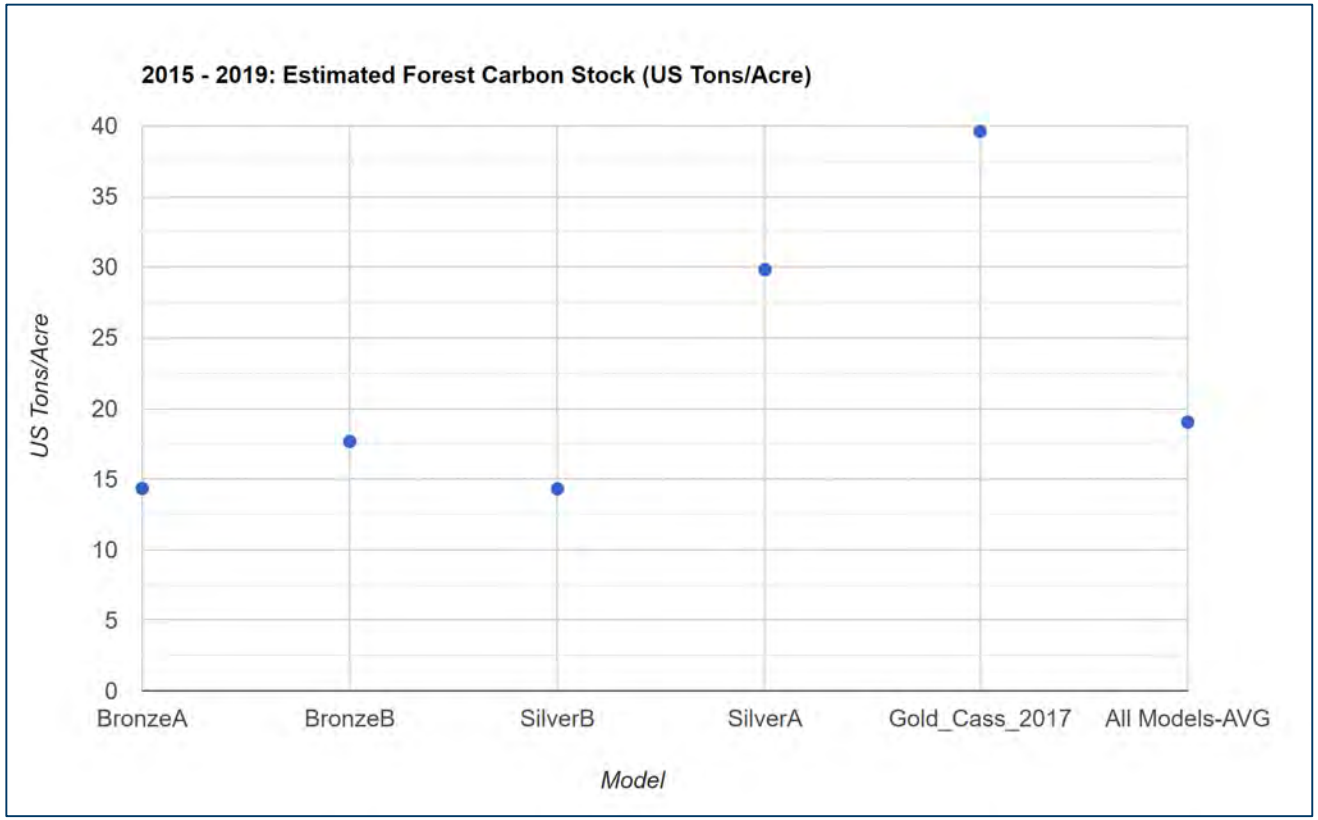


Sub-Stand Information and Landscape Scale



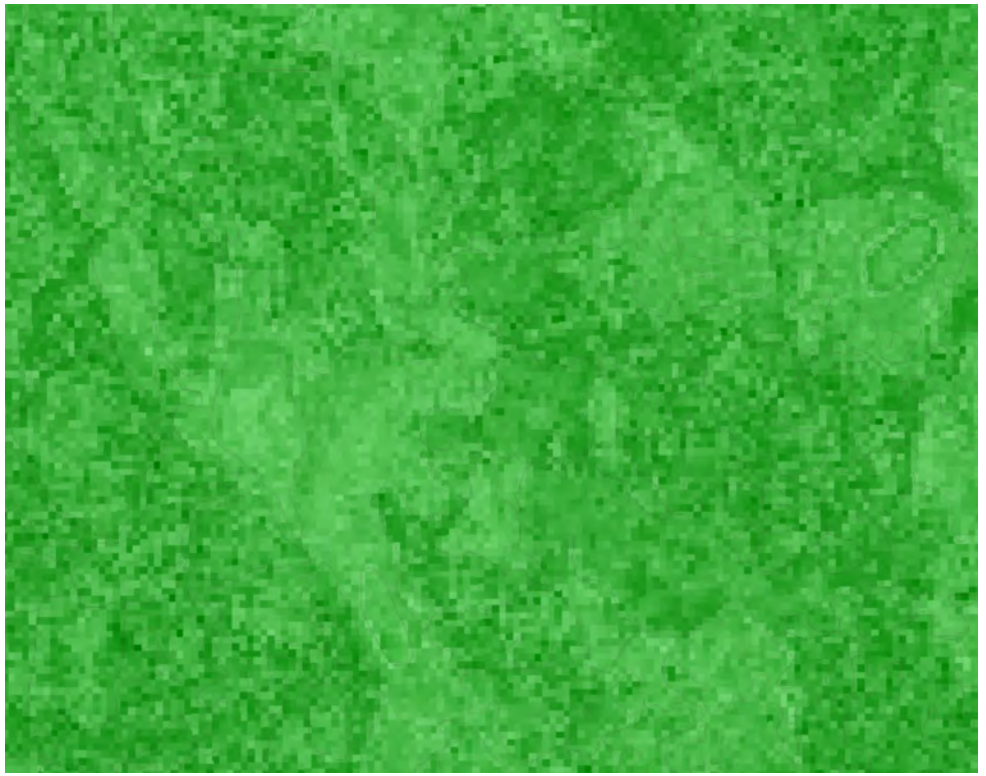
Carbon Stock Model – Testing Methods





Carbon Stock Model – Testing Methods

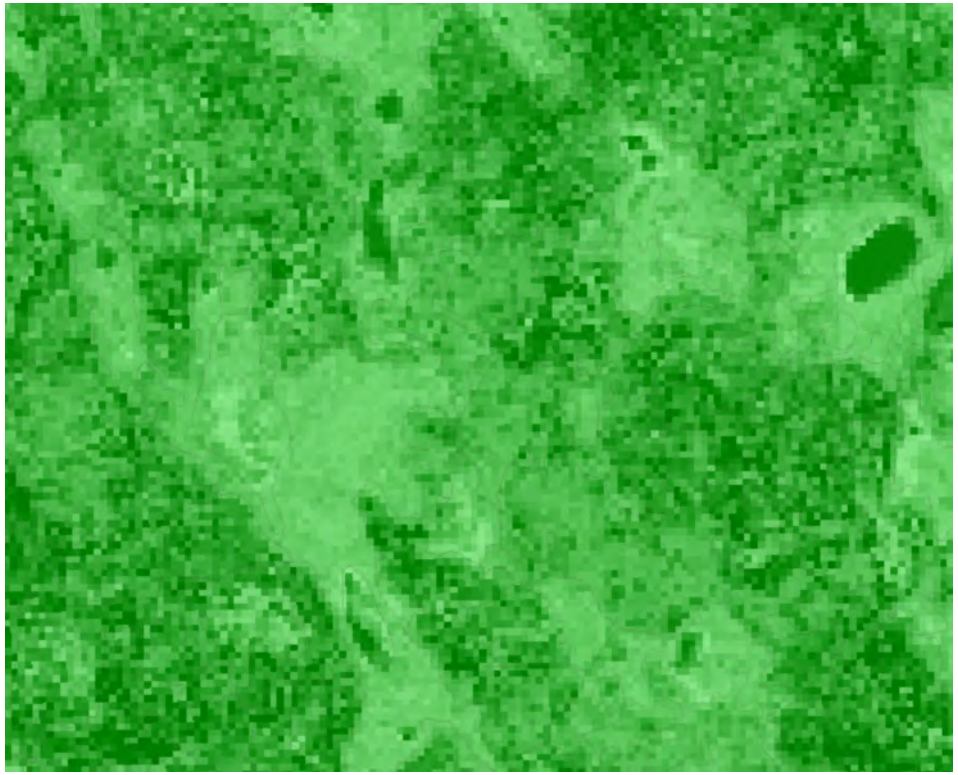
Summer 2010 Image (NAIP)



Bronze Model (Imagery Only, Fuzzed FIA Locations)

Carbon Stock Model – Testing Methods

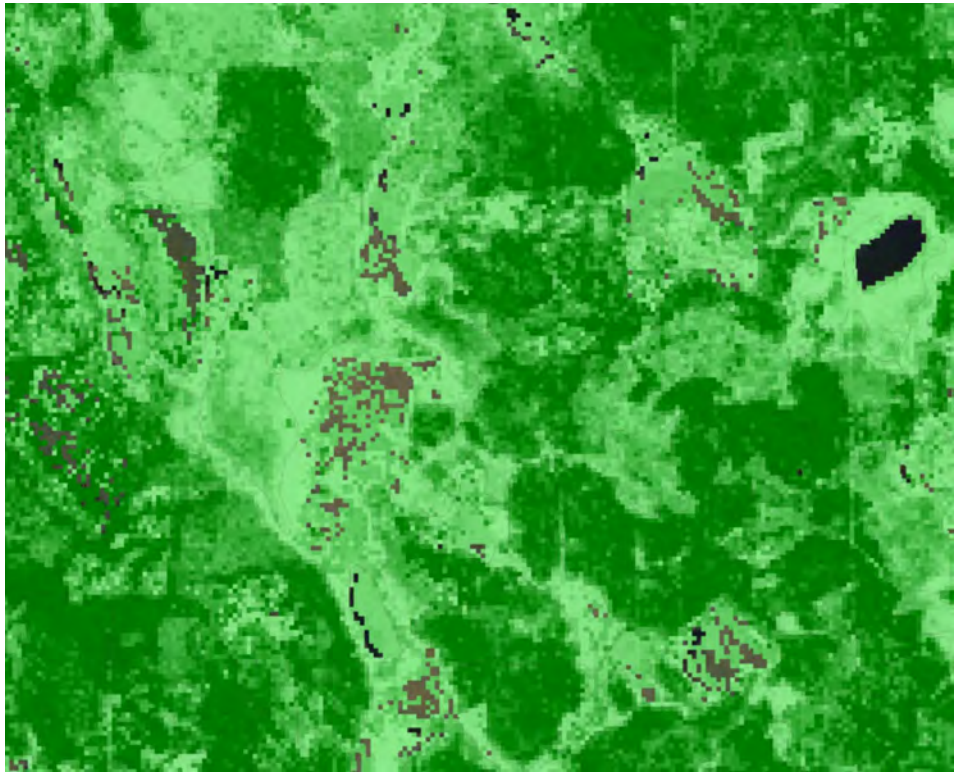
Summer 2010 Image (NAIP)



Silver B Model (Imagery Only, True FIA Locations)

Carbon Stock Model – Testing Methods

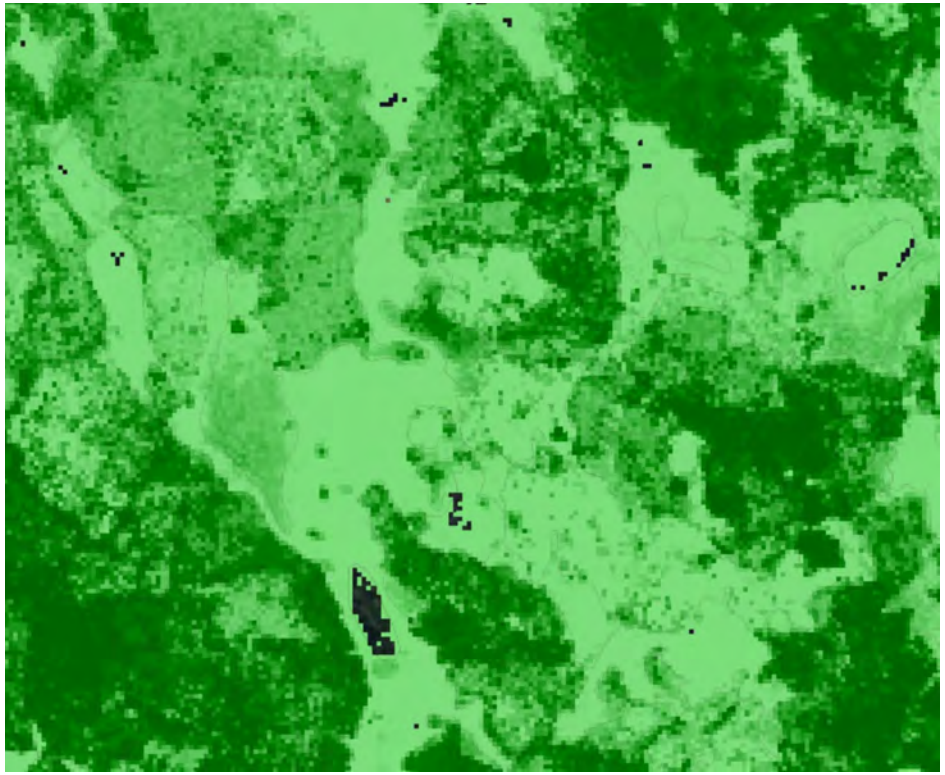
Summer 2010 Image (NAIP)



Silver A Model (Imagery, Lidar Height Metrics, and True FIA Locations)

Carbon Stock Model – Testing Methods

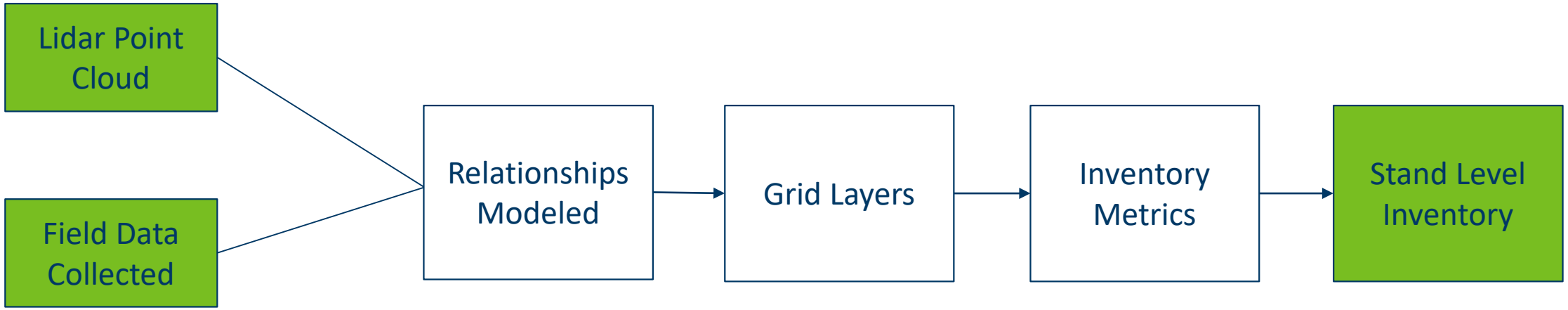
Summer 2019 Image (NAIP)

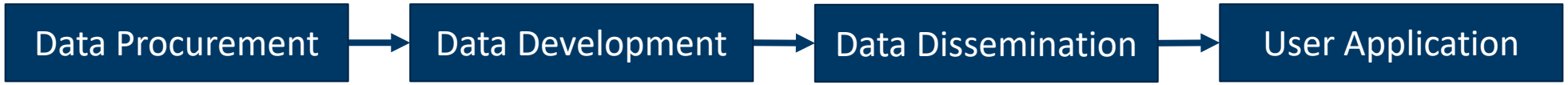


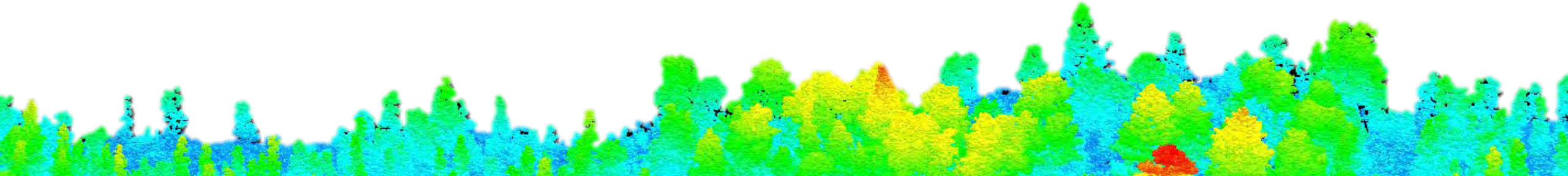
Gold Model (Imagery, High Density Lidar Height Metrics, and State Forest Inventory)

Forestry Inventory - Pulling Elements Together

Lidar is Foundational Data for DNR







Next Steps - Pulling Elements Together

Forest inventory engagement on other land ownerships

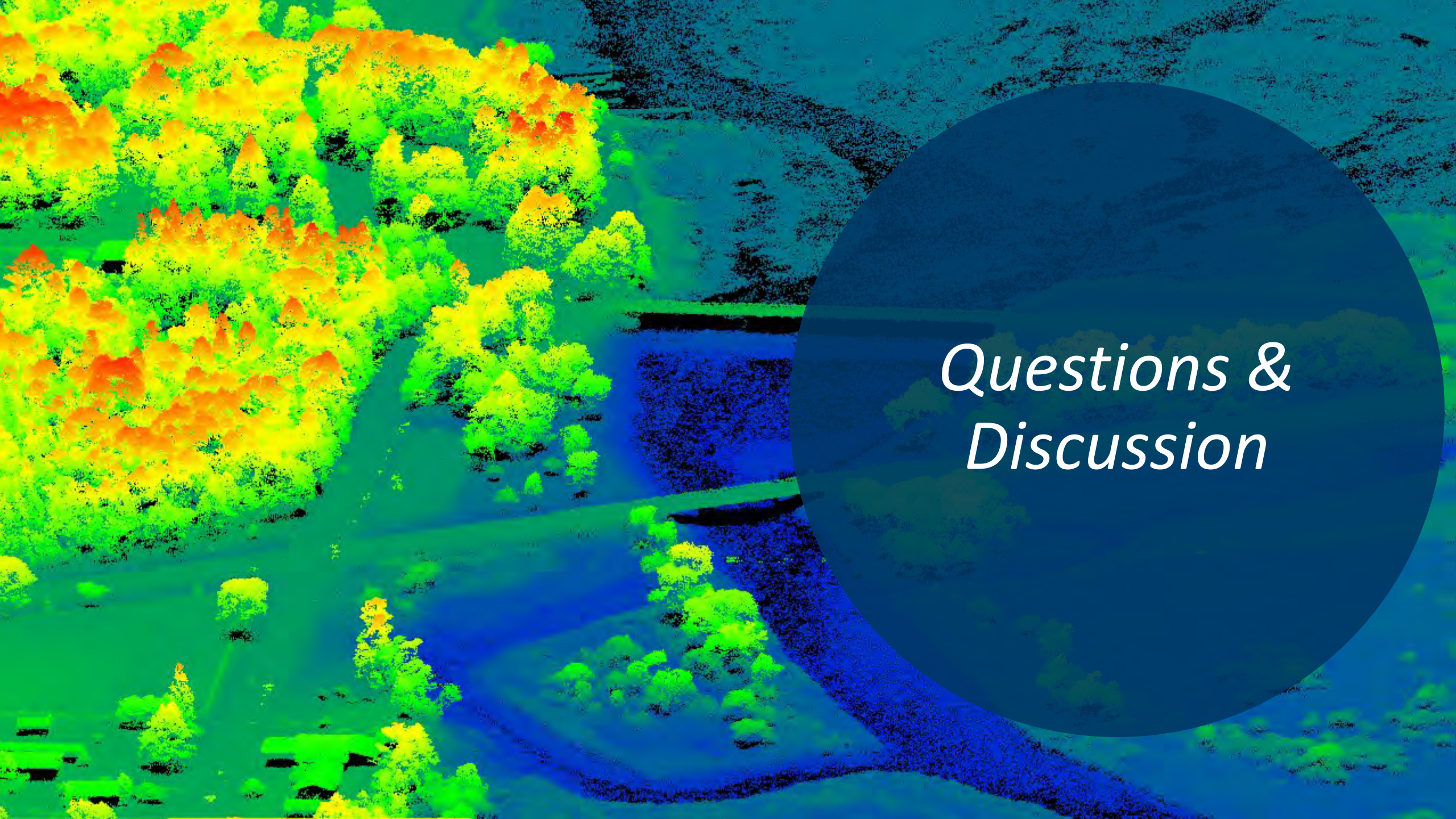
- Private forest land – collaboration for funding requests
- County and City/Municipal forest land – partnerships developing

Collect high density lidar to operationalize PBI model building far and wide

- High density lidar expected to come online within about a year from now
- Additional partnerships needed

Information sharing and data hosting

- Needed: platform to share results – different tools for different business needs


Questions &
Discussion

DEPARTMENT OF NATURAL RESOURCES

Thank You!

Jennifer Corcoran,
MN DNR Resource Assessment

Jennifer.Corcoran@state.mn.us