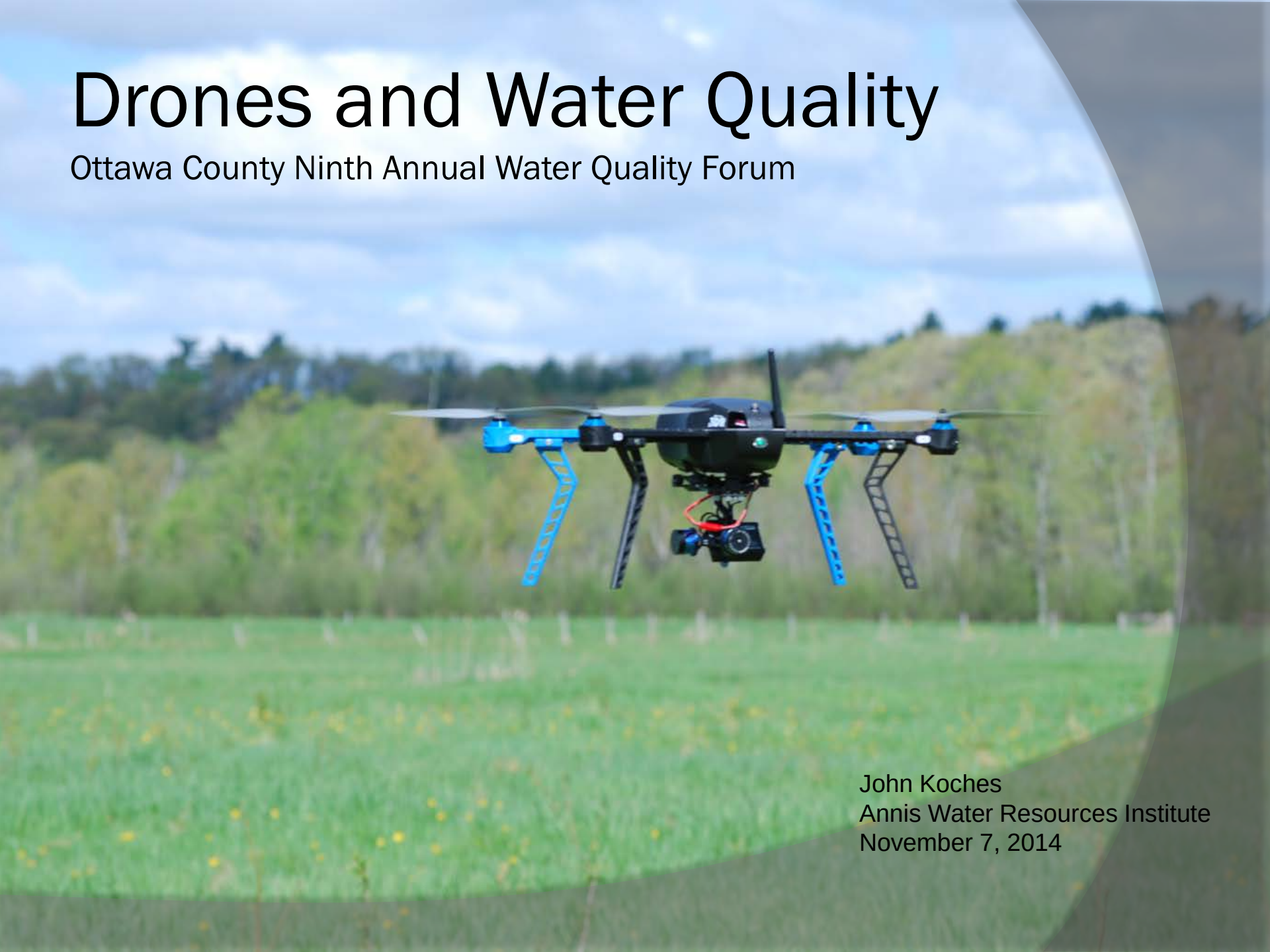
Drones and Water Quality

Ottawa County Ninth Annual Water Quality Forum



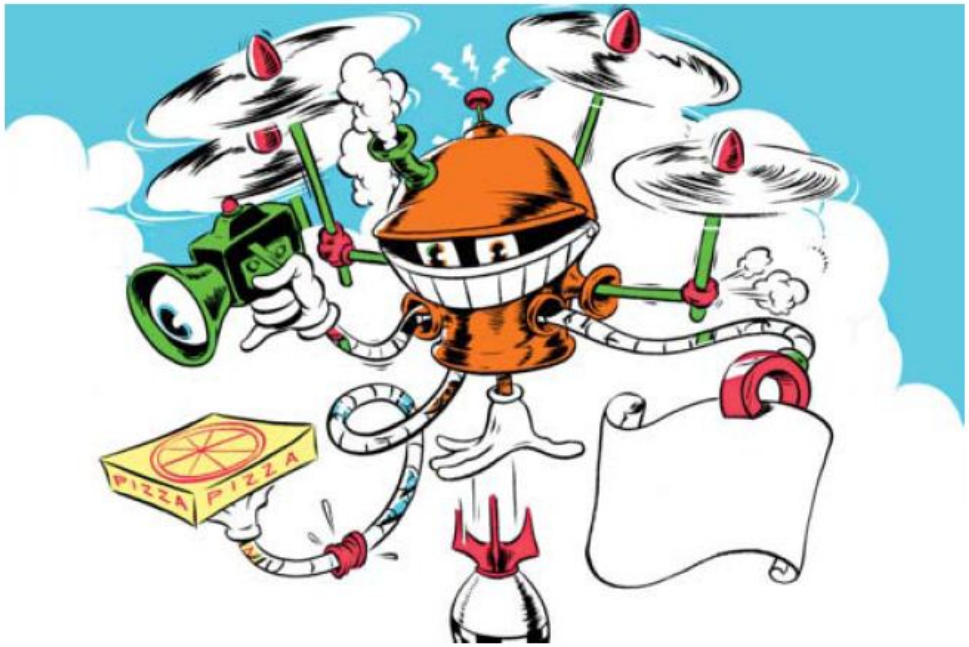
John Koches
Annis Water Resources Institute
November 7, 2014

NEW YORK nymag.com

Daily Intelligencer | the future | October 5, 2014 9:05 p.m.

Drones and Everything After

By **Benjamin Wallace-Wells**



Drones And Everything After
The flying, spying, killing machines that are turning humans into superheroes.
By Benjamin Wallace-Wells
Illustrations by Andrew Rae

"I want to buy...a drone" now fourth most popular Google autocomplete term for that phrase

Posted by Chris Anderson on October 5, 2014 at 9:32pm Send Message View Blog

From Guns to Drones

Recurring autofill terms when Google users start a search.

I want to buy...

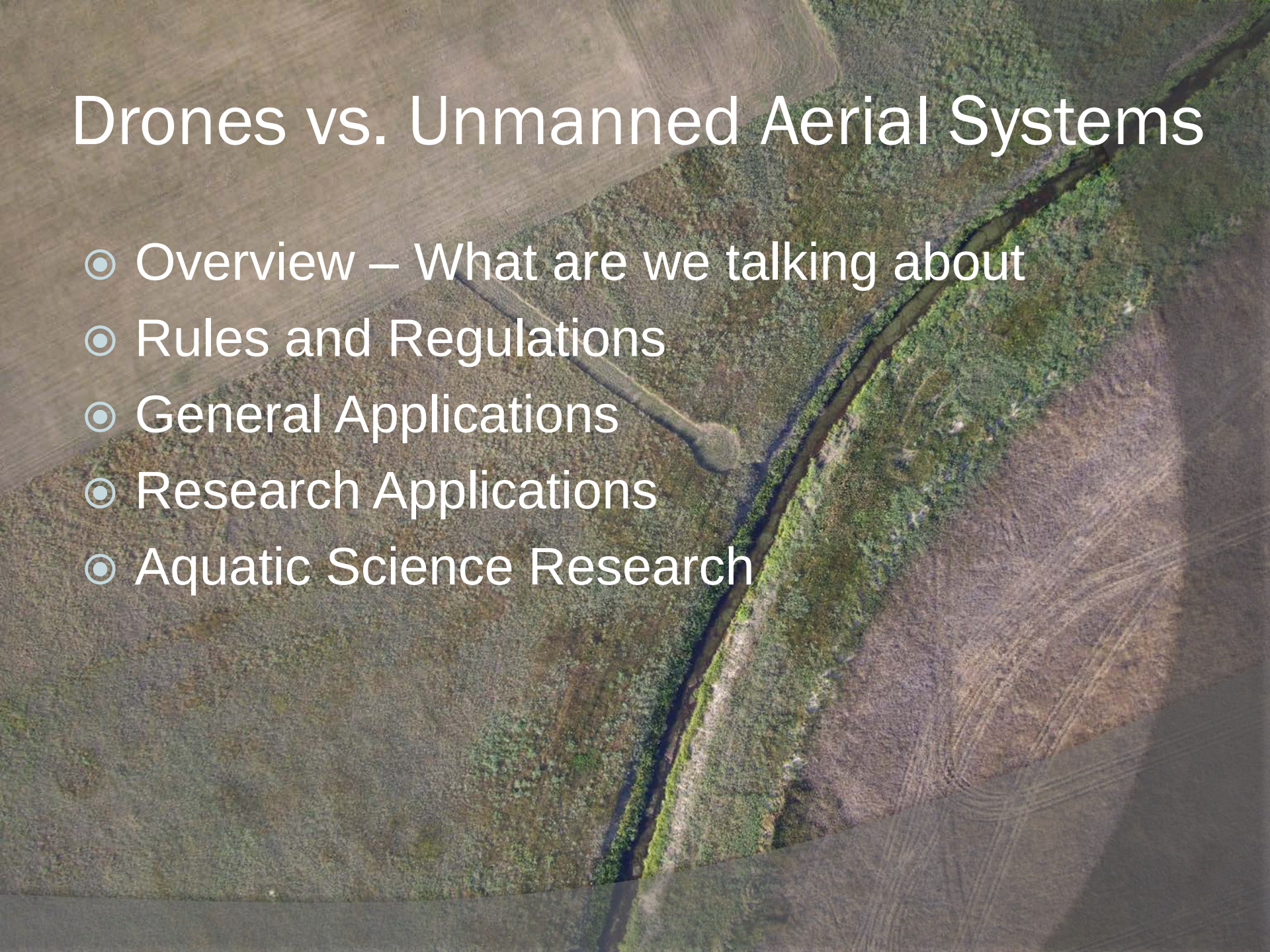
First Quarter, 2011	First Quarter, 2012	First Quarter, 2013	First Quarter, 2014	Second Quarter	Third Quarter
a house	you something	a gun	a house	a house	a house
a car	a car	a car	stock	stock	a car
stock	stock	stock	a dog	a car	stock
a gun	something	something	a car	something	a drone

Source: ConvergEx Group

Google now gives "a drone" as the fourth most popular answer to the search term "I want to buy..."! Data from the New York Times

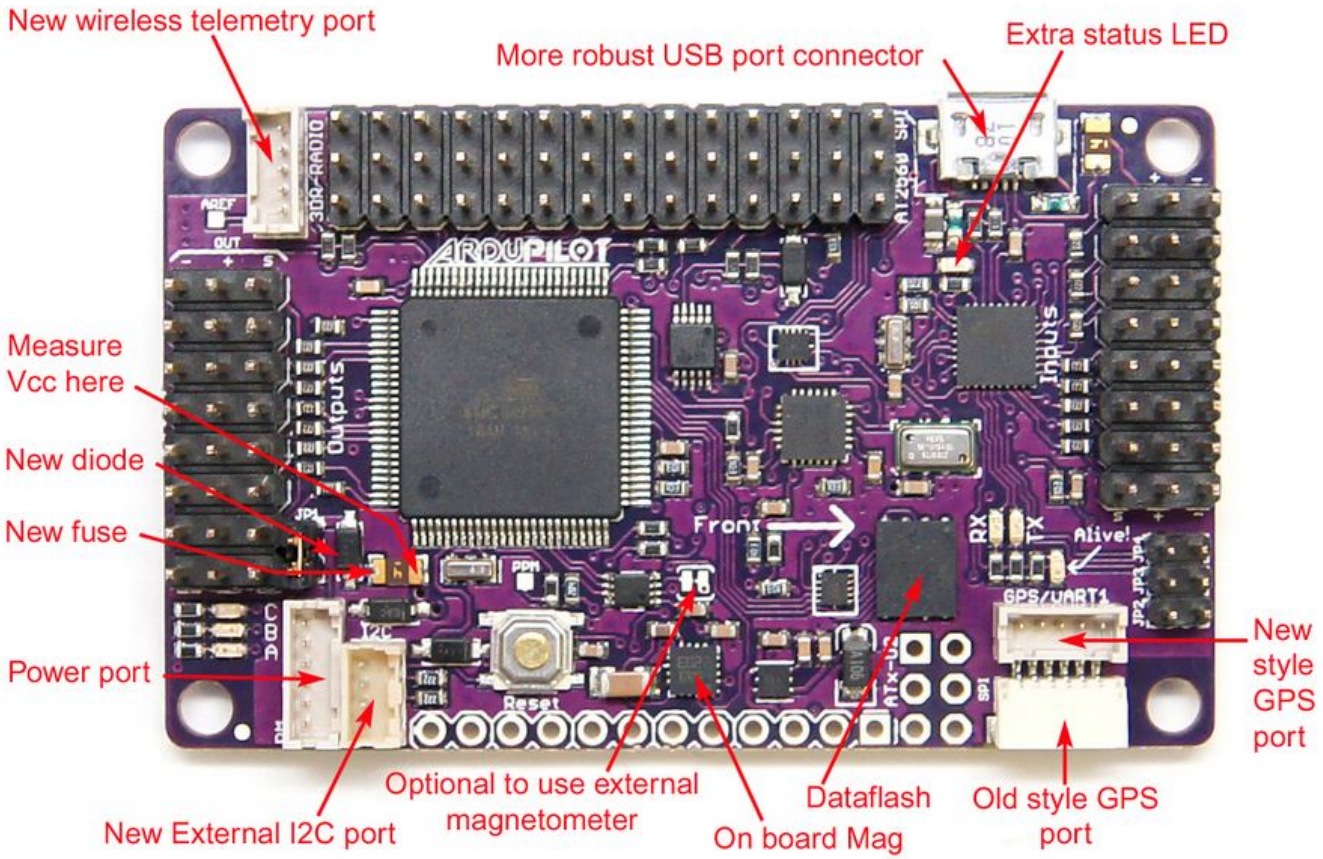
Drones vs. Unmanned Aerial Systems

- Overview – What are we talking about
- Rules and Regulations
- General Applications
- Research Applications
- Aquatic Science Research



APM 2.6

- **APM 2.6** is a revision of the APM that makes use of an external magnetometer (compass).
- The APM 2.6 has no on board compass, and is optimized for vehicles where the compass should be placed as far from power and motor sources as possible to avoid magnetic interference.
- APM 2.6 is designed to be used with the 3DR GPS uBlox LEA-6 with Compass module.
- The GPS/Compass module may be mounted further from noise sources than the APM itself.
- APM 2.6 requires a GPS unit with an on board compass for full autonomy.
- For information on installing a 3DR GPS uBlox LEA-6 with Compass, visit (Here!).
- Details APM 2.0



APM Autopilot Suite

Hardware — Firmware — Software — Community

Hardware- The embedded systems and peripheral sensors that 3DRobotics designs, manufactures, and sells.

Think of hardware as the brain, eyes, ears, etc.

Almost any mobile machine can be transformed into a robot, by simply integrating a small hardware package into it.

Firmware- The "skill set" code running on the hardware, which configures it for the kind of vehicle you've put it in. You choose the firmware and vehicle that match your mission: Plane, Copter, Rover…

The choice is yours — one autopilot for any mission. An easy firmware update is all it takes to repurpose your hardware into a different role.

Software- Your interface to the hardware.

Initial set-up, configuration, and testing. Mission-planning/operation, and post-mission analysis.

Point-and-click intuitive interaction with your hardware, or advanced custom scripting for niche mission profiles. Options are everything with APM.

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APM:Plane

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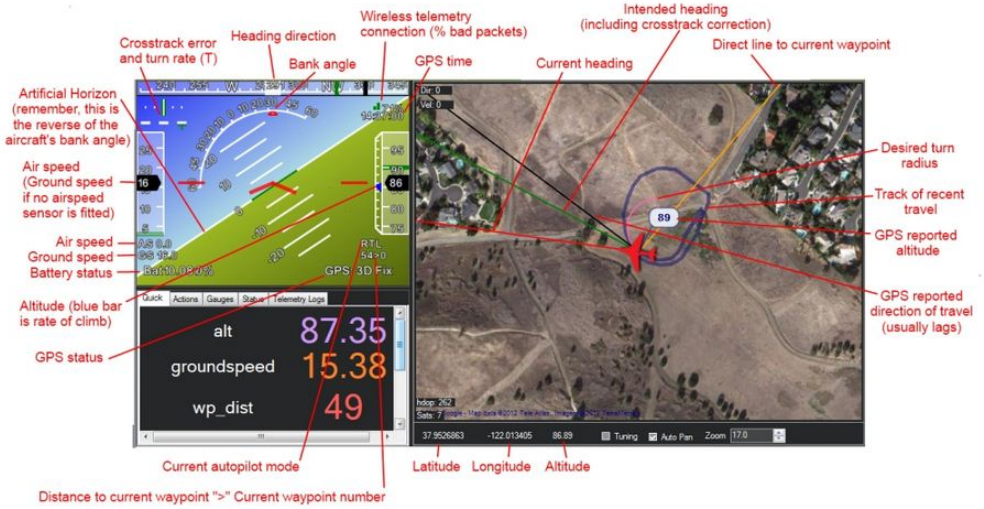
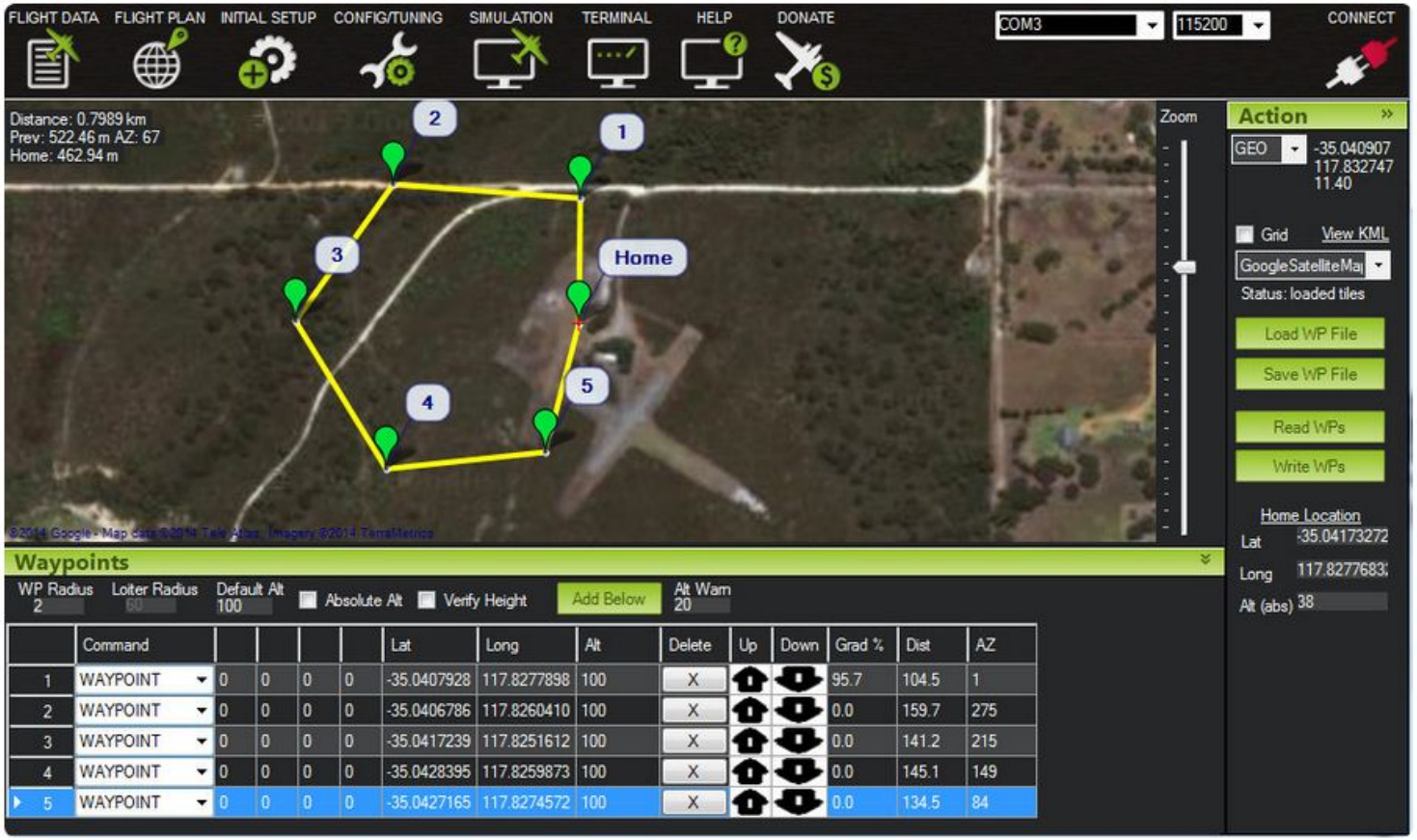
The GCS Flight Data Screen



The above is the main Ground Station view of the Mission Planner, showing the Heads-up Display (HUD). Once you have connected via MAVLink over USB or wireless telemetry the dials and position on this screen will display the telemetry sent by APM.

Mission Planner

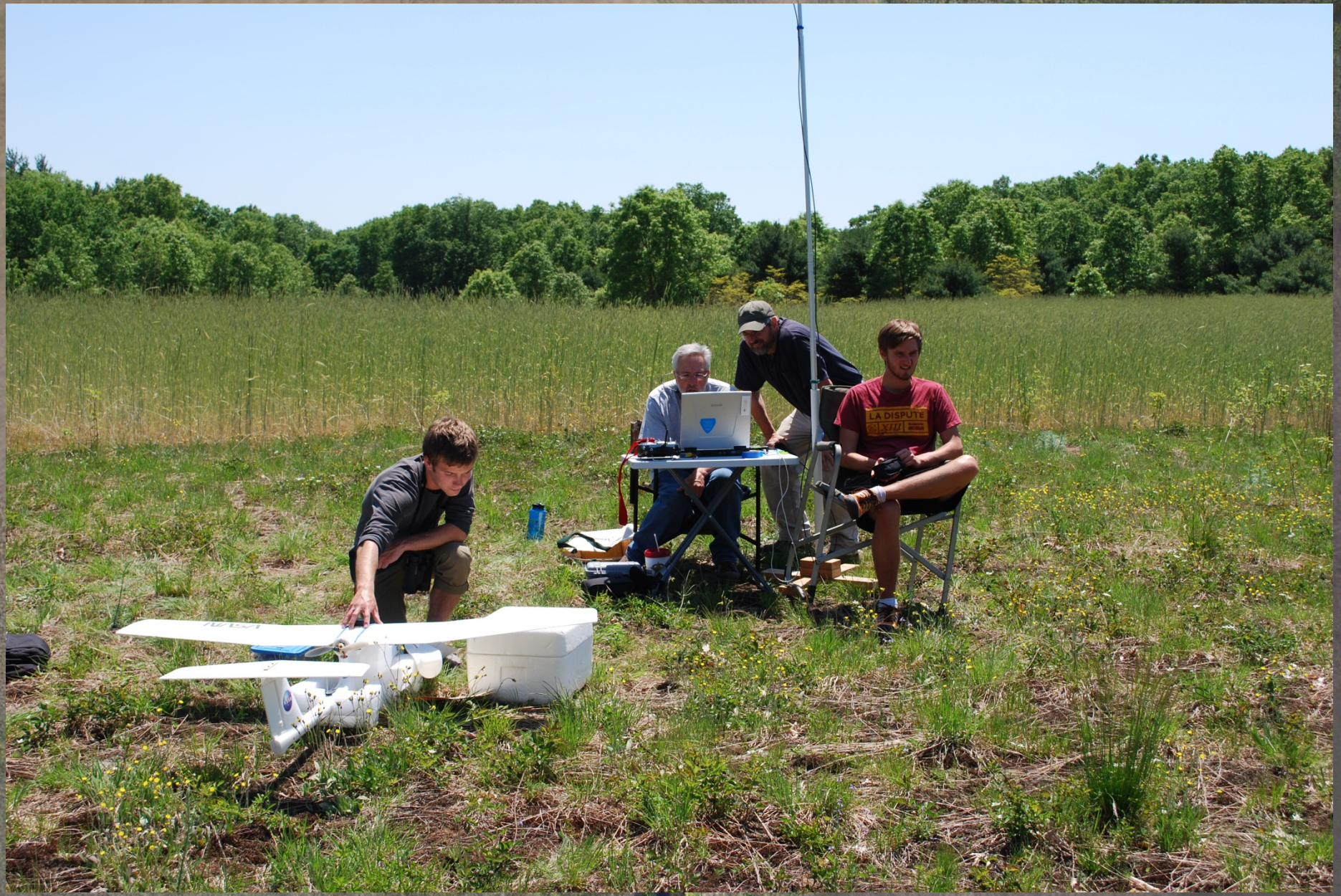


The Mission Planner, created by Michael Oborne, does a lot more than its name. Here are some of the features:

- Point-and-click waypoint entry, using Google Maps/Bing/Open street maps/Custom WMS.
- Select mission commands from drop-down menus
- Download mission log files and analyze them
- Configure APM settings for your airframe
- Interface with a PC flight simulator to create a full hardware-in-the-loop UAV simulator.
- See the output from APM's serial terminal

Please use the menus above for instructions and more information.


Panasonic
CF-51
SPEKTRUM
DX7s


LA DISPUTE

Rules and Regulations

- June 9, 1981- Advisory Circular 91-57 “Model Aircraft Operating Standards”
- February 13, 2007 – FAA says all model aircraft are “Unmanned Aircraft” and included as UAS. Public Aircraft, Civil Aircraft, and Model Aircraft
- February 14, 2012 – FAA Modernization and Reform Act of 2012
- December 30, 2013 – FAA announces six sites across the country where drones can be tested

Rules and Regulations – Cont.

- February 26, 2014 FAA releases “Busting Myths about the FAA and Unmanned Aircraft”
- March 6, 2014 Judge with National Transportation Safety Board strikes down FAA fine for TV commercial
- June 18, 2014 – FAA releases “Interpretation of Special Rules for Model Aircraft”
- June 30, 2014 – FAA unlikely to meet September 2015 deadline set by Congress

General Applications

- Military Drones
- Real Estate
- Entertainment
- Emergency Response
- Surveillance – Law Enforcement
- Package Delivery
- Construction

Research Applications

- Agriculture – Pest and Nutrient Management
- Forest Management
- Habitat Management / Conservation
- Archeological Investigation
- Air Quality Assessment
- Weather and Climate Change

Los Angeles Times

Business

Drones may provide big lift to agriculture when FAA allows their use

This article is related to: Business, Agriculture, Dining and Drinking, Air Transportation Industry, Federal Aviation Administration, Lifestyle and Leisure, Amazon.com Inc.

A drone lifts off at Kunde Family Vineyards near Santa Rosa, Calif. Ryan Kunde, a winemaker at DRNK Wines, flies his drones recreationally and has been testing drones with the goal of one day using them to help make decisions in the vineyard. (Discover Sonoma County Wine)

By CHAD GARLAND

CONSERVATION DRONES FOR SEABIRD MONITORING

May 5, 2014 *by ConservationDrones*

Crested Tern colony on a remote island in north-western Australia photographed by a UAV.

Orangutan nest image from the drone

Vancouver Aquarium Uses Hexacopter to Track Killer Whales

1

by **Vancouver Aquarium** | Sep. 23, 2014

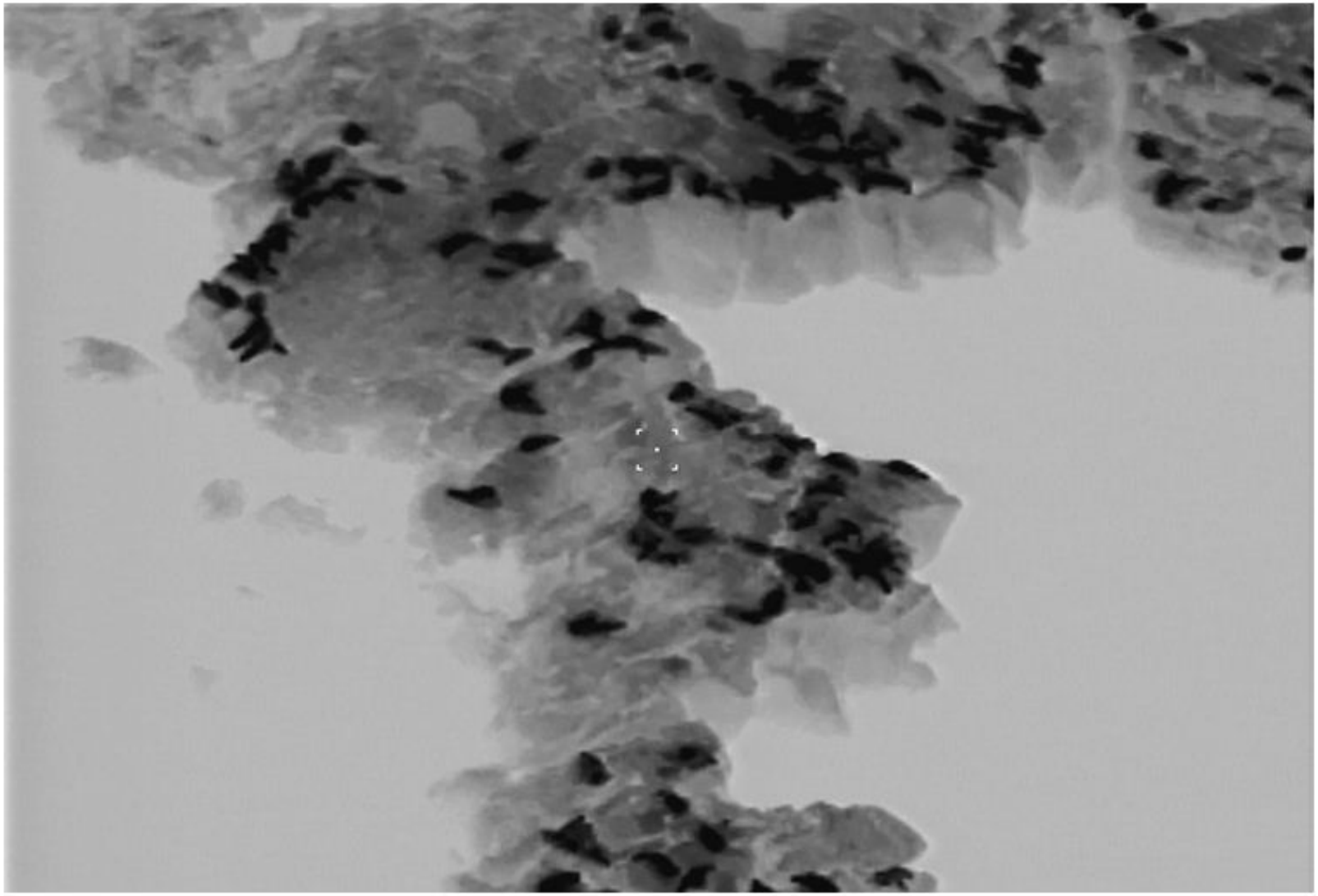
Hexacopters assist with groundbreaking killer whale research. Photo credit: Vancouver Aquarium and NOAA

vancouver aquarium

OUR BLOGS

- Aquarium
- Marine Mammal Rescue
- Ocean Wise
- Marine Biodiversity
- Whale Sightings
- Marine Mammal Research
- Shoreline Cleanup
- Arctic Connections

PHOTOS/COURTESY/ALASKA CENTER FOR UNMANNED AIRCRAFT SYSTEMS INTEGRATION



Dino drone helps track fossil finds

Drones for bones

Researchers at the Royal Tyrrell Museum are using technology to create massive digital maps of bone beds. Kevin Fleming explains...

Colleen Schmidt, CTV Calgary
Published Friday, September 19, 2014 12:54PM MDT
Last Updated Friday, September 19, 2014 5:22PM MDT

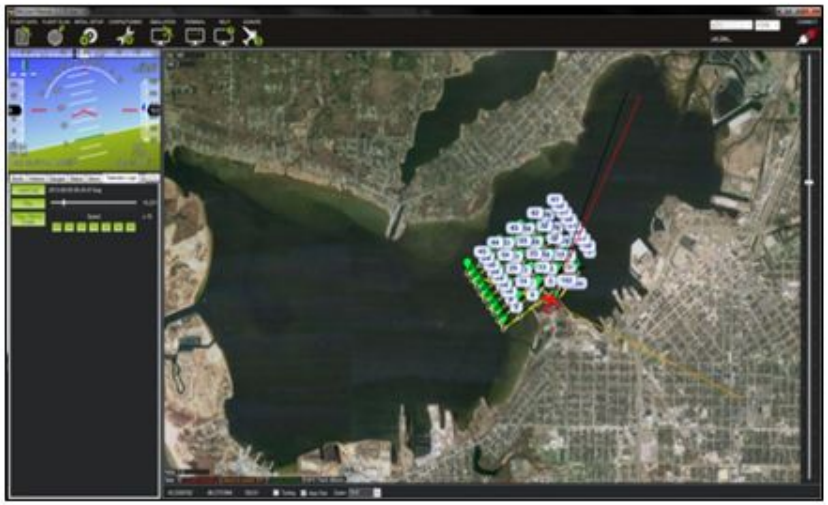
Aquatic Science Research

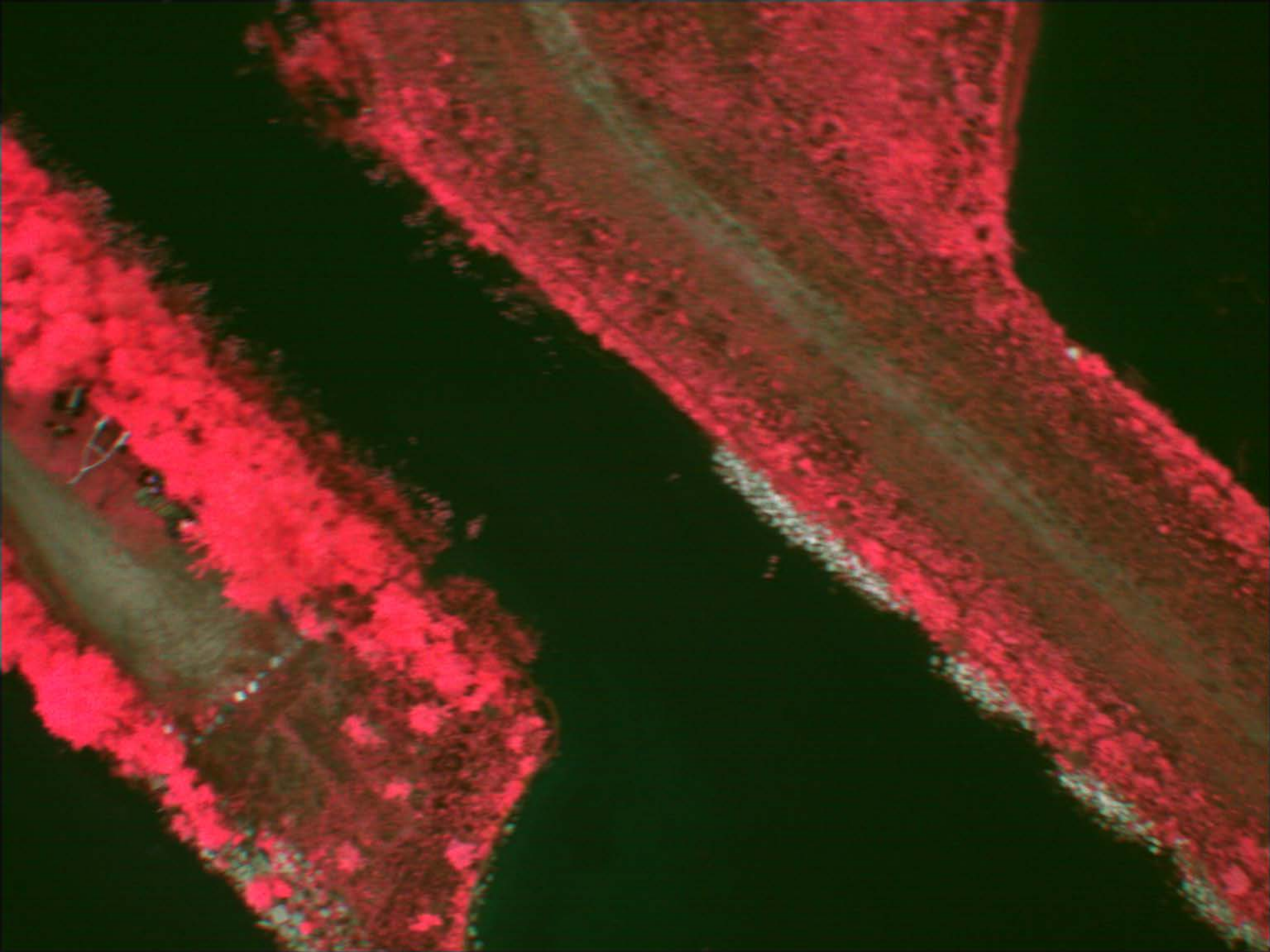
- Hazardous Algal Blooms
- Lake Production / Trophic Status
- Septic Tank Discharge / Water Pollution
- Shoreline Erosion / 3D Assessments
- Airborne Pollution and Pathogens
- Invasive Aquatic Plants
- Habitat Assessment / Project Evaluation

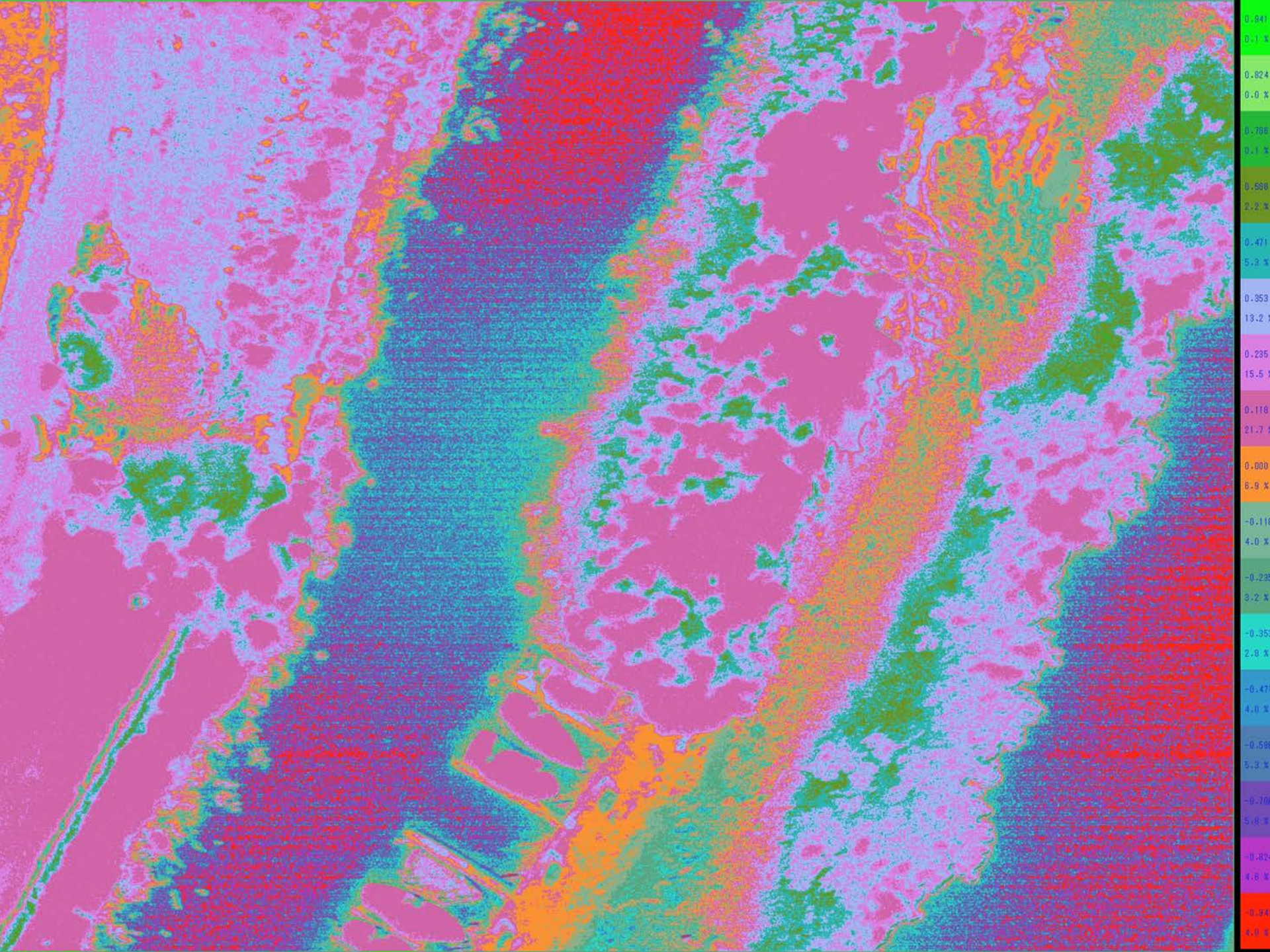
Methods and Materials

Study Area

The project study site was the 16.8 km2 Muskegon Lake in Muskegon County, MI. While the entire lake was up for consideration, the UAV missions and field sampling focused on the central region of the lake near the buoy-based observatory operated by Grand Valley State University's (GVSU) Annis Water Resources Institute (AWRI) (Figure 1).



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0.824
0.0 %
0.706
0.1 %
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13.2 %
0.235
15.5 %
0.118
21.7 %
0.000
6.9 %
-0.118
4.0 %
-0.235
3.2 %
-0.353
2.8 %
-0.471
4.0 %
-0.588
5.3 %
-0.706
5.8 %
-0.824
4.8 %
-0.941
4.0 %

Table 1. Muskegon Lake Data for July 10 and August 5, 2013.

Sample	Chl	Avg NIR DN	Avg Red DN	Red/NIR	ln(Red/NIR)	NIR/Red	ln(NIR/Red)
B-1	16.8	1	52	77.615	4.352	0.013	-4.352
B-2	15.2	2	57	42.539	3.750	0.024	-3.750
B-3	15.7	5	51	15.225	2.723	0.066	-2.723
B-4	17	2	54	40.300	3.696	0.025	-3.696
B-5	14.3	10	58	8.657	2.158	0.116	-2.158
B-6	16.2	6	57	14.180	2.652	0.071	-2.652
B-7	17.5	3	59	29.354	3.379	0.034	-3.379
D-1	10.7	8	27	3.759	1.324	0.266	-1.324
D-2	12.9	8	25	3.480	1.247	0.287	-1.247
D-3	11.5	8	24	3.341	1.206	0.299	-1.206
D-4	10.3	7	23	3.659	1.297	0.273	-1.297
D-5	12	8	24	3.341	1.206	0.299	-1.206
D-6	11.8	8	25	3.480	1.247	0.287	-1.247
D-7	9.1	8	28	3.898	1.360	0.257	-1.360
D-8	12	8	28	3.898	1.360	0.257	-1.360
D-9	12.4	8	26	3.620	1.286	0.276	-1.286
D-10	12.9	9	28	3.465	1.243	0.289	-1.243
D-11	10.1	8	27	3.759	1.324	0.266	-1.324
D-12	9.6	8	27	3.759	1.324	0.266	-1.324
D-13	8.3	9	26	3.217	1.169	0.311	-1.169
D-14	10.7	9	26	3.217	1.169	0.311	-1.169
D-15	10.6	8	26	3.620	1.286	0.276	-1.286

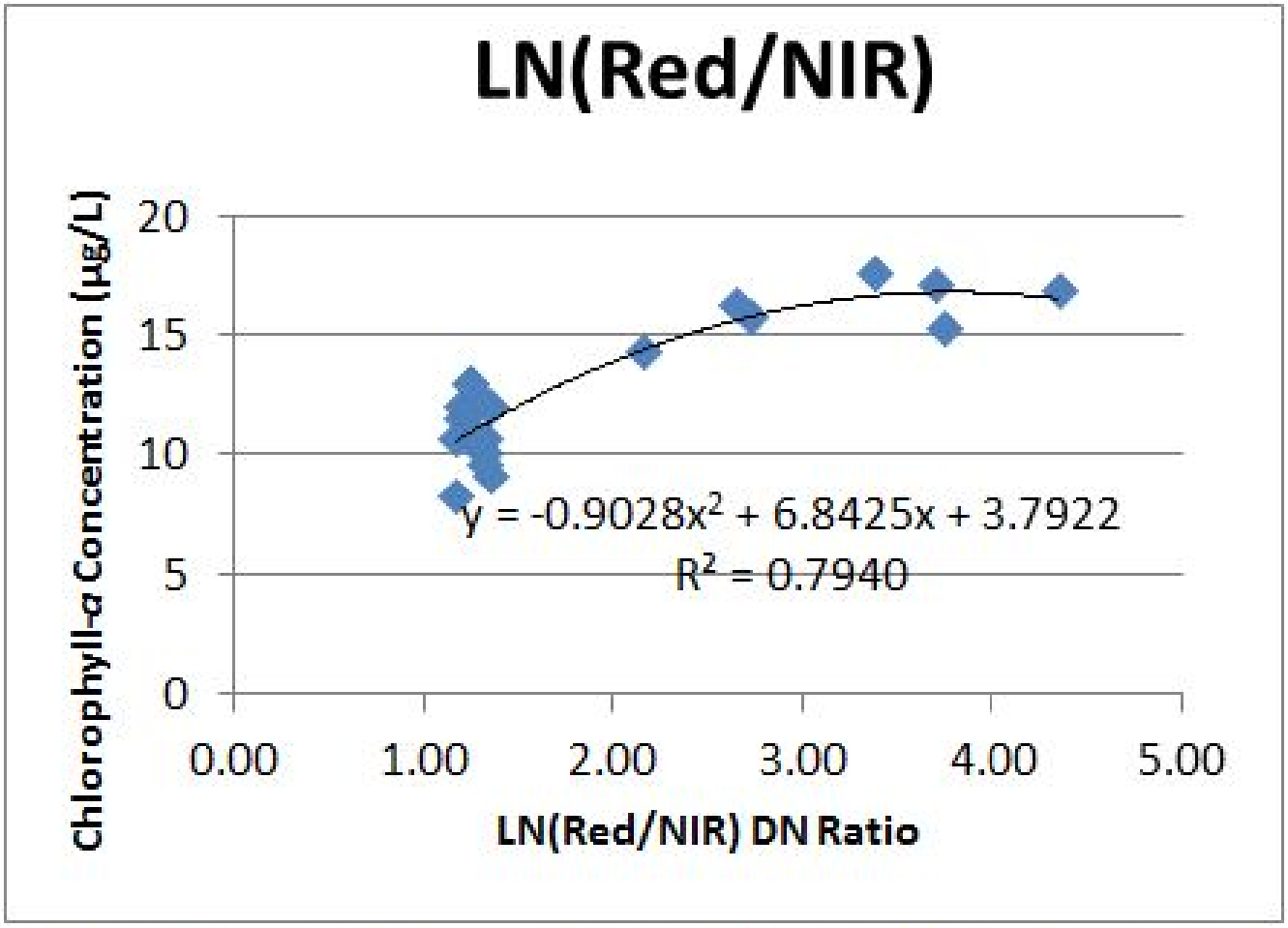
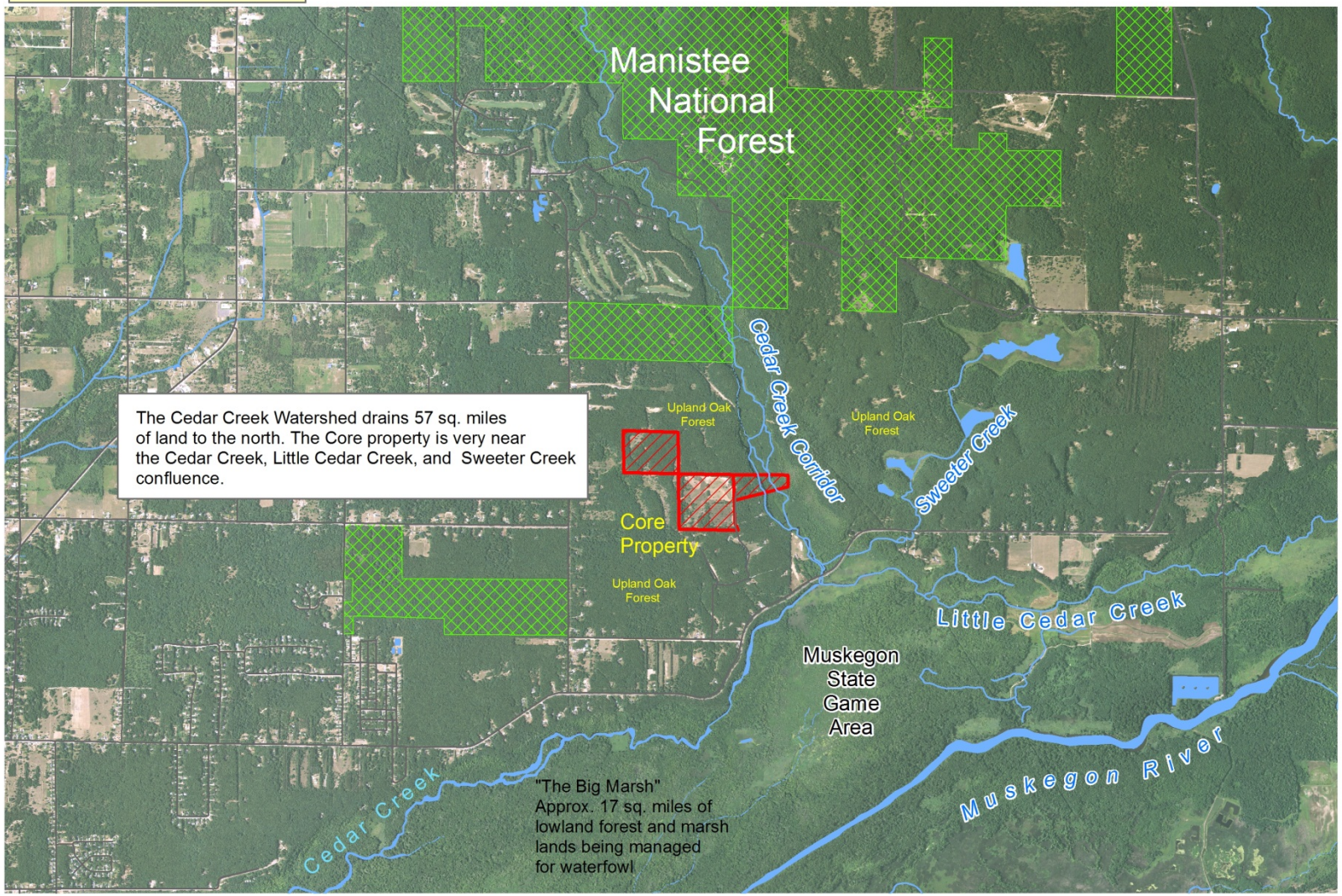
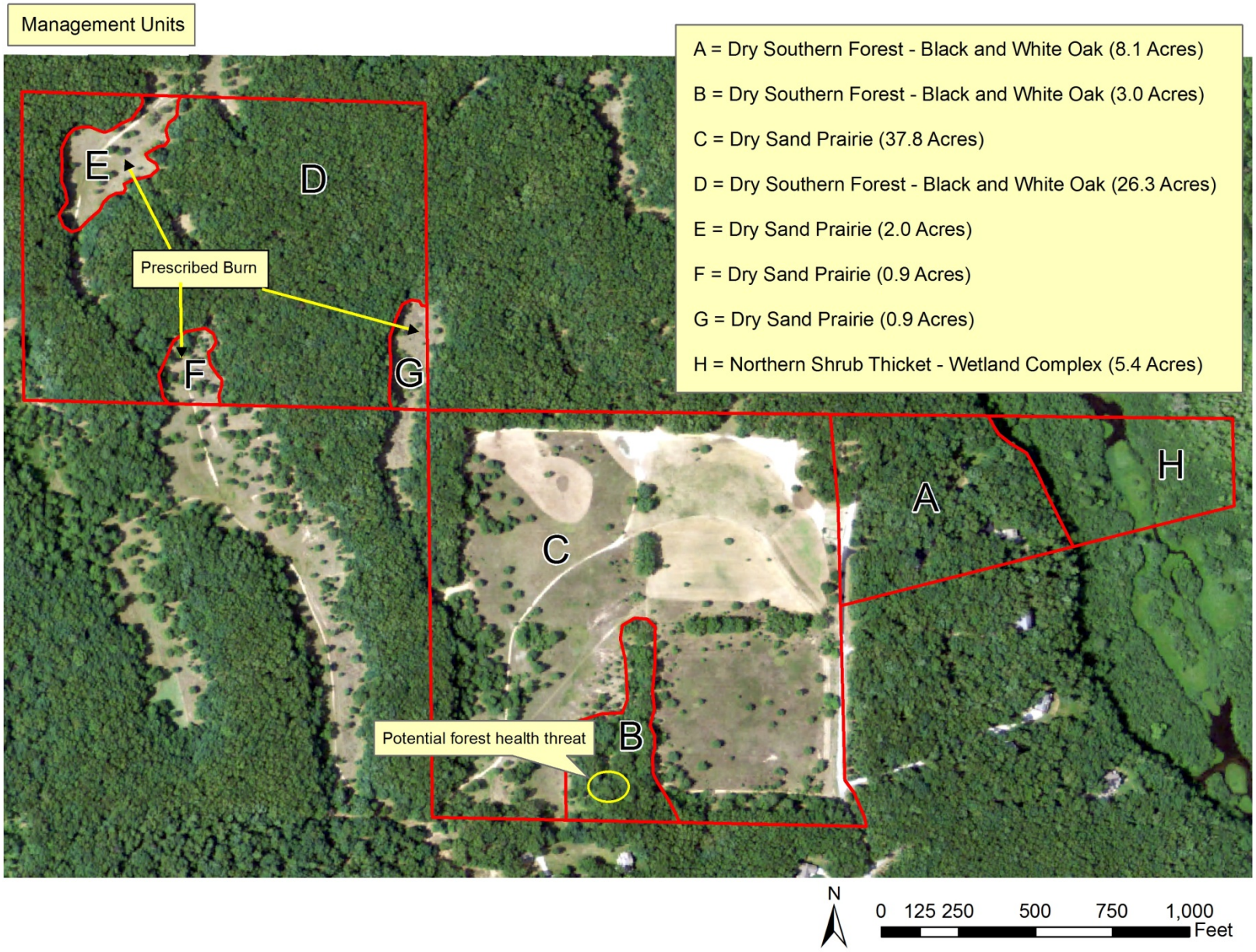


Figure 5. Chlorophyll concentration vs. LN(Red/NIR) and resultant trendline and R^2 value.

Landscape Connectivity Map




Management Units
A = Dry Southern Forest - Black and White Oak (8.1 Acres)
B = Dry Southern Forest - Black and White Oak (3.0 Acres)
C = Dry Sand Prairie (37.8 Acres)
D = Dry Southern Forest - Black and White Oak (26.3 Acres)
E = Dry Sand Prairie (2.0 Acres)
F = Dry Sand Prairie (0.9 Acres)
G = Dry Sand Prairie (0.9 Acres)
H = Northern Shrub Thicket - Wetland Complex (5.4 Acres)
E
D
Prescribed Burn
F
G
A
H
C
B
Potential forest health threat
N
0 125 250 500 750 1,000
Feet

Forked Bluecurls Population - Management Unit C

Legend

Forked Bluecurls Populations *(Trichostema dichotomum)* a State Threatened Plant (1.6 Acres)

N

0 50 100 200 300 400
Feet

Acknowledgements

- Alex Ebenstein – Summer 2013 Student Research Assistant
- Chris Vandenberg – Summer 2014 Student Research Assistant
- Jack Gibson – Summer 2014 Student Research Assistant
- Rod Denning – AWRI Research Associate