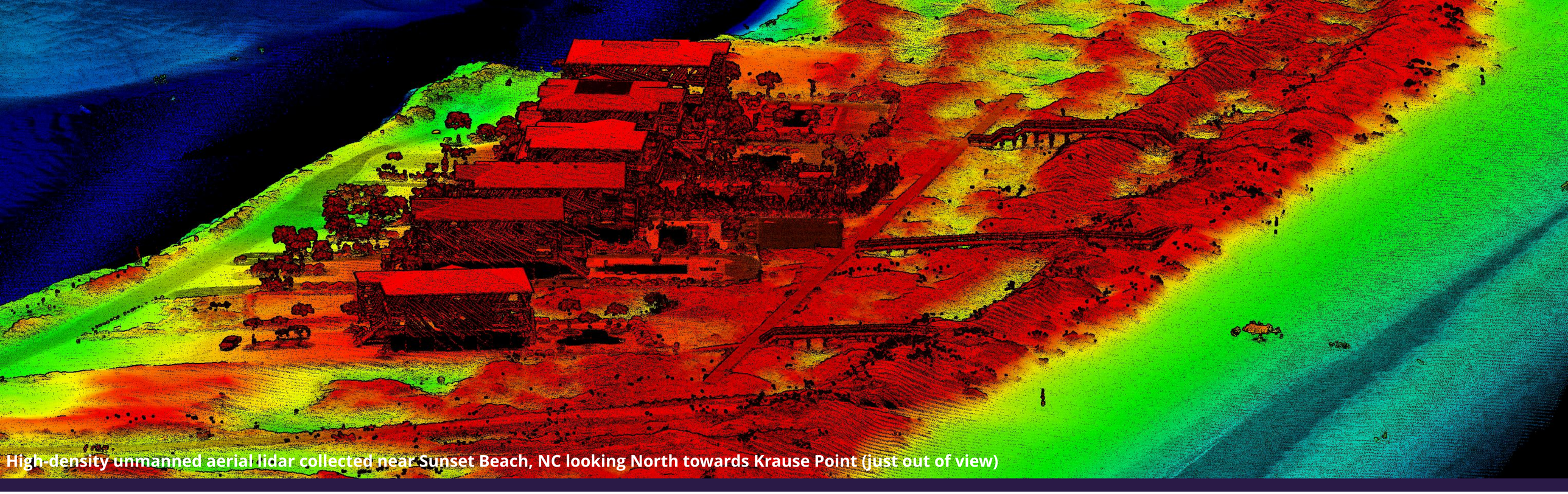


High-density unmanned aerial lidar collected near Sunset Beach, NC looking North towards Krause Point (just out of view)

NORTH CAROLINA BEACH, INLET AND WATERWAY ASSOCIATION

INTEGRATING MANNED AND UNMANNED AIRBORNE LIDAR FOR COASTAL SURVEY AND MANAGEMENT

THURSDAY, OCTOBER 22ND

McKIM&CREED
ENGINEERS SURVEYORS PLANNERS

ABOUT

MCKIM & CREED

McKim & Creed combines a **LOCAL TEAM** with a **DEEP BENCH** of **NATIONAL RESOURCES** to ensure that appropriate resources and staff are allocated to each project.



48
Years In Business

40
National Offices

1200+
U.S. Employees

#40
Top Texas & Southeast Design Firms [ENR]

#157
Top 200 Environmental Firms [ENR]

#158
Top 500 Design Firms [ENR]

OUR SERVICES



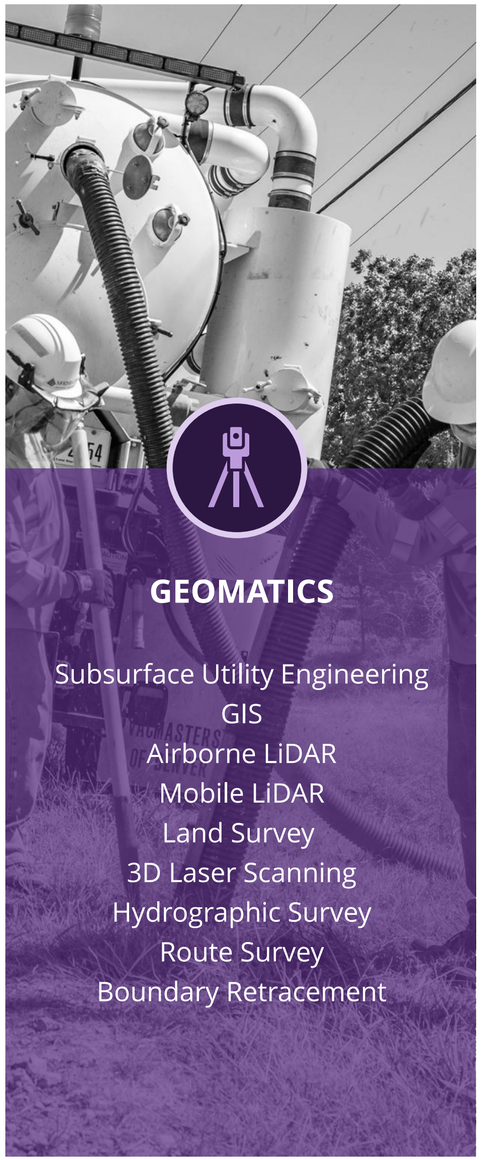
WATER / WASTEWATER

SCADA
Wastewater
Reclaimed Water
Water Management
Renewal & Replacement
Instrumentation & Controls
Trenchless Technology
Hydraulic Modeling
Alternative Delivery



MECHANICAL, ELECTRICAL, PLUMBING, FIRE PROTECTION

Mechanical
Electrical
Plumbing
Fire Protection
Commissioning
Solar



GEOMATICS

Subsurface Utility Engineering
GIS
Airborne LiDAR
Mobile LiDAR
Land Survey
3D Laser Scanning
Hydrographic Survey
Route Survey
Boundary Retracement



SITE / CIVIL

Master Planning
Landscape Architecture
Site/Civil Engineering
Stormwater
Low Impact Development (LID)
Roadway Design



INDUSTRIAL DESIGN-BUILD

Project Development Design
Estimating
Procurement
Scheduling
Commissioning
Project Management
Construction

GEOMATICS

MARKETS

- Transportation
- Electrical Utility
- State/Local
- Institutional
- Federal
- Power Generation
- Developments

SERVICES

- Subsurface Utility Engineering
- GIS
- Airborne LiDAR
- Mobile LiDAR
- Land Survey
- 3D Laser Scanning
- Hydrographic Survey
- Route Survey
- Boundary Retracement

BY THE NUMBERS

520+ Geomatics Staff Firmwide

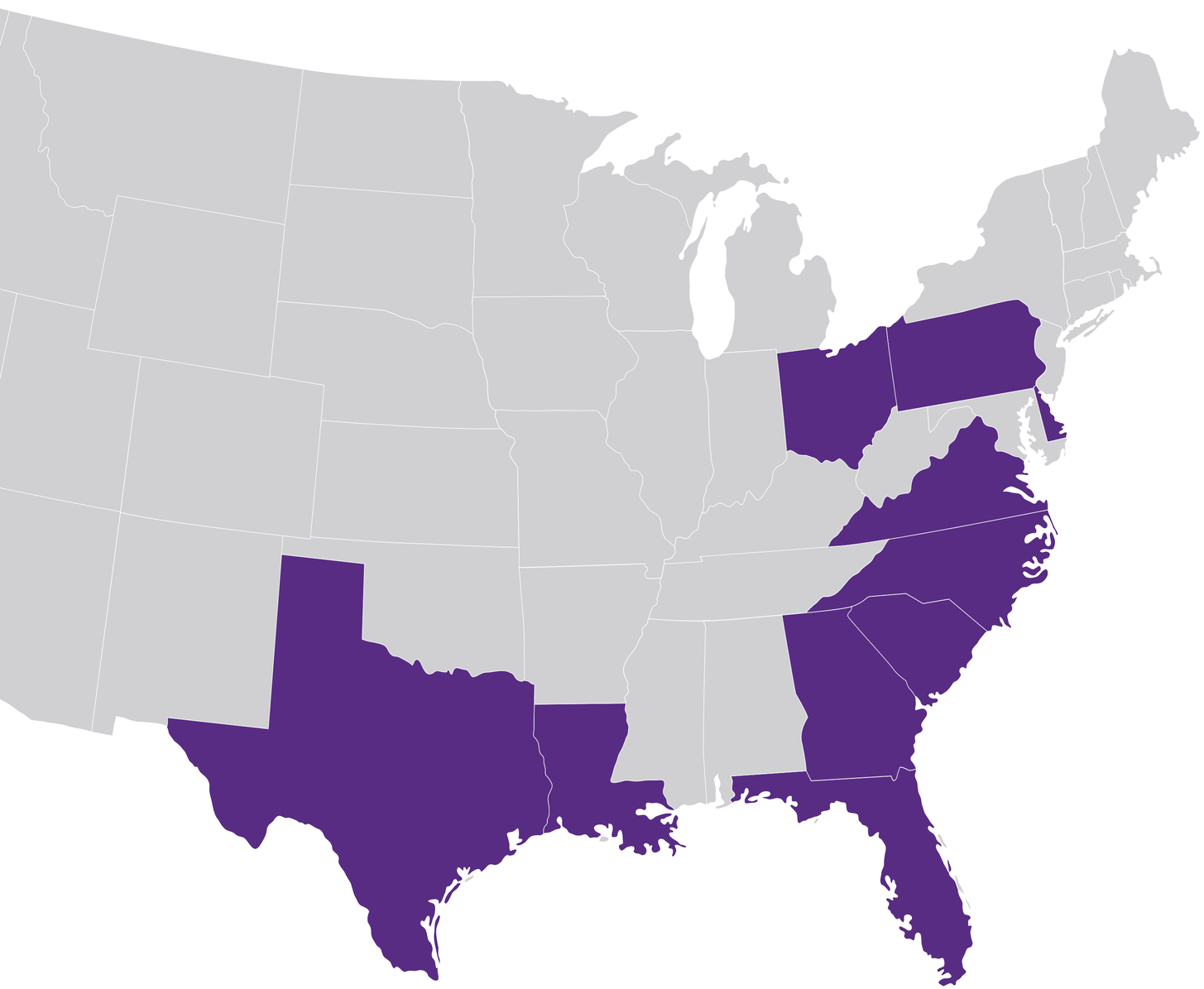
48 Licensed Surveyors

100+ SUE Crews Firmwide

#15 Top 50 North American Trenchless Firms



OFFICE LOCATIONS



NORTH CAROLINA
Asheville
Charlotte
High Point
Raleigh (Headquarters)
Wilmington
Winston-Salem

FLORIDA
Boca Raton
Clearwater
Daytona Beach
Fort Myers
Jacksonville
Orange City
Orlando
Pensacola
Sarasota
Tampa

SOUTH CAROLINA
Charleston
Greenville

GEORGIA
Atlanta

LOUISIANA
Baton Rouge
Gonzales

TEXAS
Austin
Dallas/Fort Worth
Houston
San Antonio

PENNSYLVANIA
Pittsburgh
Sewickley

OHIO
Columbus

DELAWARE
Newark

VIRGINIA
Charlottesville
Norfolk

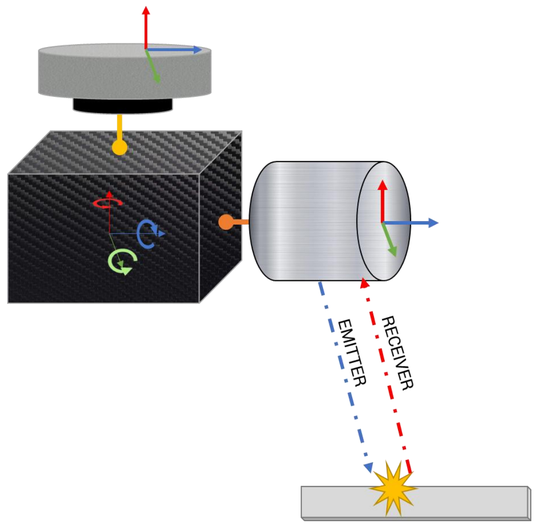
MEET THE PRESENTER



RAVI SONEJA, CMS-LIDAR
GEOSPATIAL PROJECT MANAGER

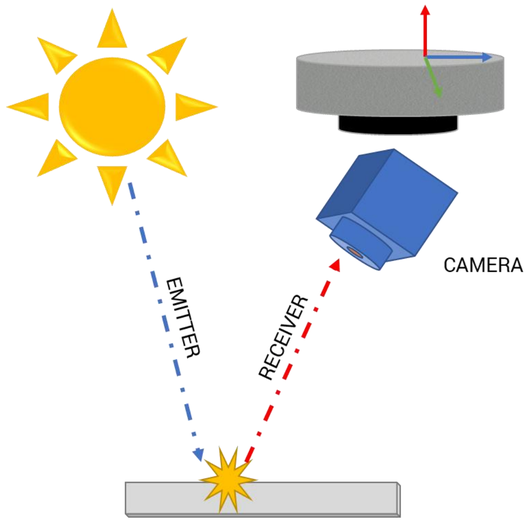
- ASPRS Certified Mapping Scientist – Lidar (L111)
- Manage Aerial Mapping projects throughout the US involving the use of airborne lidar and digital imagery
  - UAS Program Manager
- Before moving to Project Management, career was heavily acquisition and calibration focused
  - 5+ years experience working with airborne lidar sensors
- Professional involvement with ASPRS:
  - Lidar workshop instructor
  - Potomac Region – Immediate Past President
  - Division Director, Primary Data Acquisition Division
  - Chair, Technical Division Directors Council

Light Detection & Ranging (Lidar)



ACTIVE

Photogrammetry



PASSIVE

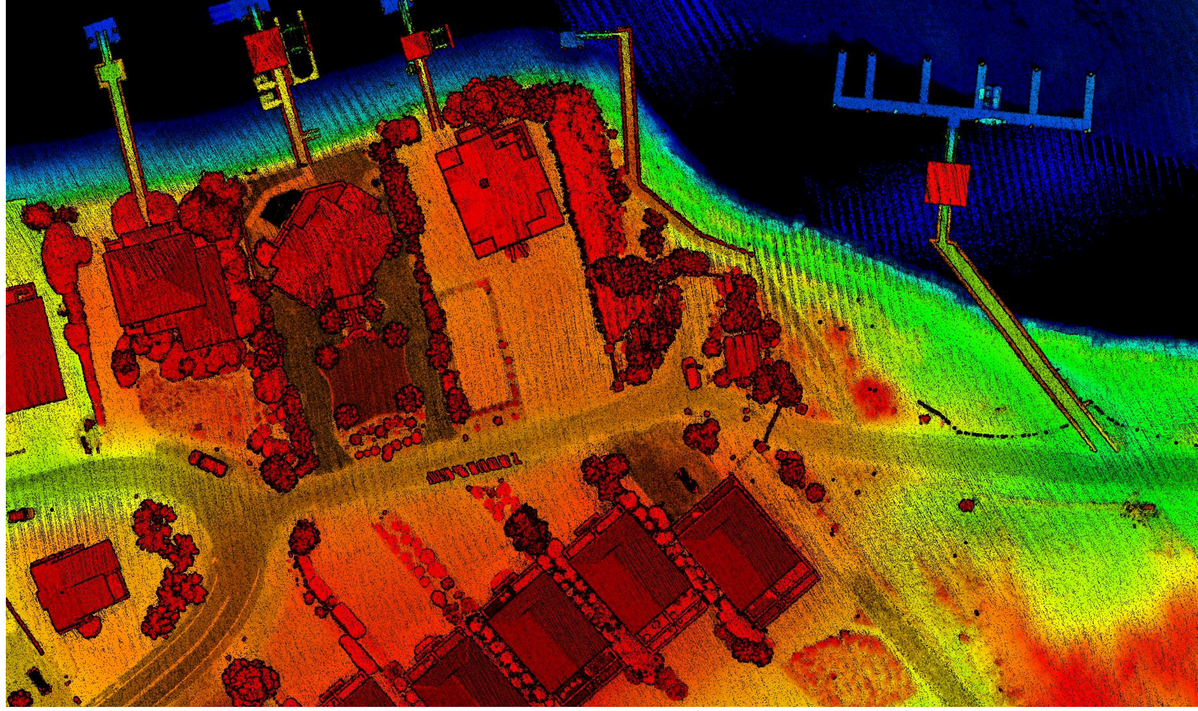
UNDERSTANDING ACTIVE & PASSIVE SENSORS

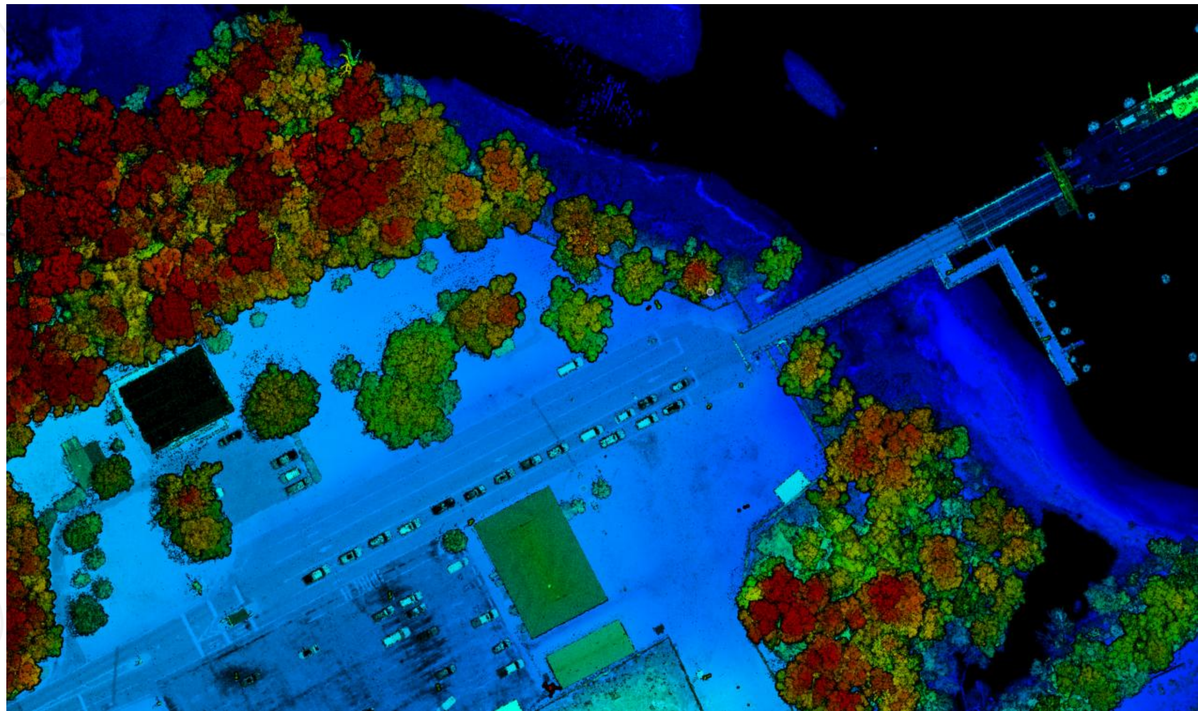
WHAT IS Lidar?

- Stands for “Light Detection & Ranging”
- Can be Airborne, Mobile, or Terrestrial
- Active sensor technology
- Random Sampling
- Multiple returns per outgoing pulse

ADVANTAGES

- ✓ Acquisition can occur day or night
- ✓ Able to penetrate vegetation
- ✓ Dense data with high-fidelity of features





WHAT IS PHOTOGRAMMETRY?

- Overlapping images used to create maps
- Passive sensor technology
- Optimal lighting conditions required for acquisition
- Better suited for bare earth sites with minimal to no vegetation
- Overall feature extraction process is much more manual

PHOTOGRAMMETRY is not **OBSOLETE**!





WHICH SHOULD YOU USE FOR YOUR PROJECT?

DEPENDS, NEED TO UNDERSTAND THE FOLLOWING…

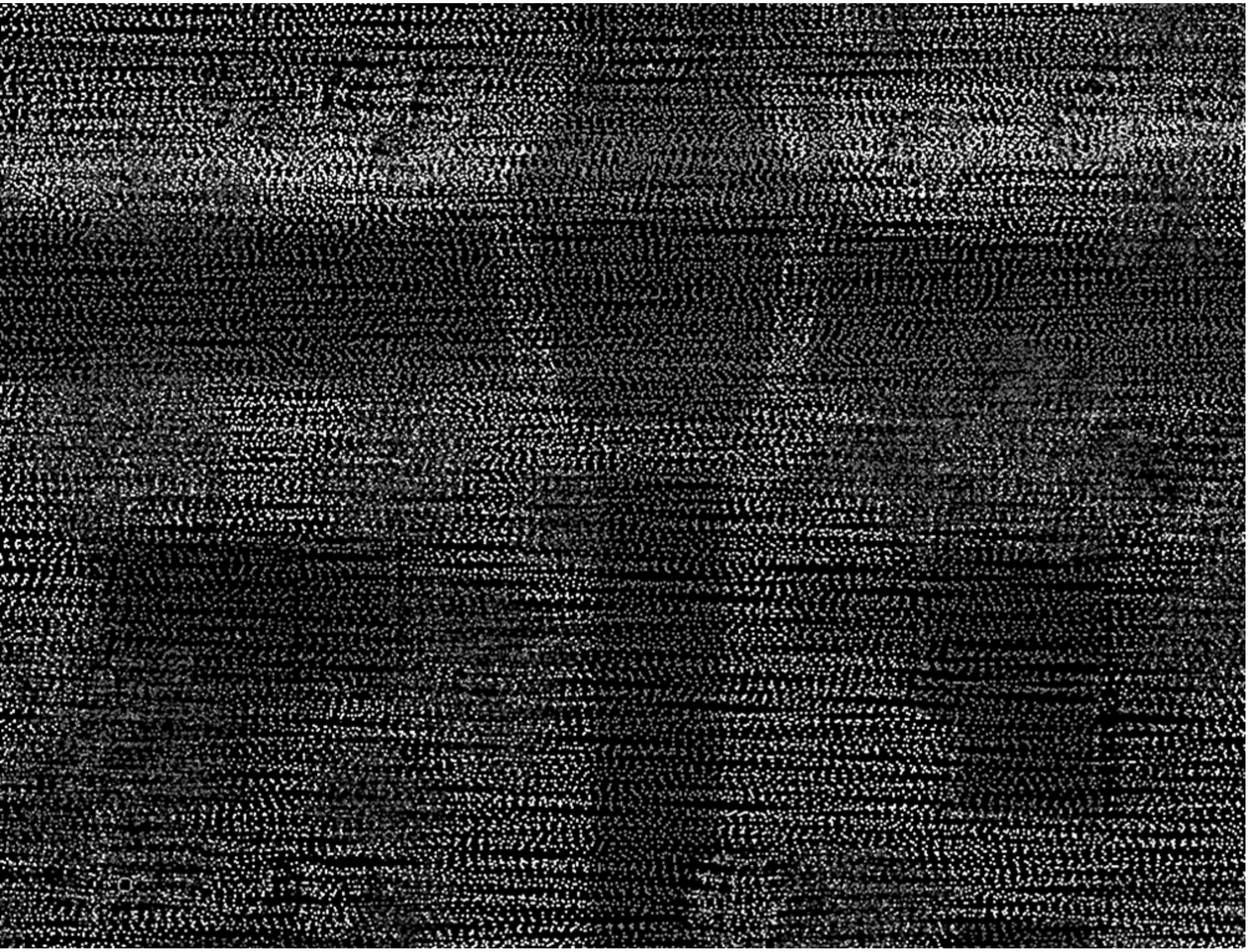
- Site Conditions
- Feature(s) of Interest
- Deliverables
- Project specifications & required accuracies (of **both** final product and control)

SOLUTIONS-BASED approach

CONVENTIONAL SURVEY methods necessary to supplement lidar/imagery



Lidar VS. DENSE IMAGE MATCHING (DIM)











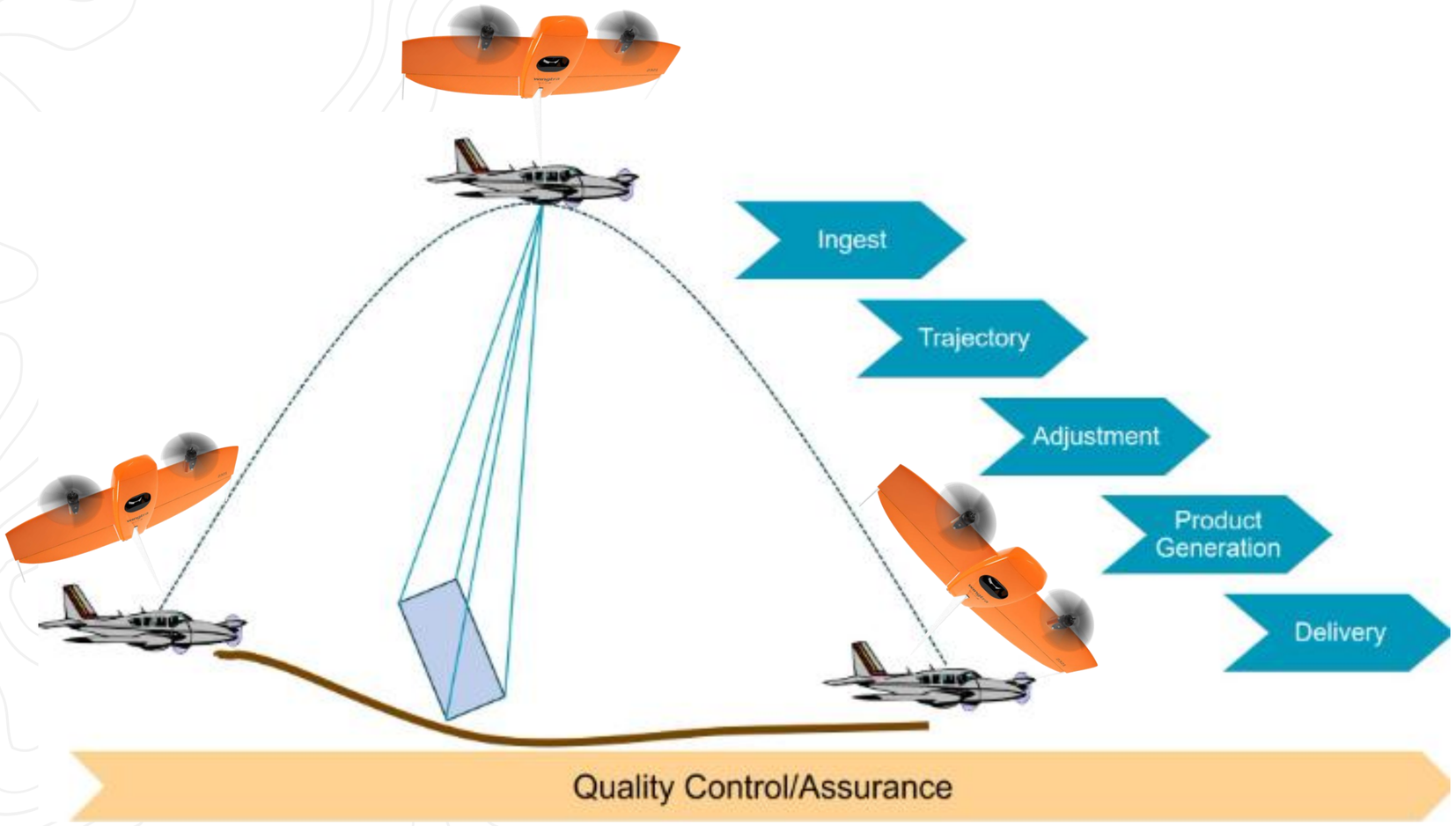
AERIAL LIDAR – A TOOL IN THE TOOLBOX

Principles and science behind lidar acquisition/processing remain the same, only the method of acquisition is changing

WORKFLOW OVERVIEW

- Design/review/approve flight plans and control/targeting layout
- Set/establish control and aerial targeting
- Acquire lidar & imagery
- Process data
- Calibrate to control
- Classify
- Derive final products
- Test vertical accuracy

QA/QC occurs throughout

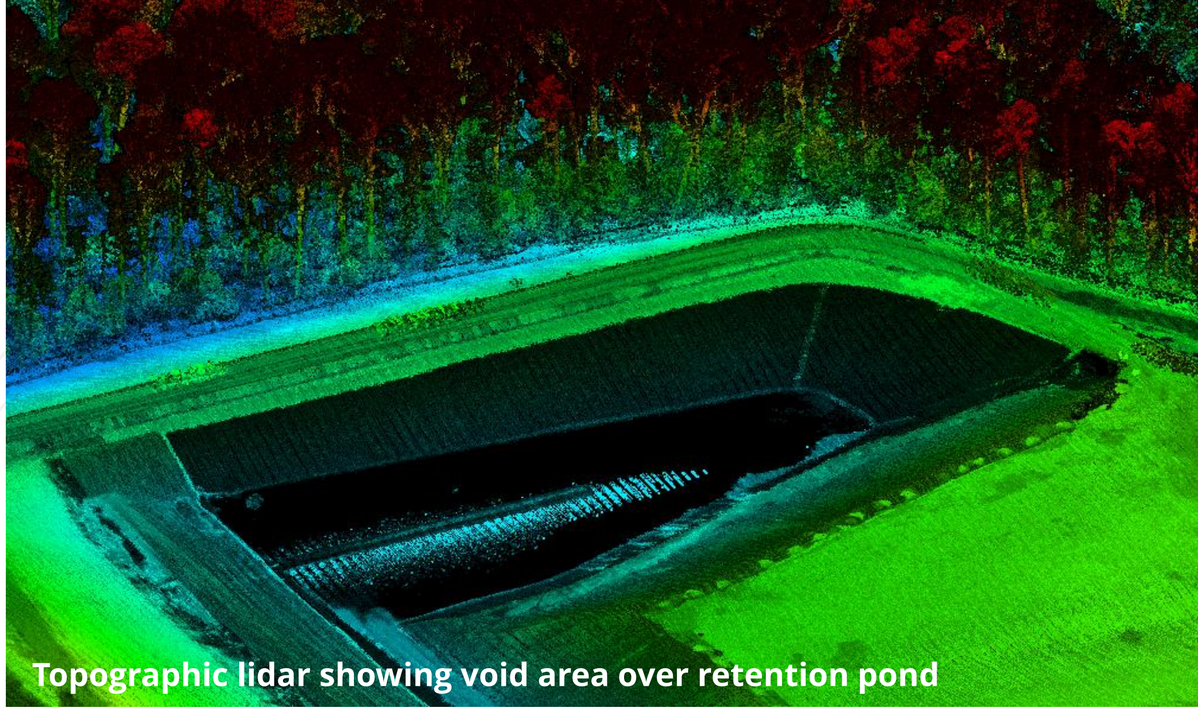


TOPOGRAPHIC VS. TOPOBATHY Lidar

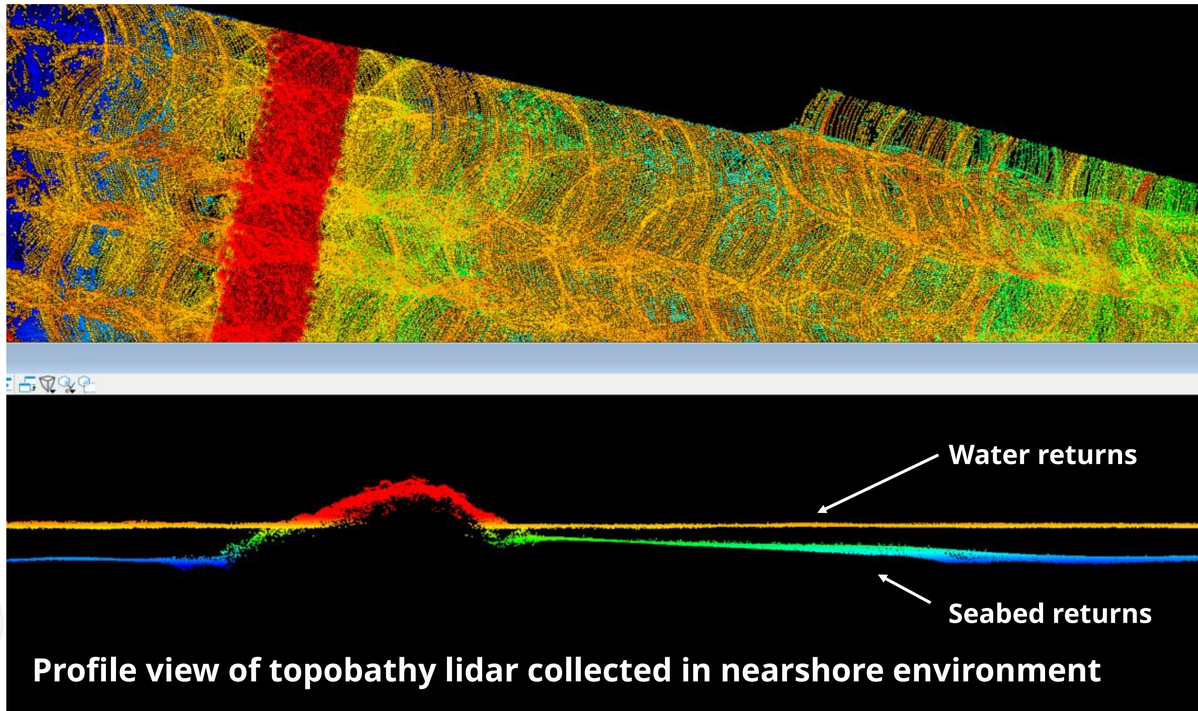
- Topographic lidar is used to acquire terrain or elevation information on the surface of the earth
- Laser wavelength used for topographic mapping systems are strongly absorbed or refracted by water
- Topobathy lidar is used to acquire data in bodies of water using specific laser wavelength and scan patten

WHAT AFFECTS THE QUALITY OF TOPOBATHY LIDAR?

- Water column dynamics (clarity, sediment, turbidity)
- Composition of seabed or riverbed
- Sensor depth capability is dependent upon measured Secchi depth



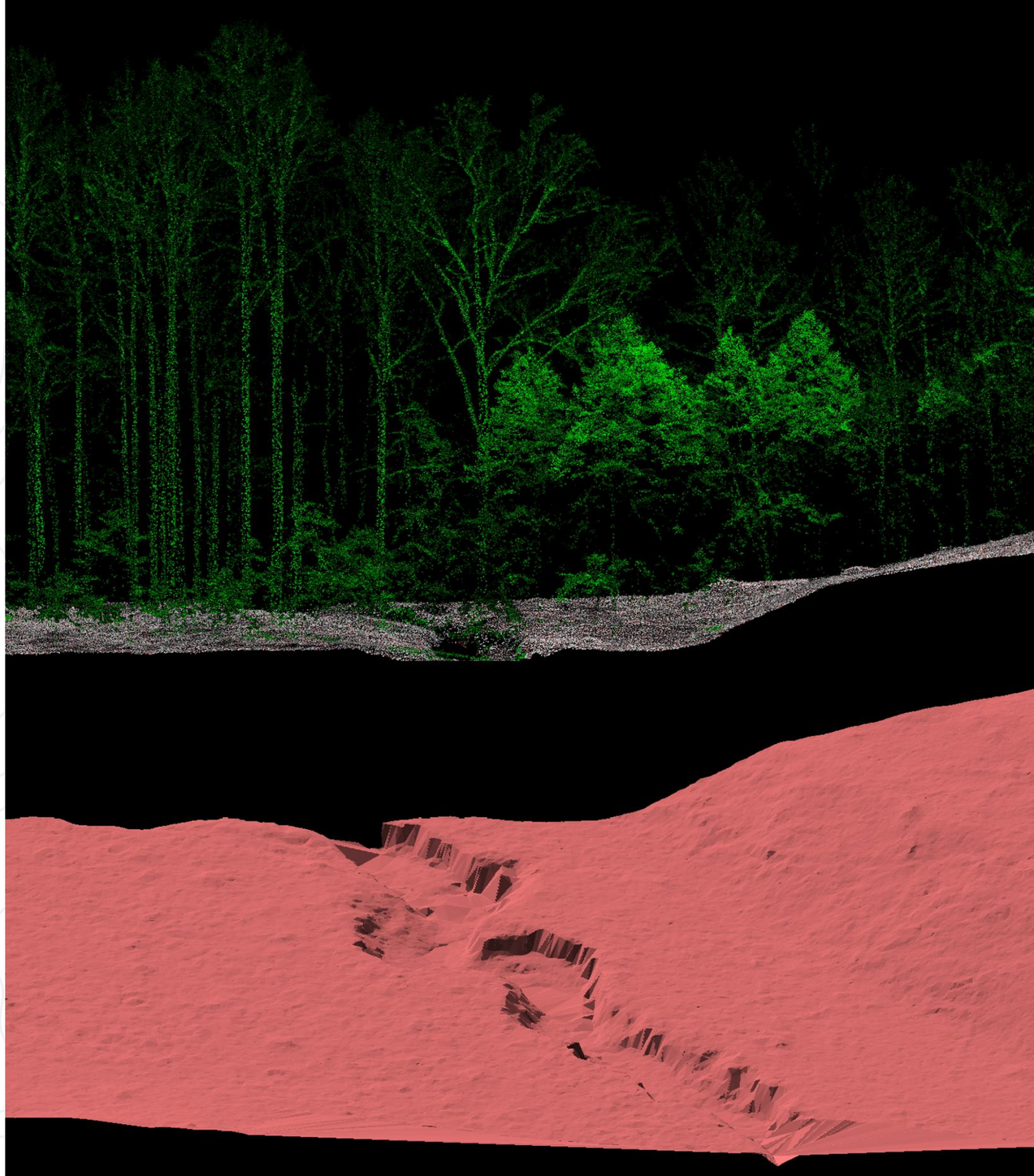
Topographic lidar showing void area over retention pond



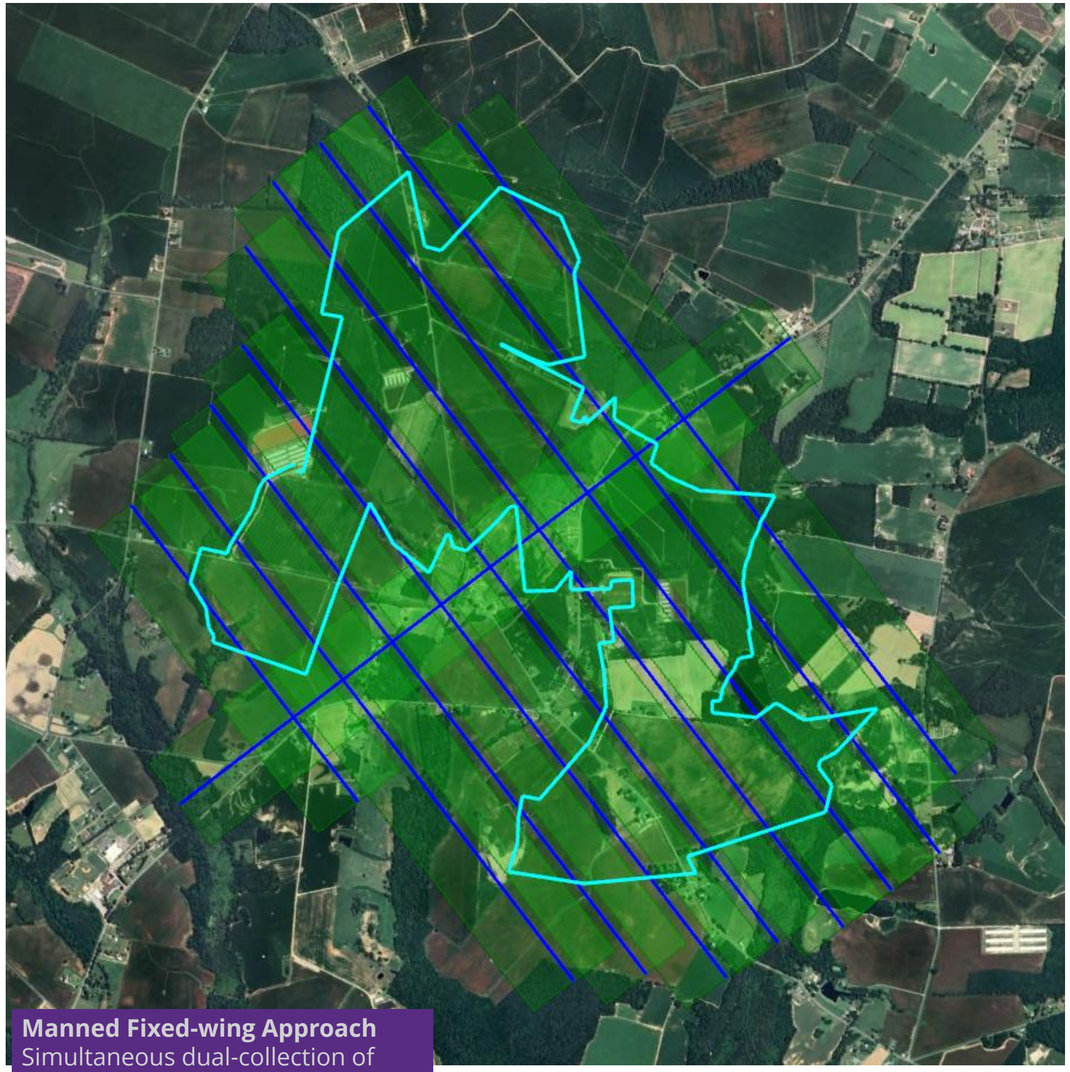
Profile view of topobathy lidar collected in nearshore environment

DEFINING HIGH DENSITY LIDAR

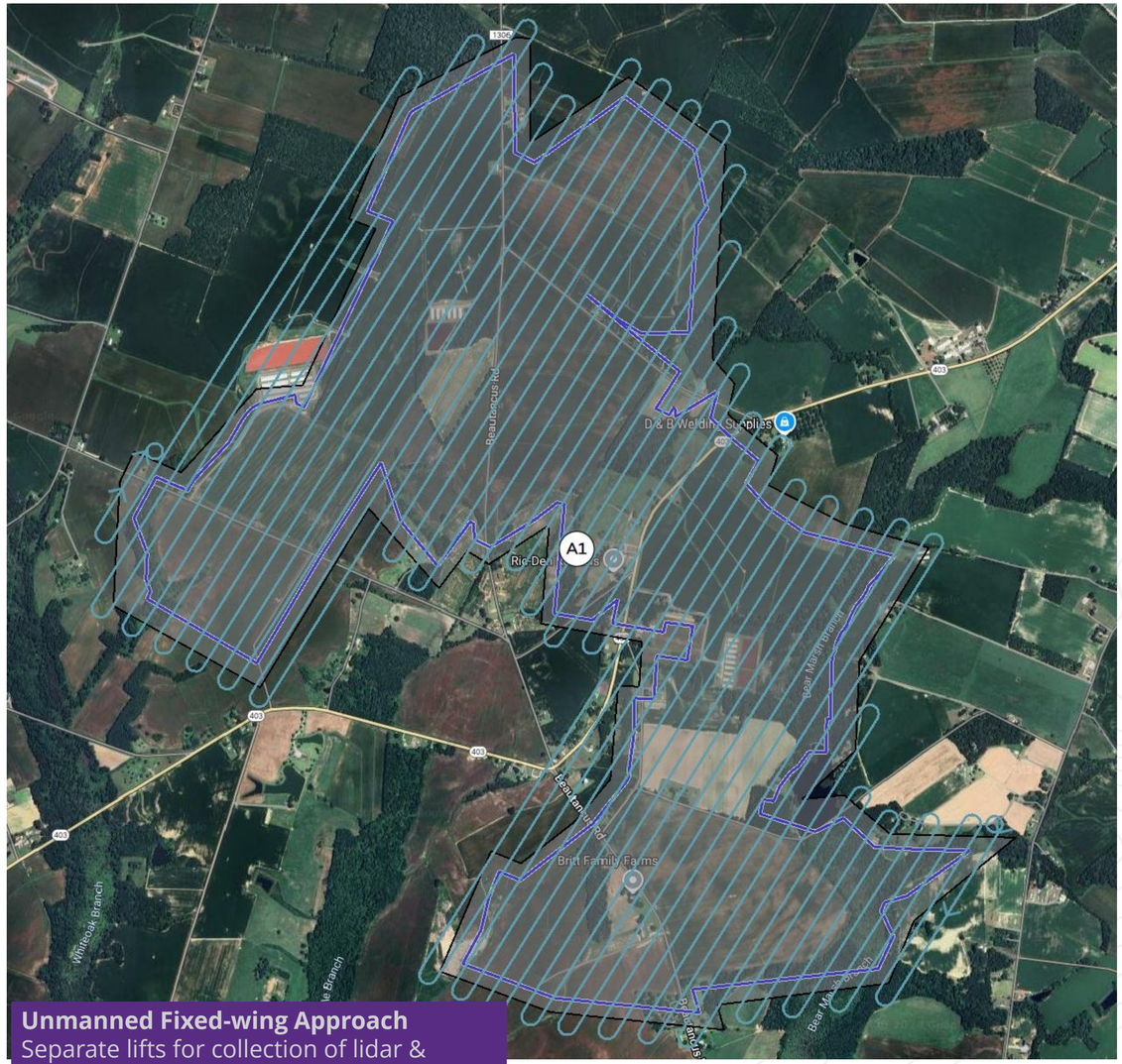
- Most topographic mapping can be supported with lidar collected at or between 2-20 ppsm
- Somewhat subjective… generally ~30+ ppsm considered high density
- Increase in point density = increase in surface definition (diminishing returns)
- Many of today's UAS lidar sensors capable of producing 60+ ppsm lidar (nominal – single pass)
  - ➢ Ground classified points will be a fraction of this
  - ➢ Breakline extraction still required to enforce terrain model (DTM)



IF ALL YOU HAVE IS A HAMMER…



Manned Fixed-wing Approach
Simultaneous dual-collection of lidar & imagery
10 flight lines w/ 307 exposures

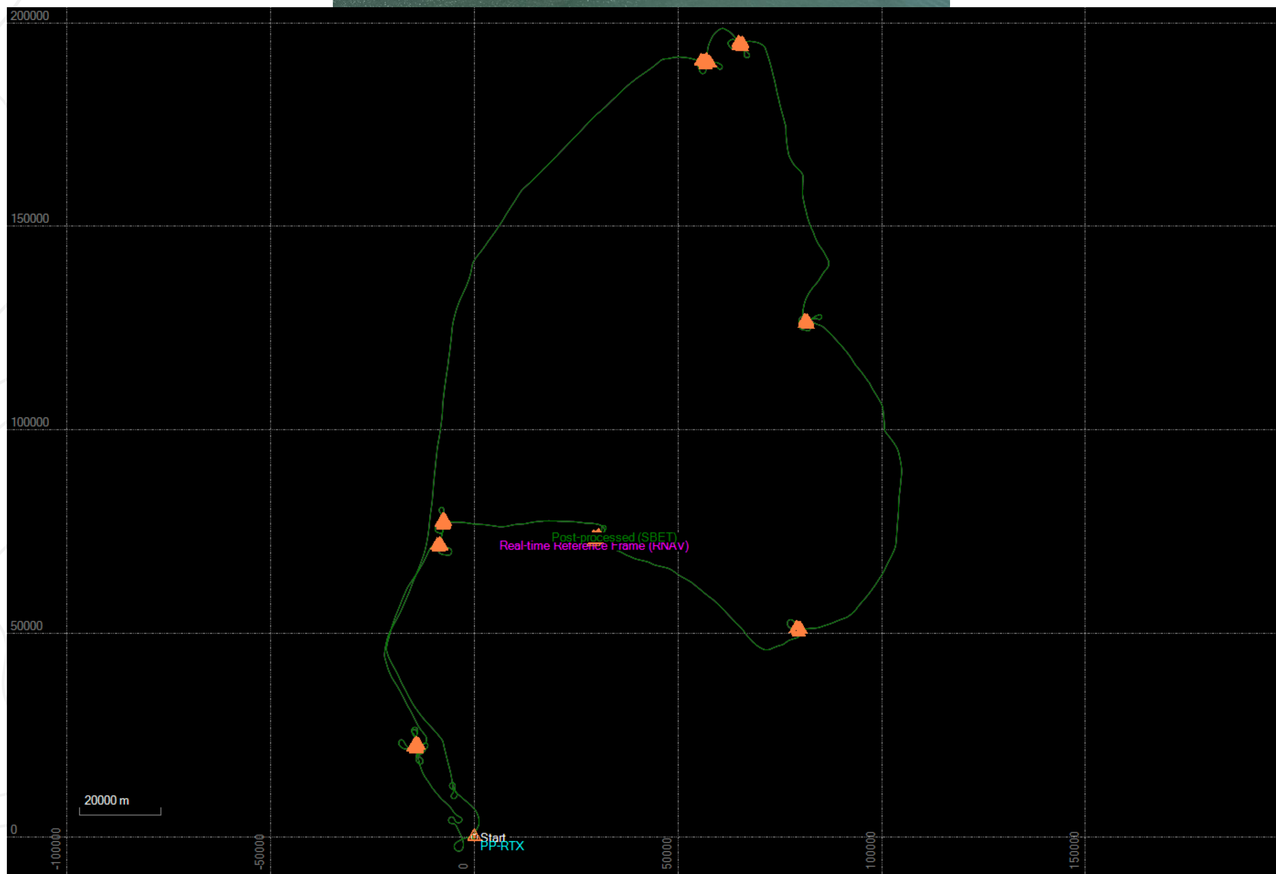


Unmanned Fixed-wing Approach
Separate lifts for collection of lidar & imagery
52 flight lines w/ 6240 exposures

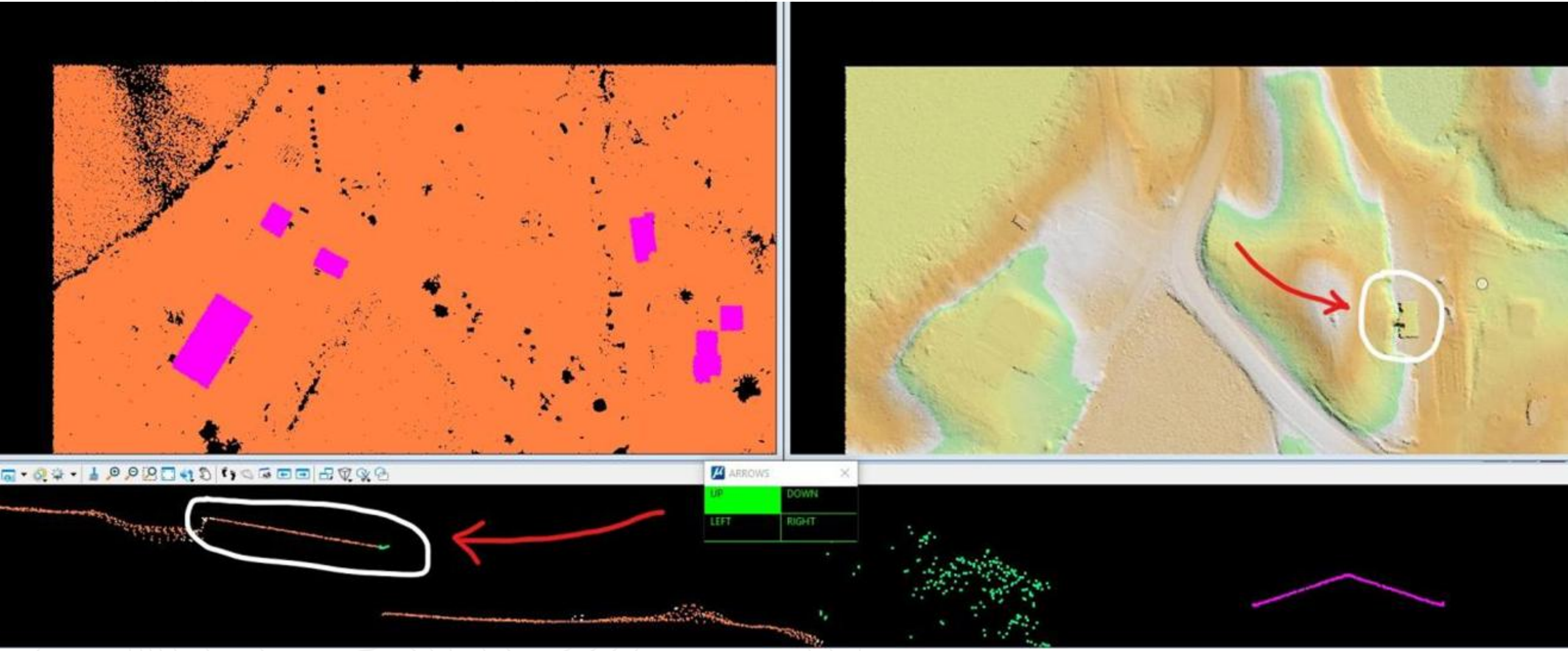
SELECT THE RIGHT TOOL

- McKim & Creed's Aerial Mapping group tasked with collecting and processing high-density lidar and high-resolution digital imagery
- 12 sites across coastal North Carolina
  - ➢ Remote
  - ➢ Geographically dispersed
- UAS Lidar & Imagery:
  - ➢ Two-person crew, 5 field days (assuming no weather delays)
- Manned aircraft:
  - ✓ Sensor operator collected 8 of the 12 sites in a single lift
  - ✓ Remaining sites acquired the following morning <u>along with a separate project in Wilmington, NC</u>





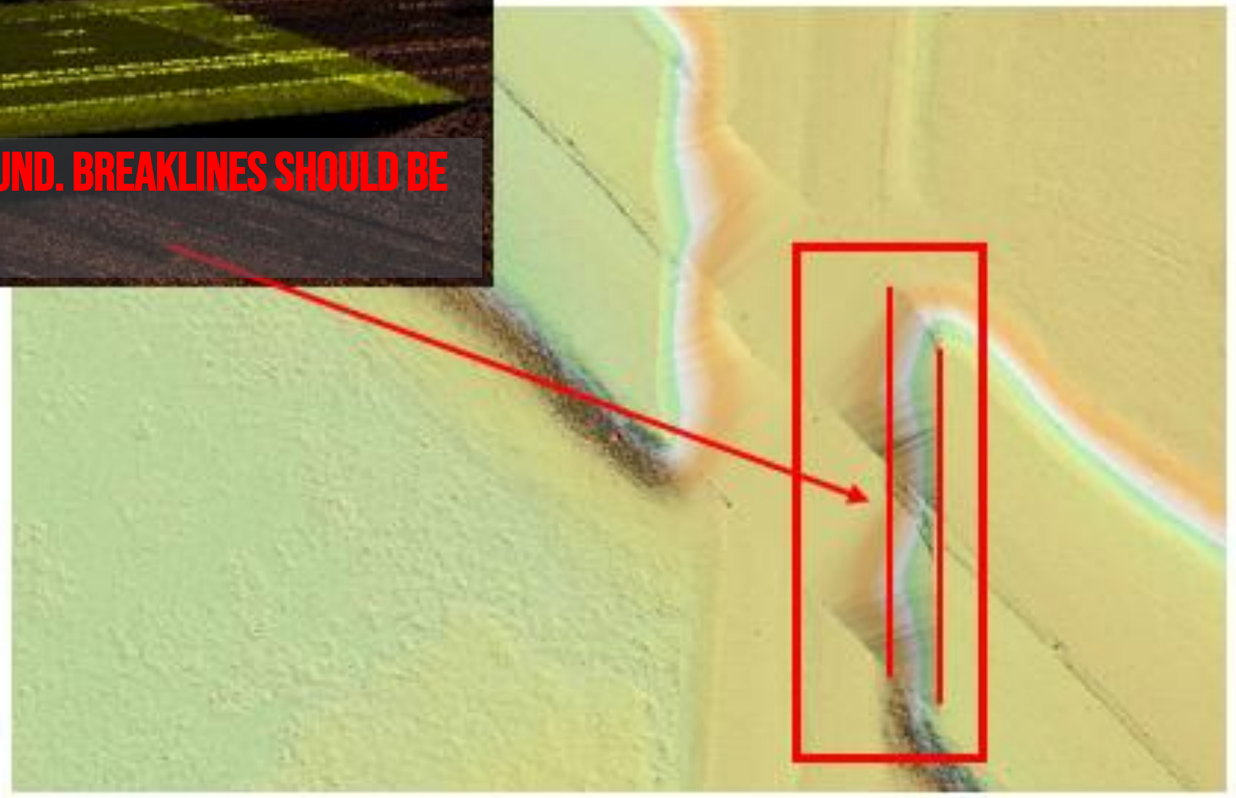
LIDAR PROCESSING – MANUAL EDITING



LIDAR PROCESSING – MANUAL EDITING



BRIDGE DECK HAS BEEN MANUALLY EDITED AND REMOVED FROM CLASS 2 – GROUND. BREAKLINES SHOULD BE ADDED TO ENFORCE TERRAIN MODEL.



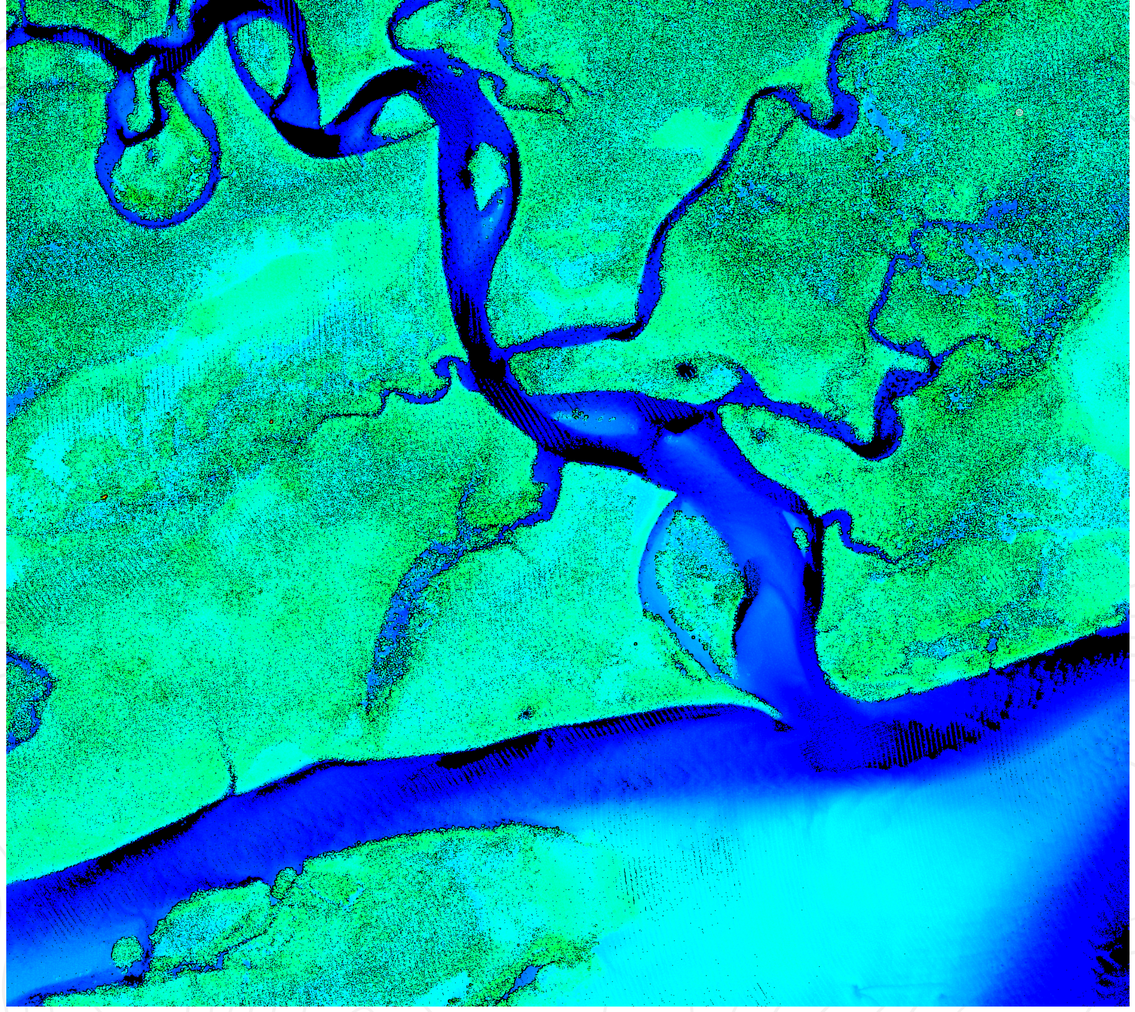


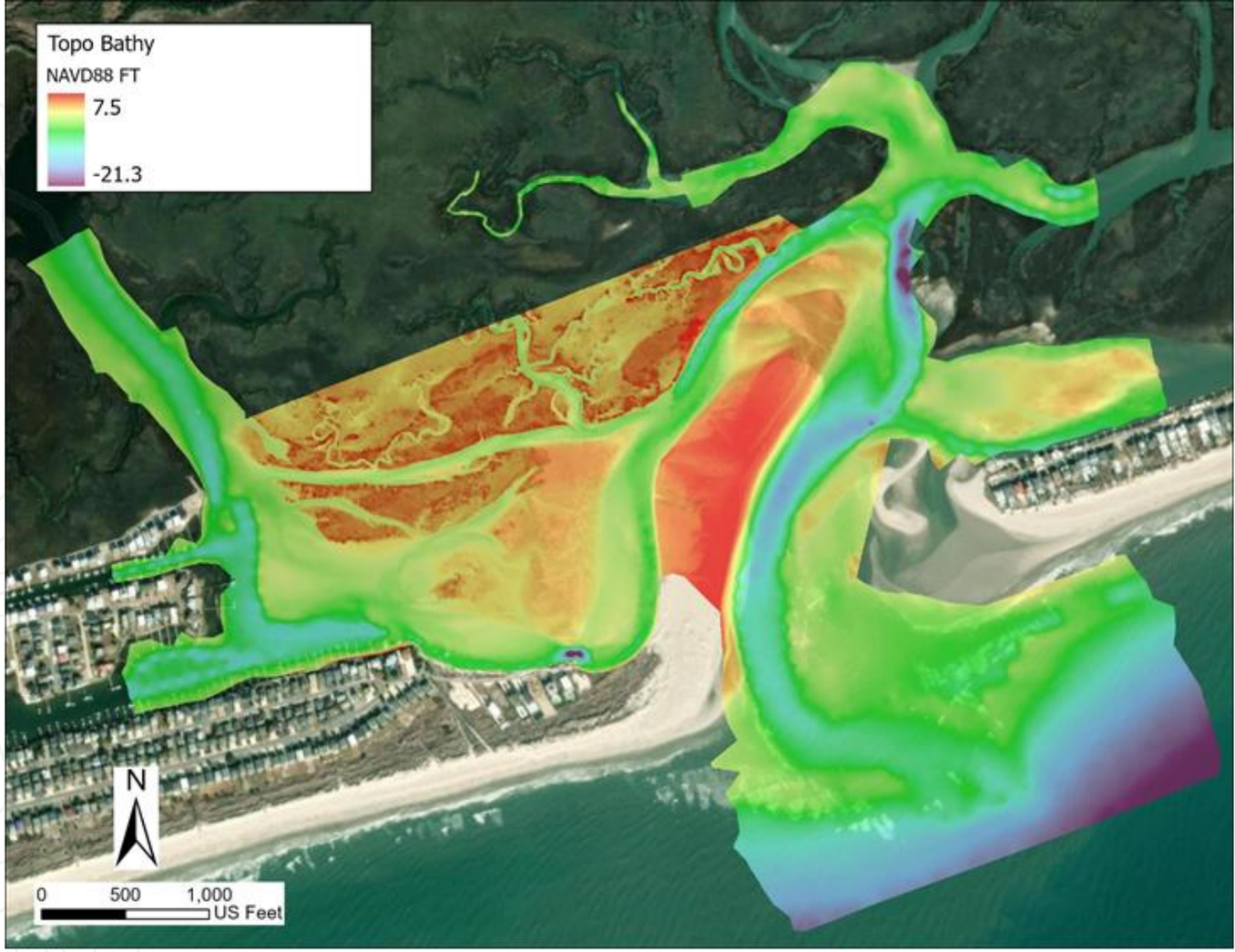
McKim & Creed's manned aerial lidar + imagery system flying over Wilmington, NC



McKim & Creed Hydrographic Survey Vessel

APPLICATIONS OF AIRBORNE LIDAR FOR COASTAL MANAGEMENT AND SURVEY





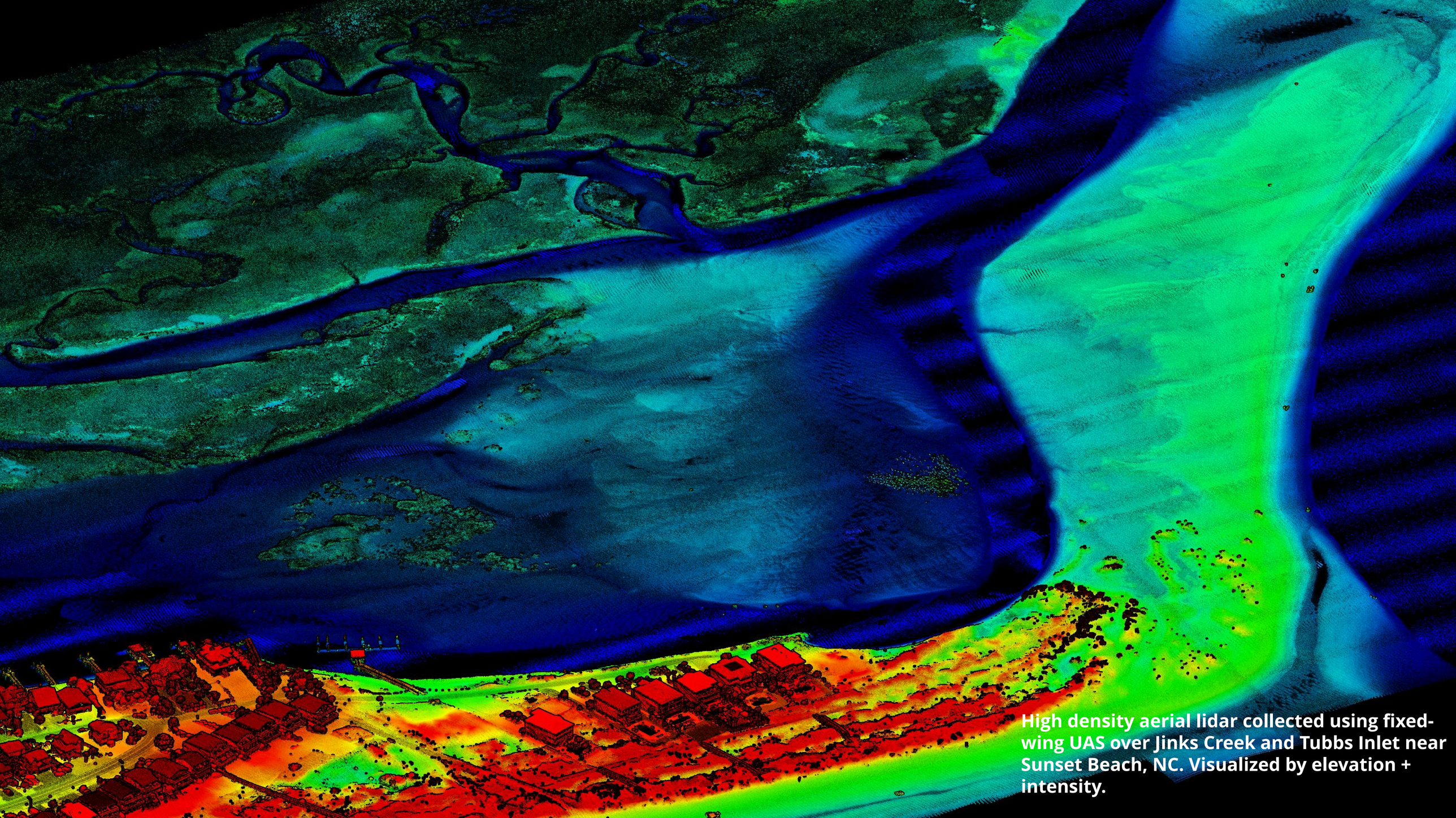
JINKS CREEK *PROPOSED* REALIGNMENT

MCKIM & CREED WAS A SUB-CONSULTANT TO COASTAL PROTECTION ENGINEERING

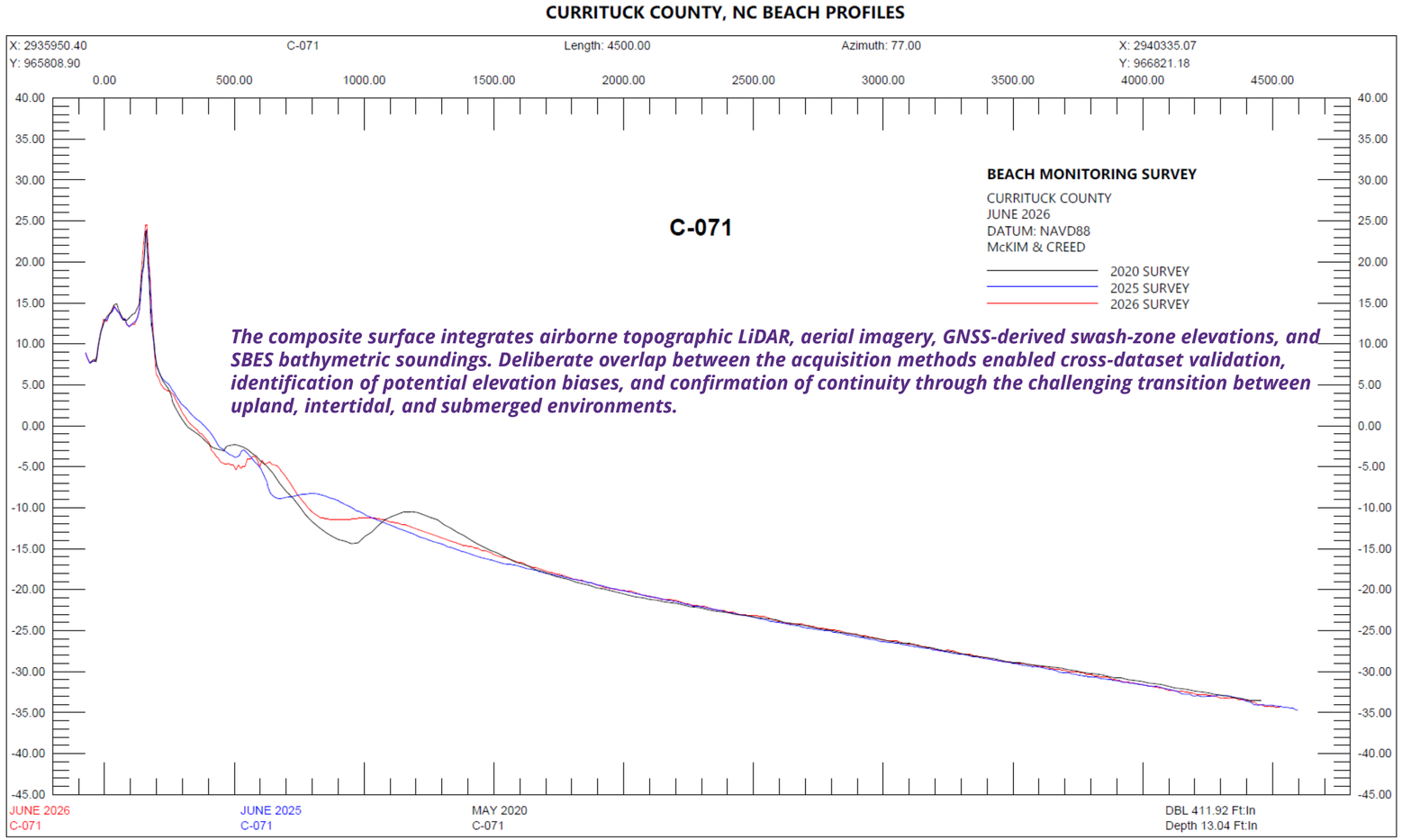
Sunset Beach, North Carolina

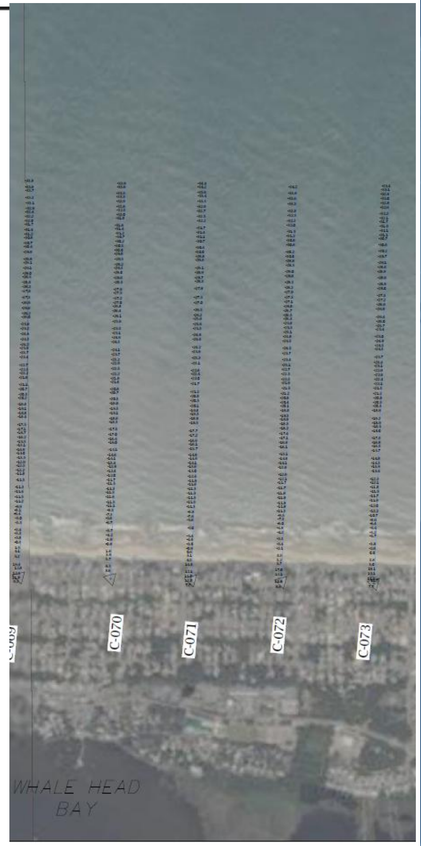
- Project objectives:
  - Extend navigation to open waters
  - Dredged spoils used to restore or fortify eroded shoreline

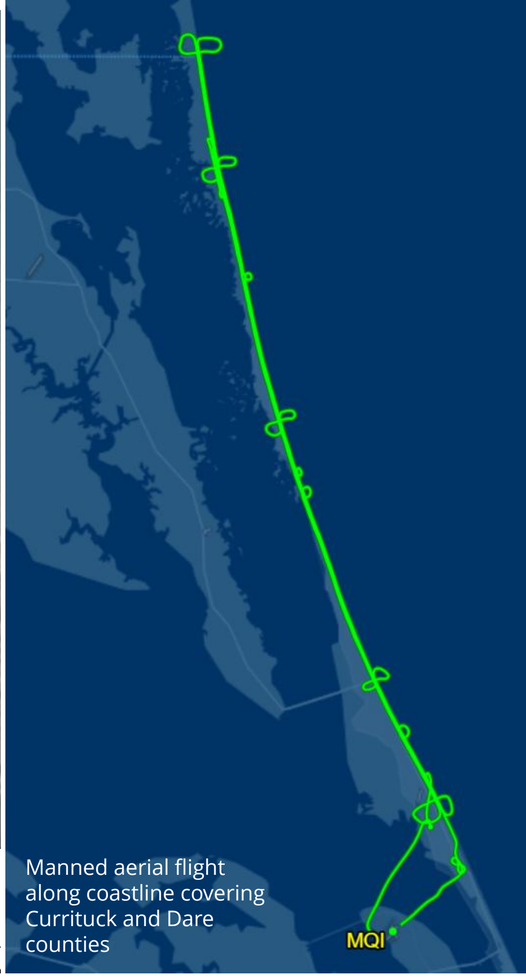
- UAS Lidar + Hydrographic survey data combined for Delft3D modeling effort which will be used to help inform design
- Numerical modeling shows how sediment moves



High density aerial lidar collected using fixed-wing UAS over Jinks Creek and Tubbs Inlet near Sunset Beach, NC. Visualized by elevation + intensity.







Manned aerial flight along coastline covering Currituck and Dare counties

CURRITUCK COUNTY BEACH NOURISHMENT

MCKIM & CREED WAS A SUB-CONSULTANT TO COASTAL PROTECTION ENGINEERING

Currituck County, North Carolina

- Dual, simultaneous collection of lidar + imagery using manned aircraft over 40 linear miles of coastline AND conventional survey of station profiles at 1000 ft intervals (aerial lidar used from C-059 to C-120)
- Only previously available topographic data source was from 2019
- Project objectives:
  - Storm simulation – how will the profiles look after a storm acts on those PROFILES?
  - Are there vulnerable low spots between station profiles?
  - **High density lidar allows for full 2D grid of surface to show impacts not only at station profiles but anywhere on the surface**



Thank you.

QUESTIONS

Email: rsoneja@mckimcreed.com