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# Energen Resources

Rio Arriba County, NM.  
Sec. 23-T32N-R6W  
San Juan 32-5 Unit 110 S

Preliminary

Design: MWD Survey



## Sperry Drilling Services Standard Report

23 June, 2009

Well Coordinates: 2,172,263.79 N, 1,295,335.16 E (36° 57' 49.75" N, 107° 25' 52.28" W)  
Ground Level: 6,337.99 ft

|                          |                                           |
|--------------------------|-------------------------------------------|
| Local Coordinate Origin: | Centered on Well San Juan 32-5 Unit 110 S |
| Viewing Datum:           | WELL @ 6351.99ft (Original Well Elev)     |
| TVDs to System:          | N                                         |
| North Reference:         | True                                      |
| Unit System:             | API - US Survey Feet - Custom             |

Version: 2003.16 Build: 431

**HALLIBURTON**

## Design Report for San Juan 32-5 Unit 110 S - MWD Survey

| Measured Depth (ft)     | Inclination (°) | Azimuth (°) | Vertical Depth (ft) | +N/-S (ft) | +E/-W (ft) | Vertical Section (ft) | Dogleg Rate (°/100ft) |
|-------------------------|-----------------|-------------|---------------------|------------|------------|-----------------------|-----------------------|
| 0.00                    | 0.00            | 0.00        | 0.00                | 0.00       | 0.00       | 0.00                  | 0.00                  |
| 603.00                  | 0.50            | 152.50      | 602.99              | -2.33      | 1.21       | -2.39                 | 0.08                  |
| <b>First MWD Survey</b> |                 |             |                     |            |            |                       |                       |
| 729.00                  | 0.50            | 156.60      | 728.99              | -3.33      | 1.69       | -3.38                 | 0.03                  |
| 825.00                  | 0.50            | 168.20      | 824.98              | -4.12      | 1.94       | -4.06                 | 0.11                  |
| 920.00                  | 0.30            | 197.10      | 919.98              | -4.76      | 1.95       | -4.47                 | 0.29                  |
| 1,015.00                | 0.50            | 168.40      | 1,014.98            | -5.41      | 1.96       | -4.87                 | 0.29                  |
| 1,109.00                | 0.20            | 172.30      | 1,108.98            | -5.97      | 2.07       | -5.30                 | 0.32                  |
| 1,205.00                | 0.20            | 165.00      | 1,204.98            | -6.30      | 2.13       | -5.55                 | 0.03                  |
| 1,299.00                | 0.30            | 210.90      | 1,298.98            | -6.67      | 2.05       | -5.72                 | 0.23                  |
| 1,395.00                | 0.40            | 203.30      | 1,394.97            | -7.19      | 1.79       | -5.83                 | 0.11                  |
| 1,488.00                | 0.50            | 225.60      | 1,487.97            | -7.78      | 1.37       | -5.86                 | 0.21                  |
| 1,583.00                | 0.40            | 197.10      | 1,582.97            | -8.38      | 0.97       | -5.92                 | 0.25                  |
| 1,678.00                | 2.80            | 300.50      | 1,677.93            | -7.52      | -1.12      | -3.74                 | 3.07                  |
| 1,773.00                | 8.00            | 309.20      | 1,772.48            | -2.16      | -8.25      | 5.18                  | 5.53                  |
| 1,865.00                | 12.80           | 307.40      | 1,862.94            | 8.08       | -21.32     | 21.78                 | 5.23                  |
| 1,957.00                | 18.00           | 302.10      | 1,951.61            | 21.83      | -41.47     | 46.13                 | 5.85                  |
| 2,048.00                | 22.20           | 300.40      | 2,037.05            | 38.01      | -68.22     | 77.17                 | 4.66                  |
| 2,139.00                | 25.80           | 299.50      | 2,120.17            | 56.47      | -100.29    | 113.82                | 3.98                  |
| 2,231.00                | 29.10           | 298.20      | 2,201.80            | 76.91      | -137.45    | 155.68                | 3.65                  |
| 2,321.00                | 33.30           | 296.00      | 2,278.77            | 98.09      | -178.96    | 201.45                | 4.83                  |
| 2,411.00                | 37.20           | 296.10      | 2,352.25            | 120.90     | -225.61    | 252.26                | 4.33                  |
| 2,502.00                | 39.00           | 292.30      | 2,423.87            | 143.87     | -276.82    | 306.77                | 3.25                  |
| 2,591.00                | 40.40           | 288.80      | 2,492.35            | 163.79     | -330.04    | 361.00                | 2.96                  |
| 2,683.00                | 44.90           | 290.10      | 2,560.01            | 184.57     | -388.79    | 420.11                | 4.98                  |
| 2,774.00                | 49.10           | 292.30      | 2,622.06            | 208.67     | -450.80    | 483.83                | 4.94                  |
| 2,856.00                | 51.90           | 293.60      | 2,674.21            | 233.35     | -509.05    | 544.94                | 3.63                  |
| 2,948.00                | 55.40           | 293.70      | 2,728.73            | 263.08     | -576.92    | 616.74                | 3.81                  |
| 2,978.00                | 56.00           | 293.80      | 2,745.64            | 273.06     | -599.60    | 640.77                | 2.02                  |
| 3,009.00                | 57.20           | 293.90      | 2,762.70            | 283.52     | -623.27    | 665.87                | 3.88                  |
| 3,039.00                | 58.30           | 294.30      | 2,778.71            | 293.88     | -646.43    | 690.50                | 3.84                  |
| 3,070.00                | 59.20           | 294.80      | 2,794.79            | 304.89     | -670.54    | 716.28                | 3.21                  |
| 3,100.00                | 60.30           | 295.20      | 2,809.91            | 315.85     | -694.02    | 741.54                | 3.84                  |
| 3,129.00                | 61.60           | 295.30      | 2,823.99            | 326.66     | -716.95    | 766.27                | 4.49                  |
| 3,159.00                | 63.20           | 295.70      | 2,837.89            | 338.11     | -740.95    | 792.23                | 5.46                  |
| 3,189.00                | 65.10           | 296.10      | 2,850.97            | 349.90     | -765.23    | 818.64                | 6.45                  |
| 3,219.00                | 67.20           | 295.80      | 2,863.10            | 361.90     | -789.90    | 845.47                | 7.06                  |
| 3,250.00                | 68.50           | 296.00      | 2,874.78            | 374.45     | -815.73    | 873.55                | 4.24                  |
| 3,280.00                | 70.90           | 296.10      | 2,885.19            | 386.80     | -841.01    | 901.09                | 8.01                  |
| 3,311.00                | 73.30           | 296.30      | 2,894.72            | 399.82     | -867.47    | 929.97                | 7.77                  |
| 3,341.00                | 76.10           | 296.20      | 2,902.63            | 412.62     | -893.42    | 958.30                | 9.34                  |
| 3,371.00                | 78.70           | 296.70      | 2,909.18            | 425.66     | -919.63    | 986.99                | 8.82                  |
| 3,401.00                | 80.50           | 297.30      | 2,914.59            | 439.06     | -945.92    | 1,015.96              | 6.31                  |
| 3,430.00                | 82.00           | 298.40      | 2,919.00            | 452.45     | -971.27    | 1,044.18              | 6.39                  |
| 3,461.00                | 83.10           | 299.20      | 2,923.02            | 467.26     | -998.20    | 1,074.52              | 4.37                  |
| 3,492.00                | 84.40           | 300.00      | 2,926.40            | 482.48     | -1,024.99  | 1,105.01              | 4.92                  |
| 3,523.00                | 86.10           | 300.50      | 2,928.97            | 498.04     | -1,051.68  | 1,135.63              | 5.71                  |
| 3,555.00                | 86.20           | 301.40      | 2,931.11            | 514.46     | -1,079.06  | 1,167.32              | 2.82                  |
| 3,587.00                | 87.10           | 302.50      | 2,932.98            | 531.36     | -1,106.17  | 1,199.09              | 4.44                  |
| 3,618.00                | 88.20           | 303.10      | 2,934.26            | 548.14     | -1,132.20  | 1,229.94              | 4.04                  |

**HALLIBURTON****Design Report for San Juan 32-5 Unit 110 S - MWD Survey**

| Measured Depth (ft) | Inclination (°) | Azimuth (°) | Vertical Depth (ft) | +N/-S (ft) | +E/-W (ft) | Vertical Section (ft) | Dogleg Rate (°/100ft) |
|---------------------|-----------------|-------------|---------------------|------------|------------|-----------------------|-----------------------|
| 3,650.00            | 88.30           | 303.70      | 2,935.23            | 565.75     | -1,158.90  | 1,261.82              | 1.90                  |
| 3,682.00            | 88.30           | 303.70      | 2,936.18            | 583.50     | -1,185.51  | 1,293.72              | 0.00                  |
| 3,713.00            | 88.60           | 303.80      | 2,937.02            | 600.71     | -1,211.28  | 1,324.62              | 1.02                  |
| 3,745.00            | 88.90           | 303.60      | 2,937.72            | 618.46     | -1,237.90  | 1,356.53              | 1.13                  |
| 3,777.00            | 89.20           | 304.90      | 2,938.25            | 636.47     | -1,264.34  | 1,388.46              | 4.17                  |
| 3,808.00            | 88.30           | 306.20      | 2,938.93            | 654.49     | -1,289.56  | 1,419.42              | 5.10                  |
| 3,840.00            | 87.70           | 307.00      | 2,940.04            | 673.56     | -1,315.23  | 1,451.39              | 3.12                  |
| 3,871.00            | 88.00           | 307.40      | 2,941.21            | 692.29     | -1,339.91  | 1,482.37              | 1.61                  |
| 3,902.00            | 88.30           | 307.30      | 2,942.21            | 711.08     | -1,364.54  | 1,513.35              | 1.02                  |
| 3,934.00            | 88.40           | 307.40      | 2,943.13            | 730.49     | -1,389.97  | 1,545.34              | 0.44                  |
| 3,966.00            | 88.70           | 307.20      | 2,943.94            | 749.87     | -1,415.41  | 1,577.32              | 1.13                  |
| 3,997.00            | 88.60           | 307.40      | 2,944.67            | 768.65     | -1,440.07  | 1,608.31              | 0.72                  |
| 4,029.00            | 87.70           | 307.50      | 2,945.70            | 787.10     | -1,465.46  | 1,640.30              | 2.83                  |
| 4,061.00            | 87.70           | 307.50      | 2,946.99            | 807.57     | -1,490.82  | 1,672.27              | 0.00                  |
| 4,092.00            | 87.70           | 308.60      | 2,948.23            | 826.66     | -1,515.21  | 1,703.24              | 3.55                  |
| 4,124.00            | 87.20           | 309.10      | 2,949.65            | 846.71     | -1,540.11  | 1,735.21              | 2.21                  |
| 4,156.00            | 87.10           | 309.00      | 2,951.24            | 866.85     | -1,564.93  | 1,767.16              | 0.44                  |
| 4,187.00            | 86.60           | 309.10      | 2,952.95            | 886.35     | -1,588.97  | 1,798.11              | 1.64                  |
| 4,285.00            | 86.80           | 311.00      | 2,958.59            | 949.30     | -1,663.86  | 1,895.88              | 1.95                  |
| 4,315.00            | 86.80           | 310.90      | 2,960.26            | 968.93     | -1,686.48  | 1,925.79              | 0.33                  |
| 4,344.00            | 86.70           | 311.10      | 2,961.91            | 987.92     | -1,708.33  | 1,954.70              | 0.77                  |
| 4,375.00            | 87.30           | 312.70      | 2,963.53            | 1,008.60   | -1,731.37  | 1,985.58              | 5.51                  |
| 4,407.00            | 89.60           | 313.70      | 2,964.40            | 1,030.49   | -1,754.69  | 2,017.43              | 7.84                  |
| 4,439.00            | 89.80           | 313.50      | 2,964.56            | 1,052.56   | -1,777.86  | 2,049.28              | 0.88                  |
| 4,471.00            | 92.00           | 314.00      | 2,964.06            | 1,074.69   | -1,800.98  | 2,081.11              | 7.05                  |
| 4,502.00            | 92.30           | 314.20      | 2,962.90            | 1,096.24   | -1,823.22  | 2,111.91              | 1.16                  |
| 4,534.00            | 92.40           | 313.90      | 2,961.59            | 1,118.47   | -1,846.20  | 2,143.70              | 0.99                  |
| 4,566.00            | 91.50           | 313.70      | 2,960.50            | 1,140.61   | -1,869.28  | 2,175.51              | 2.88                  |
| 4,597.00            | 89.90           | 313.30      | 2,960.12            | 1,161.95   | -1,891.77  | 2,206.36              | 5.32                  |
| 4,628.00            | 89.80           | 313.20      | 2,960.20            | 1,183.19   | -1,914.35  | 2,237.23              | 0.46                  |
| 4,659.00            | 90.20           | 313.40      | 2,960.20            | 1,204.45   | -1,936.91  | 2,268.09              | 1.44                  |
| 4,690.00            | 90.80           | 313.70      | 2,959.93            | 1,225.81   | -1,959.38  | 2,298.94              | 2.16                  |
| 4,722.00            | 91.00           | 314.00      | 2,959.43            | 1,247.97   | -1,982.45  | 2,330.77              | 1.13                  |
| 4,754.00            | 91.30           | 314.00      | 2,958.78            | 1,270.20   | -2,005.46  | 2,362.58              | 0.94                  |
| 4,785.00            | 91.60           | 313.80      | 2,958.00            | 1,291.68   | -2,027.79  | 2,393.41              | 1.16                  |
| 4,817.00            | 91.50           | 313.20      | 2,957.13            | 1,313.70   | -2,051.00  | 2,425.24              | 1.90                  |
| 4,848.00            | 90.60           | 312.60      | 2,956.57            | 1,334.80   | -2,073.70  | 2,456.12              | 3.49                  |
| 4,880.00            | 90.10           | 312.50      | 2,956.37            | 1,356.44   | -2,097.28  | 2,488.02              | 1.59                  |
| 4,911.00            | 90.10           | 312.60      | 2,956.32            | 1,377.40   | -2,120.11  | 2,518.92              | 0.32                  |
| 4,943.00            | 89.80           | 312.20      | 2,956.34            | 1,398.98   | -2,143.74  | 2,550.82              | 1.56                  |
| 4,975.00            | 89.80           | 311.90      | 2,956.46            | 1,420.41   | -2,167.51  | 2,582.74              | 0.94                  |
| 5,007.00            | 89.30           | 312.00      | 2,956.71            | 1,441.80   | -2,191.30  | 2,614.66              | 1.59                  |
| 5,038.00            | 89.50           | 311.50      | 2,957.03            | 1,462.45   | -2,214.43  | 2,645.59              | 1.74                  |
| 5,069.00            | 89.20           | 311.70      | 2,957.38            | 1,483.03   | -2,237.61  | 2,676.52              | 1.16                  |
| 5,101.00            | 89.20           | 313.00      | 2,957.83            | 1,504.58   | -2,261.26  | 2,708.42              | 4.06                  |
| 5,133.00            | 89.40           | 313.40      | 2,958.22            | 1,526.48   | -2,284.58  | 2,740.29              | 1.40                  |
| 5,164.00            | 91.50           | 315.20      | 2,957.98            | 1,548.13   | -2,306.77  | 2,771.09              | 8.92                  |
| 5,196.00            | 91.70           | 315.90      | 2,957.08            | 1,570.97   | -2,329.17  | 2,802.80              | 2.27                  |
| 5,227.00            | 92.10           | 316.20      | 2,956.06            | 1,593.27   | -2,350.67  | 2,833.47              | 1.61                  |
| 5,259.00            | 92.10           | 316.60      | 2,954.88            | 1,616.43   | -2,372.72  | 2,865.10              | 1.25                  |
| 5,290.00            | 92.10           | 316.70      | 2,953.75            | 1,638.96   | -2,393.99  | 2,895.72              | 0.32                  |

9" at 4220

2462

907

1614

**HALLIBURTON****Design Report for San Juan 32-5 Unit 110 S - MWD Survey**

| Measured Depth (ft)            | Inclination (°) | Azimuth (°) | Vertical Depth (ft) | +N/-S (ft) | +E/-W (ft) | Vertical Section (ft) | Dogleg Rate (°/100ft) |
|--------------------------------|-----------------|-------------|---------------------|------------|------------|-----------------------|-----------------------|
| 5,322.00                       | 92.20           | 316.30      | 2,952.55            | 1,662.15   | -2,416.00  | 2,927.34              | 1.29                  |
| 5,354.00                       | 92.30           | 315.60      | 2,951.29            | 1,685.14   | -2,438.23  | 2,959.01              | 2.21                  |
| 5,385.00                       | 91.40           | 314.30      | 2,950.29            | 1,707.02   | -2,460.16  | 2,989.76              | 5.10                  |
| 5,417.00                       | 90.70           | 315.20      | 2,949.70            | 1,729.55   | -2,482.88  | 3,021.53              | 3.56                  |
| 5,448.00                       | 89.70           | 314.90      | 2,949.60            | 1,751.49   | -2,504.78  | 3,052.29              | 3.37                  |
| 5,480.00                       | 89.50           | 314.50      | 2,949.82            | 1,774.00   | -2,527.53  | 3,084.06              | 1.40                  |
| 5,511.00                       | 89.90           | 315.00      | 2,949.98            | 1,795.82   | -2,549.54  | 3,114.85              | 2.07                  |
| 5,543.00                       | 90.50           | 315.40      | 2,949.87            | 1,818.53   | -2,572.09  | 3,146.59              | 2.25                  |
| 5,575.00                       | 90.10           | 314.70      | 2,949.70            | 1,841.17   | -2,594.70  | 3,178.34              | 2.52                  |
| 5,607.00                       | 89.60           | 314.50      | 2,949.79            | 1,863.64   | -2,617.48  | 3,210.13              | 1.68                  |
| 5,638.00                       | 89.40           | 314.70      | 2,950.06            | 1,885.41   | -2,639.55  | 3,240.91              | 0.91                  |
| 5,669.00                       | 89.40           | 314.90      | 2,950.38            | 1,907.25   | -2,661.55  | 3,271.69              | 0.65                  |
| 5,700.00                       | 89.80           | 316.20      | 2,950.60            | 1,929.38   | -2,683.26  | 3,302.42              | 4.39                  |
| 5,732.00                       | 89.90           | 316.10      | 2,950.68            | 1,952.46   | -2,705.43  | 3,334.09              | 0.44                  |
| 5,764.00                       | 87.90           | 317.30      | 2,951.30            | 1,975.74   | -2,727.37  | 3,365.71              | 7.29                  |
| 5,795.00                       | 88.30           | 318.50      | 2,952.32            | 1,998.73   | -2,748.14  | 3,396.22              | 4.08                  |
| 5,827.00                       | 88.30           | 318.40      | 2,953.27            | 2,022.66   | -2,769.35  | 3,427.67              | 0.31                  |
| 5,859.00                       | 88.80           | 318.50      | 2,954.08            | 2,046.60   | -2,790.57  | 3,459.12              | 1.59                  |
| 5,890.00                       | 88.90           | 318.80      | 2,954.70            | 2,069.87   | -2,811.05  | 3,489.58              | 1.02                  |
| 5,922.00                       | 88.80           | 318.20      | 2,955.35            | 2,093.83   | -2,832.25  | 3,521.03              | 1.90                  |
| 5,954.00                       | 87.00           | 317.20      | 2,956.52            | 2,117.48   | -2,853.77  | 3,552.54              | 6.43                  |
| 5,985.00                       | 86.60           | 316.50      | 2,958.25            | 2,140.06   | -2,874.94  | 3,583.12              | 2.60                  |
| 6,016.00                       | 86.50           | 316.60      | 2,960.12            | 2,162.53   | -2,896.22  | 3,613.72              | 0.46                  |
| 6,048.00                       | 86.50           | 316.30      | 2,962.07            | 2,185.68   | -2,918.22  | 3,645.31              | 0.94                  |
| 6,080.00                       | 86.20           | 315.90      | 2,964.11            | 2,208.69   | -2,940.37  | 3,676.92              | 1.56                  |
| 6,111.00                       | 86.60           | 315.50      | 2,966.05            | 2,230.83   | -2,961.97  | 3,707.57              | 1.82                  |
| 6,142.00                       | 86.80           | 315.40      | 2,967.84            | 2,252.89   | -2,983.69  | 3,738.26              | 0.72                  |
| 6,174.00                       | 87.20           | 316.40      | 2,969.51            | 2,275.84   | -3,005.92  | 3,769.90              | 3.36                  |
| 6,206.00                       | 86.90           | 315.30      | 2,971.16            | 2,298.77   | -3,028.18  | 3,801.56              | 3.56                  |
| 6,238.00                       | 87.40           | 315.70      | 2,972.75            | 2,321.56   | -3,050.58  | 3,833.24              | 2.00                  |
| 6,269.00                       | 87.90           | 316.40      | 2,974.02            | 2,343.86   | -3,072.08  | 3,863.90              | 2.77                  |
| 6,301.00                       | 89.30           | 316.30      | 2,974.80            | 2,367.01   | -3,094.16  | 3,895.55              | 4.39                  |
| 6,333.00                       | 90.60           | 316.60      | 2,974.83            | 2,390.20   | -3,116.21  | 3,927.19              | 4.17                  |
| 6,364.00                       | 90.70           | 316.70      | 2,974.48            | 2,412.74   | -3,137.49  | 3,957.84              | 0.46                  |
| 6,395.00                       | 90.70           | 316.20      | 2,974.10            | 2,435.21   | -3,158.84  | 3,988.49              | 1.61                  |
| 6,427.00                       | 91.00           | 316.30      | 2,973.63            | 2,458.32   | -3,180.97  | 4,020.15              | 0.99                  |
| 6,458.00                       | 91.60           | 316.90      | 2,972.92            | 2,480.84   | -3,202.26  | 4,050.79              | 2.74                  |
| 6,490.00                       | 92.40           | 317.20      | 2,971.81            | 2,504.24   | -3,224.05  | 4,082.37              | 2.67                  |
| 6,521.00                       | 93.00           | 317.20      | 2,970.35            | 2,526.97   | -3,245.09  | 4,112.93              | 1.94                  |
| 6,553.00                       | 92.80           | 316.50      | 2,968.73            | 2,550.28   | -3,266.95  | 4,144.50              | 2.27                  |
| 6,585.00                       | 93.10           | 316.90      | 2,967.08            | 2,573.54   | -3,288.87  | 4,176.09              | 1.56                  |
| 6,600.00                       | 93.20           | 316.90      | 2,966.26            | 2,584.47   | -3,299.10  | 4,190.88              | 0.67                  |
| <b>Final MWD Survey</b>        |                 |             |                     |            |            |                       |                       |
| 6,667.00                       | 93.20           | 316.90      | 2,962.52            | 2,633.32   | -3,344.81  | 4,256.96              | 0.00                  |
| <b>Survey Projection to TD</b> |                 |             |                     |            |            |                       |                       |

## Design Report for San Juan 32-5 Unit 110 S - MWD Survey

### Design Annotations

| Measured<br>Depth<br>(ft) | Vertical<br>Depth<br>(ft) | Local Coordinates |               | Comment                 |
|---------------------------|---------------------------|-------------------|---------------|-------------------------|
|                           |                           | +N/-S<br>(ft)     | +E/-W<br>(ft) |                         |
| 603.00                    | 602.99                    | -2.33             | 1.21          | First MWD Survey        |
| 6,600.00                  | 2,966.26                  | 2,584.47          | -3,299.10     | Final MWD Survey        |
| 6,667.00                  | 2,962.52                  | 2,633.32          | -3,344.81     | Survey Projection to TD |

### Vertical Section Information

| Angle<br>Type | Target                                 | Azimuth<br>(°) | Origin<br>Type | Origin        |               | Start<br>TVD<br>(ft) |
|---------------|----------------------------------------|----------------|----------------|---------------|---------------|----------------------|
|               |                                        |                |                | +N/-S<br>(ft) | +E/-W<br>(ft) |                      |
| Target        | San Juan 32-5 Design #1 BH<br>Tgt 110S | 307.94         | Slot           | 0.00          | 0.00          | 0.00                 |

### Survey tool program

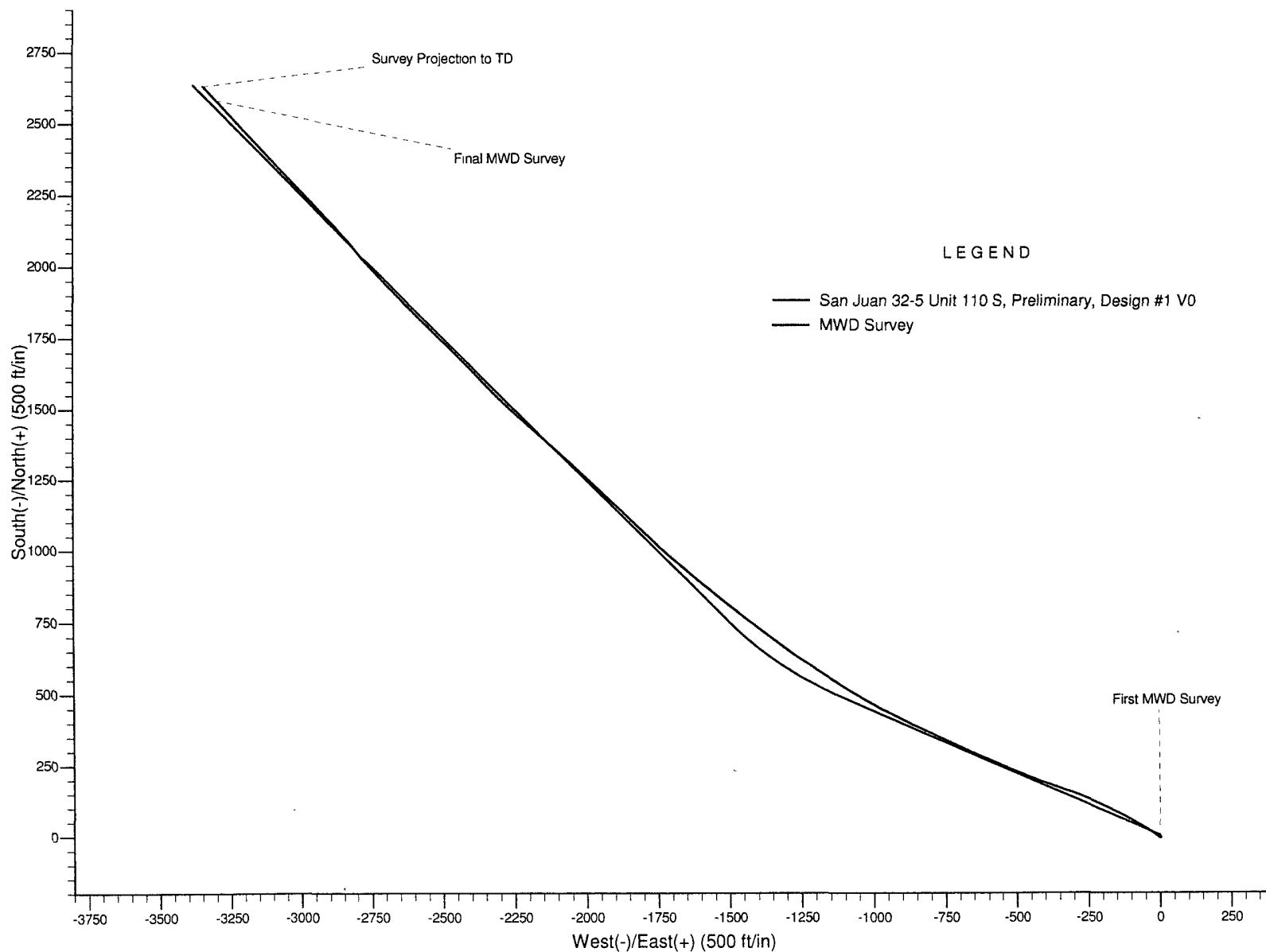
| From<br>(ft) | To<br>(ft) | Survey/Plan | Survey Tool |
|--------------|------------|-------------|-------------|
| 603.00       | 6,667.00   | MWD Surveys | MWD         |

Project: Rio Arriba County, NM.  
Site: Sec. 23-T32N-R6W  
Well: San Juan 32-5 Unit 110 S

# Energen Resources

**HALLIBURTON**

Surveying Division



Project: Rio Arriba County, NM.  
Site: Sec. 23-T32N-R6W  
Well: San Juan 32-5 Unit 110 S

# Energen Resources

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Surveying Division

## LEGEND

- San Juan 32-5 Unit 110 S, Preliminary, Design #1 V0
- MWD Survey

