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Helping Evaluate New York's Marginal and Inactive Oil and Gas Wells – Assets or Liabilities?

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As one of the earliest petroleum producing regions in the United States, the State of New York has a long history of oil and natural gas production. Although most of the current oil and gas wells in New York would be classified as marginal or sub-marginal producers, the petroleum industry remains a valuable mineral industry for the State. New York has approximately 15,000 unplugged commercial oil and gas wells. In 2001, more than 4,850 oil wells and 6,750 gas wells were reported to be active and producing; the status of the remaining wells was inactive or unknown.

New York's inventory of drilled wells is both a potential asset and a potential liability. The 'drilled well resource' allows industry to respond to and benefit from upswings in oil and natural gas prices as occurred during 2000 and 2001. However, the current inventory of aging, inactive and sub-economic wells will need to be plugged and abandoned at some point, and the future costs for well plugging and site restoration will be substantial. Typical well plugging and abandonment costs in New York range from $1,500 per well to more than $40,000 per well depending on the well depth, well condition, site access, and site condition. To the extent that New York operators cannot comply with requirements to plug idle wells or to maintain the mechanical integrity of their inactive wells, the growing inventory of long-term inactive wells represents a potential future plugging liability to the State and local governments.

Recognizing both the potential value and the potential risks presented by New York's drilled well inventory, the New York State Energy Research and Development Authority (NYSERDA), in coordination with the New York State Department of Environmental Conservation, Minerals Division (NYSDEC), undertook a project to develop a system to characterize New York's oil and gas wells and to review various regulatory and technology-based options for the State's marginal and inactive wells. The goal of the well characterization system is to balance the potential viability of a well — the likelihood of producing commercial quantities of oil or gas - against the potential of the well to become a future financial or environmental liability to the State. The objectives for the project were the following:

- Ensure that the large population of marginal producers and idle wells does not become a future liability to the State and local governments.
- Ensure that marginal and inactive wells are not prematurely abandoned before the wells can be evaluated for by-passed production and alternative uses.
- Identify cost-effective technologies that could reduce the cost to evaluate, rework, or plug and abandon marginal and uneconomic wells.

This project was conducted by ICF Consulting between February and August 2002 and culminated in the development of a Well Characterization Tool and methodology to identify and rank wells according to criteria that imply potential liability or future value.

Well Characterization Tool

New York's oil and gas wells were characterized according to a variety of criteria using the Well Characterization Tool, a Microsoft Access Visual Basic Module that was developed for this project to perform quick and efficient queries of information from New York's current Risk Based Data Management System (RBDMS) and oil and gas databases. [1] The Well Characterization Tool consists of three components:

[1] RBDMS is a state-based oil and gas regulatory data management system used by 20 states. For more information on RBDMS, contact the Ground Water Protection Council at www.gwpc.org.

• Master well database of data tables extracted from New York's SQL Server RBDMS
• Graphical user interface to construct data base queries (User Query Form)
• Customized query results table.

New York's RBDMS database platform is Microsoft SQL Server 2000. The Well Characterization Tool was originally designed as a stand-alone desktop analysis tool to be updated periodically with a current version of RBDMS. The New York Department of Environmental Conservation Minerals Division has since fully implemented the Well Characterization Tool into New York's SQL Server RBDMS. The master tables for the Well Characterization Tool must be extracted into Microsoft Access from a current version of the New York RBDMS. The RBDMS data tables that are incorporated into the Well Characterization Tool master database include: well location, API number, spud date, completion date, well status, well type, geologic formations, producing formations, field names, well ownership, financial security, current oil, gas, and water production, annual oil and gas production for the prior years, casing and cemented intervals, cement type and volumes. Figure 1 shows an example of the graphical user interface or user query form.

The "'User Query Form'' has the following elements: two rows of tabs at the top of the form; two boxes named '*Criteria*' and '*Fields to Show*'; two buttons located in the right hand side named '*Reset All Criteria*' and '*Run Query*'; and a '*Results Table*' which is located at the bottom. The User Query Form has sixteen tabs, which represent the criteria that can be used to select wells from the database and are the basis for the queries. Each tab provides a selection of criteria that can be used to filter or select records from the well characterization database. Selecting one or more criteria on a single tab filters the criteria available to view in the other tabs. For example, if 'oil' is selected on the '*Well Type*' tab, when the '*County*' tab is opened only the counties with oil wells will appear under the '*County*' tab.

The sixteen tabs that are currently used to select wells from the database include:

• ***Type*** - well type: gas, oil, storage, injection, dry hole, not logged, other
• ***Status*** - well status codes such as AC (active), IN (inactive), SI (shut in), etc.
• ***Company*** – refers to the registered owner or operator of the well
• ***County***
• ***Town***
• ***Field*** – name of the producing field
• ***Formation*** – producing formation
• ***Depth*** – total well depth in feet
• ***Age*** – age of the well. Wells are selected according to pre-defined age categories. The age of the well is calculated from the base year for the query. Selecting an age category on the 'Age' tab will select all of the wells with in the database that are within the age category. The age category '999' means that the well is more than 75 years old or data is not available.
• ***Out of Prod'n (Yrs)*** – years out of production. 'Years out of production' is calculated from the base year. A '0' value means production was reported for the well in the base year. The criterion of '≥ 9 years' means that no production was reported for the well for the ten years prior to the base year. 'No data means there is a null value for production in the master RBDMS database.
• ***Gas Prod (MCF/Yr)*** – annual gas production. Various production categories are defined ranging from '*1 Mcf – 100 Mcf*' to '*>10,000 Mcf*', in addition to '0' and 'no data' categories. Selecting a production category will select all the wells in the database with annual gas production within the production range of the category.
• ***Avg Oil Prod (BBL/Yr)*** – an estimated average oil production per well, which is calculated by dividing total annual tank production by the number of wells associated with the tank. This value does not represent the actual oil production from individual wells, but it can be used to flag marginal oil wells.
• ***Oil Tank Prod (BBL/Yr***) – reported production for the oil tank connected to an individual well. The criteria on this tab allow the tank production to be filtered according to various production categories.
• ***No. of Oil Wells Connected to Tank*** - the number of individual wells connected to a tank. Currently this tab contains a single criterion representing wells with 'No Data'

• ***Financial*** – general criteria that indicate whether the owner/operators of individual wells meet New York's current requirements to provide financial security for oil and gas operations. The criteria range includes '*no data*', '*not required*', '*not enough*' (current bonds/financial security do not meet statutory requirements), '*enough*' (meets current requirements), '*more than enough*' (operator's bonds and securities exceed current requirements).
• ***No. of Cemented Casing Intervals*** – Number of intervals ranges from '1' to '6'. The criteria under this tab select wells with data pertaining to cased and cemented zones within the well. Although many of the wells in the master database currently have no data, this tab can be used to screen wells according to the well data that is available. For example, selecting a producing formation on the '*Formation*' tab and then selecting criteria from the '*No. of Cemented Cased Intervals*' tab, will quickly indicate if well completion data is available for the formation of interest.

The criteria selected under each tab are displayed in the Criteria box. The user selects criteria from the required tab by clicking in the arrow or double clicking the selected criteria. The selected criteria appear in the criteria box and an asterisk (*) appears on the upper right hand corner of the tab indicating that tab is active in the query. This feature allows the user to keep track of the tabs have been selected for a query. The 'Reset All Criteria' button followed by the 'Run Query' button resets all previously selected criteria and returns the user to the Master Table. The 'Fields- to-Show' box indicates what data fields have been selected for display in the 'Results' table. The data fields are displayed in the Results table in the order in which they are selected in the 'Fields to Show' box. If no data fields are selected, the Results table will show all data fields. After all criteria and data fields are selected, click the 'Run Query' button to generate the query. The entire Master Table appears as the Result table when the User Query Form is first opened. Each time that a user runs a new query, a new Results table is generated. To save a Results table for future reference or use with other applications in Microsoft Access, the user must go to 'Table View' in Access and rename and save the Result table.

Special Features of the Well Characterization Tool
The field 'RankID' was created in the Well Characterization Tool database to 'score and rank' individual wells according to various criteria such as age of the well, estimated production, years inactive. Rank ID is a six-digit code assigned to each well by the Well Characterization Tool, which is designed so that wells can be ordered according to the potential for financial or environmental risk implied by the selection criteria - from highest potential risk to lowest risk. Each character represents a single criterion or risk factor. The first character indicates well type: oil, gas, storage, or injector. The remaining characters indicate: operator/owner (whether known or unknown); number of years out of production compliance of the corresponding operator/owner with current financial security requirements (no data, not enough, not required, etc.); age of the well (<10 years to >75 years); data available for casing and cemented intervals (yes/no). The RankID is flexible and the string of characters that comprise the RankID code can be regrouped or modified. A descending sort by Rank ID in the Results table will bring wells with the greatest potential risk to the top rows of the table (based on the criteria available). Figure 2 illustrates the Rank ID concept.

Application of the Well Characterization Tool to New York
Applications of the Well Characterization Tool include: 1) assessing regulatory compliance and management, 2) ranking and classifying wells according to potential environmental risk, 3) monitoring production operations, and 4) evaluating the impact of policy and regulatory changes. The result is a flexible and versatile ''best practice'' tool that can benefit both regulators and operators in evaluating the various risks and opportunities presented by a large population of marginal and inactive wells.

Using the Well Characterization Tool to quickly execute database queries, New York wells were grouped into a number of categories according to well type and well status, in addition to various criteria such as the age of the wells, years out of production, owner compliance with financial security, etc. These criteria (completion date, number of years inactive, production rate, insufficient bonding, and lack of basic well data) are assumed to represent risk factors that indicate the potential for a well to become a financial or environmental liability. An example of a high risk well might be seventy-year-old oil well that has reported no production for the last ten years. No information is available about the well construction, such as depth and type of surface casing, production casing, or cement. Under current New York

regulations, the well is exempt from bonding requirements, so no financial security has been provided for the eventual plugging of the well. While none of these factors provides a direct indication of the financial or environmental risk posed by a well, they indicate potential areas for concern or further investigation.

Figure 3 provides an example of how the Well Characterization Tool can be used to screen active, marginal oil wells for *de facto* long-term idle wells, potential financial and environmental liabilities, and potential candidate wells for remedial action. Operators A, B, C in Figure 3 represent a total of 153 active wells and approximately 966 barrels of annual oil production. Most of this oil production may be coming from only two wells, the recent wells operated by Operators A and B. The 92 wells of unknown age operated by 'A' and 'B', and all wells operated by 'C', which are more than 68 - 100 years old, could be investigated further to determine the actual production status and condition of the wells. The remaining 42 wells operated by 'A' and 'B' could be investigated further for potential technology applications to improve well performance. The lease held by Operator 'C, might be a candidate for further evaluation of reservoir performance in the context of a larger field evaluation of the potential for by-passed pay zones or potential undrained reservoir compartments.

Potential future applications of the Well Characterization Tool in New York include identification and management of long-term idle wells; expanding the capabilities of the Well Characterization Tool to rank individual wells according to direct risk factors for environmental contamination; and screening marginal oil and gas fields to identify potential applications of new technologies and management practices to extend and enhance New York production.

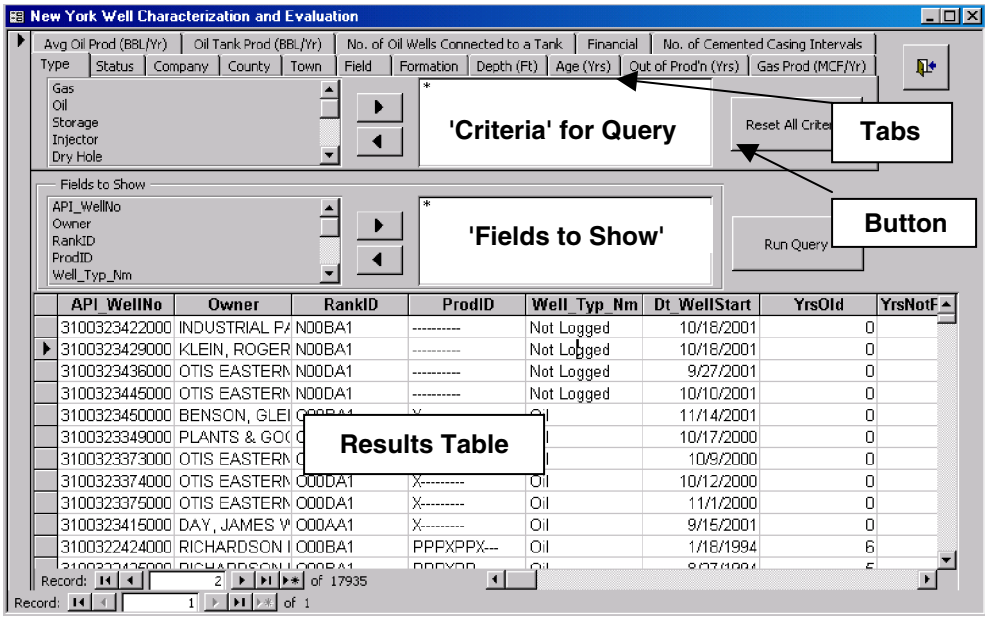

Figure 1. Well Characterization Tool Graphical User Interface (User Query Form)

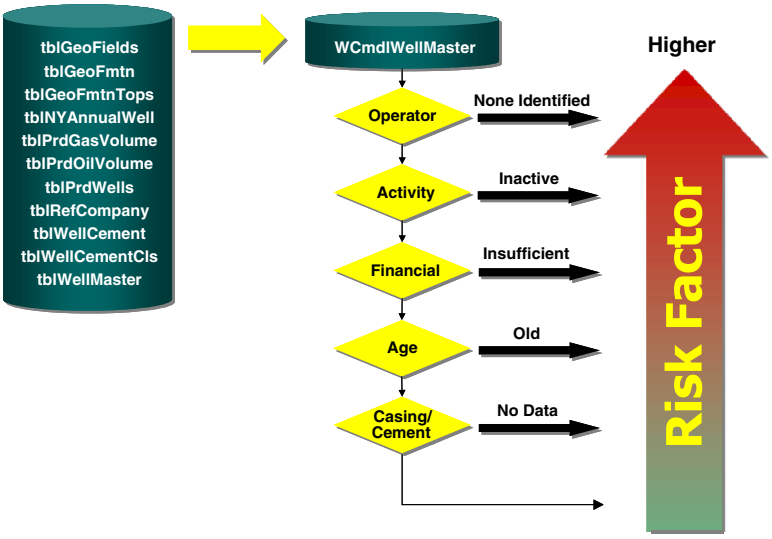

Figure 2. Overview of the Well Characterization Tool "RankID" Concept

Well Characterization Tool Query:
1. Select Criteria: ***Well Type*** = Oil; ***Avg Oil Prod (Bbl/Yr)*** = "1" and "1 – 10"
2. Run User Query
3. Query Results Table: Sort "Descending" on *OilTanknWell_1999.* This groups all the oil wells connected to a single tank and brings the tanks with the largest number of wells to the top of the list.
4. Analyze Query Results Table: For each tank look at the number of wells connected to the tank, the age of the wells, and the total annual tank production, financial security compliance.
Examples:
Operator A: 91 Wells Connected to Production Tank Total Annual Tank Production = 606 barrels Estimated Average Annual Production = 6 – 7 barrels/well 83 Wells: Age Unknown 7 Wells: Completed 1970 – 1982 1 Well: Completed 1998
Operator B: 45 Wells Connected to Production Tank Total Annual Tank Production = 350 barrels Estimated Average Annual Production = 7 – 8 barrels/well 9 Wells: Age Unknown 35 Wells: Completed 1967 – 1974 1 Well: Completed 1999
Operator C: 17 Wells Connected to Production Tank Total Annual Tank Production = 10 barrels Estimated Average Annual Production = 0.6 barrels/well 1 Well: Completed 1900 16 Wells: Completed 1934 - 1936

Figure 3. Query Example for Potential High Risk Non-Producing Active Oil Wells