

## NUSTIM™ SERVICE – PERMIAN BASIN

### OPERATOR CHALLENGE:

A New Mexico operator was faced with a **difficult completion in a well with multiple Morrow sands** in Eddy County, NM. Erratic post-fracture production results in the area poised several questions:

- Were the intervals as productive as first thought by conventional log interpretation and field analysis?
- Is it reasonable to use net ft of pay as a determination of stimulation treatment size?
- Are the experienced production results, often including predominant water production, a culprit of an inefficient stimulation strategy?
- Is it good practice to compare net feet of measured porosity from the conventional log analysis as a measure of well performance?
- Is the current field-wide completion strategy adequate for each well?
- Could further completion optimization be economically realized in this tight sand play?

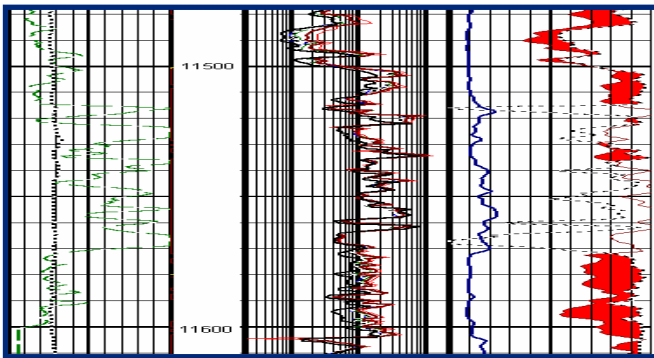


Figure 1: Conventional log data for the lower Morrow.

After completing the lower-most Morrow sand interval using **conventional log analysis techniques and a typical fracturing procedure** for the field (Fig. 1), the operator **produced mostly water with slight gas**. Needing help to diagnose where the water was being produced from, the operator requested NuTech apply their petrophysical and stimulation services to diagnose the problem and **aid them with the completion of the additional Morrow intervals** in the wellbore.

### NUTECH SOLUTION:

NuTech Energy Alliance employed its **NuLook 2004™ and NuStim™ processes** to properly evaluate the intervals and guide the operator to a **practical solution**. NuTech evaluated the target well with the NuLook 2004 process which properly characterized the reservoir by **identifying the quantity of bound and free fluids** and describing the **permeability distribution** in the reservoir. NuLook allowed for a proper comparison of each of the well's Morrow sand intervals. The reservoir description provided by the NuLook 2004 process included:

- Core calibrated permeability distribution
- Sand, shale, and silt volume
- Quantification of moveable and bound fluids

With the normalization and reservoir description steps completed, NuTech applied the NuLook data via the NuStim process and evaluated the completion of the lower interval.

Using sonic porosity measurements provided by the operator, several rock mechanics curves were created. From these curves, a **detailed in-situ stress profile** was created and calibrated to the previous fracturing treatment on the lower Morrow interval. The permeability distribution was further calibrated to **match the production response in concert with the leakoff profile** from the pressure matched fracture dimensions.

From the evaluation of the lower Morrow completion, the process showed that the **lower fracturing treatment grew upward into a wet Morrow interval** about 70 ft above the target sand (Fig. 2). After investigating the predicted production response from the first Morrow, the operator decided to pursue the upper sands. Now with a calibrated in-situ stress and permeability profile, the NuStim process easily pointed to the **optimal fracturing treatment size** in each of the sands.

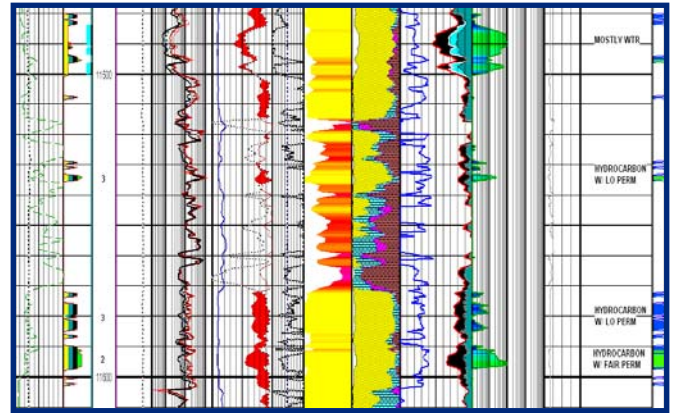


Figure 2: NuLook 2004 analysis of the lower Morrow.

#### NuList Parameters: Lower Morrow

Pay Ft	AVE Rank	PHIE <sub>AVE</sub>	Perm <sub>ABS</sub>	Perm <sub>ABS</sub> Ft
17 Ft	2.8	7.4%	0.156 md	2.654 md Ft

Design improvement is essential to any field development. Within the NuStim process, **calibration is designed into the flow cycle**. Thus, the follow-up and crucial design improvement is a mandatory constant step. Only by completing the cycle shown in Fig. 3 can improvement be realized. In the case of this Morrow completion, the bottom interval was completed and matched via the design process. The bottom Morrow stage's calibration coefficients were then used to improve predictions on the subsequent stages in the well. Through the NuStim process, predictions evolve after each completion in this manner.



Figure 3: NuStim process flow chart.

## THE RESULTS:

The NuStim process guided the operator to significant improvement on each of the well's Morrow intervals versus typical designs for the area. By comparing the economics for up to **30 individual fracturing scenarios for each frac stage**, the optimal treatments were determined.

By evaluating the treatment cost versus the modeled fracture dimensions, the operator was allowed to select the treatment which gave the **longest fracture length for the least expense** (Fig. 6) which proved to be critical to the success of this low permeability sand.

After comparing the simulated decline curves of all of the different treatment scenarios (Fig. 4) and applying the operator's economic data, a cost to benefit comparison was made for each of the scenarios (Fig. 7) leading the operator to the **unique stimulation treatment** for the precise fracturing stage in that specific wellbore.

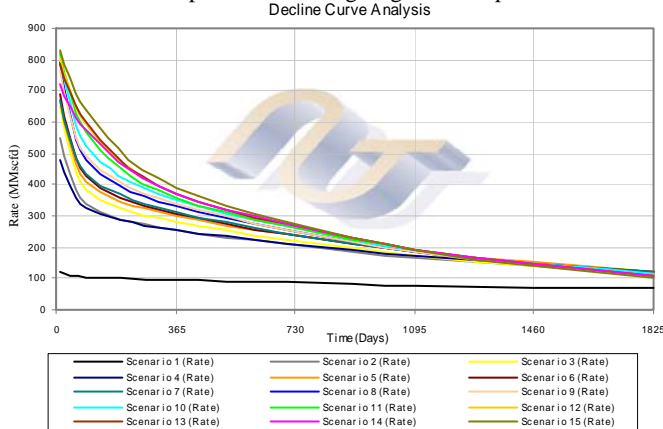


Figure 4: Production decline comparison.

In the case of the 4<sup>th</sup> Morrow stage, a larger treatment than normally applied within the field and considering the net ft of pay present proved to be optimal, as seen in Fig. 7 as Scenario #12. This treatment resulted in a relatively long fracture half-length, while limiting the completion costs and stimulating the entire interval (Fig. 5). By optimizing this interval in the wellbore alone, the NuStim process created an **additional \$197,000 for the operator** over 5 yrs. The predicted initial production rate from the process of 800 Mscf per day **matched the actual recorded IP** of 760 Mscfd from the operator to within 95% accuracy (Fig. 4).

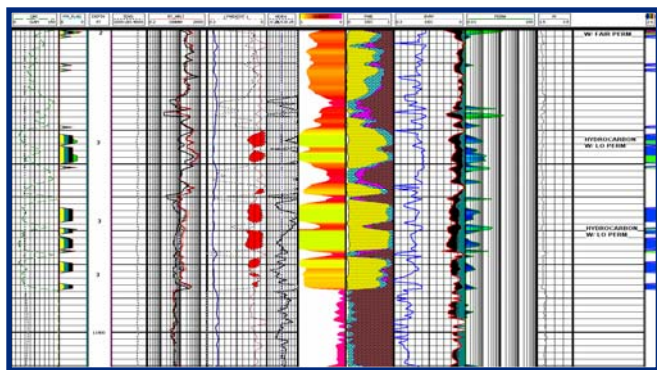


Figure 5: NuLook depiction of the 4<sup>th</sup> Morrow interval in the wellbore.

**NuStim**  
Stimulation Vision

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

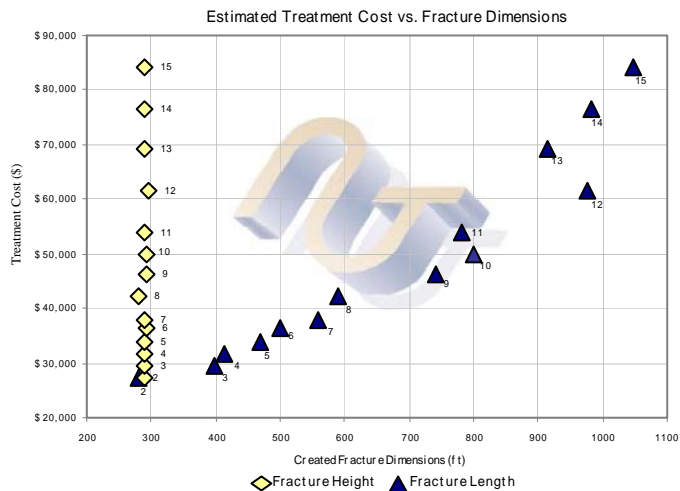


Figure 6: Treatment cost vs. created fracture dimensions.

## CONCLUSIONS:

By utilizing the NuLook and NuStim technologies, the operator was able to establish the proper reservoir and completion parameters and diagnose the **true capacity of each interval's potential**. This information greatly influenced the operator's completion strategy and **dramatically decreased the \$/Mscfe** ratio by optimizing the treatment size of each of the 5 fracturing stages remaining in the wellbore in addition to **keeping the operator away from any free water** present in the system. The benefits of the NuStim process were **easily measured** and quickly determined by the operator.

Because the NuStim predictions evolve after each completion (Fig. 3), the operator maximized the benefit of any and all knowledge learned from the previous intervals completed in the wellbore and allowed the operator to apply a **unique solution prior to the completion of the well**.

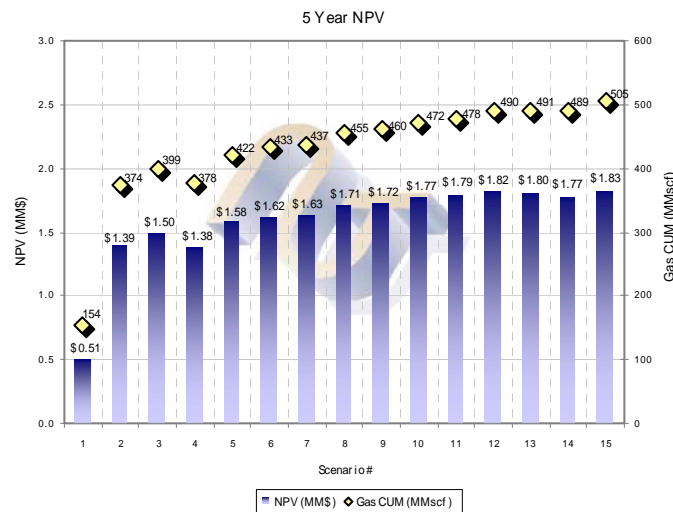


Figure 7: 5 year NPV comparative analysis.