

Instrumentation Support and Data Processing/Visualization with the RAPID Facility

Joe Wartman and Jeff Berman
University of Washington
Dir. and Opps Dir., RAPID Facility

SHORELINE21

NSF Award Number: CMMI 1611820



RAPID Facility

The RAPID facility provides investigators with the equipment, software, and support services needed to collect, process, and analyze perishable data from natural hazard events.



Since becoming field operational in 2018, the RAPID has supported over 70 deployments worldwide

RAPID Facility Activities



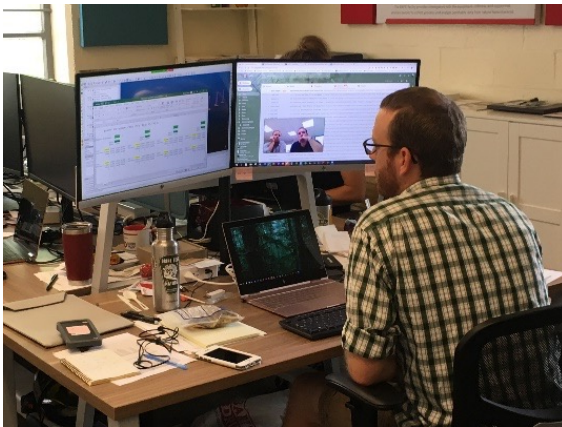
Acquire, maintain, and operating state-of-the-art mission-ready instrumentation



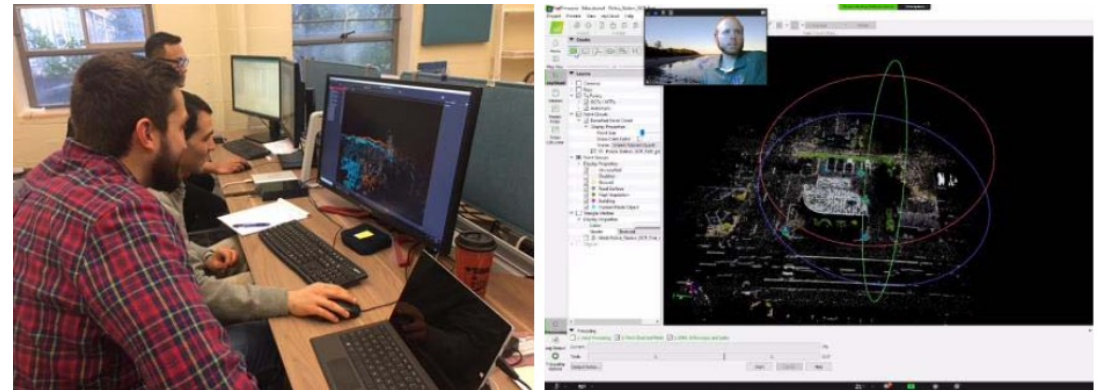
Train a broad user base



Field support, as needed



Provide advisory services and basic logistics support for research investigations



Provide user support through the project lifecycle

Unique Aspects of Natural Hazard Reconnaissance Data

- The high volume of data generated by an extreme event is often highly "**perishable**"
- Disaster data sets include the **real-world complexities** (e.g., interplay between natural, human, and built systems) that allow us to understand better and to quantify the socio-technical dimensions related to damage, restoration, and resiliency of the built environment;

Such data is **difficult to duplicate in the laboratory**

- These data can be used to:
 - develop new, fundamental discoveries and insights
 - test and verify simulation models; reduce reducing uncertainties in probabilistic models
 - inform next generation simulation models (e.g. AI algorithms)



Strategic Approaches for Reconnaissance: Cross-Scale Data Collection and Synthesis, Across Disciplines

Cross-Temporal Scale - *Resilience*

- Pre-event: pre-existing "conditioning" factors
- Event: direct impacts, character of the event
- After-event: recovery and evolution

Cross-Geospatial Scale - *Context*

- Improving our understanding of hazard impacts and advancing regional scale modeling requires collection and synthesis of data over spatial scales spanning multiple orders of magnitude

Cross-Social Scale – *Reaching all populations*

- Events can have varying impacts on socio-economic groups

Multidisciplinary Data - *Integration*

Understanding of the complicated relationship between hazards, the built environment, and communities requires that the physical and socioeconomic factors leading to disasters be untangled.

Wartman et al. (2020) Front. Built. Env.



RAPID Instrumentation



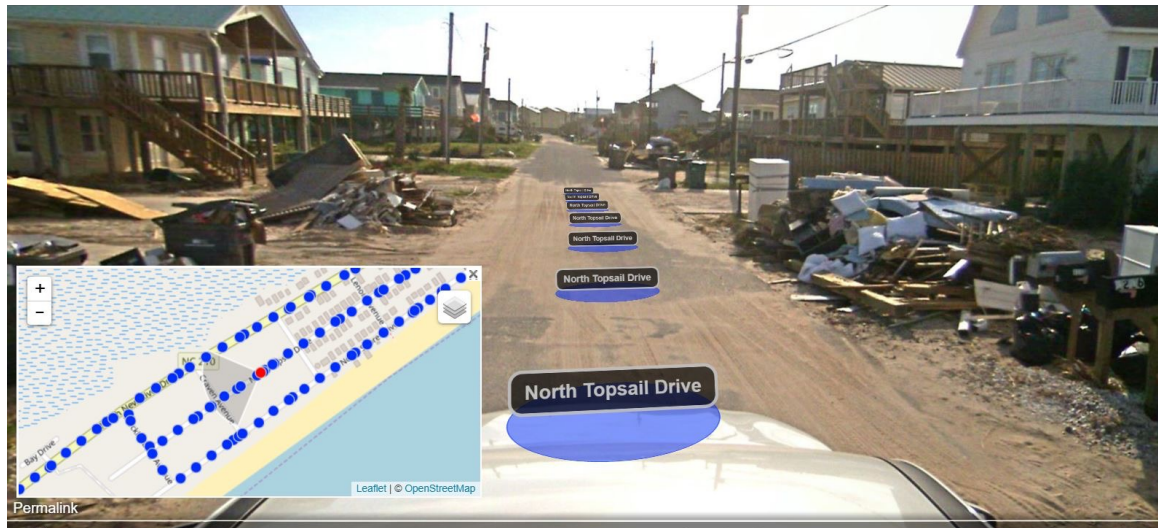
<https://rapid.designsafe-ci.org/equipment-portfolio/>

Unmanned Aircraft Systems (UAS)

- ◆ Industrial: weatherproof, high-resolution data for SfM
- ◆ MiniRanger: lidar system



Streetview



Streetview data collected by StEER team (Daniel Smith, UF) after Hurricane Florence (NSF 1841667)

- ◆ Your own, personal Streetview
- ◆ 360-degree, car-mounted camera
- ◆ GNSS georeferencing
- ◆ Remove sensitive info (faces, license plates)
- ◆ Easy mount to vehicle
- ◆ Visualization Software for organizing and querying projects
- ◆ Growing interest in the AI community

3D Laser Scanning Equipment



Leica BLK360 (x3)



Leica RTC360

- ◆ Short, medium and long range systems
- ◆ Simple, easy to use interfaces
- ◆ Portable and durable
- ◆ Streamlined workflows



Leica P50



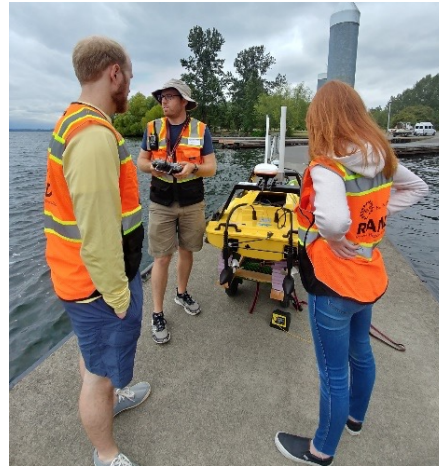
Maptek LR3



Maptek XR3

Coastal Equipment

Z-boat (Single Beam Echo Sounder)



Depth: 30cm to 600m
RTK GNSS position
5cm Heave accuracy

Aquadopp Profiler 2 MHz



True Blue Water Level loggers (x20)



Depth: 0m to 200m
Log rate: Up to 4Hz

RJE Acoustic Beacon (x10)



Used to locate
submerged
equipment, i.e.
True Blue and
Aquadopp or
others...

Petit Ponar Grab Sampler



RApp: Field Data Collection Ecosystem

The data collection ecosystem is comprised of three main components:

DesignSafe-CI

- ◆ Cyberinfrastructure for the natural hazards community
- ◆ Cloud-based data storage, analysis, collaboration, and publication
- ◆ Provides user account services for **RApp**



Mission Control

- ◆ Web-based portal
- ◆ Create Checklists
- ◆ Create Questionnaires
- ◆ Review **RApp** data



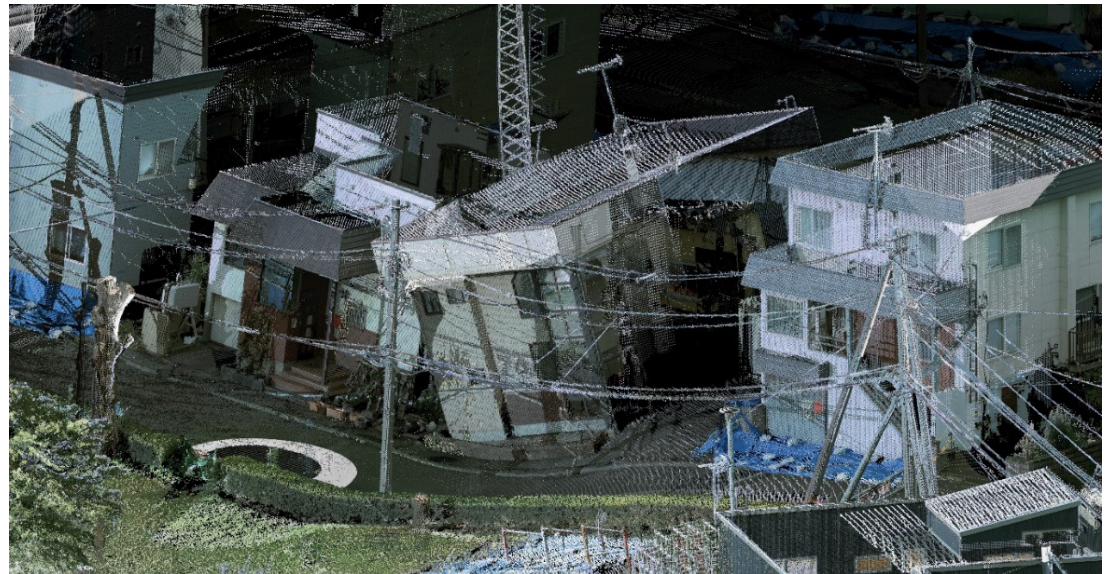
RApp

- ◆ Mobile app used for data collection
- ◆ Data collected with **RApp** is automatically synced to **Mission Control** and **DesignSafe-CI**



Using the RAPID

- ◆ Open to anyone:
 - Academics, government agencies, private industry, etc.
 - Different rates for NSF vs. non-NSF (RAPID equipment is subsidized by NSF)
 - Priority for natural hazards reconnaissance but can deploy equipment for many different applications
 - We aim to accommodate all requests
- ◆ Go to the RAPID website at <https://rapid.designsafe-ci.org/>



Data collected with long range lidar, processed in iSite

Collected by GEER reconnaissance team (Alex Grant, USGS, Robert Kayen, UCB/USGS, NSF 1826118)

Example Recent Projects

- ◆ Alaska rockfall investigation (PacTrans (FHWA) and Alaska DOT)
- ◆ Hokkaido, Japan earthquake (GEER)
- ◆ Hurricane Florence (GEER, StEER)
- ◆ Hurricane Michael (StEER, NSF Rapid Grant)
- ◆ Sulawesi, Indonesia earthquake and tsunami (GEER)
- ◆ Spangler landslide (OSU, ODOT)
- ◆ Breitenbush river restoration (OSU, USFS)
- ◆ Paradise, CA wildfires (NSF Rapid Grant)
- ◆ E-Defense shake table tests, Kobe, Japan (NSF Rapid Grant)
- ◆ Ridgecrest, CA earthquake (GEER)
- ◆ Hurricane Dorian, Bahamas (StEER)
- ◆ 2020 Hurricanes (StEER, GEER)

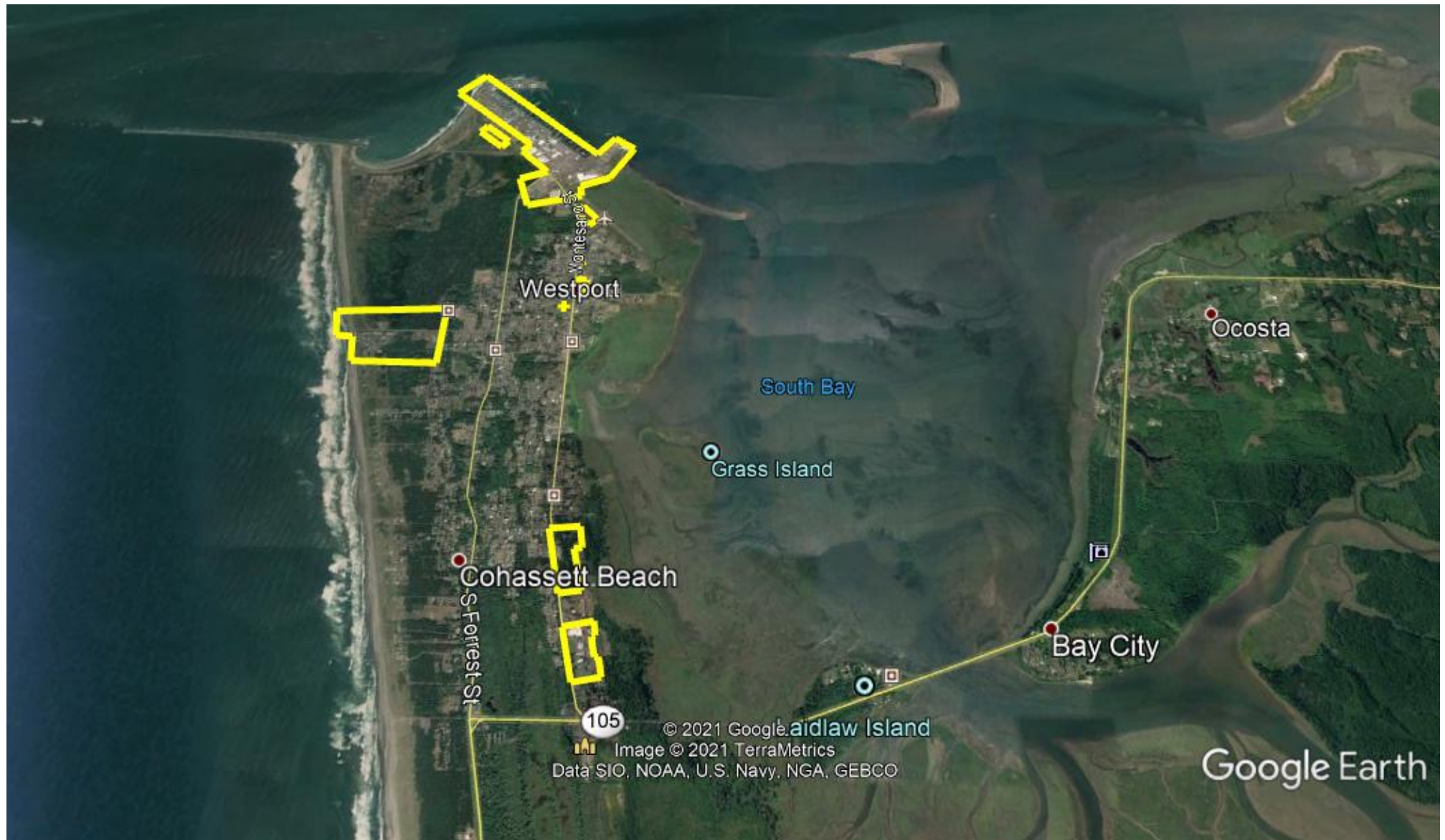


Westport, WA Data Collection

- ◆ PI: Dan Abramson (UW, Urban Planning), NSF Award#: 1940024
- ◆ Grant for exploratory research, to develop “geo-narratives” to help selected coastal WA communities for a CSZ generated tsunami
- ◆ Deployed RAPID equipment to Westport, WA
- ◆ August, 2020 for ~5 days
- ◆ Had a huge team including RAPID staff and CoPe EAGER researchers
- ◆ Gather data to assemble 3D models of key community assets:
 - Identified in collaboration with Westport (Kevin Goodrich and others)
 - Key facilities
 - Potential sites for vertical evacuation
 - Evacuation routes
 - Provide 3D geospatial data for use in geo-narratives



Westport, WA



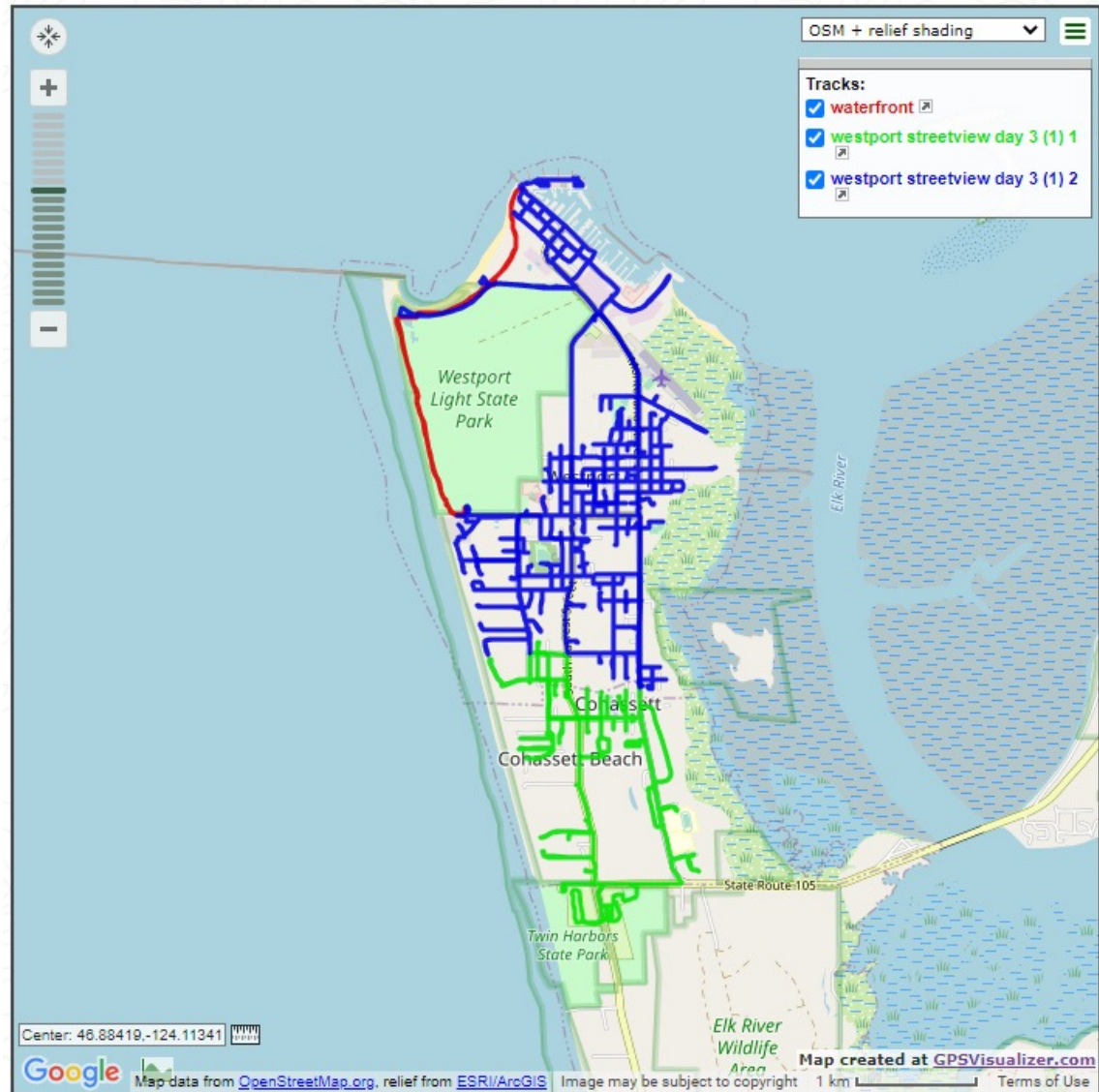
Westport Data Collection



- ◆ UAS flights:
 - High flights over most of the city
 - Lower flights for detailed models over key assets
- ◆ GPS points for ground control
- ◆ Lidar for some key assets

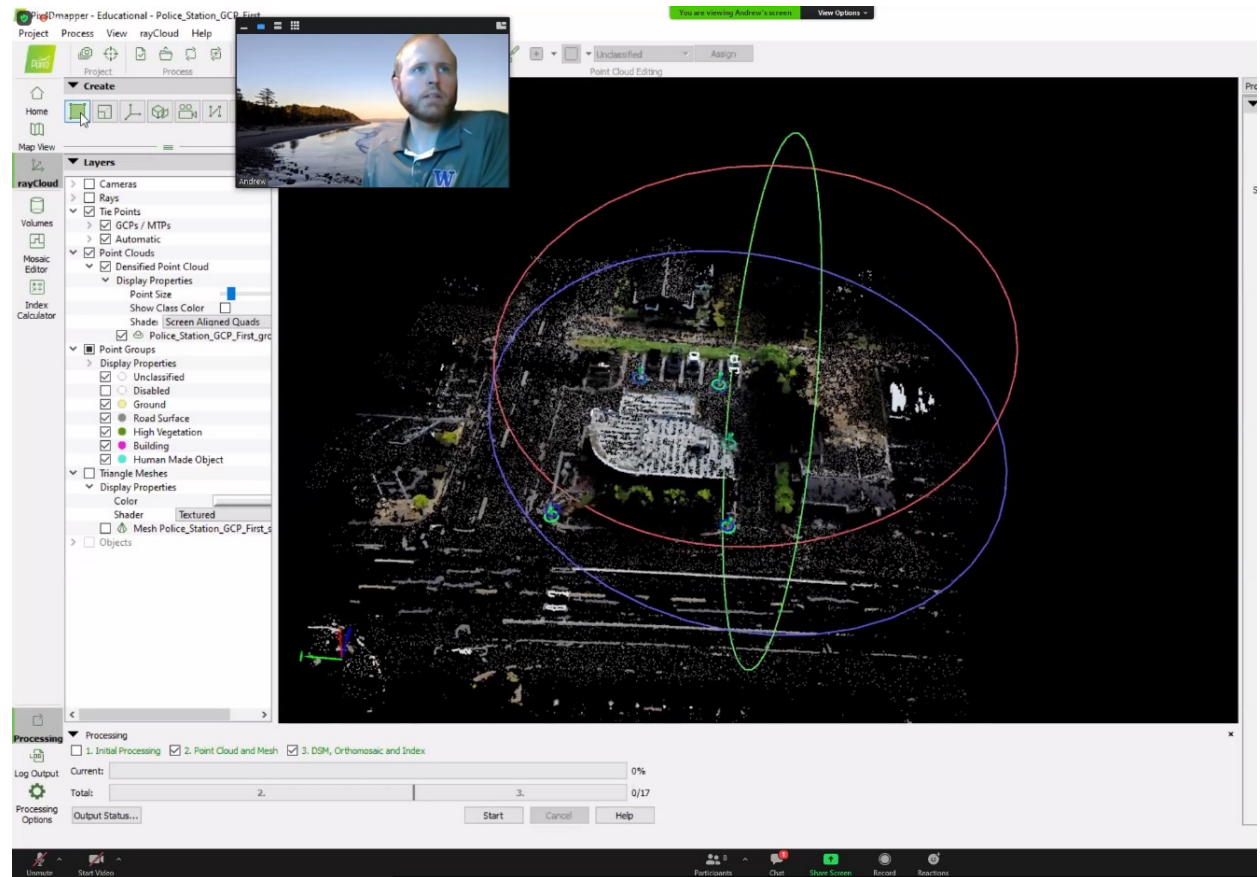
Westport Data Collection

- ◆ Streetview over entire, including beachfront on foot and bike with backpack

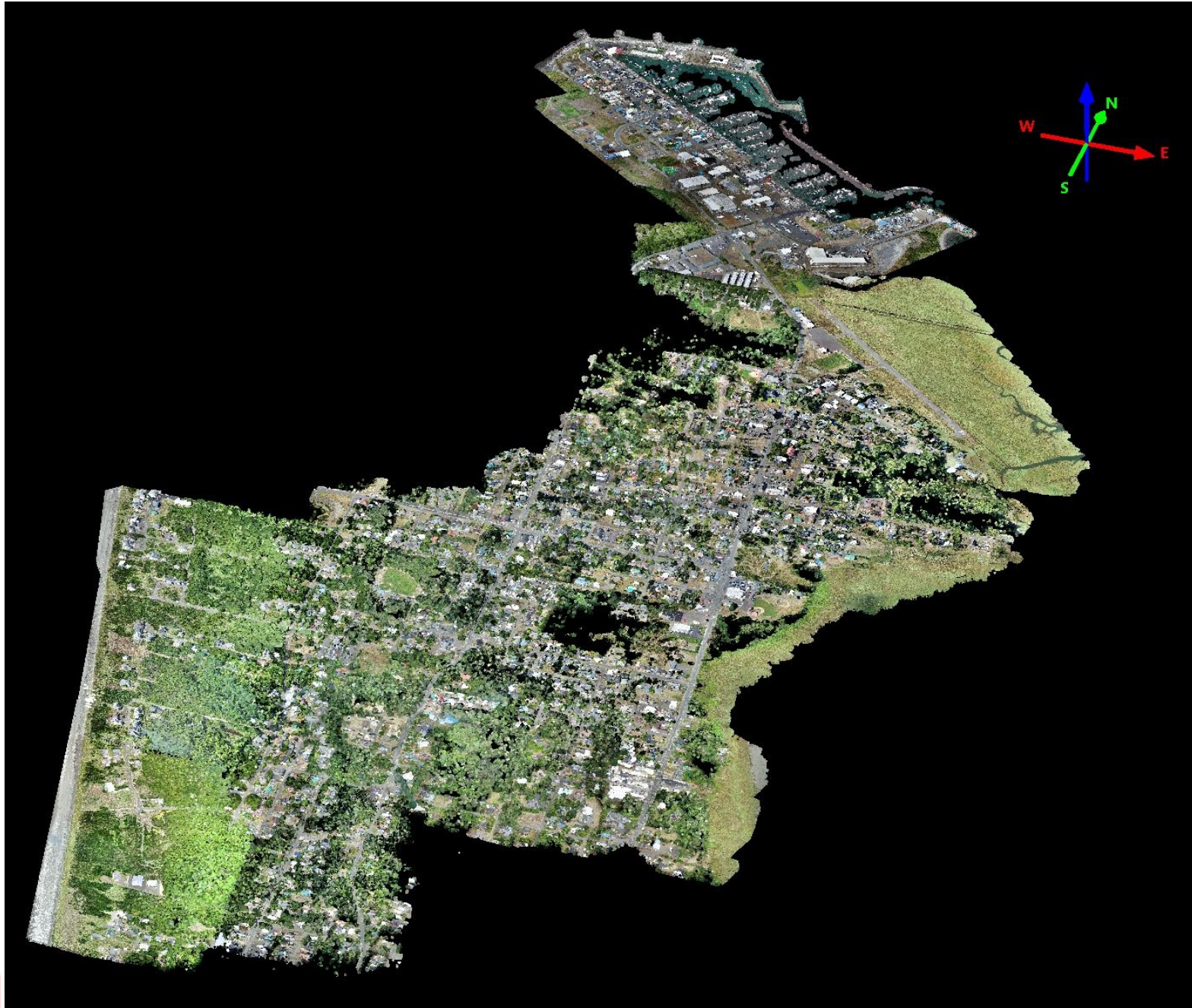


Westport Data Processing

- ◆ RAPID staff processed:
 - Streetview data
 - GPS data
 - Some lidar
 - Initial SfM models from UAS images
- ◆ Partnerships with students from:
 - Geography (Bo Zhao's students)
 - Urban planning (Dan Abramson's students)
- ◆ Major number of hours required to process the large volume of data



Example Data Products: SfM Models

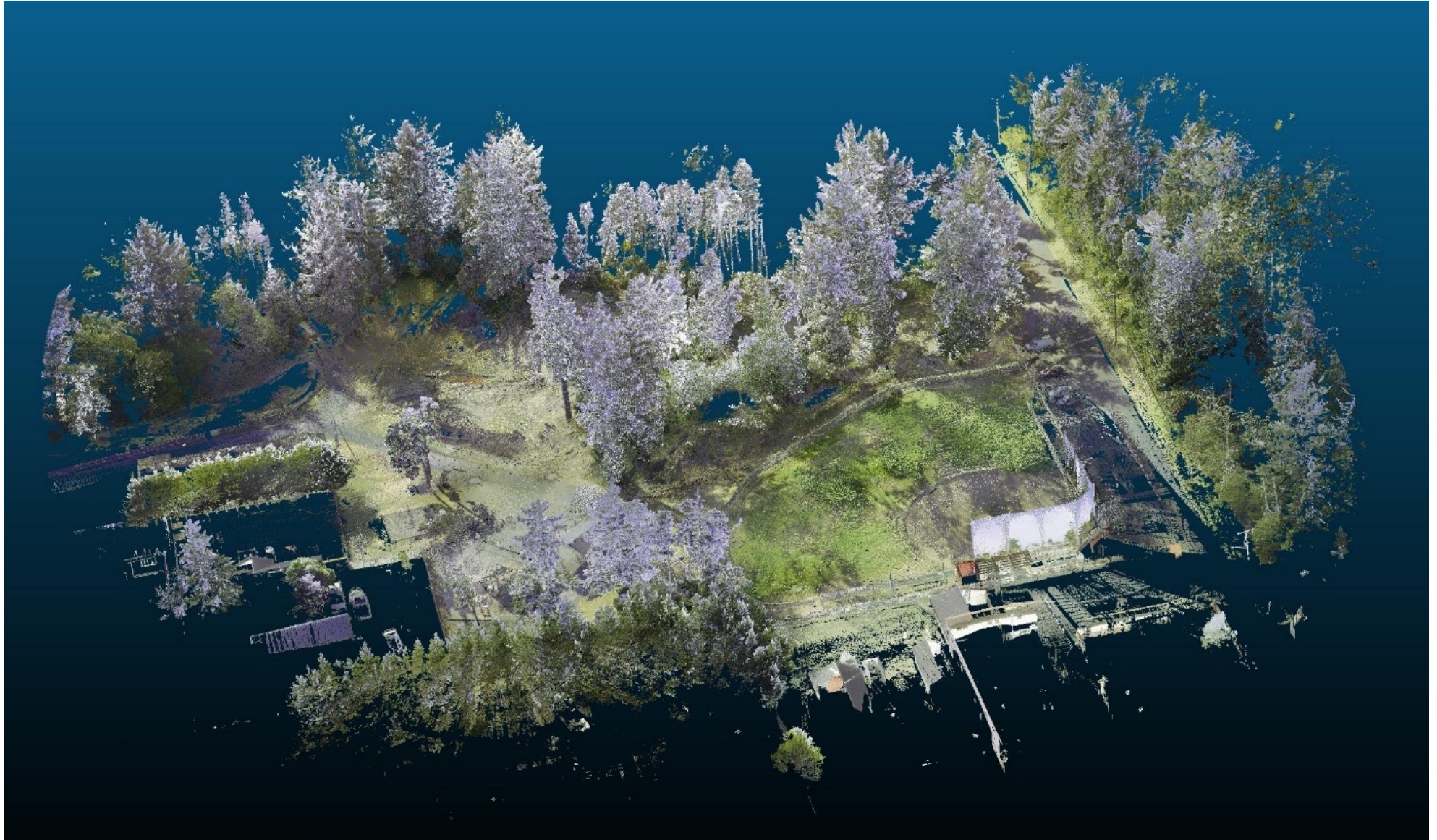


Example Data Products: SfM Models

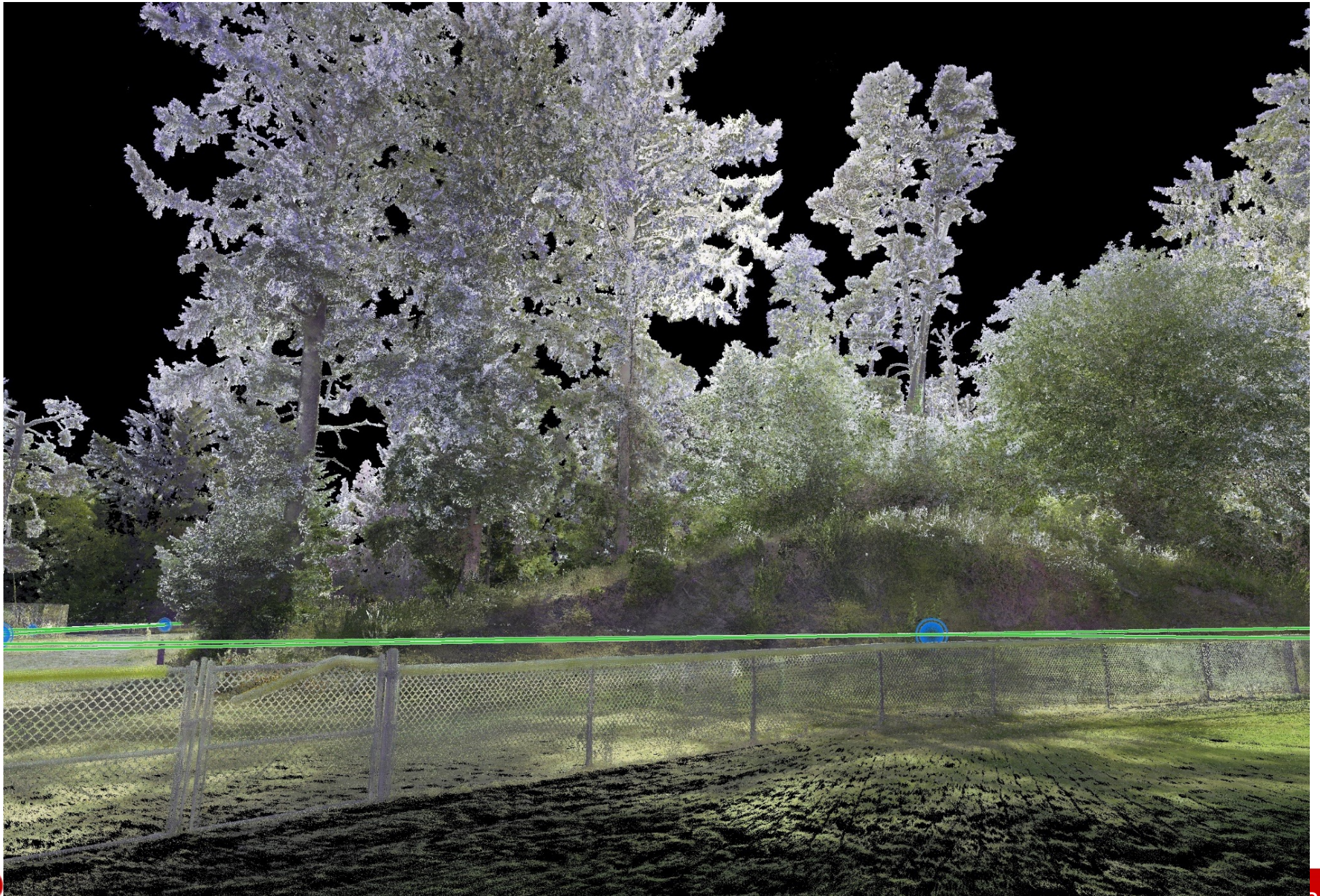


Wastewater Treatment Plant

Example Data Products: Lidar



Example Data Products: Lidar



Example Data Products: Streetview

- ◆ Processed streetview imagery available on Mapillary
- ◆ <https://www.mapillary.com/>
- ◆ Direct link to Westport streetview: <http://bit.ly/3oJK3E2>



Thank You

<https://rapid.designsafe-ci.org/>

