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Advances in Technology

for Storm Water Quality and Watershed Management Applications

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Overview

- **Feasibility Study**
  - Constraints
  - Aerial Overview
  - Drone Equipment
  - Drone Regulations
  - Drone Applications
    - GPS and Rover vs Photogrammetry

- **Implementation**
  - Real-time Monitoring
    - Water quality, flow, level
  - Drone monitoring

- **Benefits of New Technology**
  - Bathymetric survey
  - LiDAR options

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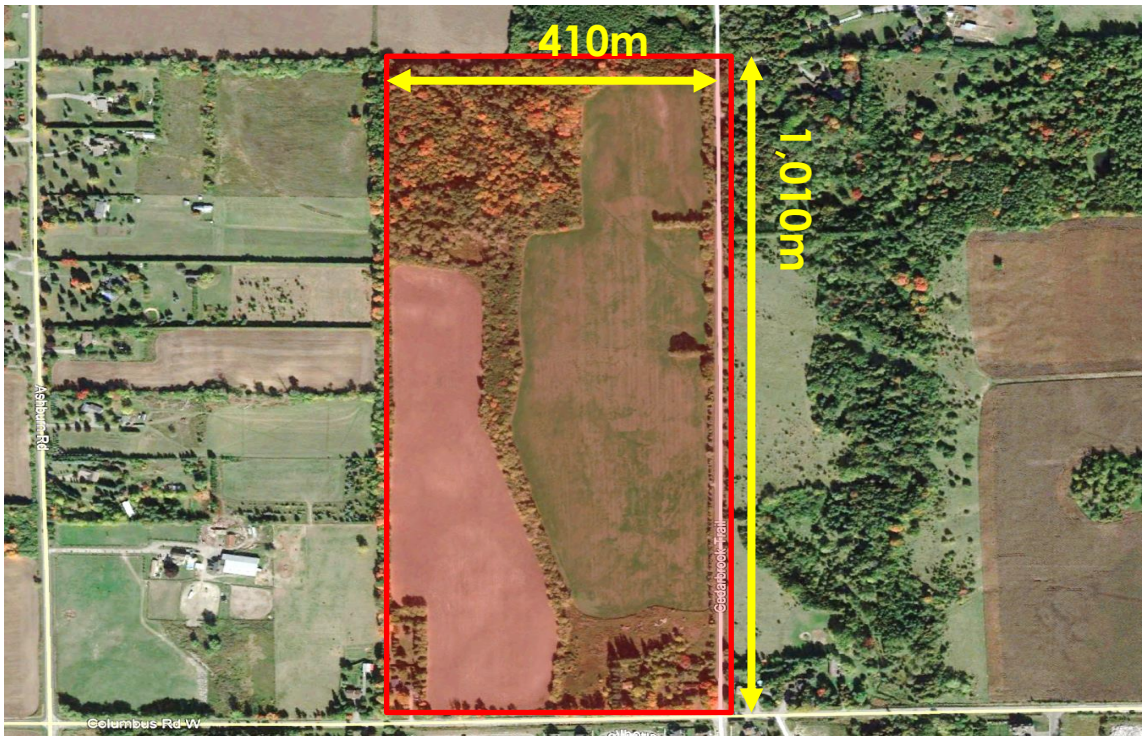
Feasibility Study: Constraints

Background

- 0.41 Square KM
- Located in Whitby, ON
- Currently a soy bean farm



Species At Risk

Bobolink

Eastern Meadowlark

Barn Swallow

Wood Thrush

Eastern Wood Pewee

Multiple Bat Species

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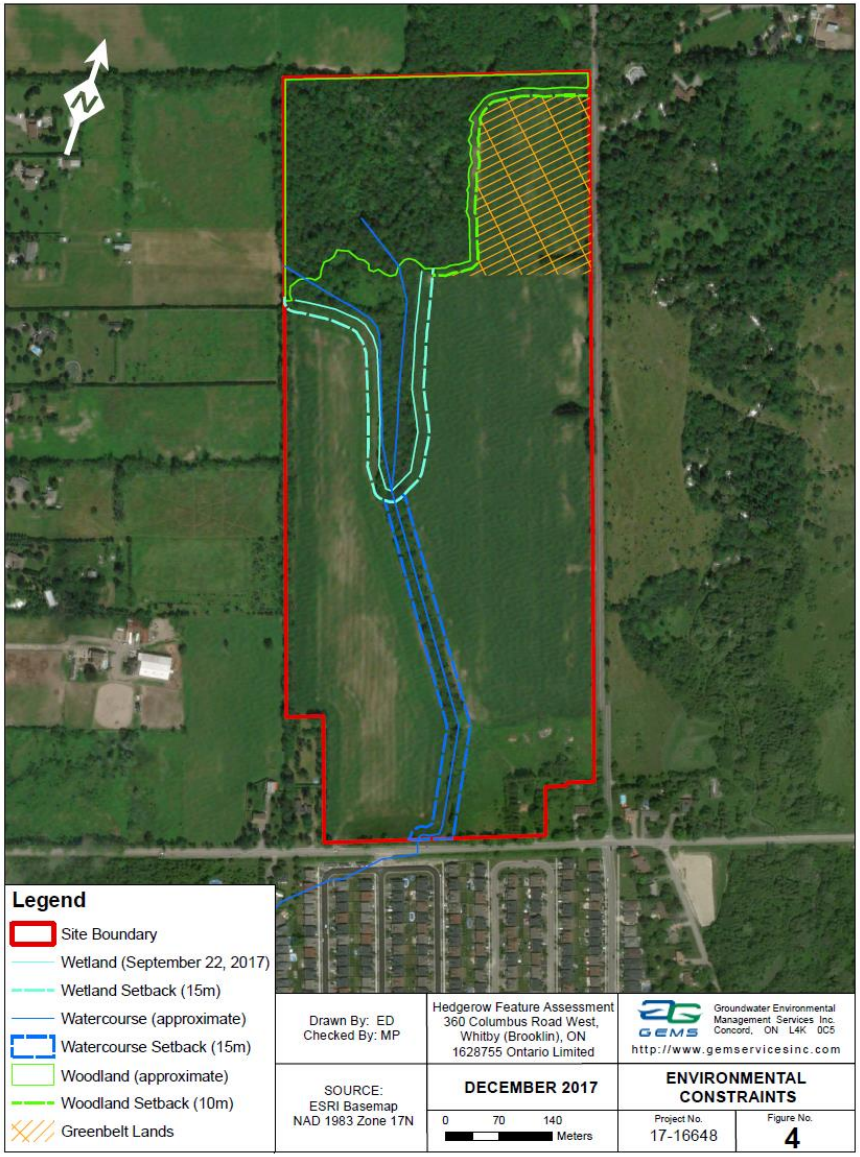
Feasibility Study: **Constraints**



Findings:

- Protected Countryside – Greenbelt
- Unevaluated Wetland – setback buffer of 15m
- Central Lake Ontario Conservation Authority (CLOCA) regulated lands
- Water course – buffer is required

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Feasibility Study: **Constraints**

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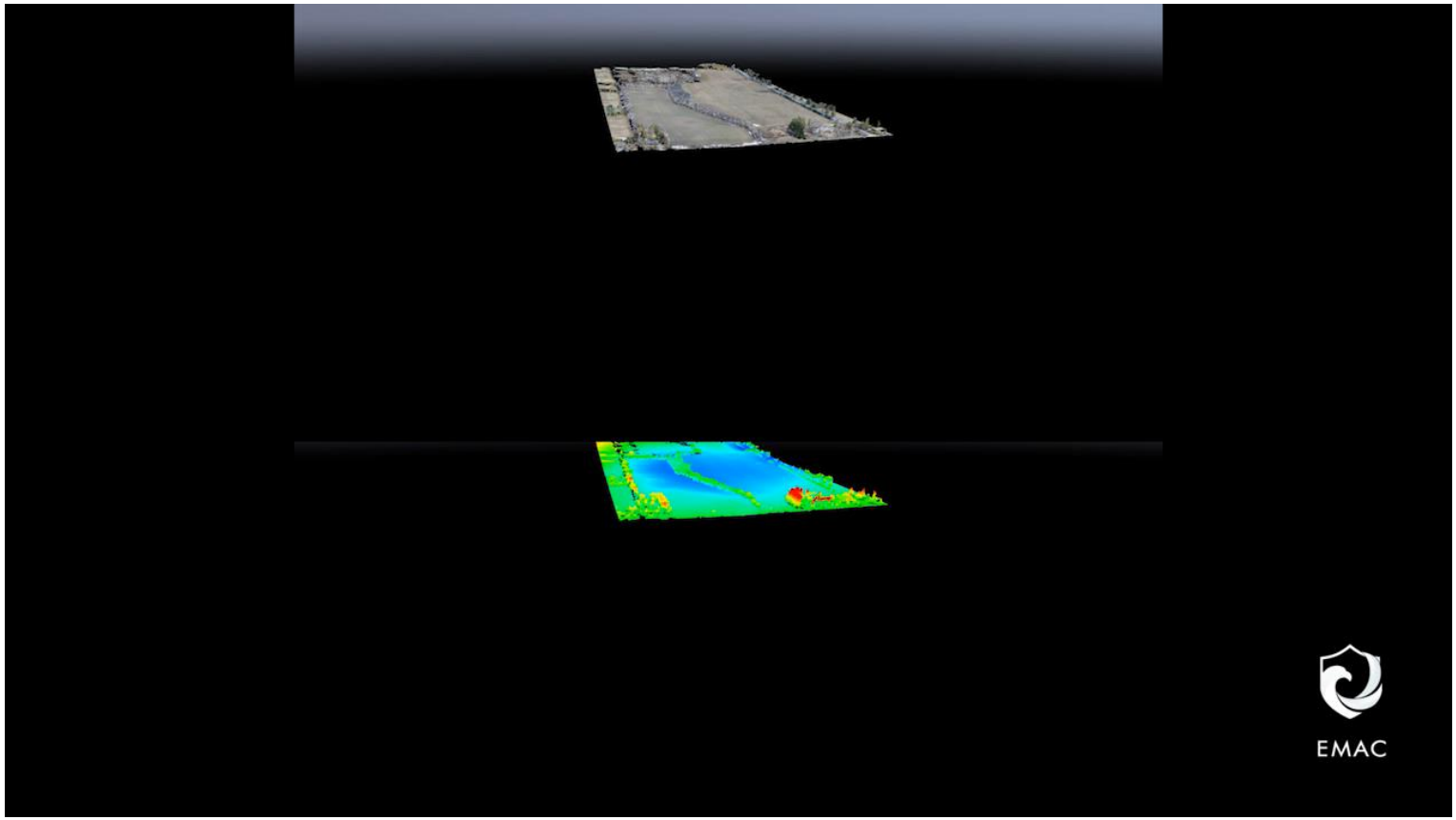
Feasibility Study: Aerial Overview



https://youtu.be/6B4MXyjTu8M

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Feasibility Study: **Drone Equipment**

- Topcon Hiper V Base and Rover
- Topcon FC-5000 Data Collector
- Ground Control Points (GCP) – to be surveyed in
- DJI Phantom 4 Pro with iPad

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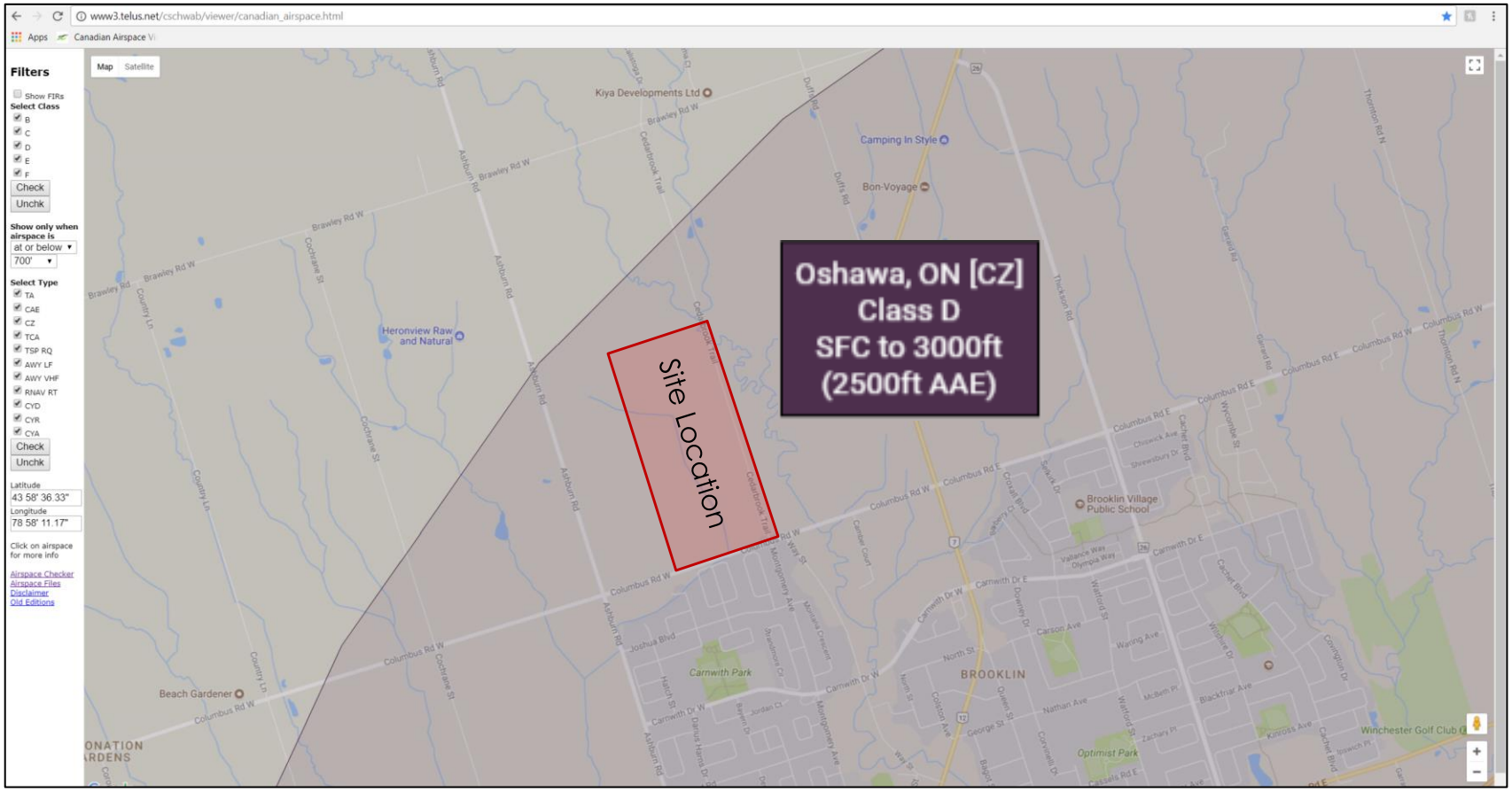
Feasibility Study: **Drone Regulations**

- Within Controlled Airspace (Class D – Surface to 3000ft)
- In contact with NAV Canada before and after flight
- Require an Special Flight Operational Certificate (SFOC)



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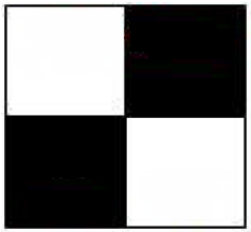
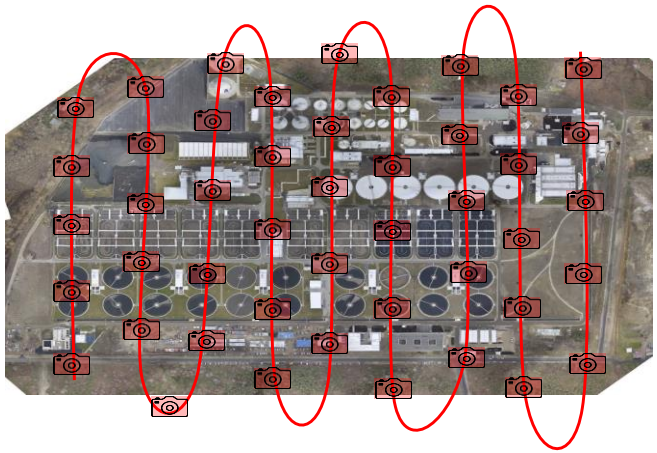
Feasibility Study: Drone Applications - GPS and Rover vs Photogrammetry

- **Photogrammetry** – uses images to make measurements between objects to create a geometric representation
- Stitches together the images to create one detailed Orthomosaic image of the area
- Survey equipment to make Geographic

Ground Control Points





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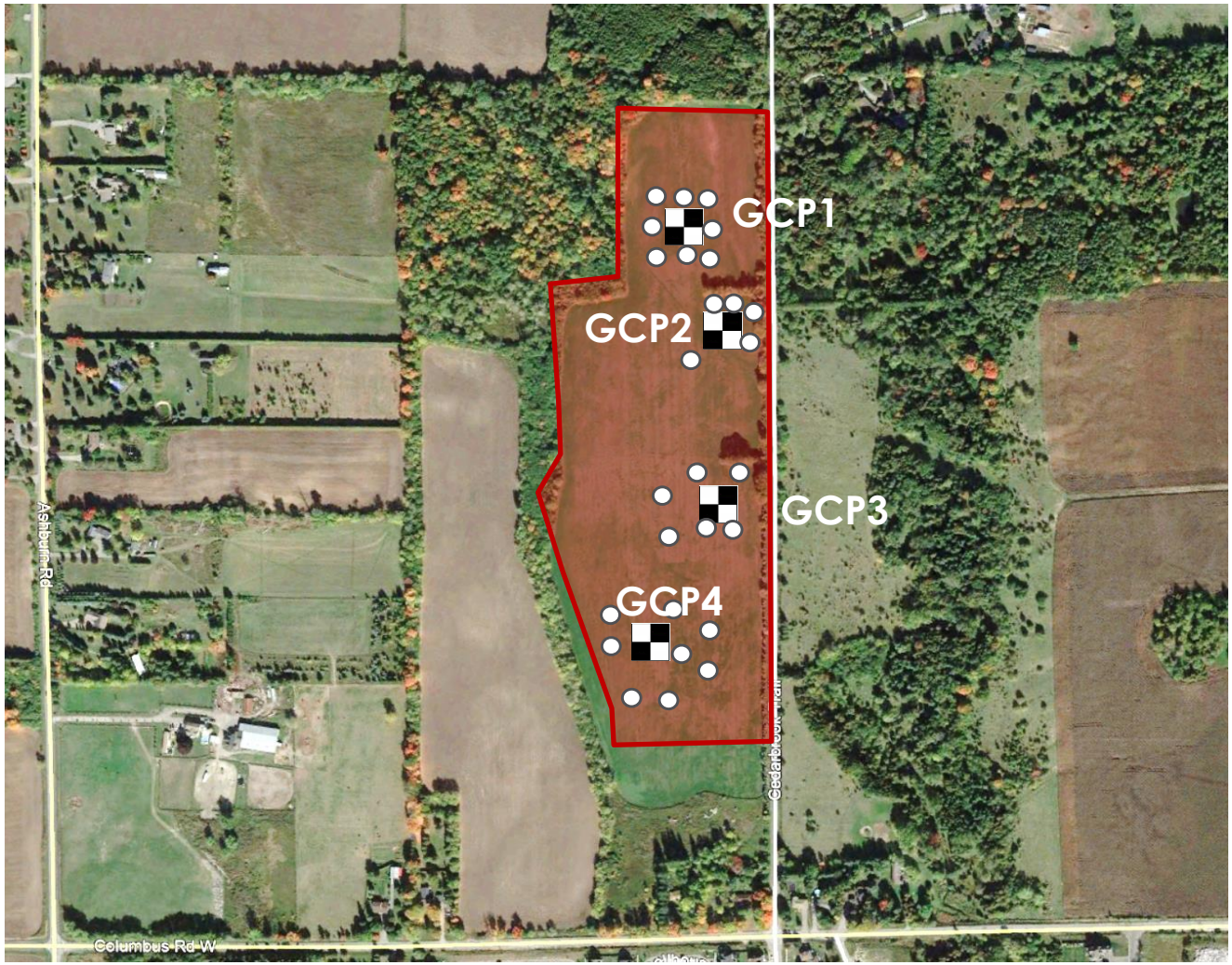
Feasibility Study: Drone Applications - GPS and Rover vs Photogrammetry



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Feasibility Study: Drone Applications - GPS and Rover vs Photogrammetry

Things to Consider:

- Original Ground was covered with a foot of vegetation (~0.3m across the entire site)
- This will affect the Z elevation coordinate

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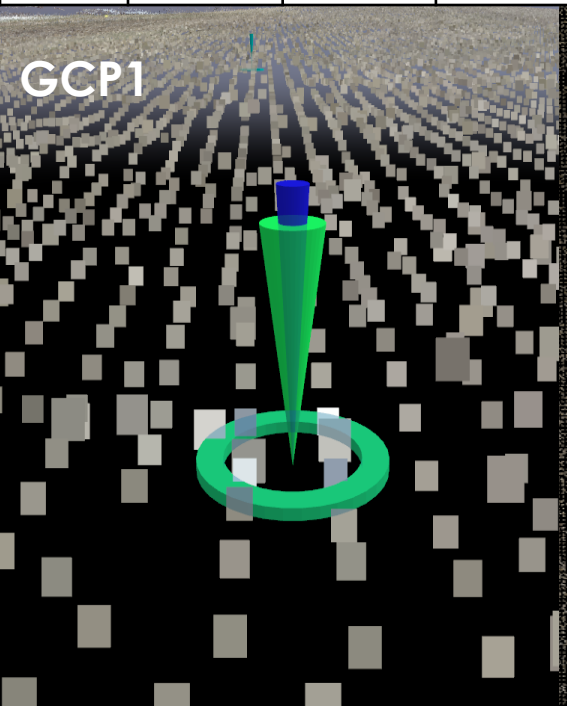
Feasibility Study: Drone Applications - GPS and Rover vs Photogrammetry

	Point Cloud	GPS/Rover	Difference
1	184.015	183.670	0.345
2	184.41	183.810	0.600
3	184.57	183.890	0.680
4	183.45	183.490	-0.040
5	183.99	183.890	0.100
6	184.075	183.800	0.275
7	183.695	183.200	0.495
8	183.22	183.490	-0.270
9	183.565	183.700	-0.135
10	183.455	183.510	-0.055

Average Mean Error = 0.1995m



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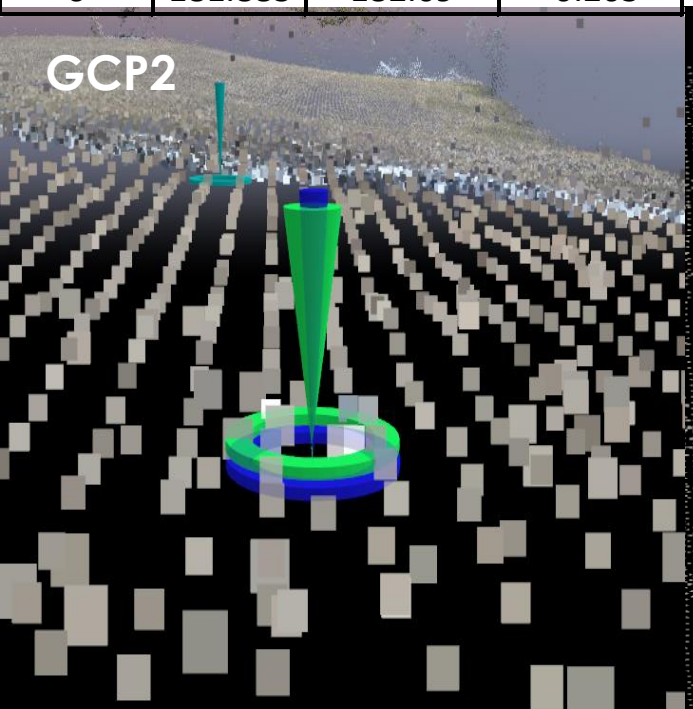
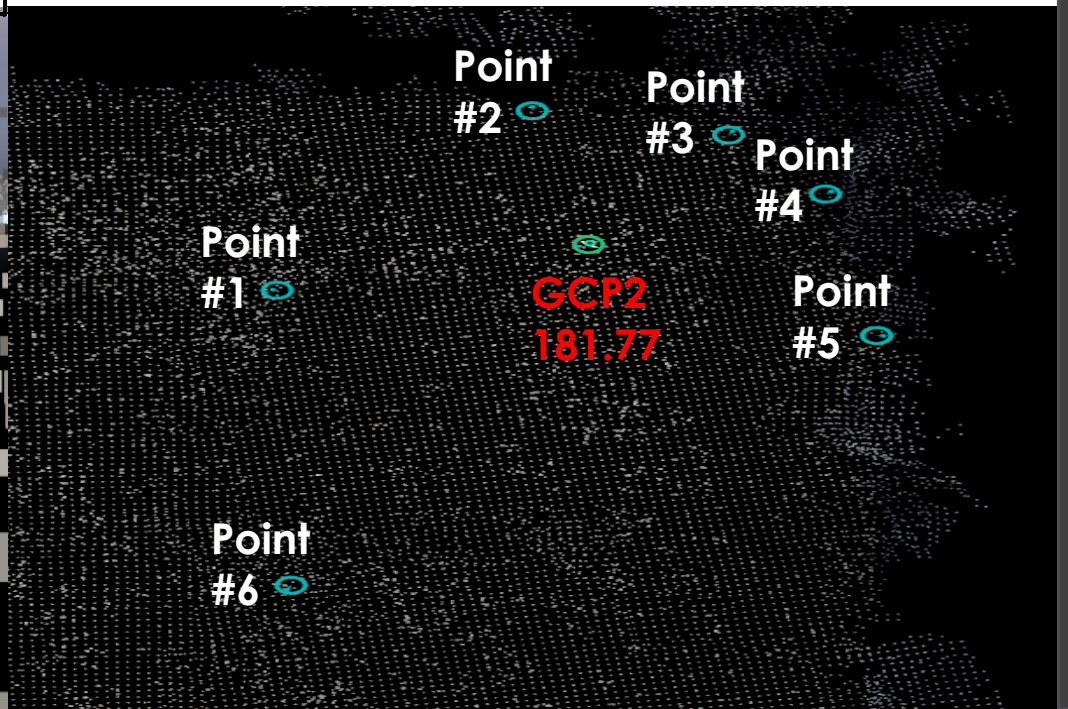
Feasibility Study: Drone Applications - GPS and Rover vs Photogrammetry

	Point Cloud	GPS/Rover	Difference
1	182.48	182.45	0.03
2	182.295	182.12	0.175
3	181.735	181.55	0.185
4	181.69	181.4	0.29
5	181.75	181.71	0.04
6	181.885	182.09	-0.205

Average Mean Error = 0.085m





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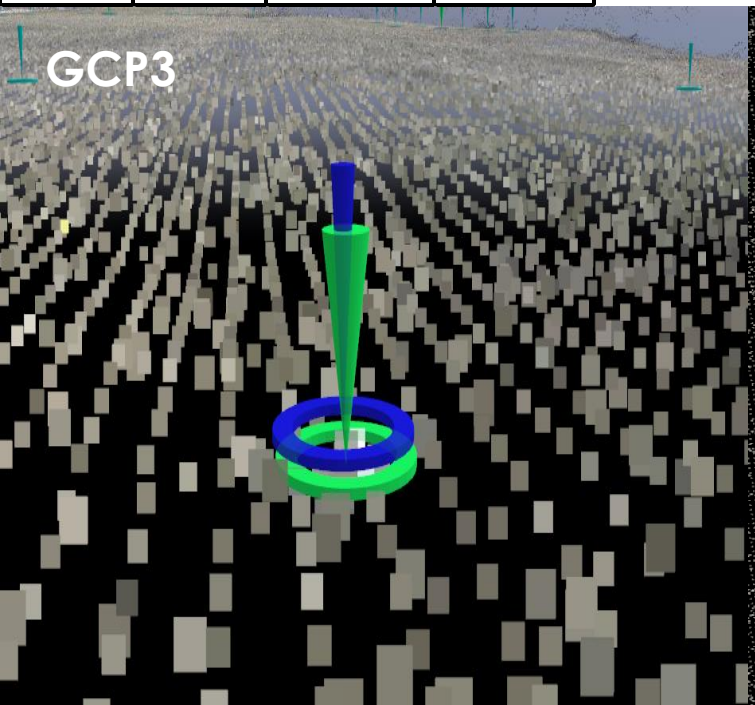
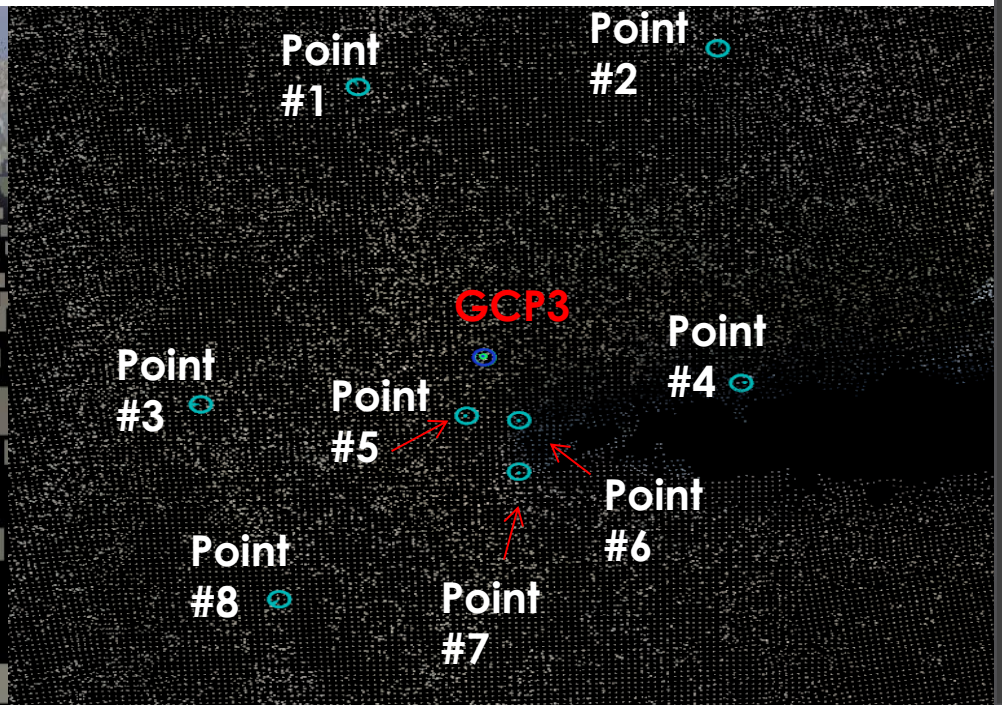
Feasibility Study: Drone Applications - GPS and Rover vs Photogrammetry

	Point Cloud	GPS/Rover	Difference
1	181.02	181.38	-0.36
2	180.79	180.94	-0.15
3	181.055	181.19	-0.135
4	180.48	180.41	0.07
5	181.955	181.01	0.945
6	180.975	180.91	0.065
7	181.02	181.1	-0.08
8	180.965	181.13	-0.165

Average Mean Error = 0.023m





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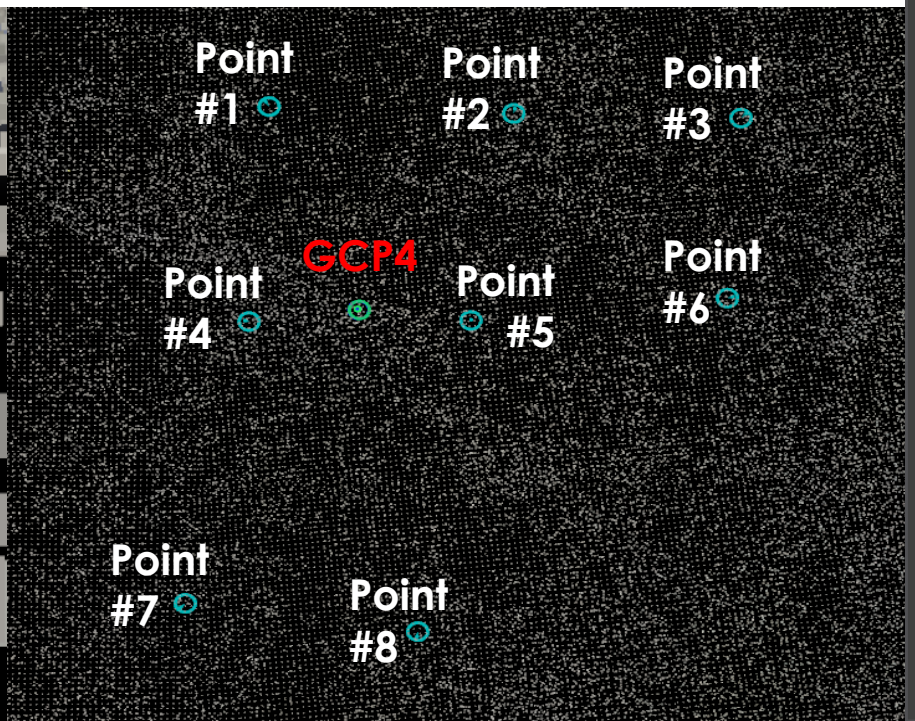
Feasibility Study: Drone Applications - GPS and Rover vs Photogrammetry

	Point Cloud	GPS/Rover	Difference
1	180.53	180.44	0.09
2	180.425	180.33	0.095
3	180.54	180.34	0.2
4	180.345	180.22	0.125
5	180.44	180.19	0.25
6	180.565	180.22	0.345
7	180.465	179.95	0.515
8	180.485	179.94	0.545

Average Mean Error = 0.270m



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Implementation: Real Time Monitoring

- Single monitoring platform communicates with multiple sensors
- Remote communication
  - Remotely configured
  - Real-time data
- Proactive solution for eliminating unforeseeables
- Informed decision making

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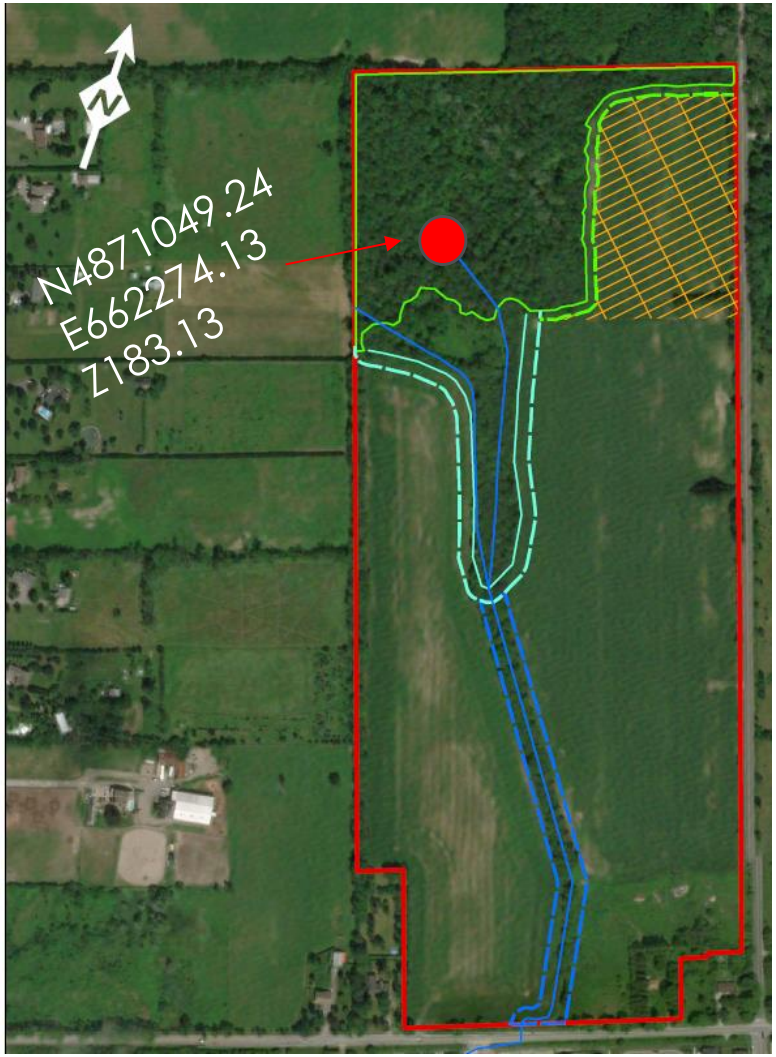
Implementation: Real Time Monitoring

Legend

- Site Boundary
- Wetland (September 22, 2017)
- Wetland Setback (15m)
- Watercourse (approximate)
- Watercourse Setback (15m)
- Woodland (approximate)
- Woodland Setback (10m)
- Greenbelt Lands
- Monitoring Station (Upstream)



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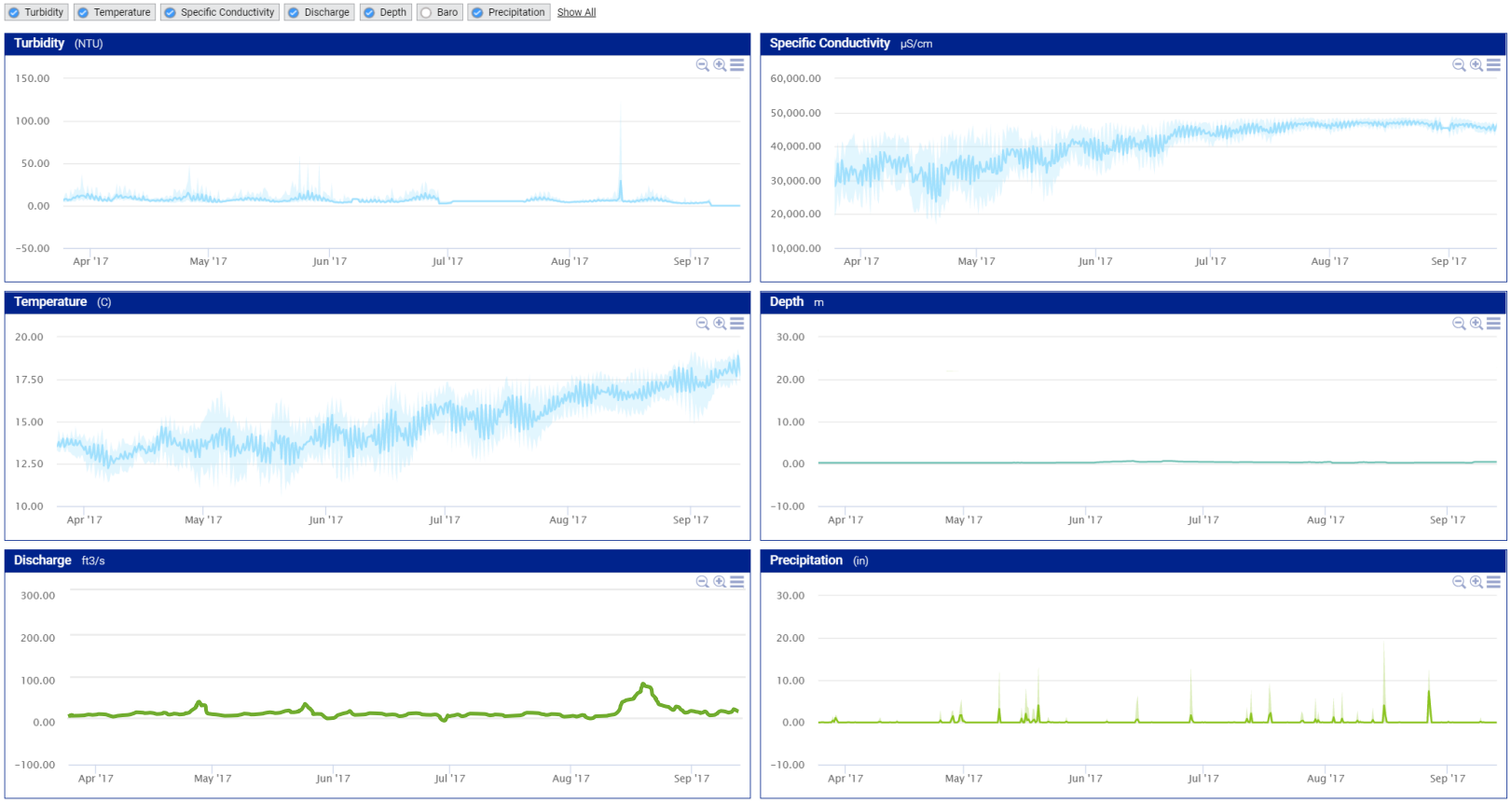

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Implementation: Drone Monitoring

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Implementation: Drone Monitoring

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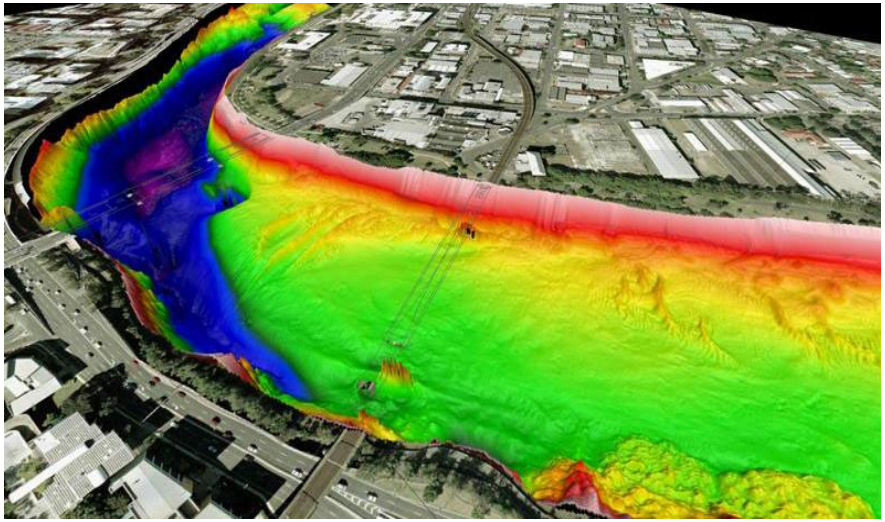
Benefits of New Technology: Bathymetric

- GPS technology combined with single beam sonar
- Captures the soft bottom of the pond



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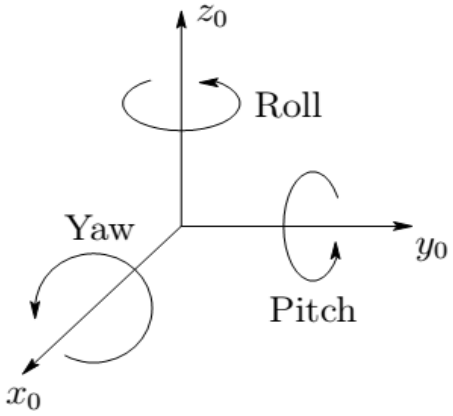
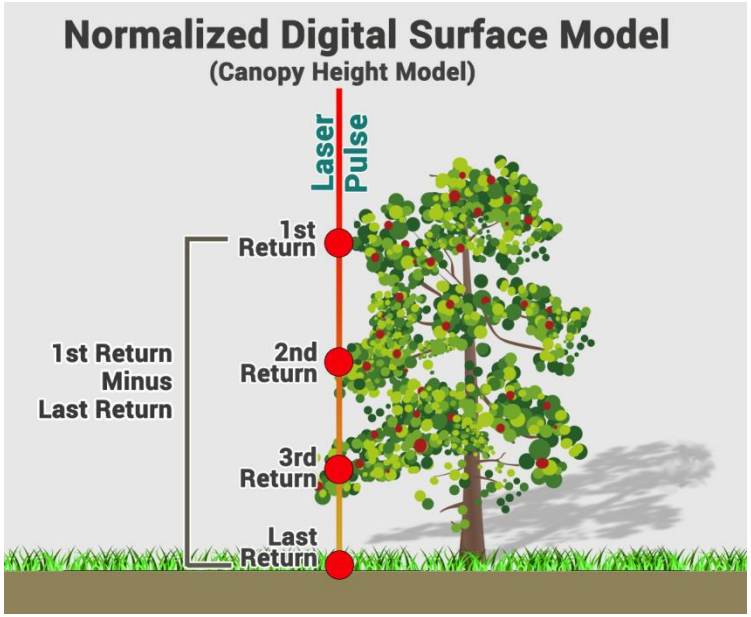
Benefits of New Technology: LiDAR

- **LiDAR** – Light Detection and Ranging
- Uses near infrared laser in the form of pulses and returns
  - Reflects strongly against vegetation
- IMU Sensor (inertial measurement unit)
  - Tracks the yaw, pitch and roll to ensure data
  - Important for accuracy and positioning





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