Marcellus Shale: Pioneering the Terrain & History within Appalachia

PRESENTERS
TREVOR SWINDELL
JERRY KLINK
Map of USA
• The Marcellus ranges in thickness between 40 to 900 feet, and is locked between two layers of impervious limestone trapping its gas.
• The depth of the Marcellus also ranges significantly from 5,000 to 9,000 feet below the surface.

Diagram:
- Tully Limestone
- Marcellus Shale
- Onondaga Limestone
As mentioned earlier, the Marcellus rises to the surface in NY as well as southern PA & NJ.
The Marcellus shale can be found under most of PA and WV, as well as parts of OH, NY, and MD
POTENTIAL OF THE MARCELLUS

- Although the Marcellus shale and the natural gas within it are not new discoveries, the recovery of its resources are
- The gas within the Marcellus exists mainly in its small and isolated pores
- For this reason the more conventional vertical drilling techniques used to recover natural gas prove ineffective in the Marcellus
It was only recently that our very own Bill Zagorski (aka “The Father of the Marcellus”) unlocked the true potential of the Marcellus shale.

Using his knowledge of its potential in combination with the technologies of horizontal drilling and hydraulic fracturing, the Marcellus has become one of the largest shale plays in the United States.

The techniques now used allows the gas to escape from the pores over a much greater area, resulting in the enormous recoveries of natural gas that we now see from the Marcellus.
GIS IN THE MARCELLUS

• GIS serves as the visual database in nearly all aspects of the industries surrounding the Marcellus
• At Range, GIS is used from the very start of the geologic research all the way to the pipeline that will lead the final product to market
• We are here today to discuss our specialties in lease mapping and site design
BRIEF HISTORY OF PA SURFACE LAND AND MINERAL RIGHTS

- In PA, along with the rest of the United States, the minerals (oil, gas, coal, etc) beneath a property’s surface are privately owned.
- Once the value of these minerals was discovered, issues of surface land being severed from the mineral rights began to arise.
- Property owners began to sell, lease, and divide their mineral rights while retaining the surface property.
After years of property ownership changes and varying levels of attention to minerals, many landowners are unaware if they do or do not own their mineral rights.

Many of today’s landowners have unknowingly purchased land that had its mineral rights severed decades before the purchase.
• To complicate the matter, many of the severed mineral rights are subject to leases taken years earlier.
• In the early and mid 1900’s many small operators drilled shallow vertical natural gas wells on their leased properties.
• The majority of these leases state that as long as the well is producing the lease remains in effect.
• The producing wells from that time period are holding leases to this day that often no longer reflect the surface parcels
• With the new boom of the Marcellus shale, it is becoming increasingly important to locate these historic leases
• Companies today frequently acquire these wells in an effort to secure or “cloud” the property from competitor leasing
• Although these leases, for the most part, do not allow new deep drilling or unitization they do hold the mineral rights to the original property
• This hold provides the purchasing company with additional time to secure the proper leasing needed for Marcellus drilling
• These leases pose a unique challenge to today’s GIS employees, that involves incorporating the history of Pennsylvania in both surface land and mineral rights
• Example of the challenge to GIS departments when the history of surface land and the mineral rights have evolved into separate entities

SURFACE OWNER MAINTAINS RIGHTS FROM AIR TO THE AQUIFER

COAL COMPANY PURCHASED RIGHTS FROM THE AQUIFER TO BOTTOM OF THE COAL SEAM

ALL MINERALS BELOW THE COAL SEAM ARE LEASED FROM THE ORIGINAL PROPERTY OWNER AND HELD BY A PRODUCING WELL
DIFFICULTIES OF MAPPING HISTORY

- Many of these smaller and older companies that had drilled the wells are now more or less maintaining the wells with little concern of the leases.
- The records, if available, can be very difficult to sift through and the leases of the time don’t conform to today’s standards and more importantly today’s surface land.
Many of these leases were taken on old farms which have since been absorbed to neighboring property or parceled out over the past 50 to 100 years.
• We are often provided with legal descriptions that read “part of parcel...” or “see exhibit”
• The deed descriptions often refer to starting points that cannot be located, and sometimes do not have enough calls to close the plot
• The bounded by descriptions are typically of property that no longer exists
In addition to poor lease descriptions we also have to deal with “pre-GPS” well locations that contradict the lease location.
If research continues to suggest that the well locations might be incorrect, we have no choice but to try to field verify the wells.
This process not only corrects the inaccurate data, but also now serves as a great starting point to locate the original lease.
The most effective tool in locating these historic leases comes from our ability to use our mapping predecessors work.

Finding historic maps of PA from the general time period of the lease dates, allows us to better use and understand the original lease references.
Being able to georeference the land history of PA to the current look of today’s surface land allows us to visually process all of the lease information. Simply reading the property descriptions from both the original lease and what is provided today, generally leads to confusion and frustration. By overlaying these time periods we can see what was then, and how it affects what is now.
LOCATING THE MILLER LEASE

- Leased in 1910
- Well drilled in 1913
- Lease is “Held By Production” or “HBP”
- Well has been Field Verified
- Leased property is 155 acres
- Parcel numbers have been provided
THE NUMBERS DON’T ADD UP
-Parcels listed only total 130 of the 155 acres
THE PAST MEETS THE PRESENT

A series of PA quad maps were completed around 1911, which were an ideal source for the project.
TRACING THE ORIGINAL MILLER PROPERTY LINES SHOWS US EXACTLY WHERE THE MISSING ACREAGE IS LOCATED
GEOREFERENCING THE PAST TO THE PRESENT ALLOWED US TO LOCATE THE FULL LEASE AND KNOW WHO IT AFFECTS TODAY
LOCATING THE KENIMOND LEASE

- Leased in 1924
- Wells drilled in 1929 and 1939
- Lease is HBP
- Wells have been field verified
- Lease is for 31 acres
- Parcel number has been provided
PARCEL & WELL LOCATIONS DON'T MATCH
- Leases of the time were often pieces of property
- Parcel listed is 20 acres larger than lease acreage
PARCEL LISTED AND WELLS DO REFLECT THE ORIGINAL KENIMOND PROPERTY
KENIMOND LEASE FINDINGS

- We can see that the parcel provided in the lease is not being held by the wells.
- But by georeferencing the 1911 farm map we do see that the wells are from the original Kenimond property, and that there is a valid lease somewhere on the property.
- We can now alert the land department that the lease needs corrected and the location needs further research.
• Jerry explained how he analyzes and manages historic PA land using the GIS
• What else could we use this leased acreage for besides wells?
• Compressors, Risers/Valve Sets, Production Equipment, Processing Plants, & Meter Taps
Topography in PA is unlike TX (insert pic comparison)
Introduction

- Most Facilities in the O&G industry require a flat pad
- Pads are built more easily on hills, non-wooded areas, and near road accesses
- These facility criteria limit the quantity of buildable areas
- I will show you how we use GIS to aid in the selection of sites today – particularly the meter sites.
What is a Meter-Site

- The location on the Transmission Co.’s pipeline where the Producer (Range Resources) sells their gas.
- Meter Site typically encompasses 200’x200’
- Basic Equipment includes GC Building, Meter Skids (measurement, pressure control, flow control, filtration), and utilities (electrical and communications).
Project

Meter Site Requested

- South of I-70; East of I-79
- Near the Transmission Line
- On Lightly Sloping Hilltop
- On Light Herbaceous / Agricultural Land
- Within 150' of Road Access
- Out of DOT Jurisdiction
• Aerial Depicts Rural Landscape
• Proposed Wells
• AOI Selected Around Transmission Pipeline
• Utilize Spatial Analyst’s Extract Tool by Mask for each DEM
- Set Up the Merge’s Extent & Cellsize
- Run Spatial Analyst’s Calculator using the Merge Function
<table>
<thead>
<tr>
<th>6.01 - 12%</th>
<th>6.01 - 12%</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.01 - 12%</td>
<td>&lt;6%</td>
</tr>
<tr>
<td>6.01 - 12%</td>
<td>6.01 - 12%</td>
</tr>
</tbody>
</table>

- 65° Pixels
- 200' Square Areas are Scarce
• Utilized the Slope Tool
• ROW, Hilltops, & Streams Evident
• Prefer <6% Slope
• Converted the
• Reclassed Raster into
  a shp
• Omitted Option to
  Generalize
• Acquired Residence Data
• Ran the Buffer tool – 150’ & 660’
• Avoid Jurisdictional Sales Pipeline
• Select Flat Areas that are Within Open Areas

map
• Select from currently selected flat areas that are within 150' from Road Access
- Eliminate Any Area Intersecting a Residence Buffer
- Most suitable Meter Sites
- Leases?
We are often provided with legal descriptions that read "part of parcel..." or "see exhibit." The deed descriptions often refer to starting points that cannot be located, and sometimes do not have enough calls to close the plot. The bounded by descriptions are typically of property that no longer exists.

¿Questions¿