DOE/WIPP-99-2308
REV. 4

Delaware Basin Monitoring Annual Report

September 2003

United States Department of Energy
Waste Isolation Pilot Plant

Carlsbad Field Office
Carlsbad, New Mexico

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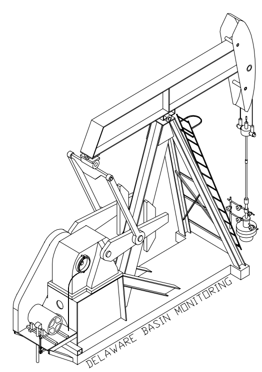

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the **Department of Energy** by
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Delaware Basin Drilling Surveillance Program

Table of Contents

List of Figures

List of Tables

1.0 Delaware Basin Drilling Surveillance Program

The Delaware Basin Drilling Surveillance Program (DBDSP) is designed to monitor drilling activities in the vicinity of the Waste Isolation Pilot Plant (WIPP). This program is based on Environmental Protection Agency (EPA) requirements. The EPA environmental radiation protection standards for the management and disposal of spent nuclear fuel, high-level and transuranic radioactive wastes are codified in Title 40 Code of Federal Regulations (CFR) Part 191 (EPA 1993). Subpart B of the standard addresses the disposal of radioactive waste. The standard requires the Department of Energy (DOE) to demonstrate the expected performance of the disposal system using a probabilistic risk assessment or performance assessment (PA). The results of the PA must show that the expected repository performance will not result in the release of radioactive material above limits set by the EPA's standard. This assessment must include the consideration of inadvertent drilling into the repository at some future time.

In Title 40 CFR Part 194 (EPA 1996), the EPA defined the geographical area for the evaluation of the historical rate of drilling for resources, as the Delaware Basin. This same area is to be used for monitoring drilling and drilling-related activities. The definition of the Delaware Basin in Title 40 CFR Part 194.2 is:

> "Delaware Basin means those surface and subsurface features which lie inside the boundary formed to the north, east and west of the [WIPP] disposal system, by the innermost edge of the Capitan Reef, and formed, to the south, by a straight line drawn from the southeastern point of the Davis Mountains to the most southwestern point of the Glass Mountains."

The Delaware Basin, depicted in Figure 1, includes all or part of Brewster, Culberson, Jeff Davis, Loving, Pecos, Reeves, Ward, and Winkler counties in west Texas, and portions of Eddy and Lea counties in southeastern New Mexico.

The DOE continues to provide surveillance of the drilling activity in the Delaware Basin in accordance with the criteria established in Title 40 CFR Part 194. This will continue until the DOE and the EPA mutually agree no further benefit can be gained from continued surveillance. The results of the ongoing surveillance will be used to determine if a significant and detrimental change has occurred that would affect the performance of the disposal system.

The *Delaware Basin Drilling Surveillance Plan* (WP 02-PC.02) places specific emphasis on the nine-township area that includes the WIPP Site and provides data to build on the information presented in Appendix DEL of the Compliance Certification Application (CCA) (DOE 1996).

2.0 2003 Updates

PA is required by regulation to consider disturbed case scenarios that include intrusions into the repository by inadvertent and intermittent drilling for resources. The probability of these intrusions is based on a future drilling rate of 46.8 boreholes per square kilometer per 10,000 years which was established for the 1996 CCA in Appendix DEL. This rate is based on consideration of the past record of drilling events in the Delaware Basin. The DOE models multiple types of human intrusion scenarios in the PA. These include both single intrusion events and combinations of multiple boreholes.

Two different types of boreholes are considered: (1) those that penetrate a pressurized brine reservoir in the underlying Castile Formation and (2) those that do not. While the presence of pressurized brine under the repository is speculative, it cannot be completely ruled out based on available information. The primary consequence of contacting pressurized brine is the introduction of an additional source of brine beyond that which is assumed to be released into the repository from the Salado Formation. The human intrusion scenario models are based on extensive field data sets collected by the DOE. The DBDSP collects the drilling related data to be used for future PA calculations. The data have been collected from the time of the 1996 submittal of the CCA to the present and include specific wells drilled during the last year in the New Mexico portion of the Delaware Basin, specifically that of the nine-township area immediately surrounding the WIPP Site. These data are summarized in the following sections.

2.1 Miscellaneous Drilling Information

The EPA provided criteria in Title 40 CFR §194.33(c) to address the consideration of drilling in PA. These criteria led to the formulation of conceptual models that incorporate the effects of these activities. The conceptual models use parameter values as documented in Appendix DEL of the CCA, such as:

- drill collar diameter and length
- casing diameters
- drill pipe diameter
- speed of drill string rotation through the Salado Formation
- penetration rate through the Salado Formation
- instances of air drilling
- types of drilling fluids
- amounts of drilling fluids
- borehole depths
- borehole diameters
- borehole plugs
- fraction of each borehole that is plugged
- instances of encountering pressurized brine in the Castile Formation

The DBDSP tracks borehole depths for all wells drilled in the Delaware Basin. Borehole depths tracked by the DBDSP range from 19 feet to 25,201 feet. The 19-foot hole is an exhaust shaft water monitoring well located on the WIPP Site, and the 25,201-foot hole is a gas well located in Texas. Borehole depths in the immediate vicinity of the WIPP Site typically range from 8,000 to 9,000 feet for oil wells and 13,000 to 16,000 feet for gas wells.

The diameter of each well bore is more difficult to ascertain. The DBDSP tracks the casing size and depth for each section of the hole (Table 1). Drill bit size is not a reportable element, although hole sizes are sometimes reported on Sundry notices (miscellaneous forms) maintained by the New Mexico Oil Conservation Division (NMOCD). The casing size or hole size is used to determine the size of the bit used to drill that particular section of the well. Currently, the most common bit sizes being used are 17 ½" for the surface section, 11" for the intermediate section, and 7 ⅞" for the production section of the hole. Table 2 shows the bit sizes used in drilling a well in the nine-township area.

In the early days of well drilling, the 12 ¼" bit was popular with rotary drill operators for the surface section of the hole. In those days, the wells were much shallower and did not require the larger sections of casing. Most holes drilled at that time were two-string (string refers to the different size of casing in the wellbore) holes versus the three- and four-strings commonly used now. In the area of the WIPP Site, regulations require a three-string hole making the larger bit sizes more popular. The typical hole and casing sizes for a three-string well in the vicinity of the WIPP Site are shown in Figure 2.

Table 3 shows miscellaneous drilling information collected during the Annual Survey of area operators and Table 4 shows the estimated time (from records) to drill a well.

2.1.1 Drilling Techniques

The drilling techniques reported in Appendix DEL of the CCA are still being implemented by area drillers. There were a total of 148 hydrocarbon wells spudded, not necessarily completed, in the New Mexico portion of the Delaware Basin from September 1, 2002 through August 31, 2003. This number is derived from the databases maintained by the DBDSP. In reality, the number of new wells is higher; but the paperwork on some of the wells has not been filed with the NMOCD or will be filed after the writing of this report. Therefore, those wells are not included in the count listed above. For example, during the last year 153 wells were added to the databases for New Mexico, meaning five wells were reported late.

Rotary drilling rigs were used to drill all 148 wells. Some have been completed as oil wells, others as gas wells, while the rest are still in the process of being completed. All were conventionally drilled utilizing mud as a medium for circulation. Fifty-six of these wells were in the nine-township area. The depths of the completed wells in the nine-township area range from 8,160 feet to 11,300 feet. Outside of the nine-township area the depths of the completed wells range from 3,200 feet to 14,085 feet.

A technique used by operators to increase production is to drill a well directionally or horizontally, which allows for more area of the wellbore to be in the production zone. As reported in Appendix DEL, this technique is not often used in this area because of the increased costs. The DBDSP monitors directional or horizontal drilled wells only in the nine-township area. None of the 56 new wells spudded during the last year in the nine-township area were directional or horizontal drilled wells. One well, spudded in 2000 and reported in Rev. 1 of this report, was completed as a directionally drilled well. This well is located outside of the WIPP Site boundary but is drilled into a lease located on Section 31 underneath the WIPP Site. There were nine more wells slated to be drilled into the same lease, all of which have been canceled since the initial well was drilled. There are currently two wells that have been drilled under the WIPP Site in Section 31 leases, with surface locations outside the WIPP Site boundary.

2.1.2 Drilling Fluids

Employing a rotary rig for drilling involves the use of drilling fluids. Drilling fluid is commonly known as mud, which is the liquid circulated through the wellbore during rotary drilling and workover operations. In addition to its function of bringing cuttings to the surface, drilling mud cools and lubricates the bit and drill stem, protects against blowouts by holding back subsurface pressures, and deposits a mud cake on the wall of the borehole to prevent loss of fluids to the formation.

Typically, a driller will use fresh water and additives to drill the surface section of the hole which ends at the top of the Salado Formation. A change in drilling practices would necessitate a change in the application of drilling fluids. Within the Known Potash Lease Area (KPLA) of southeastern New Mexico, drillers are required under Title 19, Chapter 15, Order R-111-P of the New Mexico Administrative Code (NMAC) to use a saturated brine to drill through the salt formation which is usually called the intermediate section. This requirement is to keep the salt from washing out and making the hole larger than necessary and to protect the potash reserves that occur in this formation. Once this section has been drilled and cased, the driller again changes to fresh water and additives to finish drilling the hole to depth.

All the operators of new wells completed in the New Mexico portion of the Delaware Basin during the last year that reported information on mud weights, listed mud weights from 8.6 to 8.8 pounds per gallon while drilling the intermediate portion of the wellbore. The operators completing wells in the nine-township area that reported mud weights used a solution of 9.9 to 10.2 pounds per gallon saturated brine for drilling the intermediate section of the well through the salt formation. Further information on drilling fluids used in the nine-township area is available in Table 5.

2.1.3 Air Drilling

A method of hydrocarbon drilling not emphasized in Appendix DEL is air drilling. As defined by the oil industry, air drilling is a method of rotary drilling using compressed air as the circulation medium. The conventional method of removing cuttings from the wellbore is to use a flow of water or drilling mud. In some cases, compressed air removes the cuttings with equal or greater efficiency. The rate of penetration is usually increased considerably when air drilling is used; however, a fundamental problem in air drilling is the penetration of formations containing water, since the entry of water into the system reduces the ability of the air to remove cuttings.

Critics noted the air drilling scenario was not included by the DOE in the CCA and raised several issues: (1) air drilling technology is currently successfully used in the Delaware Basin, (2) air drilling is thought to be a viable drilling technology under the hydrological and geological conditions at the WIPP Site, and (3) air drilling could result in releases of radionuclides that are substantially greater than those considered by the DOE in the CCA. Much research on the issue of air drilling in the Delaware Basin has been done. It has been shown that although air drilling is a common method of drilling wells it is not practiced in the vicinity of the WIPP Site because (1) it is against R-111-P regulations to drill with anything but saturated brine through the salt formation in the KPLA; (2) it is not economical to drill with air when a driller has to use saturated brine for the intermediate section; and (3) if water is encountered prior to or after drilling the salt formation, the driller would have to convert to a conventional system of drilling.

Additional information was provided to EPA Air Docket No. A-93-02, IV-G-7. In this information, the following was provided:

> The well record search has continued and now includes information from the entire New Mexico portion of the Delaware Basin. Within the nine-townships surrounding the WIPP, the records showed no evidence of air drilling. One possible exception to this may be the Lincoln Federal #1. This well is said to have been air drilled due to a loss of circulation at a depth of 1290 feet, but this has not been verified. The records associated with the Lincoln Federal #1 do not contain any evidence of air drilling. Rather, this information is based on verbal communications with the operating and drilling companies involved with the well. Nonetheless, the Lincoln Federal #1 may have been drilled with air, although it was not a systematic use of the technology. Air drilling at this well was used from 2984' to 4725' merely as a mitigative attempt to continue drilling to the next casing transition depth. After this casing transition, mud drilling was used for the remainder of the hole.
>
> The area of the expanded search contains 3,756 boreholes. Of these, 407 well files were unavailable for viewing (in process), therefore, 3,349 well files constitute the database. Among these wells, 11 instances of air drilling were found in which any portion of the borehole was drilled with air. Only 7 of these were drilled through the Salado Formation at the depth of the repository. This results in a frequency of 7/3349, or 0.0021. This value is conservative in that it includes the Lincoln Federal #1, and four other wells which were proposed to be drilled with air, but no subsequent verification of actual drilling exists in the records.

During the summer of 1999, another search of these same records was conducted as a follow up to the original research. This search of the records was performed by an independent third party and was used as a quality assurance check of the original search. The database consisted of 3,810 boreholes with only 12 records unavailable for viewing. This search added five more wells with indications of some portion of the hole being drilled with air. None were air drilled through the Salado Formation or were located in the nine-township area. Of the five wells added to the count, one (the Sheep Draw "28" Federal #13) had the first 358 feet air drilled while the other four had the conductor pipe drilled with air which consists of the first 40 feet of the borehole and is not usually reported in the drilling process. The conductor casing is typically drilled, set in place, and cemented prior to setting up the rotary drilling rig that will eventually drill the well.

The records on the new wells spudded during the last year (September 1, 2002 through August 31, 2003) are being checked as they become available at the NMOCD Internet site for instances of air drilling. The records can be submitted to the NMOCD offices as late as two years after the well has been drilled. The record review is an ongoing process conducted on a continuous basis. None of the records reviewed to date have indicated any instances of air drilling. As was presented in the testimony (public hearings conducted by the EPA on WIPP certification) and continues to be validated by ongoing review, air drilling is not a common practice in the vicinity of the WIPP Site. Table 6 shows all of the known air drilling incidents that have occurred in the New Mexico portion of the Delaware Basin.

2.2 Shallow Drilling Events

One of the requirements of Title 40 CFR Part 194 is that the CCA must adequately and accurately characterize the frequency of shallow drilling within the Delaware Basin, as well as, support the assumptions and determinations, particularly those that limit consideration of shallow drilling events based on the presence of resources of similar type and quantity found in the controlled area. The DOE concluded in Appendix SCR that shallow drilling could be removed from PA consideration based on low consequence. As a result, the DOE did not include shallow drilling in its PA drilling rate calculations and did not include any reduction in shallow drilling rates during the active and passive institutional control periods. In Compliance Application Review Document (CARD) 32, the EPA accepted the DOE's finding that shallow drilling would not be of consequence to repository performance and need not be included in the PA.

Although the EPA has agreed shallow drilling can be eliminated from PA and need not be tracked, the DBDSP collects data on all wells drilled within the boundaries of the Delaware Basin. The program makes no distinctions between shallow and deep drilling events except when calculating the intrusion rate for deep drilling. Information on all wells drilled is vital for trending future activities. Table 7 shows a breakdown of the various types and number of shallow wells located within the Delaware Basin.

2.3 Deep Drilling Events

In accordance with the criteria, the DOE used the historical rate of drilling for resources in the Delaware Basin to calculate a future drilling rate. In particular, in calculating the frequency of future deep drilling, Title 40 CFR §194.33(b)(3)(i) (EPA 1996) provided the following criteria to the DOE:

> Identify deep drilling that has occurred for each resource in the Delaware Basin over the past 100 years prior to the time at which a compliance application is prepared.

The DOE used the historical record of deep drilling for resources below 2,150 feet that has occurred over the past 100 years in the Delaware Basin. This was chosen because it is the depth of the repository, and the repository is not directly breached by boreholes less than this depth. In the past 100 years, deep drilling occurred for oil, gas, potash, and sulfur. These drilling events were used in calculating a rate for deep drilling for PA as discussed in Appendix DEL of the CCA. The period of calculation used was from 1896 through June 1995. Historical drilling for purposes other than resource exploration and recovery (such as WIPP Site investigation) were excluded from the calculation in accordance with criteria provided in §194.33.

In the Delaware Basin, deep drilling events are usually associated with oil and gas drilling. Commercial sources and visits to the NMOCD offices and Internet site are used to identify these events. The DBDSP collects data on all drilled wells within the Delaware Basin, making no distinction between resources. Two separate databases are maintained on hydrocarbon wells, one for Texas and one for New Mexico. As information on wells is acquired, it is entered into the individual databases. The Texas database contains information only on the current status of the well, when it was drilled, its location, who the operator is, and the total depth of the well. The Texas portion of the Delaware Basin is used only for calculating the drilling rate. The database for the New Mexico portion of the Delaware Basin contains the same basic information as Texas along with all the information required for PA related drilling events.

The DBDSP continues to monitor all hydrocarbon drilling activity and any new potash, sulfur, water, or monitoring wells for deep-drilling events. Information from the drilling of these wells is added to the databases maintained for these separate resources. During the last year, there were 226 new wells added to the databases. Most of the wells were drilled for hydrocarbon extraction and almost all were deep drilling events. Fifty-six of these new wells are in the nine-township area immediately surrounding the WIPP Site. Table 8 shows the number and type of deep wells located in the Delaware Basin.

2.4 Past Drilling Rates

The EPA provided a formula for calculating the current drilling rate or intrusion rate when 40 CFR Part 194 was promulgated. The formula is as follows: number of holes times 10,000 years divided by the area of the Delaware Basin (23,102.1 km^2) divided by 100 years (1897-1996, the year the CCA was submitted). This formula is used to calculate both shallow and deep drilling rates for each resource. Since shallow drilling events are of no consequence, only deep drilling events are applied to the formula. The DBDSP uses all deep drilling events of any resource (potash, oil, gas, water, etc.) to calculate the drilling or intrusion rate. Including resources other than hydrocarbon will not affect the product of the formula due to the high number of deep drilling events recorded over the last 100 years in the Delaware Basin.

The drilling rates since the submittal of the CCA in 1996 are shown in Table 9. The large increase between 1996 and 1997 is the result of updating the databases with information from June 1995 through August 1997. Also, the 100-year window is considered a sliding window, in which 100 years worth of data is used each time the calculation is performed. As each new year's data are added, the oldest year's data are dropped. For example, the drilling rate was calculated in 1999 by using the data from 1900 through 1999. In 2000, the data from 1901 through 2000 was used to calculate the drilling rate.

2.5 Current Drilling Rate

The calculated intrusion or drilling rate for 2003 was derived from the information provided in Table 8. There were 18,346 resource holes within the Delaware Basin; of those, 12,316 were deeper than 2,150 feet. Applying the formula results in the following: 12,316 boreholes x 10,000 years / 23,102.1 km^2 / 100 years. This results in a drilling or intrusion rate of 53.3 boreholes per km^2 over 10,000 years.

This is an increase from the 46.8 boreholes per km^2 reported in the 1996 CCA. This number is anticipated to rise for quite a few years before it begins to drop. This is because of the 100-year time frame used for drilling results. As new wells are added to the count, wells older than 100 years are dropped. It will be 2011 before any wells are dropped from the count while a number of new wells will be added due to increased oil and gas activity, thus driving up the count. Petroleum exploration activity is directly related to the price of crude oil and gas. The number of wells drilled per year for the last 24 years in the Delaware Basin and the average price per barrel of domestic crude oil is shown in Table 10.

2.5.1 Nine-Township Area Drilling Activities

From September 1, 2002 to August 31, 2003, there were 56 new wells spudded in the nine-township area immediately surrounding the WIPP Site. Four new wells were drilled in the one-mile area surrounding the WIPP Site. Figure 3 shows the status of all known hydrocarbon wells drilled within the one-mile area of the WIPP Site. Of the 56 new wells, 35 were drilled in Eddy County and 21 in Lea County. Thirty-four of the wells were to the northeast and east of the site, four to the west of the site, while the rest were all south of the site. Yates Petroleum Corporation drilled the most new wells in the nine-township area with 17 wells. Pogo Producing Company had 16 new wells, and Devon Energy Production Company drilled 15 new wells in the nine-township area during the last year. These three companies are the major producers in the area along with other companies such as, EOG Resources, Bass Enterprises Production Company, Chevron USA, Harvard Petroleum, Maralo, Inc., and Matador Operating Company.

2.6 Castile Brine Encounters

WIPP PA included the assumption that a borehole results in the establishment of a flow path between the repository and a pressurized brine pocket that might be located beneath the repository in the Castile Formation. Research was performed in an attempt to verify this assumption. Studies recorded a total of 27 encounters with pressurized brine in the Castile Formation; of these, 25 were hydrocarbon wells scattered over a wide area in the vicinity of the WIPP Site. Two wells, ERDA 6 and WIPP 12, were drilled in support of WIPP Site characterization.

As indicated earlier, the independent search of the records performed in 1999 for instances of air drilling also looked for instances of pressurized brine. Although the search of the records noted a number of instances of encounters with sulfur water and brine water, none but the original 27 were found to have been pressurized brine encounters in the Castile Formation.

The DBDSP researches the well files of all new wells drilled in the New Mexico portion of the Delaware Basin each year looking for instances of encounters with pressurized brine. The program also sends out an annual survey to operators of new wells asking if they encountered pressurized brine during the drilling process. As of this report, none of the records reviewed indicated encounters with pressurized brine during the drilling process on new wells spudded in the New Mexico portion of the Delaware Basin between September 2002 and August 2003.

As reported in Rev. 2 of this report, there were two Castile Brine encounters by area drillers reported to WIPP Site personnel but not reported in records on file at NMOCD offices. Rev. 3 of this document recorded three more brine encounters, all unofficial as they do not appear in the records for these wells at the NMOCD offices. Two were located near ERDA 6 northeast of the WIPP Site and reported encountering several hundred barrels of brine per hour. All brine was contained within the pits thus requiring no report to the NMOCD. The other encounter was to the southwest of the WIPP Site reporting an initial flow from 400 to 500 barrels per hour. Flow dissipated in a matter of minutes. Of the five new Castile Brine encounters recorded since the 1996 CCA, four were picked up when WIPP Site personnel performing field work talked to area drillers. The other encounter was reported by an operator in the Annual Survey of area drillers. All the new encounters have been in areas where Castile Brine is expected to be encountered during the drilling process. Table 11 shows all known Castile Brine encounters in the vicinity of the WIPP Site.

2.7 Borehole Permeability Assessment - Plugging Practices

The hydrocarbon well plugging practices used for the borehole permeability assessment remain valid. The regulations in place during the submittal of the CCA have not changed. The assessment will not change unless the regulations change to allow a different method of plugging. Regulations require the well be plugged in a manner that will permanently confine all oil, gas, and water in the separate strata in which they were originally found. These regulations require a notice of intent to plug from the operator. This notice includes a diagram of the well bore and the placement of the plugs. A 24-hour notice to the NMOCD or to the Bureau of Land Management (BLM) is required before plugging may commence.

Most of the wells in the vicinity of the WIPP Site are in the KPLA. Under R-111-P regulations, the operator is required to run a solid cement plug through the entire salt section and water-bearing zones in addition to installing a bridge plug above the perforations. Installing a solid cement plug through the salt provides additional assurance no fluids or gases escape through the casing into potash mining areas or fresh water formations.

In the New Mexico portion of the Delaware Basin, the DBDSP retrieves a copy of the plugging report from the NMOCD Internet site when a well has been plugged and abandoned. This information is added to the records maintained by the DBDSP on each well drilled within the Delaware Basin. By maintaining records in such a fashion, should the regulations change and the plugging methods differ from what is now occurring, a trend would be noticed and the borehole permeability assessment revisited. Table 12 shows various plug information on the wells plugged and abandoned within the New Mexico portion of the Delaware Basin in the last year.

CCA Appendix MASS, Attachment 16-1 describes the development of a conceptual model for long-term performance of plugged boreholes. The study did not attempt to predict the effectiveness of plugs, but to identify the location and physical characteristics of plugs which might be important to performance assessment. Guidance in 40 CFR 194 states that "Performance assessments should assume that the permeability of sealed boreholes will be affected by natural processes, and should assume that the fraction of boreholes that will be sealed by man equals the fraction of boreholes which are currently sealed in the Delaware Basin." The rule also state that "...drilling practices will remain as those of today." Only wells plugged in the New Mexico portion of the Delaware Basin were used for the study and only wells drilled after 1988, when the current plugging regulation went into effect, were used. The results of this study indicated that PA should assume a 100% plugging frequency.

To determine the typical configuration and composition of a borehole plug, the study considered both current drilling and plugging practices to arrive at a model depicting six different types of plugging configurations (see Figure 4):

Type I — Plugs will be located at the transition between the surface and intermediate casings and the transition between the intermediate and production casings. This area is usually the top of the Salado Formation and the bottom of the Castile Formation, roughly 800 feet and 4,000 feet below the surface.

Type II — This plugging configuration has a portion of the production casing salvaged. Where the production casing was cut a plug must be installed. If a plug occurs between 2,150 and 2,700 feet (above the hypothetical brine pocket) and the other plugs occur at the top of the Salado Formation and below the Castile Formation, it is considered a Type II configuration.

Type III This configuration is the same as above except the removed production casing plug occurs above 2,150 feet.

Type IV Extra plugs, in addition to those of Type II, have been emplaced above 2,150 feet.

Type V The minimum regulatory requirements require a surface plug and a plug occurring at the bottom, provided no water-bearing zones were encountered. This type of plugging configuration is not common.

Type VI This configuration has a solid cement plug through a significant portion of the salt section. This configuration, like the others, may have additional plugs above and below the salt-section plug.

There was one hydrocarbon well, which was not located in the R-111-P area, plugged in the nine-township area during 2003 and 22 others outside the nine-township area. Only 20 of the 23 will be used in the permeability assessment update (see Table 13), because three were too shallow (less than 2,150 feet deep).

2.8 Seismic Activity in the Delaware Basin

The DBDSP records in a database and on a map all known seismic events occurring in Southeast New Mexico and West Texas, specifically that of the Delaware Basin. This information is provided every quarter in a report from New Mexico Institute of Mining and Technology, Socorro, New Mexico, which utilizes an array of seven seismographs in the vicinity of the WIPP Site.

During 2003, 121 events occurred in the area monitored by the DBDSP. Since the DBDSP monitors an area smaller than the area monitored by New Mexico Tech, there are a greater number of events reported in New Mexico Tech's report. Of the 121 events, three occurred in the Delaware Basin, one in Lea County, New Mexico and two in Culberson County, Texas. The smallest event in the Delaware Basin was 0.8 magnitude and the largest was 2.0 magnitude. Of the events that occurred outside of the Delaware Basin, the smallest was 0.8 magnitude and the largest was 3.4 magnitude. New Mexico accounted for one hundred seven events, with the remainder occurring in Texas. In Eddy County there were one hundred events. All were located northwest of the WIPP Site, outside of the Delaware Basin, in the Dagger Draw, or the Cass Ranch area of Central Eddy County where a large number of oil and gas activities are conducted. Table 14 provides information on all recorded events which occurred in the Delaware Basin.

2.9 Secondary and Tertiary Recovery

Secondary recovery is defined by the oil industry as the first improved recovery method of any type applied to a reservoir to produce oil not recoverable by primary recovery methods. Waterflooding is one such method. This method involves pumping water through the existing perforations in a well in which production has decreased sufficiently to merit stimulation. As the water is pumped into a formation, it stimulates production of oil or gas in other nearby wells. This is a proven method of recovering hydrocarbons that otherwise would be economically unretrievable. Waterflooding has been a popular form of secondary recovery for over 40 years. Waterflooding can be accomplished by one injection well or several injection wells in the immediate vicinity of other producing wells.

In the New Mexico portion of the Delaware Basin, there are three major waterflood projects and several one and two injection well operations. One of the major waterflood projects in the area is the El Mar, located in T26S-R32E, on the Texas border. At one time, this project (currently operated by Quay Valley, Inc.) had 31 permitted injection wells. Currently, there are only two wells actively injecting water. The remaining wells are either shut-in (not being used) or plugged and abandoned. The operation for this facility has not changed since last year. The Paduca waterflood project, located in T25S-R32E, has 19 permitted injection wells with eight (up from seven this time last year) injecting water into the formation. The third major waterflood project in this area (Indian Draw), located in T22S-R28E, is currently injecting into nine of the ten permitted wells. At this time last year, this facility was not injecting into any of its permitted wells.

Tertiary recovery is defined by the oil industry as the use of any improved recovery method to remove additional oil after secondary recovery. One method of tertiary recovery practiced in the industry, where conditions permit, is the injection of carbon dioxide (CO_2) into the formation. This consists of injecting a prescribed amount of CO_2 into the reservoir followed by an injection of water and a subsequent injection of CO_2. Although CO_2 can be injected continuously, it is not cost effective to implement this process. At the time of this report, there are no known CO_2 injection wells or tertiary recovery projects being operated in the vicinity of the WIPP Site, although several are being operated by oil companies in the Texas portion of the Delaware Basin.

2.9.1 Nine-Township Injection Wells

Secondary recovery projects occurring in the nine-township area are on a small scale. There are six injection wells, up from five this time last year, located in the nine-township area surrounding the WIPP Site. Phillips Petroleum operates two injection wells, James “A” #3 and #12, located in section 2-T22S-R30E, northwest of the site. Both are active and injecting near the maximum permitted pressure of 945 psi for #3 and 1,120 psi for #12. Both first injected water in the early 1990s. The other four injection wells are operated by Pogo Producing Company. The Neff Federal #3 is located in section 25-T22S-R31E. This well went on-line in 1995 and has injected approximately 3,807,382 barrels (2,850,700 barrels this time last year) of water at a maximum permitted pressure of 1,410 psi. The Pure Gold “B” Federal #20 (23S-31E-20) has injected 244,642 barrels to date but is currently sitting idle. The third Pogo well (Prize Federal #4 located in 22S-32E-27) recently went on-line and no injection data has been reported at this time. The fourth Pogo well (State “2" #5 located in 22S-31E-02) was just recently permitted but has yet to start actively injecting. All six wells are or will be injecting into the Brushy Canyon Formation of the Delaware Mountain Group at approximately 7,200 feet. Figure 5 shows a typical injection or salt water disposal well configuration.

2.9.2 Nine-Township Salt Water Disposal Wells

The most common type of injection well is for the disposal of brine water coming from the producing formation in oil and gas wells. Figure 6 shows the location of active injection and salt water disposal wells in the nine-township area. Most producing oil and gas wells produce water along with oil or gas. Salt Water Disposal (SWD) wells have become necessary as a result of the EPA’s ruling that formation water may no longer be disposed of on the surface. The oil companies now dispose of this water by injecting it into approved SWD wells.

There are currently 35 SWD wells, an increase of one over the last year, operated by 12 companies (12 companies in 2002) located in the nine-township area surrounding the WIPP Site. Two operators, Devon Energy and Pogo Producing, operate the majority of the SWD wells. Injection depths range from 3,800 to 8,200 feet. During the last year, all operated within their maximum permitted injection pressure. The volume of disposed brine water depends on the number of producing wells maintained by the operator in the immediate vicinity of the SWD well. Table 15 provides disposal information on all SWD and injection wells in the nine-township area.

2.10 Pipeline Activity

Pipeline activity is monitored in the nine-township area, specifically within a five mile radius of the WIPP Site. Only pipelines of permanent construction, such as buried rigid metal pipelines, are of concern to the DBDSP. Many oil, gas, and SWD wells are connected to tank batteries by gathering systems constructed of poly flowlines (flexible plastic pipe) that may or may not be buried. These flowlines are semi-permanent. When they are no longer needed, they are removed for use elsewhere. This type of pipeline activity is not monitored by the DBDSP. Metal pipeline activity is of interest because it will be around for a long time thus requiring the locations of these pipelines to be documented. Only natural gas and water pipelines are located within the immediate vicinity of the WIPP Site. The natural gas pipelines are owned and operated by three companies, El Paso Natural Gas Company, Natural Gas Pipeline Company of America, and Transwestern Pipeline Company.

One type of pipeline activity of major concern to the DBDSP is CO_2 pipelines, a form of tertiary recovery of oil discussed previously involving the use of CO_2. An indicator of this form of recovery would be the construction of a CO_2 pipeline in the area. Currently, there are no CO_2

pipelines within the New Mexico portion of the Delaware Basin. The nearest CO_2 pipeline is located south of the WIPP Site in the Texas portion of the Delaware Basin.

2.11 Mining

Resources found in the Delaware Basin that can be mined are potash, sulfur, caliche, gypsum, and halite. Potash and sulfur are present in quantities large enough to be mined profitably. Only caliche, of the other resources available, is economically extracted from the earth in conventional mining methods. Caliche is mainly used in the construction of pads for oil and gas well drilling rigs.

2.11.1 Potash Mining

Potash mining in the immediate vicinity of the WIPP Site continues as reported in Appendix DEL of the CCA. Figure 7 shows the location and the extent of mining of the potash mines in the vicinity of the WIPP Site. There have been several changes to the companies that operate in the area, most notably, only two potash mining companies remain in operation. No plans have been promulgated by either company to sink new shafts or encroach upon the potash reserves identified in Appendix DEL. Currently, these reserves are not economically recoverable.

In August 1996, Mississippi Potash (a subsidiary of Mississippi Chemical Corporation) purchased all the assets of New Mexico Potash Corporation and Eddy Potash, Inc. These plants were renamed Mississippi East and Mississippi North, respectively. December 1997 saw the Mississippi North plant shut down because it could no longer be economically operated. Mississippi Potash continues to produce potash fertilizer from both the east and west plant mines and refineries.

The other potash producer in the area, IMC Kalium Potash, is a wholly-owned subsidiary of IMC Global. Western Ag-Minerals was purchased by IMC Global September 1997. This acquisition doubled the potash reserves for IMC Kalium and increased their other reserves by 30 percent. IMC Global merged with Freeport-McMoRan, a major world potash producer, December 1997 with IMC Global as the surviving entity in the transaction.

2.11.2 Sulfur Extraction

The only viable sulfur mining activity within the Delaware Basin was being conducted by Freeport-McMoRan Sulphur, Inc., a wholly-owned subsidiary of McMoRan Exploration Company. The mine is located in Culberson County, Texas. The mine recovered sulfur utilizing the Frasch process (solution mining) which consists of a hole drilled into the sulfur bearing formation and then cased. The next step involves the placement of three concentric pipes within the protective casing to facilitate pumping superheated water down the hole, melting the sulfur, and recovering the molten sulfur to the surface. In June 1998, it was announced the mine would cease production September 1998 because it was no longer economically feasible to operate. Because of problems at other sulfur facilities, the Culberson mine was operated until it permanently ceased production on June 30, 1999. Abandonment and salvage operations continued until the early summer of 2000.

Recently, a number of sulfur exploration coreholes were found in the BLM records. These coreholes were drilled in the late 1960s through the early 1980s in the Yeso Hills near Washington Ranch in the far southwest corner of the New Mexico portion of the Delaware Basin. These coreholes have yet to be added to the databases. All were shallow (less than 2,150 feet) drilling events that were conducted for various small-time operators. There have been no reports on whether any of the holes encountered sufficient quantities of mineable sulfur.

2.11.3 Solution Mining

Solution mining is the process by which water is injected into a mineral formation, circulated to dissolve the mineral, and the solution then pumped back to the surface where the minerals are precipitated out of the water, usually by evaporation. There are several brine mines or wells in the area, two in New Mexico and nine in Texas (see Figure 8), that use this process to provide a brine solution for area drilling operators to use in the drilling process. These are all shallow wells using injected fresh water to dissolve the salt into a brine solution.

In early 1997, Mississippi Potash proposed to set up a pilot potash solution mining project at the former Eddy Potash mine located north of the WIPP Site and outside of the Delaware Basin. BLM was provided with all of the necessary documentation to acquire a permit to operate the pilot project, but the project was postponed. In March 2002, Mississippi Potash again applied for a permit to operate a pilot potash solution mining project. In May 2002, the project was given approval to proceed by the BLM though the project has not been started. If the project is initiated, it will be approximately three acres in size. Although this project is outside of the Delaware Basin, it will be closely followed because of its importance.

In the late 1960s, Conoco Minerals installed a pilot solution mining project on leases it held on the former AMAX property north of the WIPP Site. The project was designed to test solution mining of potassium minerals and consisted of one injection well and three withdrawal wells, but the potash ore zone was deemed too thin to make this method economically viable.

2.11.4 Brine Wells

Brine wells are classified as Class II injection wells. In the Delaware Basin, the process involves injecting fresh water through the wells into a salt formation to create a saturated brine solution, which is then extracted and utilized as a drilling agent when drilling a new well. These wells are tracked by the DBDSP on a continuing basis. Table 16 provides the status of brine wells in the Delaware Basin.

2.12 New Drilling Technology

New drilling methods are researched by the DBDSP for impacts to the drilling methods currently used in the area. To date, no new methods of drilling have been identified or implemented in the vicinity of the WIPP Site.

3.0 Survey of Well Operators for Drilling Information

A survey of local well operators is performed annually to acquire information on drilling practices normally not available on the Sundry notices supplied to the local state and federal offices by the operator or through commercial sources maintained by the DBDSP. There are no regulatory requirements to provide the information. This survey requests information on other items of interest to the WIPP such as hydrogen sulfide (H_2S) encounters, Castile Brine encounters, or if any section of the well was drilled with air. The DBDSP personnel review the records on all new wells drilled to look for the above data. The survey provides an additional source of information on drilling activities in the New Mexico portion of the Delaware Basin.

The first survey of area operators was performed July 1999. Drilling information was requested on the 16 wells drilled in the nine-township area of the New Mexico portion of the Delaware Basin. In July 2000, 45 surveys were sent out to nine different operators on wells their companies drilled in the nine-township area during that year (twelve surveys were returned). In July 2001, 44 surveys were sent out to nine different operators and no responses were received. During July 2002, 27 surveys were mailed to three local operators. One operator returned five surveys on wells drilled by their company in the nine-township area. One of the surveys reported on a Castile Brine encounter as discussed in Section 2.6 of this report. The survey conducted for 2003 saw 49 surveys mailed out to eight area operators. To date, 12 surveys have been returned from four operators. Information from this survey is provided in Table 3.

4.0 Summary - 2003 Delaware Basin Drilling Surveillance Program

Very little has changed since 1996 when the CCA was submitted to the EPA. Drilling practices continue to be the same, as do the methods for mineral extraction. The 2003 drilling rate is steadily increasing although not at the same rate as in recent years, even though the price of oil is relatively high. The potash mining activity has declined from five companies to two companies in recent years with several mines operated by these two companies ceasing active production.

5.0 References

New Mexico Bureau of Mines and Mineral Resources, 1995, *Evaluation of Mineral Resources at the Waste Isolation Pilot Plant,* Final Report, Vols. I-IV

New Mexico Institute of Mining and Technology, Seismicity of the WIPP Site for the Period April 1, 2003 through June 30, 2003, Socorro, New Mexico

New Mexico Junior College, 1995, *Analytical Study of an Inadvertent Intrusion of the WIPP Site,* Hobbs, New Mexico

New Mexico Oil & Gas Engineering Committee, Inc., *Monthly Injection & Saltwater Report for Southeast New Mexico,* March 2002

Ross Kirkes, *Current Drilling Practices Near WIPP*, 1998. EPA Air Docket No. A-93-02, IV-G-7, January 22, 1998

The University of Texas, Petroleum Extension Service, Division of Continuing Education, 1986, *Fundamentals of Petroleum,* Third Edition

The University of Texas, Petroleum Extension Service, Division of Continuing Education, 1991, *A Dictionary for the Petroleum Industry,* First Edition

U.S. Department of Energy, DOE/WIPP-99-2308, Rev. 3, *Delaware Basin Monitoring Annual Report*, September 2002

U.S. Department of Energy, 1996, *Inadvertent Intrusion Borehole Permeability,* Prepared by T.W. Thompson, W.E. Coons, J.L. Krumhansl, and F.D. Hansen

U.S. Department of Energy, DOE/WIPP-97-2240, *Injection Methods: Current Practices and Failure Rates in the Delaware Basin,* June 1997

U.S. Department of Energy, DOE/CAO-1996-2184, *Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant,* October 1996

U.S. Environmental Protection Agency (EPA), 1996. *Title 40 CFR Part 194*, *Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations*

Westinghouse TRU Solutions LLC, WP 02-PC.02, *Delaware Basin Drilling Surveillance Plan,* March 1997

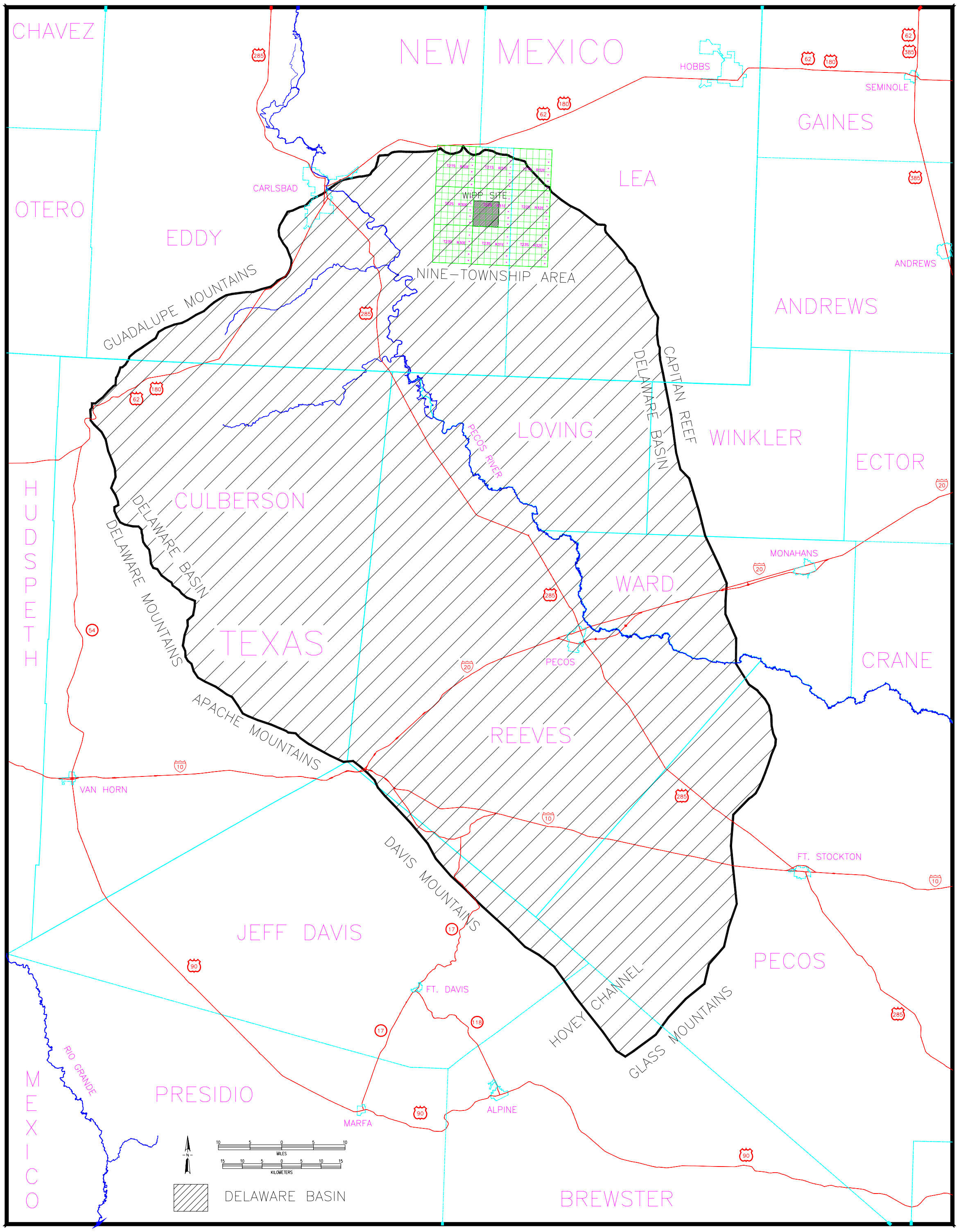

FIGURE 1
WIPP Site, Delaware Basin, and Surrounding Area

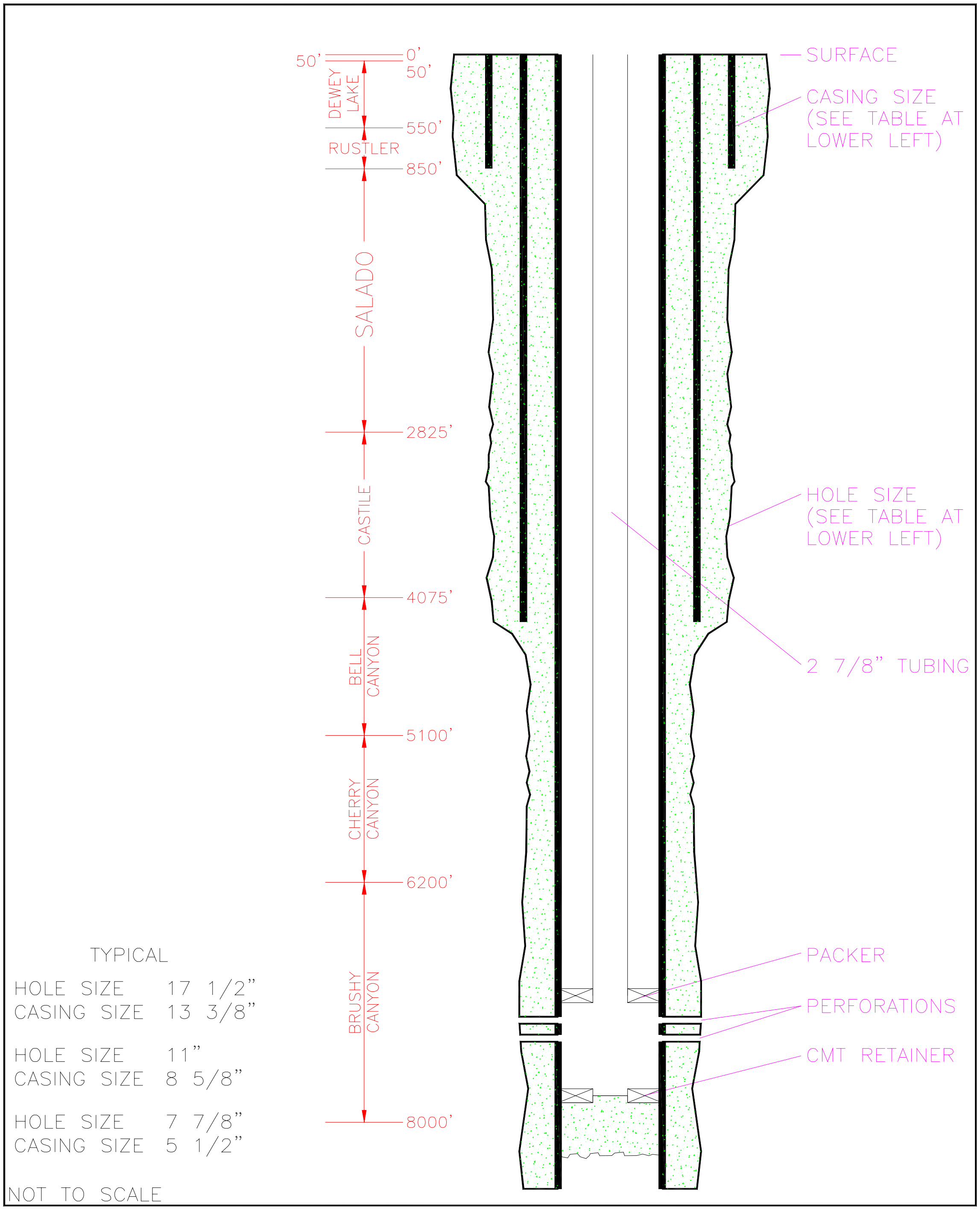

FIGURE 2
Typical Well Structure and General Stratigraphy Near the WIPP Site

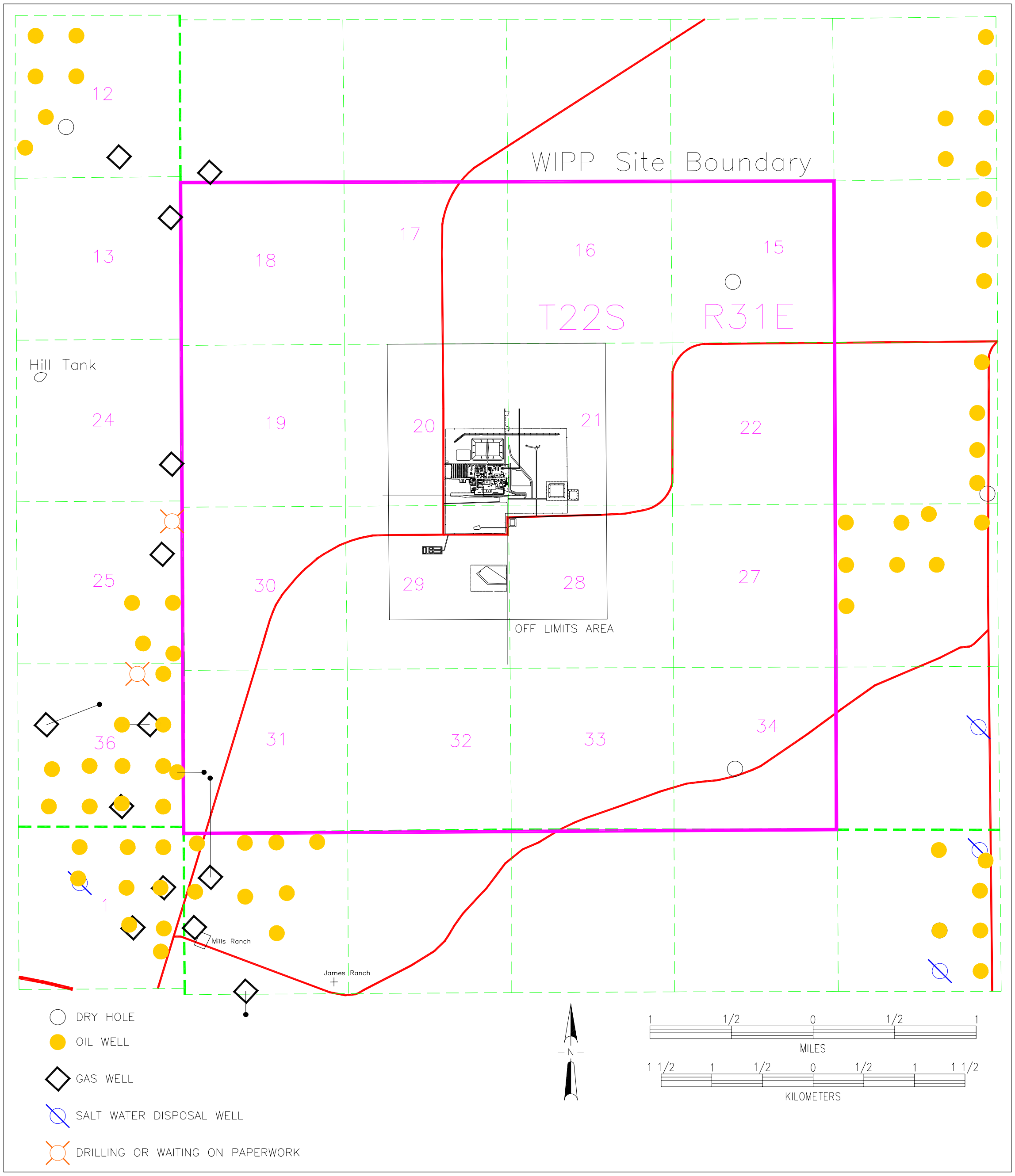

FIGURE 3
Oil and Gas Wells Within One-Mile of the WIPP Site

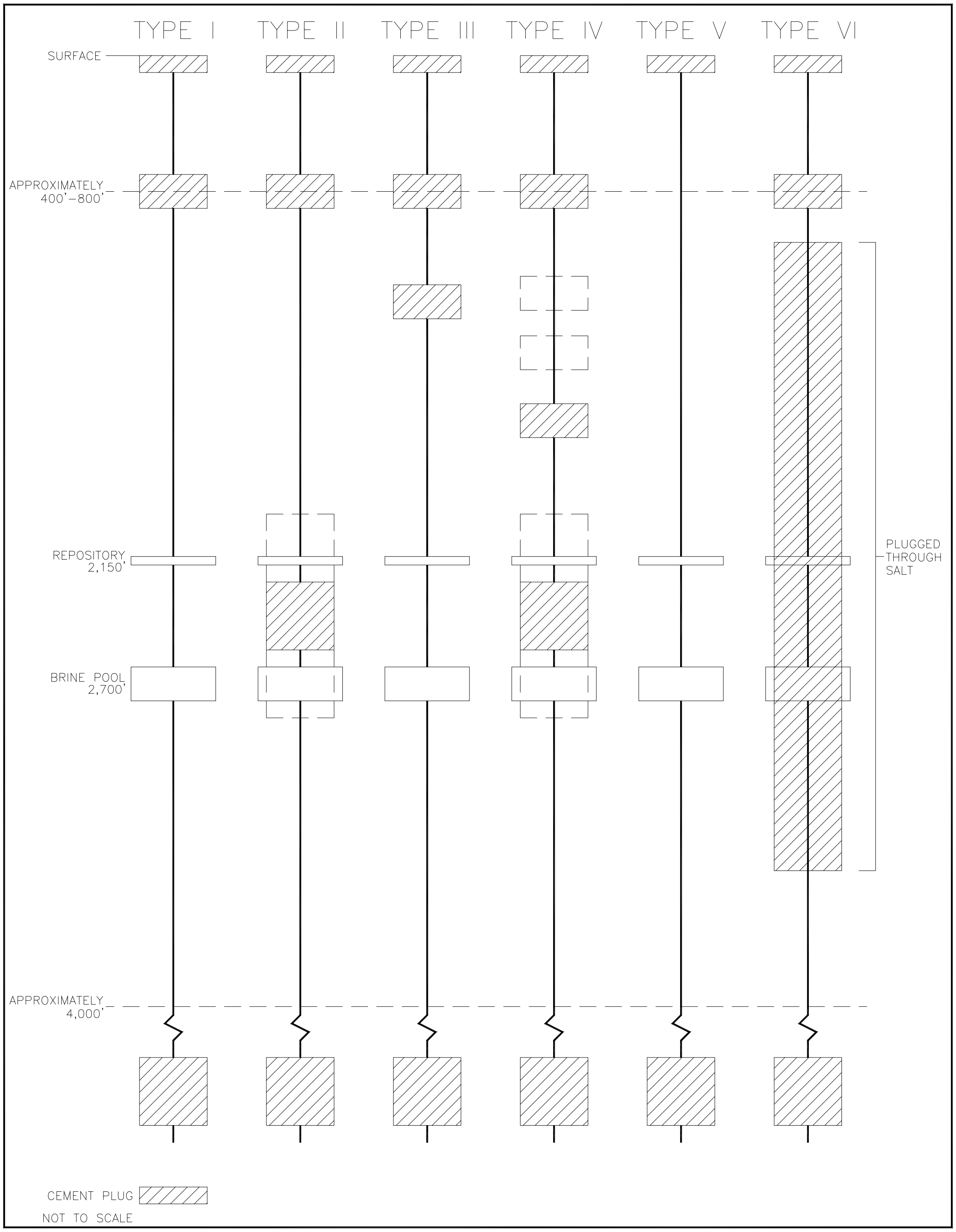

FIGURE 4
Typical Borehole Plug Configurations in the Delaware Basin

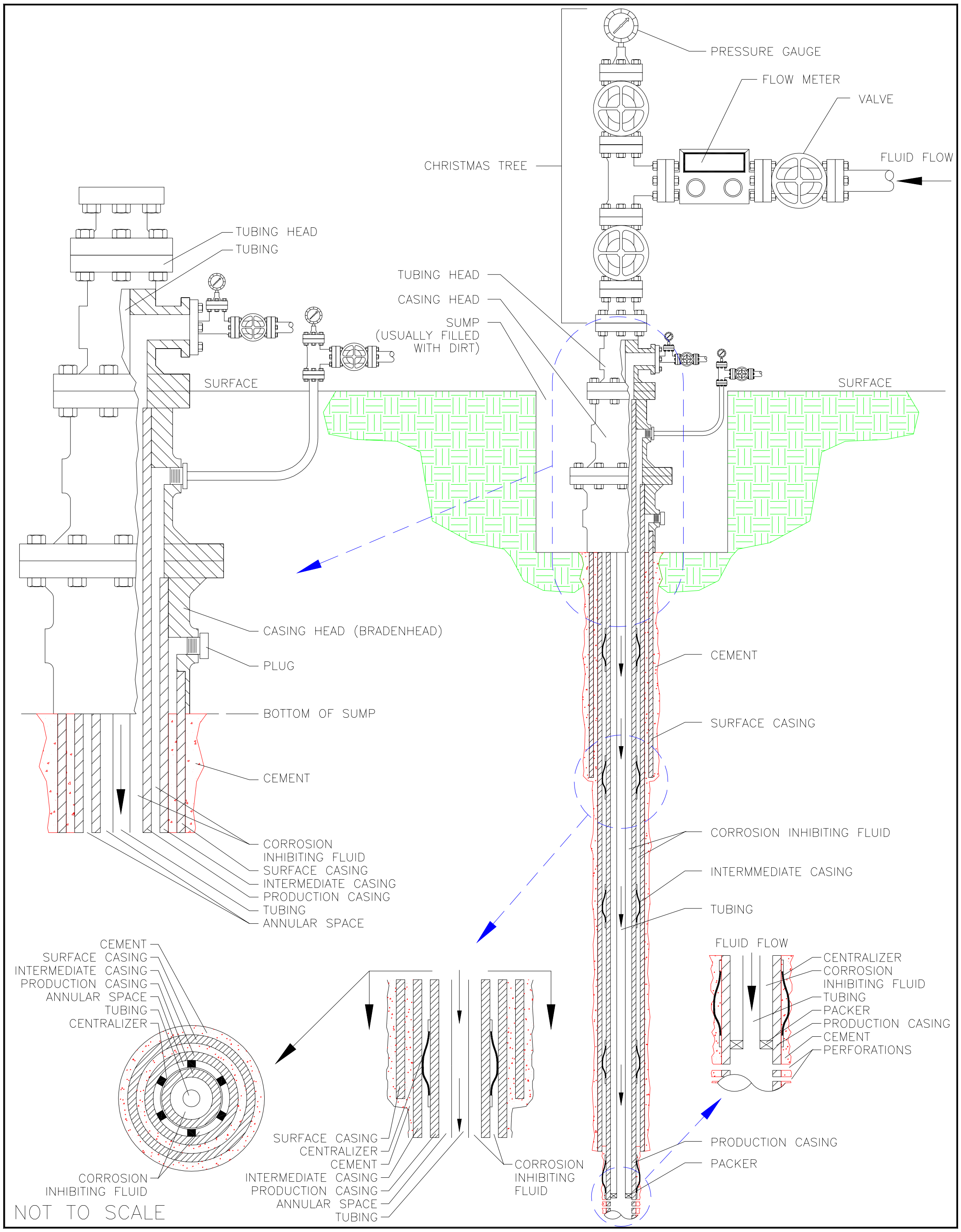

FIGURE 5
Typical Injection or Salt Water Disposal Well

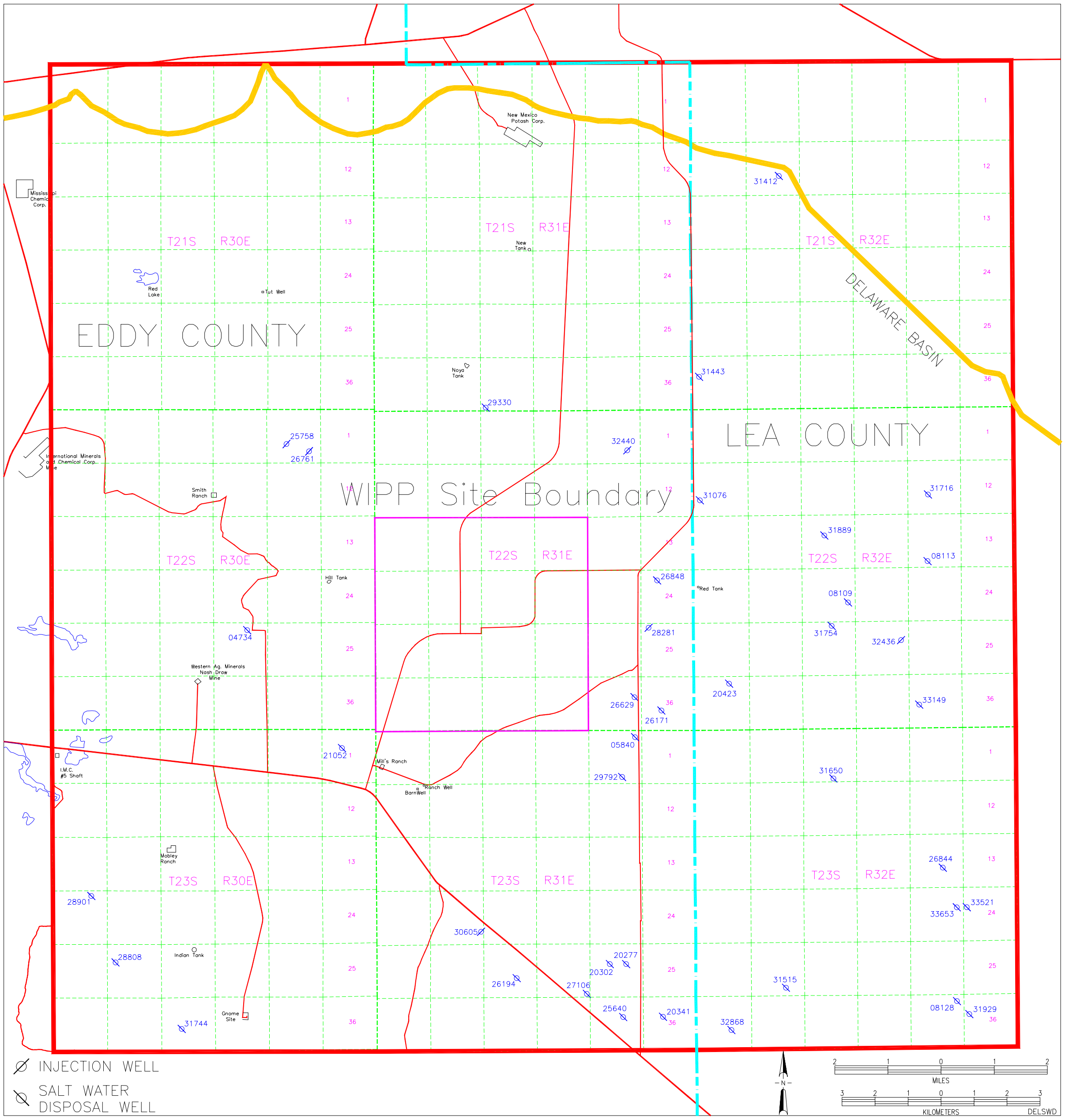

FIGURE 6
Active Injection and SWD Wells in the Nine-Township Area

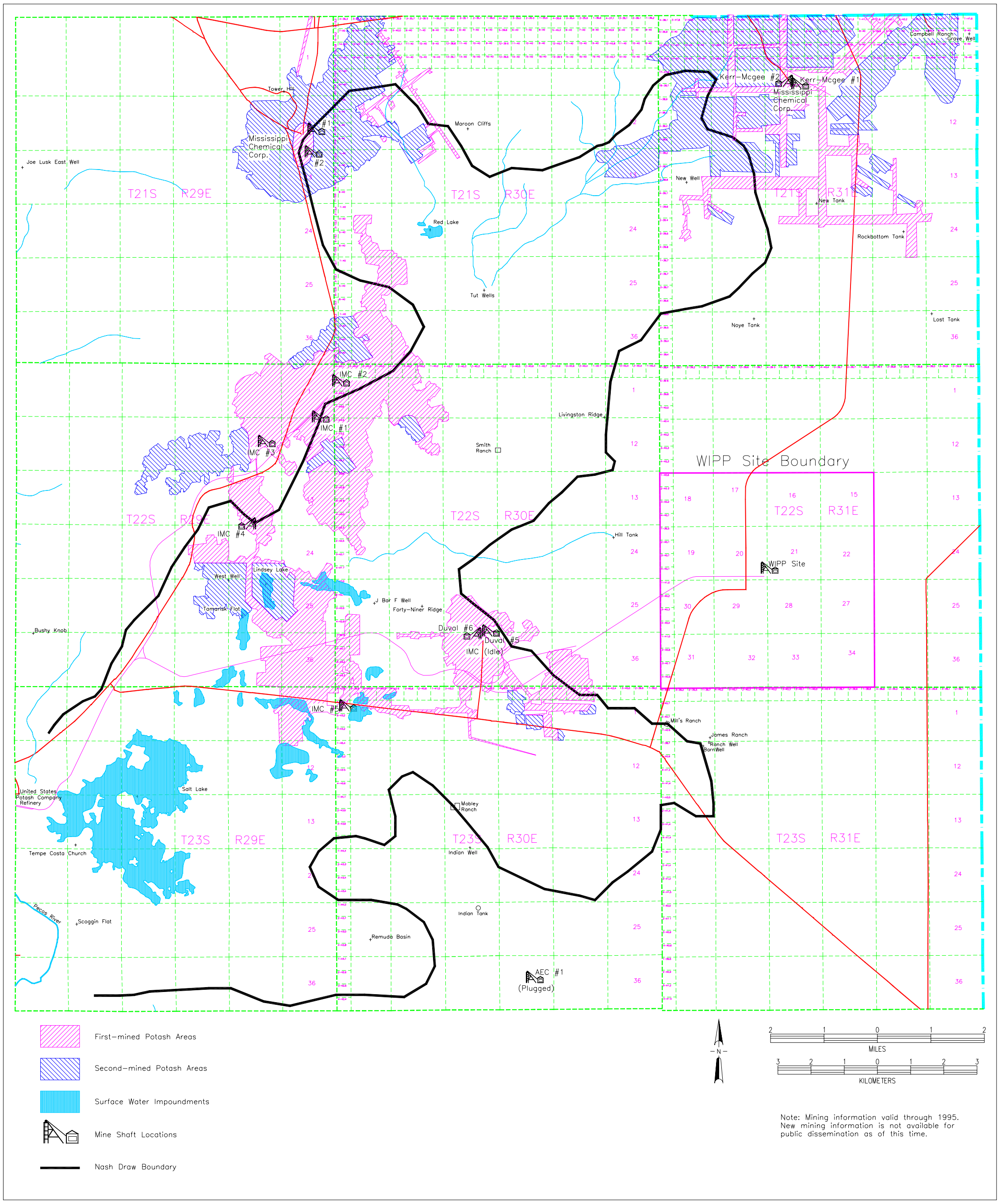

FIGURE 7
Potash Mining in the Vicinity of the WIPP Site

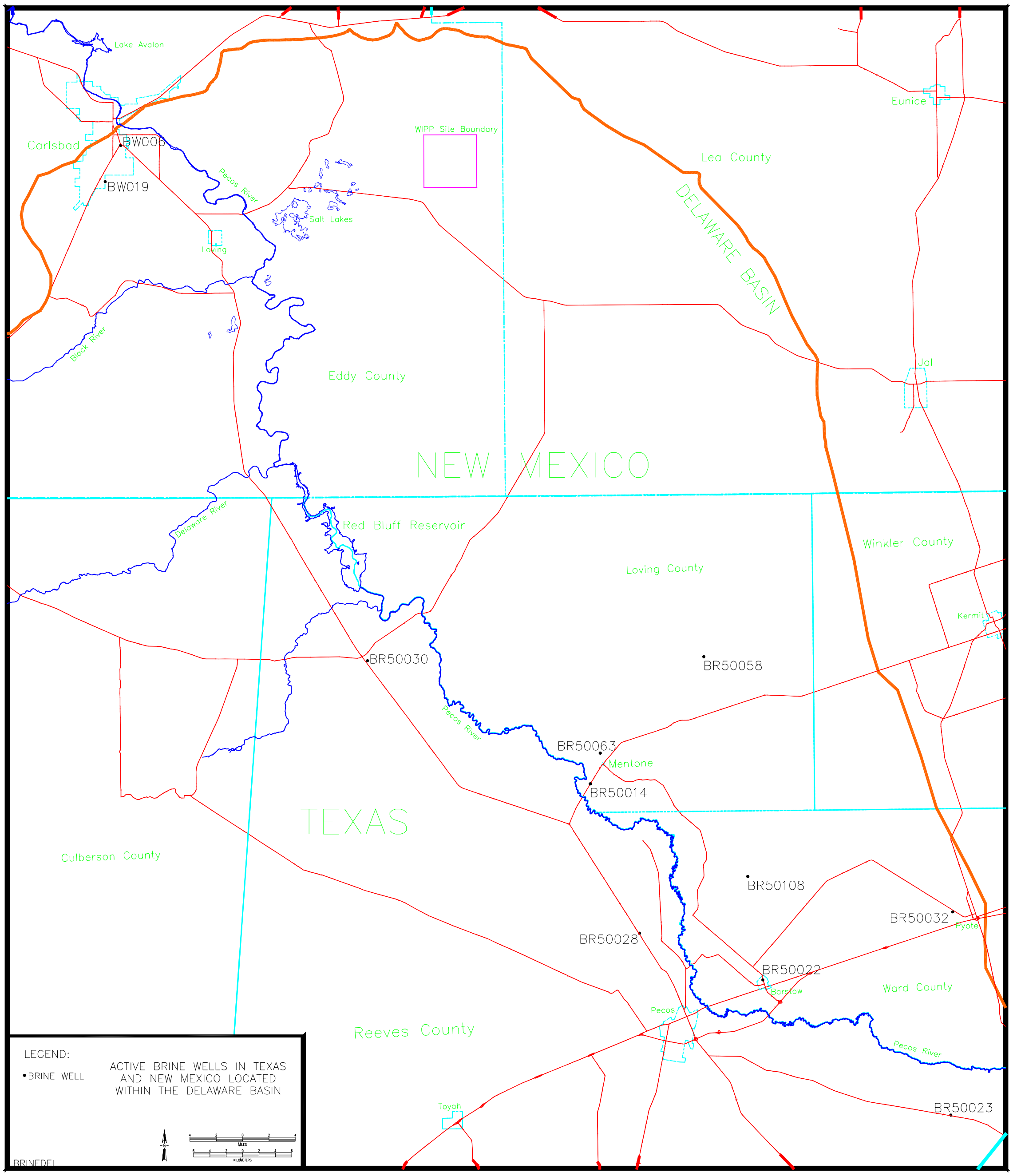

FIGURE 8
Active Brine Well Locations in the Delaware Basin

TABLE 1
Nine-Township Area Casing Sizes

Casing Size	*Surface Casing*	*Intermediate Casing*	*Production Casing*	*Totals*
13 ⅜”	53	0	0	53
11 ¾”	1	0	0	1
9 ⅝”	0	1	0	1
8 ⅝”	0	51	0	51
7"	0	0	1	1
5 ½”	0	0	50	50
TOTALS	54	52	51	157

NOTE: There were 56 wells drilled in the nine-township area between September 1, 2002 and August 31, 2003. Fifty-one of the wells had complete records available on casing sizes. The other five wells had partial records available on casing sizes. All available information is indicated in the above table.

TABLE 2
Nine-Township Area Bit Sizes

Bit Size	*Surface Hole*	*Intermediate Hole*	*Production Hole*	*Totals*
17 ½”	51	0	0	51
14 ¾”	1	0	0	1
12 ¼”	0	2	0	2
11"	0	48	0	48
7 ⅞”	0	0	49	49
TOTALS	52	50	49	151

NOTE: Of the 56 wells drilled in the nine-township area, complete records were available on 49 wells. The other seven wells had partial records available on bit sizes. All available information is reported in the above table.

TABLE 3
Nine-Township Area Drilling Survey Information

#	*Well Name and No.*	*Drill Pipe*	*Rotation Speed*	*Penetration Rate*	*Collar Diameter*	*Collar Length*
1	Neff “13" Federal #16	4 ½”	70 RPM	28 Ft/Hr	S=8" and 6" I=8" and 6" P=6"	S=737 Ft I=984 Ft P=929 Ft
2	Getty “24" Federal #16	4 ½”	60-75 RPM	40 Ft/Hr	S=8" and 6" I=8" and 6" P=6"	S=706 Ft I=1,016 Ft P=927 Ft
3	Getty “24" Federal #14	4 ½”	70 RPM	33.4 Ft/Hr	S=8" I=8" and 6" P=6"	S=476 Ft I=766 Ft P=800 Ft
4	Getty “24" Federal #13	4 ½”	70 RPM	49 Ft/Hr	S=8" and 6" I=8" and 6" P=6"	S=584 Ft I=640 Ft P=848 Ft
5	Federal “BA” #1	4 ½”	65 RPM	29 Ft/Hr	S=8" and 6" I=8" and 6" P=6"	S=850 Ft I=800 Ft P=635 Ft
6	Bootleg “11" Federal Com #1	4 ½”	0.78 Ft/Sec	40 Ft/Hr	S=8"	30 Ft
7	Todd “13 L” Federal #12	4 ½”	65 RPM	29 Ft/Hr	S=8" and 6" I=8" and 6" P=6"	S=674 Ft I=886 Ft P=857 Ft
8	Todd “14 N” Federal #14	4 ½”	60 RPM	30 Ft/Hr	S=8" and 6" I=8" and 6" P=6"	S=835 Ft I=768 Ft P=887 Ft
9	Todd “23 C” Federal #18	4 ½”	70 RPM	32 Ft/Hr	S=8" and 6" I=8" and 6" P=8" and 6"	S=419 Ft I=767 Ft P=912 Ft
10	Todd “13 E” Federal #26	4 ½”	70 RPM	51 Ft/Hr	S=8" and 6" I=8" and 6" P=6"	S=720 Ft I=767 Ft P=887 Ft
11	Todd “13 M” Federal #31	4 ½”	70 RPM	36 Ft/Hr	S=8" and 6" I=8" and 6" P=6"	S=712 Ft I=891 Ft P=870 Ft
12	Todd “14 I” Federal #9	4 ½”	65 RPM	45 Ft/Hr	S=8" and 6" I=8" and 6" P=6"	S=705 Ft I=848 Ft P=904 Ft

S=indicates surface string, I=indicates intermediate string, and P=indicates production string

NOTE: Of the 49 surveys mailed out to eight area operators, four operators responded with a total of 12 surveys. The requested information appears in the table above.

TABLE 4
Nine-Township Area Estimated Drilling Completion Times

API #	***Surface Section of Hole 17 ½” Diameter***	***Intermediate Section of Hole 11" Diameter***	***Production Section of Hole 7 ⅞” Diameter***
Drilling times are estimated to the nearest day and derived from records on file with the NMOCD.			
30-015-32000	4 days to complete to 850'	10 days to complete to 4,100'	9 days to complete to 8,322'
30-015-32001	3 days to complete to 858'	9 days to complete to 4,100'	8 days to complete to 8,281'
30-015-32002	2 days to complete to 860'	8 days to complete to 4,125'	7 days to complete to 8,300'
30-015-32003	3 days to complete to 850'	6 days to complete to 4,100'	7 days to complete to 8,300'
30-015-32240	4 days to complete to 829'	7 days to complete to 4,100'	12 days to complete to 8,350'
30-015-32352	3 days to complete to 813'	10 days to complete to 4,107'	7 days to complete to 8,350'
30-015-32522	2 days to complete to 850'	8 days to complete to 4,200'	7 days to complete to 8,508'
30-015-32527	3 days to complete to 865'	8 days to complete to 4,220'	6 days to complete to 8,500'
30-015-32720	3 days to complete to 596'	7 days to complete to 3,868'	25 days to complete to 11,295'
30-015-32797	2 days to complete to 605'	5 days to complete to 3,830'	23 days to complete to 11,230'
30-015-32719	2 days to complete to 624'	6 days to complete to 3,812'	9 days to complete to 7,960'
30-015-32028	4 days to complete to 830'	11 days to complete to 4,105'	9 days to complete to 8,350'
30-015-31912	4 days to complete to 865'	8 days to complete to 4,125'	10 days to complete to 8,400'
30-015-32726	4 days to complete to 940'	6 days to complete to 4,100'	7 days to complete to 8,250'
30-015-32761	3 days to complete to 795'	9 days to complete to 4,465'	11 days to complete to 8,600'
30-015-31802	2 days to complete to 805'	9 days to complete to 4,466'	9 days to complete to 8,630'
30-015-32644	3 days to complete to 807'	6 days to complete to 4,462'	12 days to complete to 8,600'
30-025-35960	4 days to complete to 802'	7 days to complete to 4,390'	5 days to complete to 8,650'
30-025-35918	3 days to complete to 845'	9 days to complete to4,420'	7 days to complete to 8,570'
30-025-35940[1]	14 days to complete to 1,017'	7 days to complete to 4,761'	17 days to complete to 10,077'
30-025-36004	3 days to complete to 868'	9 days to complete to 4,510'	8 days to complete to 8,620'
30-025-36135	4 days to complete to 853'	8 days to complete to 4,475'	9 days to complete to 8,600'
30-025-36136	4 days to complete to 863'	7 days to complete to 4,500'	6 days to complete to 8,574'
30-015-32619	2 days to complete to 461'	6 days to complete to 4,056'	7 days to complete to 8,160'
30-015-32333	3 days to complete to 856'	7 days to complete to 4,390'	12 days to complete to 8,495'
30-015-32624	3 days to complete to 846'	7 days to complete to 4,436'	8 days to complete to 8,512'

API #	*Surface Section of Hole 17 ½" Diameter*	*Intermediate Section of Hole 11" Diameter*	*Production Section of Hole 7 ⅞" Diameter*
Drilling times are estimated to the nearest day and derived from records on file with the NMOCD.			
30-015-32632	5 days to complete to 862'	7 days to complete to 4,438'	8 days to complete to 8,540'
30-015-32625	4 days to complete to 815'	6 days to complete to 4,430'	9 days to complete to 8,500'
30-015-32628	3 days to complete to 832'	8 days to complete to 4,410'	8 days to complete to 8,486'
30-015-32777	3 days to complete to 865'	7 days to complete to 4,408'	8 days to complete to 8,515'
30-015-32866	3 days to complete to 868'	7 days to complete to 4,430'	7 days to complete to 8,500'
30-015-32123	3 days to complete to 603'	7 days to complete to 4,089'	6 days to complete to 8,150'
30-015-32203	3 days to complete to 711'	7 days to complete to 4,360'	9 days to complete to8,375'
30-015-32629	4 days to complete to 840'	7 days to complete to 4,376'	7 days to complete to 8,340'
30-015-32019	6 days to complete to 763'	7 days to complete to 4,373'	10 days to complete to 8,415'
30-015-32496[2]	3 days to complete to 888'	6 days to complete to 4,357'	56 days to complete to 7,909'
30-025-36111	2 days to complete to 866'	5 days to complete to 4,678'	8 days to complete to 8,750'
30-025-36031	3 days to complete to 563'	11 days to complete to 4,628'	8 days to complete to 8,657'

NOTE: Estimated drilling times for each section of the well may include several and/or all of the following:

- actual drilling times
- tripping in and out of hole (bit changes)
- setting casing
- cementing casing
- waiting on cement to harden
- bad cement jobs
- lost circulation while drilling
- mechanical breakdowns
- holidays

1 This well lost circulation on the surface section of the hole; several methods were attempted to correct problem with no results. Hole was eventually cemented and re-drilled adding approximately 10 days to the estimated drilling time.

2 This well had the production section of the hole drilled to 8,450' in nine days. The cement job on the production casing was faulty and necessitated the rig being set up again and the production casing cement job being repaired. Repairs did not work so the 5 ½" casing was cut at 5,700' and removed. Hole was cemented and re-drilled to 7,909' adding approximately 47 days to the completion time.

TABLE 5
Nine-Township Area Drilling Fluids Information

#	*Well Name and No.*	*Mud Density*	*Mud Viscosity*	*Mud Yield*
1	Neff “13" Federal #16	10.0 PPG	29 Sec/Qt	No Report
2	Getty “24" Federal #16	10.1 PPG	29 Sec/Qt	No Report
3	Getty “24" Federal #14	10.0 PPG	30 Sec/Qt	No Report
4	Getty “24" Federal #13	9.9 PPG	29 Sec/Qt	1
5	Federal “BA” #1	10-10.1 PPG	29 Sec/Qt	No Report
6	Bootleg “11" Federal Com #1	10.0 PPG	29 Sec/Qt	No Report
7	Todd “13 L” Federal #12	10.1 PPG	29 Sec/Qt	0
8	Todd “14 N” Federal #14	10.2 PPG	29 Sec/Qt	0
9	Todd “23 C” Federal #18	10.0 PPG	29 Sec/Qt	0
10	Todd “13 E” Federal #26	10.0 PPG	29 Sec/Qt	0
11	Todd “13 M” Federal #31	10.0 PPG	29 Sec/Qt	0
12	Todd “14 I” Federal #9	10.0 PPG	29 Sec/Qt	0

NOTE: Mud Density = the mass or weight of a substance per unit volume. In this case, PPG is pounds per gallon.

Mud Viscosity = viscosity as measured by the Marsh funnel, based on the number of seconds it takes for 1,000 cubic centimeters of drilling fluid to flow through the funnel. One thousand cubic centimeters roughly equals one quart.

TABLE 6
Air-Drilled Wells in the New Mexico Portion of the Delaware Basin

#	Location	Well Name and No.	Spud Date	Status	Well Information
Wells Drilled Prior to Submittal of the 1996 CCA With Some Portion Drilled by Air.					
1	21S-28E-33	Richardson & Bass #1	07/27/1961	P&A	Air drilled through the salt. Between 2,545' and 2,685' encountered water and changed from air to mud-based drilling.
2	21S-32E-26	Lincoln Federal Unit #1	04/01/1991	P&A	Lost circulation at 1,290'. Hole was dry drilled to 1,792'. Supposedly, air drilled from 2,984' to 4,725'.
3	23S-26E-17	Exxon “17" Federal #1	08/01/1989	Gas Well	Air drilled through the salt from 575' to 2,707'.
4	23S-28E-11	CP Pardue #1	10/28/1958	P&A	Air drilled through the salt from 390' to 2,620'.
5	23S-28E-11	Amoco Federal #1	08/04/1979	Oil Well	Air drilled from 475' to 9,700'.
6	23S-28E-11	Amoco Federal #3	02/28/1980	Oil Well	Air drilled from 6,271' to 9,692'.
7	23S-28E-23	South Culebra Bluff Unit #3	01/21/1979	Oil Well	Air drilled from 6,345' to 8,000'.
8	23S-28E-23	South Culebra Bluff Unit #4	08/09/1979	Oil Well	Air drilled from 450' to 9,802'.
9	24S-31E-03	Lilly “ALY” Federal #2	05/01/1994	Oil Well	Air drilled conductor hole to 40'.
10	24S-31E-03	Lilly “ALY” Federal #4	05/16/1994	Oil Well	Air drilled conductor hole to 40'.
11	24S-34E-04	Antelope Ridge Unit #2	09/13/1962	Gas Well	Attempted to drill with gas. Had to convert to water at 1,035'. Tried again several times at different depths.
12	24S-34E-09	Federal “9" Com #1	12/03/1963	Gas Well	Hit water while gas drilling at 4,865'.
13	24S-34E-13	Federal Johnson #1	06/23/1958	P&A	Proposed to drill with air, but no information in the records indicate air drilling.
14	26S-32E-20	Russell Federal #1	03/16/1966	Oil Well	Drilled with air to 1,330'.
15	26S-32E-36	North El Mar Unit #44	02/19/1959	Oil Well	Proposed to drill with air, but no information in the records indicate air drilling.
Wells Drilled after Supplemental Information Provided to the EPA Docket in 1997.					
16	22S-26E-28	Sheep Draw “28" Federal #13	07/01/1997	Oil Well	Air drilled the first 358'.

NOTE: The research on “air drilling” is a continuous effort since every new well drilled is checked to determine if any portion of the well was drilled by air. A copy of all completion reports are on file for all wells completed within the New Mexico portion of the Delaware Basin.

TABLE 7
Shallow Well Status in the Delaware Basin

Well Type	*Texas*	*New Mexico*	*Totals*
Core Hole	31	2	33
Dry Hole	326	150	476
Gas Well	6	0	6
Injection Well	5	0	5
Junked and Abandoned Well	59	28	87
Oil Well	87	7	94
Oil and Gas Well	1	0	1
Plugged Gas Well	1	2	3
Plugged Oil Well	14	13	27
Plugged Brine Well	2	1	3
Plugged Salt Water Disposal Well	0	4	4
Drilling or Waiting on Paperwork	40	43	83
Brine Well	1	2	3
Salt Water Disposal Well	0	1	1
Service Well	13	0	13
Stratigraphic Test Hole	1,170	0	1,170
Sulfur Core Hole	502	0	502
Potash Core Hole	0	992	992
Water Well	1,706	590	2,296
WIPP Well	0	187	187
Other (Mine Shafts, Gnome Project Wells)	0	44	44
TOTALS	3,964	2,066	6,030

NOTE: Only the known holes that occur in the Delaware Basin, except several WIPP holes, are listed in the above table. The WIPP holes are shown for completeness. The 83 wells under the listing of "Drilling or Waiting on Paperwork" do not have an associated depth until one has been reported on paperwork. These are listed as shallow wells but will eventually be placed in the deep classification when a depth has been listed in the paperwork.

TABLE 8
Deep Well Status in the Delaware Basin

Well Type	*Texas*	*New Mexico*	*Totals*
Core Hole	5	0	5
Dry Hole	2,176	842	3,018
Gas Well	845	641	1,486
Injection Well	244	63	307
Junked and Abandoned Well	56	15	71
Oil Well	3,845	1,890	5,735
Oil and Gas Well	91	5	96
Plugged Gas Well	177	135	312
Plugged Injection Well	4	30	34
Plugged Oil Well	511	285	796
Plugged Oil and Gas Well	36	0	36
Plugged Brine Well	0	1	1
Plugged Salt Water Disposal Well	0	10	10
Drilling or Waiting on Paperwork	17	6	23
Brine Well	8	0	8
Salt Water Disposal Well	6	103	109
Service Well	100	3	103
Stratigraphic Test Hole	43	2	45
Sulfur Core Hole	85	0	85
Potash Core Hole	0	19	19
WIPP Well	0	11	11
Other (Mine Shafts, Gnome Project Wells)	0	6	6
TOTALS	8,249	4,067	12,316

NOTE: The 23 wells under the category of "Drilling or Waiting on Paperwork" have a depth associated with them which classifies them as deep wells, but the paperwork classifying these wells as oil, gas, or some other type of well have yet to be posted. When posted, the classification of these types of wells will be changed.

TABLE 9
Past Drilling Rates for the Delaware Basin

Year	***No. of Deep Holes***	***Drilling Rate***
1996	10,804 Holes Deeper Than 2,150 Ft	46.8
1997	11,444 Holes Deeper Than 2,150 Ft	49.5
1998	11,616 Holes Deeper Than 2,150 Ft	50.3
1999	11,684 Holes Deeper Than 2,150 Ft	50.6
2000	11,828 Holes Deeper Than 2,150 Ft	51.2
2001	12,056 Holes Deeper Than 2,150 Ft	52.2
2002[1]	12,139 Holes Deeper Than 2,150 Ft	52.5

NOTE: The notable increase in the drilling rate between 1996 and 1997 was not due to the drilling of wells, but to the fact that the Delaware Basin Drilling Surveillance Program was not began until 1997 when a review of the records from July 1995 through 1997 was necessary to bring the databases up to date. Since that time, the drilling rate has risen approximately the same each year.

1 In Rev. 3 of this report dated September 2002, the drilling rate for 2002 was shown as 52.9 with 12,219 deep holes. While reviewing the databases to develop reports for the Compliance Recertification Application, it was noticed that 80 shallow wells in Texas were listed as being deep. Several days investigation found the problem, and it was corrected. Correcting the classification of the 80 holes to shallow resulted in a reduction in the drilling rate from 52.9 to 52.5. This was reported in the *Delaware Basin Monitoring Quarterly Report*, December 2002.

TABLE 10
Drilling in Relationship to the Cost of Crude Oil Since 1980

Year	*No. of New Wells in NM*[1]	*No. of New Wells in Texas*[1]	*Total No. of New Wells*	*Domestic Price of Crude Oil*[2]
1980	99	232	331	$21.59
1981	133	327	460	$31.77
1982	149	295	444	$28.52
1983	99	235	334	$26.19
1984	101	268	369	$25.88
1985	127	231	358	$24.09
1986	81	223	304	$12.51
1987	50	143	193	$15.40
1988	42	179	221	$12.58
1989	29	103	132	$15.86
1990	79	166	245	$20.03
1991	112	139	251	$16.54
1992	125	75	200	$15.99
1993	199	67	266	$14.25
1994	192	58	250	$13.19
1995	193	54	247	$14.62
1996	149	75	224	$18.46
1997	181	121	302	$17.23
1998	118	54	172	$10.87
1999	38	30	68	$15.56
2000	95	42	137	$26.72
2001	122	151	273	$21.84
2002	77	83	160	$22.51
2003	148	56	204	$27.93[3]

[1] Retrieved from Delaware Basin Drilling Surveillance Program Databases.
[2] Price per barrel from the DOE-Energy Information Administration.
[3] Price for current year is the average of the first six months and does not reflect the entire year.

TABLE 11
Castile Brine Encounters in the Vicinity of the WIPP Site

#	Location	Well Name and No.	Spud Date	Status	Well Information
Original CCA-related Castile Brine Encounters - 1896 Through June 1995					
1	21S-31E-26	Federal #1	10/31/1979	P&A	Identified as encountering Castile Brine.
2	21S-31E-35	ERDA-6	06/13/1975	P&A	Identified as encountering Castile Brine.
3	21S-31E-35	Federal “FI" #1	09/25/1981	P&A	Identified as encountering Castile Brine.
4	21S-31E-36	Lost Tank “AIS” State #1	12/07/1991	Oil Well	Identified as encountering Castile Brine.
5	21S-31E-36	Lost Tank “AIS” State #4	11/19/1991	Oil Well	Identified as encountering Castile Brine.
6	21S-32E-31	Lost Tank SWD #1	11/12/1991	SWD	Identified as encountering Castile Brine.
7	22S-29E-09	Danford Permit #1	05/18/1937	P&A	Identified as encountering Castile Brine.
8	22S-31E-01	Unocal “AHU” Federal #1	04/02/1991	Oil Well	Identified as encountering Castile Brine.
9	22S-31E-01	Molly State #1	09/25/1991	Oil Well	Identified as encountering Castile Brine.
10	22S-31E-01	Molly State #3	10/20/1991	Oil Well	Identified as encountering Castile Brine.
11	22S-31E-02	State “2" #3	11/28/1991	Oil Well	Identified as encountering Castile Brine.
12	22S-31E-11	Martha “AIK” Federal #3	05/06/1991	Oil Well	Identified as encountering Castile Brine.
13	22S-31E-11	Martha “AIK” Federal #4	09/02/1991	Oil Well	Identified as encountering Castile Brine.
14	22S-31E-12	Federal “12" #8	03/28/1992	Oil Well	Identified as encountering Castile Brine.
15	22S-31E-13	Neff “13" Federal #5	02/04/1991	Oil Well	Identified as encountering Castile Brine.
16	22S-31E-17	WIPP-12	11/17/1978	Monitoring	Identified as encountering Castile Brine.
17	22S-32E-05	Bilbrey “5" Federal #1	11/26/1981	Oil Well	Identified as encountering Castile Brine.
18	22S-32E-15	Lechuza Federal #4	12/29/1992	Oil Well	Identified as encountering Castile Brine.
19	22S-32E-16	Kiwi “AKX” State #1	04/28/1992	Oil Well	Identified as encountering Castile Brine.
20	22S-32E-25	Covington “A” Federal #1	02/07/1975	Oil Well	Identified as encountering Castile Brine.
21	22S-32E-26	Culberson #1	12/15/1944	P&A	Identified as encountering Castile Brine.
22	22S-32E-34	Red Tank “34" Federal #1	09/23/1992	Oil Well	Identified as encountering Castile Brine.
23	22S-32E-36	Richardson State #1	07/20/1962	P&A	Identified as encountering Castile Brine.
24	22S-32E-36	Shell State #1	02/22/1964	Oil Well	Identified as encountering Castile Brine.
25	22S-33E-20	Cloyd Permit #1	09/07/1937	P&A	Identified as encountering Castile Brine.
26	22S-33E-20	Cloyd Permit #2	06/22/1938	P&A	Identified as encountering Castile Brine.
27	23S-30E-01	Hudson Federal #1	02/25/1974	SWD	Identified as encountering Castile Brine.
Castile Brine Encounters Since July 1995					
1	21S-31E-35	Lost Tank “35" State #4	09/11/2000	Oil Well	Estimated several hundred barrels per hour. Continued drilling.
2	21S-31E-35	Lost Tank “35" State #16	02/06/2002	Oil Well	At 2,705 ft., encountered 1,000 B/H. Shut-in to get room in reserve pit with pressure of 180 psi. Shut-in next day with pressure at 100 psi and waterflow of 450 B/H. Two days later now water flow and full returns.
3	22S-31E-02	Graham “AKB”State #8	04/12/2002	Oil Well	Estimated 105 barrels per hour. Continued drilling.
4	23S-30E-01	James Ranch Unit #63	12/23/1999	Oil Well	Sulfur water encountered at 2,900 ft. 35 PPM was reported but quickly dissipated to 3 PPM in a matter of minutes. Continued drilling.
5	23S-30E-01	Hudson “1" Federal #7	01/06/2001	Oil Well	Estimated initial flow at 400 to 500 barrels per hour with a total volume of 600 to 800 barrels. Continued drilling.

TABLE 12
Plugged Well Information

#	*Location*	*API #*	*Plug Date*	*R-111-P*	*Well Depth*	*Plug Depth*	*Plug Length*
1	21S-27E-36	30-015-32688[1]	06/10/2003	No	12143 Ft	595-0	595 Ft
2	22S-26E-36	30-015-10908	07/29/2003	No	2208 Ft	1,900-1,850 1,759-1,650 414-303 100-0	50 Ft 109 Ft 111 Ft 100 Ft
3	22S-27E-30	30-015-20430	05/31/2003	No	11760 Ft	11,290-11,255 10,450-10,350 8,745-8,645 5,350-5,250 3,150-3,050 1,692-1,592 385-285 Surface	35 Ft 100 Ft 100 Ft 100 Ft 100 Ft 100 Ft 100 Ft
4	22S-27E-30	30-015-20336	01/29/2003	No	11840 Ft	11,350-11,315 10,730-10,630 10,062-9,962 8,776-8,676 7,000-6,900 5,343-5,243 2,300-2,200 1,678-1,578 402-302 Surface	35 Ft 100 Ft 100 Ft 100 Ft 100 Ft 100 Ft 100 Ft 100 Ft 100 Ft
5	23S-26E-19	30-015-32144	04/25/2003	No	11650 Ft	3,375-3,275 1,775-1,492 1,200-1,075 735-605 350-221 50-0	100 Ft 283 Ft 125 Ft 130 Ft 129 Ft 50 Ft
6	23S-27E-09	30-015-22290	06/27/2003	No	12205 Ft	11,485-11,450 10,890-10,855 8,070-7,708 5,655-5,390 2,606-2,441 415-0	35 Ft 35 Ft 362 Ft 265 Ft 165 Ft 415 Ft
7	23S-32E-31	30-015-32717	04/08/2003	No	10005 Ft	8,585-8,358 5,400-5,200 2,650-2,397 1,074-877 212-0	227 Ft 200 Ft 253 Ft 197 Ft 212 Ft
8	23S-33E-25	30-025-34762	04/04/2003	No	9000 Ft	7,770-7,392 7,270-6,892 5,290-4,985 2,200-2,004 1,500-1,378 734-632 Surface	378 Ft 378 Ft 305 Ft 196 Ft 122 Ft 102 Ft
9	25S-26E-01	30-015-28561	04/17/2003	No	5625 Ft	2,300-2,068 1,975-1,689 325-0	232 Ft 286 Ft 325 Ft

#	Location	API #	Plug Date	R-111-P	Well Depth	Plug Depth	Plug Length
10	25S-26E-14	30-015-25661	06/20/2003	No	12225 Ft	1,900-1,750 1,070-9,05 466-346 60-0	150 Ft 165 Ft 120 Ft 60 Ft
11	26S-32E-25	30-025-08274	04/17/2003	No	4656 Ft	4,550-4,440 3,750-3,460 733-518 Surface	110 Ft 290 Ft 215 Ft
12	26S-32E-25	30-025-08277	04/01/2003	No	4665 Ft	4,623-4,500 705-466 Surface	123 Ft 239 Ft
13	26S-32E-25	30-025-08278	04/28/2003	No	4719 Ft	4,625-4,256 3,400-3,266 3,245-2,876 700-686 670-295 30-0	369 Ft 134 Ft 369 Ft 14 Ft 375 Ft 30 Ft
14	26S-32E-25	30-025-08283	04/02/2003	No	4683 Ft	4,545-4,195 938-724 570-128 Surface	350 Ft 214 Ft 442 Ft
15	26S-32E-26	30-025-08292	03/12/2003	No	4641 Ft	4,641-4,333 457-0	308 Ft 457 Ft
16	26S-32E-26	30-025-08293	03/28/2003	No	4643 Ft	4,490-4,287 992-769 406-112 Surface	203 Ft 223 Ft 294 Ft
17	26S-32E-27	30-025-08300	03/25/2003	No	4550 Ft	4,295 2,938-667 351-137 30-0	 2,271 Ft 214 Ft 30 Ft
18	26S-32E-35	30-025-08309	03/20/2003	No	4523 Ft	4,430-4,174 938-780 403-188 30-0	256 Ft 158 Ft 215 Ft 30 Ft
19	26S-32E-36	30-025-08316	04/09/2003	No	4721 Ft	4,575-4,444 938-772 506-198 Surface	131 Ft 166 Ft 308 Ft
20	26S-33E-30	30-025-08430	04/11/2003	No	4742 Ft	4,675-4,417 3,300-3,182 900-790 388-0	258 Ft 118 Ft 110 Ft 388 Ft

[1] This well had the casing collapse at approximately 600 feet when cementing the production casing in the well bore. Numerous attempts to correct the problem failed. Permission was obtained from NMOCD to leave the well bore full of mud and install a solid plug 597 feet from the surface.

TABLE 13
Plugging Summary by Well Type

Type	*CRA*	*CRA Frequency*	*2003*	*2004*	*2005*	*2006*	*2007*	*Total*	*Current Frequency*	*Change*
I	116	34.1%	3					119	33.0%	-1.1%
II	60	17.7%	2					62	17.2%	-0.5%
III	111	32.6%	10					121	33.6%	+1.0%
IV	38	11.2%	3					41	11.4%	+0.2%
V	10	02.9%	1					11	03.1%	+0.2%
VI	5	01.5%	1					6	01.7%	+0.2%
TOTALS	340	100.0%	20					360	100.0%	

NOTE: The 1996 CCA used the 188 wells categorized into the above classifications to arrive at the percentage or frequency of each plugging event. The CRA followed up on that study and 152 wells were added to the original number to update the frequency. In 2003, 23 wells were plugged and abandoned in the New Mexico portion of the Delaware Basin. Three were ruled out because they were less than 2,150 feet deep. Twenty wells were categorized into one of the above plugging configurations and added to the count. The change indicated above is between the current and the CRA frequencies for each type of plugging configuration.

TABLE 14
Seismic Activity in the Delaware Basin

County	No. of Events	Earliest Event	Latest Event	Smallest Magnitude	Largest Magnitude
Culberson	8	12/30/1997	03/13/2003	1	2.0
Eddy	5	04/24/1983	12/03/1998	1.1	3.5
Lea	1	04/24/2003	04/24/2003	2.0	2.0
Loving	3	02/04/1976	04/28/1997	1.1	1.3
Pecos	10	04/03/1977	12/22/1998	1	2.2
Reeves	16	08/03/1975	05/25/2002	1	2.5
Ward	26	09/24/1971	08/18/1984	0.8	3
Winkler	1	04/30/1976	04/30/1976	1.5	1.5
TOTALS	70	09/24/1971	08/04/2002	0.8	3.5

KEY:
Magnitude

Less than 2	Very seldom ever felt
2.0 to 3.4	Barely felt
3.5 to 4.2	Felt as a rumble
4.3 to 4.9	Shakes furniture; can break dishes
5.0 to 5.9	Dislodges heavy objects; cracks walls
6.0 to 6.9	Considerable damage to buildings
7.0 to 7.3	Major damage to buildings; breaks underground pipes
7.4 to 7.9	Great damage; destroys masonry and frame buildings
Above 8.0	Complete destruction; ground moves in waves

NOTE: Three of the five earthquake events in Eddy County can be directly attributed to mining activities. The other two remain unexplained. Most of the seismic events recorded in the vicinity of the Delaware Basin can be attributed to oil and gas activities - such as the number of events that continue to occur in the Dagger Draw or Cass Ranch area of Central Eddy County - where a large number of oil and gas activities are being conducted.

TABLE 15
Nine-Township Injection and SWD Well Information

#	Location	API #	Status	Injection Zone	Permitted	Last Injection	Cumulative Barrels
1	21S-31E-33	30-015-29330	SWD	4166-5160	1998	April-2003	1,701,602
2	21S-32E-08	30-025-31412	SWD	4826-5978	1991	April-2003	5,536,033
3	21S-32E-31	30-025-31443	SWD	4618-6012	1992	April-2003	162,423
4	22S-30E-02	30-015-25758	Injection	7200-7264	1993	April-2003	6,959,524
5	22S-30E-02	30-015-26761	Injection	5600-7400	1991	April-2003	7,339,347
6	22S-30E-27	30-015-04734	SWD	3820-3915	1981	April-2003	2,232,043
7	22S-31E-02	30-015-32440	Injection	6989-7020	2003	No Report	No Report
8	22S-31E-24	30-015-26848	SWD	4519-5110	1991	Dec-2002	5,134,605
9	22S-31E-25	30-015-28281	Injection	7050-7068	1995	April-2003	3,807,382
10	22S-31E-35	30-015-26629	SWD	4500-5670	1991	April-2003	8,813,961
11	22S-31E-36	30-015-26171	SWD	4500-5700	1998	Jan-2003	3,174,636
12	22S-32E-07	30-025-31076	SWD	4676-5814	1991	April-2003	5,389,999
13	22S-32E-11	30-025-31716	SWD	5200-8706	1994	April-2003	1,018,905
14	22S-32E-14	30-025-08113	SWD	4900-6080	1994	April-2003	2,793,571
15	22S-32E-16	30-025-31889	SWD	5240-8710	1995	April-2003	5,779,929
16	22S-32E-21	30-025-08109	SWD	4755-5110	1992	April-2003	2,009,378
17	22S-32E-27	30-025-32436	Injection	6831-8388	1998	No Report	No Report
18	22S-32E-28	30-025-31754	SWD	4690-5800	1993	April-2003	595,907
19	22S-32E-31	30-025-20423	SWD	4662-5915	1993	April-2003	3,169,987
20	22S-32E-35	30-025-33149	SWD	4950-6252	1995	March-2003	2,431,527
21	23S-30E-01	30-015-21052	SWD	4040-4825	2001	April-2003	835,024
22	23S-30E-19	30-015-28901	SWD	3402-4609	1997	No Report	No Report
23	23S-30E-29	30-015-28808	SWD	5479-7220	1996	April-2003	1,798,297
24	23S-30E-33	30-015-31744	SWD	4546-6760	2002	No Report	No Report
25	23S-31E-02	30-015-05840	SWD	4489-5670	1997	April-2003	4,948,254
26	23S-31E-02	30-015-29792	SWD	4500-5850	1998	April-2003	4,442,566
27	23S-31E-20	30-015-30605	Injection	7740-7774	2001	Dec-2001	244,642
28	23S-31E-26	30-015-20277	SWD	4460-5134	1992	April-2003	3,382,327
29	23S-31E-26	30-015-20302	SWD	4390-6048	1971	April-2003	4,679,900
30	23S-31E-27	30-015-27106	SWD	4694-5284	1998	No Report	No Report
31	23S-31E-28	30-015-26194	SWD	4295-5570	1993	April-2003	3,052,626

#	Location	API #	Status	Injection Zone	Permitted	Last Injection	Cumulative Barrels
32	23S-31E-35	30-015-25640	SWD	4484-5780	1993	April-2003	2,662,051
33	23S-31E-36	30-015-20341	SWD	5980-6560	1994	April-2003	7,698,860
34	23S-32E-04	30-025-31650	SWD	No Report	2003	April-2003	472,969
35	23S-32E-14	30-025-26844	SWD	5496-6014	1991	April-2003	1,111,234
36	23S-32E-23	30-025-33653	SWD	5954-6064	No Report	May-2001	911,167
37	23S-32E-24	30-025-33521	SWD	5925-6042	No Report	April-2003	887,025
38	23S-32E-29	30-025-31515	SWD	4844-4944	1992	April-2003	3,437,655
39	23S-32E-31	30-025-32868	SWD	5150-5700	1996	Dec-2002	657,195
40	23S-32E-35	30-025-08128	SWD	5062-5100	1969	March-2002	142,681
41	23S-32E-36	30-025-31929	SWD	5364-6138	1995	April-2003	1,219,399

NOTE: Information collected from OCD offices in Artesia and Hobbs, New Mexico. Also, cumulative barrels information is collected from the New Mexico Oil & Gas Engineering Committee, Inc. and is always six months behind the current date.

TABLE 16
Brine Well Status in the Delaware Basin

County	*Location*	*API #*	*Well Name and No.*	*Operator*	*Status*
Eddy	22S-26E-36	30-015-21842	City Of Carlsbad #WS-1	Key Energy Services	Brine Well
Eddy	22S-27E-03	30-015-20331	Tracy #3	Ray Westall	Plugged Brine Well
Eddy	22S-27E-17	30-015-22474	Eugenie #WS-1	I & W, Inc.	Brine Well
Eddy	22S-27E-17	30-015-23031	Eugenie #WS-2	I & W, Inc.	Plugged Brine Well
Loving	Blk 29-03	42-301-10142	Lineberry Brine Station #1	Chance Properties	Brine Well
Loving	Blk 01-82	42-301-30680	Chapman Ford #BR1	Herricks & Son Co.	Plugged Brine Well
Loving	Blk 33-80	42-301-80318	Mentone Brine Station #1D	Basic Energy Services	Brine Well
Loving	Blk 29-28	42-301-80319	East Mentone Brine Station #1	Permian Brine Sales, Inc.	Plugged Brine Well
Loving	Blk 01-83	42-301-80320	North Mentone #1	Chance Properties	Brine Well
Reeves	Blk 56-30	42-389-00408	Orla Brine Station #1D	Mesquite SWD, Inc.	Brine Well
Reeves	Blk 04-08	42-389-20100	North Pecos Brine Station #WD-1	Chance Properties	Brine Well
Reeves	Blk 07-21	42-389-80476	Coyanosa Brine Station #1	Chance Properties	Brine Well
Ward	Blk 17-20	42-475-31742	Pyote Brine Station #WD-1	Chance Properties	Brine Well
Ward	Blk 01-13	42-475-34514	Quito West Unit #207	Seaboard Oil Co.	Brine Well
Ward	Blk 34-174	42-475-82265	Barstow Brine Station #1	Chance Properties	Brine Well