

QUARTERLY TECHNICAL PROGRESS REPORT
(32nd Quarter)

**ADVANCED OIL RECOVERY TECHNOLOGIES FOR IMPROVED
RECOVERY FROM SLOPE BASIN CLASTIC RESERVOIRS,
NASH DRAW BRUSHY CANYON POOL, EDDY COUNTY, NM**

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ABSTRACT

The overall objective of this project is to demonstrate that a development program based on advanced reservoir management methods can significantly improve oil recovery at the Nash Draw Pool (NDP). The plan includes developing a control area using standard reservoir management techniques and comparing its performance to an area developed using advanced reservoir management methods. Specific goals are (1) to demonstrate that an advanced development drilling and pressure maintenance program can significantly improve oil recovery compared to existing technology applications and (2) to transfer these advanced methodologies to oil and gas producers in the Permian Basin and elsewhere throughout the U.S. oil and gas industry.

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EXECUTIVE SUMMARY

The use of the Advanced Log Analysis techniques developed from the NDP project have proven useful in defining additional productive zones and refining completion techniques. The Advanced Log Analysis program proved to be especially helpful in locating and evaluating potential recompletion intervals, which has resulted in low development costs with only small incremental increases in lifting costs. To develop additional reserves at lower costs, zones behind pipe in existing wells were evaluated using techniques developed for the Brushy Canyon interval. Log analysis techniques developed in Phase I have been used to complete a total of thirteen of the NDP wells in uphole zones. Four wells were recompleted in 1999, which allowed the development of economical reserves during a period of low crude oil prices. An additional four wells were recompleted during 2000, which resulted in 123,462 BO and 453,424 MCFG reserves being added at a development cost of \$1.57 per B.O.E. Two wells, #29 and #38 were recompleted in 2001 which added 7,000 BO and 18 MMCFG to the reserves at a cost of \$9.70 per BOE. NDP Wells #1, #12, #15 and #20 were completed in uphole zones during 2002-03 which added 128,000 BO and 150 MMCFG to the reserves at a cost of \$1.64 per BOE.

The NDP #36 well toe zone was completed in October 2001, then restimulated in April 2002. During the workover an additional zone in the deviated section of the well was added. Cumulative production through August 2003 is 94,036 BO, 258.2 MMCFG and 43,693 BW.

The NDP #33 well toe zone and "H" zone were completed in December 2002. Cumulative production through August 2003 is 29,996 BO, 114.5 MMCFG and 86,000 BW.

Continued interpretation of the original 3-D seismic survey using the results from drilling NDP Well #36 and #33 has resulted in a more complete characterization of the Brushy Canyon reservoir. The new 3-D seismic survey has refined the original interpretation and added at least two (2) targets for additional development.

INTRODUCTION

The Nash Draw Pool (NDP) in Eddy County, New Mexico produces oil and associated gas from the Permian (Guadalupean) Brushy Canyon Formation. The Brushy Canyon is a relatively new producer in the Delaware Basin of West Texas, with most drilling having occurred since the late 1980s and many discoveries occurring in the 1990s. Regionally, the fine-grained sandstones of the Brushy Canyon contain as much as 400-800 MMbbls of oil-in-place and thus this formation represents a significant reservoir interval in the Permian Basin. However, low permeability and petrophysical heterogeneity limit primary recovery to only 10-16%.

The NDP is one of the project sites in the Department of Energy (DOE) Class III field demonstration program for slope-basin clastic reservoirs. The objective of the NDP Class III project is to demonstrate that an advanced development drilling and pressure maintenance program can significantly improve oil recovery compared to existing technology applications. A further goal of the project is to transfer these advanced methodologies to oil and gas producers in the Permian Basin and elsewhere throughout the U.S. oil and gas industry.

In the first phase of the NDP project, an integrated reservoir characterization study was performed to better understand the nature of Brushy Canyon production and to explore options for enhanced recovery. Results obtained in the NDP project indicate that a combination of early pressure maintenance (gas injection) and secondary carbon dioxide flooding may maximize production in these complex, laterally variable reservoirs. Because of low permeabilities involved and high water-to-oil relative permeabilities, the use of gas instead of water is suggested as preferable as an oil-mobilizing agent.

Phase II is directed toward enhancing the ultimate recovery from the project. The plan includes directional/horizontal drilling of new wells in order to develop reserves under surface-restricted areas and potash mines and evaluation of prospects of early pressure maintenance.

RESULTS AND DISCUSSION

This is the thirty-second technical progress report on this project. Results obtained to date are summarized.

Geology and Engineering

The production database was updated through August 2003. This data was added to the history of each well to update the decline curves and to project ultimate recoveries as well as to assess the effects of interference and production strategies.

Nash Draw #33

The analysis of the second seismic survey has shown that the toe zone lies at the top of the “L” zone and the stimulation treatment did not extend down into the “L” zone. This has resulted in a “K” and “K-2” zone completion with characteristically high water cuts and low oil cuts. To correct this situation a deepening operation has been designed to extend the openhole section 367 feet while dropping the TVD 50 feet deeper. This should place the BHL at the bottom of the “L” zone porosity interval and allow fracture stimulation of the “L” zone.

A openhole packer assembly will be used to isolate the new openhole section from the previously completed toe zone. A packer seat will be attempted in the tighter upper “L” section, generally in the upper 7 feet of the “L” interval. A groove will be hydrojetted into the lower “L” interval to create a stress point to control fracture initiation.

This workover is scheduled for early November and should be completed in approximately two weeks. A representation of the proposed wellbore configuration is presented in Figure 1. The new openhole section is shown as the black portion at the tip of the wellbore.

Nash Draw #36

The second generation seismic shows the #36 well toe zone is completed at the top of the "L" zone and probably did not achieve penetration through all of the "L" zone pay. Initial testing showed good oil cuts, but final testing showed high water cuts consistent with "K" and "K-2" characterization.

A deepening operation has been designed to extend the openhole section 2014 feet while dropping the TVD 50 feet deeper. This should place the BHL at the bottom of the "L" zone porosity interval and allow fracture stimulation of the "L" zone.

An openhole packer assembly will be used to isolate the new openhole section from the previously completed toe zone. A packer seat will be attempted in the tighter upper "L" section, generally in the upper 7 feet of the "L" interval. A groove will be hydrojetted into the lower "L" interval to create a stress point to control fracture initiation.

This workover is scheduled after the #33 deepening is completed and tested. A representation of the proposed wellbore configuration is presented in Figure 2. The new openhole section is shown as the black portion at the tip of the wellbore.

Nash Draw #34

The preliminary interpretation of the second generation 3-D seismic survey has yielded a drilling target in the NE/4 of section 12. A well is being planned from the #19 location to the NE/4 of section 12 as shown in Figure 3.

Upon the successful completion of the #33 and #36 deepenings and confirmation that the "L" zone is as productive as the seismic predicts, the #34 well will be drilled through the NE/4 of section 12-T23S-R29E. The well is designed to be a directional/horizontal well with the directional section intersecting the "L" zone approximately 1400 feet northeast of the surface location at an azimuth of 51.98°. After intersecting the "L" zone the wellbore will continue horizontally to a BHL 400 FSL and 400 FEL of section 1. The bottom hole location is projected to be 1800 feet east and 3181.74 feet north of the surface location, A total of 3655 feet from the surface location at an azimuth of 25.50°. A representation of the proposed wellbore path is presented in Figure 3.

3-D Seismic

Interpretation of the second generation seismic structure map indicates that there is only 55 feet of west to east dip across section 11. The first generation seismic structure map showed 125 feet of west to east dip. This reinterpretation causes a problem with targeting the BHL of the horizontal wells drilled in section 11. The #33 and #36 wells were drilled using the dip exhibited by the first generation seismic survey and followed the "L" zone updip 75 feet to 50 feet. The second generation seismic structure map indicates that these wells only needed to go updip +/-

25 feet. Therefore, if the second generation structure map is correct, the #33 and #36 BHL are at the top of the “L” zone or in the bottom of the “K-2”. This explains why the water cut is higher than expected from the #33 well. This interpretation is shown in Figure 4 and Table 1.

Other Applications

Strata has applied the characterization and 3-D seismic technology developed from the Nash Draw Project to two other fields in Eddy County and a new prospect west of the Nash Draw Unit. Another application is being modeled for a Bone Spring prospect in Lea County.

Internet Homepage

The web site for the Nash Draw Project can be accessed at <http://baervan.nmt.edu/nashdraw/>. The site includes a project summary, list of participants, summary of the technical team, technical transfer including quarterly and annual reports, and future plans and current activities.

Technology Transfer

Disseminating technical information generated during the course of this project is a prime objective of the project. A summary of technology transfer activities during this quarter is outlined below.

Web Site: <http://baervan.nmt.edu/nashdraw/>

EXPERIMENTAL RESULTS

No experiments are associated with this project.

CONCLUSION

The production database was updated through August 2002. Evaluation of the completion, stimulation, and production testing and analysis of the Nash Draw #33 horizontal well is continuing. The Nash Draw #33 production matches the model from the #15 “K” and “K-2” indicating production is coming from zones above the “L” zone. Analysis of the seismic data has identified a target in the NE/4 of section 12 for the drilling of the next deviated/horizontal well. The web site for the Nash Draw Project is online and can be accessed at <http://baervan.nmt.edu/nashdraw/>. Technology transfer activities are outlined on this web site.

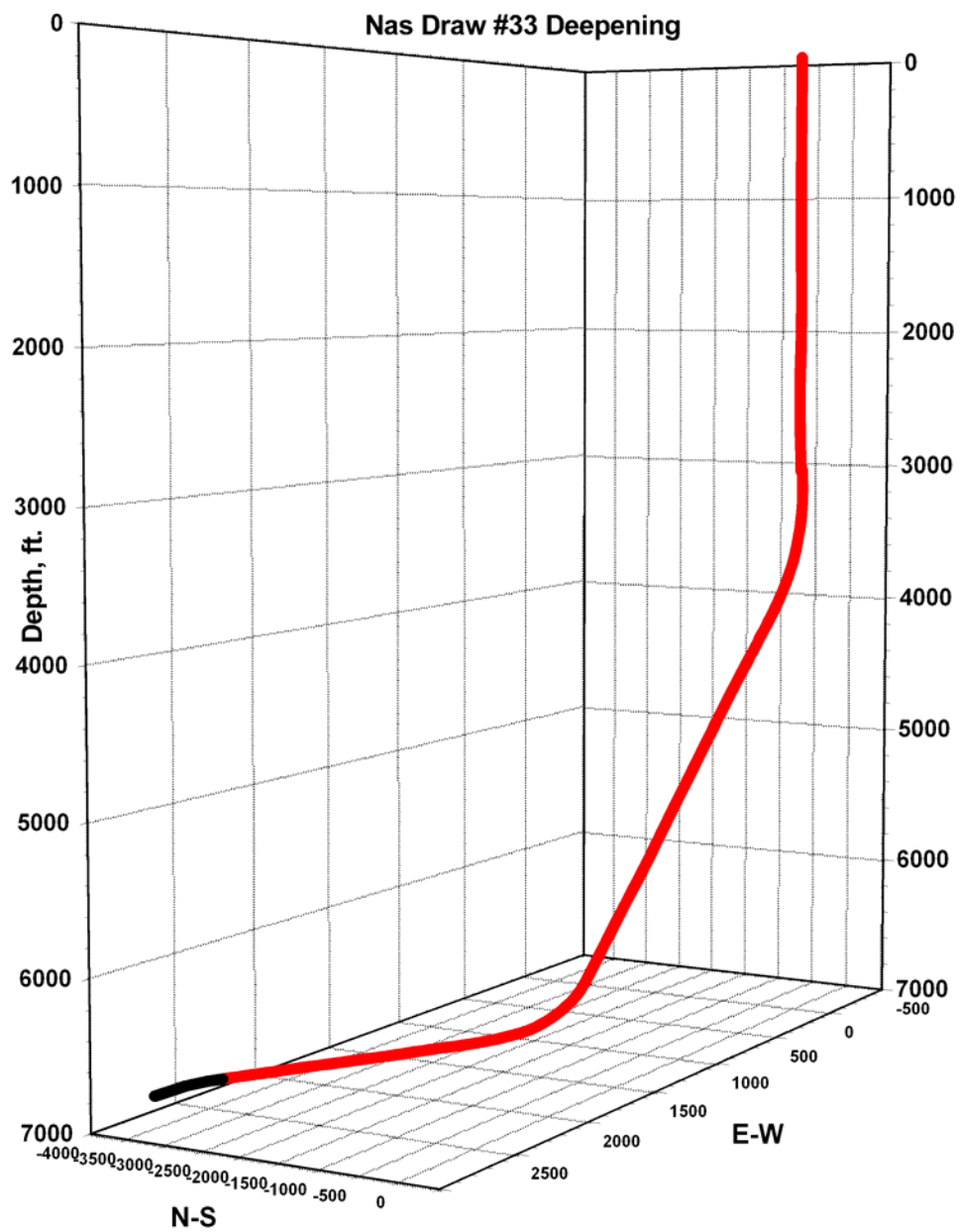


Figure 1. Nash Draw #33 proposed wellbore extension.

Nash Draw #36 Deepening

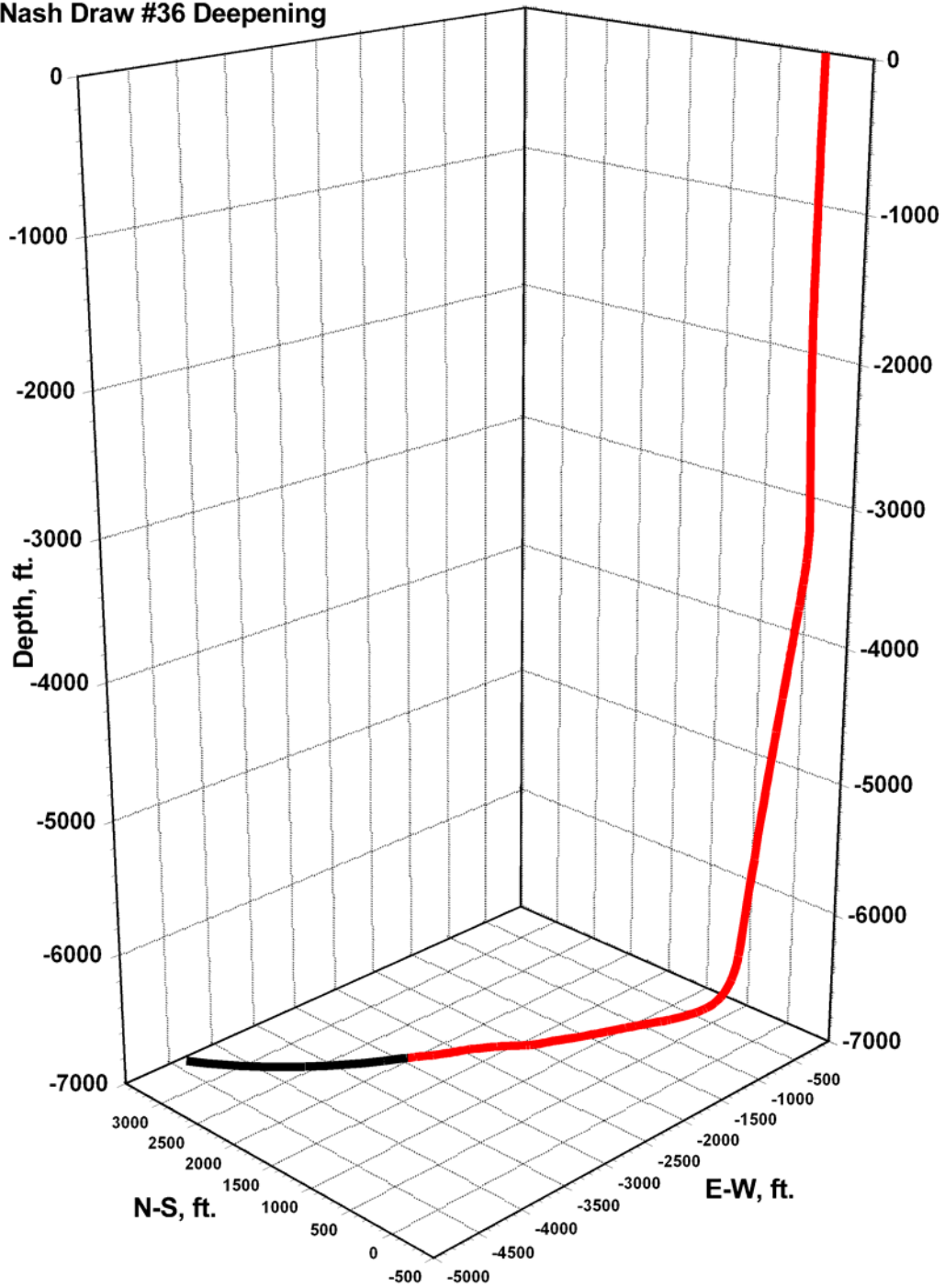


Figure 2. Nash Draw #36 proposed wellbore extension.

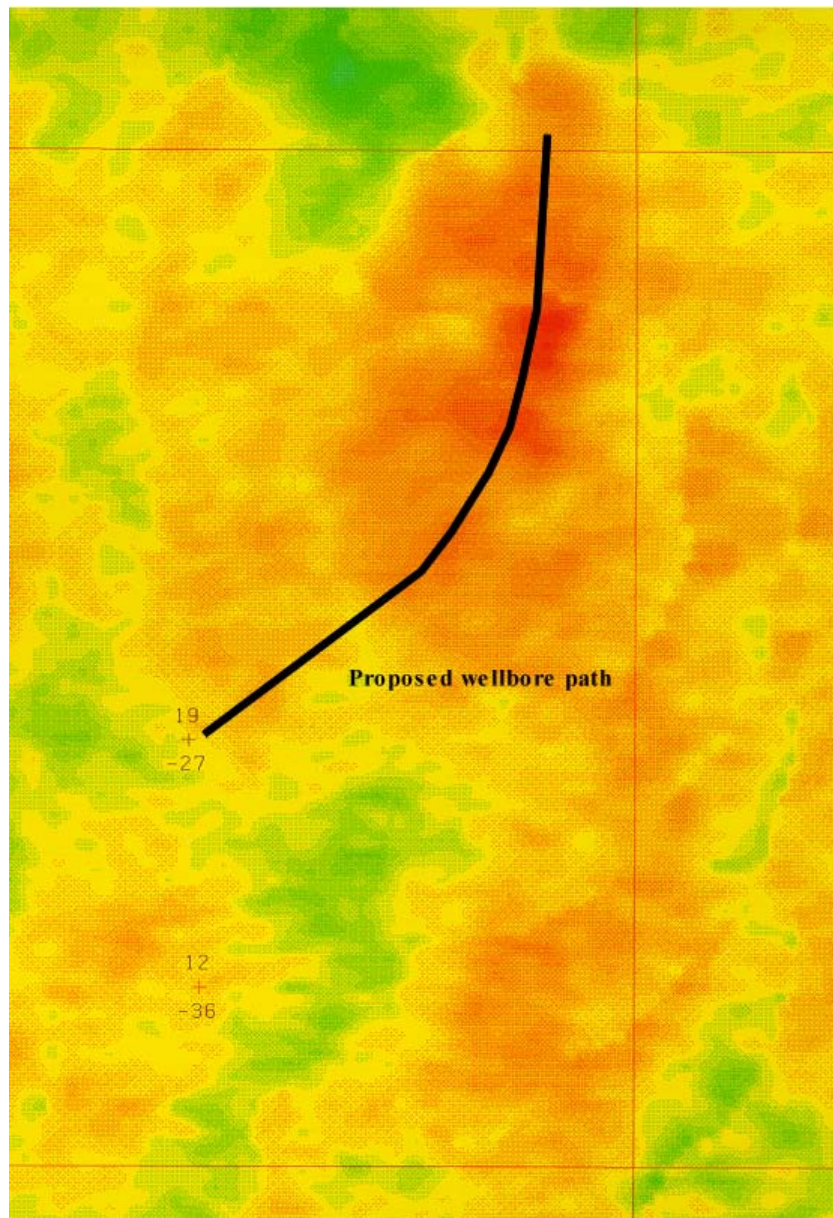


Figure 3. "L" zone amplitude anomaly in the NE/4 of section 12.

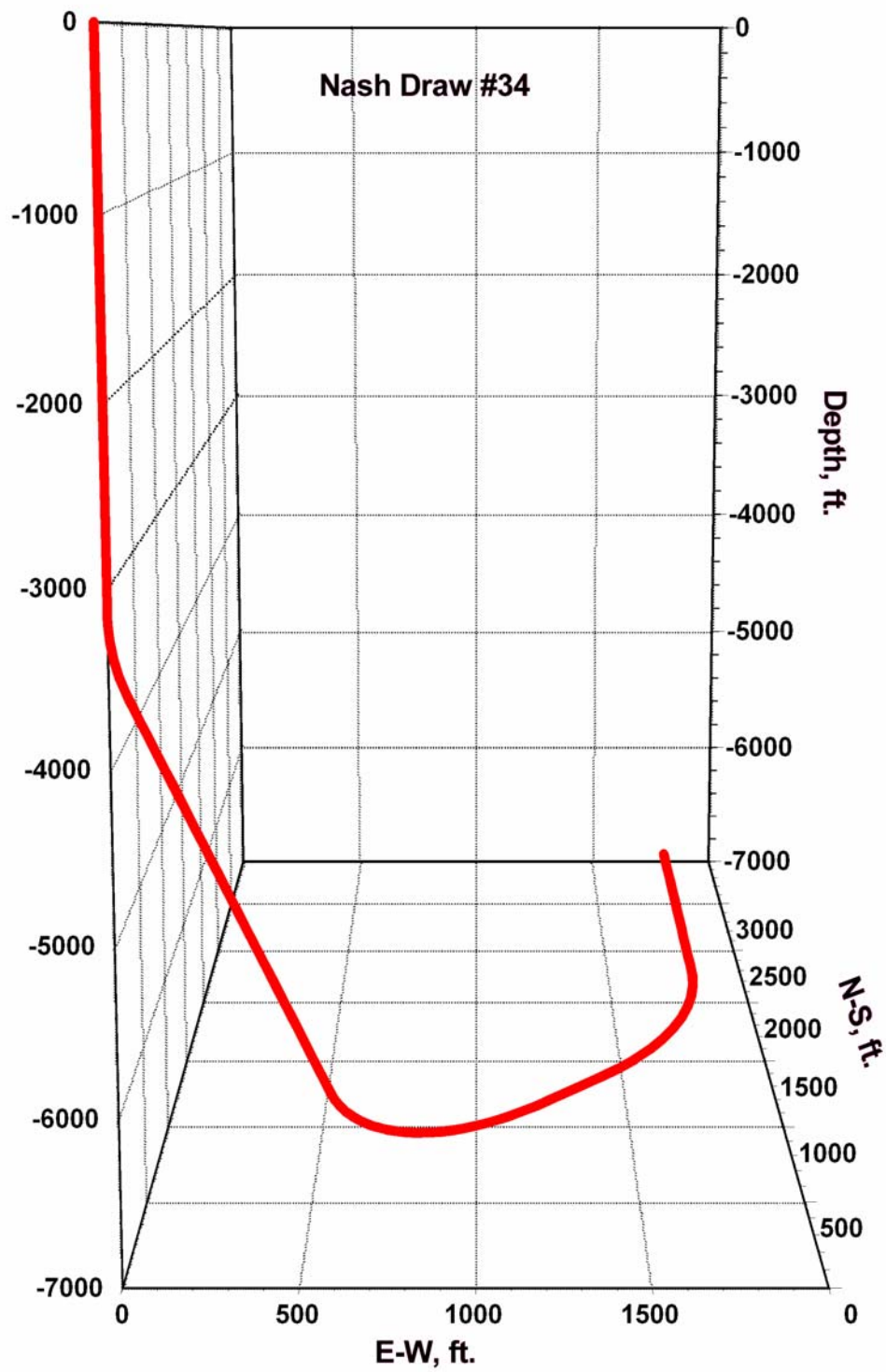


Figure 4. Nash Draw #34 proposed wellbore path..

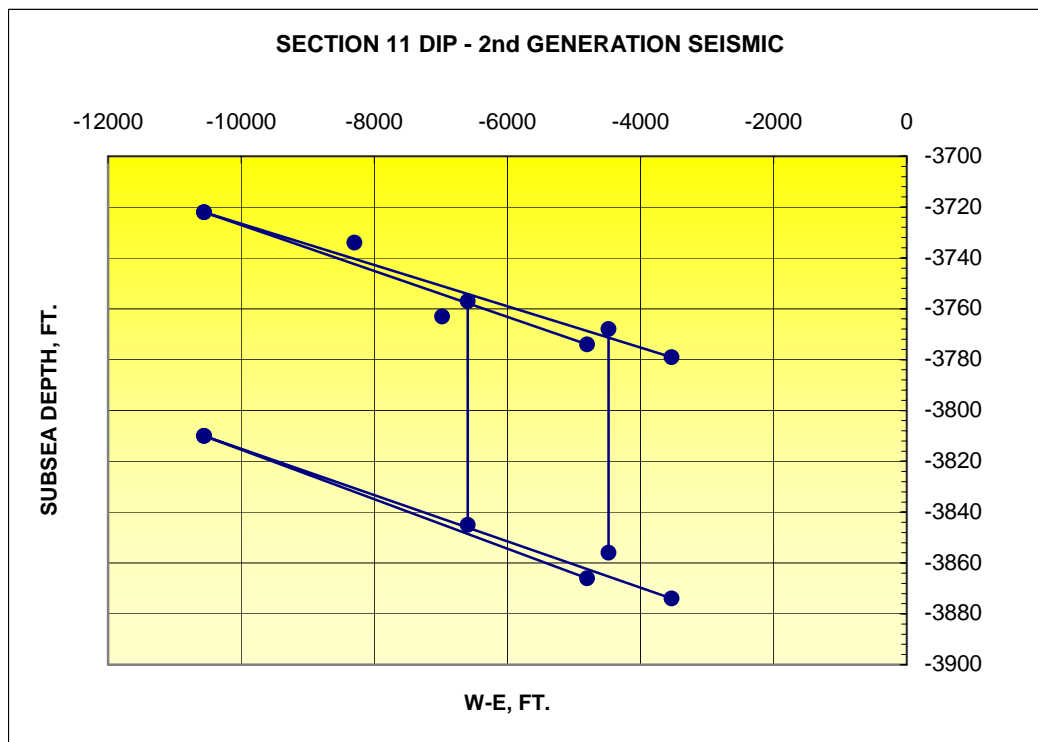


Figure 5. West to east dip using 2nd generation seismic data.

Table 1**SECTION 11 DIP - 2nd GENERATION SEISMIC**

		<u>X</u>	<u>Y</u>	<u>Z</u>		<u>DIP</u>
SEISMIC N-WL	TBS	-10560	10210	-3810	NW X ND13	48.10FT/MI.
ND #13	TBS	-3534	7595	-3874		
SEISMIC S-WL	TBS	-10560	6030	-3810	SW X ND 15	51.38FT/MI.
ND #15	TBS	-4805	5270	-3866		
SEISMIC S-WL	TL	-10560	6030	-3722		47.71FT/MI.
ND #15	TL	-4805	5270	-3774		
SEISMIC N-WL	TL	-10560	10210	-3722		42.84FT/MI.
ND #13	TL	-3534	7595	-3779		
ND #33	BHL	-8297	7947	-3734		
ND #36	BHL	-6980	8380	-3763		
ND #33	TL	-6595	6546	-3757		
	TBS	-6595	6546	-3845		
ND #36	TL	-4482	7098	-3768		
	TBS	-4482	7098	-3856		