

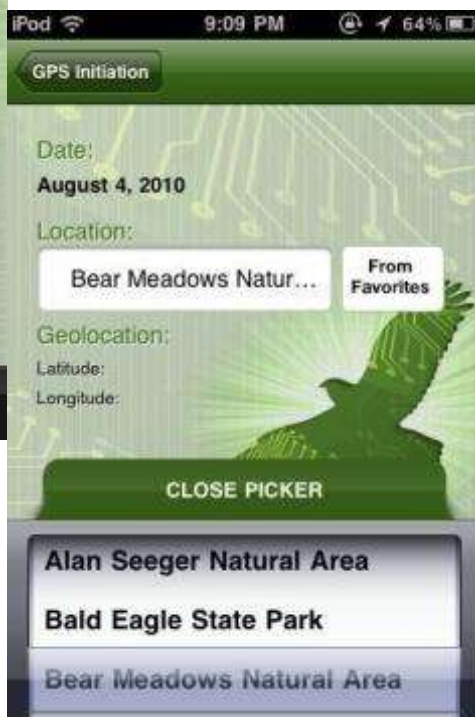
# An Overview of Mobile GIS Apps for Field Data Collection

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- 2010
  - iOS GIS Apps
  - No accurate GPS/GNSS (*Tested iPhone 6 and iPad Air = 6.5m [95% CI]*)



# New Tech Opens New Doors

2012-ish

- BlueTooth External 2.5-meter GPS

- Bad Elf Pro GPS
  - *(Tested 2.2m at 95% CI)*



- Garmin Glo



- Dual XGPS150



# Submeter GNSS Finally Arrives!

- iSXBlue II GNSS (2013)
  - Accuracy  $\leq 0.60$  meter
- Arrow 100 GNSS (2014)
  - Accuracy  $\leq 0.60$  meter
- Trimble R1 (2015)
  - Accuracy  $< 1.0$  meter



# RTK Market Grows

- SXBlue III GNSS (2014)
  - Accuracy 1 cm



- Arrow 200 GNSS (2014)
  - Accuracy 1 cm



- CHC X91+ GNSS (2015)
  - Accuracy 1 cm



# Full Hardware Solution

## iPad (or equivalent tablet)

- Waterproof case
- Strap system
- Apps Aplenty!
  - Mobile GIS
  - Plant Guides
  - Compass/Camera
  - PDF Reader
- External battery
- Cellular service (*optional*)
  - Real-time access to GIS server
  - Internet access

## GNSS

- 2.5 meter GPS
- Submeter GNSS
- RTK



# Workflow

- Tablet paired to GNSS
- Monitor GNSS “health”
- Mobile GIS App for data collection and export
  - Cloud server

	Internal	External
Latitude	45.441067	45.44106742
Longitude	-122.826092	-122.82635...
Altitude	72.40	72.49
Course	180.22	
Speed	0.00	
Horizontal Accuracy	0.19 m	HDOP 0.60
Fix Type	DGPS	VDOP 1.10
Age of Diff Correction	4.0	PDOP 1.20
GPS/Glonass Used	11 / 6	GPS/Glonass Tracked 12 / 9

Location Satellites Data Configuration



Cloud Computing

# Successful Experiences

## Projects

- 2012 – 1
- 2013 – 3
- 2014 – 18
- 2015 – 5

## Types of Surveys

- Wetland Delineations
- Habitat Mapping
- T&E Species Surveys
- Aerial Raptor Nest
- Post-con Habitat  
Restoration Monitoring  
(3 years)



# iPad Benefits

## TIME AND MONEY SAVINGS

1. Better Navigation
2. Helpful Aerial Imagery
3. Quicker Data Entry
4. Direct Photo Integration
5. Real Time Data Access (Cloud)
6. Long-term Asset Monitoring
7. Better Security (Passcode Lock)



# iPad Benefits

- Numbers based on general environmental field surveys in remote areas



iPad and Bluetooth GPS startup times **save 6% of your work day** lost to other GPS technology glitches



iPad provides easier field navigation that **saves teams 5% of their work day**



Recording photos and corresponding GPS points is **37% faster** than other methods



Nightly data upload to the cloud database is **30 times faster** than other methods

# The Difficult Part

## Software

- Multitude of Mobile GIS Apps
  - iGeoTrak
  - Collector
  - Fulcrum
  - GIS Pro
  - Wolf GIS
  - iCMTGIS
  - Theodolite
  - GeoJot+
  - TerraGo
  - Mapistry
  - Geospago
  - Avenza PDF Maps



Date & Time: Wed Jun 25 09:20:59 PDT 2014

Position: 041.40014°N / 114.70380°W

Altitude: 5619ft

Azimuth/Bearing: 230° S50W 4089mils (True)

Elevation Angle: -05.2°

Horizon Angle: -01.1°

Zoom: 1X

WW-06-002-NE

# Theodolite HD



# GeoJot+

## Good Photolog Software

- Photos automatically linked to GPS point and compass bearing
- Eliminates manual photo loading
  - Saves on expensive office data entry time



# GeoJot+

Multiple formatting options

- PDF
- Word

Export KMZ with photos and attribute data attached



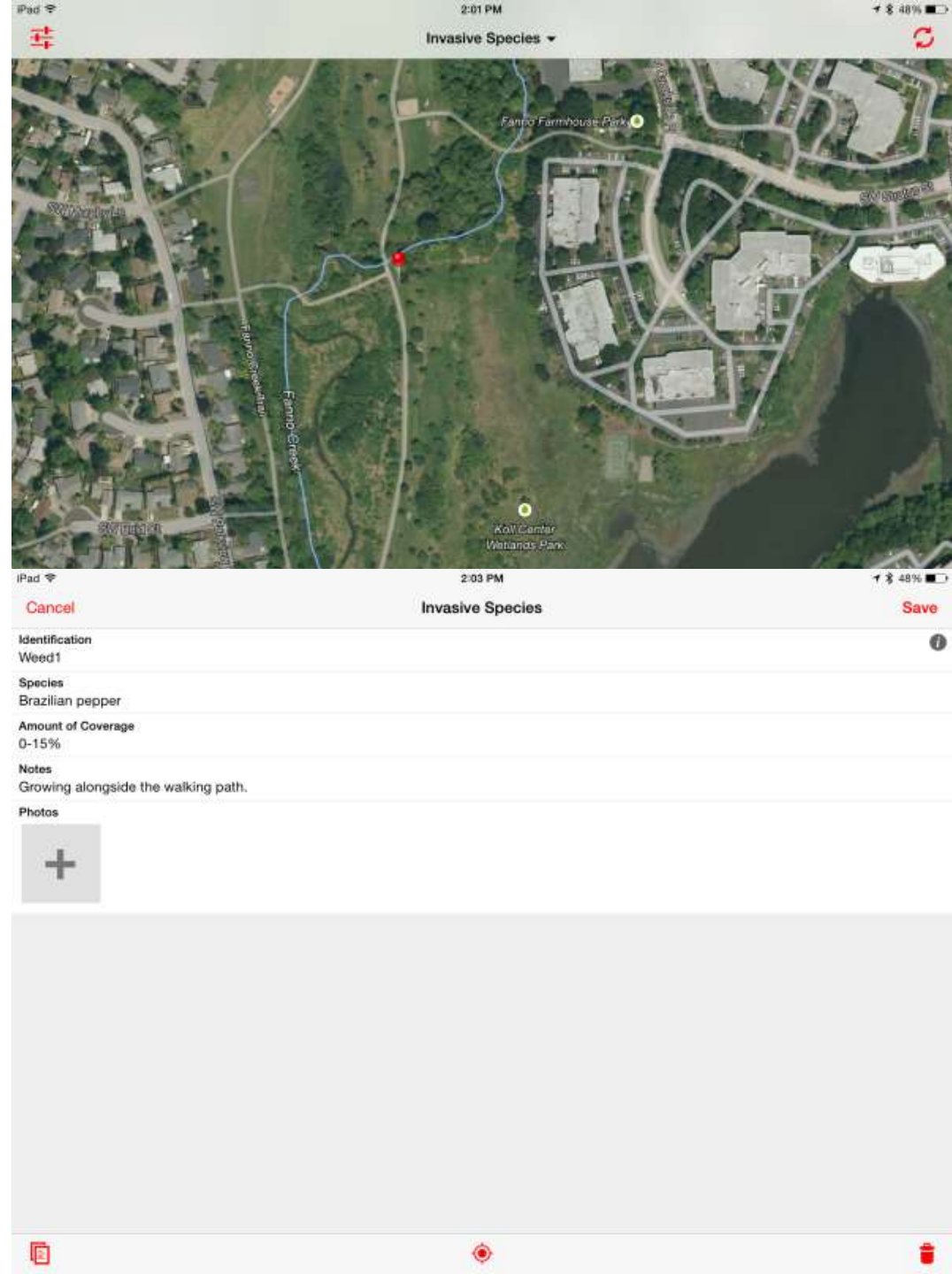
Attributes	
General Assesment:	NA
Type	Map
Condition	Disrepair
Comments	NA
Action Needed	Repair
Title	South Boulder Peak Trail Survey
Elevation	6449 ft
Latitude	N 39° 56' 44"
Longitude	W 105° 17' 13"
Date Stamp	5/8/2011

# Fulcrum

Simple back end (HTML)

Multiple export options

- Shapefile
- CSV
- KMZ
- GeoJSON



# Fulcrum

Default report PDF export

Export reports customizable



## T-2

<b>Project</b>	Mustang Run
<b>Created</b>	2014-03-20 21:32:25 UTC by Matthew Alexander
<b>Updated</b>	2014-04-02 14:32:25 UTC by Matthew Alexander
<b>Location</b>	36.7143845640001, -96.558241203

## Bald Eagle Point Count Data

<b>Point Count #</b>	T-2
<b>Date</b>	2014-03-25
<b>Observer</b>	Sarah Rehme
<b>Start Time Full Count</b>	08:52
<b>End Time Full Count</b>	09:52

## Bald Eagles Encountered

### Birds observed 1

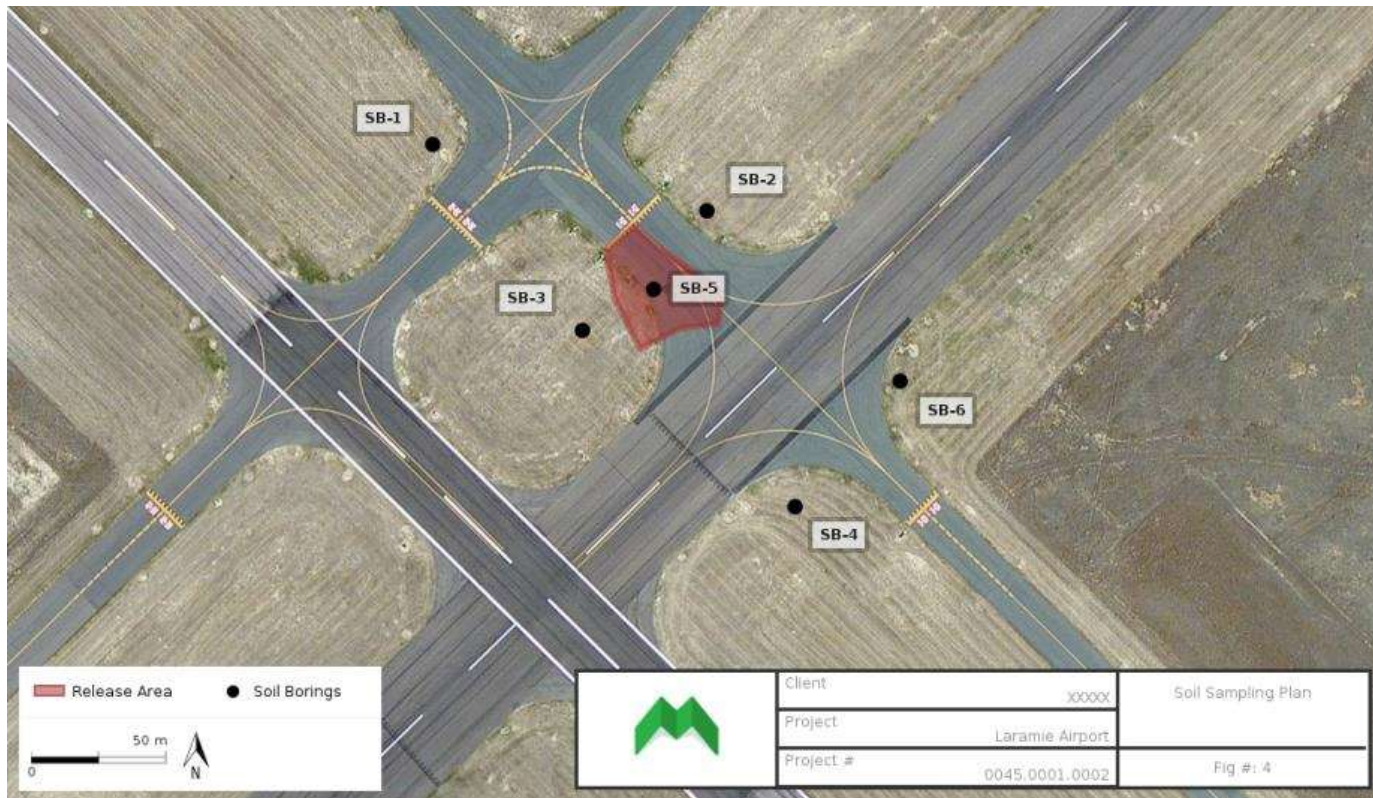
<b>Eagle ID 1</b>	NOHA
<b>Start Time 1</b>	09:44
<b>End Time 1</b>	09:45
<b>Total Eagle Minutes Eagle ID 1</b>	1
<b>Age 1</b>	Adult
<b>800m Radius 1</b>	In
<b>Height 1</b>	Low: 0 - 200 m AGL
<b>Direction of Flight 1</b>	NE
<b>Behavior 1</b>	Gliding
<b>Notes 1</b>	Northern Harrier

## Weather Data



# Mapistry

- Web browser based system for data collection
- Customizable legend and title box for simple map creation



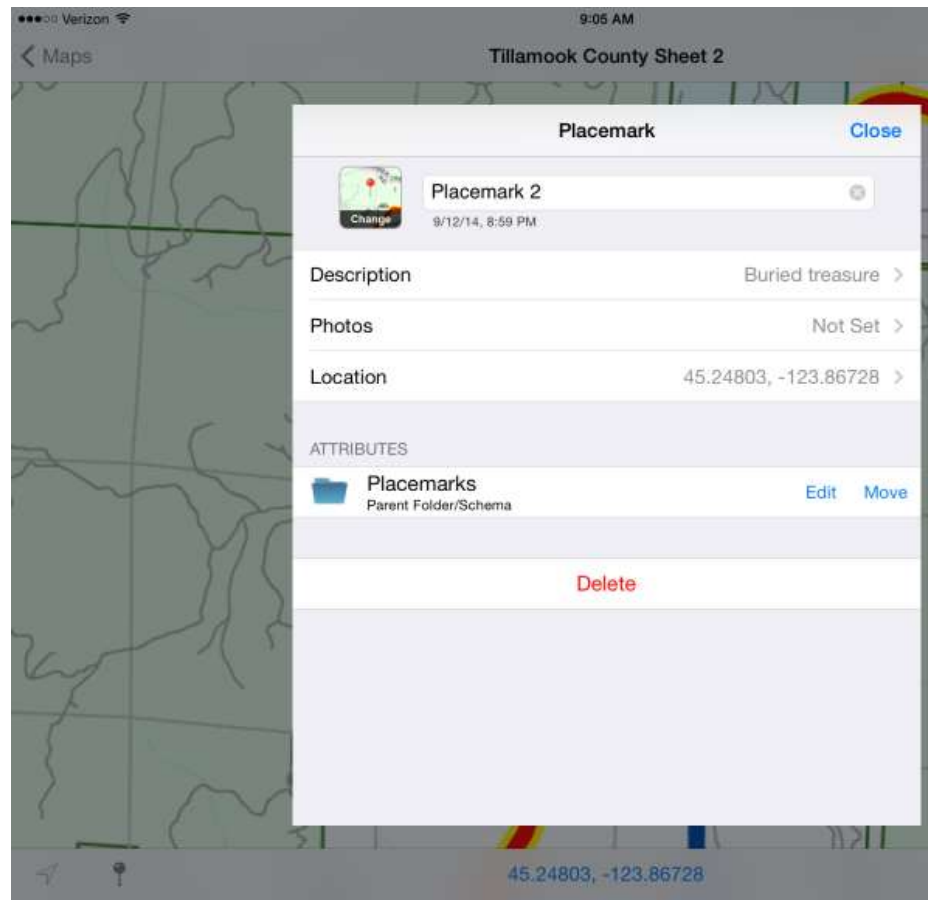
# TerraGo Edge

- Custom offline maps
- Create “Task Orders”
- WMS feeds
- Record audio

The screenshot displays the TerraGo Edge mobile application interface. The top navigation bar includes the 'TERRAGO edge' logo and a 'Welcome malexander' message. A central modal window titled 'Fish Survey' is open, featuring a 'Close' button on the left and a 'Done' button on the right. The form is organized into three sections: 'Location & Information', 'Water Details', and 'Fish Details'. The 'Location & Information' section contains fields for 'Location Name' (filled with 'Amazon River pt. 34') and 'Department' (filled with 'Text Input'). The 'Water Details' section includes a 'Resource Type' dropdown menu (with options: River, Lake, Stream, Other), 'Water Oxygen Level', 'Water pH', and 'Water Algae Survey'. The 'Fish Details' section has a 'Dead Fish / sq mile' field filled with the number '4'. The background shows a map with a red location pin and a sidebar with navigation options like 'Notes', 'TaskNo', 'Pipeline 123', and 'Refinery A'.

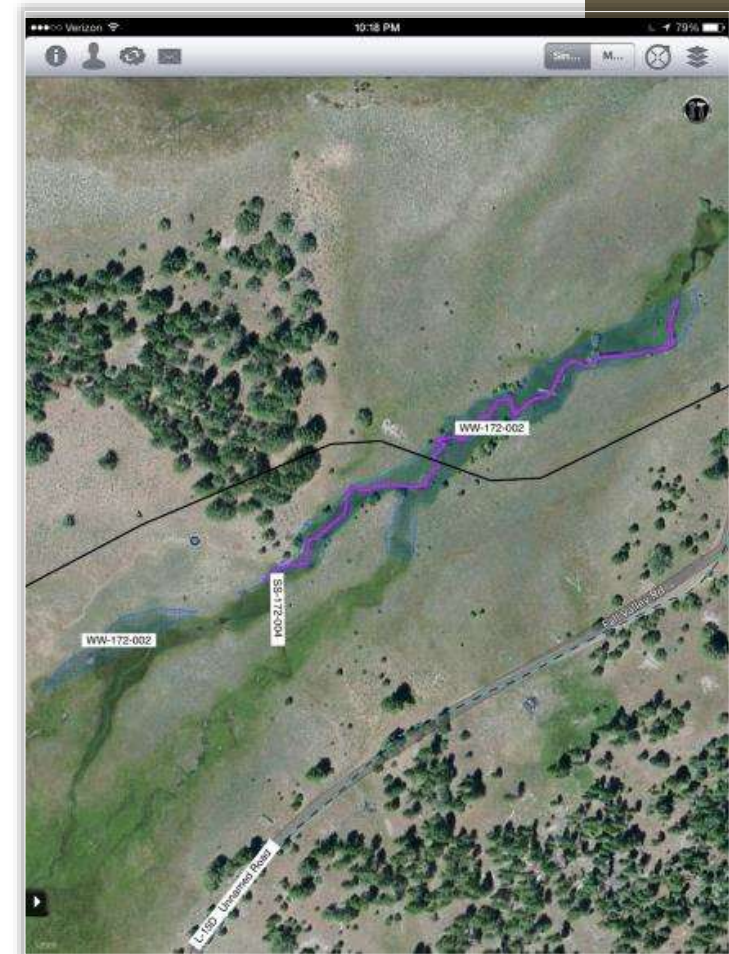
# Avenza PDF Maps

- Buy GeoPDF's of USGS, USFS, and aerial maps
- Create simple attribute collection forms
- Pay for business

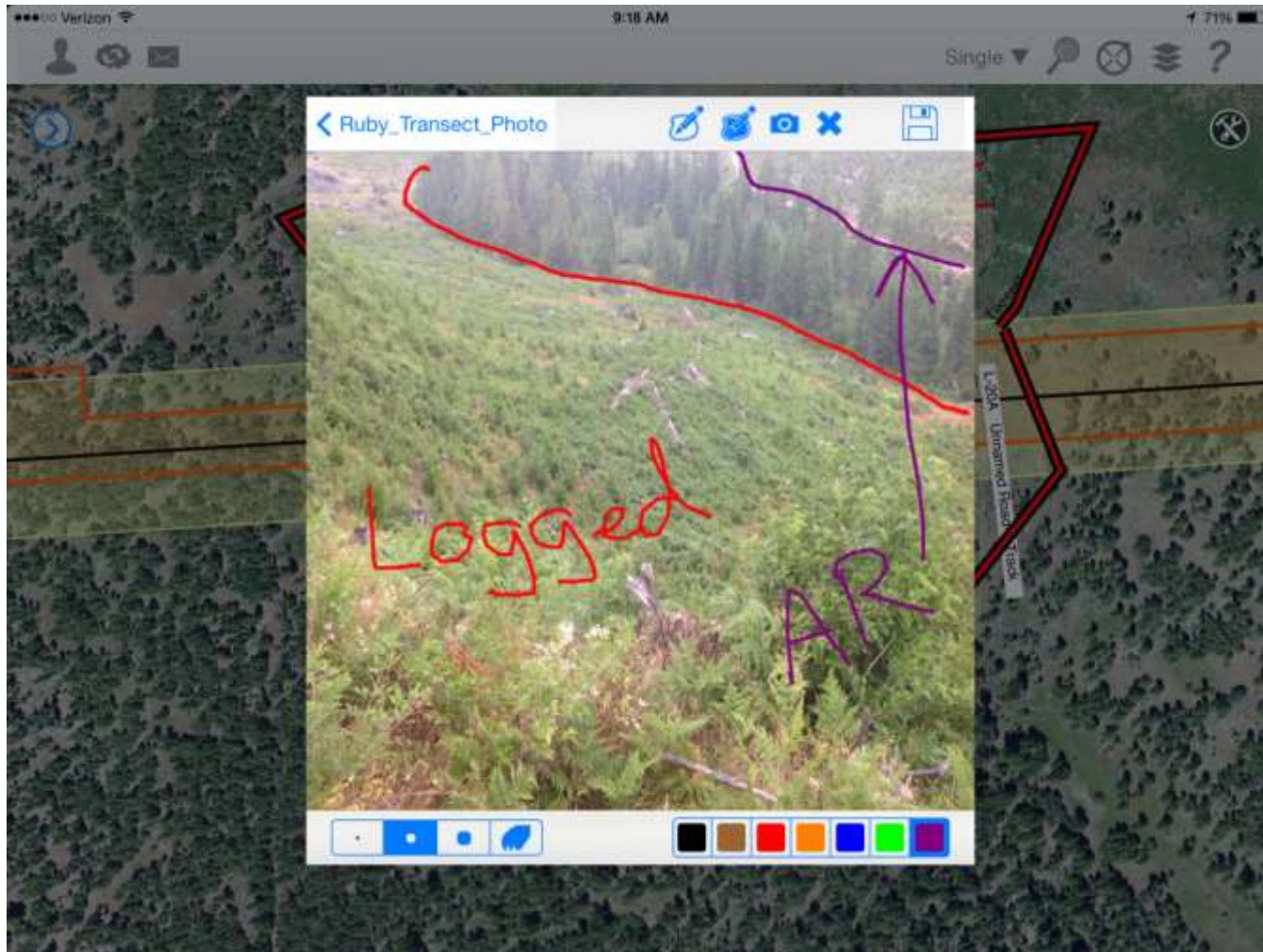


# iGeoTrak

- Best mapping system: zoom *ANYWHERE* & offline image caching
- Direct integration of aerial imagery at all times
- Can upload additional imagery layers
  - NAIP satellite
  - UAV imagery
  - SSURGO soils data
  - USGS National Hydrography Data
- Points, Lines, Polygons
- Data syncs only DELTA
- SQL based system for robust database



# iGeoTrak



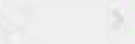


# iGeoTrak

Customizable data collection forms  
(simple or complex)

- Multiple photo capture
  - Draw on photos
- Sketchpad
- Save map screenshot to point
- Dropdown picklists (5,000 species)
- Linked data fields
- Auto calculations
- Data history

The screenshot displays the iGeoTrak mobile application interface. At the top, the status bar shows the time as 8:54 AM. Below the status bar is a navigation bar with a back arrow, an information icon, a user profile icon, a settings gear, and a mail icon. The main header is a green bar with the text 'Close' on the left, 'Ruby Transect Intercept' in the center, and a list icon on the right. The form is titled 'Transect Point Intercept' and contains several data entry fields:

Project	Ruby2013
Transect	OR-SM-7-666.2-C-2
Line Length(m)	47
Intercept Spacing Interval(m)	0.75
Photo	 
Comments	

Below the main form is a section for 'Pt-1' with a list of canopy and soil surface observations:

Pt-1 Top Canopy	ARTR8
Pt-1 Lower Canopy 1	FEID
Pt-1 Lower Canopy 2	BRTE
Pt-1 Lower Canopy 3	
Pt-1 Soil Surface	L

# Post-con Habitat Monitoring Yr1

Old Field Data Management		iPad Field Data Management	
Activity	Time	Activity	Time
Photos: Trimble + Camera	24	Photos: iPad	14
Nightly download to laptop	2.5	Nightly synch to cloud database	0.2
Download new project files to Trimble	0.5	Synch new files to iPad	0.2
Weekly upload to FTP	1	Synch with cloud database	0.2
GIS data compilation	3	Data automatically compiled	0
Manual photo upload	4	Photos automatically linked to GIS features	0
<b>Total hours per week</b>	<b>31</b>	<b>Total hours per week</b>	<b>14.6</b>
<b>Cost</b>	<b>\$2x</b>	<b>Cost</b>	<b>\$x</b>

*Time estimated per team per week for photo centric field work*

# Habitat Monitoring Yr 2: All In

## 6 Field Teams

- All teams switched to iPads paired with external GPS and electronic data sheet collection and photos (*no paper*)
- Each team completed scheduled tasks 20 – 30% faster than estimated thanks to:
  - Field iPad
  - External GPS
  - iGeoTrak utilizing cloud interface
  - Cellular data plan when service was available (*mostly offline; very remote areas*)



# Additional Information

[www.anatumfieldsolutions.com](http://www.anatumfieldsolutions.com)

## Visit Field Talk Blog

- Discussions of Mobile GIS best practices
- Links to our Mobile GIS publications
- Interviews with:
  - iGeoTrak
  - Fulcrum
  - Mapistry
  - Avenza PDF Maps
  - Geospago



# Publications

- *Increasing the Efficiency of Aerial Surveys By Using Tablets for Project Siting*, March 2015
- *Using the Tablet in the Field: Pipeline Post-Construction Restoration Monitoring Case Study*, March 2015





# Handheld GPS vs. Mobile GIS

- Handheld GNSS
  - ArcPad/Terrasync
  - GPS Correct (*needed for post-processing*)
  - Internal GNSS
    - System can use Real-Time Differential GPS and/or Post-Processing
  
- Mobile GIS: Tablet and External GNSS
  - GNSS
  - Manufacturer specific SDK
  - GIS App
    - System relies on Real-Time Differential GPS