Using Drone Magnetometry to Locate Four (4) Abandoned Wells Before Lunch

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A Brief Summary Bio (of the world’s only geoDRONEologist)

# years in the geoscience industry: 40+

formal education: B.S. Applied Physics, Michigan Technological University, course work in geology

informal education (aka “practical experience”):
acquired, processed, visualized and interpreted a large volume of ground, airborne, and borehole geophysical data for resource exploration (ground water, minerals, hydrocarbons, and geothermal) as well as environmental & engineering site subsurface characterization.

geoDRONEology: 5 years of applying drones for geoscientific mapping
Talking Points

Defining the Problem
Evaluating the Site
Assessing the Options
Deciding on the Approach
Making up the Plan
Executing the Site Scan
Analyzing the Results
Tagging the Location
**Defining the Problem**

Objective is to precisely locate a vertically oriented cylinder made of **steel** extending into the subsurface. Typically, the top segment has been cut off ~10 ft below the ground surface with no indication of well at the surface.

The well location information available in Colorado Oil and Gas Conservation Commission (COGCC) for older wells is quite often inaccurate.

The client wishes to locate four (4) abandoned wells.
Evaluating the Site
Assessing the Options

- Excavate until it is found
- Remotely sense the subsurface using a geophysical method

Applicable Geophysical Methods

- Magnetometry
- Electromagnetic Induction
- Ground Penetrating Radar
- Electrical Resistivity
Why does magnetometry work?

The earth’s magnetic field preferentially concentrates in material of higher magnetic susceptibility. (aka induced magnetization)

Well casings and pipe made of steel - a ferromagnetic material with a very high intrinsic magnetic susceptibility - will cause a magnetic anomaly.

The vertical orientation of the well and length of the well casing and pipe results in a uniquely circular and often high amplitude magnetic anomaly.

Horizontal orientation of a pipeline results in a series of dipolar – positive and negative anomalies.
Deciding on the Approach

MagArrow™

- GPS Location and Timing
- Wi-Fi Comm. and Data QC
- USB Configuration and Data Offload
- Physics Packages
- Sensor Driver
- Cable
- MFAM Module
- Data Logger
- Timing and Synchronization
- Communication Interface
- Battery power

Low Power
Light Weight
High Sensitivity
Drone Compatible
Readily Deployable
Factors impacting the success of a drone enabled magnetic survey for precisely locating abandoned wells.

- Air Space Restrictions
- Weather
- Site Accessibility
- Line Spacing
- Sensor Altitude

- Well Construction
- Non-vertical well
- Casing & pipe integrity
- Buried pipe and debris
Making up the Plan

# flight blocks: 4
area: 300 ft by 300 ft
Locate: ~ centered on COGCC
lon & lat
line spacing: ~30 ft
tie line spacing: ~ 30 ft

# of FOSL: 1

FOSL= Flight Operation Staging Location
Executing the Site Scan

Total flight time: 20 min

Total flight time: 40 min
Total Magnetic Intensity
Analyzing the Results

A  abandoned well
P  buried pipeline
O  operating well

- COGCC well location
Tagging the Location

MagHeat well location

COGCC well location
Thank you for your attention.

Questions?
For more information, contact:

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