Utilizing UAV Photogrammetry to Determine Proppant Stockpile Volumes

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Outline

• Select Sands History/Background
• Equipment/Software
• Workflow
• Ground Control Points (GCPs)
• Mining Site Locations
• Drone Aerial Survey Specs
• Final Report
• Monitoring Mining Operations and Environmental Impact
• Traditional Vs Drone Stockpile Inventory Method
• Q&A
Select Sands History/Background

• Original Company – Ozark Premium Sand located in Newark, Arkansas
• Select Sands Corporation Acquires Ozark Premium Sand in December, 2016
• Mine White Silica Sand (99% SiO2) from the St. Peter Sandstone Formation
• Target markets are Oil & Gas and Industrial & Specialty Products
• Site Visit and POC took place May 25-27, 2017
• Began Quarterly Drone Surveys on June 30, 2017, and continued to the Present
Select Sands History/Background

- Inventory Surveys Performed with Traditional Survey Methods started in late December, 2016
- Work Took 1-2 Weeks to Complete the Inventory at all 3 sites
- Preliminary Hardcopy Reports Issued in January, 2017
Equipment/Software

- Drone:
  - DJI Inspire 2 with Zenmuse X5S Camera (2 – primary and backup)

- Ground Control Points (GCPs):
  - EOS Arrow Gold RTK GNSS Positioning System
  - GNSS Networks: Missouri DOT (MDOT) or TopCon’s TopNet Live
  - GCP Targets

- DJI GS Pro (Mission Planning)
- DJI GO 4 (Drone Settings and Compass Calibration)
- EOSToolsPro/ICMTGIS PRO/MDOT RTK Network (GCP Positioning)
- SimActive Correlator3D (Processing)
- Blue Marble’s Global Mapper GIS (General Mapping)
- Virtual Surveyor (Visualization, 3D Measurements including Volumes)
- Snagit (Screen Capture)
- MS Office Suite (Reports)
- “Zoom” Web Conferencing (Collaboration)
Select Sands American Corporation Silica Sand (Proppant) Stockpile Volumetrics Workflow

Select Sands American Corporation Silica Sand (Proppant) Stockpile Volumetrics Workflow

2 Hours
Plan Aerial Surveys (3 Sites)

3 Days Including Travel - Last Day of Each Quarter: Repeated for each Site
Layout and Ground Control Points (GCPS) Positioning

Camera Setting in DJI Go 4 App (Optional)

Perform pre-flight checks and initiate take off

1 Day
Fly and Capture Images

1 Day
Process Images

Using Global Mapper (GMS) Create Maps and Send to Updrilling.com for Hardcopy Print

1 Day

7 Days
Create Terrain Models

Scren Sharing Session with Select Sands Corp. To Review/Validate Volumetrics

Generate Final Quarterly Volumetrics Report

Handcopy Plots of Maps and Montage Delivered to Select Sands Corp Offices

Invoice Sent to Select Sands Office for Payment

Office

Field

DJI GS Pro
EOS Tools Pro/CMYG5S Pro
Global Mapper

DJI Go 4
Zoom Web Conferencing

Correlator3D
Office 365

Stockpile Volumetrics Workflow
Mike Allison
Last Updated: 02-11-18
Ground Control Points (GCPs)

- GCPs are clearly marked targets on the ground, spaced strategically throughout your area of interest.

- The GCPs and their coordinates are then used to help drone mapping software accurately position your map in relation to the real world around it.

- Recommend at least 5-7 GCPs located in the 4 corners, the center and highest and lowest points in your area of interest.

- GNSS (Global Navigation Satellite System) Network for the most accurate GCP positioning.
Drone Aerial Survey Specs

• 3 Sites Ranging from 35-89 Acres
• 5-7 Ground Control Points (GCPs)
• 250’ Above Ground Level (AGL)
• 80% Sidelap/Frontlap
• DJI Inspire 2 with Zenmuse X5S Camera
• 0.8 Inches/ Pixel Ground Sample Distance (GSD) or Resolution
• 2 Passes Each, Perpendicular Grid Pattern
2 Passes, Perpendicular Grid Pattern
Sandtown Quarry (36 Acres)
Freeze Bend Mine (89 Acres)
Possum Grape Dry Plant (35 Acres)
## Quarterly Stockpile Volumes Report

<table>
<thead>
<tr>
<th>Site</th>
<th>Stockpile</th>
<th>Area (sq. ft.)</th>
<th>Volume (cu. ft.)</th>
<th>Volume (cu. yd.)</th>
<th>Tons</th>
<th>Reference</th>
<th>Totals</th>
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<td>100 Mesh #1</td>
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![Image of stockpile volumes](image-url)
Sandtown Quarry Evolution

Orthophotomosaic – 12/18

Orthophotomosaic – 06/18

Orthophotomosaic – 03/19

Orthophotomosaic – 09/19
Environmental Impact Monitoring
Traditional Stockpile Inventory Method

• Performed Annually
• Time Consuming and Labor Intensive Resulting in Higher Costs
• 1-2 Weeks Turnaround from Start to Finish
• Safety Risks with Survey Team Climbing on Stockpiles
• Summarized Final Report for Each Site
Drone Stockpile Inventory Method

• Performed Quarterly (10)
• 7 Days or Less (Goal is 5 Days) Turnaround including Travel
• Stockpile Polygons for Each Site Visually Confirmed Collaboratively
• Detailed Final Report (Spreadsheet and Word Documents)
• 34”x44” (ANSI E) Scaled Hardcopy Plots Provided for Each Site Delivered To Offices within 10 days
• Digital Data delivered via Dropbox including Georeferenced Orthomosaic Photos, Digital Surface Elevation Models, 3D Models, and Plot Files for Each Site
Thank Select Sands America Corporation for Permission to do this Presentation

And IPEC for the opportunity to present this talk.
Q&A
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