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Historic Map Digitizing in the Marcellus Shale

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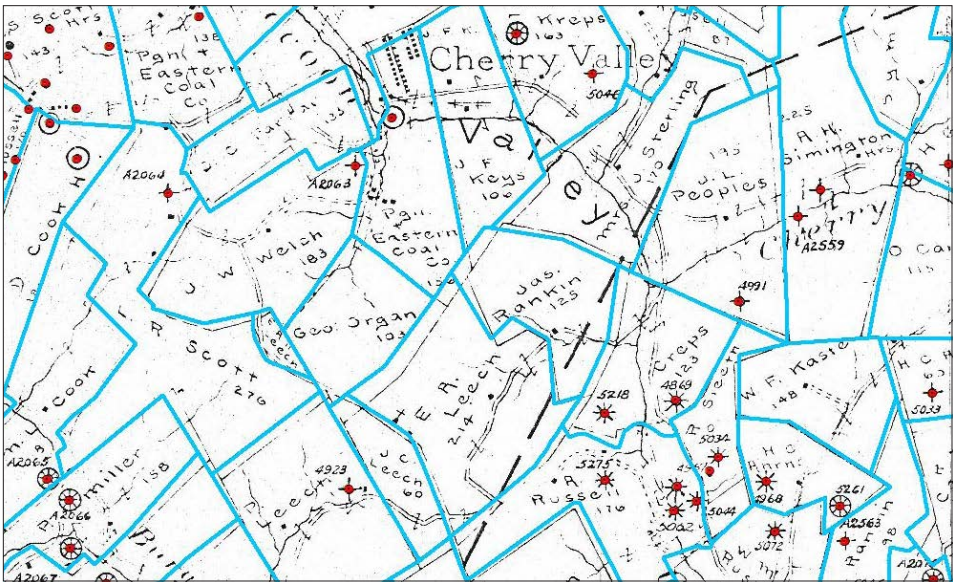
For more than a century, few people knew about the large natural gas reserves that lay beneath the birthplace of the oil and gas industry in Pennsylvania. Today, the Marcellus Shale, in the Appalachian Basin, produces more natural gas than any other field in the United States.

In 2004, Range Resources Corporation began testing newly developed extraction techniques. Within two years, it had unlocked the potential of the new Marcellus Shale play. Now, Range Resources leads US independent oil and natural gas production. Esri technology has been integral to Range's land management department.

Soon after Range began drilling volume wells, other companies started applying for permits in the play. Lease prices soared. Previously, the standard lease agreement, on average, cost $25 an acre for five years, with 12.5 percent royalty. After Range's success, lease costs in the area rose as high as $6,500 an acre, with 15 to 20 percent royalties. Range quickly acted to enlarge its land acquisition program.

In every department, people needed intelligent maps for land management. Decision makers needed to know which mineral rights the company controlled and which ones were controlled by others.



↑ 1911 Digitized with Wells: A digitized 1911 farm line map in the GIS shows lease ownership and mineral rights.

The land acquisition department wanted to determine who previously owned lands and leases and whether prior lease transfers were legal. The geology and drilling departments needed historic well location data so that they could better plan future wellbore paths as well as reduce the risk of environmental impact.

To manage, visualize, and analyze data throughout the business, Range uses Esri geographic information system (GIS) technology along with Esri partner Latitude Geographics' Geocortex, a web-based mapping technology. The self-service GIS platforms allow every department in the company to create its own basic maps. This gives GIS technicians more time to focus on high-level mapping tasks and analyses.

In a quest for historic information, technicians combed through records and maps that showed landownership as far back as the early 1900s. They found paper maps that had been collected over the years by various employees. Landowners donated historic maps of their acreage. Oil and gas companies also had a variety of old maps, and the GIS technicians even found a huge selection of maps at an estate sale. These historic maps generally included well information; municipal and property boundaries; and local features such as roads, streams, and building locations for a given area and time. Staff also looked through historic mineral ownership records.

Legacy Information Drives Planning

GIS technicians turned the maps and information into data layers. They georeferenced more than 250 historic farm line and tax parcel maps. Using a light table, they digitized 4,600 farm boundaries. The technicians also added coordinates to mapped historic wells and digitized their locations and accompanying geologic data. They were then ready to upload the data to Range's GIS database.

↑ A Pump Jack, Production Equipment, and Tanks That Were Found during a Field Inspection

↑ Remains of a Historic Well That Was Abandoned and Overgrown by Brush and Trees

To validate historic well locations, the GIS team enlisted the help of crews to collect data in the field. Crew members looked for clues—such as a rusted casing in the ground, an open hole, or a small depression—indicating the presence of an old well. In some places, they found wells intact along with the pump jack, derrick, and production equipment above ground. In other places, crews found no evidence of a well at all; either drillers had buried and abandoned the well or they had removed all casing and equipment when they plugged the well.

While in the field, crews collected well data coordinates with GPS receivers and logged site information. They recorded information such as casing size and the condition of the well head and equipment, and they sent all this information to the GIS team. The team assigned an internal ID number to each well so that they could easily track it. Range digitized maps, field data, and more than 86,000 historic wells throughout the area. Now the team could build farm line boundary and historic well data layers for creating maps in GIS.

Having this information readily available in the GIS platform saved the company time and money. Previously, the land department and hired contractors researched property titles using only hard-copy historic maps. Now, with this information in GIS, they access maps more easily. Departments go to Range Resource's web-based GIS platform and instantly find land information for a specific farm and nearby historic well locations. They are able to easily run queries, create buffers, and use identify tools.

The historic land and well map provides a starting point for title clearance. Users click historic wells to see the production status of the well and thus deduce the status of their lease. Rather than search through hard-to-read, hand-drawn maps, users can easily access and analyze maps within a GIS web application. GIS greatly reduces research time and lowers costs. Understanding historic well location, geology, and environmental constraints allows engineers to better plan future well pad placement.

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