

NUSTIM™ SERVICE – Western OK

OPERATOR CHALLENGE:

A Western Oklahoma operator was faced with a producing **Morrow well with a potential for recompletion**. Typical well diagnostic test results, including conventional log analysis and pressure transient analysis, **could not adequately characterize the reservoir** due to several **inaccurate assumptions**. After acquiring the well from another operator, several questions were raised:

- Is the current completion strategy for all wells in the field adequate for this interval?
- Is the Morrow interval as productive as first thought by conventional log interpretation and field analysis?
- Is the comparison of net feet of measured porosity from the conventional log analysis an adequate measure of well performance in the field?
- Is it reasonable to use net feet of pay as a determination of stimulation treatment size?
- Are the assumptions made by the build-up analysis correct?
- Was the completion adequate for the Morrow interval?

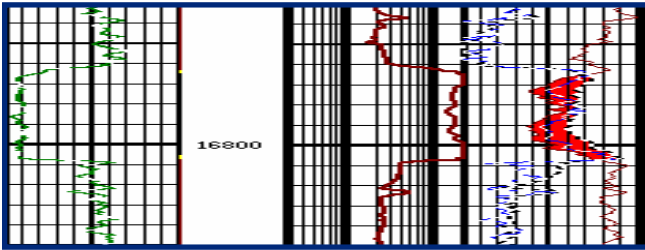


Figure 1: Conventional log data for Morrow interval.

From the well test analysis performed prior to zone stimulation, the original operator estimated the pressure, permeability, and skin factor of the interval using **pressure transient analysis and conventional log interpretation techniques** (Fig. 1). Analysis of the data mistakenly led the operator to believe in the existence of a no-flow boundary roughly 50 ft from the wellbore in one direction and a 10 fold permeability increase in the reservoir about 100 ft from the wellbore in the opposite direction. A virgin pressure regime and a high skin value were also believed to exist. Utilizing this data, the operator **designed the fracturing treatment for a short fracture length** and high fracture conductivity in an effort to connect to the higher perm region 100 ft from the wellbore. The operator’s design is depicted in Fig. 2.

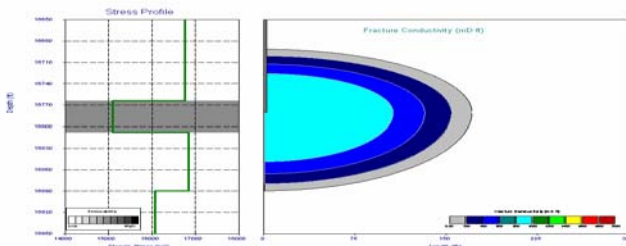


Figure 2: Initial stimulation design for the Morrow interval.

After taking the well over, the current operator desired to evaluate the data collected by the original operator, while incorporating the additional post fracturing production and treatment response data, in order to **evaluate the well’s potential for recompletion**.

NUTECH SOLUTION:

NuTech Energy Alliance applied its **NuLook Textural Vision™ (NTV) and NuStim™ processes** to the data set to properly evaluate the Morrow and present the operator with a **unique solution**. NuTech evaluated the interval through the NTV process, which properly characterized the permeability by **modeling the pore size distribution within the reservoir** (Fig. 3). NTV allowed for a quantified reservoir description.

With the reservoir normalization and description steps completed, NuTech fed each reservoir curve into the NuStim process at 0.5 foot increments and evaluated each completion. The reservoir description provided by the NuLook Textural Vision process included:

- Core calibrated textural permeability distribution
- Sand, shale, and silt volume
- Quantification of moveable and bound fluids
- Gross and net feet of productive sand

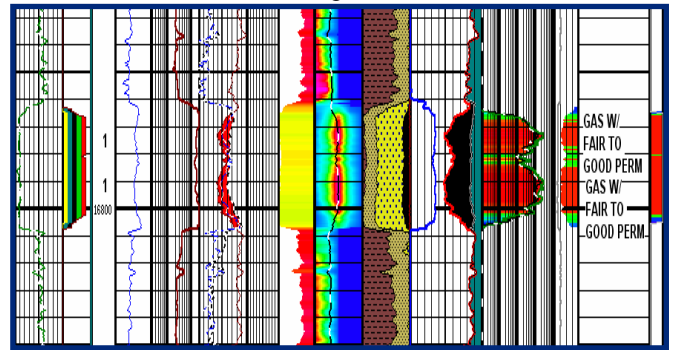


Figure 3: NuLook Textural Vision analysis of Morrow interval.

NuList Parameters: Morrow

Pay Ft	AVE Rank	PHIE _{AVE}	Perm _{ABS}	Perm _{ABS} Ft
41 Ft	1.171	12.9%	2.929 md	120.1 md Ft

By calculating the mechanical rock properties for each half foot increment of the wellbore, a **detailed in-situ stress profile** was created and calibrated to the previous pump-ins and fracturing treatment. The textural permeability distribution was further **calibrated to match the production response** in concert with the pressure matched fracture dimensions and the build-up test. By investigating the previous well completion in conjunction with the pre- and post-fracture production with the **increased level of detail** from the process, the true calibration coefficients for the Morrow sand were easily quantified via the process, and an **exact simulation of the past well production and treatment responses was created**. Several well completions were then evaluated and their effectiveness compared.

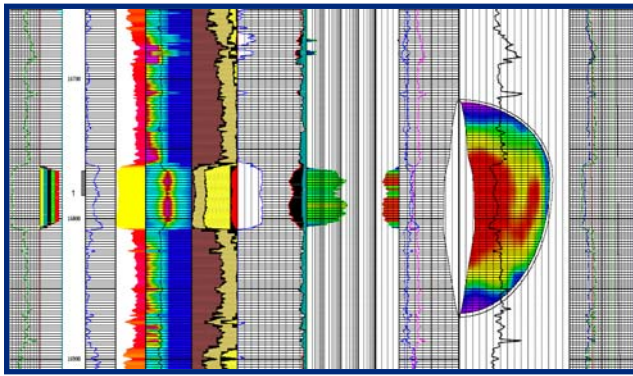


Figure 4: NuStim log depicting optimal stimulation of the Morrow.

THE RESULTS:

The NuStim process illustrated that **significant improvement could have been realized with a larger fracturing treatment** (Fig. 4). By incorrectly determining the reservoir attributes from the pressure transient analysis, the original operator **under-stimulated the wellbore**. By **honoring all of the data** collectively and in concert with the NuLook NTV analysis, an accurate reservoir characterization was achieved. Based on the reservoir uniqueness and incorporation of the customer’s cost, **economic comparisons were made** for a variety of treatment scenarios. As shown in Fig. 5, scenario 10 presented the highest NPV (**\$7.38MM**) over 5 years while presenting a job which was still small enough to have a reasonable probability of pumping to completion.

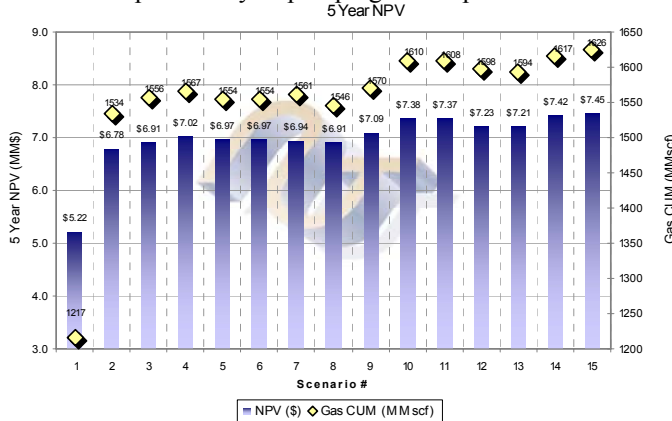


Figure 5: NPV Comparative Analysis.

By completing the well prior to NuStim analysis, the original operator **misdiagnosed the pressure transient analysis** by making bad assumptions. The previous treatment, depicted as scenario #2 in Fig. 7, was then compared to the NuStim optimized recommendation. The analysis presented a recompletion opportunity for the operator and an **additional \$598,000.00** over 5 yrs. Initial production from the optimal completion would have **more than doubled** from what was observed and the resulting cumulative gas production over 5 yrs would have been increased by 54 MMscf (Fig. 6).

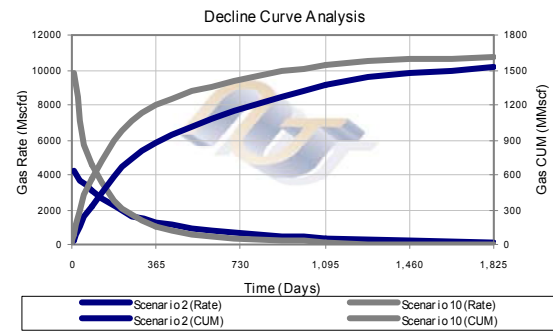


Figure 6: Production decline comparison for actual vs. optimal stimulation of the Morrow.

CONCLUSIONS:

By utilizing the practical petrophysical and completion optimization processes NuLook NTV and NuStim, the operator was able to **identify a recompletion opportunity and add significant reserves and value**. Several assumptions must be made when using a solitary method of investigation in which to characterize the reservoir and determine the best means of completion. When **incorrect assumptions are made, a completion decision can be dramatically influenced**.

NuTech understands that only by incorporating all available data from the well and the field, can one focus in on a unique solution. Through the NuStim process, NuTech provides the operator a completion recommendation which **honors all available data in which to evolve to a unique, well specific solution**. Once calibrated in an area, the NuStim process can provide this unique solution **prior to the completion of the well**.

With the power of NuLook, NuStim breaks down the description of the reservoir beyond any product on the market. By describing the reservoir at 0.5 ft increments, a **more accurate fracture and reservoir model** may be developed and utilized. This dramatically **increased level of detail enhances the completion design** and adds value to NuTech clients. All components during the fracturing treatment, such as the reservoir cool down during pumping and treating pressure estimates, as well as the production are enhanced from this complete wellbore description. This level of detail drastically surpasses any other completion design tool on the market today.

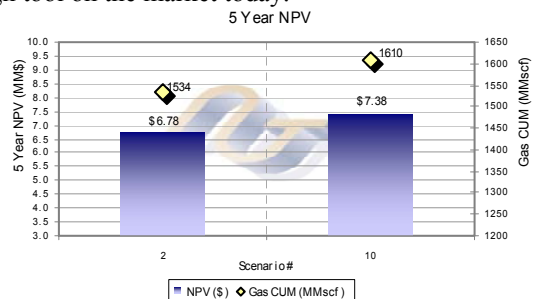


Figure 7: NPV comparative analysis for NuStim recommended scenario vs. actual treatment scenario.



For more information about how NuStim and NuLook TEXTURAL VISION can impact your bottom line, contact your local NuTech representative.



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