

Geospatial Technology for Easement Flights

USFWS Devils Lake Wetland
Management District

Developed by Scott Ralston



Easement Flights

- Surveys conducted annually
- Fly over entire district
- Record locations of easement violations
- Photograph violation for evidence



Current Method

- Use paper maps for navigation
- Count section lines to track position
- Mark violations on paper map
- Second flights use paper maps with violations marked to find location
- Circle location and take oblique photographs of violation out the window of the airplane

Improvements to the System

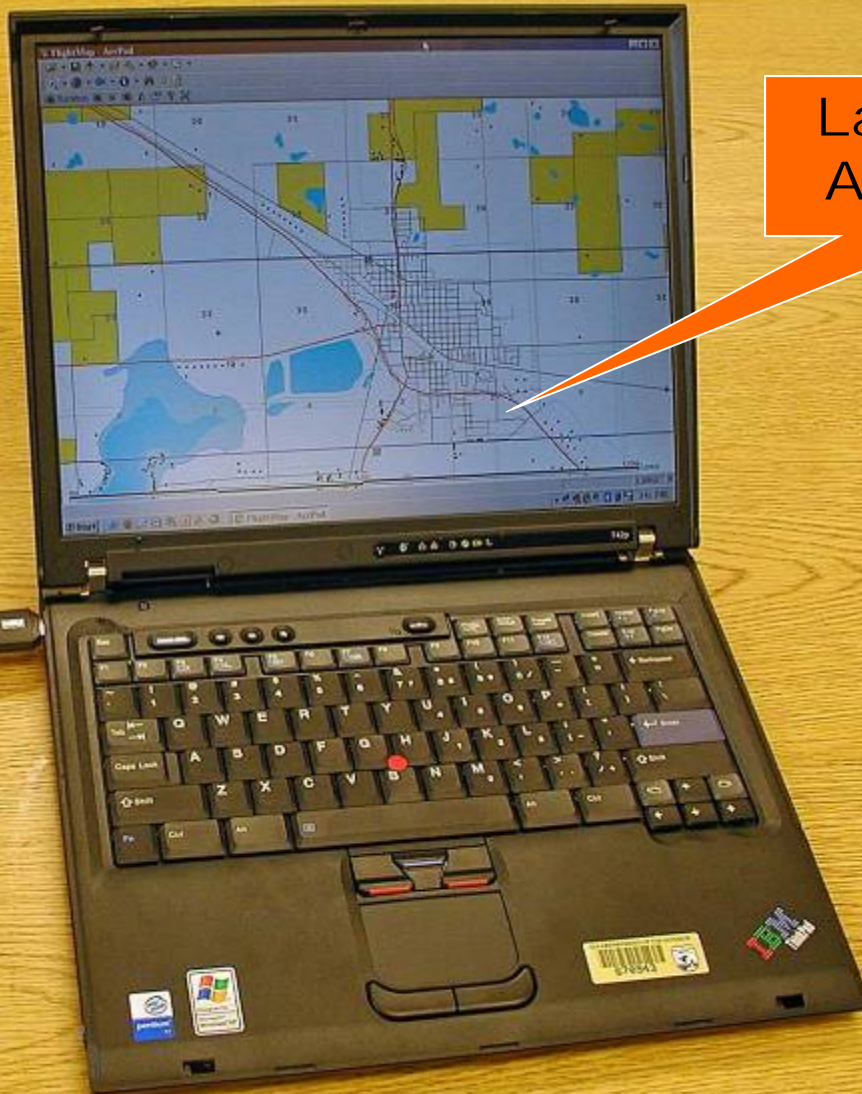
- Apply GPS and GIS technology to flights
- Laptop with GPS connection and Arcpad software used for navigation
- Violations marked on screen with dropdown list for violation type
- Violation point Shapefiles merged and used to generate second flight maps of best flight path
- Belly mounted camera used to take vertical photographs and GPS/GIS used for flightline navigation.

GIS / GPS Equipment

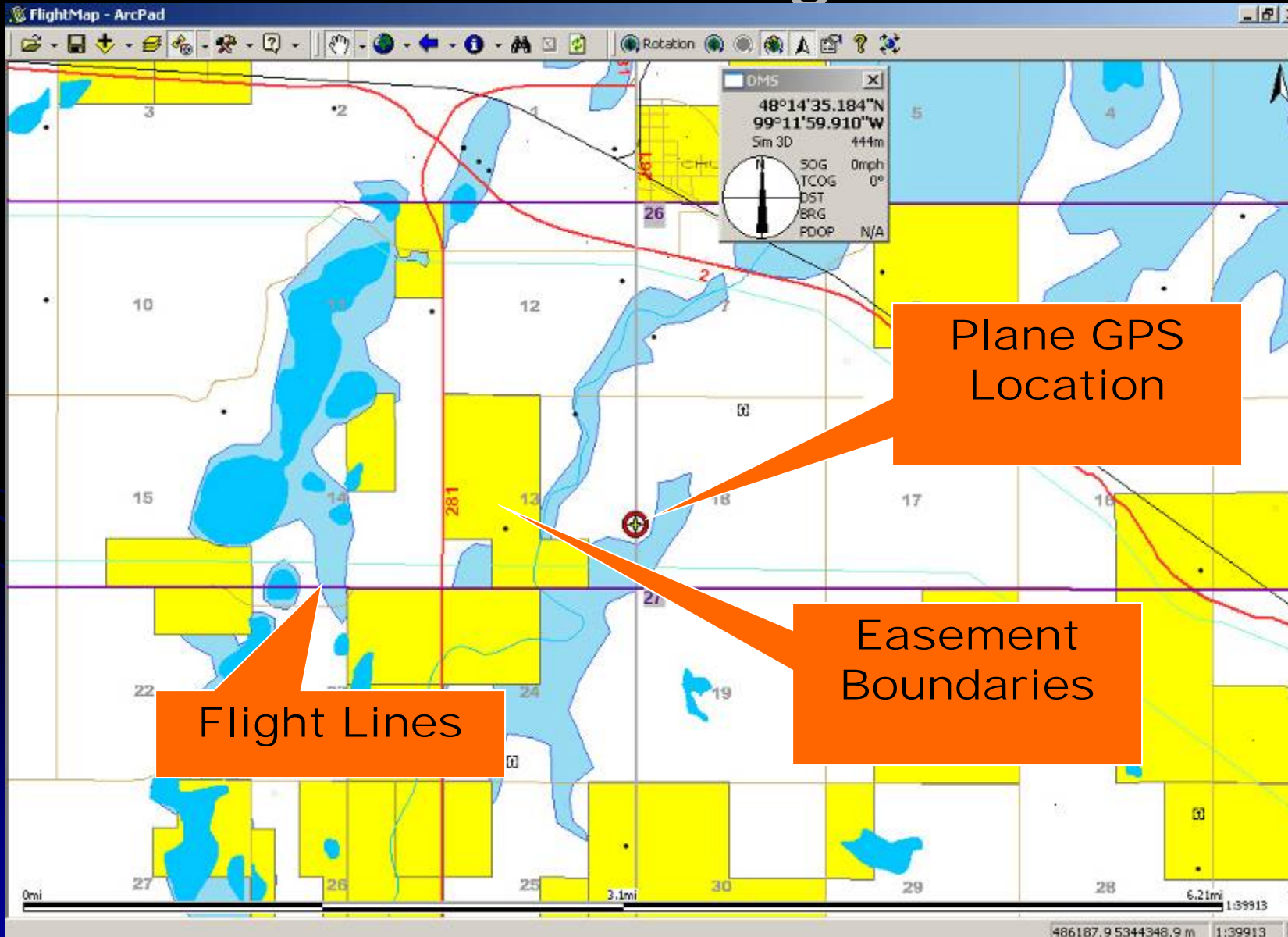
Wireless
Antenna

Laptop with
Arcpad GIS

Wireless GPS



ArcPad Navigation



Recording Violations

The screenshot displays the FlightMap - ArcPad interface. The main map shows a grid of yellow and blue areas, with a red star marking a location. A 'Violations' dialog box is open, showing a dropdown menu with the following options: Scraper Ditch, Burned Wetland, Flow Furrow, Scraper Ditch (highlighted), Fill Wetland, Gra Pit, Oth Violation, and old. A 'DMS' data window is also visible, showing coordinates: 48°14'35.104"N, 99°11'59.910"W, and other data points like SOG, TCOG, DST, BRG, and PDOP. Two orange callout boxes are present: one pointing to the red star on the map with the text 'Mark Violation Location', and another pointing to the dropdown menu in the dialog box with the text 'Choose Violation Type From Dropdown List'.

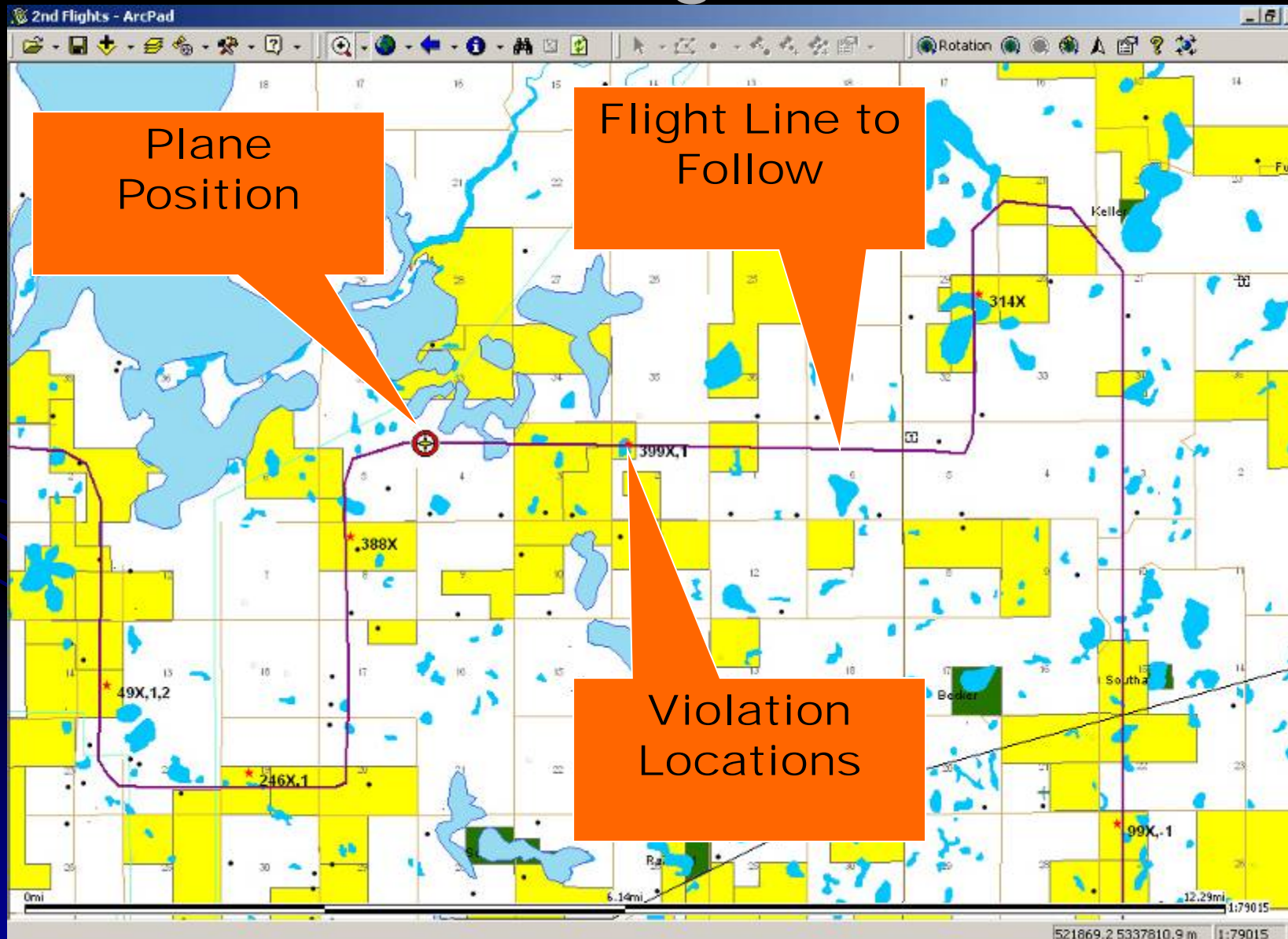
Mark Violation Location

Choose Violation Type From Dropdown List

Photography Flights

- Merge recorded violations from all observers into a single file
- Use GIS tools to easily and quickly obtain legal description and easement tract identity information for each potential violation recorded.
- Create flight lines to transect all points
- Obtain photographs of entire quarter section containing the violation
 - Approximate altitude above ground level of 5,000 feet produces about 1.0mi X 0.7mi coverage with about 2ft pixel resolution using Canon 6mpxl digital rebel camera and 18mm lens.

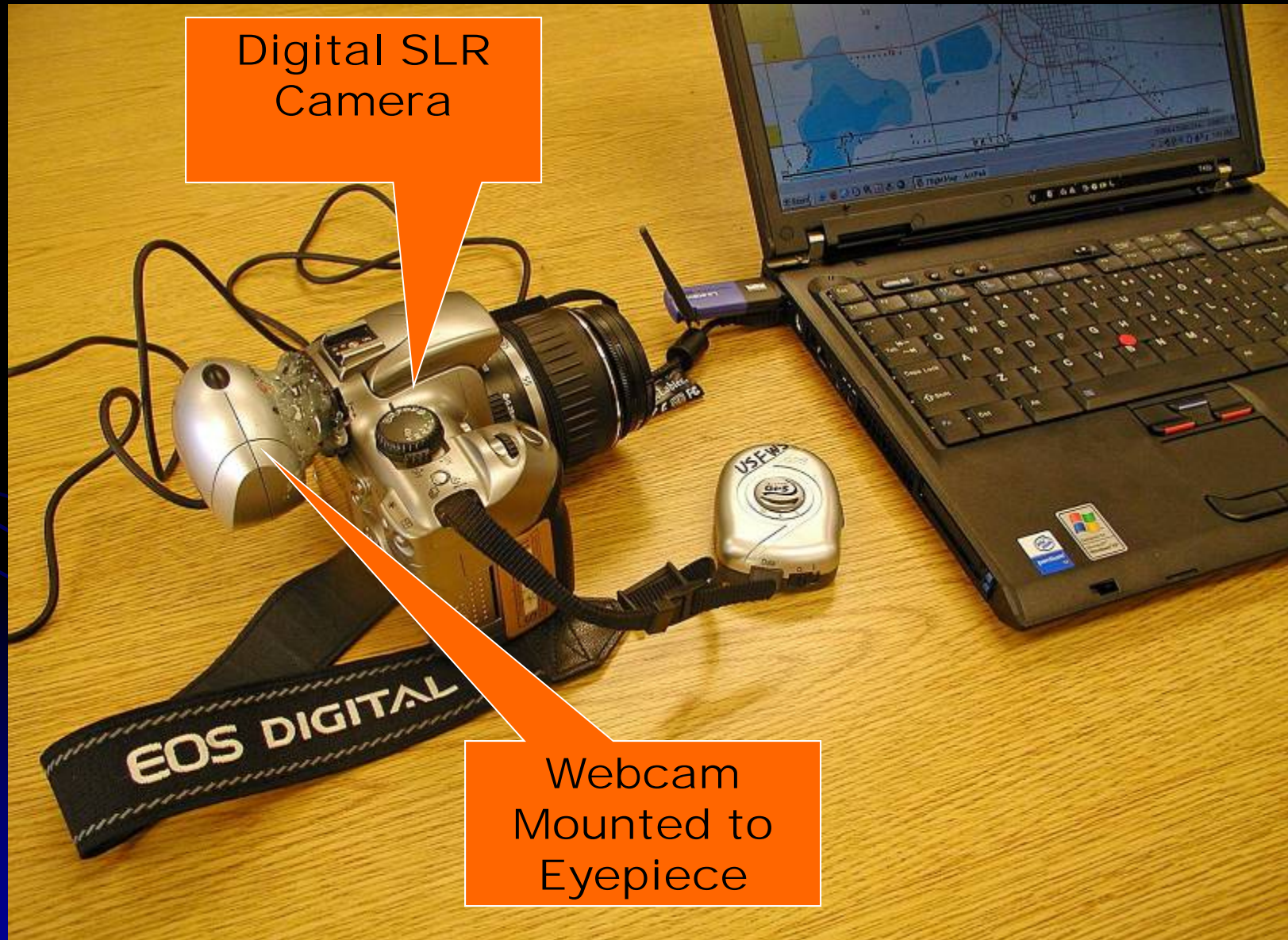
Second Flight-lines



Photography Equipment

Digital SLR
Camera

Webcam
Mounted to
Eyepiece



Photographic Monitoring

The image displays a screenshot of the ArcPad software interface, titled "2nd Flights - ArcPad". The main window shows a map with a yellow grid overlay. A purple line, labeled "Flight Line to Follow", is drawn across the map. A red circle with a white center, labeled "Plane Position", is located on the flight line. A small inset window in the bottom-left corner, titled "TRACKERCAM", shows a live video feed from a webcam, displaying a view through a belly camera viewfinder. The viewfinder shows a dark, textured surface with a white crosshair. The software interface includes a toolbar at the top with various icons for navigation and editing. A status bar at the bottom right shows coordinates: 496376.6 5337402.3 m. A data panel in the top right corner displays flight parameters: 47°59'15.480"N, 98°31'15.126"W, 3D 1796m, SOG 183mph, TCOG 180°, DIST, ERG, and PDOP 2.0.

Flight Line to Follow

Plane Position

View through Belly Camera Viewfinder using Webcam

TRACKERCAM

496376.6 5337402.3 m

Image Enhancement



Resulting Images



Resulting Images



Resulting Images



Resulting Images



Resulting Images




Resulting Images



Overlay image in GIS



Benefits of New Method

- Reduced flight time
 - Flight time is the most costly part of easement surveys
 - Faster and more accurate navigation to and from locations
 - Easy and accurate marking of violation locations
 - Permanent electronic record of violations to be used in record keeping or future maps
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Benefits of New Method

- Reduced flight time
 - Faster air speed for photography (130mph vs. 180mph ground speed)
 - Less time circling violations for photos. One over-flight for photography
 - Flexibility of moving to another area of the district because of inclement weather without having to return for separate paper maps.
- Faster transfer of violation points to customizable maps used in ground visitation
- Ability to transfer locations to handheld GPS for ground check.

Benefits of New Method

- Belly photography can be used in GIS programs and overlaid with other GIS layers.
- Digital images can be easily magnified to zoom in on particular features
- Digital images can be easily replicated, backed up and printed as needed.
- Navigation and Photography setup could have other management and monitoring applications beyond easements.

Benefits of New Method

- Photo flights can be conducted with the pilot and one other person saving man hours by eliminating a navigator.
- Reduced airsickness cause by constant circling of the plane
- Less mental fatigue due to effortless navigation
- Improved efficiency of time, equipment and manpower

Drawbacks to New Method

- Cost of equipment at startup
 - Training for new techniques
 - Overcoming “fear” of new technology and bypassing “the way it’s always been done”.
 - The technology is simple to use and with little training time users can feel comfortable.
- 

Drawbacks to New Method

- Limited Equipment Available
 - Some personal equipment was used to supplement available Service equipment.
 - Limited compatible GPS and laptops available.
 - Resolution of images lower than desired due to limited pixels in camera used
 - Poor quality lens causes distorted images giving the appearance of curvature of the outer portions of the image

Equipment Needed

- Tablet Laptop
 - Tablet PC (\$2,500)
 - Compact enough to be use in confined space of the airplane.
 - Fast and easy to use touch screen to reduce dexterity problems with mouse pad.
 - Plenty of storage space and processing speed to operate ArcPad GIS or ArcGIS
 - 2 Computers / Plane (1 / Observer)



Equipment Needed

- GPS

- Teletype Wireless GPS (\$120)
- Fast, Accurate and Easy to Use
- Bluetooth Connectivity
- 2 GPS Units Needed / Plane



- Bluetooth Antenna

- Built into some laptops
- USB Bluetooth Antenna (\$45)
- One / Laptop if computer does not have it built in



- 400 Watt DC to AC power inverter for plug-in adapters in plane. (\$50)

Equipment Needed

- High Resolution Digital SLR Camera.

- Canon EOS 5D

- 13 megapixel

- Cost: \$3,300

- Standard Canon 28-105mm lens for when oblique photos are required

Cost \$220

- High Quality Wide Angle Aerial Photography Lens (Canon 14mm)

- Cost: \$1,800



Equipment Needed

- Webcam
 - Must work well in Bright and Dim Light
 - Creative NX Pro Recommended (\$50)
 - Adaptable to mount to Camera Eyepiece
- Camera Mount
 - Use camera mount design from HAPET
 - Estimated Cost \$200



Software Needed

- ArcGIS Desktop

- Most field stations should already be using this program and it is not required to be used on the laptop in the plane.
- To be used for map preparation and data manipulation pre and post flights.
- Possibly used for navigation with advanced GIS options but would require more training than ArcPad

- ArcPad (\$100)

- Simpler to use and learn for inexperienced GIS users than the full ArcGIS software. Also has lower computer performance requirements than ArcGIS.
- Must use rotation applet to orient direction of travel to the top of the screen or users will get disoriented when North is always up and you are traveling a different direction.

Cost

- Purchase one set of equipment to be permanently assigned to a plane for the region.
- One set of high quality equipment shared among many districts would be better and cheaper than each District purchasing their own equipment as they can afford it and not getting the quality they need.
- Total estimated cost for 1 fully equipped airplane.
 - About \$12,000

Projected Performance with Better Equipment

- Navigation capabilities have already been proven
- Estimated Photographic Results
 - Fly at 2,000 feet above ground level
 - Photo area = 0.65 mi X 0.97 mi
 - Pixel resolution = 1 foot, 2 inches
- <2,000 foot altitude will provide more opportunities to fly under low cloud cover and produce less haze than the current 5,000 foot altitude.

Current Quality

(Simulation)



Proposed Quality

Simulation

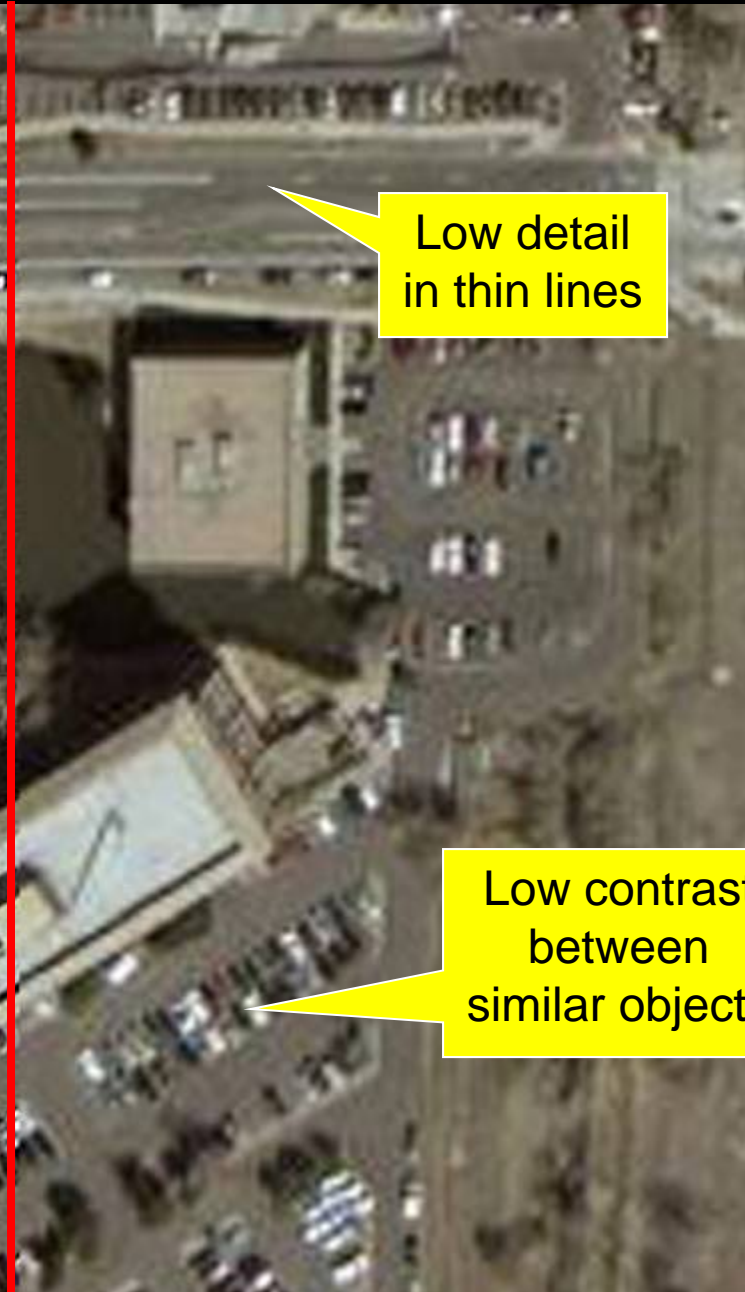


Comparison



High detail
in thin lines

High contrast
between
similar objects



Low detail
in thin lines

Low contrast
between
similar objects

Bottom Line

- Improving quality of easement work = Better protection of habitat and resources
- Improving efficiency of work = \$\$\$ money saved and manpower maximized
- Improving accessible technology = More available tools to utilize for all aspects of Wildlife Management work including planning, law enforcement and biological monitoring.