Utah Division of Oil, Gas and Mining

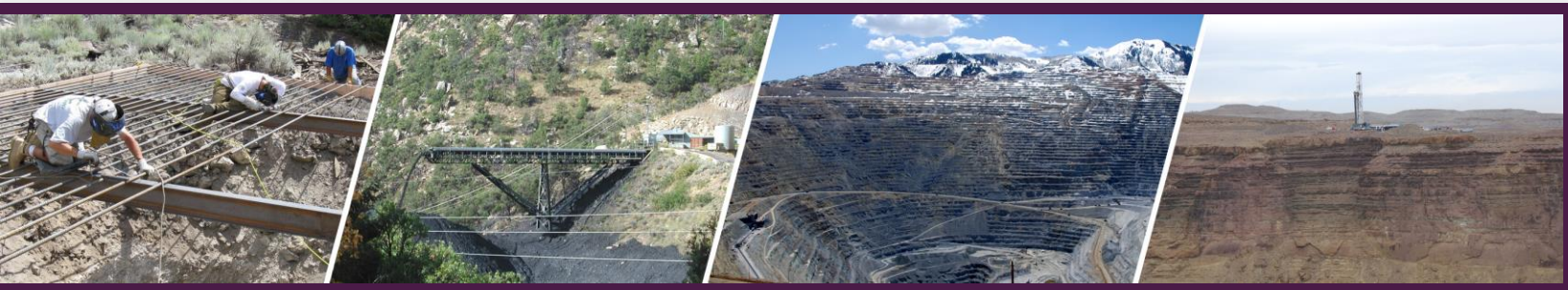
Setting up a Drone Program for a State Regulatory Agency:

Altering a Culture

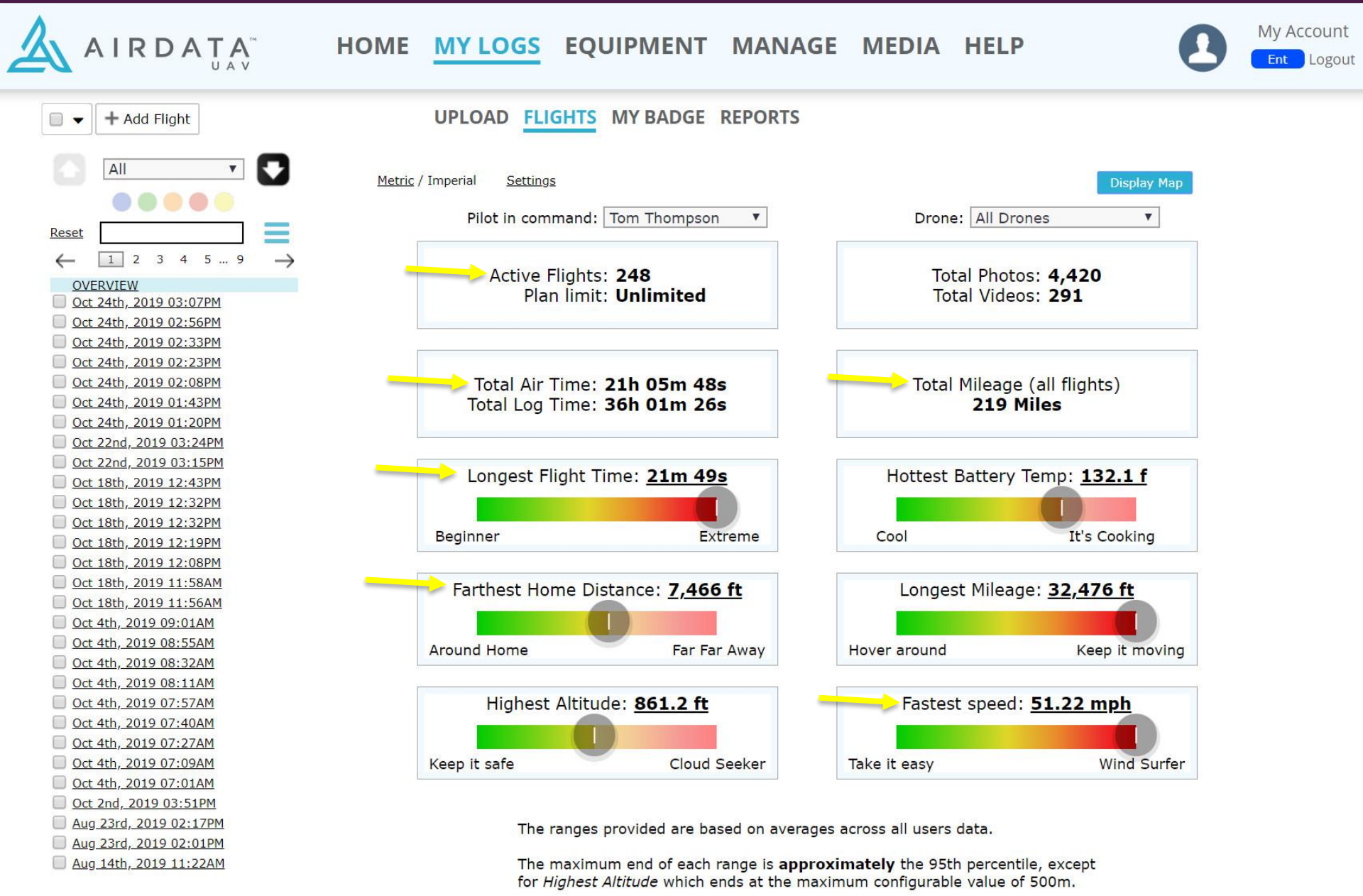
State Oil and Gas Regulatory Exchange 11/13/2019
Tom Thompson

3 Factors for your Concept of Operation

- People
  - Get People Excited: Executives, Managers, Inspectors, and Data Analysts
    - Involve those outside your agency with a Community Engagement Plan
- Technology
  - Consider your organizations mission plan
    - Your organizational goals needs to drive the technology, not the other way around
  - Flight Planning and Fleet management (CYA)
  - Prove your impact and value to the organization
    - Do an ROI
- Policy (be prepared for a situation before it happens)
  - Training Pilots
  - Unexpected landing / Insurance
  - Legal Elements



OGM Drone Program



How We Started

- Started with My Personal Drone
  - Experience through Master's Degree
  - Stakeholder Buy In
  - Slope Map
  - Abandoned Mine Reclamation Program
  - $40,000 Savings

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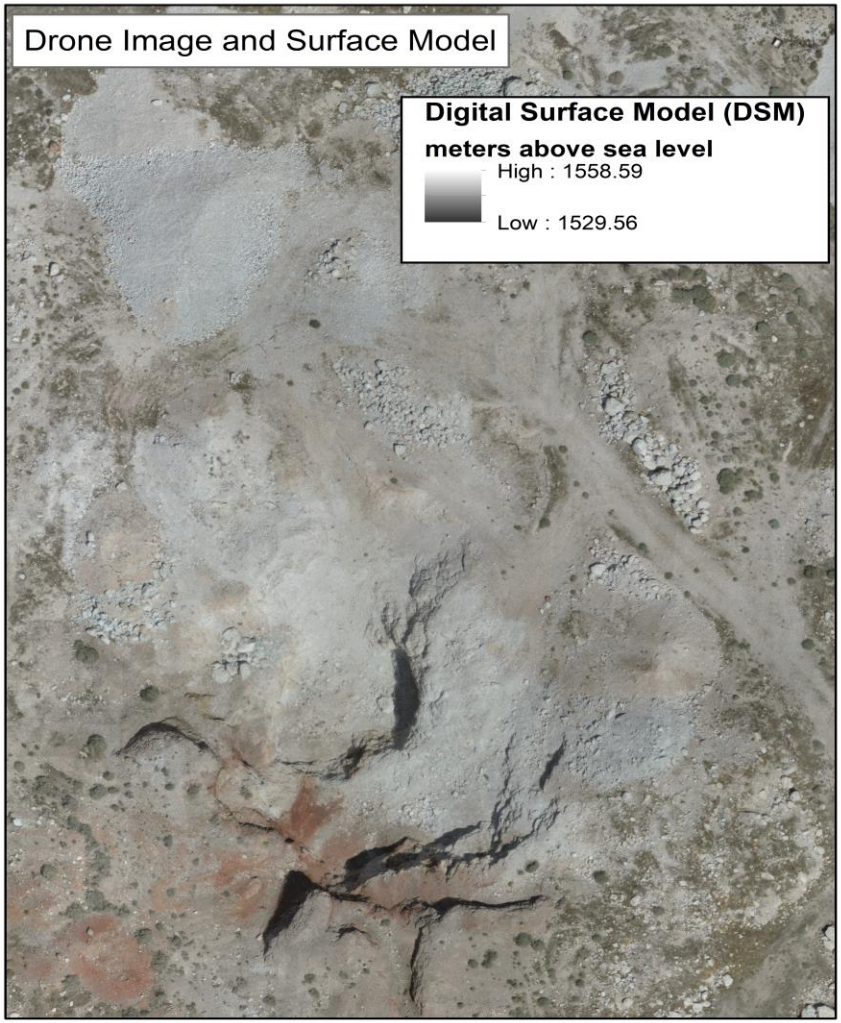
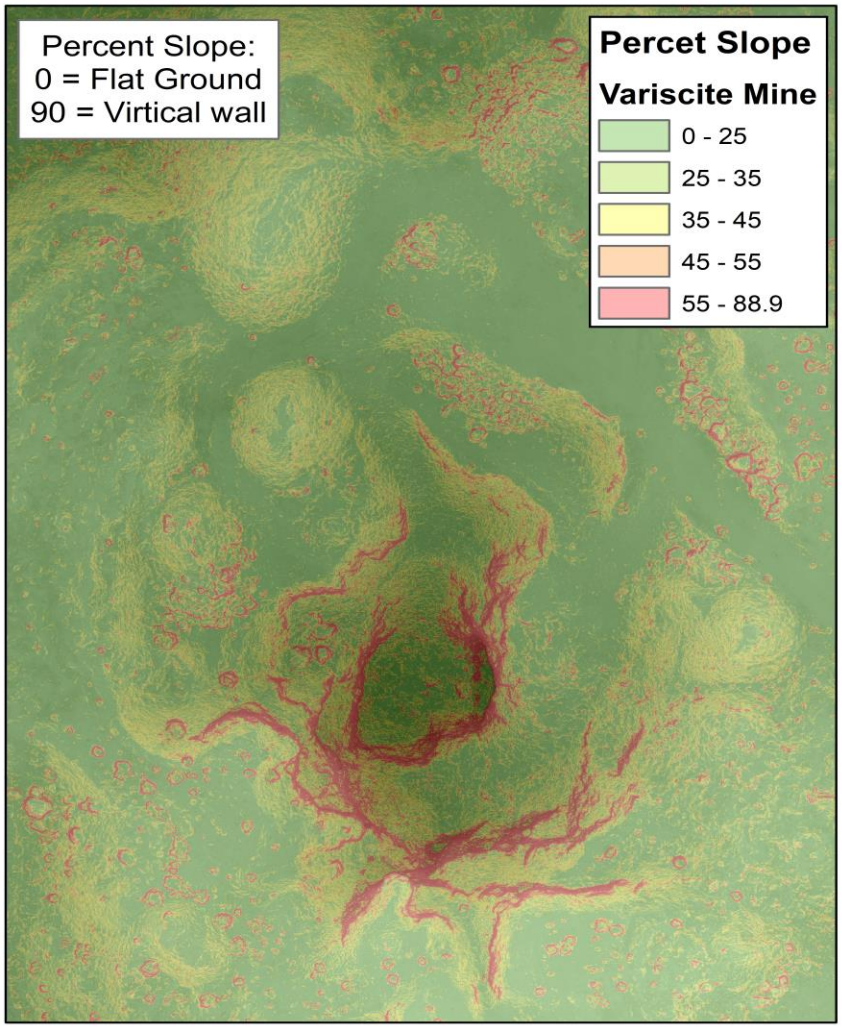
Slope Map

Lucin Variscite Mine & Slope Map





0 37.5 75 150 Meters

Comparison of Estimate Results.

The quantity we were billed for was the tuck count estimate, which was 12,831 cy (or $51,324). We found the engineers estimate of 23,000 cy (or $92,000) overestimated the billed amount by 10,169 cy (or $40,676). The drone estimate of 9,200 cy (or $36,000) underestimated the billed amount by 3,631 cy (or $14,524). We determined that for projects such as this that the drone estimate is much closer to the actual quantity billed to us in comparison to the engineers estimate.

	Engineer Estimate	Drone Estimate	Truck Count Estimate (actual billed amount)
Cubic Yards (cy)	23,000	9,200	12,831
Cost ($4 per cubic yard)	$92,000	$36,800	$51,324

Set Goals for Your Drone Program

1. Improve OGM program efficiency, effectiveness, and overall staff/public safety
2. Leverage drones to make data driven land management decisions
3. Expedite business process (pre-sites, inspections, & bonding)
4. Reduce negative impacts to people and the environment

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Assign Roles & Create Stewardships

- Division Director – John Baza
  - –Approves sUAS Strategic Plan and has final decision making on sUAS policy
  - –Designates sUAS Program Lead
- sUAS Program Lead – Tom Thompson
  - –Coordinate Strategic Plan and Pilot Training
  - –Train Pilots, Maintain Fleet and Flight Logging Solutions (AirData)
- sUAS Team (up to 5)
  - –Management Team Members, GIS Program, and Field Staff from our various programs
- GIS Program to process, analyze, distribute and archive data

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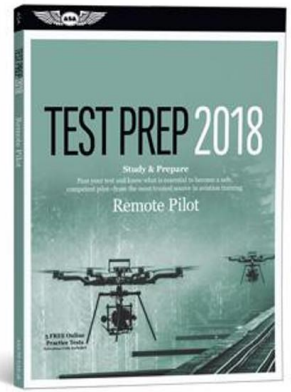
Training and Pilots (People)

- Part 107 Certification
  - –Set up “Tips and Tricks” Document to help others get certified

Tommy’s Tips to Pass the Aeronautical Knowledge Test

1. Purchase this book online (link to most recent quest from FAA) and while you wait for the book to arrive go to the next step



2. Get started by watching or listening to this Free Drone Certification Study Guide through this video and read through the” fact information” below (make flash cards if necessary). The video is roughly 1 hour 45 minutes

a. If you don’t understand something look for more videos on that subject matter (i.e. understanding airspace, or video on just aeronautical charts, etc.)

3. Take online test through link in the video (3DR Example Test)

4. Take the 5 practice tests that come with the UAS Remote Pilot Test Prep book (Prepware signin/login link)

. Reminder to look for any possible updated questions.

5. Schedule a test time with a proctor (I took mine at, here is a link to possible testing sites PDF) Phone#: for Computer Assisted Testing Service (CATS) 1-800-947-4228

6. Pass Aeronautical Knowledge Test with a 70% or higher

7. Apply for Remote Pilot Certificate and Register with Integrated Airman Certification and Rating Application (IACRA) (signup/login link and watch the how to video link). You will receive a temporary registration should be posted online in 5-10 business days.

8. Receive your Part 107 UAS Certification card (takes 4-6 weeks) and it should look like this:

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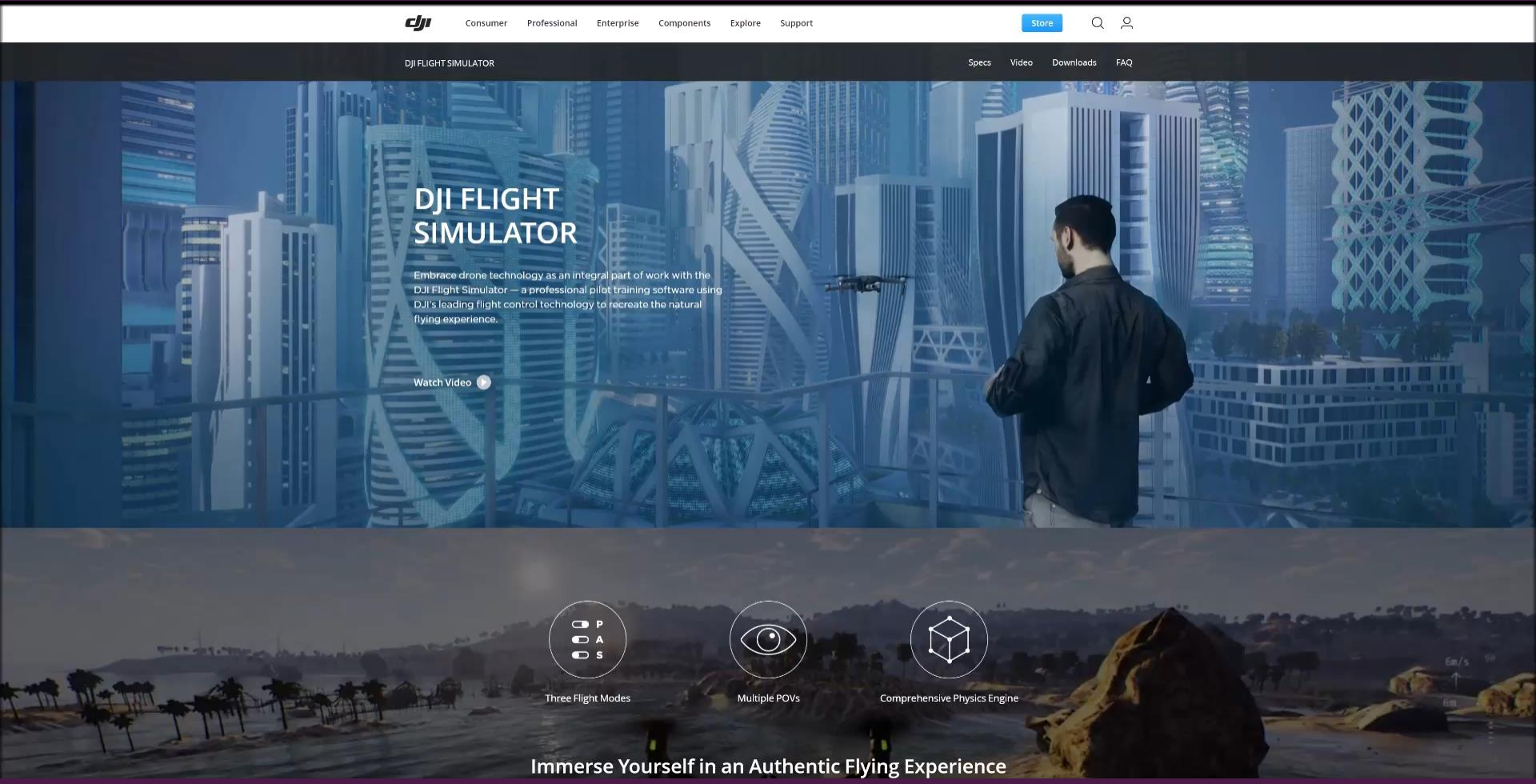
Test Information

- Test Code is Unmanned Aircraft General - small (UAG)
- The test is multiple choice (a,b, or c)
- 60 questions (2 hour time limit)
- Pass with a 70% or higher
- UAS Topics and Percentages
  - Regulations: 15-25%
  - Airspace and Requirements: 8-15%
  - Weather: 11-16%
  - Loading and Performance: 7-11%
  - Operations: 13-18%
- Example test of mine

Finally If you have a drone register it with the FAA here (step by step video of registration process)

Print your registration # on a sticker or use label maker so you can attach the registration# on your drone and keep registration card with you during operation (or in the carrying case in the field)

Flight Simulators (People)



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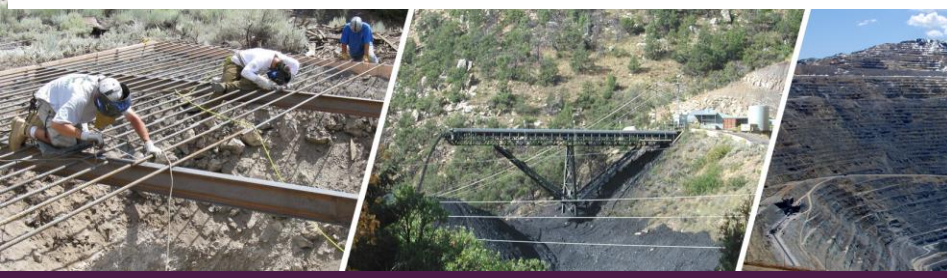
Technology

- Appropriate Drones for missions and pilots

M210 RTK and Mavic Pro 2

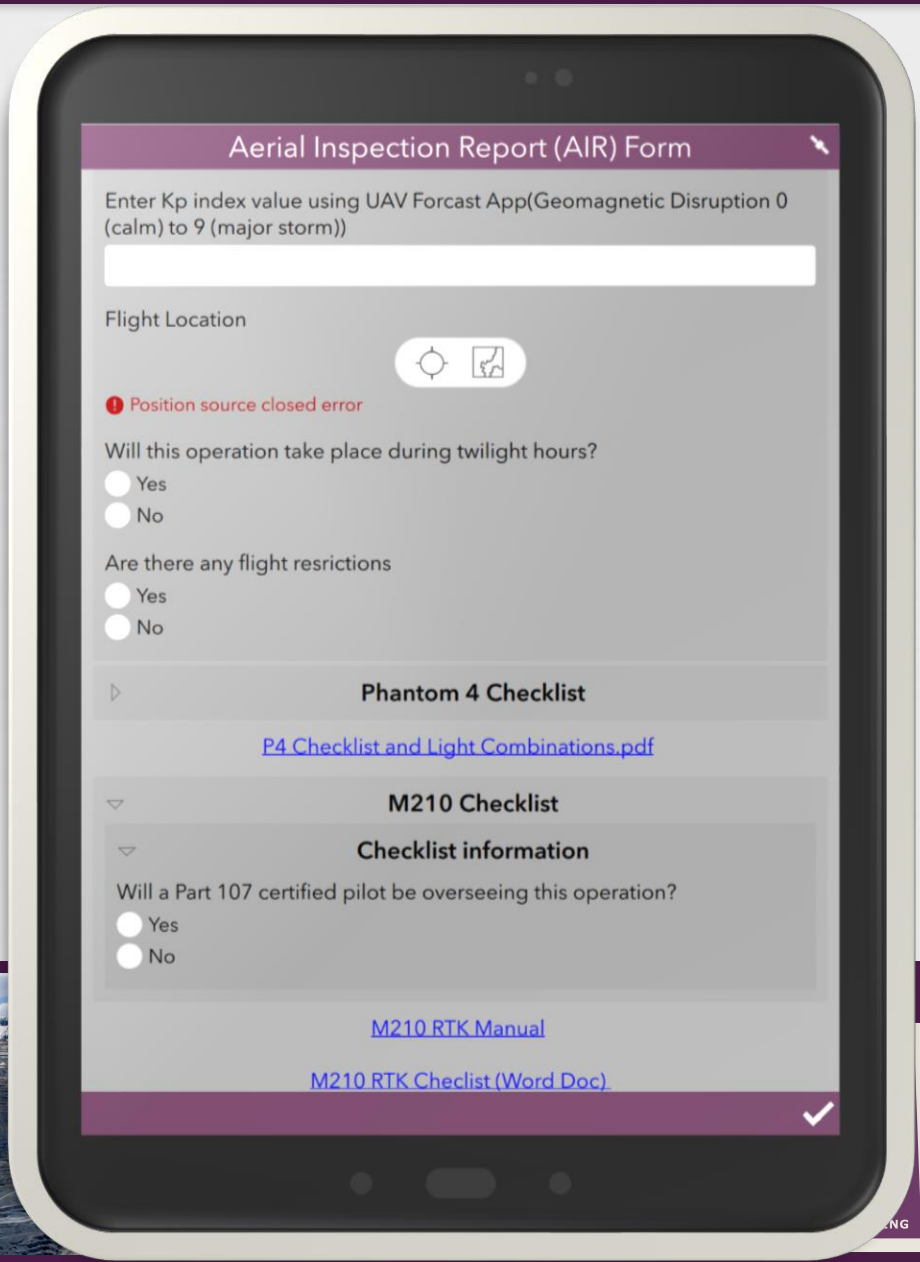
$10,000 to $30,000

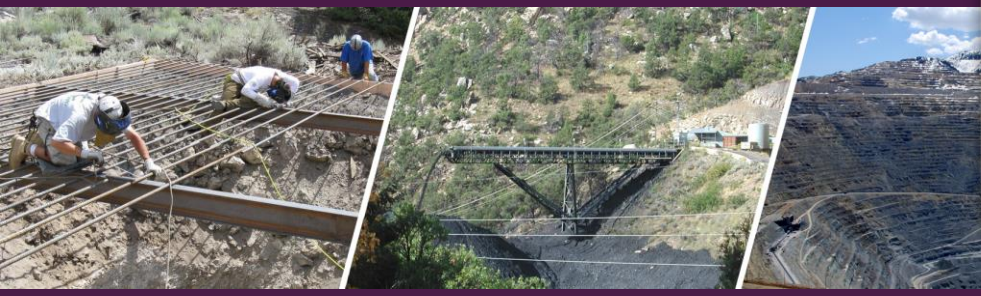
$1,000 to $3,000



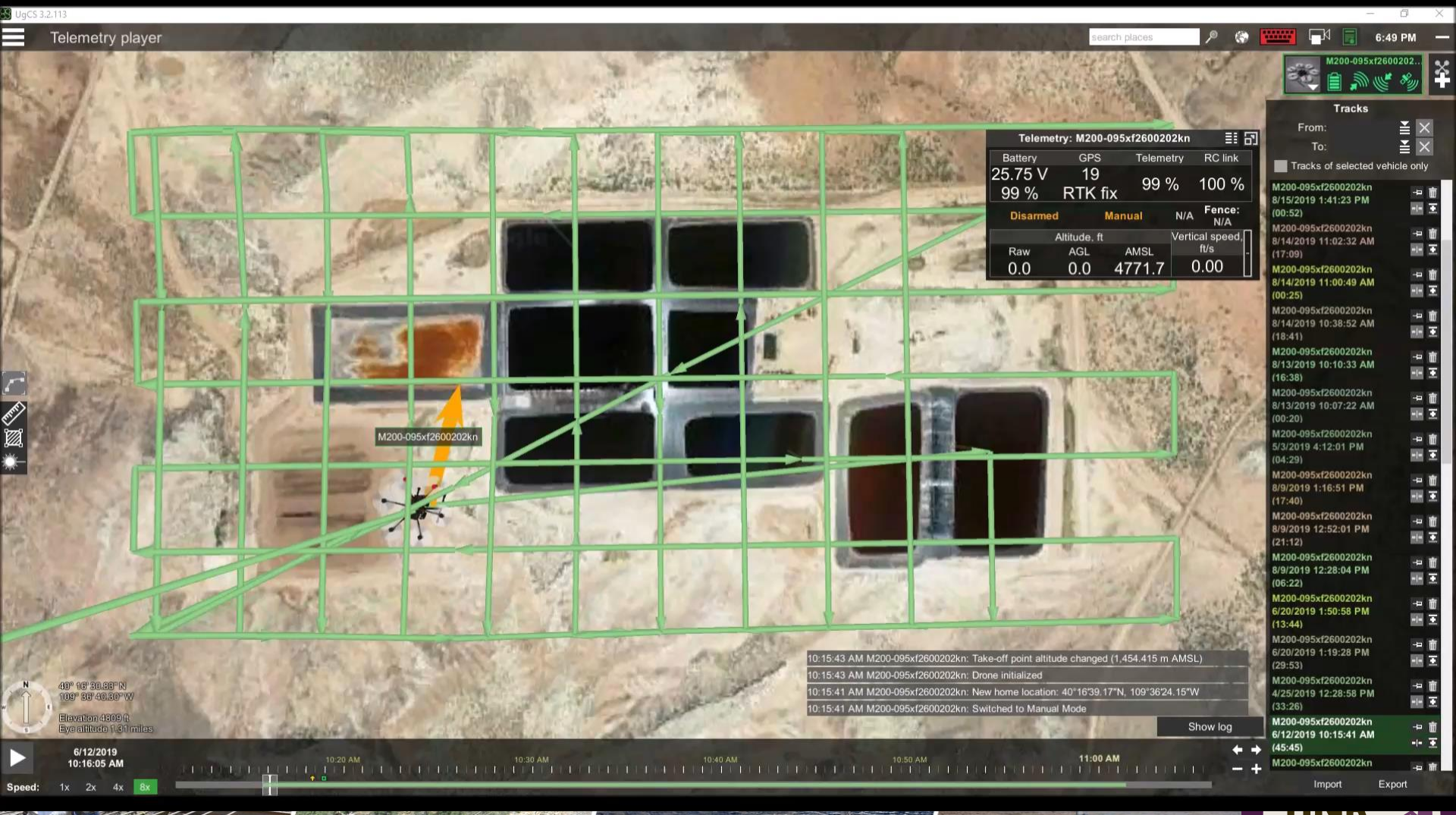
Have a Checklist

- Achieve repeatable and predictable results
- Avoid conflicts that produce failures





Know Your Auto Pilot System



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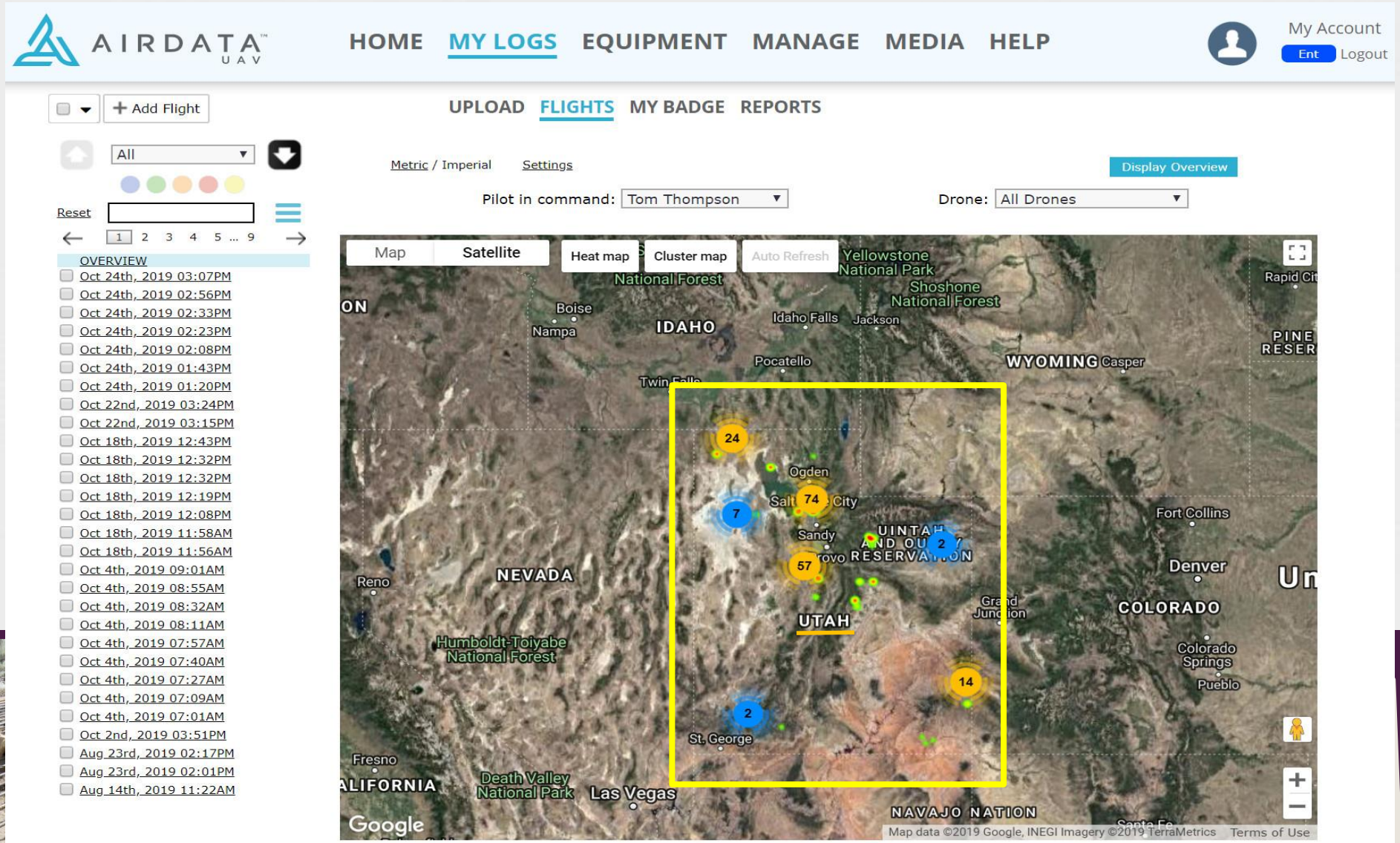
When Your Boss Asks Where You Have Been

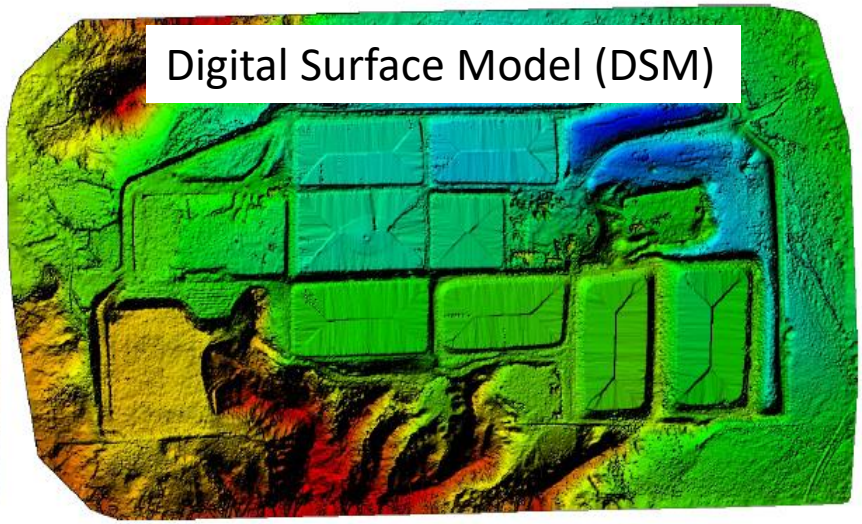
- Have a Flight Logging Solution



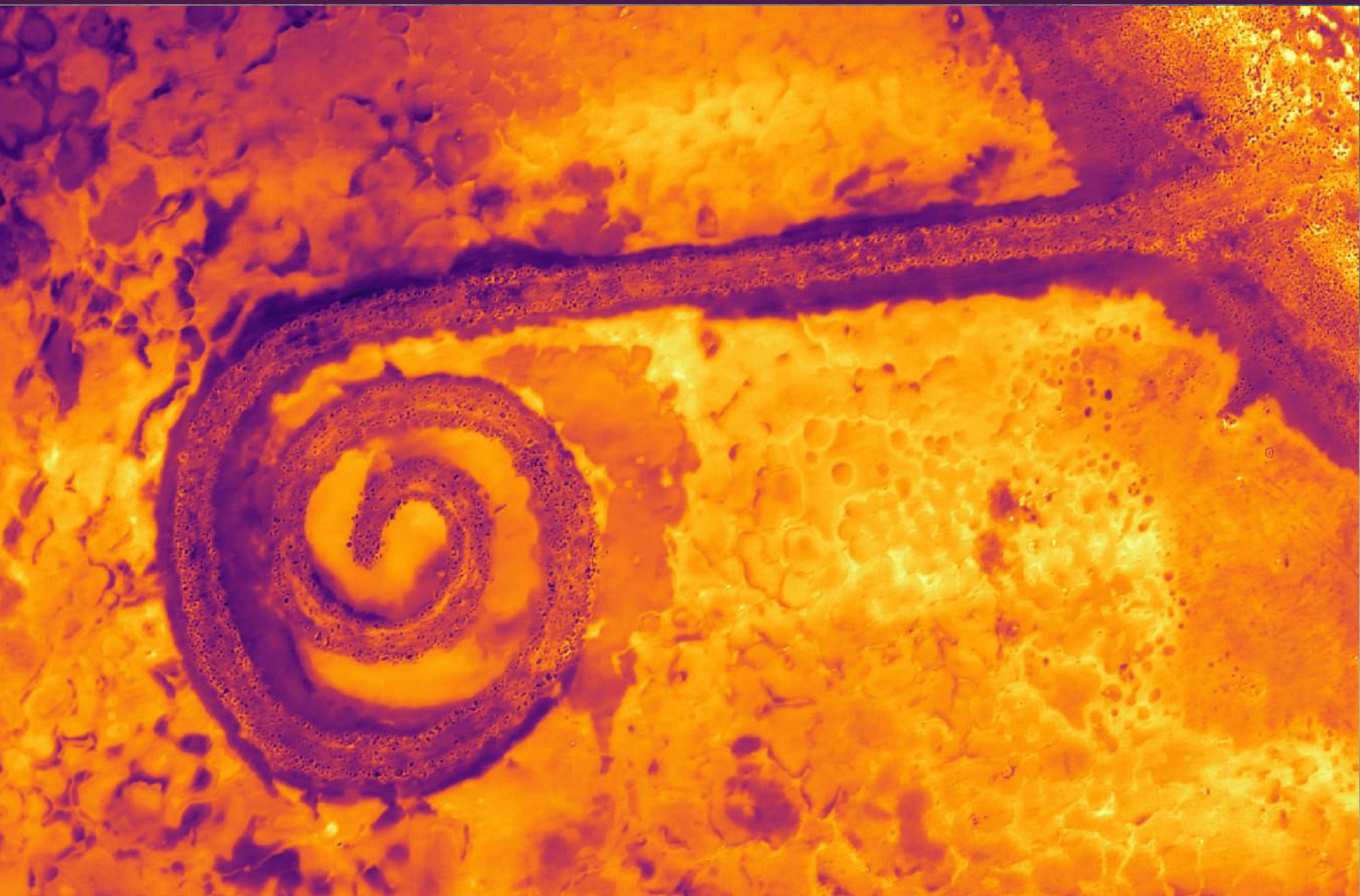
Know Your Processing Software (Pix4D)

Orthomosaic and corresponding Digital Surface Model (DSM) 7hrs to process

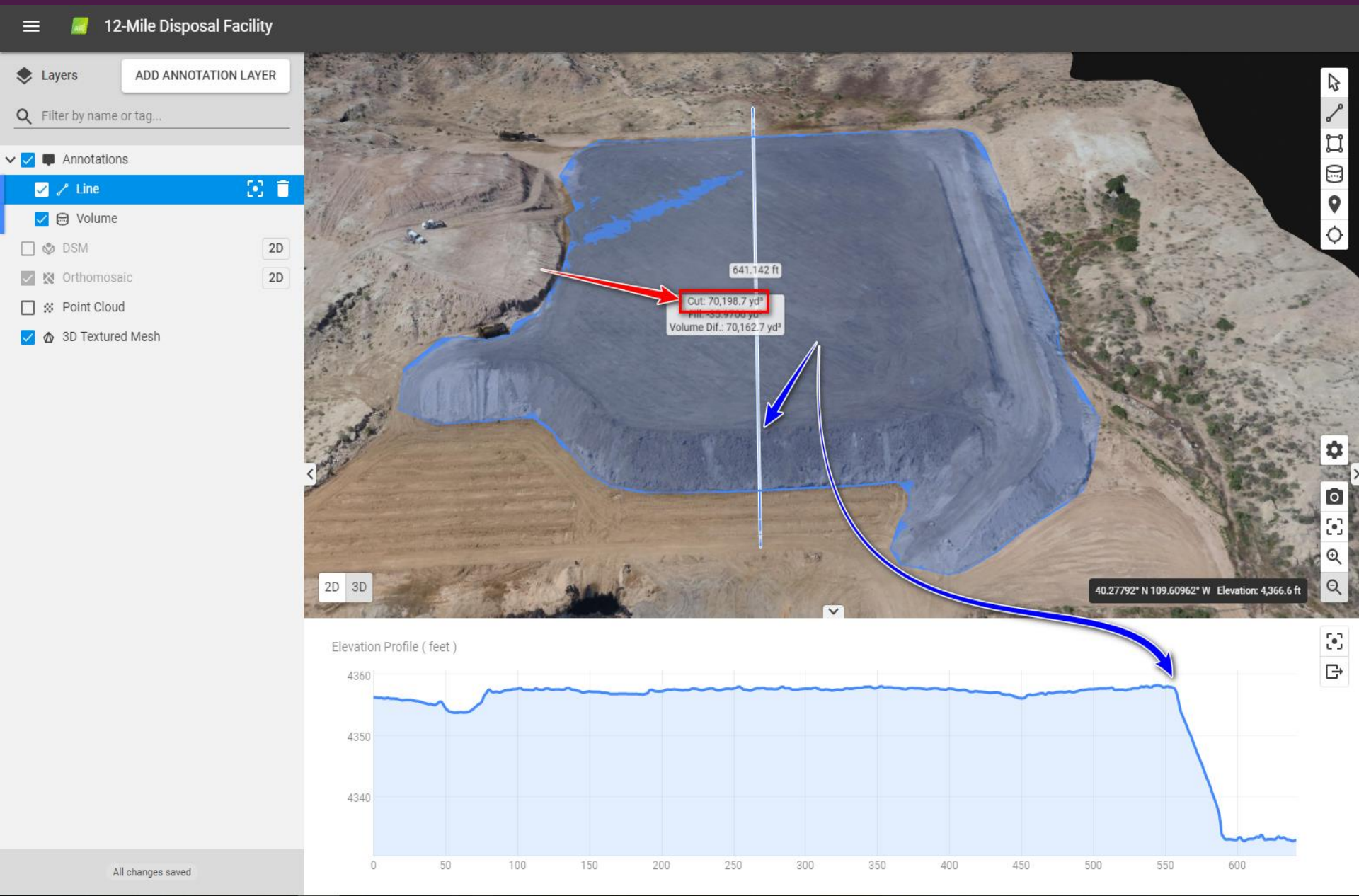
Project	12-Mile Disposal Facility
Processed	2019-10-08 10:58:44
Camera Model Name(s)	FC6520_DJIMFT15mmF1.7ASPH_15.0_5280x3956 (RGB)(1), FC6520_DJIMFT15mmF1.7ASPH_15.0_5280x3956 (RGB)(2), FC6520_DJIMFT15mmF1.7ASPH_15.0_5280x3956 (RGB)(3)
Average Ground Sampling Distance (GSD)	2.92 cm / 1.15 in
Area Covered	0.580 km^2 / 57.9775 ha / 0.22 sq. mi. / 143.3397 acres
Time for Initial Processing (without report)	47m:53s



Teach Pattern Recognition

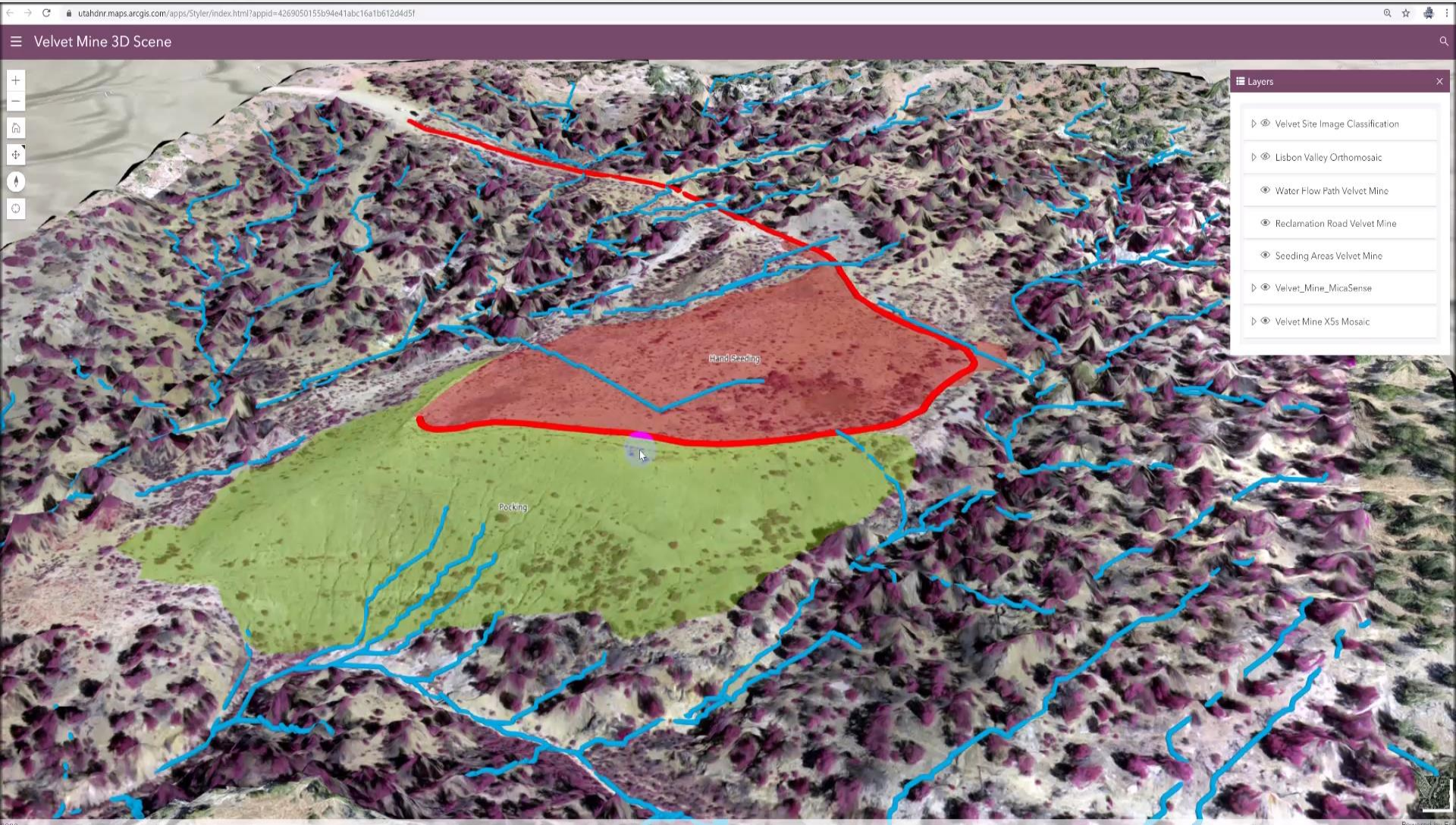


Know Your Analysis: Land Farm Volume



Know How You Will Distribute Data

- Data Viewer Software (ArcGIS Online)



Have a Purpose in Drone Flight

Collect Photogrammetric Data

- Traditional Mapping/Non Traditional Mapping
  - Orthomosaic, Thermal (Heat) and Infrared (Veg)
- 3D Modeling
  - Point Cloud & Digital Surface Model (DSM)
- Types of measurements
  - Area, Stockpile and site survey

UTAH DNR OIL, GAS & MINING

Drone Policy

State of Utah
DIVISION OF OIL, GAS AND MINING

POLICIES & PROCEDURES – *UAS Operations*

John Baza, Director of the Division of Oil Gas and

I. PURPOSE

The purpose of this policy is to s
(sUAS) within the Division of O

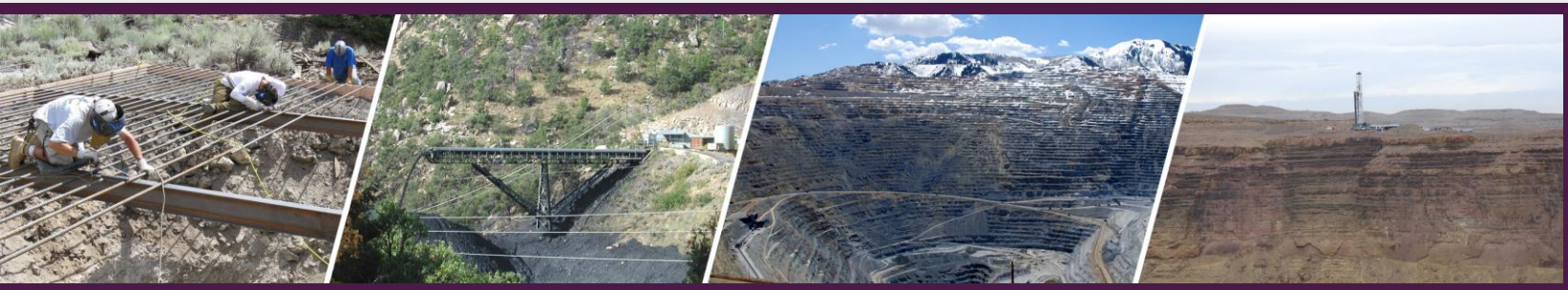
The proliferation of sUAS can b
rapidly across state agencies. The Federal Aviation Administration (FAA) amended its regulations on August 21st 2016 to adopt specific rules for the operation of small Unmanned Aircraft Systems (sUAS) in the National Airspace System (NAS). The Division of Oil, Gas and Mining will comply with Title 14 of the Code of Federal Regulations (14 CFR) Part 107 along with its sections and subsections. DOGM is establishing policy, procedures, roles and responsibilities for operating sUAS in compliance with FAA regulations. For reference see FAA 14 CFR Parts 21,43,61,91,101,107, 119, 133, and 183 https://www.faa.gov/uas/media/RIN_2120-AJ60_Clean_Signed.pdf and https://www.faa.gov/uas/media/Part_107_Summary.pdf

II. DEFINITIONS (AS DEFINED BY ADVISORY CIRCULAR (AC) 107-2)

Remote Pilot in Command (Remote PIC or Remote Pilot). A person who holds a remote pilot certificate with an sUAS rating and has the final authority and responsibility for the operation and safety of an sUAS operation conducted under part 107.

Small Unmanned Aircraft (UA). A UA weighing less than 55 pounds, including everything that is onboard or otherwise attached to the aircraft, and can be flown without the possibility of direct human intervention from within or on the aircraft.

Small Unmanned Aircraft System (sUAS). A sUAS and its associated elements (including communication links and the components that control the sUAS) that are required for the safe and efficient operation of the sUAS in the National Airspace



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OGM Policy Requirements

- Our Pilot Training
  - –Required by FAA
    - Part 107 Certified by the FAA
  - –Not Required by FAA
    - Tier 2 Pilot (Beginning Pilots)
      - –5 hrs of total air flight time under supervision of sUAS Program Lead
      - –Manual flights and autonomous flights in flat terrain
    - Tier 1 Pilots (Advanced Pilots)
      - –20 hrs of actual air flight time for advanced pilots
      - –Automated flights in complex terrain, night ops, over 400 ft

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Insurance Policy

- State Risk Management
- droneinsurance.com

Incident Report for OGM sUAS Loss of GPS Signal and Obstacle Avoidance Sensor Failure

Tom Thompson – Pilot in command (PIC): tomthompson@utha.gov (801) 538- 5203
Part 107 Certified Airman, Certificate# 4107481 (issue date March 13th 2018)

Michael Van Hatten – Visual Observer: michaelvanhatten@utah.gov (801) 538-5430

John Webster – Visual Observer: jwebster@utah.gov (801) 538-5332

On August 13th Tom Thompson, Michael Van Hatten, and John Webster left the Desert Rose Hotel in Bluff Utah to conduct a drone flight over the Mexican Hat Mine site. We went and successfully conducted our drone survey at the mine site accompanied by the local Sheriff. Once the flight was completed successfully with our DJI M210 RTK drone we began heading to our next mine site being led by the Sheriff. He took us to an outlook that he suggested would give us a good cinematic shot of the mine and the landscape. We pulled over at the outlook (seen in figure 1 which shows our "Launch Site") and decided to fly the Mavic 2 Pro rather than the M210 RTK as this was not a mapping mission and due to the steep terrain there was an inherent increase in risk factor.

At 11:15 a.m. the Sheriff left and around approximately 11:20 a.m. I began to get the Mavic 2 Pro out to fly it. At this point we began the drone initialization sequence (our checklist) which concluded at approximately 11:30 a.m. It took us roughly 10 minutes complete our checklist and get the drone up and going using an iPhone as the mobile device running the DJI Go 4 drone piloting application. Then at exactly 11:30:44 a.m. the motors turned on and I began to fly. I recorded several passes along the flight route seen in Figure 1.

The next few statements refer to the attached video file "Mavic 2 Pro Flight Log Video (8-13-2019)" so please watch this video as you read through this paragraph. Exactly 5 minutes into the flight (seen as "Flight Time" in the upper right hand side of the attached video file) I began flying south west, noting my drone was approximately 377 ft. above our launch site and 1,342 ft. away from us horizontally. As I flew south west towards our location (the launch site) I began descending the drone until I got it directly in front of me where my visual observers and I could get a good visual on the drone asset. When the flight time hits 5 minutes and 56 seconds the drone was exactly at eye level (0 ft. in elevation height) and its horizontal distance was 204.9 ft. away from me giving me a good line of site of the drone. As I could see the drone I continued to descend the drone to -100 ft. in height and 205 ft. in horizontal distance. This is where I began backing the drone in a south western trajectory away from the cliffs decreasing my drone height from -100 ft. to -406 ft. in addition to that I had increased my horizontal distance from 205 ft. to 512 ft. At 6 minutes and 50 seconds into the flight I maintained my height and began flying back towards our location (in a north eastern trajectory) attempting to get the drone back to the horizontal distance of 205 ft. At 6 minutes and 58 seconds I began to increase my altitude and continued flying north east slowly. When the flight time hits 7 minutes and 2 seconds I took my eye off of the drone to look at the horizontal distance number on the screen as it was decreasing from 512 ft. away from us to ensure I was not approaching the horizontal distance of 205 ft. which is the number I had previously achieved. As I looked down at the screen I saw the numbers appeared to be a safe distance and height, -350 ft. height and 440 ft. distance. I was also anticipating the obstacle avoidance sensor warning to let me know if I was getting to close to any object. At 7 minutes and 4 seconds the drone continued flying north east increasing height and decreasing distance. At this time I looked up to locate the drone visually, which I did, then I looked back down at the controller to make sure I was not closer than 205 ft. horizontally where I saw I was still 244 ft. away. At 7 minutes and 10 seconds into the flight the drone had a height of -236.8 ft. with a distance of 222.8 ft. which is where I lost signal to my remote. I looked up and the drone was nowhere in sight and it could no longer be heard flying in the air. At this point the drone had an unexpected landing (or crash). The visual observers confirmed that they had also lost sight of the drone at this point. No warnings (obstacle avoidance, poor satellite signal, or poor radio signal) were actually triggered in either real-time or in the flight log. However, in looking at the flight log I can see that it had dropped to 11 satellites, which the minimum number the drone should fly with, and no obstacle avoidance warning appeared on the screen or flight log. The total flight time was 7 minutes and 10 seconds.

Figure 1: Mavic Pro 2 flight log for August 13th 2019 starting at 11:30 a.m. ending at 11:37 a.m. The blue helicopter symbol represents the launch site and the yellow line is route the drone took according the Mavic Pro 2 Flight Log.

Next Steps in our Oil/Gas Program

- Oil and Gas program
  - Fly all of our Disposal Facilities
  - Do our Pre-site Inspections
  - Locate our LA and PA Wells (Location Abandoned & Plugged Abandoned Wells)
  - Create Division “Standard Operating Procedures” for our Drone Program

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Thanks From Our Team To Yours
Questions?

My Contact Info

tomthompson@utah.gov

Phone: 1-801-538-5203

State Oil and Gas Regulatory Exchange 11/13/2019

Tom Thompson

Drones Help Us

Improve Our

- Data Driven Decision Making
- Return On Investment (ROI)
- Outreach and Communication
- Quantitative Measurements
- Timeliness
- Cost Effectiveness
- Safety
- Accuracy/Confidence
- Compliance
- Environmental/Ecological Analysis
- Engagement and Collaboration

Using New Tools on Our sUAS

- Thermal Imaging (FLIR XT2)
- Multi-Spectral Sensors (MicaSense)
- LiDAR (Light Detection and Ranging)
  (friends @OSM)

New Tools we want to use

- LiDAR (want our own)
- SO2 Sensors
- Optical Gas Imagers
- GPR (Ground Penetration Radar)

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