

**A STUDY TO EVALUATE THE EFFECT OF COMPLETION AND PRODUCTION PROCEDURES  
ON THE ULTIMATE RECOVERABLE RESERVES FROM KNOX FORMATION WELLS:  
ROSE RUN SANDSTONE AND BEEKMANTOWN DOLOMITE**

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Over the years various drilling, completion, and production methodologies have been applied to the Knox Formation, specifically the Rose Run Sandstone and the Beekmantown Dolomite, resulting in various levels of production. The varying levels of success are due not only to the technology used to identify the prospects and the quality of reservoirs encountered, but also to the petroleum engineering principles applied to the completion and the production methodologies employed.

The completion and production technical issues include: cased-hole versus open-hole completions, matrix acidizing versus fracture stimulation, perforation concentration and interval selection, fluid removal methods, paraffin treatments, operating wellhead pressures, gas sales line pressures, as well as general operating procedures. As in all plays, the combined influence of these factors and the reservoir quality ultimately determine the recoverable oil and natural gas reserves.

The Knox/Beekmantown (or equivalent) has been drilled though or tested in approximately 9,500 wells in the Appalachian Basin including the states of Kentucky, New York, Ohio, Pennsylvania, and Tennessee. Some of the earliest Knox well production was in Ohio in 1919, in Kentucky in 1941, and in New York in 1949. Knox drilling represents an increasing percentage of the wells drilled in Ohio.

In Ohio alone, over 257,000 wells have been drilled from 1888 through 2004 with 215,000 being classified as productive and 42,000 as dry. The wells drilled through the Knox are identified as 5,400 Cambrian and 2,700 Knox Formation. Only 550 Knox wells were drilled from 1963 through 1989, while over 2,100 wells were drilled from 1990 through 2004 at an average success rate of 56%. A Ohio's Mineral Management's database query identified 1,480 Rose Run wells statewide accounting for greater than 11,000,000 barrels of oil and 186,300,000 mcf. In Holmes County, Ohio alone 188 Rose Run wells have cumulative average production of greater than 9,000 barrels of oil and 282,000 mcf of gas. Assuming that modifications in completion or production practices could affect 10-20% of the 1,500 Ohio Knox producing wells, and assuming that a 10-20% increase in ultimate reserves would result for each well with an estimate of 300,000 mcfq ultimate reserves per well. The potential overall increases range from 4.5 to 18 bcf of recoverable reserves.

It is well known that many Knox/Beekmantown wells are initially very prolific. However, all these wells eventually become stripper wells and could potentially benefit from the production practices portion of this study. The most significant value of the study may be the potential of stimulation of the poorer quality reservoirs encountered in a large percentage of the wells drilled, especially to the Beekmantown.

Experience indicates that past and current completion and production practices employed have negatively impacted the ultimate recoveries of some Knox wells. The proposed study will evaluate the critical factors associated with completion and production practices and the effect on the ultimate reserves predicted. The ultimate reserves will be estimated through volumetric analysis based on open-hole log analysis, material balance, P/Z, traditional decline curve analysis, and Reciprocal Productivity Index analyses performed by BJ Services. The comparison of these reserve estimates to the critical completion and production factors should result in a methodology and application guide to delineate areas of opportunity to increase production and ultimate recoverable reserves. The study will include Knox/Beekmantown wells (or equivalent) from the Appalachian Basin and will assist operators to optimize both production and ultimate reserves. The same methodology utilized for Appalachian Basin Knox wells is anticipated to be applicable to operators of similar reservoirs in other basins.