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**TECHNICAL SUPPORT DOCUMENT FOR**

**THE LWA: LEASE EVALUATION**

**U. S. ENVIRONMENTAL PROTECTION AGENCY  
Office of Radiation and Indoor Air  
Center for the Waste Isolation Pilot Plant  
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## EXECUTIVE SUMMARY

The WIPP site is located in the center of the WIPP Land Withdrawal Act (LWA) boundary, an area of approximately 16 square miles located in T22S, R31E, Eddy County, New Mexico. This study focuses on the evaluation of oil and gas industry activities on two 320 acre leases on and adjacent to the southwestern portion of the WIPP LWA boundary (NMNM 2953 and NMNM 2953C), and potential for impact to the repository from industry related activities on the subject leases. Information from an EPA study - "Technical Support Document Section for 194.32: Fluid Injection Analysis", (USEPA, 1998), is used in this report. This study evaluated the potential impact of fluid transport pathways due to oil and gas activity in the WIPP vicinity.

Reservoir characteristics of prospective production and injection zones were reviewed based on three wells that are productive in Los Medanos Field and are expected to be representative of prospective production and injection zones across the subject leases. The wells, located between ½ and 1 mile northwest, west, and south of the subject leases, were drilled to sufficient depth to evaluate the majority of prospective strata within the geologic column. The geologic column is similar in respect to formations, rock type, and thicknesses as in the WIPP Compliance Certification Application (CCA). Intervals exhibiting porosities of between 1 percent and 13 percent were identified. Based on observed reservoir characteristics of prospective formations on and adjacent to the subject leases, and proximity to production activity in the Los Medanos Field, it is likely, dependent upon favorable economic conditions, that near term drilling activity may include directional drilling into the subject leases from outside the WIPP land withdrawal area in order to exploit potential oil and gas formations productive at Los Medanos Field. If no other restrictions are applied, standard land use requirements could allow up to 16 wells to be drilled outside of condemned lands for exploitation of a single oil pool, and up to 4 gas wells to be drilled for exploitation of a single gas pool. Multiple pool development, and/or conversion of production wells to injection wells, could increase well density.

In the WIPP vicinity, current oil and gas operations include conversion of selected depleted production wells into brine disposal wells or waterflood injection wells for secondary recovery. Disposal is typically into the Bell Canyon Formation. Based on observed porous intervals across the subject leases, and industry practice of conversion for injection, it is likely that a field operator may, upon depletion of reserves, convert a well which has been producing from the Bell Canyon or another zone into a brine disposal well for disposal of oil field brines. It is also likely that secondary recovery efforts in Los Medanos Field may include conversion of depleted wells into injection wells to enhance oil and/or gas recovery efforts.

This study also reviewed interbed characteristics relative to potential interbed transport pathways in the Salado Formation based on well data from an additional four wells adjacent to the subject leases. Well log characteristics regarding the number of interbeds, thicknesses of interbeds, and gross thickness of porous intervals within interbeds were evaluated and compared to wells included in an EPA study (USEPA, 1998), of interbed units in the WIPP vicinity. Analysis and statistical comparison of interbed characteristics from well log data indicates that interbeds present in wells within the lease area are consistent with interbed characteristics of wells surrounding the WIPP land withdrawal area.

Review of well file and completion data for the Bass James Ranch #13 (Bass JR 13), which was

directionally drilled into the subject leases, and adjacent wells indicate that the wells appear to have been completed in accordance with industry standards. Detailed review of the Bass JR 13 well file does not provide all information that would be required to verify that pressure tests were performed after casing cementation and that specific test parameters were met. Based on review of deviation survey data, the Bass JR 13 intersects Salado interbeds (potential impact pathway) to the south of the subject leases. Under the hypothetical injectate release scenario, any release of injectate from deeper horizons would migrate up the borehole and come into contact with the Salado interbeds outside the subject leases, and outside the WIPP LWA boundaries. Cementation of multiple casings over the Salado interbed interval in the Bass JR 13 makes this scenario highly unlikely.

The DOE evaluated the possibility of drilling activities impacting the WIPP repository as part of its CCA features, events, and processes screening evaluations (FEPs). The DOE concluded that drilling for resources such as oil and gas outside of the LWA area would have little impact on the WIPP in the near term and, therefore, DOE was not required to examine the effects of such drilling in the more distant future as per 40 CFR §194.25(a). However, the DOE included drilling for resources within the LWA (and, specifically, penetrating the repository) in the CCA performance assessment. Additionally, DOE evaluated the potential impact of injection activities immediately outside of the LWA area and concluded that such activities would have little if any impact on the disposal performance of WIPP, based upon geologic containment characteristics of the WIPP site, well completion practices in the WIPP area, etc. DOE therefore screened fluid injection and secondary oil/gas recovery from performance assessment based on low consequence. The previously discussed EPA study (USEPA, 1998) independently evaluated the impact of fluid injection on repository performance. The study confirmed the relatively favorable site characteristics and well completion practices, and concluded that it is highly unlikely that the combination of events and site characteristics, necessary for a worse-case injection scenario to occur would be present in the WIPP area. EPA therefore concurred with DOE's decision to exclude fluid injection from performance assessment.

Based on the similar geologic characteristics and well completion practices in the lease analysis area relative to conditions identified in previous CCA screening and EPA's fluid injection studies, conclusions regarding the impact of oil and gas activities to the WIPP repository developed in the previous studies also apply to those of the subject leases. That is, because the lease area has similar geologic, well completion, and other characteristics similar to the CCA's injection analysis and EPA's independent injection analysis, the conclusion of no consequence drawn by these studies also applies to the subject lease area. All potential uses of these leases related to oil and gas production have been examined, and no activities related to oil and gas production in the subject leases will adversely affect the WIPP disposal system performance during the regulatory time period.

## 1.0 INTRODUCTION

This study was conducted to evaluate the potential impact of oil and gas drilling activities on the leases in the southwestern section of the WIPP Land Withdrawal Boundary. The WIPP site is located in the center of the WIPP Land Withdrawal Act (LWA) boundary, an area of 16 square miles located in Sections 16 through 22 and 27 through 36 of Township 22 South (T22S), Range 31 East (R31E), Eddy County, New Mexico (Figure 1). This study focuses on the evaluation of oil and gas industry activities on two 320 acre leases (NMNM 2953 and NMNM 2953C) on and adjacent to the southwestern portion of the WIPP LWA boundary, and potential for industry related activities on the subject leases to impact to the WIPP repository (Figure 1).

The LWA established the management responsibilities and plan for the land withdrawal that encompasses the WIPP. The management plan portion of the LWA, contained in Section 4 - Establishment of Management Responsibilities, provides that the Secretary shall develop a management plan for the use of the withdrawal area until the end of the decommissioning phase.

Section 4(b)(5)(A) disallows surface or subsurface mining, or oil or gas production, including slant drilling from outside the boundaries, on land on or under the LWA. However, Section 4(b)(5)(B), creates an exception to the above restriction for Federal Oil and Gas Lease Numbers NMNM 2953 and NMNM 2953C, the subject leases of this study. The exception states that “existing rights ... shall not be affected unless the Administrator determines, after consultation with the Secretary and the Secretary of the Interior, that the acquisition of such leases by the Secretary is required to comply with the final disposal regulations or with the Solid Waste Disposal Act (42 U.S.C. 6901 et seq.)”.

The DOE evaluated the possibility of drilling activities impacting the WIPP repository as part of it's CCA features, events, and processes screening evaluations (FEPs). The DOE concluded that drilling for resources such as oil and gas outside of the LWA area would have little impact on the WIPP in the near term and, therefore, DOE was not required to examine the effects of such drilling in the more distant future as per 40 CFR §194.25(a). However, the DOE included drilling for resources within the LWA (and, specifically, penetrating the repository) in performance assessment. Additionally, DOE evaluated the potential impact of injection activities immediately outside of the LWA area (Stoelzel, 1997a, Stoelzel 1997b). These previous DOE studies focused on deep injection of produced brine and the potential for brine injectate to migrate (subject to injection well malfunction) from wells located adjacent to the WIPP land withdrawal area upwards into strata that surround and abut the WIPP repository (Salado interbeds), and horizontally across to the WIPP site. The results of the previous DOE studies indicate that it is unlikely for pressure effects or significant flow of injectate fluids to reach the WIPP repository and concluded that such activities would have little if any impact on the disposal performance of WIPP, based upon geologic containment characteristics of the WIPP site, well completion practices in the WIPP area, etc. These DOE injection studies assumed the presence of injection wells immediately adjacent to the WIPP; the NMNM 2953 and NMNM2953C leases are also immediately along, but within, the WIPP LWA boundary.

The EPA also conducted it's own fluid injection analysis (F.A.) study (“Technical Support Document Section for 194.32: Fluid Injection Analysis”, USEPA, 1998) which independently evaluated the impact of fluid injection on repository performance. The FIA study examined oil and gas activity and geological conditions inclusive and adjacent to the WIPP land withdrawal

area that includes a 9 township study area and potential for impact on the WIPP repository of industry related fluid injection activities. The FIA study also examined the characteristics of the Salado interbeds in the WIPP vicinity (9 township study area). The FIA study confirmed the relatively favorable site characteristics and well completion practices, and concluded that it is highly unlikely that the combination of events, site characteristics, necessary for a worse-case injection scenario to occur would be present in the WIPP area. EPA therefore concurred with DOE's decision to exclude fluid injection from performance assessment.

This lease analysis study is supplemental to the FIA study (USEPA, 1998). In addition, this lease analysis study incorporates findings from the previous DOE studies, and examines applicability of all relevant previous studies to the subject leases.

## 1.1 PURPOSE

The primary objectives of this study are to develop a summary regarding all oil and gas activities which have occurred and are likely to occur on the subject leases, and to evaluate the potential for oil and gas activities to impact the WIPP site. The findings of this report include:

- Evaluation of the potential for development of prospective hydrocarbon reservoirs and injection zones within the subject leases;
- Identification of land use requirements that may impact lease development;
- Characterization of the Salado interbeds (potential migration pathways for injection fluids) relative to the findings of the WIPP vicinity study; and
- Review of the Bass James Ranch #13 (Bass JR 13), a directionally drilled well producing from the subject leases, as well as three surrounding wells, to evaluate the potential impact to the WIPP site resulting from current and future production and disposal operations.

## 1.2 LEASE SETTING

The subject leases (NMNM 2953 and NMNM 2953C) include 640 acres located within the James Ranch Participating Unit (Figure 2). Los Medanos Field, productive from six formations, includes 23 oil and/or gas wells that are between 1/8 and 1 mile to the northwest, west and south of the subject leases, and one gas well, the Bass JR 13, that produces from the subject leases (Figure 2). The lease locations include areas condemned under the LWA in Section 31, T22S, R31E. Lease # NMNM2953 includes 320 acres making up the north 1/2 of Section 31, T22S, R31E, and additional acreage outside the land withdrawal area. Lease #NMNM2953C includes 320 acres in the south 1/2 of Section 31, T22S, R31E. The surface location of the Bass JR 13 is located approximately 1/4 mile south of subject lease NMNM2953C and is directionally drilled to the north, causing the borehole to cross into and produce from the subject lease.

## 1.3 SCOPE OF WORK

Petrotek/RMCI were to perform the following tasks for this study:

- Review and incorporate findings of the FIA (USEPA, 1998) as appropriate;
- Review the LWA, leases and unit agreements, and New Mexico State Oil and Gas Rules;
- Review current (September, 1997) drilling and permit activity on the subject leases as identified by Petroleum Information (PI) activity reports.
- Review well logs, state well file data, and production data for the Bass JR 13 and three adjacent wells (Enron 17JR, Enron 73JR, Enron 76JR) located south of the subject leases in the northwest 1/4 of Section 6, T23S, R31E, in an effort to characterize the Salado interbed zone as a potential impact pathway resulting from production and disposal activity, and evaluate completion details in order to compare completion practices of wells adjacent to the subject leases with industry standards (Figure 2). A detailed evaluation of the Bass JR 13, which produces from the subject lease via a directionally drilled borehole, was conducted. The following wells were reviewed for the interbed analysis:

Bass James Ranch #13 - SWNW Section 6-Township 23 S, Range 31 E.  
Enron James Ranch #76 - NWNW Section 6-Township 23 S, Range 31 E.  
Enron James Ranch #73 - NENW Section 6-Township 23 S, Range 31 E.  
Enron James Ranch #17 - SENW Section 6-Township 23 S, Range 31 E.

- Review well log data, representative of conditions on the subject leases, to evaluate site stratigraphy and assess the presence of potential oil/gas production and waste injection zones in immediate WIPP area. The wells selected for analysis were drilled deep enough to provide the most comprehensive representation of the stratigraphic column available. Additionally, the three wells (Mitchell/Apache 25-1, Shell 1JR, Conoco 7JR) are located to the northwest, west, and south of the subject leases, so that formation characteristics can be extrapolated across the subject leases (Figure 2). The following wells were included in the stratigraphic analysis:

Shell James Ranch #1, 1/4 Sec. 36-T22S-R30 E, approximately 1/2 mile west of the subject leases, TD - 17,555 feet (5,351m) BGS;

Mitchell/Apache #25-1, Sec. 25-T22S-R30 E, approximately 1 mile north of the subject leases, TD - 14,493 feet (4,555m) BGS; and

Conoco #7 James Ranch, Sec. 6-T23S-R31 E, approximately 1/4 mile east of the subject leases, TD -14,590 feet (4,447m) BGS.

## **2.0 DATA COLLECTION**

### **2.1 LAND USE CONDITIONS**

In order to determine applicable restrictions on oil and gas development activities on the subject leases, operator and lease holder status, and development requirements based on spacing rules, a review was conducted of the LWA lease and unit agreements, and the NMOCD.

As part of the study, a review was conducted of the Waste Isolation Pilot Plant LWA, Public Law 102-579 (S. 1671), October 30, 1992. The LWA is presented in Appendix A. Lease and unit agreement information available at the New Mexico Oil Conservation Division (NMOCD) office in Artesia, New Mexico, was also reviewed. Lease and unit information is presented in Appendix B. Rules of the NMOCD, contained in "State of New Mexico, Energy and Minerals Department, Oil Conservation Division, Rules and Regulations", February 1, 1996, were also reviewed.

## 2.2 OIL AND GAS DEVELOPMENT POTENTIAL

In order to evaluate the potential for future oil and gas development based on current activity and geologic conditions, and to evaluate the potential impact on the subject leases, a review of well logs, well files, production records, and completion records for selected wells in Los Medanos Field was conducted. A review of completion practices and Salado interbed geologic characteristics of the Salado interbeds was conducted based on data for 4 wells south of the subject leases. A review of WIPP site stratigraphy, as well as potential production and injection zones was conducted from review of data from 3 wells that best represent stratigraphy across the subject lease.

The Fluid Injection Analysis (FIA) (USEPA 1998) study focused on the evaluation of oil and gas industry activities in the vicinity of the WIPP site and the potential industry-related fluid injection activities to impact the repository. The FIA study summarizes oil and gas activities that have occurred and are likely to occur in the WIPP vicinity, characterizes geologic and operational conditions, and evaluates the possibility for oil and gas fluid injection activities to effect the WIPP disposal system. The FIA incorporates a 9 township area including and adjacent to the WIPP withdrawal boundary. The FIA also includes a detailed analysis of oil and gas industry activities, well characteristics, stratigraphic and structural analysis, and an analysis of well logs representative of the geologic section that is equivalent to the section that contains the WIPP repository. The leases of interest in this report form a small subset of the area investigated in the FIA.

A review of current activity on the subject leases was conducted in order to evaluate potential for future activity. Data was obtained from the Denver Earth Resources Library (DERL), Denver, Colorado, on September 2, 1997. "Petroleum Information/Dwights Midland Region Report Section II - 09/02/97" was reviewed for the 4 township area including and adjacent to the subject leases. The Petroleum Information report, presented in Appendix C, includes listings of first reports (permitted wells), drilling wells, and completed wells.

Well files, well logs, production records, and completion records for wells in Los Medanos Field were reviewed. Well files and production records were obtained from the NMOCD in Artesia, New Mexico. Well logs and completion records were obtained from commercially available information services.

Evaluation of well completion practices and geologic characteristics of the Salado interbeds (interbed analysis) as potential impact pathways to the WIPP included review of well files and well logs for the following wells (Figure 2):

Bass James Ranch #13 - SWNW Section 6-T23 S, R31 E.  
Enron James Ranch #76 - NWNW Section 6-T23 S, R31 E.  
Enron James Ranch #73 - NENW Section 6-T23 S, R31 E.  
Enron James Ranch #17 - SENW Section 6-T23 S, R31 E.

Full well files for each of these four wells are provided in and Appendix D. Production records for these four wells are provided in Appendix E.

Evaluation of site stratigraphy and potential production and injection zones across the lease area (stratigraphic analysis) included review of the following three well logs (Figure 2):

Shell James Ranch #1, SWSE Section 36-T22S, R30 E.  
Mitchell/Apache #25-1, SWSE Section 25-T22S, R30 E.  
Conoco James Ranch #7, SWNE Section 6-T23S, R31 E.

### 3.0 DATA PRESENTATION

#### 3.1 LAND USE CONDITIONS

##### 3.1.1 Land Withdrawal Act

The LWA established the management responsibilities and management plan for the land withdrawal that encompasses the WIPP. Section 4(b)(5)(A), contained within the management plan portion of the LWA, disallows surface or subsurface mining or oil or gas production, including slant drilling from outside the boundaries, on land on or under the LWA. Section 4(b)(5)(B), creates an exception to the above restriction for Federal Oil and Gas Lease Numbers NMNM02953 and NMNM 02953C, the subject leases of this study. The exception states that “existing rights ... shall not be affected unless the Administrator determines, after consultation with the Secretary and the Secretary of the Interior, that the acquisition of such leases by the Secretary is required to comply with the final disposal regulations or with the Solid Waste Disposal Act (42 U.S.C. 6901 et seq.)”.

##### 3.1.2 Lease and Unit Agreements

A mineral ownership review was conducted on September 12, 1997 for the following lands in Eddy County, New Mexico (approximately 640 acres):

T22S R31E Sec. 31: S ½ in Lease NMNM 2953C  
T22S R31E Sec. 31: N ½ in Lease NMNM 2953

The lease status and mineral ownership for the captioned lands are as follows:

Operator:	Bass Enterprises (Midland, TX)
Non-operating working interest:	Enron (Houston, TX)
Status:	Federal past primary term; Held By Unit James Ranch Unit, approved 1953
Participating Area (PA):	2nd revised Atoka PA
Potash Mining Priority:	Effective in James Ranch Unit (non-condemned)
Condemnation:	Surface to 6,000 feet, DOE.

A Decision of Condemnation finalized May 6, 1983 condemns the upper 6,000 feet of the subject leases (NMNM 2953 and NMNM 2953C) as follows:

"The exclusive use of the surface and uppermost 6000 feet of subsurface for the specific purpose only of preventing any drilling activity intended for the purpose of exploration, development, production or removal of oil and gas by entry through said surface and initial subsurface; subject, however, to the outstanding interests of the United States, existing easements for public roads and highways, utilities, railroads and pipelines. The estate hereby taken shall in no way interfere with the exploration, development, production or removal of oil and gas by way of entries other than through the aforesaid surface and uppermost 6000 feet of subsurface." (USA vs. Eddy County Land and Bass Enterprises Production Company, Et Al, CV. No. 77-435p)

The James Ranch Unit outline includes portions of townships: T22S-R30 & R31 E, and a portion of T23S-R30 & R31 E, which includes production from at least six zones. The greater unit outline, established in 1953, remains in effect due to the priority of potash mining. The subject leases have been condemned for petroleum production from surface to 6,000 feet, which preclude drilling to strata below 6,000 feet from the surface of the subject leases.

### 3.1.3 State Oil and Gas Rules

New Mexico Oil Conservation Division (NMOCD) Rule 104. - Well Spacing: Acreage Requirements for Drilling Tracts, sets forth spacing requirements for producing oil and gas wells in New Mexico. Section 104C - Acreage and Well Location Requirements for Development Wells, provides that the development of oil wells shall consist of tracts consisting of approximately 40 contiguous acres substantially in the form of a square, and shall not be located closer than 330 feet to any boundary of a development tract. The rule provides that, unless otherwise provided in special pool rules, each development well in a defined gas pool of Pennsylvanian age or older which was created and defined by the Division prior to June 1, 1964, shall be located on a designated drilling tract consisting of 160 contiguous acres, comprising any two contiguous quarter sections for a single governmental section. The James Ranch Participating Area - Atoka, is subject to this spacing. Gas pools in the Wolfcamp Formation created and defined after November 1, 1975, or Pennsylvanian age or older created and defined after June 1, 1964, shall be located on drilling tracts of 320 contiguous acres.

## 3.2 OIL AND GAS DEVELOPMENT POTENTIAL

### 3.2.1 Geological Summary of Oil and Gas Development in the Vicinity of WIPP

The subject leases are located in the Delaware Basin, the western-most sub basin of the Permian basin. The Delaware Basin is a major oil and gas producing area of southeastern New Mexico and western Texas. The Delaware Basin has been a productive province for oil and gas operators since the early 1900's. More than 10,000 wells have been drilled in the Delaware Basin and approximately 803 wells have been drilled in the 9 township area of interest surrounding the WIPP site through September 1996 (USEPA, 1998).

The Delaware Basin productivity is dominated by oil and associated gas found the Permian strata and gas condensate in the Pennsylvanian strata (Figure 3). Other formations produce minor amounts of oil and gas. The FIA (USEPA, 1998) summarizes production in the 9 township area as being primarily from the following geologic strata:

- Delaware Mountain Group sandstones, approximately 6,000 to 8,000 feet [1,829 to 2,438 meters (m) below ground surface (BGS)];
- Bone Spring sandstones and carbonates, approximately 8,000 to 10,000 feet (2,438 to 3,048 m) BGS;
- Wolfcamp carbonates, approximately 12,000 feet (3,658 m) BGS;
- Strawn (Cisco Canyon) carbonates, approximately 13,000 feet (3,962 m) BGS: and
- Atoka and Morrow sandstones, approximately 13,000 and 14,000 feet (3,962 to 4,267 m) BGS.

The formations listed above are continuous across the WIPP area.

The production potential of strata present in the WIPP withdrawal area can be rated as either probable, possible, or speculative. The probable category is defined as potential petroleum resources associated with existing fields, such as extensions of existing production. Five prospective formations adjacent to the WIPP site are considered to contain probable reserves under the WIPP withdrawal area, including Permian Bell Canyon, Cherry Canyon, and Brushy Canyon Formations, and Pennsylvanian Atoka and Morrow Formations. Possible reserves refers to potential production within the same area of the Delaware Basin that has similar geologic conditions. Prospective formations adjacent to the WIPP site include seven strata considered to contain possible reserves: Permian Wolfcamp, Pennsylvanian Cisco, Canyon Strawn, Silurian Fusselman, and Ordovician Simpson sandstone and Ellenburger dolomite reservoirs. Mississippian limestone and Devonian shale are considered speculative reserves (USEPA, 1998).

The FIA (USEPA, 1998) reviewed data on injection activity in the 9 township study area in and around the WIPP withdrawal area. According to the study, brine disposal, pressure maintenance, and water flooding occur throughout the Delaware Basin and currently are underway in the immediate vicinity of the WIPP site.

Field operators typically choose to begin brine disposal operations via fluid injection immediately upon well completions and initiation of production. Typical water cuts (percentage of water in total fluid produced) for new production in the vicinity ranges widely from 10% to 90%, with water cuts in excess of 50 % being typical. At the time of the FIA (USEPA, 1998), Class II Underground Injection Control (UIC) permits authorize the injection of produced brine into the Bell Canyon and deeper formations in the vicinity of the WIPP site. There are currently 36 permitted injection wells in the 9 township study area surrounding the WIPP site. Injection wells are typically completed in the Delaware Mountain Group with depth ranging from 3,820 to 8,344 feet [1,164 to 2,543 meters (m)] BGS, with injection typically taking place into the Bell Canyon Formation of the Delaware Mountain Group. Most of the wells inject at a rate of 500 to

2,000 barrels of water per day (BWPD) (80 to 318 m<sup>3</sup> /day).

### 3.2.2 Geologic Perspective for Oil and Gas Development on the Leases Area

#### 3.2.2.1 Los Medanos Field Summary

The subject leases are located within James Ranch Unit, Los Medanos Field. The Los Medanos Field contains 24 oil and/or gas wells within 5 sections (Figures 1 and 2). The field was discovered in 1958 and is productive from the Bell Canyon, Brushy Canyon, Bone Spring, Strawn, Wolfcamp, Atoka, and Morrow formations (Figure 3). The Los Medanos Field includes a well which produces from beneath the WIPP withdrawal area, the Bass JR 13. This well was directionally drilled northward from the adjacent section to the south (Section 6, T23S, R31E) into the leased area (Lease # NMNM 2953C in Section 31, T22S, R31E) to intersect the productive horizon, Pennsylvanian Atoka (Figures 3 and 4). The well was drilled in 1982 and is currently producing natural gas from a sandstone reservoir, cumulative production to date is 7.528 billion cubic feet ( $2.1 \times 10^7$  cubic m) of gas and 40,586 barrels (6.45 million liters) of condensate. Depth to the top of the producing interval is 13,466 feet (4,105 m) BGS.

Enron drilled three wells adjacent to the Bass Jones Ranch #13 since 1994, with two completions in late 1996. Each well targeted oil production zones and has already been recompleted several times. Oil, gas and associated water are commingled in production from these wells. Table 1 summarizes the Bass JR 13 and the three adjacent wells drilled in the NW 1/4 of Section 6-T23S, R31E.

Review of the FIA (USEPA, 1998) Appendix 9 - Summary of all Injectors in Eddy and Lea Counties, does not identify any injection wells in the James Ranch Unit or Los Medanos Field.

Current drilling activity in the Los Medanos Field area was reviewed and is presented below. Review of the September 2, 1997 PI reports for a 4 township area incorporating the subject leases (T22S-R30E, T22S-R31E, T23S-R30E, and T23S-R31E) indicates there are no "first reports" on newly permitted well locations or newly completed wells. The review presents the following drilling activity in the 4 township area:

- No wells are currently being drilled in T22S, R30E.
- Four wells are currently being drilled in Sections 3, 24, and 36 of T22S-R31E. Of these wells the closest is approximately 5 miles east of the subject leases. Three of the drilling wells are 1 to 2 miles east of the WIPP withdrawal area boundary.
- Three wells are currently being drilled in Sections 20, 30, and 32 of T23S-R30E. The location of the nearest of the wells is approximately 5 miles west of the subject leases.
- Sixteen wells are currently being drilled in Sections 1, 2, 12, 25, and 36 of T23S-R31E. The location of the nearest of these wells is approximately 4 miles east of the subject leases.

#### 3.2.2.2 Future Development on Subject Leases

This report includes an investigation performed to identify potential production/injection intervals of prospective strata within the 640 acre encompassed by the subject leases. In addition to other formation characteristics, zones that have porosity characteristics of potential reservoir quality are identified. Due to processes associated with brine disposal and secondary recovery operations, reservoir quality strata are also considered prospective injection zones. A preliminary geologic type section is presented in Table 2 that presents aquitard and reservoir characteristics of the sedimentary column for the study area between depths of 6,000 feet to approximately 17,700 feet. This study includes information from public-domain well logs and completion information. Formation names, depths below ground surface, aquitard characteristics, and porosity characteristics are shown.

A review of wells in Los Medinos field activities identified three wells, based on depth penetrated and relative position to the subject leases, that were used in the stratigraphic analysis to develop the geologic type section (Figure 2):

- Shell James Ranch #1, Sec. 36-T22S-R30 E, approximately ½ mile west of the subject leases, TD - 17,555 feet (5,351m) BGS;
- Mitchell/Apache #25-1, Sec. 25-T22S-R30 E, approximately 1 mile north of the subject leases, TD - 14,493 feet (4,555m) BGS; and
- Conoco #7 James Ranch, Sec. 6-T23S-R31 E, approximately 1/4 mile east of the subject leases, TD -14,590 feet (4,447m) BGS.

Review of the above wells show that the stratigraphic section from surface to 17,555 feet (5,351m) BGS in the vicinity of the subject leases is similar in regards to formations encountered, rock type, and thickness as the stratigraphic section evaluated in the FIA report (USEPA, 1998). The three wells were reviewed to identify strata that can be classified as potential aquitards, potential intervals with porosity suitable for reservoirs or injection zones, and possible intervals for oil and gas production based on log and test data. This report presents estimated depths, thicknesses, porosity ranges, and spatial relationships that can guide models for fluid flow within the study area sedimentary section (Table 2 and Figure 2). The two shallower wells, the Mitchell/Apache #25-1 and Conoco James Ranch #7, were used to define aquitards and porous intervals for depths above 14,470 feet (4,410m) BGS (Table 2). Based on the relationships of the wells relative to the lease areas, average zone thicknesses are used for characterization across the lease areas (Figure 2). The Shell James Ranch #1 well was used to define aquitards and porous intervals between 14,470 feet (4,410m) and 17,410 feet (5,307m) (Table 2).

Aquitards are zones of low permeability that effectively prohibit fluid or gas transmissibility. For the purposes of this study, aquitards are defined as gross shale intervals identified on porosity logs. Shale intervals are defined by a gamma-log threshold greater than 75 API units. Aquitard intervals contain sandstone and limestone reservoirs in some cases, though the gross intervals are assumed to act as barriers to vertical fluid flow in well operations. Because fluid flow restriction and fluid containment is a requirement for both oil/gas reservoirs and injection zones, potential reservoirs or injection zones are typically bounded by aquitards (Figure 5).

Intervals of higher porosity are potential oil/gas reservoirs or injection zones. Potential reservoirs/injection zones are defined as strata with log characteristics less than 40 API gamma, which are those lithologies within porous zones containing less naturally radioactive shale/clay such as porous and permeable sandstones and limestones. Permeability, or the ability of the strata to allow fluid flow, is also a requirement for strata to be of reservoir or injection quality. A detailed permeability analysis for permeable strata identified in this report was not performed.

Table 2 presents 13 aquitards (A through M) and 13 potential reservoir intervals between depths of 6,420 ft (1,957m). and 17,700 ft. (5,395m) (Precambrian crystalline basement). Potential reservoirs in intervals below corresponding aquitards, are shown. Porosity minima, maxima, and estimated averages are listed. The average porosity was then multiplied by the reservoir interval thickness to yield relative feet within the interval at 100% porosity (porosity feet). Porosity feet provide an overall indication of the level of porosity within potential reservoirs in the stratigraphic section.

Data from Table 2 was used to construct Figure 5, which presents relationships of formations, aquitards, porous intervals, and potential hydrocarbon intervals. Potential hydrocarbon intervals were identified from density-neutron logs of Conoco James Ranch #7 and from fluid recovery descriptions in the Shell James Ranch #1.

### 3.3 POTENTIAL IMPACT PATHWAYS

#### 3.3.1 Summary of WIPP Vicinity Impact Pathways

The WIPP repository is located in evaporites younger in age and stratigraphically above the oil and gas productive strata. The evaporites are also above the formations with potential for related injection activities (Figure 5). The WIPP repository was constructed in salts of the Salado Formation, and is over 1000 feet above the shallowest potential injection zone (Delaware Formation). The Fluid Injection Analysis (FIA) (USEPA, 1998) focused on the most likely impact scenario of transmission of fluids through, and fracturing of, interbeds within Salado evaporite deposits (interbeds) as an unintended consequence of injection into deeper horizons combined with a hypothetical leaking well that violates current Underground Injection Control (UIC) requirements. All oil/gas industry-related withdrawal and injection activities are anticipated at depths well below the base of the Castile, which is approximately 3,800 feet (1,158 m) BGS, and approximately 1,500 feet (579m) below the WIPP repository. Potential injectate transfer pathways in this report focus on the impacts of injection on the Salado interbeds resulting from failure of injection wells intended to inject into deeper horizons.

The injection well scenario discussion in the FIA (USEPA, 1998) is dependent upon fluid and pressure being introduced into the disposal system through the injection of fluids into the subsurface. Field operations, including drilling, completion, stimulation, disposal, pressure maintenance, water flood, enhanced recovery operations, and plugging activities all may involve the displacement of fluid into the subsurface under pressure. The FIA addressed two primary injection mechanisms - brine disposal operations and injection for waterflood. Information presented in the FIA indicates that there is more potential for produced brine disposal than secondary hydrocarbon recovery via waterflooding to occur in the WIPP area, based on the

anticipated quantity and duration of injection activities of disposal wells and the degree to which secondary recovery operations are regulated.

The FIA describes a hypothetical scenario in which injectate from an injection interval below the Castile is allowed to flow upward through a failed borehole to the Salado Formation. Because the WIPP repository is approximately 2,150 feet (655 m) BGS, fluids and pressures would need to move both vertically up the well annulus and then horizontally along Salado interbeds. Therefore, injectate would have to move a significant distance from an injection operation at the boundary of the site to have any possible effect on the WIPP repository. Specifically, this would involve communication through a vertical pathway of approximately 1,600 to 3,000 feet (579 to 914 m) (USEPA, 1998) that subsequently communicated with a horizontal pathway of more than 8,800 feet (2,882 m) (Figure 1) to the repository. Vertical pathways that could potentially be present are limited to injection boreholes that allow upward flow due to problems associated with an injection well completion or from deterioration caused by a history of well use.

Vertical pathways connecting injection zones to the Salado Formation and subsequently horizontal pathways within the Salado, could consist of manmade features such as: a poorly cased or cemented injection well annulus; deteriorated casing or cement allowing leakage from an injector; poorly plugged abandoned wells neighboring an injector; and hydraulic stimulation fracture up the annulus or vertically out of underlying strata. If flow contacts the Salado Formation from a vertical pathway outside the WIPP site, horizontal movement through natural pathways within the Salado Formation toward the WIPP repository would need to take place in order to move the fluid and pressure to the WIPP repository. This parting pressure would increase both the effective porosity and effective permeability of Salado interbed unit(s). If interbed fracture opening does occur at elevated pore pressures, it is probable that many of the interbed units through the system would dilate and could provide significantly increased fluid or gas storage that would facilitate injectate movement toward the WIPP repository. A combination of interbeds with induced pressures is one remotely possible mechanism for horizontal flow transport in the system (USEPA, 1998).

### 3.3.2 Potential Impact Pathways from the Subject Leases

#### 3.3.2.1 Stratigraphic Analysis of Interbed Zone

The FIA (USEPA, 1998) discussed the Salado interbed zone through analysis of well logs. The Salado-Castile section evaporites are more than 3,000 feet (914 m) thick and generally range in depth from 500 to 3,800 feet (152 to 1,158 m) BGS. The WIPP site is located within evaporite deposits of the Salado Formation, approximately 600 feet (183 m) above the Castile Formation (Figure 6 - Cross section A-A', and Figure 7 - Cross section B - B'). The WIPP site is encased by evaporites deposited in cyclical sequences. The typical sequence of Salado facies is, in ascending order: clastic stratum; anhydrite; halite; and mixed halite-clastic stratum. Deposition within the Salado is apparently continuous from one facies to the next, and from one cycle to the next. Strata between halites and anhydrites are called interbeds and consist of siltstone, clay, sandstone, and conglomerate (USEPA, 1998).

The FIA (USEPA, 1998) used well log information to identify and map clastic interbed units in selected oil and gas wells located along the boundaries of the WIPP land withdrawal area. The

study identified more than 45 interbeds using neutron-log porosity curves coincidental with elevated gamma signatures (gamma curves greater than 20 API). Two interbed zones, M-138 and M-139, for the purpose of this study, are consistently present across the WIPP vicinity and occur immediately above and below the WIPP repository, respectively. The two interbed zones are at the approximate stratigraphic equivalent of the WIPP repository. Based on the FIA interbed study, the hypothetical pathway necessary for oil and gas related fluid injection to have a potential impact on the WIPP repository, is a vertical flow conduit from a Bell Canyon Formation injection zone to the Salado marker beds M-138 and M-139.

Log response characteristics representative of the Salado interbeds zones in wells drilled in the WIPP vicinity are presented in Cross Sections A - A' and B - B' (Figures 6 and 7, respectively). The western well of Cross Section A - A', Enron James Ranch #71, is located less than ¼ mile to west of the subject leases. Cross section A-A' presents the Salado-to-Castile interval, interbeds and selection criteria, curves for each interbed, and location of the WIPP facility relative to stratigraphic correlations between marker beds M-138 and M-139.

Similarly, correlation cross section B-B' (Figure 6) is drawn from the Enron James Ranch #17 well, located in the subject lease. The Salado-to-Castile interval in the James Ranch #17 well is 1,950 ft (594m) thick, and the interval in the POGO Fed. 26-4 well, about 4 miles to the northeast, is 1,918 ft (585m) thick.

This report presents interbed data for the Bass JR 13 and 3 adjacent wells in the NW section 6-T23S, R31E areas in Tables 3, 4, 5, and 6. Data presented in Tables 3, 4, and 5 include: the number of interbeds identified; depth to the top of individual beds; thickness of each bed; porosity determined for each bed; vertical distance of each interbed from marker bed M-139; product porosity feet within each interbed; number of interbeds; sum of interbed thicknesses; mean interbed thickness; and the sum of porosity feet for each of the wells analyzed. The approximate horizontal information related to the distance from those wells analyzed to the WIPP facility is 11,000 ft (3,353m).

A statistical summary of the interbed characteristics for the 11 wells studied in the FIA report and the 4 wells studied in this report, are shown in Figures 8, 9, 10, and 11 for overall comparison. The data from Tables 3 through 6, and from other tabular data of the FIA interbed study, were used to develop the histograms in Figures 8 through 11. Figures 8 through 11 compare the number of interbeds identified; net sum of interbed thicknesses, mean interbed thicknesses, and mean interbed porosity (given in porosity-feet) between wells. Additionally, the 4 wells analyzed in this study are presented on Figures 8, 9, 10, and 11 for comparison with the FIA 11 wells. These analysis show the four wells included in this report's interbed analysis lie within the stratigraphic and interbed characteristics common to the WIPP area.

### 3.3.2.2 Well Construction Data

Well construction data was reviewed for the Bass JR 13 in order to evaluate completion integrity and potential to impact the WIPP site, as a potential future injection well, or as a conduit between the Salado interbeds and lower strata. The well was drilled and completed between 1982 and 1983 by Perry R. Bass (operator was later changed to Bass Enterprises Production Co).

The surface location is 1,440 ft (439m) south from the north line and 860 ft (262m) east from the west line of Section 6, T23S, R31E, in the James Ranch Participating area, Lease number NM02887-D. Surface elevation was 3,308.5 ft (1,008m) at ground level. The well was directionally drilled to a total depth of 15,078 ft (4,596m), with a bottom hole location 1,787 ft (545m) north of the south line and 860 ft (262m) east of the west line of Section 31, T22S, R31E, lease number NMNM 2953C.

Completion of the Bass JR 13 included installation and cementation of a surface casing, two intermediate casings, and a production liner. Figure 12 presents a diagram of the construction of the Bass JR 13, which presents casing intervals, cementation zones and cement quantities, tubing interval, perforated zones. Production casing was set and the well was completed as producing from the Atoka Formation from perforated intervals between 13,466 ft (4,104m) and 13,477 ft (4,108m) depth. Initial production was gauged at an absolute open flow (AOF) of 1.591 million cubic feet of gas per day (MMCFGPD) (4,505.7m<sup>3</sup>).

Final completion date was September 21, 1982. Review of production records indicate the well has produced 7.528 billion cubic feet of gas ( $2.1 \times 10^7$  cubic m) and 40,586 barrels (6.45 million liters) of condensate through June of 1997. Production as of June, 1997 was approximately 2.380 MMCFGPD (6,740m<sup>3</sup>), 6.4 barrels (1,017 liters) of condensate per day (BCPD), and 1 barrel (159 liters) of water per day (BWPD).

Review of deviation surveys contained in the well file indicate that the deviation commenced at a drilling depth of approximately 8,800 ft (2,602m), and the directionally drilled well entered the lease area to the north (under Section 31-T22S, R31W) at a well depth of approximately 11,500 ft (3,505m) (Figure 4). Based on formation tops present in the well files, the depth of approximately 11,500 ft (3,505m) corresponds roughly to the top of the Pennsylvanian Wolfcamp Formation.

Other wells have not been reported drilled or completed on the subject leases (Section 31 T22S, R31E). Subsequent development activity adjacent to the surface location of the Bass JR 13 include drilling and completion of three vertically drilled wells operated by Enron, the James Ranch #'s 76, 73, and 17. These wells, located in the northwest 1/4 of Section 6, T23S, R31 E, were drilled and completed between 1994 and 1996, at total depths between 11,250 ft (3,429m) and 11,331 ft (3,454m), and are productive from shallower oil horizons. They are each within one-quarter mile of the Bass JR 13 borehole. Due to the proximity of these wells to the wellbore of the Bass JR 13, they are include in this evaluation of completion practices. Engineering parameters including hole size, casing size, and cementation details for the Bass JR 13, and the Enron James Ranch #76, #73, and #17 wells are presented in Table 7 - Well Completion Data. Review of Table 7 shows that the anhydrite interbeds, which are present at a depth above approximately 2,150 feet BGS, are behind surface casing, two intermediate casings, and tubing advancement in all four wells. If any of these wells are converted to injection wells, hypothetical flow from below 3,800 feet to the anhydrite interbeds due to a leak in casing or cement is unlikely because of multiple casing sets installed over the anhydrite interbed interval.

A common industry practice is to convert dry holes and formerly producing wells (after production has been depleted) in the WIPP area to injection wells (USEPA, 1998, and Stoelzel, 1997b). Due to the possibility of an eventual conversion of the Bass JR 13 to an injection well,

a detailed construction review of the well is presented in this report. Construction of producing well is similar to an injection well, and a hypothetical conversion of the Bass JR 13 could be achieved with little modification. Stoelzel (1997b) describes the construction of an injection well - "From outside in, most injection wells have a cement sheath filling the outermost annulus between casing and rock, then one or more "strings" of steel casing, with annuli between casing strings often cemented, and then an inner tubing string through which fluid is pumped down the hole. At the top of the injection interval the tubing passes through a "packer", which separates the annulus between the tubing and casing from the injection interval. Deeper formations penetrated by the borehole, if any, are typically plugged off with cement. In a properly functioning injection well, high pressures are confined to the tubing and injection interval, and all injection occurs into the target horizon."

Stoelzel (1997b) summarized types of wellbore failure scenarios possible in an injection well that would hypothetically impact the WIPP site. Four types of potential wellbore failures are identified: tubing leak, packer leak, casing leak, and breakdown of casing cement sheath. Stoelzel also identifies one type of wellbore failure, the creation of fluid path by hydraulically fracturing the injection zone by injection above fracture pressure for a given formation.

Completion practices for the Bass JR 13 were compared with the requirements of the NMOCD, Rules and Regulations, February 1, 1996. The NMOCD regulates well casing and cementation in Rule 107, Casing and Tubing Requirements. Table 8 presents the requirements of Rule 107, and the level of compliance in the Bass JR 13 as documented in the well file review.

## **4.0 DATA INTERPRETATION**

### **4.1 DEVELOPMENT POTENTIAL FOR LEASE AREAS**

#### **4.1.1 Development Well Potential for Lease Areas**

Review of log characteristics for the Bell Canyon and other potential production/injection zones indicate reservoir qualities capable of supporting both production and injection activities. For example, Table 2 presents 35 discrete porosity intervals between 6,000 ft (1,829m) and 17,410 ft (5,307m), with average porosities between 1 and 13 percent, all of which may be capable of sustaining production/injection activities. Table 2 presents a sum of approximately 30 porosity feet within reservoirs between aquitards. Porosity feet is a function of the porosity (percent of void space in total rock volume) multiplied by the length of the interval that contains the porosity. Porosity feet represents the total footage of porosity within the section if it were present as 100 percent porosity (complete void space). The 30 porosity feet in the section is less than one percent of total thickness of the porosity intervals, indicating that, although capable of supporting production and injection activities, the total porosity within the porous intervals is relatively low.

The WIPP vicinity contains numerous formations within the geologic column that are used for injection purposes, either for brine disposal or secondary recovery. The majority of injection in the area is focused in the Bell Canyon, which represents the shallowest potential injection zone in the WIPP vicinity.

Review of land use requirements indicate that DOE purchased all leases in the Land Withdrawal Area between surface to 6,000 feet (1829 m), however, oil and gas resources may be recoverable under the leases in section 31 via directional drilling from adjacent leases not on the LWA. Based on spacing rules, oil development could hypothetically occur on 40 acre spacing, leaving the potential for up to 16 producing well to be installed to produce from one pool. Additional gas development in the Atoka could hypothetically be on 160 acre spacing, leaving the possibility of 3 additional Atoka gas wells. Other gas pools not yet discovered would be allowed to be developed on 320 acre spacing. The above spacing intervals are applicable to discrete stratigraphic levels, therefore, development of multiple reservoirs at differing stratigraphic levels would allow similar spacing at each level. Economic considerations would encourage production from multiple stratigraphic levels from a single well. The hypothetical presence of a large amount of production wells directionally drilled into the lease area also would potentially allow for the conversion of multiple wells to injection wells upon depletion of production.

## 4.2 POTENTIAL EFFECTS OF LEASE DEVELOPMENT ON ANYDRITE INTERBEDS

### 4.2.1 Potential Impact Pathways to the Anhydrite Interbeds

#### 4.2.1.1 Analysis of Well Construction Data

Based on analysis of well construction data for the Bass JR 13 (Bass JR 13), the well appears substantially constructed in accordance with NMOCD standards. Three casing strings and a production string was installed along the entire length of the borehole (Figure 12). Information contained in Bass JR #13 well files do not document that surface casing was pressure tested, although it is indicated that Mr. Arlin Coke (U.S.G.S.) was present for cementation. Well file information indicates that each casing interval was cemented with appropriate quantities of cement to fill substantial portions of the casing annuli, and that except for the production liner, all cement was allowed to stand for the 18 hours as is required (Figure 12).

Cement on the production liner was allowed to stand for 14 ½ hours, under Rule 107(G) Option 2 this is an acceptable setting time if the compressive strength of 500 PSI in the zone of interest is reached prior to commencing tests. Cement specifications required to calculate actual compressive strength obtained were not provided in the well files, and therefore compressive strength was not calculated.

For Bass JR #13, pressure tests after each casing installation, except surface casings, are indicated on the Sundry Notices and Reports for Wells form as conducted and passed. Documentation of pressure tests, including information on maximum pressures, test durations, and pressure drops, were not provided in the well file information reviewed. The forms are not signed to indicate witnessing of the tests by U.S.G.S personnel.

Preliminary review of completion data from wells adjacent to the Bass JR 13, the Enron James Ranch #s 76, 73, and 17, appear to have set casing and production strings consistent with industry practices. A detailed review of the completion practices of the above well was not conducted.

A deviation survey of the Bass JR 13 indicates that the directionally drilled borehole entered the lease area (under Section 31-T22S, R31W) at a depth of approximately 11,500 ft (3,505m) BGS.

The Salado interbed zone (potential impact pathway) and Delaware Mountain Group (most prospective injection zones) are above this stratigraphic interval, and therefore are not in contact with the subject leases by this well. Any release of fluid from zones into the wellbore that could occur directly in the lease area, as a result of fluid injection, would be below the Salado interbed zone and Delaware Mountain Group. Migration of fluids up the borehole would bring the fluids out of the subject lease and into the adjacent lease where the upper borehole is contained, and come into contact with potential impact pathways (anhydrite interbeds) outside the land withdrawal area. Based on the multiple casing intervals across the anhydrite interbed interval in the well, it is unlikely that if the well were ever converted to an injection well, leakage would occur into the anhydrite interbeds.

#### 4.2.1.3 Comparison of Interbed Zone in Leases Area to WIPP Vicinity Study

Permian Salado evaporite and interbeds related to 4 wells located at the southwestern corner of the WIPP site were compared to Salado interbed characterizations for 11 wells in the vicinity of WIPP (USEPA, 1998). Logs from the four wells drilled in the northwest one-quarter of Section 6, Bass JR 13, Enron James Ranch #17, Enron James Ranch #76, and the Enron James Ranch #73, were compared with 11 other wells near the perimeter of the WIPP site studied in the WIPP vicinity report. Evaporite strata and interbed markers bounding the WIPP storage facility are correlated to wells on the subject leases, and reservoir properties such as number of interbeds in the Salado; total thickness of Salado interbeds; mean thickness of interbeds; and porosity feet are compared with the eleven other wells in the WIPP vicinity study (Figures 8, 9, 10, and 11).

This analysis indicates that the parameters measured in interbeds within the Salado Formation adjacent to the lease areas are within the range of values present for the same parameters measured in the WIPP vicinity. The study area interbeds are similar to interbeds throughout the WIPP withdrawal area, based on log properties reviewed.

## 5.0 CONCLUSIONS

Based on observed reservoir characteristics of prospective formations on and adjacent to the subject leases, and proximity to production activity in the Los Medanos Field, near term oil industry activity could include directional drilling into the subject leases in order to evaluate potential oil and gas formations productive at Los Medanos Field. Land use requirements could allow up to 16 wells to be drilled for exploitation of an oil pool, and up to 4 gas wells to be drilled for exploitation of a gas pool.

Industry practice includes conversion of some depleted production wells to brine disposal wells or injection wells for secondary recovery. Injection zones used for disposal are typically in the Bell Canyon Formation. It is possible that a field operator may, upon depletion of reserves, convert a well which has been producing, from the Bell Canyon or another zone, into a brine disposal well in order to reduce disposal costs associated with brine transportation to a remote disposal well. It is also possible that secondary recovery efforts in Los Medanos Field may include conversion of depleted wells into waterflood injection wells in order to enhance recovery efforts. Directionally drilled wells into the subject leases could be less attractive for conversion into brine disposal wells than vertical wells, based on the additional depth and borehole maintenance requirements. However, determination of optimal wells to select for injection for secondary recovery would be dependent upon reservoir characteristics. Therefore, it is possible, although not probable, that wells directionally drilled into the lease areas in the future could be used for injection purposes.

Based on the similarity of interbed characteristics, geologic section, and well construction practices in the area of the subject leases to other areas studied in the WIPP vicinity, and that the subject leases are a similar distance from the WIPP repository as those wells nearest the WIPP repository which are addressed in the study, it is concluded that the fluid injection analysis results and conclusions (USEPA, 1998) are applicable to the subject leases. Therefore, because the CCA screened injection well effects from the Performance Assessment based on low consequence, it is concluded that these conclusions are applicable to injection well activities in the subject lease areas. As a result, it is highly unlikely that oil and gas-related activity in the subject area would effect the containment capability of WIPP.

The DOE's FEP analysis also concluded that fluid injection in wells adjacent to the LWA would have very little impact -if any- on the containment capabilities of the WIPP. DOE's conclusions were drawn upon the results of two separate analysis, the second of which included modeling revisions requested by EPA, including changes in assumed injection duration, disturbed rock zone characteristics, and increased injection zone transmissivity. Even with these modifications, DOE again concluded that injection activities would have little consequence on the containment capabilities of the WIPP (Stoelzel, 1997b).

Based on the similar geologic characteristics and well completion practices to conditions identified in previous CCA screening and FIA modeling studies, conclusions regarding the impact of oil and gas activities to the WIPP repository developed in the previous studies are consistent with the subject leases. That is, because the lease area has similar geologic, well completion, and other characteristics similar to the CCA's injection analysis and EPA's independent injection analysis, the conclusion of no consequence drawn by these studies also

applies to the subject lease area. All potential uses of these leases related to oil and gas production have been examined, and no activities related to oil and gas production in the subject leases are expected to adversely affect the WIPP disposal system performance during the regulatory time period.

## **6.0 REFERENCES**

Stoelzel, Daniel M, 1997b, *Supplementary Analyses of the Effect of Salt Water Disposal and Waterflooding on the WIPP*; June.

Stoelzel, Daniel M, 1997a, *Injection Methods: Current Practices and Failure Rates in the Delaware Basin*; 1997

**Title 40 Part 191, Compliance Certification Application for the WIPP, October 1996, Appendix SCR, Section SCR 3.3.1.3.**

USEPA, 1998, *Technical Support Document for Section 194.32: Fluid Injection Analysis*; Docket A-93-02, V-B-22, May, 1998.

**TABLES 1 - 8**

**FIGURES 1 - 12**

**APPENDIX A**  
**LAND WITHDRAWAL ACT**

**APPENDIX B**

**LEASE AND UNIT AGREEMENTS**

## **APPENDIX C**

### **PETROLEUM INFORMATION ACTIVITY REPORT**

## **APPENDIX D**

### **WELL FILES**

**APPENDIX E**  
**PRODUCTION RECORDS**