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RISK ANALYSES FOR DISPOSING NONHAZARDOUS OIL FIELD WASTES IN SALT CAVERNS

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Risk Analyses for Disposing Nonhazardous Oil Field Wastes in Salt Caverns

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Executive Summary

Salt caverns have been used for several decades to store various hydrocarbon products. In the past few years, four facilities in the United States have been permitted to dispose nonhazardous oil field wastes in salt caverns. Several other disposal caverns have been permitted in Canada and in Europe. This report evaluates the possibility that adverse human health effects (carcinogenic and noncarcinogenic) could result from exposure to contaminants released from the caverns in domal salt formations used for nonhazardous oil field waste disposal. The evaluation assumes normal operations but considers the possibility of leaks in cavern seals and cavern walls during the post-closure phase of operation. In this assessment, several steps were followed to identify possible human health risks. At the broadest level, these steps include identifying a reasonable set of contaminants of possible concern, identifying how humans could be exposed to these contaminants, assessing the toxicities of these contaminants, estimating their intakes, and characterizing their associated human health risks.

The contaminants of concern for the assessment are benzene, cadmium, arsenic, and chromium. These were selected as being components of oil field waste and having a likelihood to remain in solution for a long enough time to reach a human receptor.

Post-closure releases of fluids from the caverns can be classified under the following scenarios for the present study: inadvertent intrusion by unintentionally drilling a new well into a closed cavern; failure of the cavern seal due to increased pressure from salt creep and geothermal heating; release of contaminated fluid through cracks, leaky interbeds, or nonhomogeneous zones composed of higher permeability material; and partial cavern roof fall. Most releases would be to deep aquifers at or near the top of the cavern, although under several scenarios, released contaminants can move upward through the well casing and leak out into shallow aquifers.

For the inadvertent intrusion scenario, up to 2,000 gallons (gal) of contaminated fluids would move quickly to the surface where, if not contained by the drilling blowout-prevention system, would most likely form a pool on the ground surface. These materials would not penetrate very far into the ground and could be readily cleaned up. Because the volume of released fluid for this scenario would be small, the effects would be of very short duration, the liquid would not be potable, and such a spill would be quickly remediated, the scenario was eliminated from further analyses.

In most of the other scenarios, the release pattern would be to have the pressure build up in the cavern to a level that causes seal failure or cracks. A small amount of contaminated fluids (assumed to be 2,000 gal) would be released and the internal cavern pressure would decrease. The cracks or leaks could self-heal after the release because of additional salt creep. With repressurization of the cavern, the cracks or leaks could once again open, producing a series of short contaminant pulses (probably on the order of hours to days in duration). Under the remaining scenarios, releases would be gradual and long-term seeps through cracks, leaky interbeds, or other nonhomogeneous zones composed of higher permeability material.

Not every closed cavern is expected to undergo releases, so some measure of the probability of failure must be incorporated into the analyses. Because experience with disposal caverns is limited and they have not been in operation for very many years, virtually no information exists about the accident or release rates from disposal caverns. In order to estimate the range of the probabilities of occurrence, a questionnaire was distributed to experts in the field of salt caverns. The panel of experts was asked to provide both a "best-estimate" and a "worst-case" estimate of the probability of occurrence for each of the release scenarios. The estimates from each expert were averaged. Averaged best-estimates for the different scenarios ranged from 0.006 for partial roof fall plus cavern seal failure and fluid release at shallow depth to 0.1 for partial roof fall plus fluid release at depth. Averaged worst-case estimates ranged from 0.04 for seal failure with fluid release at shallow depth to 0.29 for partial roof fall plus fluid release at depth.

Once contaminated fluids leave the cavern, they are expected to migrate laterally and vertically through different formations and aquifers. During the time the fluids travel from the point of release to the receptor site (assumed to be 1,000 ft laterally from the cavern) various physical, chemical, and biological processes occur that reduce the concentration of the contaminants. Fate and transport modeling was used estimate the contaminant concentrations at the receptor point (exposure point concentrations).

Risk calculations were conducted using the exposure point concentrations, assumed drinking water intake rates, and standard assumptions regarding exposure time, duration, and frequency. Based on assumptions that were developed for a generic cavern and generic oil field wastes, the estimated human health risks for worst-case conditions are very low (excess cancer risks of between 1.1×10^{-8} and 2.0×10^{-17}) and hazard indices (referring to noncancer health effects) of between 6×10^{-5} and 1.0×10^{-7} . Normally, risk managers consider risks of 1×10^{-6} and less and hazard indices of less than 1 to be acceptable. For best-estimate conditions, the excess cancer risks were calculated to be between 1.3×10^{-9} and 3.8×10^{-18} and the hazard indices were between 1.4×10^{-5} and 1.9×10^{-8} .

Caveats regarding the use of the results of this report include the following. First, the assessment does not address risks to workers at the cavern disposal site. Such risks would be comparable to or less than worker risks associated with hydrocarbon cavern storage operations. Second, the assessment does not determine whether any health effects will occur in the future; it only estimates cancer risk and potential for noncarcinogenic effects. Third, risks have only been

estimated for contaminants for which toxicity values were available; just because there is no toxicity value does not mean there is no risk. Finally, the assessment is limited to human health effects produced by nonradioactive contamination; it does not address the possible ecological risks associated with salt cavern disposal, nor does it estimate risks associated with NORM that may be included in oil field wastes.

1. Introduction

In 1996, the U.S. Department of Energy (DOE), Office of Fossil Energy, asked Argonne National Laboratory (ANL) to conduct a preliminary technical and legal evaluation of disposing of nonhazardous oil field wastes (NOW) into salt caverns. The conclusions of that study, based on preliminary research, were that disposal of oil field wastes into salt caverns is feasible and legal. If caverns are sited and designed well, operated carefully, closed properly, and monitored routinely, they can be a suitable means for disposing of oil field waste (Veil et al. 1996). Considering these findings and the increased U.S. interest in using salt caverns for nonhazardous oil field waste disposal, the Office of Fossil Energy asked ANL to conduct a preliminary identification and investigation of the risks associated with such disposal.

The purpose of this report is to evaluate the possibility that adverse human health effects (carcinogenic and noncarcinogenic) could result from exposure to contaminants released from the caverns in domal salt formations used for nonhazardous oil field waste disposal. The evaluation assumes normal operations but considers the possibility of leaks in cavern seals and cavern walls during the post-closure phase of operation. It does not consider the risks associated with emissions from surface equipment operating at the site, nor does it consider the risks associated with surface oil leaks or other equipment-related spills or accidents.

The study focuses on possible long-term risks to human health. It does not address potential ecological effects, although such effects could result. Also, risks associated with naturally occurring radioactive materials (NORM) are not addressed. This preliminary assessment estimates risks associated with disposal in a single generic cavern only. No attempt has been made to address the possibly or likelihood that several caverns may be located in relatively close proximity and that more than one cavern could be a source of contamination to a given receptor. Also, no attempt has been made to evaluate the possible impacts of synergistic effects of multiple contaminants on a single receptor.

Because the history of salt cavern use for solid waste disposal is very limited, no readily available data could be accessed for this study. As a result, data from similar operations and professional judgment were used to develop the possible release mechanisms assumed in this hypothetical, generic analysis. The validity of the results would be enhanced if real data could be used. As data are generated on the use and post-closure operations of salt caverns used for solid waste disposal, they should be incorporated to update this study.

In this assessment, several steps were followed to identify possible human health risks. At the broadest level, these steps include identifying a reasonable set of contaminants of possible concern, identifying how humans could be exposed to these contaminants, assessing the toxicities of these contaminants, estimating their intakes, and characterizing their associated human health risks. The risk assessment methodology and techniques used in this report are based in large part on two documents. The first document is a training manual that was developed for a risk assessment workshop sponsored by DOE (DOE 1996). The second is the Risk Assessment Guidance for Superfund (U.S. Environmental Protection Agency [EPA] 1989).

The remainder of this report consists of nine sections. Section 2 provides background on the development, use, and closure of salt caverns that may be used for disposal of nonhazardous oil field wastes and possible cavern release scenarios. Section 3 identifies contaminants of potential concern that could cause harm to human health. Sections 4, 5, and 6 provide information for assessing potential exposure pathways that the contaminants of concern could take to reach human populations. Specifically, Section 4 describes fate and transport mechanisms of the contaminants of concern; Section 5 describes specific hydrogeologic conditions of locations where salt caverns are most likely to be used for oil field disposal (Gulf Coast, Texas, and New Mexico); and Section 6 describes potential release modes that could cause contaminants to leak from the cavern and be transported to areas where human populations may be exposed. Section 6 also estimates possible concentrations of the contaminants to which humans could be exposed under various release scenarios. Section 7 describes the toxicity of those contaminants that could come in contact with humans, given the fate and transport mechanisms identified in Section 5 combined with the potential exposure pathways described in Section 6. Section 8 estimates the potential intakes of those contaminants by humans and characterizes the risks to which those humans may be subjected on the basis of the intake of the contaminants (the potential for harm), their toxicities, and the release assumptions. Section 9 addresses the sensitivity of the estimated risks to operating procedures and potential regulatory structures, and Section 10 summarizes the results of the analyses.

2. Salt Cavern Background

The following section discusses the origins and development of salt caverns in the United States, waste disposal in caverns, sealing and abandoning salt caverns, and scenarios under which cavern contents could leave the cavern.

2.1 Origins and Development

As discussed in Veil et al. (1996), subsurface salt deposits occur in two major forms in the United States: bedded salt and salt domes. Although salt deposits occur in many parts of the United States, the occurrence of salt in quantities and locations that would promote commercial development is limited. There are 16 states in which salt occurs in sufficient quantity to be mined by either excavation or solution mining or to be recovered through solar evaporation. States having major salt deposits are Alabama, Arizona, Colorado, Kansas, Louisiana, Michigan, Mississippi, Montana, New Mexico, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, Texas, and Utah. Of these states, those with the most significant salt mining are Kansas, Louisiana, Michigan, New Mexico, New York, Ohio, and Texas (Veil et al. 1996).

Bedded salt formations occur in layers interspersed with such sedimentary materials as anhydrite, shale, dolomite, and other more soluble salts (e.g., potassium chloride). These materials have varying degrees of permeability, but all are generally low (Freeze and Cherry 1979). The bedded salt deposits are tabular and can contain significant quantities of impurities.

Salt domes are large, nearly homogeneous formations of sodium chloride, although they may contain nonhomogeneous zones. Pfeifle et al. (1995) report that the typical anhydrite (CaSO₄) content of Gulf Coast salt domes averages less than 5%. These domes were created by geological processes that spanned millions of years (Chilingarian et al. 1989). About 30 million years ago, salt buried by more dense materials flowed to form pillows. Because of its lower density, salt flowed upward to form diapirs (domes or anticlinal folds whose overlying rocks have been ruptured by the squeezing-up of the more plastic salt core) and piercing overlying units.

As the salt passed up through the overlying sediments, long, finger-like projections developed. The depth of the intruded salt (sedimentary piercements) can be greater than 10,000 ft (Whiting 1981a), and the top width of the salt domes ranges from about 0.5 to 2.5 miles (Chilingarian et al. 1989). If the intruded salt contacted undersaturated water, dissolution would occur. Through a complex interaction of dissolution, recrystallization, hydration of anhydrite to form gypsum, sulfate reduction, cementation, etc., a caprock was often formed. Although caprocks are common in the vicinity of salt domes, they do not always exist there (Linn 1997).

At the top of the caprock, a region of limestone frequently developed. This limestone may have been formed by a number of processes, including reduction of the calcium-sulfate caprock, and precipitation from calcium-sulfate-rich water (Werner 1986).

As the salt intruded the Cenozoic sediments along the Gulf Coast, various minerals were often precipitated in the vicinity of the caprock. Along with the minerals, oil was frequently trapped under the edge of the caprock. Because of the high probability of finding oil and other valuable minerals, salt domes have been extensively explored and mined for more than 100 years.

Starting in the late 1800s, salt domes were commercially mined for salt by using various leaching techniques. The shapes of the resulting caverns were often irregular because of the techniques applied, but a number of caverns, such as West Hackberry Cavern 11, are nearly symmetrical (Tomasko 1985).

Salt caverns are used for storing hydrocarbons. The earliest cavern storage in salt domes for liquified petroleum gas (LPG) started in 1951; LPG storage in bedded salt started somewhat sooner, in the early 1940s (Querio 1980). Some of the liquified products stored include propane, butane, ethane, fuel oil, gas, and crude oil.

DOE acquired the rights to some existing caverns for the Early Storage Reserve (ESR) of the Strategic Petroleum Reserve (SPR). The ESR was designed to store 250 million barrels of oil of which about two thirds were to be placed in solution-mined caverns and one third in a conventional rock salt mine. Acquisitions for the ESR were made about 1977. SPR now has a capacity of 680 million barrels, and the rock salt mine has been removed from the program (SMRI 1997).

Private industry in the United States operates a large number of caverns for storing liquid petroleum products, petrochemicals, and natural gas. European countries have also used salt caverns as containment sites for the disposal of drilling muds and cuttings from deep oil and gas wells (Testa 1994).

Nearly all salt caverns in the SPR are 2,000 ft tall and have a cavern roof that is at a depth of about 2,000 ft. The diameters of the caverns vary greatly, but a typical value is about 300 ft (Biringer 1984). The distance between caverns is variable, but a typical separation distance from center-to-center is more than 600 ft (Whiting 1981b). Volumetrically, SPR caverns are large, and each cavern contains about 10 million barrels (420 million gallons) of crude oil. Private sector caverns are generally smaller than the SPR caverns and have various sizes, shapes, and depths (Hickerson 1995).

To create salt caverns, water that is not fully salt-saturated is injected into a salt stock and the resulting brine solution is withdrawn. This method is referred to as solution mining (Testa 1994). The development and shape of the salt cavern can be controlled by the method used for construction. In the direct circulation method, fresh water is injected through a tubing string from the surface, and brine is withdrawn through an annular space between the tubing and final casing. In the reverse circulation method, fresh water enters through the annulus, and brine is removed through the tubing string. A combination of these two methods, or other more complicated methods, can be used to obtain the desired cavern shape. The American Petroleum Institute (API) provides illustrations and more details on these methods (API 1994).

2.2 Waste Disposal in Caverns

Use of salt caverns for waste disposal in the United States has been limited. A summary of current disposal practices is given in Veil et al. (1996) along with a discussion on using caverns for waste disposal in Canada, the United Kingdom, Germany, the Netherlands, and Mexico.

In this study, we consider the disposal of nonhazardous oil field wastes in salt caverns. As discussed in Section 3, the majority of material disposed of would be tank bottom wastes (waste material from washing tanks, heater tanks, and stock tanks). This solid or sludge-like waste consists of accumulated heavy hydrocarbons, paraffins, inorganic solids, and heavy emulsions (EPA 1994b). Physically, the waste consists of approximately 50% water, 15% clay, 10% scale, 10% corrosion products, 10% oil, and 5% sand. Its specific gravity ranges from about 1.5 to 2.0. The principal contaminants of concern in the waste include benzene, lead, arsenic, cadmium, chromium, and boron (see Section 3).

Initially, the caverns would be filled with brine. Wastes would then be introduced as a slurry of waste and a fluid carrier (brine or fresh water). Three scenarios are possible for introducing the waste material: (1) the waste can be pumped down tubing to the bottom of the cavern and the displaced brine can be withdrawn through an annulus; (2) the waste can be pumped down an annulus and the displaced brine can be withdrawn through the tubing; and (3) the waste can be injected through one well and the brine withdrawn from another well. The first scenario is the most likely method because of associated costs and ease of use (Veil et al. 1996).

As the slurry is injected, the cavern acts as an oil/water/solids separator. The heavier solids sink to the bottom of the cavern and form a pile. Any free oils and hydrocarbons float to the top of the cavern, because they are less dense than water. An organic blanket could be injected into the cavern to prevent additional leaching of the cavern's roof by water that is not fully saturated with salt. Clays in the slurry can mix with the brine, forming a suspension above a brine/waste interface. Clean brine displaced by the incoming slurry would be removed from the cavern and either sold as a product or disposed of in an injection well.

Early in the life of the disposal cavern, clean brine is withdrawn from hundreds of feet above the surface of the waste pile or interface. As the cavern fills, the brine becomes dirtier (i.e., it will have a higher clay and oil content). This dirty brine can produce operational difficulties (e.g., clogging of pumps) and additional expenses (Veil et al. 1996). The cavern is considered to be "full" of waste when disposed material being returned with the displaced fluid becomes a problem. When the cavern is full, the operator seals the cavern.

2.3 Post-Closure Cavern Behavior

Once the cavern has been filled with waste, the cavern would be sealed and the borehole plugged with cement. Bridge plugs would be placed in the well bore above and below water-

bearing intervals to isolate these intervals permanently. This procedure is often used in the oil and gas industry to abandon wells.

A waste-filled cavern that has been sealed is subject to a number of complex physical processes: reduction in cavern volume caused by salt creep (the process by which salt surrounding the cavern flows into the cavern space as a pseudo-fluid [Bishop 1986, Freeze et al. 1995]); convective mixing in the upper, brine-filled portion of the cavern; differential settling and compaction of solids; chemical reaction and compaction of the waste material; and an increase in pressure produced by the combined effects of salt creep and the addition of sensible heat (heat derived from the geothermal gradient vertically across the cavern — approximately 13 °F per 1,000 ft at a depth of 1,000 ft [Tomasko 1985]);

During a transient period of several years after closure of a cavern filled with brine, pressure can exceed the lithostatic value (pressure in surrounding salt) because of thermal expansion of the brine. The amount of over-pressurization is a function of cavern size (Berest and Brouard 1995). Similarly, cavern pressure can exceed the lithostatic value after a longer time period when, due to salt creep, brine pressure will balance average lithostatic pressure, resulting in a slight excess of brine pressure at the top of the cavern (Langer et al. 1984; Wallner 1986). This occurs because lithostatic pressure increases linearly with depth, while brine pressure is constant within the cavern.

The presence of a small quantity of gas in the sealed cavern can mitigate the effects of pressure buildup because the gas drastically increases the cavern compressibility or decreases the cavern stiffness (Berest et al. 1997a). Gases can be produced in a sealed disposal cavern in a number of ways, including bacterial degradation of the waste, corrosion, and natural releases from the salt formation itself (e.g., carbon dioxide, hydrogen sulfide, hydrogen, methane, etc.). Bacterial degradation of organic material in the waste can generate such gases as carbon dioxide, hydrogen sulfide, and methane. However, for several reasons, bacterial action would not generate a large quantity of gas. For example, because many bacteria have a limited tolerance for salt, conditions in the cavern would not be conducive for bacterial growth and reproduction (Stanier et al. 1963; and Postgate 1965). Even if the bacteria could survive in brine, there are other natural curbs on their activity. For aerobic bacteria, the supply of oxygen would be limited (only 8 parts per million [ppm] of oxygen are in the fresh water that is in contact with air at 25°C). For anaerobic conditions, bacteria could produce hydrogen sulfide gas if the waste contains sulfate. The hydrogen sulfide produced would, however, be water soluble and would dissolve in the brine. As the pressure in the cavern increased with time, the solubility of the hydrogen sulfide would also increase and minimize free-gas production.

Metal components of the waste material could corrode and generate hydrogen gas, especially at low pH conditions (acid environment). Such processes are common causes for equipment failures in oil and gas production systems. In a waste cavern, pH would be controlled by the partial pressure of carbon dioxide. Ambient carbon dioxide levels in the cavern would not support a significant corrosion rate, and hydrogen gas would not be generated. The only other source of acid in oil field waste would be spent acid from well stimulations (Bradley 1992). If the pH of such wastes is adjusted to six or above prior to disposal, no significant gas production would occur. Because the principal waste material for this study is tank bottom material and not spent acids, little acid would be present and the production of hydrogen gas would be negligible.

Gas production in caverns is also controlled by pressure effects. As the pressure in a cavern builds up, the gas production rates would fall correspondingly. This process would limit the volume of any gases produced.

A recent study of the behavior of brine-filled, sealed caverns suggests that the permeability of the material surrounding the cavern can also influence pressure buildup (Wallner and Paar 1997). Because of a very slow pressure increase within a sealed salt cavern, the pressure at the top of the cavern would only exceed the lithostatic value after a long time (on the order of thousands of years for a 1,000-ft tall cavern). Because the rock salt formation becomes permeable if the fluid pressure exceeds the stress in the salt, small leakage rates of fluids from the top of the cavern are predicted. This leakage would compensate for the overpressurization at the top of the cavern and return the system to an equilibrium condition.

Details on the pressurization of a sealed cavern that is filled with NOW are currently unavailable, although the behavior is expected to be similar to that discussed above with the exception that the compressibility of the wastes may alter the time scale and magnitude of the system response. More study of actual waste disposal caverns would help to clarify this issue.

2.4 Cavern Release Scenarios

In assessing risks to the public from disposing of NOW in caverns, potential release modes must be determined. At the present time, there is little information on accidents for cavern disposal systems because there are only a few disposal caverns in operation and they have not been operating for very many years. However, what little accident information exists from disposal and storage caverns indicates that the caverns are safe and that the only accidents that have occurred were associated with surface facilities. Because insufficient information exists for quantifying release probabilities for cavern disposal, results from the liquid petroleum gas (LPG) storage industry and the Strategic Petroleum Reserve (SPR) are used in this study as a basis for identifying potential release scenarios.

Although LPG industries and the SPR have a long history of safe operations, a statistically meaningful data base for risk analysis is absent. To overcome this difficulty, a subjective, semiquantitative methodology was developed by Radian Corporation to evaluate risks for the LPG industry (Radian Corporation 1995). This methodology, developed by a panel of experts in the field of salt-cavern conversion for LPG storage, was based on a modified-Delphi approach (Brown and Helmer 1964) in which variability of the estimated parameters are reduced through group interaction.

The Radian study identified 22 accident scenarios that could lead to releases to the environment. These accident scenarios can be grouped into three general categories: (1) cavern development and conversion, (2) cavern filling, and (3) post-closure releases. In this study, impacts were analyzed for only the last of the accident scenarios identified, post-closure releases. Impacts from the first two scenarios are better addressed in a second tier assessment, in which site-specific information would be used and more detailed design parameters would be defined.

Post-closure releases can be classified under the following categories for the present study: inadvertent intrusion; failure of the cavern seal; release of contaminated fluid through cracks, leaky interbeds, or nonhomogeneous zones composed of higher permeability material; and partial cavern roof fall.

3. Contaminants of Potential Concern

In a standard risk assessment, the first step is collecting and evaluating data. One result of the data collection exercise is the identification of contaminants of potential concern. Contaminants of potential concern at a site are those that may be hazardous to human health and/or the environment under current or future site conditions. Selecting contaminants of potential concern helps focus the risk assessment on those contaminants that may be of potential significance to human health.

It is important to select contaminants of potential concern for several reasons. If all possible contaminants were considered, the risks associated with naturally occurring contaminants could drive the assessment. For example, high background levels of particular contaminants, such as manganese, could obscure risks related to oil field wastes. Also, the level of effort and the cost of analysis increase with the number of contaminants being evaluated. Probably hundreds of contaminants associated with nonhazardous oil field wastes could be identified, depending on the types of crude that were produced, the types of drilling muds used, and the geochemistry of the formation from which the oils were extracted.

As the risk assessment is conducted, it may be determined that the risks associated with some potential contaminants are insignificant and can be dropped from further consideration. For example, the ability of some potential contaminants to be transported may be insufficient to allow them to come in contact with humans. In such cases, the contaminant would not be considered further in the risk assessment.

The term nonhazardous oil-field waste should not be interpreted to mean that no hazardous substances are found in oil-field wastes. In 1988, EPA made a determination that exempted wastes from the exploration, development, and production of crude oil, natural gas, and geothermal energy from regulation as hazardous under Subtitle C of the Resource Conservation and Recovery Act (RCRA). In 1993, EPA added many other wastes that were uniquely associated with exploration and production operations to those already exempted from RCRA Subtitle C requirements. Thus, exempt wastes include drilling fluids, produced water, and other wastes associated with the exploration, development, or production of crude oil, natural gas, or geothermal energy. However, even though a waste is exempted from Subtitle C requirements, it may still contain hazardous contaminants. In its regulatory determination, EPA concluded that the wastes exempted from regulation under Subtitle C could be better controlled through improvements to existing state and Federal regulatory programs.

The current study is a preliminary, generic risk assessment; collecting the primary data needed to identify contaminants of potential concern is beyond its intended scope. Rather, results of the analysis presented in EPA's 1987 Report to Congress (EPA 1987) and a later draft pertaining to Selected Associated Wastes (EPA 1994b) were used to identify contaminants of potential concern.

As described in its Report to Congress, EPA used waste sampling and analysis data to characterize drilling wastes and produced water for quantitative risk modeling. Limited available data prohibited the EPA from developing separate waste-stream characterizations for various geographic zones; as a result, one set of waste characteristics was used to represent the nation. The major factors EPA used in selecting contaminants of concern were (1) median and maximum concentrations in the waste samples, (2) frequency of detection in the waste samples, (3) mobility in groundwater, and (4) concentrations at which human health effects, aquatic toxicity, or resource damage start to occur. By using this screening process, EPA selected several chemicals considered likely to dominate risk estimates. These chemicals included arsenic, benzene, boron, cadmium, and chromium (VI).

The 1987 Report to Congress focused primarily on produced water and drilling muds. Because the EPA estimated that these two types of waste constituted over 98% of the industry waste stream in 1988, the EPA began evaluating the relative hazards posed by various associated waste streams, including tank bottoms, oily debris, workover fluids, produced sand, and emulsions. It found that tank bottom samples exceeded the RCRA toxicity characteristics for benzene and lead. On the basis of these two EPA studies, the contaminants of concern for salt cavern disposal are arsenic, benzene, boron, cadmium, chromium, and lead.

Because these contaminants may behave differently in the environment than in the laboratory, an evaluation of the fate and transport mechanisms for each contaminant is presented in Section 4. On the basis of that evaluation, combined with a consideration of the hydrogeologic conditions in areas where cavern disposal is likely to occur (Section 5) and an assessment of potential release modes and exposure pathways (Section 6), a subset of the contaminants listed above that have the ability to produce human health risks was identified. Because risk is a function not only of the probability of exposure, but also of the potential for harm due to the chemical, the toxicity of these contaminants must also be assessed. Section 7 addresses the toxicity of this subset of contaminants, and in Section 8, the risks associated with exposure to releases of those contaminants considered dangerous to humans are estimated.

4. Fate and Transport for Contaminants of Potential Concern

In this section, the fate and transport of the contaminants of potential concern for salt cavern disposal is described. Specific information is provided for benzene, lead, arsenic, cadmium, chromium, and boron. This information is used in estimating contaminant concentrations at the location of a receptor for risk assessment.

4.1 Benzene

Benzene (C_6H_6) is the most important aromatic hydrocarbon in this study because of its physical properties. Benzene is unsaturated and reacts to add hydrogen and other elements to its ring of six carbon atoms.

Benzene, also known as annulene, carbon oil, and coal naphtha, is a clear, colorless to light yellow, watery liquid with an aromatic or gasoline-like odor. Benzene has a density less than that of water (0.8765 g/cm^3) (Mackay et al. 1992).

Benzene is a Class A carcinogen that has an EPA maximum contaminant level (MCL) of 0.005 mg/L (EPA 1994a). It is soluble in water (1.780 g/L at 20 °C for fresh water) and readily volatilizes (changes from the aqueous to the gas phase) with a dimensionless Henry's Law constant of 0.2199 (Montgomery 1991; Montgomery and Welkom 1991). The Henry's Law constant gives the ratio of a compound's saturated vapor concentration to its concentration in the associated liquid phase and is an index of partitioning between dissolved and gaseous phases (Hern and Melancon 1987). For benzene, the effective half-life for volatilization is about 4.8 hours (Montgomery 1991; Montgomery and Welkom 1991). In saline water, the solubility of benzene decreases (Stumm and Morgan 1981).

In water, benzene has a distribution coefficient (mass of solute sorbed on solid surfaces per solid mass divided by the mass of solute per volume of solute [Freeze and Cherry 1979]), K_{\pm} of 0.62 mL/g (Lyman et al. 1992). Sorption of benzene onto a solid surface produces a retardation of benzene's transport velocity in groundwater; that is, the velocity of the center of mass of a contaminant plume of benzene, V_c , will move at a retarded velocity of V/R, where V is the velocity of groundwater and R is a retardation coefficient. Retardation coefficients can be estimated by using the following relationship (Freeze and Cherry 1979):

$$R = 1 + \frac{\rho_b K_d}{\Phi} \tag{1}$$

where ρ_0 is the bulk density of the matrix material, and Φ is its porosity (Freeze and Cherry 1979). For a bulk density of 1.7 g/cm³ and a porosity of 0.1 (typical values for this study [Freeze and Cherry 1979]), the retardation coefficient for benzene is about 10.

Under aerobic conditions, benzene has an effective biodegradation half-life of about 10 days; for anaerobic conditions, its half-life is about 2 years (Howard et al. 1991). If exposed to air and sunlight, benzene undergoes photo-oxidation, with an effective half-life of 5-16 days; however, it does not apparently undergo hydrolysis (i.e., it does not react with water to form another compound [Mackay et al. 1992]).

As the above data show, benzene is very soluble in water, and once in a groundwater system, it is very mobile. Because of biodegradation and volatilization, however, it would have a somewhat limited range of travel in an aquifer. When biodegrading, benzene would be mineralized to form water (H₂O) and carbon dioxide (CO₂). Possible transformation products include cisbenzene glycol accompanied by partial dehydrogenation, yielding catechol, or cis,cis-muconic acid and α -hydroxymuconic semialdehyde (Montgomery and Welkom 1991). Because little information is available on the toxicity or fate and transport of these intermediate products, and their behavior can be site-specific, complete biodegradation of the decay products of benzene is assumed for this study.

4.2 Lead

Lead is generally found in the divalent form and tends to form relatively insoluble compounds with such common anions as hydroxide and sulfate. An insoluble precipitate can also form with sulfide, which can be present under reducing conditions. Lead can also form insoluble complexes with carbonate at pH values higher than 5.4 (Adriano 1986). In the presence of clays, lead is very immobile. An approximate K_d for lead is 900 mL/g (Baes and Sharp 1983; Baes et al. 1984). By using Equation 1 with a bulk density of 1.7 g/cm³ and a porosity of 0.1, the retardation coefficient for lead would exceed 15,000. The maximum recommended concentration of lead in drinking water is 0.015 mg/L (EPA 1994a).

Because of its low solubility, large distribution coefficient, and very large retardation coefficient, further analyses of lead-associated risks are not presented in this study.

4.3 Arsenic

Arsenic generally forms insoluble complexes, typically reacting with hydrous oxide coatings and various anions. For example, the solubility of pentavalent arsenic sulfide (As_2S_3) is 0.000136 g/L in cold, fresh water (CRC 1968). In brine, the solubility of arsenic would be less (Stumm and Morgan 1981). Arsenic readily adsorbs onto clays, iron or manganese compounds, or aluminum complexes. Arsenic can also be immobilized by forming complexes or chelates with iron or calcium (Callahan et al. 1979). The distribution coefficient for trivalent arsenic reported for agricultural soils and clay ranges from about 1- 8 mL/g; for pentavalent arsenic, the range is approximately 2 - 18 mL/g (Baes and Sharp 1983). For this study, a K_d of 10 mL/g was assumed. By using Equation 1 with a bulk density of 1.7 g/cm³ and a porosity of 0.1, the retardation coefficient for arsenic would be about 170 (rounded to 200). The MCL for arsenic is 0.05 mg/L (EPA 1994a).

Because of the low solubility and large distribution coefficient of arsenic, its concentration and mobility in groundwater would be very low.

4.4 Cadmium

Cadmium can exist as soluble or insoluble species or can be immobilized by sorption onto clays or iron oxides. Cadmium forms soluble complexes and insoluble precipitates with carbonates and hydroxide ions, and it can also exist as the hydrated ion (Baker and Amacher 1982). Under acidic conditions, cadmium can be relatively mobile, with its mobility decreasing as increasing pH and ion exchange capacity increase (Lu et al. 1975). In soil that contains clay and iron hydroxides, cadmium has a low mobility and commonly coprecipitates with iron and manganese hydroxides.

The solubility of cadmium is generally low; however, the solubility of cadmium chloride is about 140 g/L in cold, fresh water, and that of cadmium hydroxide is about 0.00026 g/L (CRC 1968). In brine, this solubility would be less (Stumm and Morgan 1981). The K_d values for cadmium in soil and clay range from about 1.3 to 27 mL/g (Baes and Sharp 1983). For this study, a K_d value of 3 mL/g was used. By using Equation 1 with a bulk density of 1.7 g/cm³ and a porosity of 0.1, the retardation coefficient for cadmium would be about 50. Cadmium has an MCL of 0.005 mg/L (EPA 1994a).

Because of the presence of iron in the tank bottom wastes, cadmium is likely to precipitate out as a hydroxide. Given the low solubility of cadmium hydroxide and its moderate rate of sorption, the mobility of cadmium in groundwater would be low.

4.5 Chromium

The predominant form of chromium likely to occur in the vicinity of a failed salt cavern would be insoluble, trivalent chromate (Cr₂O₃) (ATSDR 1989). Soluble chromate generally forms precipitates, with hexavalent chromium undergoing anion adsorption and reduction, and trivalent chromium undergoing adsorption, hydrolysis, and chelation (Reisenauer 1982). Manganese and iron oxides can affect chromium adsorption. Adsorption of all chromium species can occur in substrates in the pH range of 6 to 7.5, making the chromium fairly immobile. Adsorption of the hexavalent form can decrease with increasing pH, while adsorption of the more predominant trivalent form can increase with increasing pH, probably as a result of cation exchange (Adriano 1986). In the presence of organic matter, hexavalent chromium is converted to the more insoluble trivalent form. The hydrated form of trivalent chromium sulfate $[Cr_2(SO_4)_3]$ has a solubility of about 120 g/L in cold, fresh water (CRC 1968). Brine conditions would be expected to reduce this solubility. The K_d values reported for soil and clay range from about 1.2 - 1,800 mL/g for the hexavalent form and 470 - 150,000 mL/g for the trivalent form (Baes and Sharp 1983). A K_d value of 30 mL/g was assumed for this study. By using Equation 1 with a bulk density of 1.7 g/cm³ and a porosity of 0.1, the retardation coefficient for chromium would be about 500. Total chromium has an MCL of 0.1 mg/L (EPA 1994a).

Because of low solubility and high distribution coefficients, both trivalent and hexavalent forms of chromium are expected to have low concentrations and mobilities in groundwater. The mobility of the hexavalent form, however, is expected to be greater than that of the trivalent form.

4.6 Boron

Boron is a nonvolatile metalloid that occurs in combination with most of the other elements. Boron readily hydrolyzes in water to form the electrically neutral, weak monobasic acid H_3BO_3 and the monovalent ion $B(OH)_4$ (ATSDR 1990). Although most boron compounds are highly soluble in water (Rai et al. 1986), boron may be precipitated with aluminum, silicon, or iron in the form of fairly insoluble hydroxyborate compounds on the surfaces of minerals. In elemental form, boron is insoluble in water (Windholz et al. 1983). The adsorption of boron may not be reversible in some media. This irreversibility may be the result of solid-phase formation on mineral surfaces. Little information is available on boron sorption; however, for clays, K_d may be as high as 20 mL/g, with a range for soils of 0 to 10 mL/g (Sheppard et al. 1984). For this study, a K_d value of 8 mL/g was assumed. By using Equation 1 and values for bulk density of 1.7 g/cm³ and for porosity of 0.1, the retardation coefficient for boron would be about 150. As of 1994, the EPA did not have any defined drinking water standards for boron, although its lifetime health advisory is 0.6 mg/L for a 70-kg adult (EPA 1994a).

It is likely that boron would precipitate to form insoluble hydroxyborate compounds on mineral surfaces because of the iron and silicon content of the tank bottoms component of the wastes. Because of this precipitation, further analyses of boron-associated risks are not presented in this study.

5. Hydrogeology

As discussed in Section 2, the majority of salt formations of interest for waste disposal occur along the Gulf Coast and in Texas and New Mexico, although other states, such as Kansas and Michigan, could also be considered as potential candidate states for NOW disposal in salt caverns. The following sections discuss hydrogeological conditions for the Gulf Coast, the western Texas panhandle, and New Mexico. A composite of these areas is then used for a generic analysis of disposing of NOW in a hypothetical salt cavern in domal salt. Additional site-specific calculations are recommended for future studies in other states and bedded salt formations.

5.1 Gulf Coast Hydrogeology

Salt caverns along the Gulf Coast of the United States are located in the Coastal Plain Physiographic Province (Back et al. 1988). This province is underlain by a gulfward thickening wedge of unconsolidated to semiconsolidated sedimentary rocks (sand, silt, and clay derived from erosion of nearby continental upland areas). These sediments overlie consolidated rocks of Mesozoic Age and range in thickness from a few feet near their landward limit to more than 30,000 ft in southern Louisiana.

As part of the Gulf Coast Regional Aquifer-System Analysis (GCC RASA) program, the depth to groundwater was evaluated for a 230,000-mi² study area that included coastal regions in Texas, Louisiana, Mississippi, and Florida (Williams and Williamson 1989). Based on data from 6,825 wells, the depth to the water table ranges from 0 to 74 ft, with a median value of 20 ft. This shallow groundwater system is primarily composed of sands interbedded with deposits of silt and clay. Where the silts and clay have been eroded and the aquifer is in communication with the atmosphere, the aquifer is unconfined. Confined to semiconfined conditions exist where low-permeability clays and silt overlay the more permeable sands (Hanor 1993). Beneath the shallow groundwater system are other sequences of clays and silts, interspersed with beds of sand. The sand areas constitute other potential aquifers that are predominantly confined (Capuano and Jan 1996).

Recharge to the shallow groundwater system is derived from precipitation. The majority of recharge occurs in areas where the clay and silt layers are absent. Discharge of this aquifer occurs to surface waters, underlying deeper aquifers, and pumping wells.

5.2 Texas and New Mexico Hydrogeology

Bedded salt occurs in the Texas panhandle area and West Texas, as well as in central and southeastern New Mexico. These bedded salts are located, for the most part, in deep formations (the top of salt occurs at a depth of 500 to 2,000 ft below the land surface, and the salt thickness is about 1,000 to 3,000 ft thick). Although most of these bedded salts occur below 1,000 ft, some of the bedded salts in west Texas can be much shallower (e.g., one of the Permian Brine Sales' caverns starts at a depth of about 700 ft [Hickerson 1995]).

Overlying the bedded salt layers are the Ogallala fluvial aquifer, which is composed of stream and river deposits, and the Dockum aquifer, which is composed of fluvial and lacustrine (lake) deposits (Bassett and Bentley 1982). These aquifers make up a shallow, fresh-water system that is used for domestic, municipal, industrial, and agricultural purposes. The combined thickness of these two aquifers can be as great as 2,300 ft (Bair et al. 1985). The Ogallala is the shallower of the two aquifers and occurs at a depth that ranges between 20 and 400 ft (Wood and Sanford 1995). It has a thickness that ranges from 0 to 800 ft (Seni 1980), and it underlies about 134,000 mi² of land that extends from Nebraska to New Mexico (Back et al. 1988). Its principal composition is sand and gravel.

The Dockum aquifer lies below the Ogallala aquifer. Locally, its depth is variable; it can outcrop at the surface or occur as deep as 800 ft below the ground. It is typically composed of a sandstone and conglomerate unit (fluvial) overlying a fine silt and clay unit (lacustrine). The thick Permian evaporite-bearing unit beneath the Dockum is an aquitard and a barrier to vertical groundwater flow. Depth to bedded salt ranges from about 500 to 2,000 ft. The uppermost extensive salt is the Salado Formation. Where this unit has been dissolved, various older formations (e.g., Seven Rivers, Grayburg, San Andres, and Castile) contain the uppermost salt units. In some areas, salt has been completely removed.

Bedded salts are being developed for low-level nuclear waste disposal at the Waste Isolation Pilot Plant (WIPP) in New Mexico. The facility has been constructed and will shortly begin operation. It is located at a depth of 2,150 ft below the ground surface in the Salado Formation (DOE 1990). The Ogallala and Dockum aquifers are absent in this area of New Mexico, and the shallowest groundwater of consequence occurs in the Culebra Dolomite of the Rustler Formation at a depth of about 750 ft.

Recharge to the shallow groundwater system in the semi-arid Texas/New Mexico environment is derived from precipitation. Wood and Sanford (1995) estimate the annual recharge to be 11 ± 2 mm/yr. Recharge is small because of high potential evaporation, plant transpiration, limited precipitation, and runoff. In the past, discharge was to springs; other, deeper, groundwater systems; and pumps. Because of heavy pumping, most of the discharge springs are now dry, and the only discharge is to deeper aquifers.

In general, water quality in Texas and New Mexico decreases with depth. For example, the Rustler Formation water quality is generally poor, with total dissolved solids ranging from 286 mg/L in Ward County to 157,000 mg/L in Winkler County. Chloride concentrations can be as high as 89,700 mg/L in Winkler County, Texas (Richey et al. 1985). Because of this poor water quality, water for public water supply, irrigation, industry, livestock, and rural domestic use is often obtained from overlying aquifers, such as the Santa Rosa Sandstone Formation in the Dockum and from the Cenozoic alluvium in the Delaware basin (including the Ogallala Aquifer, if present). In the Texas panhandle area, similar observations have been made on groundwater quality (Bair 1987); i.e., total dissolved solids and the concentration of brine increase with depth.

6. Release Calculations

Impact analyses were performed for the general categories of cavern-release scenarios discussed in Section 2: inadvertent intrusion; failure of the cavern seal; release of contaminated fluid through cracks, leaky interbeds, or nonhomogeneous zones of higher impermeability; and partial cavern roof fall. Details on these analyses are presented in Section 6.2. Concentrations for the contaminants of potential concern presented in these sections are used for risk analyses in Section 8.

For all of the release scenarios, the initial concentrations of contaminants leaving the cavern must be known. These concentrations are discussed in Section 6.1.

6.1 Initial Concentrations for Contaminants Released from a Cavern

In the event of a release, some of the brine overlying the waste would leave the cavern. This brine will contain dissolved contaminants of potential concern. No data are available to show the chemical characteristics of the cavern brine at the time of release, because no disposal cavern has yet been closed. After the cavern is closed, the chemical constituents of the waste will reach an equilibrium solubility with the overlying brine. Theoretical solubility values for the four constituents of potential concern (benzene, arsenic, cadmium, and chromium) are available in the literature (e.g., ATSDR 1989; CRC 1968; Montgomery 1991; and Montgomery and Welkom 1991), but these values are based on the solubility of the contaminants in cool, fresh water using pure laboratory-grade chemicals and are not relevant for in-cavern conditions.

The conditions found in a closed cavern will have a significant effect on final solubility. Two factors that are especially important are the salt content and the pH of the water in the cavern. Fresh water will dissolve more organic materials (e.g., benzene) than brine. Consequently, the brine will reach an equilibrium benzene concentration with the waste that is lower than the theoretical fresh water solubility. In addition, the brine in the cavern will contain chloride, sulfate, sodium, calcium, and hydroxide. Many toxic metals form insoluble precipitates with one or more of these ions, which will limit the solubility of the metals. Also some ions of arsenic form insoluble calcium compounds.

One of the main types of waste disposed of in salt caverns is drilling waste, which tends to be alkaline. The presence of a high-pH waste will cause the cavern brine to have a pH higher than neutral. The solubility of metals is much higher at low pH values than at the higher pH values expected in the cavern brine. Therefore, the brine will reach equilibrium metals concentrations with the waste that are somewhat lower than the theoretical fresh-water solubilities.

One way of estimating the chemical characteristics of the cavern brine is to look at other brines that have been in contact with both crude oil and many of the solid materials that will be in the wastes for a long enough time to reach equilibrium values. Perhaps the best example of such brines is produced water. Produced water characteristics vary somewhat, but extensive data are available to estimate chemical concentrations. The following analyses contain data on concentrations of chemical constituents in produced water:

- As part of its proposed effluent limitations guidelines for the coastal oil and gas industry, EPA sampled ten coastal oil and gas facilities for produced water constituents (SAIC 1994).
- EPA summarized several produced water studies covering 55 facilities as part of its final effluent limitations guidelines for the offshore oil and gas industry (EPA 1993).
- EPA (1987) selected median and upper 90th percentile concentrations for arsenic and benzene in produced water as inputs to a risk assessment model.

Concentration ranges for the constituents of concern cited in these three studies are given in Table 6-1.

Another approach for estimating fully saturated brine concentrations is to look at the relative proportions and concentrations of the major waste types that are placed into the caverns and to estimate how much of those wastes will leach into the cavern brine. The operators of the four disposal caverns in Texas were asked to provide qualitative estimates of the proportions of different types of wastes entering the caverns. Depending on the operator, drilling wastes make up from 20-50% and tank bottoms make up about 50-60% of the total incoming waste stream¹. Miscellaneous wastes make up the remainder. In many cases, the solids in the wastes contain chemical concentrations much higher than those reported for produced water. However, under conditions where wastes are in contact with water, concentrations of chemicals in the surrounding water are typically much lower than those in the waste. The amounts of chemicals likely to leach out of the waste when it is exposed to water have been estimated by EPA.

The EPA (1987) provides comparative data on both drilling waste solids and solids that have undergone the toxicity characteristic leaching procedure or TCLP (40 CFR 261, Appendix II). The TCLP test measures a waste's tendency to leach into water. The TCLP can serve as an analog of the extent to which wastes in a cavern will leach into the overlying brine. In the TCLP, solids samples are extracted by mixing them for 18 hours in a flask containing water adjusted to an acidic pH. Because metals are more likely to leach out of a solid under low pH conditions, the TCLP test is more conservative than leaching at a neutral pH. Under these conservative, low-pH conditions, the upper 90th percentile TCLP results are much lower than the results from analysis of drilling waste solids, which had been measured without being subjected to leaching (see Table 6-1). These data support the premise that only a small fraction of the total waste is likely to leach into water or the cavern brine.

The other major type of waste disposed of in caverns is tank bottoms. The EPA (1994b)

¹Telephone conversations between John Veil, Argonne National Laboratory, Washington, DC, and Russ Hickerson, Permian Brine Sales, Odessa, TX; Grady Moore, Taylor Disposal Operating, Inc., Carthage, TX; and Tom Voskamp, Voskamp Exploration, Midland, TX, on March 12, 1997.

provides extensive characterization of tank bottoms. The range of TCLP values and analysis of samples as reported in EPA (1994b) for tank bottoms at production facilities (the predominant source of tank bottoms likely to go to the caverns) are shown in Table 6-1. Only a small fraction of the total tank bottom chemical concentration is likely to leach into water or the cavern brine.

For the initial concentrations of constituents to be used in the fate and transport modeling in this report, we have chosen the highest concentration for each constituent of concern from the (a) produced water data, (b) drilling waste TCLP data, and (c) tank bottoms TCLP data. In each of these data sets, we already are looking at the maximum concentrations, which typically are many times higher than average values. The concentrations of the contaminants of potential concern in brine when they leave the cavern under different release modes are as follows: benzene, 20.4 mg/L; arsenic, 1.7 mg/L; cadmium, 0.29 mg/L; and chromium, 0.85 mg/L.

6.2 Cavern Release Scenarios

Five release scenarios are discussed in this section: inadvertent intrusion, which could produce a release of cavern fluid to the ground surface; failure of the cavern seal, which could release contaminated fluid to the groundwater (the release could be either at the depth of the cavern or at more shallow depths); release of contaminated fluid through cavern cracks; release of contaminated fluid through leaky interbeds or non-homogeneous zones of higher permeability material; and a partial cavern roof fall, which could release contaminated fluid to deep or shallow groundwater depending on the condition of the cavern seal. Calculations for these release scenarios are discussed below.

6.2.1 Inadvertent Intrusion

In the inadvertent intrusion scenario, an exploratory well for oil or minerals penetrates a hypothetical waste disposal cavern that has an initial brine volume of one million ft³ (about 7.5 million gallons). Assuming that the cavern contains 750,000 ft³ of NOW when full, approximately 2 million gallons of brine lie above the NOW. Groundwater wells probably would not reach the cavern because drinking or irrigation water could be obtained at shallower depths, and groundwater at the depth of the cavern would probably not be potable because of brine (Section 5). Based on an average modulus of elasticity of 337,000 psi (Streeter 1961), a depth of 1,500 ft, and an initial pressure in the cavern equal to the lithostatic pressure (about 1,500 psi for a depth of 1,500 ft assuming a lithostatic pressure gradient of 1 psi per ft [SMRI 1997]), a maximum of about 2,000 gallons of contaminated fluid would flow from the cavern toward the surface. This value is about 0.1% of the fluid present in the cavern. In addition to brine and dissolved waste constituents, drilling muds and other associated fluids would also flow toward the surface.

If the blowout-protection system of the well failed, fluids from the cavern could spill onto the ground surface and form a pool in the vicinity of the well pad or be discharged into a lined pond. If the discharge occurs directly to the ground and the local topography is depressed, a small surface pond would form. If the pond has a radius of 25 ft, the depth of the spill would be about 1 inch without considering evaporative losses. For a spill this small, fluids from the cavern would not reach the underlying unconfined aquifer that occurs at a median depth of 20 ft (Section 5.1), but would form a contaminated zone in the unsaturated soil. If the porosity of the soil is 0.3 (Freeze and Cherry 1979), a mass-conservation calculation shows that the penetration depth of the fluids from the cavern would be less than 6 inches. Mobilization of contaminants out of the contaminated zone could then occur by leaching. However, remediation activities at the site (e.g., removal of contaminated soil) would occur before the contaminants could dissolve and be transported by advection and dispersion to the water table.

In addition to lasting for a short duration, the pond water would be very unappetizing for ingestion (i.e., the water would have a very high turbidity because of the drilling mud, it would be very salty [saturated brine], it would be oily because of the presence of organic materials, and it would probably have an unpleasant odor). Because the volume of released fluid for this scenario would be small, the effects would be of very short duration, the liquid would not be potable, and such a spill would be quickly remediated, the scenario was eliminated from further analyses.

6.2.2 Release through the Cavern Seal

For this scenario, the seal that keeps liquids within the cavern is assumed to fail and release brine and contaminants to the well bore. As discussed in Section 2.4, the well bore would have cement plugs installed during cavern closure and abandonment. With time, the well casing may deteriorate because of the presence of brine in the vicinity of the caprock or the top of the cavern if a caprock is not present. For anticipated conditions, the well casing will corrode and fail near the top of the cavern first. With additional time, the well casing will fail at shallower depths.

Once the cavern is full of waste, it would be sealed and abandoned. At the time of sealing, the cavern would be mostly filled with solids and semisolids that are not fully compacted. Brine would remain between the top of the cavern and the top of the waste mass.

As discussed in Section 2.4, the pressure in the cavern would increase because of the combined effects of the addition of sensible heat from the surrounding salt and salt creep. Although the pressurization of sealed caverns containing liquids or dry granular wastes is currently under investigation (e.g., Langer et al. 1984; Wallner 1986; Berest and Brouard 1995; Wallner and Paar 1997; and Berest et al. 1997a), little research has been directed at predicting pressure behavior in caverns containing NOW. Future work should be performed to reduce the uncertainty in this process.

For this scenario, the pressure in the cavern is assumed to reach a high enough value that the cavern seal fails because of a crack in the plug, dissolution of salt around the seal, or by some other means. Contaminated fluid then moves up the well bore toward the ground as the pressure in the cavern is reduced to the hydrostatic value.

Assuming that the cavern had an initial brine volume of 1,000,000 ft³, and that it was filled to three-quarters of its capacity with NOW, about 250,000 ft³ of free brine and 750,000 ft³ of

waste would be present. If the cavern failed at a pressure equal to the lithostatic value (approximately 1,500 psi for a cavern located at a depth of 1,500 ft), a maximum of only about 0.1% of the free liquid (about 2,000 gal) would exit the cavern because of the effects of compressibility (Streeter 1961), if the well bore was free of liquid and at atmospheric pressure. If the well bore contained water, or if the released volume was greater than the volume of the well bore up to the location of the deepest bridge plug, less than 0.1% of the fluid would escape from the cavern. For conservative results, this study assumes that the full 0.1% volume would be released.

Flow of the released fluid would be greatly restricted in the well bore at the locations of the cement bridge plugs. Flow through the bridge plugs would resemble flow through a porous medium having a low hydraulic conductivity (about 1×10^{-8} to 1×10^{-5} cm/s), similar to that of cemented sandstone (Maidment 1993). If the cavern fluid moves up the borehole at a rate equal to the saturated hydraulic conductivity of the cement (Freeze and Cherry 1979), it would have a velocity between 3×10^{-5} and 0.03 ft/d. For a cavern at a depth of 1,500 ft, fluid would not reach the surface for about 140 years if the well casing remained intact, and evapotranspiration did not deplete the volume of free liquid near the ground surface.

While moving up the borehole, fluid from the cavern could also move laterally into adjoining formations if the well casing had failed. Because the casing would probably be made of ordinary steel, there is a high probability that the casing would fail when exposed to groundwater containing brine over a time period ranging into the thousands of years. Two possible cases are considered under this scenario: (1) the casing fails at the depth of the cavern (at or near the cavern roof) and contaminated fluid is released to a deep aquifer, and (2) the casing fails at a shallow depth and releases fluid to a near-surface aquifer. Because of hydrogeological differences between the aquifers considered, these scenarios are discussed separately below.

For a deep casing failure, fluid moving up the well bore would move into the deep aquifer and be transported laterally. The presence of low-permeability beds at shallower depths would prevent vertical transport of the contaminated fluid to overlying aquifers and the ground surface. Assuming that the well bore has a diameter of 2 ft and that the ambient groundwater velocity is 10 ft/year, contaminated water would enter the surrounding porous medium for a period of about 0.2 years.

The extent and magnitude of contamination created by this type of release would depend on the hydrological properties of the material in the vicinity of the failed casing, the volume of fluid that is released, the duration of the discharge, and the transport properties of the contaminants. In the vicinity of the cavern, hydrological properties are unlikely to favor rapid transport of the contaminants. For example, the groundwater velocity at depth is estimated on the basis of engineering judgment to be less than 10 ft/yr. Because of adsorption and subsequent retardation (Section 4.1), contaminants (particularly metals) would be transported at even lower velocities. For example, cadmium, which has a distribution coefficient of 3 mL/g (Section 4.4), would have a retardation coefficient, R, of about 50 for an assumed bulk density of 1.7 g/cm³ and a porosity of 0.10 (Equation 1). Therefore, the center of mass velocity of cadmium would be 50 times less than that of the groundwater (0.2 ft/yr). In 100 years, cadmium would travel about 20 ft.

Benzene would move much more quickly than the dissolved metals because of its greater mobility. As discussed in Section 4.1, benzene has a distribution coefficient of about 0.6 mL/g and a retardation coefficient of about 10. In 100 years benzene would, therefore, move about 100 ft. Unlike the metals, however, benzene would be likely to degrade biologically with time. For the calculations presented in this study, benzene was assumed to have an effective half-life of 2 years, the upper end of the values for anaerobic conditions presented in Section 4.1. In 100 years, its concentration would decrease by a factor of about 1.0×10^{15} (50 half-lives).

In addition to the extent of contamination created by the release, the contaminant's concentration is also needed for risk assessment. In general, the downstream concentrations of contaminants depend on the length of time that the cavern acts as source of contaminated fluid. For either a release at the depth of the cavern or to a shallow aquifer, the cavern is assumed to depressurize to conditions in the well bore within one day. Fluid released during the depressurization would then be swept into adjacent aquifers by moving groundwater (10 ft/yr at the depth of the cavern and 100 ft/yr for a shallow release). Under these conditions, a two-foot well bore would act as a source of contamination for 0.2 and 0.02 years at the depth of the cavern and in a shallow aquifer, respectively. After the system depressurizes, salt creep would once again occur and the pressuri in the cavern would increase, particularly if the point of failure selfheals. Because of this repressurization, the seal may again fail, and the process can then repeat itself as a series of short, pulsed releases. Because the time between releases would be long (repressurization is a slow process), the pulses would not interact with each other along the flow path.

Contaminant concentrations in the exiting fluid are discussed in Section 6.1 and are listed in Table 6-1. Because of the short duration time of a pulse release scenario, little dilution would occur because of mixing with uncontaminated groundwater. The contaminant concentrations in the water adjacent to the failure point would, therefore, be the same as in the cavern.

After release, the aqueous phase contaminants would be transported in the direction of lower hydraulic head (pressure) and would undergo sorption (loss of material to particle surfaces), dispersion (reduction in concentration produced by non-uniform fluid velocities), and degradation (decrease in concentration produced by chemical or biological interactions). Transport calculations were performed with a one-dimensional analytical solution to the governing partial differential equation incorporating advection, dispersion, and biodegradation (Tomasko 1991; 1994) to estimate the concentrations of benzene, cadmium, arsenic, and chromium at a lateral distance of 1,000 ft from the location of the casing failure, the assumed location of the nearest human receptor.

For transport calculations, the groundwater velocity was assumed to be 10 ft/yr and dispersion was assumed to be scale dependent, with dispersivity set equal to one-tenth of the

travel distance (Lallemand-Barres and Peaudecerf 1978). Contaminant concentrations in the groundwater were evaluated at the location of a potential receptor at a time of 1,000 years in the future, a typical value for risk analyses. In the case of cadmium released to shallow aquifers, the maximum estimated concentration would reach the receptor after 334 years. This value is noted, where applicable, in the tables associated with Section 8 and is used in the risk calculations. A compilation of contaminant concentrations for these conditions is given in Table 6.2. As shown in Table 6.2, the concentration of benzene would be 0.0 mg/L at 1,000 years because of degradation along the flow path (approximately 500 half-lives). Values for arsenic and chromium would both be very small because of retardation along the flow path and the short duration of the release (0.2 yr).

For the second alternative considered for this release scenario, the cavern seal is again assumed to fail; however, the well bore casing at depth is assumed to be intact. Contaminated fluid then flows up the well bore and exits the casing at a failure point adjacent to a shallow groundwater aquifer such as the Dockum or the Ogallala. The initial concentration of the contaminants entering the system would be the same as for the scenarios discussed above (Table 6-1), and there would be no substantial dilution. The duration of the source term would be ten times less than that used at depth because of the higher groundwater velocity in the shallow groundwater system (100 ft/yr). For a release to shallow groundwater, the concentrations (Table 6.2) would be larger than those discussed above because of shorter travel time. The concentration of benzene, however, is still at 0.0 mg/L because of its biological degradation. In spite of the higher velocity and shorter travel time for a shallow groundwater release, the contaminant concentrations at the receptor 1,000 years after the release would all be much less than their MCLs discussed in Section 4 (Table 6.2).

6.2.3 Release of Contaminated Fluid through Cracks

During pressurization of the cavern because of the combined effects of thermal heating and salt creep, cracks might develop that would release fluid into the surrounding material, thereby reducing the pressure in the cavern. The volume of fluid released would be a function of the pressure in the cavern, the volume of the cracks, and the crack pressure. If the pressure in the cracks is atmospheric, the volume of fluid released would be the same as that discussed under the inadvertent intrusion scenario (2,000 gallons). However, the actual volume released could be much less than this value if the cracks are at the local hydrostatic or lithostatic pressure. For conservative results, the volume of released fluid is assumed to be 2,000 gallons.

Depending on the pressure in the cracks, they could self-heal after the release because of additional salt creep. With repressurization of the cavern, the cracks could once again open, producing a series of short contaminant pulses (probably on the order of hours to days in duration) that would not interact with one another because of the time needed to repressurize the cavern to a value that approaches or exceeds the local lithostatic value. Because of gradients in the lithostatic pressure, cracks would open in a vertically upward direction (SMRI 1997). With time, the contaminated fluid in the cracks could reach a deep underground aquifer and be

transported laterally to the location of a potential receptor (1,000 ft away from the point of release).

The contaminant concentrations at the location of the receptor 1,000 years after the release into the underground aquifer would be the same as those presented above for failure of the cavern seal with a subsequent pulsed release at the depth of the cavern (Table 6.2). The resulting contaminant concentrations would all be much less than their associated MCLs (Section 4).

6.2.4 Release of Contaminated Fluid through Leaky Interbeds or Nonhomogeneous Zones

In this scenario, the cavern is assumed to have a leaky interbed or heterogeneity that allows communication with the outside environment. As the cavern pressure rises because of thermal effects and salt creep, fluid would be discharged into the interbed where it would be laterally transported under existing gradients. Fluid velocity in the interbed is assumed to be 10 ft/yr. In this way, the entire fluid volume of the cavern would eventually be discharged into the surrounding material.

Van Sambeek (1993) gives the following formula for the steady-state volumetric creep rate for a cylindrical cavern:

$$\frac{\frac{d}{dl}}{V} = -\sqrt{3} \left(\frac{\sqrt{3}}{n} \left(P_{\infty} - P_{i} \right) \right)^{n} A q p \qquad (2)$$

where

n, A, and Q/R = Model calibration parameters,

- \mathbf{P} = Lithostatic pressure,
- P_i = Internal pressure of the cavern,
- t = Time, and
- T = Temperature in degrees Kelvin.

Parameters for the above equation are compiled in Berest et al. (1997b). For this analysis, the following values were selected as typical: n = 5, T=304K, Q/R=7,500, and A=100,000. For a brine-filled cavern,

$$P_{\infty} - P_{i} = 0.0 \quad H \tag{3}$$

where H is the depth of the cavern (Berest et al. 1997b).

Using a value of 533 m for H (top of cavern at a depth of 1,500 ft plus 250 ft of free brine), and the above parameters, the steady-state volumetric creep rate from Equation 2 expressed as a percent would be about -0.007% per year. At this rate, it would take about

14,000 yr to discharge the cavern fluid to the interbed. For 2 million gallons of free brine in the cavern, the steady-state leak rate would, therefore, be about 150 gal/yr.

The leaking brine would mix with in-situ water and be transported down-gradient. Because of this mixing, the contaminant concentrations would be reduced by dilution. Dilution, D_{f_2} can be expressed by the following expression (Tomasko 1991):

$$D_{f} = \frac{Q_{gg}}{Q_{er}} + 1 \tag{4}$$

where Q_{cav} is the volumetric leak rate of the cavern and Q_{gw} is the volumetric flow in the interbed. For a cavern that has a diameter of 100 ft, an interbed thickness of 20 ft, and a groundwater velocity of 10 ft/yr, the dilution factor would be 1,000.

Table 6-2 lists the contaminant concentrations at the receptor for this scenario at a time of 1,000 years after the cavern has begun to leak. All of the concentrations are small compared to their MCLs.

6.2.5 Partial Cavern Roof Fall

Loss of cavern integrity through a partial roof fall coupled with failure of the cavern seal could produce impacts similar to those described in Section 6.2.2. Under these scenarios, the cavern would discharge fluid in a series of short pulses separated by periods of low to no discharge when the pressure in the cavern is increasing because of salt creep. If a partial roof fall occurs without failure of the cavern seal, the release of contaminated fluid would occur as a series of short pulses. A partial roof fall coupled with a release through leaky interbeds or non-homogeneous zones of higher permeability material would be manifested as a long slow release. Contaminant concentrations for these various scenarios are given in Table 6-2.

6.2.6 Probabilities of Occurrence

In performing a risk assessment, besides the concentrations of the contaminants of concern being required, the probability that a given scenario would occur also needs to be known. Because there is no operational history for disposing of NOW in salt caverns, the probabilities of occurrence for the release scenarios described above are uncertain. Under the most optimistic conditions, no releases would ever occur, and the associated probabilities of occurrence would be 0.0. For the most pessimistic conditions, releases would always occur and the probabilities of occurrence would be 1.0.

In order to reduce the uncertainty in the range of the probabilities of occurrence, a questionnaire was distributed to experts in the field of salt disposal. The panel of experts was asked to provide both a "best-estimate" and a "worst-case" estimate of the probability of occurrence for each of the release scenarios. In the context of this questionnaire and study, best

estimate did not refer to the "best-case" or the best or least risky case, but rather it referred to the probability of occurrence that was most likely in the best judgment of the expert. Similarly, "worst-case" referred to the least likely probability of occurrence in the best judgment of the expert rather than to the most risky case.

Following the receipt of responses from the expert panel, the estimates were aggregated to form consensus values for each of the probabilities of occurrence. A number of procedures can be used to form the consensus values from the individual estimates. These include behavioral and mechanical approaches (Winkler and Sarin 1981). In behavioral aggregation, some contact is required between the experts. The range in estimates provided is then reduced through intensive group interaction. This methodology is typically followed in the Delphi approach of Brown and Helmer (Brown and Helmer 1964). With mechanical aggregation, a mechanical rule is used to combine the estimates of the probabilities. For example, the aggregate value can be the arithmetic mean, median, weighted average, or some other weighting that uses Bayesian estimation by incorporating a priori information (Winkler 1968; Winkler 1977; Makridakis and Winkler 1983). For the present study, an arithmetic average was used to represent the aggregate value for the probabilities of occurrence. This method was selected because of the difficulties and time constraints of using a Delphi approach, the lack of appropriate weighting functions for the experts (there is no cavern release data available that could be used to rank the ability of the experts according to past predictions [Winkler and Clemen 1992]), and the average value of the data performs as well as any of the other mechanical rules (Winkler 1968).

Table 6-3 lists the best-estimate and worst-case aggregated probabilities of occurrence for the release scenarios previously discussed and their ranges. For all cases, the highest probabilities of occurrence were for a partial fall of the roof (0.10 and 0.29, respectively). The smallest probabilities of occurrence were for a partial roof fall with a cavern seal failure and release to a shallow aquifer (0.006 and 0.051, respectively), and a cavern seal failure with subsequent release to a shallow aquifer (0.012 and 0.040, respectively).

7. Toxicity of Contaminants of Potential Concern

Toxicity assessment is a key component in risk assessment. It weighs available evidence regarding the potential for the contaminants of concern to cause adverse effects in exposed individuals. It consists of two parts: hazard identification and dose-response evaluation. The hazard identification process determines whether exposure to a contaminant can cause an increase in the incidence of a particular adverse health effect (e.g., cancer, birth defect) and whether that effect is likely to occur in humans. Section 7.1 describes the potential health hazards associated with the contaminants discussed in Section 4, that is, those contaminants to which humans could be exposed under various salt cavern release scenarios and exposure pathways.

Toxicity assessment also provides an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood or severity of adverse effects. Dose-response evaluation is the process of evaluating, in a quantitative manner, the toxicity information and characterizing the relationship between the dose of the contaminant received and the incidence of adverse health effects in an exposed individual. Dose-response relationships provide toxicity values that are used to estimate the incidence or potential for adverse effects as a function of human exposure to the contaminant. Section 7.2 describes dose-response relationships for the contaminants of concern and provides toxicity values, where available, for each of those contaminants. These toxicity values are used in combination with contaminant intake information to estimate the potential for human health risks associated with salt cavern disposal of NOW.

7.1 Hazard Identification

Typically, two categories of toxicity are addressed in human health risk assessments: carcinogenic and noncarcinogenic. Carcinogens are believed to act via a "nonthreshold" mechanism of action; that is, a risk would be associated with any exposure level, no matter how small. Noncarcinogens are believed to act via a "threshold" mechanism of action; that is, there is some level of exposure (the threshold) below which the contaminant is unlikely to have an effect.

The following paragraphs describe the hazards associated with the contaminants of concern identified in the previous sections (i.e., arsenic, benzene, cadmium, and chromium). As noted in Section 4, contaminants such as boron and lead would form insoluble precipitates and would not migrate to areas where they could come in contact with humans. The information presented comes from the Agency for Toxic Substances and Disease Registry (ATSDR) Fact Sheets. These fact sheets are available on the Internet and summarize information about various hazardous substances, including their health effects (ATSDR 1993).

Arsenic. Arsenic is a metal usually found in compounds with oxygen, chlorine, sulfur, carbon, or hydrogen. Some arsenic compounds can dissolve in water. Arsenic can change from one form to another, but it does not break down. Exposure comes from ingesting contaminated water, soil, or air. Other exposure routes include breathing workplace air or burning smoke from wood containing arsenic. High levels (60 ppm [mg/L]) in food or water can be fatal; lower levels can cause nausea, decreased production of blood cells, and abnormal heart rhythms. Arsenic is a

known carcinogen; ingesting inorganic arsenic increases the risk of skin cancer and tumors of the bladder, kidney, liver, and lung. The EPA has set a limit of 0.05 ppm for arsenic in drinking water (EPA 1994a).

Benzene. Benzene is a colorless liquid with a sweet odor that is found in crude oil and gasoline. In liquid form, benzene mixes easily in water. In water, benzene can change quickly into a vapor and mix readily with the air. In air, it reacts with other chemicals and breaks down within a few days. It can move from soil to groundwater. Plants and animals do not store high levels of benzene. The most common exposure route is inhalation, but benzene can also be ingested. Most exposure comes from tobacco smoke, auto exhaust, and industrial emissions. Benzene is a known human carcinogen and is associated with leukemia. EPA has set a maximum permissible level of benzene in drinking water of five parts per billion (ppb) (5×10^{-9}) per day for a lifetime of exposure. The EPA has set a goal of 0 ppb for drinking water and rivers and lakes. The maximum permissible level of benzene in water for children for short-term exposures (10 days) is 235 ppb.

Cadmium. Cadmium is found naturally in the earth's crust. It is usually combined with other elements (e.g., oxygen, chlorine, sulfur), and it has no definite taste or odor. Cadmium binds strongly to soil particles, and some cadmium dissolves in water. It can change form in the environment but does not break down. Cadmium can accumulate in the human body from many years of low-level exposure. Exposure comes from eating foods that contain cadmium and drinking contaminated water. Other sources include breathing contaminated workplace air, cigarette smoke, or air near the burning of fossil fuels or municipal waste. On the basis of weak evidence of lung cancer in humans from breathing cadmium and strong evidence from animal studies, cadmium and cadmium compounds may be reasonably anticipated to cause cancer in humans. It is not known whether cadmium causes cancer from eating or drinking contaminated food or water. The EPA has set a limit of 5 ppb for cadmium in drinking water.

Chromium. Chromium occurs naturally in rocks, soils, plants, and animals. It has three main forms. These are chromium 0, which does not occur naturally; chromium III, the compounds of which are stable and occur naturally; and chromium VI, which rarely occurs. Chromium III is an essential nutrient in the human diet, but only small amounts are needed. Chromium adheres strongly to soil particles, but small amounts of chromium move from soil to groundwater. In surface water, most chromium sticks to dirt particles that settle to the bottom; only a small amount dissolves. Human exposure comes from ingestion or inhalation, especially breathing contaminated workplace air or sawdust from chromium-treated wood. At high levels, all forms of chromium can be toxic, but chromium VI is more toxic than chromium III. Long-term exposure to high or moderate levels of chromium VI can damage the nose and lungs. Ingesting large amounts of chromium can cause stomach upsets and ulcers, convulsions, kidney and liver damage, and death. Certain chromium VI compounds are known carcinogens. ATSDR has insufficient data to determine if chromium 0 or chromium III are carcinogens. The EPA has set an MCL for total chromium of 0.1 mg/L.

7.2 Dose-Response Relationships for Contaminants of Concern

Toxicity values are used to translate a dose of a contaminant (the intake) into a risk for cancer or a hazard index for noncancer effects. There are of two types of toxicity values: slope factors and reference doses. Section 7.2.1 describes slope factors for the contaminants of concern; Section 7.2.2 describes reference doses for the contaminants of concern.

7.2.1 Slope Factors

Slope factors are used to estimate the toxicities of carcinogens. A slope factor is defined as a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. It is used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen. A curve representing the response per unit intake for a given chemical is known as a dose-response curve. This curve is developed by evaluating toxicity information and characterizing the relationship between the dose of a contaminant received and the incidence of adverse health effects.

Dose-response curves and slope factors are developed for various exposure routes (e.g., oral, inhalation). Because the potential exposure pathways identified for salt cavern release modes is always ingestion of groundwater, the oral slope factor is used. The slope factor is the upper 95% confidence limit of the slope of the dose-response curve. Because it represents the upper 95% confidence limit of the slope of the curve and because the slope is determined using very conservative models, the slope factor itself is conservative. As a result, the risks calculated using slope factors tend to be upper-bound estimates of the "true" risks. The oral slope factors for the contaminants of concern come from EPA's Integrated Risk Information System (IRIS) and are shown in Table 7-1.

7.2.2 Reference Doses

Reference doses (RfD) are used to estimate the toxicities of noncarcinogens. An RfD is an estimate of the "safe dose" of a contaminant for humans. A variety of RfDs are available, depending on the exposure route (e.g., oral, inhalation), the critical effect (e.g., developmental) and the length of exposure being evaluated (e.g., chronic [long time] event, or acute [a single, short-time event]). Because the only potential exposure pathway to humans for salt caverns is ingestion of groundwater, only the oral RfDs are used in calculating noncarcinogenic hazards. RfDs are conservative because EPA applies order-of-magnitude safety factors to allow for uncertainty. As a result, the hazards estimated using RfDs tend to be upper-bound estimates of the "true" hazards. RfDs for the contaminants of concern come from IRIS and are listed in Table 7-2.

Often the data needed to develop toxicity values are weak or unavailable; typically, data from animal studies are extrapolated to human studies. Also, a number of uncertainties are associated with the models used to derive toxicity values, and safety factors are incorporated into the derivation of toxicity factors. Because EPA continually reviews and revises its toxicity

values, they may change over time. Toxicity values provide the major source of uncertainty in risk assessments.

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8. Risk Characterization

Human health risks from contaminants at waste disposal caverns may be carcinogenic or noncarcinogenic. This section describes these two types of risks and uses the information derived from Section 6 on exposure pathways and exposure-point concentrations and the toxicity values described in Section 7 to develop risk estimates for the contaminants of concern. Section 8.1 reviews the information developed in Section 6 to produce exposure-point concentrations for the release scenarios. Section 8.2 describes potential cancer risks from those scenarios, and Section 8.3 describes their potential noncancer risks.

8.1 Exposure Scenarios

Section 6 described the potential release modes. These were (1) failure of the cavern seal, resulting in contaminated fluid entering the groundwater at the depth of the cavern or at more shallow depths; (2) release of contaminated fluid through a crack in the salt; (3) release of contaminated fluid through a leaky interbed or higher permeability nonhomogeneous zone; and (4) a partial cavern roof fall, resulting in the release of contaminated fluids to deep or shallow groundwater. For all of the release modes, the exposure pathway would be ingestion of contaminated groundwater by residents living near the salt caverns. Table 8.1 summarizes the potential release modes.

The concentrations of the contaminants reaching the water that humans may drink depend on the location of the release, i.e., release to a shallow aquifer or release to a deep aquifer (see Table 6-2). Exposure-point concentrations are the concentrations of the contaminants in groundwater (shallow or deep) at the point of contact with a human receptor. Estimated exposure-point concentrations derived in Section 6 for the contaminants of concern are summarized in Tables 8-2 through 8-7. Note that in estimating the exposure-point concentrations, assumptions were made about the probability that the release event would actually occur. Thus, the concentrations in Section 6 were calculated assuming that the release would occur. These concentrations need to be adjusted for the likelihood of actual occurrence. Tables 8-2 through 8-7 show the exposure-point concentrations assuming release occurs, the probability that the release would occur based on the discussion in Section 6.2.6, and the resulting exposurepoint concentrations used for estimating risk. Note that the exposure-point concentrations for benzene would be zero for all scenarios because of biodegradation along the flow path.

To estimate the amount of contaminant actually received from drinking contaminated water, assumptions must be made regarding time, frequency, and duration of exposure to that water. These assumptions are presented in Table 8-7. Unless otherwise indicated, standard EPA default exposure factors are used in the assumptions (EPA 1991).

Using these assumptions and the exposure-point concentrations, an intake rate for each contaminant of concern can be calculated with the following equation:

$$I_{i} = \frac{C_{i} \times \mathbf{R} \times \mathbf{E} \times \mathbf{E} \times \mathbf{D} \times \mathbf{E}}{\mathbf{B} \times \mathbf{A}}$$

(5)

where

 $I_i = Intake of contaminant I$

 C_i = Exposure point concentration of contaminant *I*, in g/L

IR = Intake rate in L/day

ET = Exposure time, in h/d

EF = Exposure frequency in d/yr

- ED = Exposure duration, in yr
- CF = Conversion factor of 1 d/24 h
- BW = Body weight of the receptor, in kg, and
- AT = Averaging time, in d (for carcinogens, AT = 25,550 d (70 years); for noncarcinogens, AT = 365 d/y x ED)

Tables 8-9 through 8-14 show the intake rates in milligrams per kilogram-day for each contaminant of concern for the release scenarios for best-estimate and worst-case conditions.

8.2 Cancer Risks

Cancer risk is the likelihood of getting cancer. It is expressed as a probability (e.g., 1 in 100,000, which equals 10⁻⁵). A 10⁻⁵ risk is a one-in-one hundred thousand excess risk of cancer from a given level of exposure to a particular contaminant. In other words, each individual exposed to that contaminant at that level over his/her lifetime has a one-in-one-hundred-thousand chance of getting cancer from that particular exposure. Cancer risk is described as excess because it is above the existing background risk of cancer. (In a population of one million people, the number of background cancer cases is roughly between 250,000 and 333,000.) An alternative interpretation is that one additional case of cancer would be expected to occur in a population of one million people who are all exposed under the same circumstances to a particular contaminant.

Cancer risks were calculated for each contaminant and for each exposure route for that contaminant and were then summed over all contaminants and exposure routes. Because the only exposure pathway for potential contaminant releases from a disposal cavern would be groundwater, the only exposure route is ingestion.

Human cancer risks associated with disposal of nonhazardous oil-field wastes in salt caverns are estimated for the release scenarios using the following equation:

$$R_i = I_i \times \mathcal{F}_i \tag{6}$$

where

 $R_i = Risk$ from contaminant I,

 $I_i = Intake of contaminant I, and$

 $Sf_i = Slope factor for contaminant I.$

Using Equation 6 and the data in Tables 8-9 through 8-14 (intake estimates) and Table 7-1 (oral slope factors), cancer risks were estimated for each of the individual contaminants for the release scenarios for best-estimate and worst-case conditions. The results are presented in Tables 8-15 and 8-16. The total cancer risk for the release scenarios is the sum of the individual cancer risks for all contaminants of concern. Because there are no slope factors available for cadmium and chromium, and the exposure-point concentration of benzene would be 0.0 for all of the release scenarios, the total cancer risk is thus equal to the risk estimate for arsenic.

For worst-case conditions, the total cancer risks range from 2.0×10^{-17} for failure of the cavern seal with a fluid release at the depth of the cavern and for cracks releasing fluid at the depth of the cavern to 1.1×10^{-8} for a release scenario in which there is a partial roof fall and cavern seal failure with a failed casing at a shallow depth that releases contaminated fluid to the shallow aquifer (Table 8-16). Even under worst-case conditions, the excess cancer risks would lie well below the acceptable target risk range $(1 \times 10^{-4} \text{ to } 1 \times 10^{-6})$ of the EPA that was established for remedial action goals for National Priority List (NPL) sites (40 CFR300.430(e)(2)(I)(A)(2)). For best-estimate conditions, the estimated cancer risks would be less (Table 8-15). For best-estimate conditions, the estimated cancer risks would be less.

8.3 Noncancer Risks

Risks associated with noncarcinogens are expressed as hazard quotients, which is the intake of a particular contaminant divided by its RfD. Because the RfD is the estimated "safe" dose for humans, when a hazard quotient exceeds 1, there is a potential for adverse noncarcinogenic effects. Hazard quotients are not probabilities. A hazard quotient that is less than one indicates a very low potential for noncarcinogenic effects. A hazard quotient that is greater than one indicates that the information on the exposure should be reviewed to determine the significance of the finding. Like carcinogenic risks, hazard quotients are summed over contaminants and exposure routes. However, for salt caverns, the only exposure route would be the oral pathway (ingestion of groundwater). Also, hazard quotients for multiple contaminants may not be strictly additive because different chemicals may affect different organs.

For a single contaminant, I, the hazard quotient is calculated according to the equation,

$$\mathcal{B}_{i} = \frac{\mathcal{I}_{i}}{\mathcal{R}_{i}} \tag{7}$$

where

 Hq_i = Hazard quotient from contaminant I,

 $I_i = Intake of contaminant I, and$

 RfD_i = Reference dose for contaminant I.

Using Equation 7 and the data in Tables 8-9 through 8-14 (intake estimates) and Table 7-2 (oral RfDs), noncancer risks are estimated for each of the individual contaminants for the release scenarios for both best-estimate and worst-case conditions. The results are shown in Tables 8-17 and 8-18. All of the contaminants of concern would have hazard quotients that are much less than one. Even when the hazard quotients are summed for all contaminants in a given release scenario, the greatest hazard index (sum of the individual hazard quotients) under worst-case conditions would be 6×10^{-5} , which is much less than one (Table 8-18). For best-estimate conditions, the largest total hazard index would be less (1.4×10^{-5}) (Table 8-17).

9. Sensitivity of Risks to Operating Procedures and Regulatory Structures

The risk estimates calculated in Section 8 indicate that the potential for human health risks associated with disposal of nonhazardous oil field wastes in salt caverns is very low. These risks were estimated assuming normal operating conditions and standard operating procedures for cavern closure. Any relaxation in design, monitoring, or operating practices could increase these risks.

At the same time, because the projected risks from failure of the cavern seal or cavern walls are low, the results of this preliminary assessment would not appear to support the imposition of additional safety regulations (i.e., regulations beyond those assumed to be used under normal operational and post-operational conditions). For example, the health risks estimated for release of contaminants into a deep or shallow aquifer assume that the residents who drink the water would be at a lateral distance of 1,000 ft from the edge of the disposal cavern. Risks would be lower if the population drinking the water were further away. Therefore, based on the estimates of cancer and noncancer risks presented in Section 8, it would not be necessary to implement any new requirements for residents living in the vicinity of waste caverns.

Although the risks associated with spills, accidents, and equipment leaks during normal operations were not evaluated in this study, it is likely that contaminants released from such occurrences would present greater risks than those derived from the cavern itself. Consequently, care should be taken to ensure that operating practices continue to be monitored in a way that minimizes the occurrence of surface accidents.

10. Summary

This report investigated the potential for human health risks associated with the use of salt caverns for nonhazardous oil-field waste disposal. Based on assumptions that were developed for a generic cavern and generic oil-field wastes, the estimated human health risks for worst-case conditions are very low (excess cancer risks of between 1.1×10^{-8} and 2.0×10^{-17}) and hazard indices (referring to noncancer health effects) of between 6×10^{-5} and 1.0×10^{-7} . Normally, risk managers consider risks of 1×10^{-6} and less and hazard indices of less than 1 to be acceptable. For best-estimate conditions, the excess cancer risks and hazard indices would be less.

Because these risks were developed for a hypothetical cavern, and site-specific conditions related to cavern type, location, and characteristics of the waste being disposed will vary, it would be prudent to conduct a site-specific risk assessment for an actual cavern, perhaps for an existing cavern currently in use for waste disposal. Such an assessment would provide a more realistic and useful assessment than the generic one described in this report.

A few comments on the use of the results of this report are in order. First, the assessment does not address risks to workers at the cavern disposal site. Such risks would be comparable to or less than worker risks associated with hydrocarbon cavern storage operations. (Because of the potential for explosions at hydrocarbon storage operations, worker risks for nonhazardous oil-field waste disposal may be less than for hydrocarbon storage.) Second, the assessment does not determine whether any health effects will occur in the future; it only estimates cancer risk and potential for noncarcinogenic effects. Third, risks have only been estimated for contaminants for which toxicity values were available; just because there is no toxicity value does not mean there is no risk. Finally, the assessment is limited to human health effects produced by nonradioactive contamination; it does not address the possible ecological risks associated with salt cavern disposal, nor does it estimate risks associated with NORM that may be included in oil field wastes.

11. References

Adriano, D.C., 1986, *Trace Elements in the Terrestrial Environment*, Springer-Verlag, New York.

Agency for Toxic Substances and Disease Registry, 1989, "Toxicological Profile for Chromium," ATSDR/TP-88/10, prepared by Syracuse Research Corporation for Toxic Substances and Disease Registry, U.S. Public Health Service, July.

Agency for Toxic Substances and Disease Registry, 1990, "Draft Toxicological Profile for Boron," prepared by Life Systems, Inc., for Toxic Substances and Disease Registry, U.S. Public Health Service, October.

Agency for Toxic Substances and Disease Registry, 1993, ToxFAQs fact sheets, available from the Internet at http://atsdr1.atsdr.cdc.gov:8080/tfacts2.html.

API, 1994, "Design of Solution-Mined Underground Storage Practices," API Recommended Practice 1114, American Petroleum Institute, Washington, D.C., June.

ATSDR = see Agency for Toxic Substances and Disease Registry.

Back, W., J.S. Rosenshein, and P.R. Seaber, 1988, *The Geology of North America*, Volume O-2, The Geological Society of America, Inc., Boulder, Colorado, 524p.

Baes, C.F., and R.D. Sharp, 1983, "A Proposal for Estimation of Soil Leaching and Leaching Constants for Use in Assessment Models," *Journal of Environmental Quality*, 12(1):17-28.

Baes, C.F., et al., 1984, "A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture," ORNL-5786, prepared by Oak Ridge National Laboratory, Oak Ridge, Tennessee, for the U.S. Department of Energy, Oak Ridge Operations, Oak Ridge, Tennessee.

Bair, E.S., 1987, "Analysis of Hydraulic Gradients Across the Host Rock at the Proposed Texas Panhandle Nuclear-Waste Repository Site," *Ground Water*, 25(4):440-447.

Bair, E.S., T.P.O. O'Donnell, and L.W. Picking, 1985, Potentiometric Mapping from Incomplete Drill-Stem Test Data: Palo Duro Basin Area, Texas and New Mexico.

Baker, D.E., and M.C. Amacher, 1982, Nickel, Copper, Zinc, and Cadmium, in Methods of Soil Analysis, Part 2: Chemical and Microbiological Properties, Second Edition, A.L. Page et al. (editors), American Society of Agronomy, Inc., Madison, Wisconsin.

Bassett, R.L., and M.E. Bentley, 1982, "Geochemistry and Hydrodynamics of Deep Formation Brines in the Palo Duro and Dalhart Basins, Texas, U.S.A.," *Journal of Hydrology*, 59:331-372. Berest, P., and B. Brouard, 1995, "Behavior of Sealed Solution-Mined Caverns," presented at the Spring Meeting of the Solution Mining Research Institute, New Orleans, Louisiana, April.

Berest, P., B. Brouard, J. Bergues, J. Frelat, and G. Durup, 1997a, "Salt Caverns and the Compressibility Factor," presented at the Fall Meeting of the Solution Mining Research Institute, El Paso, Texas, October.

Berest, P., B. Brouard, F. Beugin, and J. Goldberg, 1997b, "Storage of Tritiated Water in Salt Caverns," presented at the Fall Meeting of the Solution Mining Research Institute, El Paso, Texas, October.

Biringer, K.L., 1984, "Strategic Petroleum Reserve Cavern, Geotechnical Data Base," SAND84-1500, Sandia National Laboratories, Albuquerque, New Mexico.

Bishop, W.M., 1986, "Long-Term Disposition of SPR Caverns Not Used for Petroleum Storage, A Draft Plan," unpublished report, employed by PB-KBB, Houston, TX, October.

Bradley, H.B., 1992, *Petroleum Engineering Handbook*, Society of Petroleum Engineers, Richardson, Texas.

Brown, B., and O. Helmer, 1964, "Improving the Reliability of Estimates Obtained from a Consensus of Experts," P-2986, The RAND Corporation.

Callahan, M.A., et al., 1979, "Water-Related Environmental Fate of 129 Priority Pollutants," EPA 440/4-79-029A, Office of Water Planning and Standards, Washington, D.C.

Capuano, R.M., and R.Z. Jan, 1996, "In-Situ Hydraulic Conductivity of Clay and Silt-Clay Fluvial-Deltaic Sediments, Texas Gulf Coast," *Ground Water*, 34(3):545-551.

CRC, 1968, Handbook of Chemistry and Physics, The Chemical Rubber Company, Cleveland, Ohio.

Chilingarian, G.V., J.O. Robertson, Jr., and S. Kumar, 1989, Surface Operations in Petroleum Production, II, Elsevier, New York, 562p.

EPA: see U.S. Environmental Protection Agency.

Freeze, R.A., and J.A Cherry, 1979, *Groundwater*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 604p.

Freeze, G.A., K.W. Larson, P.B. Davies, and S.W. Webb, 1995, "Using a Multiphase Flow Code to Model the Coupled Effects of Repository Consolidation and Multiphase Brine and Gas Flow at the Waste Isolation Pilot Plant," AIChE Heat Transfer Symposium, Portland, Oregon, E.L. Gaden, Jr., Series Editor, Volume 91, Number 306, American Institute of Chemical Engineers, New York.

Hanor, J.S., 1993, "Effective Hydraulic Conductivity of Fractured Clay Beds at a Hazardous Waste Landfill, Louisiana Gulf Coast," *Water Resources Research*, 29 (11): 3691-3698.

Hern, S.C., and S.M. Melancon, 1987, Vadose Zone Modeling of Organic Pollutants, Lewis Publishers, Chelsea, Michigan, 295p.

Hickerson, R., 1995, "Oilfield Waste Disposal in a Salt Cavern," in Proceedings of the Annual Underground Injection Control and Ground Water Protection Forum, Kansas City, Missouri, October.

Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, and E.M. Michalenko, 1991, Handbook of Environmental Degradation Rates, Lewis Publishers, Inc., Chelsea, Michigan, 225p.

Lallemand-Barres, A., and P. Peaudecerf, 1978, "Recherche des Relations Entre la Valeur de la Dispersivite Macroscopique d'un Milieu Aquifere, Ses Autres Caracteristiques et les Conditions de Mesure," *Bulletin Bureau Geologique Minieres*, Sect. 3, Vol. 4, p277-284.

Langer, M., M. Wallner, and H. Wassman, 1984, "Gebirgsmechanische Bearbeitung von Stabilatsfragen bei Deponiekaverenen im Salzgebirge" (Geoengineering with Respect to Stability of Cavities Used for Disposal Purposes, in German), *Kali und Steinsalz*, 2, p66-76.

Linn, J., 1997, personal communication, February.

Lu, P.Y., et al., 1975, "Model Ecosystem Studies of Lead and Cadmium and of Urban Sewage Sludge Containing These Elements," *Journal of Environmental Quality*, 4:505-509.

Lyman, W.J., P.J. Reidy, and B. Levy, 1992, *Mobility and Degradation of Organic Contaminants in Subsurface Environments*, C.K. Smoley, Inc., Chelsea, Michigan, 395p.

Mackay, D., W.Y. Shiu, and K.C. Ma, 1992, Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals, Volume 1, Monoaromatic Hydrocarbons, Chlorobenzenes, and PCBs, Lewis Publishers, Chelsea, Michigan, 697p.

Maidment, D.R., 1993, Handbook of Hydrology, McGraw-Hill, Inc., New York.

Makridakis, S., and R.L. Winkler, 1983, "Averages of Forecasts: Some Empirical Results," *Management Science*, 29(9):987-996.

Montgomery, J.H., 1991, Groundwater Chemicals Desk Reference Volume 2, Lewis Publishers, Chelsea, Michigan, 944p.

Montgomery, J.H., and L.M. Welkom, 1991, Groundwater Chemicals Desk Reference, Lewis Publishers, Chelsea, Michigan, 640p.

Pfeifle, T.W., T.J. Vogt, and G.A. Brekken, 1995, "Correlation of Chemical, Mineralogic, and Physical Characteristics of Gulf Coast Dome Salt to Deformation and Strength Properties," Solution Mining Research Institute Research Project Report 94-0004-S, January.

Postgate, J.K., 1965, "Recent Advances in the Study of Sulfate-Reducing Bacteria," *Bacteriological Reviews*, 29(4):December.

Querio, C.W., 1980, "Design and Construction of Solution-Mined Caverns for LPG Storage," presented at the Fall Meeting of the Solution Mining Research Institute, Minneapolis, Minnesota, October.

Radian Corporation, 1995, "Risk Assessment of Converting Salt Caverns to Natural Gas Storage, Final Report," GRI-95/0377, prepared for the Gas Research Institute, Austin, Texas, October.

Rai, D., J.M. Zachara, A.P. Schwab, et al., 1986, "Chemical Attenuation Rates, Coefficients, and Constants in Leachate Migration, Volume 1," A Critical Review, Report to Electric Power Research Institute, Palo Alto, California by Battelle, Pacific Northwest Laboratories, Richland, Washington, Research Project 2198-1.

Reisenauer, H.M., 1982, "Chromium," in Methods of Soil Analysis, Part 2: Chemical and Microbiological Properties, Second Edition, A.L. Page et al. (editors), American Society of Agronomy, Inc., Madison, Wisconsin.

Richey, S.F., J.G. Wells, and K.T. Stephens, 1985, "Geohydrology of the Delaware Basin and Vicinity, Texas and New Mexico," U.S. Geological Survey, Water Resources Investigations Report 84-4077, Albuquerque, New Mexico.

SAIC, 1994, "Statistical Analysis of Effluent from Coastal Oil and Gas Extraction Facilities," prepared by Science Applications International Corporation, Falls Church, Virginia, for U.S. Environmental Protection Agency, Office of Science and Technology, September 30.

Seni, S.J., 1980, "Sand-Body Geometry and Depositional Systems, Ogallalla Formation, Texas," The University of Texas at Austin, Bureau of Economic Geology Report of Investigation No. 5, Austin, Texas, 35p.

Sheppard, M.I., D.I. Beals, D.H. Thibault, and P. O'Connor, 1984, "Soil Nuclide Distribution Coefficients and Their Statistical Distributions," AECL-8364, Whiteshell Nuclear Research Establishment, Atomic Energy of Canada Limited, Pinawa, Manitoba, December.

SMRI: see Solution Mining Research Institute.

Solution Mining Research Institute (SMRI), 1997, Letter to J. Veil, Argonne National Laboratory, August 6.

Stanier, R.Y., et al., 1963, *The Microbial World*, Second Edition, Prentice Hall, Englewood Cliffs, New Jersey.

Streeter, V.L., 1961, Handbook of Fluid Dynamics, McGraw-Hill Book Company, Inc., New York.

Stumm, W., and J.J. Morgan, 1981, Aquatic Chemistry, An Introduction Emphasizing Chemical Equilibria in Natural Waters, John Wiley and Sons, New York, 780p.

Testa, S.A., 1994, Geological Aspects of Hazardous Waste Management, CRC Press, Boca Raton, Florida, 537p.

Tomasko, D., 1985, "A Numerical Model for Predicting the Thermal Behavior of Caverns in the Strategic Petroleum Reserve," Dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, the University of New Mexico, Albuquerque, New Mexico.

Tomasko, D., 1991, "Modeling Vertical and Horizontal Solute Transport," American Geophysical Union Fall Meeting, San Francisco, California, December.

Tomasko, D., 1994, "An Analytical Model for LNAPL Transport in the Vadose Zone," Geological Society of America Fall Meeting, Seattle, Washington, December.

U.S. Department of Energy, 1990, "Final Supplemental Environmental Impact Statement Waste Isolation Pilot Plant," DOE/EIS-0026-FS, Office of Environmental Restoration and Waste Management, January

U.S. Department of Energy, 1996, "Workshop on Managing Human Health and Ecological Risk Assessment Projects under CERCLA and RCRA," Office of Environment Safety and Health, prepared by Argonne National Laboratory, May.

U.S. Environmental Protection Agency, 1987, "Report to Congress, Management of Wastes from the Exploration, Development, and Production of Crude Oil, Natural Gas, and Geothermal Energy, Volume 1 of 3," EPA/530-SW-88-003, Office of Solid Waste and Emergency Response, Washington, D.C., December.

U.S. Environmental Protection Agency, 1989, "Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)," EPA/540/1-89/002, Office of Emergency and Remedial Response, December.

U.S. Environmental Protection Agency, 1991, "Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors," OSWER Directive 9285.6-03, Office of Solid Waste and Emergency Response, Washington, D.C., March 25.

U.S. Environmental Protection Agency, 1993, "Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Offshore Subcategory of the Oil and

Gas Extraction Point Source Category," EPA 821-R-93-003, Office of Water, Washington, D.C., January.

U.S. Environmental Protection Agency, 1994a, "Drinking Water Regulations and Health Advisories," Office of Water, Washington, D.C., May.

U.S. Environmental Protection Agency, 1994b, "Associated Waste Report: Crude Oil Tank Bottoms and Oily Debris," Office of Solid Waste, Special Waste Branch, Washington, D.C., March.

Van Sambeek, L. L., 1993, "Evaluating Cavern Tests and Subsurface Subsidence Using Simple Numerical Models," presented at the 7th Symposium on Salt, Vol. I.

Veil, J., D. Elcock, M. Raivel, D. Caudle, R.C. Ayers, Jr., and B. Grunewald, 1996, "Preliminary Technical and Legal Evaluation of Disposing of Nonhazardous Oil Field Waste into Salt Caverns," prepared for the U.S. Department of Energy, Office of Fossil Energy under contract W-31-109-ENG-38, Argonne National Laboratory, Argonne, Illinois, June.

Wallner, M., 1986, "Frac-Pressure Risk in Rock Salt," presented at the Fall Meeting of the Solution Mining Research Institute, Amsterdam.

Wallner, M., and W.A. Paar, 1997, "Risk of Progressive Pressure Build Up in a Sealed Cavern," presented at the Fall Meeting of the Solution Mining Research Institute, El Paso, Texas, October.

Werner, M.L, 1986, "Structure and Mineralization of the Richton Dome Caprock Boring MRIG-9 Technical Report," BMI/ONWI-610, Office of Nuclear Waste Isolation, Columbus, Ohio.

Whiting, G.H., 1981a, "Strategic Petroleum Reserve (SPR) Geologic Site Characterization Report, Sulphur Mines Salt Dome," SAND80-7141, Sandia National Laboratories, Albuquerque, New Mexico, March.

Whiting, G.H., 1981b, "Strategic Petroleum Reserve (SPR) Geologic Site Characterization Report, West Hackberry Salt Dome," SAND80-7131, Sandia National Laboratories, Albuquerque, New Mexico, January.

Williams, T.A., and A.K. Williamson, 1989, "Estimating Water-Table Altitudes for Regional Ground-Water Flow Modeling, U.S. Gulf Coast," *Ground Water*. 27(3):333-340.

Windholz, M., S. Budavari, R.F. Blumetti, and E.S. Otterbein, 1983, *The Merck Index, An Encyclopedia of Chemicals, Drugs, and Biologicals*, Merck & Company, Rahway, New Jersey.

Winkler, R.L., 1968, "The Consensus of Subjective Probability Distributions," *Management Science*, 15(2): B-61-B-75.

Winkler, R.L., 1977, "The Consensus of Subjective Probability Forecasts: Are Two, Three, ... Heads Better Than One?," Fifth Conference on Probability and Statistics, Las Vegas, Nevada, November.

Winkler, R.L., and R.T. Clemen, 1992, "Sensitivity of Weights in Combining Forecasts," Technical Notes, *Operations Research*, 40(3):609-614.

Winkler, R.L., and R.K. Sarin, 1981, "Risk Assessment: Consulting the Experts," *The Environmental Professional*, 3:265-276.

Wood, W.W., and W.E. Sanford, 1995, "Chemical and Isotopic Methods for Quantifying Ground-Water Recharge in a Regional, Semiarid Environment," *Ground Water*, 33(3):458-468.

Tables

(Note: Numbers presented in these tables have been rounded)

Table 6-1 Chemical Constituent Concentrations Assumed for Cavern Brine at the Time of Release

Type of	Con	centration Range (mg	/L unless otherwis	se noted)
Waste/Reference	Benzene	Arsenic	Cadmium	Chromium
Produced water				
SAIC (1994)	0.08-14	BDL ^a -0.032	BDL-0.098	BDL-0.85
EPA (1993) ^b	0.052-20.4	0.017-0.31	0.0012-0.098	
EPA (1987) ^b	0.47-2.9	0.02-1.7		
Drilling Waste				
EPA (1987) ^b TCLP data ^c	^d	BDL-0.002	0.011-0.29	BDL-0.78
EPA (1987) ^a analysis of waste itself	^d	BDL-0.01 mg/kg	2 - 5.4 mg/kg	22-190 mg/kg
Tank Bottoms				
EPA (1994b) TCLP data	BDL-13	BDL-0.06	BDL- 0.008	BDL-0.14
EPA (1994b) analysis of waste itself	0.175-2,686 mg/kg	0.47-166 mg/kg	0.32-6,500 mg/kg	1.7-1,170 mg/kg
Selected Concentrations ^e	20.4	1.7	0.29	0.85

^a BDL = value is below detection limit.

- ^b Range is from the median to the upper 90th percentile.
- [°] TCLP = toxicity characteristic leaching procedure.
- ^d No data reported in this reference.
- ^e Highest value for each constituent in TCLP samples for produced water, drilling waste, and tank bottoms.

Release Scenario	Contaminant	Retardation	Initial Conc. (mg/L)	Concentration at 1,000 yrs (mg/L) ^a	Concentration at 1,000 yrs (mg/L) ^b	MCL (mg/L)
Cavern seal fails and releases fluid at depth	Benzene	10	20.4	0.0		0.005
	Cadmium	50	0.29	4.1 × 10 ⁻⁸		0.005
	Arsenic	200	1.7	9.5×10^{-15}		0.05
	Chromium	500	0.85	7.7×10^{-15}		0.1
Cavern seal fails and releases fluid to shallow aquifer	Benzene	10	20.4	0.0		0.005
	Cadmium	50	0.29	1.0 × 10 ^{-6c}		0.005
	Arsenic	200	1.7	1.2×10^{-5}		0.05
	Chromium	500	0.85	1.2 × 10 ⁻⁸		0.1

 Table 6-2
 Summary Table of Release Calculations

Release Scenario	Contaminant	Retardation	Initial Conc. (mg/L)	Concentration at 1,000 yrs (mg/L) ^a	Concentration at 1,000 yrs (mg/L) ^b	MCL (mg/L)
Release from crack	Benzene	10	20.4	0.0		0.005
	Cadmium	50	0.29	4.1×10^{-8}		0.005
	Arsenic	200	1.7	9.5×10^{-15}		0.05
	Chromium	500	0.85	7.7×10^{-15}		0.1
Release from leaky interbed	Benzene	10	20.4		0.0	0.005
	Cadmium	50	0.29		1.6 × 10 ⁻⁸	0.005
	Arsenic	200	1.7		6.1×10^{-13}	0.05
	Chromium	500	0.85		5.2×10^{-13}	0.1
Roof fall + release at depth	Benzene	10	20.4	0.0		0.005
	Cadmium	50	0.29	4.1 × 10 ⁻⁸		0.005
	Arsenic	200	1.7	9.5×10^{-15}		0.05
	Chromium	500	0.85	7.7×10^{-15}		0.1

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Release Scenario	Contaminant	Retardation	Initial Conc. (mg/L)	Concentration at 1,000 yrs (mg/L) ^a	Concentration at 1,000 yrs (mg/L) ^b	MCL (mg/L)
Roof fall + cavern seal failure + release at depth	Benzene	10	20.4	0.0		0.005
	Cadmium	50	0.29	4.1 × 10 ⁻⁸		0.005
	Arsenic	200	1.7	9.5 × 10 ⁻¹⁵		0.05
	Chromium	500	0.85	7.7×10^{-15}		0.1
Roof fall + cavern seal failure + release at shallow depth	Benzene	10	20.4	0.0		0.005
	Cadmium	50	0.29	1.0×10^{-6c}		0.005
	Arsenic	200	1.7	1.2×10^{-5}		0.05
	Chromium	500	0.85	1.2×10^{-8}		0.1
Roof fall + release through leaky interbed	Benzene	10	20.4		0.0	
	Cadmium	50	0.29		1.6 × 10 ⁻⁸	0.005
	Arsenic	200	1.7		6.1×10^{-13}	0.05
	Chromium	500	0.85		5.2×10^{-13}	0.1

Table 6.2 Summary Table of Failure Calculations (continued)

^a Short, pulsed release.
^b Long, slow release.
^c Maximum concentration of 1.3 × 10⁻⁵ occurs at 334 yrs.

Release Scenario	No. of Responses	Best Estimate	Range	Worst Case	Range
Seal fails and releases fluid at depth	5	0.031	0.0005 to 0.1	0.12	0.002 to 0.25
Seal fails and releases fluid at shallow depth	5	0.012	0.0001 to 0.05	0.040	0.001 to 0.10
Cracks release fluid at depth	5	0.022	0.0001 to 0.10	0.120	0.001 to 0.35
Leaky interbeds release fluid at depth	5	0.022	0.0001 to 0.10	0.120	0.001 to 0.35
Roof fall plus fluid released at depth	5	0.100	10 ⁻⁶ to 0.50	0.290	10 ⁻⁵ to 1.0
Roof fall plus cavern seal fails and releases fluid at depth	5	0.062	5×10 ⁻⁶ to 0.2	0.163	2×10 ⁻⁵ to 0.35
Roof fall plus cavern seal fails and releases fluid at shallow depth	5	0.006	1×10 ⁻⁷ to 0.02	0.051	1×10 ⁻⁶ to 0.10
Roof fall plus release through leaky interbed	5	0.062	5×10 ⁻⁶ to 0.20	0.163	2×10^{-5} to 0.35

Table 6-3 Probabilities of Occurrence for Specified Release Scenarios

Table 7-1 Oral Slope Factors for Contaminants of Concern

Contaminant of Concern	Oral Slope Factor (1/ (mg/kg-day))
Arsenic	1.5
Benzene	0.029
Cadmium	NA
Chromium	NA

NA = Not available

Table 7-2 Oral Reference Doses for Contaminants of Concern

Contaminant of Concern	Oral RfD (mg/kg/day)
Arsenic	0.0003
Benzene	NA
Cadmium	0.0005
Chromium (III)	1.0
Chromium (VI)	0.005

NA = Not available

Table 8-1 Scenarios for Risk Calculations

Release Location	Release Modes
Release to shallow aquifer	 Cavern seal failure with casing failure at shallow depth Cavern roof fall with cavern seal failure and casing failure at shallow depth
Release to deep aquifer	 Cavern seal failure with casing failure at depth of cavern Cracks Leaky interbeds Roof fall with intact cavern seal Roof fall with cavern seal failure and casing failure at depth of cavern Roof fall with release through exposed leaky interbed

Table 8-2 Exposure-Point Concentrations for Deep, Best-Estimate Aquifer Release Scenarios

Contaminant	Conc. at 1,000 yr (mg/L)	Best	-Estimate Proba	Best-Estimate Probability of Occurrence	ance	Best-Estim	ate Exposure-Po	Best-Estimate Exposure-Point Concentrations (mg/L)	ns (mg/L)
		Seal fails and relcases fluid at depth	Crack releases fluid at depth	Roof fall + fluid released at depth	Roof fall + seal fails and fluid released at depth	Seal fails and releases fluid at depth	Crack releases fluid at depth	Roof fall + fluid released at depth	Roof fall + scal fails and fluid released at depth
Benzene	0.0	0.031	0.022	0.1	0.062	0.0	0.0	0.0	0.0
Cadmium	4.1×10^{-8}	0.031	0.022	0.1	0.062	1.3×10^{-9}	9.0×10^{-10}	4.1×10^{-9}	2.5×10^{-9}
Arsenic	9.5×10^{-15}	0.031	0.022	0.1	0.062	3.0×10^{-16}	2.1×10^{-16}	9.5×10^{-16}	5.9×10^{-16}
Chromium	7.7×10^{-15}	0.031	0.022	0.1	0.062	2.4×10^{-16}	1.7×10^{-16}	7.7×10^{-16}	4.8×10^{-16}

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Table 8-3 Exposure-Point Concentrations for Deep, Worst-Case Aquifer Release Scenarios

Contaminant	Conc. at 1,000 yr (mg/L)	Wo	Worst-Case Probability of Occurrence	lity of Occurren	lce	Worst-Ca	se Exposure-Poi	Worst-Case Exposure-Point Concentrations (mg/L)	is (mg/L)
		Scal fails and releases fluid at depth	Crack releases fluid at depth	Roof fall + fluid released at depth	Roof fall + seal fails and fluid released at depth	Seal fails and releases fluid at depth	Crack releases fluid at depth	Roof fall + fluid released at depth	Roof fall + seal fails and fluid released at depth
Benzene	0.0	0.120	0.120	0.290	0.163	0.0	0.0	0.0	0.0
Cadmium	4.1×10^{-8}	0.120	0.120	0.290	0.163	4.9×10^{-9}	4.9×10^{-9}	1.2×10^{-8}	6.7×10^{-9}
Arsenic	9.5×10^{-15}	0.120	0.120	0.290	0.163	1.1×10^{-15}	1.1 × 10 ⁻¹⁵	2.8×10^{-15}	1.6×10^{-15}
Chromium	7.7×10^{-15}	0.120	0.120	0.290	0.163	9.2×10^{-16}	9.2×10^{-16}	2.2×10^{-15}	1.3×10^{-15}

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Contaminant	Conc. at 1,000 yr (mg/L)	Best-Estimate Occurrence	Probability of	Best-Estimate Point Concentr	-
		Seal fails, casing fails, and fluid released to shallow aquifer	Roof fall + seal fails, + casing fails and releases fluid to shallow aquifer	Seal fails, casing fails, and fluid released to shallow aquifer	Roof fall + seal fails + casing fails and releases fluid to shallow aquifer
Benzene	0.0	0.012	0.006	0.0	0.0
Cadmium	1.0 × 10 ⁻⁶	0.012	0.006	1.2×10^{-8a}	6.0 × 10 ⁻⁹
Arsenic	1.2×10^{-5}	0.012	0.006	1.4×10^{-7}	7.2 × 10 ⁻⁸
Chromium	1.2 × 10 ⁻⁸	0.012	0.006	1.4×10^{-10}	7.2×10^{-11}

 Table 8-4
 Exposure-Point Concentrations for Shallow, Best-Estimate Aquifer Release Scenarios

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^a Maximum concentration of 1.6×10^{-7} mg/L occurs at 334 years.

Contaminant	Conc. at 1,000 yr (mg/L)	Worst-Case Pr Occurrence	obability of	Worst-Case Ex Concentrations	•
		Seal fails, casing fails, and fluid released to shallow aquifer	Roof fall + seal fails + casing fails and releases fluid to shallow aquifer	Seal fails, casing fails, and fluid released to shallow aquifer	Roof fall + seal fails + casing fails and releases fluid to shallow aquifer
Benzene	0.0	0.040	0.051	0.0	0.0
Cadmium	1.0×10^{-6}	0.040	0.051	4.0 × 10 ^{-8a}	5.1 × 10 ⁻⁸
Arsenic	1.2×10^{-5}	0.040	0.051	4.8×10^{-7}	6.1×10^{-7}
Chromium	1.2×10^{-8}	0.040	0.051	4.8×10^{-10}	6.1 × 10 ⁻¹⁰

Table 8-5 Exposure-Point Concentrations for Shallow, Worst-Case Aquifer Release Scenarios

^a Maximum concentration of 5.2×10^{-7} mg/L occurs at 334 years.

Contaminant	Conc. at 1,000 yr (mg/L)	Best-Estimate Occurrence	Probability of	Best-Estimate Point Concentr	•
		Leaky interbed releases fluid at depth	Roof fall + long slow release through leaky interbed at depth	Leaky interbed releases fluid at depth	Roof fall + release through leaky interbed at depth
Benzene	0.0	0.022	0.062	0.0	0.0
Cadmium	1.6 × 10 ⁻⁸	0.022	0.062	3.5×10^{-10}	9.9 × 10 ⁻¹⁰
Arsenic	6.1×10^{-13}	0.022	0.062	1.3×10^{-14}	3.8×10^{-14}
Chromium	5.2×10^{-13}	0.022	0.062	1.1×10^{-14}	3.2×10^{-14}

 Table 8-6
 Exposure-Point Concentrations for Additional Best-Estimate Releases at Depth

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Contaminant	Conc. at 1,000 yr (mg/L)	Worst-Case Pr Occurrence	obability of	Worst-Case Ex Concentrations	•
		Leaky interbed releases fluid at depth	Roof fall + long slow release through leaky interbed at depth	Leaky interbed releases fluid at depth	Roof fall + release through leaky interbed at depth
Benzene	0.0	0.120	0.163	0.0	0.0
Cadmium	1.6 × 10 ⁻⁸	0.120	0.163	1.9 × 10 ⁻⁹	2.6 × 10 ⁻⁹
Arsenic	6.1×10^{-13}	0.120	0.163	7.3×10^{-14}	9.9 × 10 ⁻¹⁴
Chromium	5.2×10^{-13}	0.120	0.163	6.2×10^{-14}	8.5×10^{-14}

 Table 8-7
 Exposure-Point Concentrations for Additional Worst-Case Releases at Depth

Table 8-8 Exposure Scenario Assumptions for Ingestion of Groundwater

Parameter	Value
Daily intake rate	2 L/d
Exposure time	24 h/d
Exposure frequency ^a	350 d/yr
Exposure duration ^a	30 yr
Body weight of human receptor	70 kg
Averaging time Carcinogens (70 yr) Noncarcinogens (365 d/yr × ED) ^b	25,550 d 10,950 d

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^a Exposure frequency and exposure duration based on specifics of failure mode.
 ^b ED = exposure duration.

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Table 8-9 Estimated Intake Rates for Deep, Best-Estimate Aquifer Release Scenarios

				Intake Rate (mg/kg-day)	mg/kg-day)			
	Seal fails and releases fluid at depth	releases fluid pth	Crack releases fluid at depth	fluid at depth	Roof fall and fluid released at depth	fluid released spth	Roof fall plus seal fails a fluid released at depth	Roof fall plus seal fails and fluid released at depth
Contaminant Ca	Carcinogen	Non- carcinogen	Carcinogen	Non- carcinogen	Carcinogen	Non- carcinogen	Carcinogen	Non- carcinogen
Benzene 0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cadmium 1.0	1.6×10^{-11}	3.5×10^{-11}	1.1×10^{-11}	2.4×10^{-11}	4.9×10^{-11}	1.1×10^{-10}	3.0×10^{-11}	6.8×10^{-11}
Arsenic 3.	3.6×10^{-18}	8.1×10^{-18}	2.5×10^{-18}	5.7×10^{-18}	1.1×10^{-17}	2.6×10^{-17}	7.1×10^{-18}	1.6×10^{-17}
Chromium 2.	2.9×10^{-18}	6.5×10^{-18}	2.0×10^{-18}	4.6×10^{-18}	9.2×10^{-18}	2.1×10^{-17}	5.8×10^{-18}	1.3×10^{-17}

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Table 8-10 Estimated Intake Rates for Deep, Worst-Case Aquifer Release Scenarios

				Intake Rate (mg/kg-day)	(mg/kg-day)			
	Scal fails and at d	Seal fails and releases fluid at depth	Crack releases fluid at depth	fluid at depth	Roof fall and fluid released at depth	and fluid released at depth	Roof fall plus fluid releas	Roof fall plus scal fails and fluid released at depth
Contaminant	Carcinogen	Non- carcinogen	Carcinogen	Non- carcinogen	Carcinogen	Non- carcinogen	Carcinogen	Non- carcinogen
Benzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cadmium	5.9×10^{-11}	1.3×10^{-10}	5.9×10^{-11}	1.3×10^{-10}	1.4×10^{-10}	3.2×10^{-10}	8.0×10^{-11}	1.8×10^{-10}
Arsenic	1.3×10^{-17}	3.0×10^{-17}	1.3×10^{-17}	3.0×10^{-17}	3.4×10^{-17}	7.6×10^{-17}	1.9×10^{17}	4.3×10^{-17}
Chromium	1.1×10^{17}	2.5×10^{17}	1.1×10^{-17}	2.5×10^{-17}	2.6×10^{-17}	5.9×10^{-17}	1.6×10^{17}	3.5×10^{-17}
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		Intake Rate	(mg/kg-day)	
	Seal fails, casin released to shall	g fails, and fluid low aquifer		fails + casing fails id to shallow aquifer
Contaminant	Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Benzene	0.0	0.0	0.0	0.0
Cadmium	1.4×10^{-10a}	3.2×10^{-10b}	7.2×10^{-11}	1.6×10^{-10}
Arsenic	1.7×10^{-9}	3.8×10^{-9}	8.6×10^{-10}	1.9×10^{-9}
Chromium	1.7×10^{-12}	3.8×10^{-12}	8.6×10^{-13}	1.9×10^{-12}

Table 8-11 Estimated Intake Rates for Shallow, Best-Estimate Aquifer Release Scenarios

^a Maximum concentration of 1.9×10⁻⁹ mg/kg-day occurs at 334 years. ^b Maximum concentration of 4.2×10⁻⁹ mg/kg-day occurs at 334 years.

Table 8-12	Estimated Intake	Rates for Shallow.	Worst-Case Ac	quifer Release Scenarios

		Intake Rate	(mg/kg-day)	
	Seal fails, casin released to shal	g fails, and fluid low aquifer		l fails + casing fails aid to shallow aquifer
Contaminant	Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Benzene	0.0	0.0	0.0	0.0
Cadmium	4.8×10^{-10a}	1.1 × 10 ^{-9b}	6.1×10^{-10}	1.4×10^{-9}
Arsenic	5.8 × 10 ⁻⁹	1.3 × 10 ⁻⁸	7.3 × 10 ⁻⁹	1.7 × 10 ⁻⁸
Chromium	5.8×10^{-12}	1.3 × 10 ⁻¹¹	7.3×10^{-12}	1.7×10^{-11}

^a Maximum concentration of 6.2×10⁻⁹ mg/kg-day occurs at 334 years. ^b Maximum concentration of 1.4×10⁻⁸ mg/kg-day occurs at 334 years.

		Intake Rate	(mg/kg-day)	
	Leaky interbed depth	releases fluid at	Roof fall + rele interbed at dept	ase thorough leaky
Contaminant	Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Benzene	0.0	0.0	0.0	0.0
Cadmium	4.2×10^{-12}	9.5×10^{-12}	1.2×10^{-11}	2.7×10^{-11}
Arsenic	1.6×10^{-16}	3.5×10^{-16}	4.6×10^{-16}	1.0×10^{-15}
Chromium	1.3×10^{-16}	3.0×10^{-16}	3.8×10^{-16}	8.6×10^{-16}

Table 8-13 Estimated Intake Rates for Additional, Best-Estimate Aquifer Release Scenarios

 Table 8-14
 Estimated Intake Rates for Additional, Worst-Case Aquifer Release Scenarios

		Intake Rate	(mg/kg-day)	
	Leaky interbed depth	releases fluid at	Roof fall + rele interbed at dep	ease through leaky th
Contaminant	Carcinogen	Noncarcinogen	Carcinogen	Noncarcinogen
Benzene	0.0	0.0	0.0	0.0
Cadmium	2.3×10^{-11}	5.1 × 10 ⁻¹¹	3.1×10^{-11}	7.0×10^{-11}
Arsenic	8.8 × 10 ⁻¹⁶	2.0×10^{-15}	1.2×10^{-15}	2.7×10^{-15}
Chromium	7.4×10^{-16}	1.7×10^{-15}	1.0×10^{-15}	2.3×10^{-15}

			R	Release Scenario				
Contaminant	Seal fails and releases fluid at depth	Crack releases fluid at depth	Roof fall and fluid released at depth	Roof fall plus seal fails and fluid released at depth	Seal fails, casing fails, and fluid released to shallow aquifer	Roof fall + seal fails + casing fails and releases fluid to shallow aquifer	Leaky interbed releases fluid at depth	Roof fall + release through leaky interbed at depth
Arsenic	5.4×10^{-18}	3.8×10^{-18}	1.7×10^{-17}	1.1×10^{-17}	2.6×10^{-9}	1.3×10^{-9}	2.4×10^{-16}	6.9×10^{-16}
Benzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA
Chromium III	NA	NA	NA	NA	NA	NA	NA	NA
Chromium VI	NA	NA	NA	NA	NA	NA	NA	NA
Total	5.4×10^{-18}	3.8×10^{-18}	1.7×10^{-17}	1.1×10^{-17}	2.6×10^{-9}	1.3×10^{-9}	2.4×10^{-16}	6.9×10^{-16}

Table 8-15 Estimated Cancer Risks for Best-Estimate Aquifer Release Scenarios

NA = Not available

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Table 8-16 Estimated Cancer Risks for Worst-Case Aquifer Release Scenarios

			Re	Release Scenario				
Contaminant	Seal fails and releases fluid at depth	Crack releases fluid at depth	Roof fall and fluid released at depth	Roof fall plus scal fails and fluid released at depth	Seal fails, casing fails, and fluid released to shallow aquifer	Roof fall + seal fails + casing fails and releases fluid to shallow aquifer	Leaky interbed releases fluid at depth	Roof fall + release through leaky interbed at depth
Arsenic	2.0×10^{-17}	2.0×10^{-17}	5.1×10^{-17}	2.9×10^{-17}	8.7×10^{-9}	1.1×10^{-8}	1.3×10^{-15}	1.8×10^{-15}
Benzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA
Chromium III	NA	NA	NA	NA	NA	NA	NA	NA
Chromium VI	NA	NA	NA	NA	NA	NA	NA	NA
Total	2.0×10^{-17}	2.0×10^{-17}	5.1×10^{-17}	2.9×10^{-17}	8.7×10^{-9}	1.1×10^{-8}	1.3×10^{-15}	$1.8 imes 10^{-15}$

NA = Not available

Table 8-17 Estimated Noncancer Risks for Best-Estimate Aquifer Release Scenarios

			R	Release Scenario				
Contaminant	Seal fails and releases fluid at depth	Crack releases fluid at depth	Roof fall and fluid released at depth	Roof fall plus seal fails and fluid released at depth	Seal fails, casing fails, and fluid released to shallow aquifer	Roof fall + seal fails + casing fails and releases fluid to shallow aquifer	Leaky interbed releases fluid at depth	Roof fall + release through leaky interbed at depth
Arsenic	2.7×10^{-14}	1.9×10^{-14}	8.7×10^{-14}	5.3×10^{-14}	1.3×10^{-5}	6.3×10^{-6}	1.2×10^{-12}	3.3×10^{-12}
Benzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cadmium	7.0×10^{-8}	4.8×10^{-8}	2.2×10^{-7}	1.4×10^{-7}	6.4×10^{-7a}	3.2×10^{-7}	1.9×10^{-8}	5.4×10^{-8}
Chromium III 6.5×10^{-18}	6.5×10^{-18}	4.6×10^{-18}	2.1×10^{-17}	1.3×10^{-17}	3.8×10^{-12}	1.9×10^{-12}	3.0×10^{-16}	8.6×10^{-16}
Chromium VI 1.3×10^{-15}	1.3×10^{-15}	9. 2×10^{-16}	4.2×10^{-15}	2.6×10^{-15}	$7.6 imes 10^{-10}$	3.8×10^{-10}	6.0×10^{-14}	1.7×10^{-13}
Total	7.0×10^{-8}	4.8×10^{-8}	2.2×10^{7}	1.4×10^{-7}	1.4×10^{-5}	6.6×10^{-6}	1.9×10^{-8}	5.4×10^{-8}

^a 8.4×10⁻⁶ Maximum concentration occurs at 334 years.

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Table 8-18 Estimated Noncancer Risks for Worst-Case Aquifer Release Scenarios

ContaminantSeal fails and releases fluidCrackRoof fallSeal faat depthreleasesfluidplus sealcasing and fluidat depthfluid atreleased atfails and fluidand fluidat depthdepthdepthfluidreleasedat depthfluid atdepthdepthfluidat depthfluid atdepthdepthfluidat depthdepthdepthfluidand fluidat depthdepthdepthfluidreleasedat depth1.0 × 10 ⁻¹³ 1.0×10^{-13} 2.5×10^{-13} 1.4×10^{-13} Arsenic 1.0×10^{-13} 1.0×10^{-13} 2.5×10^{-13} 1.4×10^{-13} Benzene 0.0 0.0 0.0 0.0 0.0 Cadmium 2.6×10^{-7} 2.6×10^{-7} 3.6×10^{-7} 2.2×10^{-17} Chromium VI 5.0×10^{-15} 5.0×10^{-15} 1.2×10^{-14} 7.0×10^{-15} 2.6×10^{-15}		Release Scenario	trio			
1.0×10^{-13} 1.0×10^{-13} 2.5×10^{-13} 1.4×10^{-13} 0.0 0.0 0.0 0.0 0.0 2.6×10^{-7} 2.6×10^{-7} 6.4×10^{-7} 3.6×10^{-7} 2.5×10^{-17} 2.5×10^{-17} 5.9×10^{-17} 3.5×10^{-17} 5.0×10^{-15} 5.0×10^{-15} 1.2×10^{-14} 7.0×10^{-15}	Crack releases fluid at depth	at	Seal fails, casing fails, and fluid released to shallow aquifer	Roof fall + seal fails + casing fails and releases fluid to shallow aquifer	Leaky interbed releases fluid at depth	Roof fall + release through leaky interbed at depth
0.0 0.0 0.0 0.0 2.6×10^{-7} 2.6×10^{-7} 6.4×10^{-7} 3.6×10^{-7} 2.5×10^{-17} 2.5×10^{-17} 5.9×10^{-17} 3.5×10^{-17} 5.0×10^{-15} 5.0×10^{-15} 1.2×10^{-14} 7.0×10^{-15}	1.0×10^{-13}		4.3 x 10 ⁻⁵	5.7×10^{-5}	6.7×10^{-12}	9.0×10^{-12}
2.6×10^{-7} 2.6×10^{-7} 6.4×10^{-7} 3.6×10^{-7} 2.5×10^{-17} 2.5×10^{-17} 5.9×10^{-17} 3.5×10^{-17} 5.0×10^{-15} 5.0×10^{-15} 1.2×10^{-14} 7.0×10^{-15}		0.0	0.0	0.0	0.0	0.0
	2.6×10^{-7}		2.2×10^{-6a}	2.8×10^{-6}	1.0×10^{-7}	1.4×10^{-7}
$5.0 \times 10^{-15} \qquad 5.0 \times 10^{-15} \qquad 1.2 \times 10^{-14} \qquad 7.0 \times 10^{-15}$	2.5×10^{-17}		1.3×10^{-11}	1.7×10^{-11}	1.7×10^{-15}	2.3×10^{-15}
	5.0×10^{-15}		2.6×10^{-9}	3.4×10^{-9}	3.4×10^{-13}	4.6×10^{-13}
Total 2.6×10^{-7} 2.6×10^{-7} 6.4×10^{-7} 3.6×10^{-7} 4.5×10^{-7}	2.6×10^{-7}		$4.5 \times 10^{-5*}$	6.0×10^{-5}	1.0×10^{-7}	1.4×10^{-7}

^a Maximum concentration of 2.8×10⁵ occurs at 334 years.

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B. QUICK, Inc.

9535 Forest Lane, Suite 123, Dallas, Texas 75243 Office: (972) 644-4259 * FAX: (972) 669-3911

August 15, 1997

Mr. Roger Anderson Oil Conservation Division 2040 S. Pacheco Santa Fe, New Mexico 87505

RE: Request for brine well permit and for non-hazardous oilfield waste disposal permit in abandoned Climas salt wells in S/2 of S/2 of Section 34, T-19-S, R-36-E, in Lea County

This letter is intended to inform you of our situation regarding the above referenced project and our intentions for the future of this lease.

Mr. Hickerson and Permian Brine Sales, Inc. have endeavored to obtain the appropriate permits for the past two years. As of August 14, 1997, B. Quick, Inc. assumed control of the lease and will utilize Mr. Hickerson as a consultant to B. Quick, Inc. Attached is Permian Brine Sales, Inc. termination of lease agreement dated August 14, 1997.

Our intentions are to go forward with the process of obtaining the appropriate permits in compliance with NMOCD and EPA regulations. We feel that these salt dome cavern disposal systems are environmentally superior to any surface disposal system. This system of deep salt dome disposal has been used in many areas with no surrounding contamination. In Texas alone there have been five such facilities in operation for a number of years. Historical and engineering studies can be provided as part of our anticipated permit application.

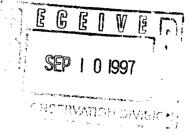
With the past two year duration of the permit process and the current assignment of the lease to B. Quick, Inc. we request the status of the application. We would like to facilitate this process and as such would be agreeable to your suggestions by mail, telephone or in a sit- down meeting with you or your people in Santa Fe.

In closing I would like to re-emphasize our belief in the safety of this disposal project. We are anticipating your response so we can move forward with this project.

Cordially, unk Bill Quick

B. QUICK, Inc.

9535 Forest Lane, Suite 123, Dallas, Texas 75243 Office: (972) 644-4259 * FAX: (972) 669-3911



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In closing I would like to re-emphasize our belief in the safety of this disposal project. We are anticipating your response so we can move forward with this project.

Cordially, Bill Quick



BRINE - FRESHWATER - WATER DISPOSAL - SOLIDS DISPOSAL

WEB SITE: http://www2.basinlink.com/us/permbrin/main.htm E-MAIL: Permbrine@basinlink.com

August 14, 1997

6067 W. TENTH ST. • ODESSA, TEXAS 79763 OFF. (915) 381-0531 FAX (915) 381-9316

Mr. Roger Anderson Oil Conservation Division 2040 S Pacheco Santa Fe, New Mexico 87505

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Re: Request for brine well permit and for non-hazardous oilfield waste disposal permit in abandoned Climas salt wells in S/2 of S/2 of Section 34, T-19-S, R-36-E, in Lea County.

Original request dated September 18, 1995

Dear Sirs:

We made the original request based on a farm-out agreement we had from B-Quick Inc. They are the holder of a lease from the land owner, Mr. James A. Foster.

I hereby terminate our agreement with Mr. Bill Quick and authorize him to assume the Permian Brine Sales, Inc. subject in his name. He proposes to actively pursue the procurement of NMOCD's approval.

We are still actively involved only as a consultant in the proposal, and will be available for consultation.

Your cooperation with Mr. Quick will be greatly appreciated. Thanks for all the help that you and Mark Ashley have given us.

If you have any further questions or are in need of any further information, you can contact me at (915)381-0531.

Very truly yours, PERMIAN BRINE SALES, INC.

A.L. Hickerson CEO

ALH/bjk

Preliminary Technical and Legal Evaluation of Disposing of Nonhazardous Oil Field Waste into Salt Caverns

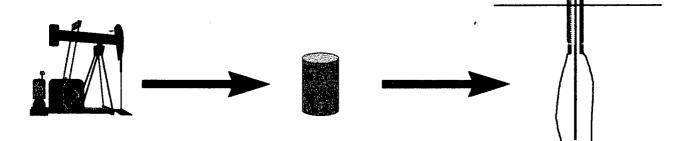
Prepared for:

U.S. Department of Energy Office of Fossil Energy under Contract W-31-109-ENG-38

Prepared by:

Argonne National Laboratory Washington, DC

John Veil Deborah Elcock Mary Raivel Dan Caudle Robert C. Ayers, Jr. Ben Grunewald



June 1996

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The authors wish to express their appreciation for the many persons who provided copies of reports and papers, spoke with us about various salt cavern issues, and provided comments on the two drafts of the report. We particularly extend thanks to Richard Ginn of the Railroad Commission of Texas, R.D. Hickerson of Permian Brine Sales, Inc., and H.W. Diamond of the Solution Mining Research Institute. Mr. Diamond coordinated an extensive review of the second draft report. The review panel consisted of the following persons:

William Barlow	Texas Brine
Charles Chabannes	Sofregaz US Inc.
Dennis Crist	Ohio Department of Natural Resources
Fritz Crotogino	Kavernen Bau- und Betriebs GmbH
Ken E. Davis	Envirocorp Services & Technology, Inc.
H.W. Diamond	Solution Mining Research Institute
Norbert Heitmann	PB-KBB, Inc.
James Linn	Sandia National Laboratories
Joe L. Ratigan	RE/SPEC, Inc.
Robert Thoms	AGM, Inc.
Frank Whelpy	Sonar and Well Testing Service
Scott Whitelaw	Texas Brine

The final report reflects the contributions of each of these persons.

Preliminary Technical and Legal Evaluation of Disposing of Nonhazardous Oil Field Waste into Salt Caverns

by

J. Veil, D.Elcock, M. Raivel, D. Caudle, R.C. Ayers, Jr., and B. Grunewald

Executive Summary

Bedded and domal salt deposits occur in many states. If salt deposits are thick enough, salt caverns can be formed through solution mining. These caverns are either created incidentally as a result of salt recovery or intentionally to create an underground chamber that can be used for storing hydrocarbon products or compressed air or for disposing of wastes. This report evaluates the suitability, feasibility, and legality of disposing of nonhazardous oil and gas exploration, development, and production wastes (hereafter referred to as oil field wastes, unless otherwise noted) in salt caverns.

In 1988, the U.S. Environmental Protection Agency (EPA) published a list of those oil field wastes that were exempt from regulation as hazardous wastes under Subtitle C of the Resource Conservation and Recovery Act (RCRA). EPA's Underground Injection Control (UIC) regulations allow most of those oil field wastes to be injected into Class II UIC wells. Efforts are currently under way to obtain clarification from EPA whether all exempted oil field wastes can be injected into Class II wells. At the state level, only the Railroad Commission of Texas (TRC) has formally authorized disposal of oil field wastes into salt caverns. The TRC has issued permits for six facilities, but as of May 1996, only four of these were active. In April 1996, the TRC released draft proposed amendments to TRC Rule 9, the regulation that governs injection into a formation not productive of oil, gas, or geothermal resources. Ten other states were contacted about their interest in disposing of oil field waste into salt caverns. Many of these states were interested in following the TRC program to see how it worked, but at this time, only New Mexico has received an application for disposal of oil field wastes into salt caverns. There are no apparent regulatory barriers to the use of salt caverns for disposal of most types of oil field wastes at either the federal level or in the eleven states discussed in this analysis.

The types of oil field waste that are planned for disposal in salt caverns are those that are most troublesome to dispose of through regular Class II injection wells, because they contain excessive levels of solids. The solids-containing oil field wastes most likely to be disposed of in salt caverns include used drilling fluids, drill cuttings, completion and stimulation waste, produced sand, tank bottoms, and soil contaminated by crude oil or produced water.

The location and design of waste disposal caverns play an important role in ensuring longterm waste isolation from the surface water or groundwater resources. Hundreds of caverns have been used safely for storing hydrocarbons. The hydrocarbon storage industry has developed useful, detailed standards and guidance for designing and constructing storage caverns that are also appropriate for creating solution-mined caverns for other uses. Several factors should be considered in selecting sites for disposal of oil field wastes in caverns, including distance to populated areas; proximity to other industrial facilities; current and future use of adjacent properties; handling of brine or other displaced fluid; proximity to environmentally sensitive wetlands, waters, and fresh water aquifers; proximity to the salt boundary; and proximity to other existing and abandoned subsurface activities, such as neighboring caverns for brine or hydrocarbon storage. Detailed knowledge of the geology should be supported by adequate documentation. Operators should be able to demonstrate that the caverns they plan to use — either new caverns developed specifically for oil field waste disposal, or existing caverns that are being converted — will remain stable in the future.

Disposal caverns act like large oil/water/solids separators. The solids in the incoming waste settle to the bottom of the cavern while the lighter oils and hydrocarbons rise to the top of the cavern, where they can be removed. When placing waste in a cavern, the cavern space is best utilized by filling evenly and uniformly, with no large voids. One method for emplacing the waste in the cavern is to inject it through the tubing to the bottom of the cavern. Under this scenario, an operator of an oil field waste disposal cavern would inject waste until the end of the tubing is covered or the back pressure from the accumulated waste precludes further injection. At this point, the operator would use a small controlled explosive charge to cut off the end of the tubing further up the cavern. Another Texas operator prefers to inject waste through the tubing/casing annulus into the top of the cavern and allow the waste to settle to the bottom. A third Texas operator has installed two wells in the cavern, one for injection and the other for brine withdrawal. Under any of these waste emplacement scenarios, cavern pressure should be monitored and controlled before the cavern is filled with oil field waste, throughout the waste emplacement cycle, and optimally, for some period of time after waste emplacement has ended.

There is no actual field experience on the long-term impacts that might arise from salt cavern disposal of oil field wastes. The literature contains many theoretical studies that speculate what might happen following closure of a cavern. Although different authors agree that pressures will build in a closed brine-filled cavern due to salt creep (domal salt only) and geothermal heating, they do not specifically address caverns filled with oil field wastes. Caverns filled with oil field wastes having specific gravities greater than that of brine will have a lower likelihood of failure than caverns filled with brine. More field research on pressure buildup in closed caverns is desirable.

Based on this preliminary research, we believe that disposal of oil field wastes into salt caverns is feasible and legal. If caverns are sited and designed well, operated carefully, closed properly, and monitored routinely, they represent a suitable means of disposing of oil field wastes.

Chapter 1 - Introduction

Content and Purpose of Report

Caverns can be readily formed in salt formations through solution mining. The caverns may be formed incidentally, as a result of salt recovery, or intentionally to create an underground chamber that can be used for storing hydrocarbon products or compressed air or disposing of wastes. The purpose of this report is to evaluate the feasibility, suitability, and legality of disposing of nonhazardous oil and gas exploration, development, and production wastes (hereafter referred to as oil field wastes, unless otherwise noted) in salt caverns.

Chapter 2 provides background information on

- Types and locations of U.S. subsurface salt deposits;
- Basic solution mining techniques used to create caverns; and
- Ways in which salt caverns are used.

Later chapters provide discussion of

- Federal and state regulatory requirements concerning disposal of oil field waste, including which wastes are considered eligible for cavern disposal;
- Waste streams that are considered to be oil field waste; and
- An evaluation of technical issues concerning the suitability of using salt caverns for disposing of oil field waste. Separate chapters present
 - Types of oil field wastes suitable for cavern disposal;
 - Cavern design and location;
 - Disposal operations; and
 - Closure and remediation.

This report does not suggest specific numerical limits for such factors or variables as distance to neighboring activities, depths for casings, pressure testing, or size and shape of cavern. The intent is to raise issues and general approaches that will contribute to the growing body of information on this subject.

Chapter 2 - Background

Types and Locations of U.S. Subsurface Salt Deposits

Figure 1 (from Johnson and Gonzales 1978) shows the location of the major U.S. subsurface salt deposits. There are two types of subsurface salt deposits in the United States: salt domes and bedded salt. Salt domes are large, generally homogeneous formations of salt that are formed when a column of salt migrates upward from a deep salt bed, passing through the overlying sediments. Pfeifle et al. (1995) report that the typical anhydrite (calcium sulfate) content of Gulf Coast salt domes averages less than 5 percent. Salt dome deposits are found in the Gulf Coast region of Texas, Louisiana, Mississippi, and Alabama. Figures 2 through 5 (taken from Jirik and Weaver 1976) show the specific locations of many onshore and offshore salt domes.

Bedded salt formations occur in layers bounded on the top and bottom by impermeable formations and interspersed with nonsalt sedimentary materials having varying levels of impermeability, such as anhydrite, shale, and dolomite. Unlike salt domes, bedded salt deposits are tabular deposits of sodium chloride that can contain significant quantities of impurities. Major bedded salt deposits occur in several parts of the United States.

Although salt deposits occur in many parts of the United States, in most states, the occurrence of salt in the quantities and locations that would promote commercial mining is limited. There are 16 states in which salt occurs in sufficient quantity to be mined by either excavation or solution mining, or recovered through solar evaporation. The states where these major salt deposits occur are: Alabama, Arizona, Colorado, Kansas, Louisiana, Michigan, Mississippi, Montana, New Mexico, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, Texas, and Utah.

Of the states listed above, those with the most significant salt mining operations are: Kansas, Louisiana, Michigan, New Mexico, New York, Ohio, and Texas. These states, either currently or in the future, could contain caverns suitable for oil and gas waste disposal. Pennsylvania contains caverns that are currently permitted for hydrocarbon storage that could potentially be converted to waste disposal caverns. Utah has some potential for future disposal cavern operations, although it is a relatively small oil and gas waste generator. The remaining states have only a limited number of salt production sites and are not likely candidates for future cavern disposal operations.

Formation of Salt Caverns

Salt caverns are formed by injecting water that is not fully salt-saturated into a salt formation and withdrawing the resulting brine solution. Figures 6 and 7 show the main features of salt cavern construction for caverns in domal salt and bedded salt, respectively. These figures are not drawn to scale or intended to show detailed construction features.

The first step in creating a salt cavern is drilling a borehole. Near the surface, the borehole

is larger in diameter to allow for installation of several concentric layers of casing, which are cemented in place to protect against contamination of drinking water sources. The outermost layer of casing is known as the surface casing. Typically, it does not extend all the way to the cavern roof. The final casing (or long string casing), which is also cemented, is set at a depth below the top of the salt formation. Generally, a non-cemented casing string, the tubing string, is placed in an open hole which has been drilled to a depth approximately where the bottom of the cavern will be, although some interconnected multi-well caverns may not have a non-cemented string in each well. In some caverns, two non-cemented casing strings may extend to a depth approximately where the bottom of the cavern will be. Under this design scenario, one string is used to inject water and the other is used to withdraw brine.

There are several methods used for developing and shaping the cavern. In the direct circulation method, fresh water is injected through the tubing string, and brine is withdrawn through the annular space between the tubing string and the final casing. In the reverse-circulation method, fresh water enters through the annulus and the brine is withdrawn through the tubing string. A combination of these two methods or other more complicated methods can be used to obtain the desired cavern geometry. API (1994) describes and provides illustrations of these methods.

During cavern formation, a rubble bed of impurities such as anhydrite can form on the bottom of the cavern. Depending on the size of the cavern and the amount of impurities present, more than 50 feet of impurities can sit on the bottom of the cavern (Tomasko 1985).

The petroleum industry has constructed many salt caverns for storing hydrocarbons. In an attempt to provide guidance for designing and operating hydrocarbon storage salt caverns, several organizations have developed standards and guidance documents (CSA 1993, API 1994, and IOGCC 1995). Readers desiring more details on design, location, and construction of salt caverns are referred to these reports.

Use of Salt Caverns

The most common use of salt caverns is production of salt, which in turn, enlarges the caverns. The post-mining uses of caverns are hydrocarbon storage, compressed air storage, and waste disposal.

Hydrocarbon Storage- Salt caverns are commonly used for storing hydrocarbons. The earliest cavern storage for liquified petroleum gas (LPG) in bedded salts occurred in the 1940s, with storage in salt dome caverns beginning in 1951. Some of the products that have been stored are propane, butane, ethane, ethylene, fuel oil, gasoline, natural gas, and crude oil (Querio 1980). In 1975, the U.S. Congress created the Strategic Petroleum Reserve (SPR) program to provide the country with sufficient petroleum reserves to reduce the impacts of future oil supply interruptions. The SPR consists of 62 leached caverns in domal salt with a total capacity of 680 million barrels. The U.S. Department of Energy (DOE) has prepared a plan for, but is not currently pursuing, the

development of an additional 250 million barrels of storage capacity.

Waste Disposal - A second use of salt caverns is disposing of various types of wastes. Several examples of actual or proposed waste disposal projects are presented below. These examples are based on limited and not completely up-to-date information from foreign countries. The current extent of cavern waste disposal may be larger now.

United States - In the United States, only limited waste disposal into salt caverns has occurred. In Texas, the Railroad Commission of Texas (TRC) issued six permits between 1991 and 1994 for disposing of oil field waste into salt caverns. As of May 1995, nearly half a million barrels of oil field waste had been disposed of in this manner (Fuller and Boyt 1995). Ten other states with significant solution mining and oil and gas production activity were asked if they currently used salt caverns for disposing of oil field waste. None of these states currently have approved any such disposal projects, although several states reported an interest in the subject. New Mexico has received an application to site and operate a disposal cavern but had made no decision on it as of May 1996. A summary of the contacts with these states is provided in Table 1.

Several proposals for storing hazardous wastes in Texas salt dome caverns were made during the past 10 years, but none have been approved by the Texas state government (Thoms and Gehle 1994). In the early 1980s, a Houston-based waste disposal company proposed to dispose of toxic wastes in the Vinton salt dome in southwest Louisiana. A vertically aligned series of caverns, separated by salt intervals, was to be solution-mined from a single well. The deepest would be mined first, filled with wastes, and then plugged with salt. The next deepest cavern would then be filled and sealed. The process would be continued until the usable salt interval for that well was fully occupied with stacked "mini-caverns". This design was referred to as the "string of pearls" concept and reportedly was patented (Thoms 1995). By minimizing the vertical extent of any particular mini-cavern, pressure differential problems could be reduced.

The DOE constructed the Waste Isolation Pilot Plant (WIPP), an underground repository for radioactive waste, in a bedded salt formation in southeastern New Mexico. Although the WIPP was excavated rather than formed through solution mining, its concept of safely disposing of wastes in a salt formation applies equally well to oil field waste disposal caverns.

The U.S.-salt mining industry disposes of impurities removed during the brine purification process into caverns¹.

¹ Personal communication between Bill Diamond, Executive Director, Solution Mining Research Institute, Deerfield, IL, and John Veil, Argonne National Laboratory, Washington, DC, on August 22, 1995.

Canada - In 1995, a U.S. patent was granted to Canadian inventors for a method of refuse disposal in solution-mined salt cavities (Pearson and Alseth 1995), but their process has not yet been used in the United States.

The Province of Alberta has authorized disposal of oil field wastes into several caverns near Edmonton².

United Kingdom- In the United Kingdom, various wastes are being disposed of into caverns at the Holford Brinefield (Hoather and Challinor 1994). The brinefield operator is authorized to dispose of 200 tons per day of brine mud solids from the purification of crude brine, and 250 tons per day of alkali wastes from local soda ash production, into salt caverns. The brine displaced from the caverns by the solids is used to slurry additional solids back to the caverns. In addition, the operator is authorized to dispose of organic residues from the production of perchloroethylene, trichloroethylene, and other related chlorohydrocarbons into specially designated caverns that contain alkaline material that will neutralize any free acid in the wastes.

Feasibility studies for disposing of hazardous or other wastes in salt caverns have been conducted in several European countries. Hoather and Challinor (1994) report on a proposal to dispose of contaminated soils, domestic and commercial solid waste (trash), and sewage sludge into the Holford Brinefield in the United Kingdom.

Germany- Germany has adopted technical regulations on hazardous waste management, TA Sonderabfall. These regulations require that all waste that cannot be stored for extended periods above ground without posing a serious threat to the biosphere, even after undergoing treatment, shall be stored underground in suitable geologic formations. The German government and the Lower Saxony Company for the Final Disposal of Hazardous Waste (NGS) co-sponsored a study of the feasibility of storing hazardous waste in salt caverns (NGS date unspecified, Crotogino 1990). The TA Sonderabfall requires that brine be removed from the caverns before emplacing wastes. The NGS study found that by adapting existing technologies for waste conditioning, waste emplacement, and cavern engineering, the requirements of TA Sonderabfall could be met. At this time, however, no hazardous wastes have been disposed of in German salt caverns.

Crotogino (1994) reports that salt-bearing drilling fluids and cuttings arising from deep drilling for natural gas, oil, and salt caverns are disposed of in salt caverns. At the time Crotogino presented this paper, projects were in the planning stage for disposing of various mineral bulk residues (e.g., contaminated soil, ashes, dusts, and sand blasting residues) in salt caverns. More recently, Germany is planning to dispose of sediments contaminated with

² Personal communication between Brenda Austin, Alberta Energy and Utilities Board, Calgary, Alberta, Canada, and John Veil, Argonne National Laboratory, Washington, DC, on May 17, 1996.

mercury from the harbor in Hamburg into salt caverns³.

Netherlands - Wassman (1983) reports that the Dutch have disposed of wastes from a brine purification plant in a salt cavern. At that time, the Dutch were making plans to dispose of drilling fluids and drill cuttings in salt caverns. Concentrated magnesium chloride brine has also been stored in caverns.

Mexico- In Mexico, sulfate purged from salt evaporators is being disposed of into salt caverns⁴.

³Personal communication between Fritz Crotogino, Kavernen Bau- und Betriebs-Gmbh, Hannover, Germany, and John Veil, Argonne National Laboratory, Washington, DC, on August 25, 1995.

⁴Personal communication between Jose Pereira, PB-KBB, Houston, TX, and John Veil, Argonn e National Laboratory, Washington, DC, on October 3, 1995.

Chapter 3 - Regulatory Considerations

Extent of Evaluation

This chapter evaluates the state and federal environmental requirements as they apply to disposal of oil field wastes into salt caverns. No attempt is made to encompass all types of permits, licenses, or approvals that must be obtained by an operator, including zoning approvals, mineral rights, and construction, safety, and fire code requirements.

Description of Nonhazardous Oil Field Wastes

On July 6, 1988, the U.S. Environmental Protection Agency (EPA) issued a regulatory determination that exempted wastes from the exploration, development, and production of crude oil, natural gas, and geothermal energy from regulation as hazardous wastes under the Resource Conservation and Recovery Act (RCRA) Subtitle C (53 FR 25477). The list of wastes exempted from RCRA Subtitle C is reproduced in Table 2. On March 22, 1993, EPA issued clarification of the 1988 determination, adding that many other wastes that were uniquely associated with exploration and production operations were also exempted from RCRA Subtitle C requirements (58 FR 15284). The clarification of the RCRA exemption restates EPA's position that wastes derived from treatment of an exempted waste generally remain exempt, and that off-site transportation does not negate the exemption. Some wastes derived from treatment of an exempt waste, the waste material derived from the exempt waste remains exempt, but the spent acid is not exempt.

EPA has emphasized the need to work with states to encourage changes in their regulations to improve management of oil and gas exploration and production wastes. For example, although RCRA Subtitle C specifically exempts produced water, drilling fluids, and "other wastes associated" with exploration, development, and production activities, most state regulations exempt produced water and drilling fluids from hazardous waste regulation (allowing for their disposal into Class II injection wells) but are often silent on the requirements for the "associated wastes". EPA specifically identified in its 1988 regulatory determination many "associated wastes" that are exempt under RCRA Subtitle C (see Table 2).

Consideration of Salt Caverns Used for Disposing of Oil Field Waste as Class II Injection Wells

Under the authority of the Safe Drinking Water Act (SDWA), EPA established regulations for the Underground Injection Control (UIC) program. All injection wells are assigned to five classes. Salt caverns used for disposing of oil field waste are Class II wells. States seeking authority to administer the UIC program can seek primacy in two ways. Under §1422 of the SDWA, states must demonstrate that their state regulations are at least as stringent as those adopted by EPA. To provide greater flexibility for states administering Class II programs, Congress added §1425 to the SDWA, which requires states seeking delegation to have an underground injection program that meets the requirements of \$1421(b)(1)(A)-(D) and represents an effective program to prevent underground injection that endangers drinking water sources. A brief discussion of the relevant federal UIC regulations follows. References to state responsibilities in the following sections are those that would apply to states seeking delegation under \$1422.

40 CFR Part 144 - These regulations establish the minimum requirements for the UIC program. Each state must meet these requirements in order to obtain primary enforcement authority for the UIC program in that state. These regulations also are part of the UIC programs in states where the program is administered directly by EPA. The SDWA provides that all underground injections are unlawful and subject to penalties unless authorized by permit or by rule. Part 144 sets forth the permitting and other program requirements that must be met by UIC Programs, whether run by a state or by EPA. Class II injection wells are defined as "wells which inject fluids:

Which are brought to the surface in connection with natural gas storage operations, or conventional oil or natural gas production and may be commingled with waste waters from gas plants which are an integral part of production operations, unless those waters are classified as a hazardous waste at the time of injection.

(2) For enhanced recovery of oil or natural gas; and

For storage of hydrocarbons which are liquid at standard temperature and pressure." (40 CFR 144.6(b))

EPA defines well as a "bored, drilled or driven shaft, or a dug hole, whose depth is greater than the largest surface dimension," and fluids as "any material or substance which flows or moves whether in a semisolid, liquid, sludge, gas, or other any other form or state" (both from 40 CFR 144.3).

The requirements in Part 144 that may affect the proposed use of salt caverns as Class II injection wells for disposal include the prohibition of movement of fluid into underground sources of drinking water (§144.12) and the compliance with a plan for plugging and abandonment of the well which meets the requirements of §146.10.

40 CFR-Part 145- These regulations specify the procedures EPA will follow in approving, revising, and withdrawing state programs under the UIC provisions of the SDWA, and include the elements that must be part of submissions to EPA for program approval and the substantive provisions that must be present in state programs for them to be approved. EPA has established UIC programs in states that do not comply with elements of a state program submission set forth in \$145.22. When a state UIC program is fully approved by EPA to regulate all classes of injections, the state assumes primary enforcement authority under section 1422(b)(3) of the SDWA. States are

not precluded, however, from omitting or modifying any provisions to impose more stringent requirements.

40.CFR Part 146- These regulations set forth technical criteria and standards for the UIC Program. Part 146 standards in the following areas may affect the proposed use of salt caverns as Class II injection wells for disposal: the area of review for each injection well, mechanical integrity, plugging and abandonment, construction of new and some existing wells, and operating and monitoring.

Comparison between RCRA and UIC Regulations

Salt caverns used for disposing of nonhazardous oil and gas waste brought to the surface in connection with conventional oil and natural gas production activities clearly would fit into the section (1) category of Class II wells. Most, but not all of the wastes exempted by the 1988 RCRA regulatory determination would meet the UIC program's "in connection with" oil and gas production criterion. Some wastes (e.g., hydrocarbon-contaminated soil) would not meet the UIC criterion, however. Although EPA's description of wastes that are "uniquely associated" with oil and gas production under RCRA (58 FR 15284) cannot be clearly applied to determining whether such wastes have been brought to the surface "in connection with" oil and gas production under the UIC Class II regulations, the waste in question (i.e., the soil) has been contaminated by wastes that have been brought to the surface. In February 1996, the Ground Water Protection Council asked EPA to clarify that all exempted oil field wastes can be injected into Class II wells. As of May 1996, EPA had not issued the requested clarification.

This potential gap is somewhat clarified by a draft 1993 memorandum from James Elder, then EPA's Director of the Office of Ground Water and Drinking Water (the part of EPA that oversees the UIC program), to EPA Regional Water Management Division directors (Elder 1993). In that memorandum, EPA headquarters states:

"The key concepts that have been used by the UIC program to determine whether waste fluids could be injected in Class II wells were that they had to be **non hazardous** and **integrally associated** with oil and gas production we believe that all exempt E&P [exploration and production] wastes under RCRA can be injected in Class II wells as long as their physical state allows it."

Although that memorandum has apparently never been issued in final form, it has been used as the basis of at least one letter from EPA Region VI to the State of Louisiana outlining the policy on waste types eligible for Class II well disposal (Knudson 1993). In that letter, Myron Knudson, the Director of Region VI's Water Management Division, states: "Under the new guidance, all exploration and production (E&P) wastes exempted under Section 3001(b)(2)(A) of the Resource Conservation and Recovery Act (RCRA) will be eligible for injection into Class II disposal wells."

EPA's position from 1993 is clearly indicated, but since the guidance from EPA headquarters is in draft form, clear guidance is needed to determine which types of exploration and production wastes may be disposed into Class II wells. Of course, those wastes determined by EPA not to be exempt from RCRA Subtitle C (i.e., hazardous oil and gas production wastes) could not be legally injected into a salt cavern permitted as a Class II injection well. The section (1) category of injection well is often referred to in state regulations as a "disposal well."

State UIC Regulations

As described earlier, regulatory agencies in eleven oil-producing states where salt caverns exist were consulted with regard to the possible use of salt caverns for disposal of oil field wastes. Most of the contact persons in each state felt that, were salt caverns to be used for this purpose, they would be considered Class II injection wells. However, with the exception of one state, Texas, these state officials said that salt caverns were not being used in such a manner in their state. Moreover, most said that such an idea has never been formally proposed in their state. These same officials, however, generally thought there were no existing provisions in their states' Class II injection well or other regulations which would specifically prohibit the practice of disposing of oil field wastes in salt caverns. Three of the eleven states, Michigan, New York, and Pennsylvania, do not have "primacy" to administer and enforce their own Class II injection well programs. Applicants in these states must therefore apply directly to EPA for Class II permits.

Relevant Differences from EPA UIC Regulations - In the three states that do not have primacy, Michigan, New York, and Pennsylvania, a person wishing to receive a permit to use salt caverns as Class II injection wells for disposal of oil field wastes must comply with the applicable EPA regulations⁵. Ohio's oil and gas law states that the Ohio injection well regulations are to be interpreted as no more stringent than the SDWA UIC regulations, unless a stricter interpretation is essential to ensure that underground sources of drinking water will not be endangered (Ohio Revised Code §1509.22(D)). Oklahoma's salt deposits are not suitable for extensive solution mining or salt cavern disposal, so no detailed analysis of that state's UIC regulations was conducted.

⁵ Michigan, New York, and Pennsylvania require state-level permits, in addition to UIC permit s issued by EPA, to drill or alter an existing oil or gas well. Michigan requires a permit to drill a well for r disposal of brine or other oil field wastes (Michigan Act 61, §319.23. Pennsylvania requires the applicant to submit a copy of the EPA UIC permit and EPA UIC application, as well as the related documentation n required by EPA. Pennsylvania requires the applicant to submit both a control and disposal plan and a n erosion and sedimentation plan, in order to comply with state water pollution, erosion, and erosion sedimentation control regulations (Pennsylvania Code, Title 25, §78.18). New York requires a "conversion permit" for the construction involved in converting a solution-mining or storage well to a disposal well (New York Department of Environmental Conservation Regulations, Title 6, Chapter V, Subchapter B, Part 552).

In the six remaining states whose regulations were analyzed, the applicable state regulations may vary from EPA regulations in the extent to which they would allow salt caverns to be used for oil field waste disposal. The relevant provisions of those states' regulations are discussed below, followed by a discussion of the Texas program.

Kansas - The Kansas General Rules and Regulations for Conservation of Crude Oil and Natural Gas set forth permit requirements for injection and disposal wells (§82-3-400 through 499). Section 82-3-101 defines disposal well as a well in which those fluids brought to the surface in connection with oil and natural gas production are injected for purposes other than enhanced recovery. The definition of fluid is identical to that in the EPA UIC regulations.

A possible impediment to the use of salt cavern disposal wells in Kansas is the existence of well location and spacing requirements (§82-3-108 and 109). Although these requirements were not specifically mentioned as impediments in discussions with the Kansas contact person, this official did express concerns about the additional dissolution of cavern walls that might occur if caverns are used for disposal of oil and gas waste. The dissolution of the caverns could affect the spacing between caverns.

It should be noted that §82-3-100 allows the state to grant an exception to any of these oil and natural gas conservation regulations.

Louisiana - The Louisiana Department of Natural Resources Regulations, §43:XIX.129, contain Class II injection well requirements, including wells for disposal of nonhazardous oil field waste generated from drilling and production of oil and gas wells at §43:XIX.129.M, which apply to the disposal of nonhazardous oil and gas waste by a commercial facility. These regulations define nonhazardous oil field waste (NOW) similarly to the description of wastes suitable for disposal under EPA's Class II injection well regulations. The Louisiana regulations also list all wastes included in the definition of NOW. The wastes listed are similar to those listed in EPA's 1988 regulatory determination on the exemption of oil and gas wastes from RCRA Subtitle C.

As in the Kansas regulations, Louisiana's regulations require the subsurface geology of any proposed injection zone to exhibit adequate thickness and areal extent. Dissolution of salt cavern disposal well walls may impede compliance with this requirement.

Mississippi - Mississippi Rule 63, governing underground injection wells, contains a description of the materials that may be injected into Class II disposal wells that is identical to that contained in 40 CFR Part 144 for Class II disposal wells. Most of the requirements of Rule 63 that are stricter than EPA's regulations are administrative and monitoring requirements. Rule 63 also contains criteria for establishing minimum distances between wells, which are not required by EPA regulations. Such minimum distance requirements

would need to be carefully considered when siting caverns for disposal of the oil and gas wastes. Incoming wastes that were not fully saturated with salt could dissolve the walls of the caverns, thereby affecting the wall thickness⁶. Rule 63 does allow for exceptions to be granted for any construction or operating requirement contained in the Rule.

Mustificity - The New Mexico Oil Conservation Division's Rules 701-711 set forth the new requirements for Class II injection and disposal wells that allow disposal of saltwater and produced water in Class II disposal wells. The Rules contain construction, operating, testing, and monitoring requirements. The New Mexico contact person felt that the process for disposal of nonhazardous oil and gas wastes into salt caverns was unclear, but that it would likely be regulated under the Class II well regulations. He stated that certain requirements of the New Mexico regulations are more stringent than the EPA regulations, including the area of review, injection pressure, and construction requirements. He could not foresee, however, that these stricter requirements would be more difficult to comply with for operators of salt cavern disposal wells than for operators of other Class II disposal wells. He stressed, however, that his opinion was qualified due to uncertainty about the process⁷.

North Dakota- The North Dakota Injection Control Regulations, Chapter 43-02-05, contain a definition of underground injection identical to that contained in 40 CFR Part 144 for disposal wells. There do not appear to be any requirements in the North Dakota regulations beyond the minimum EPA requirements that would impede the use of salt caverns as Class II injection wells in North Dakota. However, North Dakota's UIC coordinator explained that salt formations in the state are very deep. Consequently, the engineering problems and associated costs suggest that cavern disposal is probably not a realistic option for North Dakota⁸.

The Texas Program - The Texas regulation applicable to use of salt caverns as Class II injection wells for disposal of nonhazardous oil and gas waste, Texas Statewide Rule 9(§3.9), allows disposal of saltwater or other oil and gas waste by injection into a porous formation not productive of oil, gas, or geothermal resources. The TRC is the agency responsible for administering this regulation. To date, six permits under Rule 9 have been issued for disposal of oil field waste in salt caverns. Rule 9 also sets forth monitoring and reporting requirements, which require the operator to monitor the injection pressure and injection rate of each disposal well on at least a monthly basis.

⁶Personal communication between Fred Hille, State Oil and Gas Board, Jackson, MS, and Mar y Raivel, Argonne National Laboratory, Washington, DC, on August 23, 1995.

⁷Personal communication between David Catanach, New Mexico Oil Conservation Division, Santa Fe, NM, and Mary Raivel, Argonne National Laboratory, Washington, DC, on August 31, 1995.

⁸Personal communication between Charles Koch, North Dakota Industrial Commission, Oil and Gas Division, Bismark, ND, and John Veil, Argonne National Laboratory, Washington, DC, on May 14, 1996.

There are also requirements for pressure testing the well, the area of review, casing, special equipment, and plugging of wells.

In April 1996, the TRC released draft proposed amendments to Rule 9 that set forth requirements specifically for disposal of oil and gas wastes in solution-mined salt caverns. Cavern disposal wells may be created, operated, or maintained only in impermeable salt formations so that they do not cause surface water or groundwater pollution or danger to life or property. The draft proposed amendments would require the applicant to submit

- A list of the types and maximum volume of the oil and gas wastes to be disposed of;
- Geologic information concerning the overlying and surrounding formations and the size and shape of the cavern;
- A list of all wells within one-quarter mile of the proposed cavern disposal well that penetrate the salt formation and any adjacent disposal, mining, or storage cavern wells or caverns;
- Topographic maps;
- An operating plan that describes facilities, equipment, brine management, and cavern monitoring;
- A closure plan that addresses monitoring of pressures after shut-in and demonstrates that post-plugging pressure increases will not affect the well's ability to confine the injected fluids; and
- Financial security information.

The draft proposed amendments also describe standards applicable to operation of a cavern disposal well, including

- Maintaining records of the fluids used to slurry the wastes into the cavern and the type, volume, and characteristics of the wastes that are injected;
- Setting maximum injection pressure of a cavern disposal well; and
- Establishing monitoring, financial security, and recordkeeping requirements.

The amendments also establish testing, monitoring, surveying, and closure requirements for cavern disposal wells.

Regulatory Conclusions

Other than the draft proposed amendments to the Texas regulations, there are no specific regulations addressing disposal of oil field wastes in salt caverns at either the federal level or in the states discussed in this analysis. EPA's Class II well requirements do not specifically address oil and gas wastes generated on the surface (not brought to the surface in connection with conventional oil and natural gas production activities). It would be useful if EPA would explicitly address such wastes under the UIC program. Some of the types of wastes that are currently going into the four operating Texas cavern disposal wells are in this category (e.g., contaminated soils).

Another potential barrier to allowing the practice of disposal of oil field wastes in salt caverns is the general nature of a state's existing applicable regulations. States would need to make a decision about whether to allow the practice under existing regulations, amend the existing regulations to more specifically address and permit salt cavern disposal wells, or amend the regulations to specifically prohibit the practice.

Given the current level of support at the state level for the use of salt caverns for disposal of oil field waste, and the general consensus that this practice is possible and feasible, it seems entirely reasonable that oil-producing states in which salt caverns are located could allow salt cavern disposal of oil field waste where appropriate. Moreover, these states could use the Texas salt cavern disposal program as a model. Contact persons from several of the other states indicated that they were interested in seeing how the TRC program worked out.

Chapter 4 - Types of Oil Field Wastes Suitable for Cavern Disposal

Chapters 4-7 present technical issues associated with disposing of nonhazardous oil field wastes into salt caverns.

Types of Wastes to be Accepted

The types of oil field waste proposed for disposal in salt caverns are those that are most troublesome to dispose of through regular Class II injection wells because they contain higher levels of solids. Wastes containing water that is not fully saturated with salt may increase the size of caverns because the unsaturated water will leach salt from the cavern walls. The presence of fresh water in wastes should not preclude their disposal in salt caverns, but the operator must account for the increased volume of the cavern and what effect it will have on such cavern siting parameters as distance to adjacent caverns and roof span or thickness. The solids-containing oil field wastes most likely to be disposed of in salt caverns include

- Used drilling fluids,
- Drill cuttings,
- Completion and stimulation waste,
- Produced sand,
- Tank bottoms, and
- Crude oil- or salt-contaminated soil.

Each of these wastes is described below.

Used Water-Based Drilling Fluids - Water-based fluids are suspensions of drilling fluid additives and formation solids in water. They usually contain many of the following ingredients: barite, clay, chromium lignosulfonate, lignite, polymers, caustic soda, and formation solids. They may also contain low concentrations of specialty chemicals added to treat a specific problem (e.g., aluminum stearate - defoamer, zinc carbonate - hydrogen sulfide scavenger). Water-based fluids may also contain 0 - 5 percent emulsified diesel or mineral oil. The water in water-based fluids may be relatively fresh or may contain high concentrations of sodium, potassium, or calcium chloride.

Used Oil-Based Drilling Fluids - Oil-based drilling fluids are water-in-oil emulsions. They contain a base oil (diesel or mineral oil), barite, clays, emulsifiers, water, calcium chloride, lignite, and lime. Oil-based fluids are more expensive than water-based fluids and are normally recovered

and cleaned up for reuse; however, in some situations salt cavern disposal might be economically viable. Oil-based fluids are dense, viscous, exhibit low vapor pressure, do not dissolve cavern walls, and are immiscible with brine. One would expect excellent cavern integrity and minimum disturbance of the displaced brine from this type of waste.

Drill Cuttings - Cuttings consist of formation solids (shale, sandstone, chert, etc.) and associated drilling fluid liquid (water or oil and fluid additives - barite, clay, lignite, polymers, etc). Cuttings contain trace amounts of heavy metals; however, these are present as insoluble inorganic salts in concentrations comparable to those found in surface soils.

The nature of the associated fluid is the most important characteristic that distinguishes cuttings for disposal. Thus, cuttings may be classified as either water-based or oil-based. Water-based cuttings may be further classified as salt-water-based or fresh-water-based. Normally, fresh-water-based cuttings would not be candidates for cavern disposal, because in most cases it is permissible to dispose of them on site either through land farming or direct pit closure.

Waste from Completion and Stimulation Operations - Various completion and stimulation processes on oil and gas wells result in solids-containing waste. Excess cement after setting plugs or cementing casing may result in cement waste. Washing sand out of tubing will result in silicon dioxide and other formation solids. Acid stimulation wastes may contain solids or neutralized wastes may deposit solids. There are a number of other, similar waste sources. All these would be candidates for disposal in a salt cavern.

Produced Sand- Many formations composed of sandstone break down, and fine particles of the formation are produced along with oil, gas, and water. These siliceous materials are much heavier than the liquid portions of the produced stream and settle out in piping, separators, and other treatment vessels. This material is distinct from tank bottoms because it collects rapidly in large amounts and is fairly uniform in composition, mostly as particles of silicon dioxide (sand). Other small impurities in produced sand can be water-formed scales and clays. Water-formed scales tend to contain radium as a co-precipitant in the scale. At times, the naturally occurring radioactive materials (NORM) concentration can be high enough to cause this waste to fall under NORM waste disposal regulations.

Tenk Bottoms- Solids accumulate in the bottom of tanks and treating vessels. These solids usually contain oil and are dispersed in a water continuous phase. The solids content is composed of clays and other formation fines, corrosion products such as iron sulfide and iron oxide, waterformed scales such as calcium carbonate or calcium sulfate, and bacterial bodies (biomass). Trace constituents might include treating chemicals, live bacterial cultures, dissolved gases such as carbon dioxide, and hydrogen sulfide. Water-formed scales tend to contain radium as a co-precipitant in the scale. At times, the NORM concentration can be high enough to cause this waste to fall under NORM waste disposal regulations. In physical form, such wastes range from soft, flocculent materials composed of small amounts of solids dispersed in water and oil to hard, cemented masses that are almost entirely solid materials. Typically, this waste is a watery sludge, and it is collected and transported by vacuum truck. Solids entrained in the waste are of small particle size and may be almost neutrally buoyant in water.

Crude Oil-Contaminated Soil - Surface soil may become contaminated with crude oil because of spills or leaks. Crude oil-contaminated soil would be a potential candidate for cavern storage if reclamation were not economically feasible.

Salt-Contaminated Soil- Surface soils may become contaminated with salt due to brine or produced water spills or leaks. Salt-contaminated soil would be a potential candidate for cavern storage if reclamation were uneconomical.

Monitoring and Recordkeeping Considerations

It is the best interest of both the regulator and the operator to know what types of wastes have been placed in the disposal cavern. This report does not propose specific monitoring requirements; rather the reader is referred to IOGCC (1994), which puts forth criteria that are intended to guide states in assessing and improving their regulatory programs for oil field waste management. While the IOGCC criteria do not specifically apply to disposal of oil field wastes by injection (which logically includes cavern disposal), they should be considered as a useful starting point for establishing monitoring requirements. In particular, Section 5.2 - Waste Characterization should be consulted.

It is appropriate to maintain long-term records of the source, quantity, and type of each batch of waste brought to the disposal facility.

Chapter 5 - Cavern Design and Location Considerations

Hundreds of salt caverns have been constructed and operated around the world. Most of these have been structurally sound and completely free from leakage or collapse. If cavern failure does occur, however, it can lead to contamination of surface water and groundwater. This chapter discusses several potential failure modes or areas of concern and approaches for mitigating or at least addressing the concerns.

Potential Failure Modes

Sub-Greep- Selt is a material that creeps or flows under stress. Creep closure is an active process in any salt cavity where stresses or pressure differentials exist. Scientists have studied the behavior of rock salt, and the subject remains a topic of investigation. Agreement exists among most scientists that salt behaves as a fluid (it flows under even small deviatoric stresses) and that the creep rate of a cavern is a highly nonlinear function of its internal pressure and is strongly influenced by temperature (Berest and Brouard 1995). These factors provide for the "self-healing" of salt. In caverns used for gas storage, for example, fractures resulting from excessive operating pressures will close when the pressures return to normal. However, creep also results in loss of volume or closure of caverns. The effort required to obtain site-specific data may be very large, and modeling of salt is quite specialized, although models are available to do these types of calculations.

Cavern Roof Collapse and Subsidence - Cavern roof collapse would most likely occur in caverns with minimal or no salt roofs or other weight-supporting roof structure, in caverns with excessive roof spans, or in caverns with minimal internal pressure. Under such conditions, lithostatic pressure (the pressure attributable to the weight of the overlying rock) could exceed the load-carrying capability of the roof support and the roof could collapse. Collapse of a cavern roof may result in sudden major subsidence at the surface and formation of sinkholes extending for hundreds of feet around the cavern well. Nieto-Pescetto and Hendron (1977) suggest that sinkholes are less likely to occur when the thickness of the overburden is greater than ten times the thickness of the salt layer.

Failure will also depend on size of the roof span and strength of the strata overlying the salt. As salt is leached from the walls or roof of the cavern, load is transferred to the strata above the salt, increasing the stress in these less ductile layers. The cavity roof begins to fail when the stress exceeds the strength of these layers. There are several documented cases of cavern roof collapse, including solution-mined brine caverns in Grosse Ile, Michigan, and solution-mined caverns in Windsor, Ontario (Coates et al. 1983). While the potential for roof collapse exists for any cavera, the likelihood of roof collapse is very small for most caverns.

Impacts from a general collapse would occur from the dispersion of the waste that had been disposed of in the cavern or from displaced brine. The final environmental impact statement (EIS) for the Seaway Group Salt Domes prepared for the SPR described the process of general collapse

for an oil-filled cavern (DOE 1978). If the waste materials in the cavern were in a liquid or semiliquid form, the process described by DOE for collapse into an oil-filled cavern could be similar for collapse into a waste-filled cavern, assuming the properties of the waste were similar to the properties of the oil. In the DOE collapse model, the contents (a nearly incompressible fluid such as brine or oil) would be displaced volume for volume by the falling caprock and overlying sediment. If the entire column of sediment above a cavern entered it in a manner analogous to a piston in **a** cylinder, and if the cavern contents were completely displaced by percolation through the sediments of the piston, rather than compressed, there would be a surface depression equal in volume to the original cavern, filled but not overflowing with the displaced fluid.

A more realistic result would reflect various mechanisms (imperfect packing of falling particles, adsorption, absorption, dissolution, and trapping of the displaced fluid), which would reduce the amount of fluid that would continue to rise through the cone of influence and emerge to the surface or that would migrate into aquifers between the surface and the top of the cavern. Under these mechanisms, the oil would probably reach the surface as small seeps, and as sediment settled into the place formerly occupied by the oil, a small surface depression would form. Subsidence could also occur without surface emergence of oil. Using the piston analogy, and assuming that the oil percolates up through water-saturated sediments that have zero empty pore space, there would be a volume for volume displacement of oil, and the combined volume of waste and saturated sediments would remain constant. If the oil moved up from the saturated layer into the empty pores of an unsaturated layer, the volume of the unsaturated layer would remain constant as long as the oil filled only empty space. Oil would not emerge on the surface until all the pore space near a potential seep was filled with oil. This would permit the possible formation of an oil slick on top of the water table surface in the unsaturated layer (DOE 1978).

Subsidence due to cavern roof collapse could affect the surface environment as well as surface facilities, buildings, equipment, and piping. Subsidence caused by salt creep and cavern closure is generally limited and slow. In shallow caverns, for example, subsidence rates of 0.5 mm per year are common (Wassmann 1993). However, Wassmann has reported several contributing factors to surface subsidence above salt caverns. For example, one particular salt cavern in the Hegelo brine field in the Netherlands subsided due to both overmining (1,100-mm subsidence in 1 year) and disintegration of the cavern roof, which was further weakened by geologic faulting. Eventually, the brine penetrated the roof, causing it to cave in slowly and steadily and ultimately creating a 35-meter crater within a couple of hours (Wassmann 1993).

It is important to note that in a disposal cavern the oil field waste will be in the form of a solid or semi-solid. Even if the roof of a disposal cavern should collapse, the solid or semi-solid wastes will not be displaced from the cavern to the extent that the fluids considered in the DOE collapse model would be. Therefore, the consequences of a roof collapse in a disposal cavern, in the event it should occur, would be less damaging than a roof collapse in a fluid-filled cavern.

Cavern Integrity - Although caverns can and should be designed to minimize the chance for collapse and subsidence, the use of caverns historically developed for other purposes and used today for disposal of oil field wastes must be carefully assessed. Although permitted at their time of development for hydrocarbon storage or brine production, their use specifically for disposal should consider location, size and shape, and proximity to nearby caverns and other activities that could in any way be affected in the longer term.

Location of cavern - A major factor in determining cavern stability is cavern depth. Deep cavities subjected to large overburden stresses are more likely to suffer excessive closure because the potential for large shear stress is greater than for shallow cavities (Coates et al. 1983). Nearness to salt formation boundaries and to other caverns within the salt formation also affects cavern stability — caverns near salt formation boundaries may induce high deviatoric stresses in more brittle rock outside the salt.

Cavern size and shape - Cavern size and shape affect in-situ stress changes, which in turn influence stress concentrations around the cavern. Short, wide caverns tend to produce larger stresses than high, narrow cavities of equal volume. Thus, for caverns of equal volume, those with relatively high height-to-diameter ratios are considered to be less subject to roof collapse than those with lower ratios.

Proximity to other caverns - When multiple cavities are created in salt domes, a primary consideration is the thickness of the walls between cavities required to maintain system stability. This design consideration is similar to that involved in designing supporting pillars for room and pillar mining and is two-fold. First, the initial design or spacing of multiple caverns must be such that the roofs will be adequately supported. Second, there is a potential for cavern diameter to increase. This increase could occur if there were unsaturated water in the wastes that could dissolve salt from the surrounding walls, thereby increasing the size of the existing caverns and further reducing the thickness of the salt wall between them. This process could be accelerated if seams of salt more soluble than sodium chloride were present in the formation. This concern can generally be addressed by basing the original cavern design on the anticipated increase in cavern diameter caused by additional leaching. Communication between caverns, or the passage of material through porous and permeable connections from one cavern to another, may also result from activities outside the cavern and outside the control of the cavern operator, especially when the disposal cavern is near other caverns that could expand.

By using comprehensive geotechnical computations, Wallner and van Vliet (1993) assessed changes in cavity stability and surface subsidence expected to result from enlarging several brine caverns in a salt dome in the Netherlands. Salt field operators planned to enlarge cavity diameters from 100 to 200 meters, leading to an increased volume and an increased ratio of cavity spacing-to-diameter approaching 2:1. The model indicated that the existing formation is stable because of a bridging effect— the inner region of the cavity array relaxes and the

outer region of the dome receives the transferred stresses. The model also indicated that for this particular array, the stability of the cavities and the pillars would not be endangered by enlarging the cavity diameter, although the enlarged diameters resulted in slightly increased surface subsidence. The model predicted continued stability as the spacing-to-diameter ratio approached 2:1, although several published standards or regulatory requirements for hydrocarbon storage caverns require a spacing-to-diameter ratio of no less than 2:1 (CSA 1993; TNRCC 1995). The CSA standards allow alternate spacing if geological studies show that caverns may be closer. Another recent reference recommends a spacing-to-diameter ratio of 4:1 for hydrocarbon storage caverns unless site-specific geomechanical studies show that caverns may be closer (IOGCC 1995).

The Netherlands study also assumed that the cavities were open and subject to hydrostatic brine pressure only. The study suggested that long-term subsidence forecasts will depend on cavity abandonment and sealing criteria, which need to be developed and tested, and which "need substantial research effort and study in the years to come" (Wallner and van Vliet 1993).

Leakage of Cavern Contents - Although salt is by nature a creeping material and will theoretically seal under normal conditions, leaks from caverns have been encountered. DOE's SPR found one cavern at Sulphur Mines, Louisiana, that when tested, leaked at a rate of several hundred barrels per year. Other operations have occasionally experienced similar leaks. Such leaks are normally attributed to poor or deteriorated cement jobs on the entry well to the caverns. In the Sulphur Mines case, sacrificial nitrogen was maintained on the cavern roof during crude oil storage to preclude product loss. Additionally there has been at least one case in southern Louisiana of a cavern being accidentally leached through at the edge of the dome. It is important to note, however, that the vast majority of the hundreds of storage caverns in use have served as secure storage chambers and have not leaked.

Solubility of salt - All materials found in salt formations do not dissolve at the same rate. Certain nonsalt constituents (e.g., anhydrite) may dissolve at slower rates than sodium chloride, thereby leaving ledges, while other types of salts may dissolve more quickly than sodium chloride, creating unanticipated channels or enlarged areas within a cavern.

Type of salt formation - The type of formation in which the salt cavern is located may affect the potential for leakage. There are two general types of salt formations: bedded and domal, and there are significant variations in salt properties and characteristics within these two categories as well as within individual beds or domes. Bedded salt, which has historically been used for brine mining in west Texas, is often characterized by insoluble shale and anhydrite zones that jut into the cavern (see Figure 7). A concern has been raised that salt may be interbedded with porous or fractured rock layers, and that liquid waste might migrate out of the cavern through these layers, if such layers are present. However, this mechanism of migration is considered highly unlikely, because these layers would be expected to be plugged with salt. Mechanical integrity testing of disposal caverns would determine whether fluid migration through these layers is occurring.

Generally, salt domes contain salt that is relatively free of shale and anhydrite layers. The relative purity of the salt in the deeper domal areas allows uniform dissolution and the formation of regular caverns, although domal salt can also vary from formation to formation, and even within a formation. Physical tests conducted for the Solution Mining Research Institute to determine hydrofrac gradients (pressure gradients that will cause formations to physically fracture) of Gulf Coast salt domes showed that in-situ fracturing characteristics and containment properties of salt can vary greatly. The results also demonstrate that the hydraulic fracture gradient typically assumed for Gulf Coast domes leads to conservative practices in solution mining and storage (Thoms and Gehle 1990).

Construction and operating practices - During construction of a salt cavern for waste disposal, it will be necessary to avoid any serious damage (fracture, rupture) that might compromise cavern stability and long-term capacity for containment. Operating conditions and practices can lead to leakage if the integrity of the final cemented casing or the casing seat (a cemented base placed at the bottom of the casing) is compromised. Factors affecting the pressure of the casing seat include disposal injection rate, casing and tubular configuration, and system back pressure. A specific example of how system piping, wellheads, and the cavern formation can be damaged is through excessive pressure surges caused by the sudden stoppage of a flowing stream. This can happen if (in the case of hydrocarbon storage wells) product is injected or withdrawn at very high flow rates (API 1993). API reports that brine, fresh water, and some relatively non-compressible materials can cause pressure shock waves severe enough to damage piping, wellheads, and the cavern formation. Thus, it is possible that injection of oil field wastes at pressures that are too high could lead to sudden stoppages, or "water hammer" effects. The disposal caverns permitted in Texas operate at much lower injection pressures than most hydrocarbon storage caverns. Consequently, water hammer effects should not be a problem.

Approaches for Mitigating Potential Failure Modes

The concerns raised above can be addressed through appropriate design, construction, operating, and closure procedures. Presented below are suggestions for mitigating potential adverse consequences associated with using salt domes for disposing oil field waste.

Computer Modeling - Many of the concerns described above can be predicted with computer programs that forecast closure and subsidence rates. Cavern design and operating procedures can then be modified, if necessary, on the basis of the results. However, because each situation is different, such programs must be calibrated to the special circumstances of each location and not all phenomena can be modeled accurately. Thus, while modeling is valuable for helping to mitigate potential adverse effects, empirical data and actual measurements are also useful.

Site Selection Criteria - Several factors should be considered in selecting sites for disposal of oil field wastes. These include many suggested by the Interstate Oil and Gas Compact Commission for siting natural gas storage caverns (IOGCC 1995):

- Distance to populated areas;
- Proximity to other industrial facilities;
- Current and future use of adjacent properties, including agriculture, which may withdraw large amounts of groundwater and potentially increase subsidence rates;
- Handling of brine or other displaced fluid;
- Proximity to environmentally sensitive wetlands, waters, and fresh water aquifers;
- Proximity to the salt boundary; and
- Proximity to other existing and abandoned subsurface activities, e.g., neighboring caverns for brine, gas, or hydrocarbons.

Another consideration for siting is the potential for seismic activity.

Design Considerations - To minimize the chance for failure due to closure, collapse, or leakage, acceptable designs should be based on a geological review of the location that covers all features capable of affecting the cavern. Adequate studies should address regional stresses and strains; mechanical, chemical, and containment properties of the salt and confining rock formations; and structural anomalies, including faulting (IOGCC 1995). The design should also consider potentially associated low-permeability zones and the effects of those zones on disposal operations (CSA 1993). Detailed knowledge of the geology should be supported by adequate documentation. Operators should be able to demonstrate that the caverns they plan to use — either new caverns developed specifically for oil field waste disposal or existing caverns that are being converted — will remain stable in the future.

Construction Considerations - Following cavern construction and before waste disposal begins, inspection and testing should be conducted to verify the tightness of the cavern, and to ensure that there is no hydraulic communication between the cavern and other caverns or elsewhere outside the salt formation.

Operating Considerations - During disposal operations, records of operation as well as measurements of subsidence and cavern integrity should be made periodically. Care must be taken to ensure against conditions that would cause the pressure at the cemented casing seat to exceed the

fracture pressure. Emergency planning should also be undertaken to address accidental releases of brine or oily substances.

Chapter 6 - Disposal Operations

The Disposal Process

Initially, caverns are filled with clean brine. Wastes are introduced as a slurry of waste and a carrier fluid (brine or fresh water). A carrier fluid that is not fully saturated with salt will eventually leach salt from the cavern walls or roof. Expansion of cavern diameter is generally not a problem as long as the anticipated degree of expansion is accounted for when designing the caverns. To avoid excessive leaching of the cavern roof, operators may intentionally introduce a hydrocarbon pad that, by virtue of its lower density, will float to the top of the cavern and keep the unsaturated carrier fluid from coming in contact with the cavern roof.

As the waste slurry is injected, the cavern acts as a oil/water/solids separator. The heavier solids fall to the bottom of the cavern, forming a pile. Any free oils or hydrocarbons that are associated with the waste float to the top of the cavern. Clean brine displaced by the incoming slurry is removed from the cavern and either sold as a product or disposed of in an injection well. When the cavern is filled, the operator removes the hydrocarbon pad and plugs the cavern. The remainder of this chapter provides greater detail on the disposal process and discusses issues relating to disposal.

Carrier Fluid Considerations

Fully saturated brine is a good carrier fluid, but it may not always be available or may be too costly. Using fresh water or brines that are not fully saturated as carrier fluids does not present major difficulties, however. Under this scenario, the operator would need to be aware of the effect the **carrier** fluids would have on additional salt leaching. Although the presence of fresh water should cause only a relatively small change in the diameter or height through leaching, under certain circumstances, the amount of additional leaching could reduce the intra-cavern distance, the distance to the edge of the salt formation, or the cavern roof thickness to a degree that would be considered undesirable. Therefore, if the waste contains fresh water or less than fully saturated brine, the operator and the regulatory agency would need to agree in advance on the extent of additional leaching that would be allowed at that particular site and how that leaching rate could be controlled.

While caverns will expand if carrier fluids are not fully saturated, the extent of expansion is generally not particularly large. For example, if a cavern is filled completely with fresh water, which subsequently dissolves enough salt to become fully saturated, the cavern volume is expected to increase by only one-sixth and the diameter is expected to increase by only 8 percent (Diamond 1996).

Waste Emplacement Considerations

There are three potential ways to fill the cavern:

1. The waste can be pumped down the tubing and the displaced brine withdrawn from the annulus;

2. The waste can be pumped down the annulus and the displaced brine can be withdrawn from the tubing; and

3. The waste can be pumped down one well and the displaced brine can be withdrawn through a second well.

The first scenario described above is the one most likely to be used. The heavier solids in the incoming waste will be introduced near the bottom of the cavern and will have a good chance of settling and remaining in the cavern. Some of the hydrocarbons rising through the cavern may become entrained in the displaced brine that is leaving the cavern, although most hydrocarbons will accumulate in a pad or layer near the roof.

One operator in Texas follows the second scenario. Waste is introduced near the top of the cavern. The lighter material will remain at the top of the cavern while the heavier solids must fall through many feet of brine before reaching the cavern bottom. The heavier solids are moving in the same direction as the displaced brine and may mix with the displaced brine and be carried out of the cavern.

Another Texas disposal cavern operator started disposal operations with a single well and injected waste through the tubing. The cross-sectional area of the tubing and the annulus limited the rate at which the cavern could be filled. To provide additional cross-sectional area to enhance the rate of filling, the operator recently drilled a second well and is now operating the cavern using one well for injection and the other well for brine withdrawal.

Injection at the bottom of the cavern presents the problem of changing the injection tubing depth as the cavern fills. Operators of oil field waste disposal caverns using injection through the tubing inject waste until the end of the tubing is covered or the back pressure from the accumulated waste precludes further injection. At this point, the operators use a small controlled explosive charge to cut off the end of the tubing further up the cavern and then can resume filling the cavern.

Displaced Fluids Considerations

As the solid components of the incoming waste fill the bottom of the cavern, an interface forms between the accumulated waste and the overlying brine, including a transition zone of brine that is mixed with the waste. Early in the life of a disposal cavern, brine is withdrawn hundreds of feet above the surface of the waste pile or the transition zone. The vast majority of the displaced brine will be clean. As the cavern fills, however, the transition zone brine may make up a larger proportion of the remaining cavern volume. At some later time, the brine withdrawn from the cavern will consist partially or completely of brine from the transition zone. The transition zone brine will be noticeably dirtier than the clean brine that was originally displaced from the cavern. <u>The</u> waste/brine interaction in the transition zone should have no effect on the nonhazardous classification of the brine or on the environmental suitability of cavern disposal. However, there may be unanticipated operational concerns and expenses.

Displaced brine is generally sold as a product or injected into brine disposal wells. As long as the brine is clean, either method of managing displaced brine can be practiced without additional treatment or handling. However, as the transition zone brine is displaced from the cavern, the operator may be faced with additional expense to clean up the brine before it can be injected underground for disposal. Solids-laden brine could clog the formation into which it was injected; typically such wastes are filtered prior to injection. Since most of the brine that is sold is used as a constituent of drilling fluids to drill additional oil and gas wells, the presence of waste components in the brine may not affect its salability.

An alternative to cleaning up the displaced fluid for disposal is early abandonment of the cavern, before it is completely full. This results in less disposal volume than was initially planned, with a resultant loss in revenue. Yet another alternative is to fill a cavern until the displaced brine shows characteristics of the transition zone. At that point the operator could discontinue disposal for a period of time, allowing the solid wastes to more completely settle and minimizing the extent of the transition zone.

Displaced brine that is sold should not contain excessive levels of contaminants. Regulatory criteria for acceptable levels of contaminants or on the projected end use may be appropriate.

Other Considerations

Monitoring of cavern pressure should be done before the cavern is filled with oil field waste, throughout the waste emplacement cycle, and optimally, for some period of time after the cavern has been closed. In order to monitor cavern pressure after closure, a pressure transducer must be installed in the cavern at the time it is closed.

The types and volumes of wastes emplaced should be recorded on a regular basis and the records should be maintained for several years following closure of the cavern.

Since there is very limited experience with operating salt caverns for disposal of oil field waste, certain facets of operation could benefit from additional research. The few oil field waste disposal caverns in operation have not yet become full. There will be differences in brine quality as the caverns fill. Research could provide information useful to operators on how to control brine quality and when brine will have to be treated prior to disposal or sale.

Chapter 7 - Closure and Remediation

Although various industries have been operating storage and production caverns for years, the long-term behavior of caverns filled with oil field waste is unknown. Scientists have modeled cavern behavior and engineers have conducted limited tests of closed brine-filled caverns. Most have studied liquid-filled salt caverns, although some have modeled hazardous waste disposal in dry caverns. The extent to which preliminary findings in these areas relate to the behavior of caverns used for oil-field wastes is not known. However, it will depend at least in part on the ratio of brine (or other liquid waste contents) to solids and on the densities of the solid wastes relative to those of the surrounding salt. To present the current thinking regarding closure and abandonment and to highlight some of the issues associated with such activities, the status of knowledge related to closing and abandoning caverns is addressed in this chapter.

Concerns with Sealing and Abandoning Caverns

Sealing and Abandonment of Liquid-Filled Caverns

The general concern with sealing and abandoning a fluid-filled salt cavern is that the continued creep of the cavern can raise the fluid pressure at the top of the cavern to a value greater than that of the lithostatic pressure at that point (Bishop 1986). This condition can lead to a possible fracture in the area of the wellbore, allowing brine to be forced out of the cavern.

The SPR has only cursorily addressed the abandonment of SPR caverns. Saline aquifers or impermeable caprock overlay the salt around the SPR salt domes. When the SPR caverns are closed, they will be sealed as state law requires. However, even state concerns relative to brine escaping into saturated aquifers or caprock are minimal for SPR caverns. Other sites for existing or potential waste disposal caverns may be located in areas that pose greater risks. Each site should be individually evaluated for its risk potential.

In 1984, the Solution Mining Research Institute sponsored a study using computer simulations combined with knowledge of the material properties of rock salt and with comparisons with actual pressure buildup data obtained in field operations to analyze the long-term behavior of a solution cavern sealed with a cement plug (Serata 1984a). While the simulations showed the plugged cavern to steadily approach structural equilibrium with permanent stability, they also disclosed a potential danger resulting from cavern pressure buildup. If the cavern pressure buildup were to exceed the surrounding ground pressure at the cavern top or at the wellbore below the cement plug, the excess pressure could lead to brittle fracture or plastic yield, depending on the strength of materials and initial stress states at the elevation of the cement plug. Factors contributing to the magnitude of cavern pressure buildup include bottom depth, thickness and size of salt mass behind the cavern wall, proximity to cavern boundaries, influence of neighboring caverns, cavern geometry, and the initial stress state at the cavern bottom (Serata 1984b).

Serata (1984a) hypothesizes a critical depth of 1,000 feet. If the cavern top is higher than the critical depth, then the cavern roof may crack and leak. Likewise, if the wellbore plug is set above the critical depth, the wellbore would be fractured, creating a direct conduit for cavern contents to reach the surface. However, more recent research suggests that this hypothesis cannot be supported (Linn 1995).

Bishop (1994) calculates that the salt strength of domes and the compressive strength of the cement plug in the wellbore is typically much greater than the lithostatic pressure. Consequently, Bishop believes that fracturing is unlikely.

In 1994, anticipating eventual sealing and abandonment of SPR caverns, DOE sponsored a series of modeling efforts to gain insight into the long-term behavior of a typical SPR cavern (Ehgartner and Linn 1994). To predict the speed and extent of cavern pressurization, the individual and combined effects of salt creep, salt dissolution, and geothermal heating of brine on the pressures generated after plugging were modeled. The models showed that after plugging, the internal fluid pressures in a brine-filled cavern eventually exceed lithostatic pressure in the upper portion of the cavern, resulting in enlargement and increased potential for leakage. The time needed for the brine pressure to exceed the lithostatic pressure varies with brine temperature and salinity. Assuming no salt dissolution after plugging the cavern, the predicted time for geothermally heated brine to reach lithostatic pressure at the casing seat was only about two years; without geothermal heating of the brine, the predicted time was over 200 years. Salt dissolution had the effect of nearly doubling the time needed to reach lithostatic pressure. The authors suggested that the sensitivity of cavern brine pressures to temperature and salt dissolution can be used to increase the time before the casing seat exceeds lithostatic pressure and decrease the maximum fluid pressure exerted on the casing seat. Thus, heating the brine and using brine of lower salinities could help decrease fluid pressure on the casing seat. The authors conclude, however, that even without heating the brine or delaying installation of the plug, the predicted rate of brine pressurization is not high enough to result in fracturing of the salt.

A more recent study of the behavior of sealed solution-mined caverns suggests that the factors affecting cavern closure include not only brine heating and cavern creep, but also rock salt permeability. More importantly, rock salt permeability, even if very small, allows some pressure release and leads to a final equilibrium pressure that can be substantially lower than the lithostatic pressure (Berest and Brouard 1995). The authors reported three test cases. The first concerned shallow brine production caverns in France and showed that during the test measurement period, the predominant effect was thermal expansion (neither percolation nor creep played major roles). The second case was a cavern operated by Gaz de France that was closed roughly one year after leaching had ended and was kept closed for about 7½ months. Tests showed that thermal expansion remained active and could be considered responsible for 80 to 90 percent of the observed brine outflow. The third test was conducted in much deeper caverns (rock salt layers between 1,800 meters and 2,500 meters) and showed that for deep caverns, cavern creep is much more important than thermal expansion. However, when the gap between lithostatic pressure and brine pressure becomes very

small, creep is ineffective and thermal expansion becomes the primary contributor to pressure buildup.

Berest and Brouard (1995) found that pressure buildup generated by salt creep and brine heating in a sealed cavern leads to a final equilibrium pressure that is smaller than lithostatic pressure, provided that surrounding rock salt exhibits some permeability. They suggest that cavern operators consider such permeability in order to evaluate the area, especially prior to leaching. However, they acknowledge that salt permeability may not be sufficient to avoid a transient period in which the pressure in the cavern exceeds the lithostatic pressure. They suggest that this problem can be mitigated by injecting nitrogen or air into the cavern prior to plugging to modify cavern compressibility and reduce pressure buildup rate and also by delaying plug installation until the salt has heated the brine.

The temperature differential between the bottom and top of a tall cavern can lead to convective mixing of the fluids in the cavern. For oil field waste disposal caverns, the convection is unlikely to disturb the solid or semi-solid waste layer at the bottom of the cavern, but it could mix the overlying brine. This is not anticipated to lead to cavern failure⁹.

The current literature cited above, whose conclusions are based on modeling, suggests that brine-filled caverns will not leak. However, no empirical tests of these suggestions have been reported in the literature to date.

Sealing and Abandonment of Waste-Filled Caverns

It is not known how these findings for brine-filled caverns will translate to caverns filled with oil field waste. Presumably there will be some brine remaining in a waste disposal cavern at the time of closure, because the likelihood of the displaced brine coming from the transition zone increases as the amount of waste disposed increases. Therefore, the disposal process will likely reach a point at which the displaced brine can no longer be economically extracted and treated or disposed of. Further, there will be brine or other fluids in the pore spaces surrounding the solid waste particles and the rubble at the bottom of the cavern deposited during cavern formation. The wastes near the bottom of the cavern may contain less pore fluids because the increased pressure at that depth will have packed the particles more tightly. Although the solids portion of the waste mass will resist salt creep, the brine portion is likely to be subjected to creep and geothermal heating.

The effect of geothermal heating may not be as significant for waste-filled caverns as for fluid-filled caverns because the anticipated filling rate is slower than for fluid-filled caverns.

⁹ Personal communication between David Tomasko, Argonne National Laboratory, Argonne, IL, and John Veil, Argonne National Laboratory, Washington, DC, on January 24, 1996.

The oil field wastes will have a longer time to reach formation temperatures before the cavern is sealed.

Because no caverns filled with solid waste have been sealed, most of the information on the behavior of sealed, solid-waste-filled caverns is based on modeling and theory. The two studies cited below both consider disposal of predominantly dry wastes into dry caverns. It is not known how their conclusions relate to the scenario of disposing of a slurried solid/semi-solid waste into a fluid-filled cavern.

One preliminary study (Tinucci et al. 1988) modeled the response of a hazardous wastedisposal cavern in three stages over a 200-year modeling period. The stages consisted of a 5-year period for cavern creation through solution mining, a 2-year waste emplacement period (in the first 2 years the cavern was assumed to be empty, then filling occurred at the end of the 2-year period), and a 193-year sealed period. The waste material was assumed to be a weak compressible solid of high porosity in a pelletized form with low shear strength. The modeling results indicated that most deformation occurred when the cavern was empty, with a cavern volume reduction of 1.1 percent in the first 7 years, and less than 0.2 percent thereafter. However, depending on the creep equations, the results could be 3 to 5 times higher. Upon sealing, the model predicted rapid pressure buildup within 6 months, and then a levelling off. While the pressure at the top of the cavern did not significantly exceed the original lithostatic pressure, the cavern pressure was expected to exceed lithostatic pressure eventually if the stresses came to equilibrium and the cavern did not leak off pressure. Modeled deformations were large enough to fracture several of the zones, but fracturing diminished over time.

Crotogino (1990), while studying disposal of hazardous wastes into dry, empty caverns, identified at least two particular concerns for closure of caverns filled with solid wastes. The first relates to the possibility of fluid-like pressure buildup. To avoid this, the mechanical properties of the waste should be such that shear stress will be absorbed. The other concern is the possible subsidence of the surface due to the porosity of the waste materials. Upon introduction, waste materials have a porosity of 30 to 40 percent, a factor which is subsequently reduced by the impinging rock pressure. To predict cavity convergence, lab tests can be used to project compaction behavior. The objective is to achieve elastoplastic behavior of the waste by undertaking corresponding conditioning.

Approaches for Addressing Concerns

Because neither the behavior nor the impacts of a breach of cavern integrity after closure are well understood, it is difficult to suggest mitigating approaches. It can be argued that because of the unknown factors, the approaches should be conservative. However, if the impacts of actual breach of containment are low (as would be the case for caverns located away from aquifers and human activity), then it could be argued that the regulatory approach should not entail overly prescriptive and conservative requirements. Argonne National Laboratory has received funding from DOE to conduct a preliminary risk and cost analysis of salt caverns compared to other methods for disposing of oil field wastes during 1996. The findings of this study will contribute to a better understanding of the risks and impacts associated with cavern disposal.

The following issues should be considered when establishing regulatory requirements.

Testing and Analysis - Plugging and abandonment requirements should incorporate such tests as

- Geomechanical analyses of stability of the cavern and its roof prior to abandonment; and
- Pressure tests to ensure integrity of the cavern, wellbore, and cement prior to setting plugs or to demonstrate that the waste will remain in the cavern.

Plug Design - The standards developed for plugging hydrocarbon storage caverns are applicable for disposal caverns too. For example, the IOGCC (1995) standards call for installation of a drillable bridge plug within 30 feet of the casing shoe (a reinforcing collar of steel attached to the bottom of the casing) or the end of the casing if no casing shoe is present. The bridge plug is then capped with a plug of salt-saturated, sulfate-resistant cement to a depth sufficient to cover two casing collars. Additional plugs should be located within the wellbore to cover all porous or permeable zones between the casing shoe and the surface.

Some of the research into hazardous waste disposal has considered alternative plugging designs and materials. Crotogino (1990) suggests that both long-term and short-term sealing needs must be met. Long-term sealing requires a material that compacts under the effects of pressure, temperature, and humidity. Crushed rock salt appears to meet those requirements and should be considered as a component of the borehole plug. Over time, it recrystallizes to a homogeneous material that is barely distinguishable from naturally occurring rock salt, and it can be introduced as a bulk material, which gradually joins with the surrounding rock over the long term. However, since salt fines do not produce a fully functioning seal in the intermediate term, it may be necessary to seal part of the uncased section with low-permeability grout plugs (e.g., salt concrete or bitumen). Research regarding the use of plugs of designed viscosity to achieve a permanent seal is under way. A plug should have a viscosity high enough to act as a pressure seal and low enough to allow existing pressures to force it against the salt, enhancing the ability of the highly viscous salt to conform exactly to the perimeter of the plug (Bishop 1986).

Pressure Relief- One approach to relieving pressure created by cavern closure after sealing would be to bleed off brine as necessary. Under this approach, operators would need to demonstrate that there was sufficient brine remaining in the cavern after closure to allow bleeding and would have to maintain monitoring and responsibility for several years following cavern closure.

Summary Opinions of Independent Experts

To better assess the significance of these reports and findings, the authors interviewed several experienced researchers in the field to learn their opinions. Dr. James Linn of Sandia National Laboratories suggests that for liquid-filled caverns, researchers don't know what will happen, although if cavern pressure buildup is slow, the caverns should not fail. Dr. Linn also suggests that solids-filled caverns will not transmit pressure like fluid-filled caverns and consequently will not fail. Caverns filled with noncompressible solids with porosity are more stable than caverns filled with brine, but lighter, more compressible solids provide less stability than noncompressible solids. The relative stability depends on the nature of the waste¹⁰.

Dr. Joe Ratigan of RE/SPEC Inc. suggests that researchers have a good knowledge of fluidfilled cavern behavior up to internal pressures of 0.8-0.9 times lithostatic pressure, but they disagree as to what will occur beyond that point. The potential weak links where fractures could occur include the casing plug, the cement filling the annulus, and the rock itself. Another avenue for waste leakage from the cavern would be for the cavern contents to diffuse into the rock mass¹¹.

Dr. Robert Thoms of AGM Inc. suggests that very tall liquid-filled caverns could experience leakage problems at the top due to increased pressure following closure, but caverns that are shorter would be less likely to leak. Caverns filled with solids that have sufficient shear strength and adequate void spaces should have little chance of leakage. The weight of the waste pile will exert lateral pressure on the cavern walls and provide additional stability. Dr. Thoms suggests that one additional safeguard that could be employed is to fill the cavern, monitor pressure for several years, and then permanently seal the cavern¹².

As part of the Solution Mining Research Institute's comments on the second draft of this report (Diamond 1996, comment 96), two persons experienced in the salt cavern industry added additional insights on the stability of caverns filled with solids versus caverns filled with brine. Fritz Crotogino of Kavernen Bau- und Betriebs GmbH commented that his research found that solids can have a porosity exceeding 40 percent and that significant cavern pressure reduction only occurs after compaction of over 20 percent (Crotogino 1990). Mr. Crotogino expects that slurried oil field wastes introduced to a brine-filled cavern will behave in the same manner as primarily dry solids introduced into a dry cavern, the situation on which he reported in Crotogino (1990). Mr. Crotogino suggests that compaction of 20 percent can only be expected after a long period of time at the internal

¹⁰Personal communication between James Linn, Sandia National Laboratories, Albuquerque, NM, and John Veil, Argonne National Laboratory, Washington, DC, on December 8, 1995 and May 14, 1996.

¹¹Personal communication between Joe L. Ratigan, RE/SPEC Inc., Rapid City, SD, and John Veil, Argonne National Laboratory, Washington, DC, on December 7, 1995 and May 14, 1996.

¹² Personal communication between Robert L. Thoms, AGM Inc., College Station, TX, and Joh n Veil, Argonne National Laboratory, Washington, DC, on December 11, 1995.

pressure corresponding to a brine column and as long as the waste material has not been compacted to a considerable extent, there will be no increase in internal pressure.

The second person who expressed an opinion on this issue is Charles Chabannes of Sofregaz US Inc. Mr. Chabannes suggests that solid particles in the waste pile will probably not offer structural support until nearly all the pore space has been eliminated by creep-induced compaction (Diamond 1996, comment 96).

Although the comments from Mr. Crotogino and Mr. Chabannes may appear to disagree with the statements attributed to the other experienced researchers, Dr. Thoms suggests that different experts have focused on different aspects of the fill material issue and that all of their comments are valid. He offers the following summary (Thoms 1996). As a general rule, the stability of liquidfilled caverns increases with the density of the filling liquid. Caverns that are filled by displacing brine with materials more dense than brine will be more stable than those filled with brine alone. As solid particles are injected into a cavern, they introduce additional lateral forces that reinforce the stabilizing effect of the brine pressure acting outward against the cavern walls. The lateral forces have two components. The first component is lateral confinement of the solid particles by the cavern walls, which is influenced by the weight and interlocking characteristics of the solids. The second component is a propping resistance of the solids matrix in response to inward creep of the cavern walls; it tends to increase over time. If the waste pile contains large void spaces (e.g., Crotogino's 40 percent porosity), significant wall movements may be necessary to incur any propping effects.

Dr. Thoms indicates that Mr. Crotogino's and Mr. Chabannes' comments are consistent with the concept that a brine cavern that exhibits little salt creep before waste introduction will initially gain little additional stability from the propping resistance of a solid waste pile with considerable porosity. However, the presence of the solids in the cavern represents a measure of insurance against long-term creep effects. If the nature of the incoming waste is such that it deforms readily, as would a brine/oil field waste slurry, there will be an immediate gain due to confinement effects. In summary, disposal of solids into brine-filled caverns will generally tend to enhance the stability of caverns. The degree of stability enhancement depends on the nature of the material (Thoms 1996).

The experts are in agreement that disposal caverns are likely to be stable, if designed and operated properly. Even if waste-filled caverns are no more stable than brine-filled caverns, they still are very stable, as indicated by literature studies. If waste-filled caverns prove to be more stable than brine-filled caverns, either initially or at a later point following creep-induced compaction, the additional margin of safety further reduces the likelihood of cavern leakage.

Remediation Considerations

There appears to be undue concern about escape of waste from a cavern if its structural integrity is breached. Most oil field wastes that would be placed in a cavern for disposal are solids or semi-solids and would not move an appreciable distance even if the cavern ruptured. All that

remains to cause concern is oil and brine. The movement of oil would be limited if it were not accompanied by water. It would tend to adsorb on rock or soil and its movement would be minimized. The most significant danger from a waste disposal cavern failure is the escape of brine. If a failure occurred that allowed brine to escape, it would pose the greatest threat if it reached formations containing fresh water.

If brine were to escape from the cavern, the proper remediation would consist of recovery wells that could capture the escaped brine before it reached fresh water formations, assuming that the leak was detected before fresh water contamination occurred. If a drinking water aquifer becomes contaminated with brine, there are a variety of techniques that can be used for remediating the aquifer. Most state groundwater protection or waste site cleanup agencies have extensive experience with these techniques.

Matalucci (1993) provides a thorough review of techniques that could be used to repair leaks in the SPR caverns. The same techniques are applicable to the borehole and casings of disposal caverns too. The techniques reviewed by Matalucci include

- Inner full-length cemented liner;
- Inner uncemented liner options using external casing packers;
- Internal steel liner casing patch (HOMCO patch); and
- Various squeeze cementing options using small-particle-size cementing materials.

It would seem more prudent to design for low risk than to have to counteract failure. A viscous waste containing little brine, that kept all its constituents in a contiguous mass and that filled the cavern completely before closure would appear to pose the least risk.

Areas for Further Research

The current state of knowledge about the long-term behavior of closed waste-filled caverns is incomplete. Research in several key areas would improve our understanding of what happens in closed caverns and the risks that closed caverns pose relative to other disposal mechanisms. These areas include:

- Defining ways to conduct long-term monitoring of closed caverns (particularly caverns filled with oil field wastes) to ensure that leaks are discovered in a timely manner, including defining parameters to be monitored and how the monitoring would be done;
- Identifying and evaluating the risks associated with waste disposal cavern behavior following closure and the impacts of a containment breach should it occur;

- Estimating the relative risk of disposing of oil field wastes in salt caverns compared to other existing disposal methods; and
- Identifying and assessing the costs and benefits of various methods for disposing of oil field wastes.

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Chapter 8 - Conclusions

This report presents an initial evaluation of the suitability, feasibility, and legality of using salt caverns for disposal of nonhazardous oil field wastes. Given the preliminary and general nature of this report, we recognize that some of our findings and conclusions may be speculative and subject to change upon further research on this topic.

- This particular mode of disposal is in its infancy. At the time this report was prepared, we could identify only six U.S. facilities permitted for this type of disposal, and only four of those were in an active status as of May 1996. While there appears to be interest from several oil-producing states in considering this method of oil field waste disposal, no other state has approved any project yet and only New Mexico has received an application for siting and operating a disposal cavern.
- There are no apparent regulatory barriers to the use of salt caverns for disposal of oil field wastes at either the federal level or in the eleven states discussed in this analysis. One area that would benefit from clarification is further EPA guidance on what types of wastes may be disposed of into Class II wells.
- The types of oil field wastes that are exempted from RCRA hazardous wastes requirements are generally suitable for disposal in salt caverns. Many of these wastes are now disposed of in landfills or are land-farmed; these disposal methods pose environmental risks of their own.
- There are many variables to consider when siting, constructing, and operating a waste disposal cavern. The hydrocarbon storage industry has developed useful, detailed standards, guidance, and criteria for designing and constructing caverns; these are appropriate for waste disposal caverns, too. Hundreds of storage caverns have successfully been operated worldwide for several decades.
- There is no actual field experience on the long-term impacts that might arise from salt cavern storage of oil field wastes. The literature contains many theoretical studies that estimate what might happen following closure of a cavern. Although different authors agree that pressures will build in a closed cavern due to salt creep and geothermal heating, they do not specifically address caverns filled with oil field wastes. Several experienced researchers in the field interviewed by the authors believed that caverns filled with oil field wastes presented much less likelihood of leakage than fluid-filled caverns, although other experienced researchers believed that until the pore space of the waste pile is reduced through creep-induced compaction, a solids-filled cavern will behave in the same way as a fluid-filled cavern. More field research on the effects of pressure buildup in closed caverns would aid our understanding of this subject.

- No attempt was made in this study to evaluate the cost effectiveness of cavern disposal of oil field wastes. Additional research in the areas of risk assessment and costs of cavern disposal compared to other alternatives for oil field waste disposal, some of which will be conducted by Argonne National Laboratory during 1996, will facilitate the development of efficient and effective policy.
- On the basis of this preliminary research, we believe that disposal of oil field wastes into salt caverns is feasible and legal. If caverns are well-sited and designed, operated carefully, closed properly, and monitored routinely, they represent a suitable means of disposing of oil field wastes.

References

API, 1993, "Operation of Solution Mined Storage," API Recommended Practice 1115, American Petroleum Institute, Washington, DC, August 5.

API, 1994, "Design of Solution-Mined Underground Storage Practices," API Recommended Practice 1114, American Petroleum Institute, Washington, DC, June.

Berest, P., and B. Brouard, 1995, "Behavior of Sealed Solution-Mined Caverns," presented at 1995 Solution Mining Research Institute's Spring Meeting, New Orleans, LA, April 30-May 3.

Bishop, W.M., 1986, "Long-Term Disposition of SPR Caverns Not Used for Petroleum Storage, A Draft Plan," unpublished report, October 27.

Bishop, W.M., 1994, letter from Bishop, PB-KBB, Houston, TX, to R. Taylor, Taylor SWD Operating, Inc., concerning "Fracture Potential for Taylor #2 during Long Term Closure," August 11.

Coates, G.K., C.A. Lee, W.C. McClain, and P.E. Senseny, 1983, "Closure and Collapse of Man-Made Cavities in Salt," in Proceedings of Sixth International Symposium on Salt, pp. 139-157.

Crotogino, F., 1990, "Technical Concept for a Hazardous Waste Cavern in Salt in Accordance with the German Regulations on Hazardous Waste," presented at the Solution Mining Research Institute's Fall Meeting, Paris, France, October.

Crotogino, F., 1994, "Waste Disposal in Salt Caverns - The Situation in Germany," presented at Spectrum '94, Atlanta, GA, August 14-18.

CSA, 1993, "Storage of Hydrocarbons in Underground Formations - Oil and Gas Industry Systems and Materials," CSA Standard Z341-93, Canadian Standards Association, Rexdale, Ontario, Canada, July.

Diamond, H.W., 1996, letter containing Solution Mining Research Institute's comments on 2nd draft of Argonne National Laboratory report, "Preliminary Technical and Legal Evaluation of Disposing of Nonhazaradous Oil Field Waste into Salt Caverns (February 14, 1996)," from Diamond, Solution Mining Research Institute, Deerfield, IL, to J.A. Veil, Argonne National Laboratory, Washington, DC, April 30.

DOE, 1978, "Final Environmental Impact Statement, Strategic Petroleum Reserve, Seaway Group Salt Domes (Bryan Mound Expansion, Allen, Nash, Damon Mound, and West Columbia), Brazoria County Texas," U.S. Department of Energy, DOE/EIA-0021, June. Ehgartner, B.L., and J.K. Linn, 1994, "Mechanical Behavior of Sealed SPR Caverns", paper presented at Solution Mining Research Institute's Spring Meeting, Houston, TX, April 25-27.

Elder, J.R., 1993, draft memorandum from Elder, Director of EPA's Office of Ground Water and Drinking Water to Water Management Division Directors, Region II-X, "RCRA-Exempt Oil and Gas Exploration and Production Wastes and Authorization for Injection into Class II Wells - Underground Injection Control Program Guidance #XX," March 17.

Fuller, J., and J. Boyt, 1995, internal Oil and Gas Division memorandum to B. Williamson, C.K. Rylander, and C.R. Matthews, Railroad Commission of Texas, on "Cavern Disposal Wells," May 1.

Hoather, H.A., and D. Challinor, 1994, "The Use of Salt Cavities for the Disposal of Waste," presented at the Solution Mining Research Institute's Fall Meeting, Hannover, Germany, September 25-October 1.

IOGCC, 1994, "IOGCC Environmental Guidelines for State Oil & Gas Regulatory Programs," the Interstate Oil and Gas Compact Commission, Oklahoma City, OK, May.

IOGCC, 1995, "Natural Gas Storage in Salt Caverns - A Guide for State Regulators," the Interstate Oil and Gas Compact Commission, Oklahoma City, OK, October.

Jirik, C.J., and L.K. Weaver, 1976, "A Survey of Salt Deposits and Salt Caverns - Their Relevance to the Strategic Petroleum Reserve," U.S. Federal Energy Administration, FEA/S-76/310.

Johnson, K.S., and S. Gonzales, 1978, "Salt Deposits in the United States and Regional Geologic Characteristics Important for Storage of Radioactive Wastes," prepared for Office of Waste Isolation, U.S. Department of Energy, by Earth Resource Associates, Y/OWI/SUB-7414/1, March.

Knudson, M.O., 1993, letter from Knudson, Water Management Division, EPA Region 6, Dallas, TX, to H.W. Thompson, Louisiana Department of Natural Resources, Baton Rouge, LA, about Class II Wastestream Classification, April 20.

Linn, J.K., 1995, memorandum containing comments on draft salt cavern report from Linn, Sandia National Laboratories, Albuquerque, NM, to J. Veil, Argonne National Laboratory, Washington, DC, September 15.

Matalucci, R.V., 1993, "A Review of Alternative Techniques for Repairing Leaks in Strategic Petroleum Reserve (SPR) Cavern Wells," Sandia National Laboratories, Albuquerque, NM, SAND92-2475, August.

NGS, date unspecified, "Experimentaluntersuchungen zur Ablagerung von Abfallen in Salzkavernen (Experimental Studies into the Disposal of Wastes in Salt Caverns)," prepared by Niedersachsische Gesellschaft zur Endlagerung von Sonderabfall mbH (Lower Saxony Company for the Final Disposal of Hazardous Waste), Hannover, Germany.

Nieto-Pescetto, A.S., and A.J. Hendron, Jr., 1977, "Study of Sinkholes Related to Bedded Salt Production in the Area of Detroit, Michigan," published by Solution Mining Research Institute, Flossmoor, IL, November.

Pearson, A.G.A., and A. Alseth, 1995, U.S. Patent No. 5,433,553, "Method for Refuse Disposal in Solution-Mined Salt Cavities," July 18.

Pfeifle, T.W., T.J. Vogt, and G.A. Brekken, 1995, "Correlation of Chemical, Mineralogic, and Physical Characteristics of Gulf Coast Dome Salt to Deformation and Strength Properties," Solution Mining Research Institute Research Project Report 94-0004-S, Deerfield, IL, January.

Querio, C.W., 1980, "Design and Construction of Solution-Mined Caverns for LPG Storage," presented at Solution Mining Research Institute's Fall Meeting, Minneapolis, MN, October 12-15.

Serata, S., 1984a, "Ultimate Stress in the Salt Envelope of a Sealed Liquid-Filled Solution Cavern," Vol. 1, prepared for Solution Mining Research Institute, Woodstock, IL, by Serata Geomechanics, August 15.

Serata, S., 1984b, "Follow-Up Proposal for Practical Application: Ultimate Stress in the Salt Envelope of a Sealed Liquid-Filled Solution Cavern," prepared for Solution Mining Research Institute, Woodstock, IL, by Serata Geomechanics, October 15.

Thoms, R.L., 1995, memorandum containing comments on draft salt cavern report from Thoms, AGM, Inc., College Station, TX, to J. Veil, Argonne National Laboratory, Washington, DC, October 3.

Thoms, R.L., 1996, memorandum containing opinions on cavern stability from Thoms, AGM, Inc., College Station, TX, to J. Veil, Argonne National Laboratory, Washington, DC, and H.W. Diamond, Solution Mining Research Institute, Deerfield, IL, May 21.

Thoms, R.L. and R.M. Gehle, 1990, "Hydrofrac Gradient in Gulf Coast Salt Domes -Phase 2," Research Project Report for the Solution Mining Research Institute, October 31.

Thoms, R.L., and R.M. Gehle, 1994, "Analysis of a Solidified-Wastes Disposal Cavern in a Gulf Coast Salt Dome," presented at the Solution Mining Research Institute's Fall Meeting, Hannover, Germany, September 25-October 1.

Tinucci, J.P., S.-J. Chern, W.C. Yeung, and B. Dial, 1988, "A Study of Hazardous Waste Disposal in Salt," presented at the Solution Mining Research Institute's Spring Meeting, Mobile, AL, April 25.

TNRCC, 1995, Texas Natural Resource Conservation Commission, T.A.C., Title 30, Chapter 331, Subchapter J, Standards for Class I Salt Cavern Solid Waste Disposal Rules, §331.164.

Tomasko, D., 1985, "A Numerical Model for Predicting the Thermal Behavior of Caverns in the Strategic Petroleum Reserve", dissertation submitted in partial fulfillment of the requirements of the degree of Doctor of Philosophy in Civil Engineering, the University of New Mexico, Albuquerque, New Mexico.

Wallner, M., and A. van Vliet, 1993, "Assessment of Surface Subsidence above a Cavity Field Resulting from Cavity Diameter Enlargement, presented at the Seventh Symposium on Salt, Vol. I, pp. 489-496, Elsevier Science Publishers B.V., Amsterdam, Netherlands.

Wassman, T.H., 1983, "Cavity Utilization in the Netherlands," presented at the Sixth International Symposium on Salt, Vol. II, pp.191-201, Toronto, Canada, May.

Wassmann, T.H., 1993, "Mining Subsidence above Cavities Created by Solution Mining of Rocksalt," presented at the Seventh Symposium on Salt, Vol. I, pp. 425-431, Elsevier Science Publishers B.V., Amsterdam, Netherlands.

Table 1 - State Activities Regarding Disposal of Oil Field Waste into Salt Caverns
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State	Contact	Are salt caverns being used in your state for disposal of oil industry waste?	Has this practice ever been considered?	Are there any state regulations specifically addressing disposal of oil field waste into salt caverns?	Comments
тх	Richard Ginn Y Texas Railroad Comm. Austin, TX 78711-2967 Texas has fo 512/463-6796 caverns that or Jeb Boyt 512/463-7562		N/A	Proposed regulations have been drafted.	The first facility was established four years ago. The wastes that are being disposed of in these caverns have a high solids content (suspended solids), which make them less suitable for typical Class II injection. The salt brine that is displaced from the cavern to make space for the O&G waste in disposed of in Class II wells.
LA	James Welsh LA Department of Natural Resources P.O. Box 94275 Baton Rouge, LA 70804 504/342-5515	No	Yes	No	No hazardous waste can be disposed of via injection wells in Louisiana. He indicated that injection of production waste streams with a high solids content (cuttings, drilling fluids, etc.) are not much of an issue with injection into Class II wel when the technology (ball mills or grinder is used to grind the solids into fine particle They are open to the idea.
MI	R. Thomas Segail MI Dept. of Natural Resources P.O. Box 30028 Lansing, MI 48909 517/334-6923 or Raymond Ellis 517/334-6923	No	Yes	No	Michigan is interested in knowing what th other states are considering. They current permit cavern use for liquid natural gas storage.
ОН	Dennis Crist OH DNR Fountain Square Columbus, OH 43224 614/265-6926	No	Yes	No	He thinks it is a good idea for the disposal of solid wastes (drilling fluids) not typical disposed of in Class II wells. He feels that a Federal Advisory Committ on the subject should be considered.
KS	Richard Hestermann KS Corp. Comm. Colorado Derby Bldg., Rm 200 Wichita, KS 67202 316/337-6200	No	No	No	He indicated that he was not aware of any discussions about permitting such activity in the state of Kansas. Some of the older solution mines that had been abandoned and injection wells that had gone through these salt deposits have been assumed responsible for sink holes that have occurred in Kansas. It is thought that flui traveling down hole along the casing through the salt deposit displaced the salt and created a void that eventually collapse

Table 1 - State Activities Regarding I	Disposal of Oil Field Waste into Salt Caverns
---	---

State	Contact	Are salt caverns being used in your state for disposal of oil industry waste?	Has this practice ever been considered?	Are there any state regulations specifically addressing disposal of oil field waste into salt caverns?	Comments
OK	Bruce Langhus OK Corp. Comm. Jim Thorpe Building Oklahoma City, OK 73105 405/521-2500	No	No	No	The salt deposits in Oklahoma are not thick and conducive to solution mining. There is only one solution mine in the state.
MS	Fred Hille State O&G Board 500 Greymont Ave., Suite E Jackson, MS 39202 601/354-7127 or James Crawford Dept. of Env. Quality P.O. Box 10385 Jackson, MS 39289 601/961-5354	No	Yes	He indicated that the existing state regulations do not prohibit this practice. No state regulations would need to be changed to allow this practice.	They had been thinking that the disposal of Naturally Occurring Radioactive Material (NORM) wastes from O&G production might be effectively disposed of in salt caverns. Mississippi is very interested in what other states are thinking.
ND	Charles A. Koch ND Industrial Comm. 600 E. Boulevard Ave. Bismarck, ND 58505 701/328-5357 or Wesley Norton 701/328-2969	No	Νο	Νο	North Dakota only has one solution mine. It is in an O&G production area. Several years ago the state considered using salt caverns for storage but made the decision not to. O&G drillers have experienced many casin problems through the salt section which is approximately 600 feet thick. He did not feel that North Dakota would likely utilize salt caverns for O&G waste disposal since the salt formations are very deep.
NM	David Catanach NM Oil. Conserv. Div. P.O. Box 2088 Santa Fe, NM 87504 505/827-7131	No	Yes	No	NM Oil Conservation Division has receive an application from a company interested in developing a commercial oil field waste disposal facility in NM. The NM Oil Conservation Division will be handling the application. The existing state regulations are silent on the subject.

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Table 1 - State Activities Regarding Disposal of Oil Field Waste into Salt Caverns

	State	Contact	Are salt caverns being used in your state for disposal of oil industry waste?	Has this practice ever been considered?	Are there any state regulations specifically addressing disposal of oil field waste into salt caverns?	Comments
NY	NY	John C. Harmon NY Dept. of Env. Cons. 50 Wolf Road, Rm 202 Albany, NY 12233 518/457-9633 or Bradley Field 518/457-0100	No	No	No	Several years ago, there was some consideration of permitting disposal of municipal fly ash into a large conventional salt mine. However, a roof collapsed in a portion of the mine, causing flooding of the cavern, and the permit was never granted. He stated that injection of O&G waste into salt caverns is not likely in New York. There is little need for the disposal of solid drilling waste because most of the wells are air drilled (not utilizing drilling fluids).
	РА	James Erb PA Dept. of Envir. Resources P.O. Box 2357 Harrisburg, PA 17120 717/772-2199	No	No	No (See Comments)	The Division of O&G has rules to permit the use of caverns for gas storage, but the Bureau of Labor and Industry regulates caverns. There are several storage caverns permitted.

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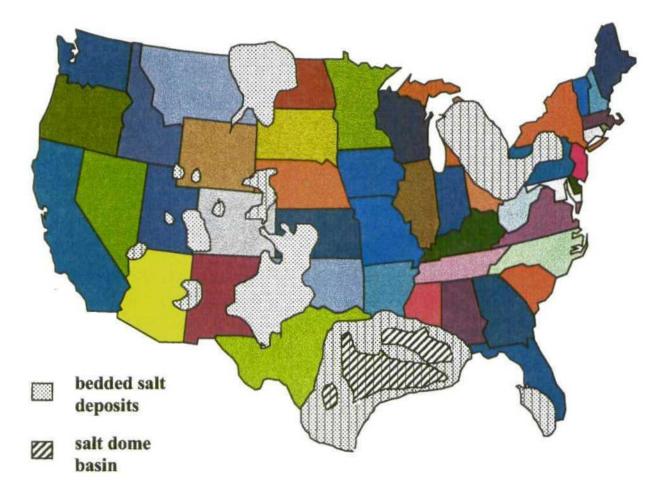
Table 2 - Oil and Gas Wastes Exempted fromRCRA Hazardous Waste Requirements (53 FR 25446, July 6, 1988)

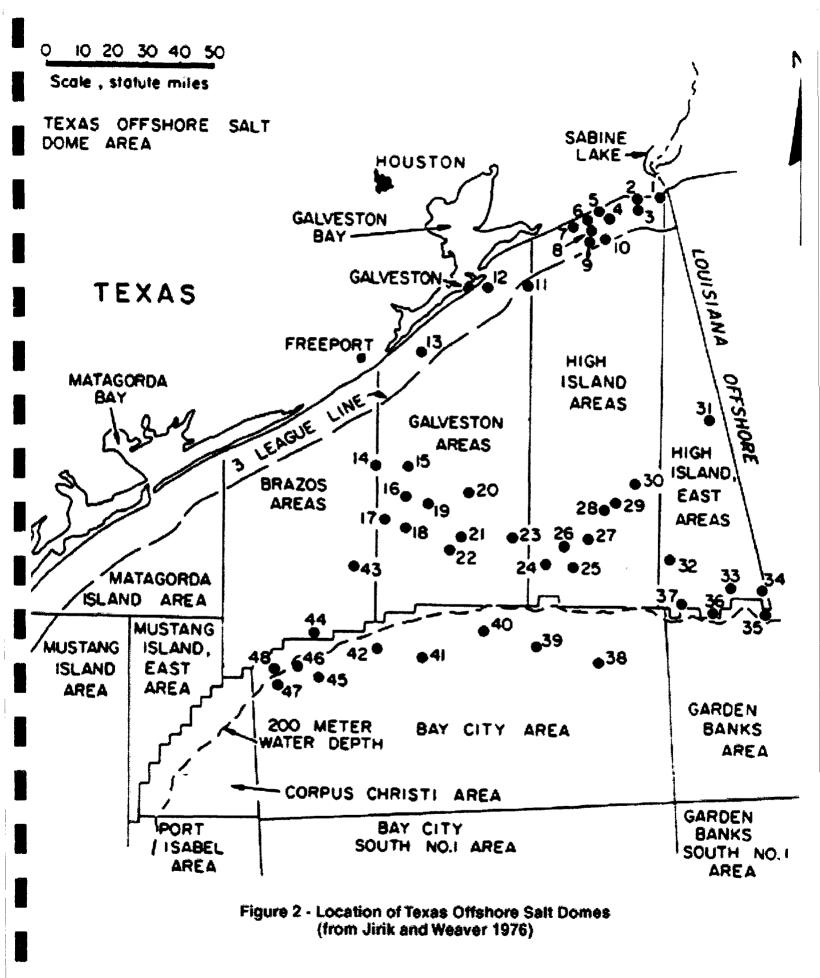
- Produced water;
- Drilling fluids;
- Drill cuttings;
- Rigwash;
- Drilling fluids and cuttings from offshore operations disposed of onshore;
- Well completion, treatment, and stimulation fluids;
- Basic sediment and water and other tank bottoms from storage facilities that hold product and exempt waste;
- Accumulated materials, such as hydrocarbons, solids, sand, and emulsion from production separators, fluid treating vessels, and production impoundments;
- Pit sludges and contaminated bottoms from storage or disposal of exempt wastes;
- Workover wastes;
- Gas plant dehydration wastes, including glycol-based compounds, glycol filters, filter media, backwash, and molecular sieves;
- Gas plant sweetening wastes for sulfur removal, including amines, amine filters, amine filter media, backwash, precipitated amine sludge, iron sponge, and hydrogen sulfide scrubber liquid and sludge;
- Cooling tower blowdown;
- Spent filters, filter media, and backwash (assuming the filter itself is not hazardous and the residue in it is from an exempt waste stream;
- Packing fluids;
- Produced sand;

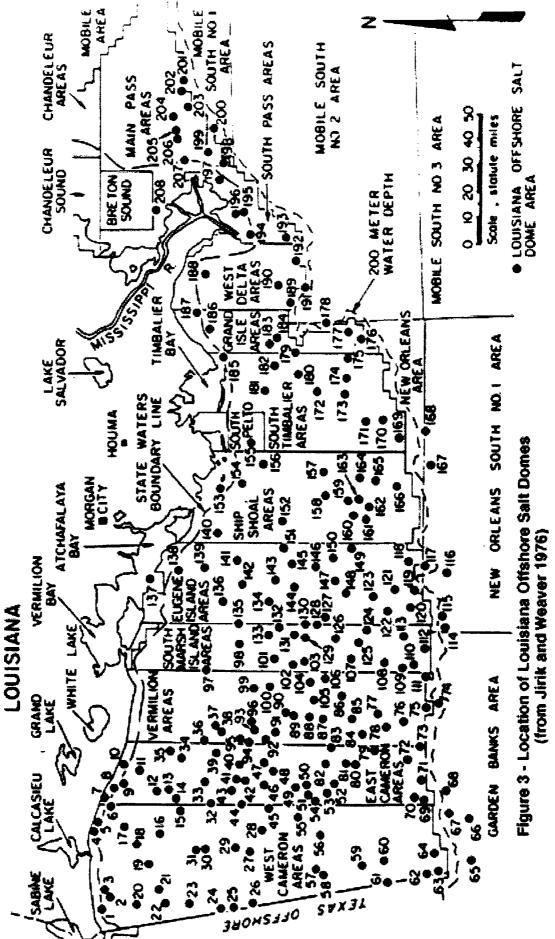
- Pipe scale, hydrocarbon solids, hydrates, and other deposits removed from piping and equipment prior to transportation;
- Hydrocarbon-bearing soil;
- Pigging wastes from gathering lines;
- Wastes from subsurface gas storage and retrieval;
- Constituents removed from produced water before it is injected or otherwise disposed of;
- Liquid hydrocarbons removed from the production stream but not from oil refining;
- Gases from the production stream, such as hydrogen sulfide and carbon dioxide, and volatilized hydrocarbons;
- Materials ejected from a producing well during the process known as blowdown;
- Waste crude oil from primary field operations and production; and
- Light organics volatilized from exempt wastes in reserve pits or impoundments or production equipment.

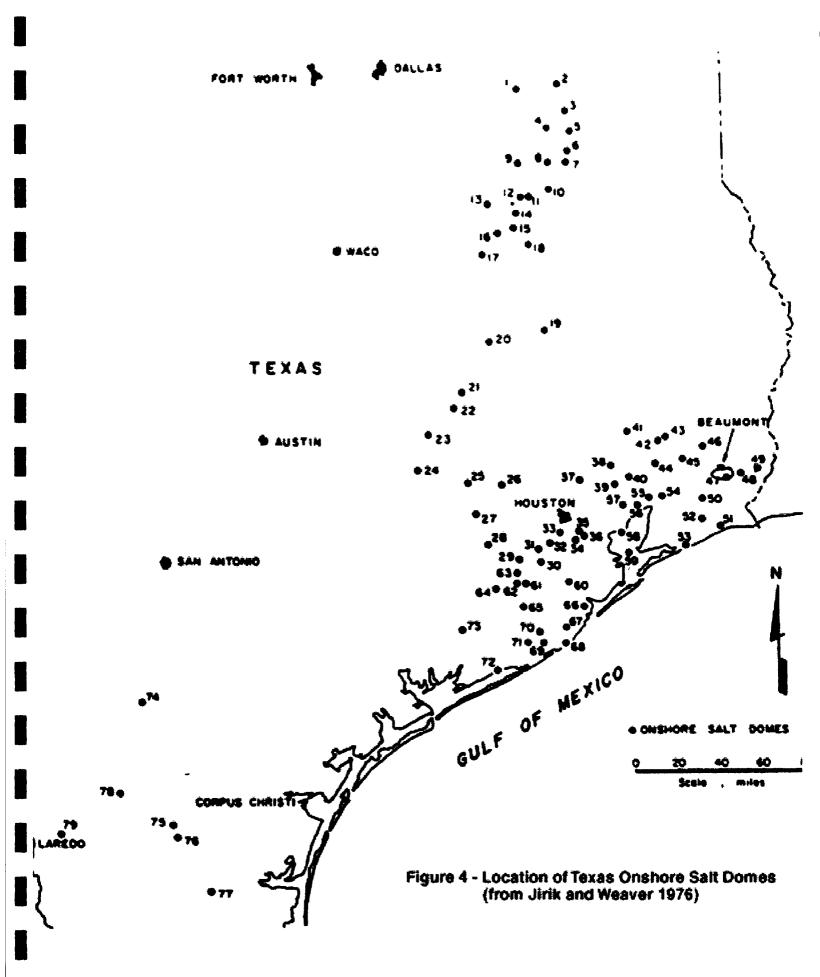
FIGURE 1 Major U.S. Subsurface Salt Deposits (redrawn from Johnson and Gonzales 1978)

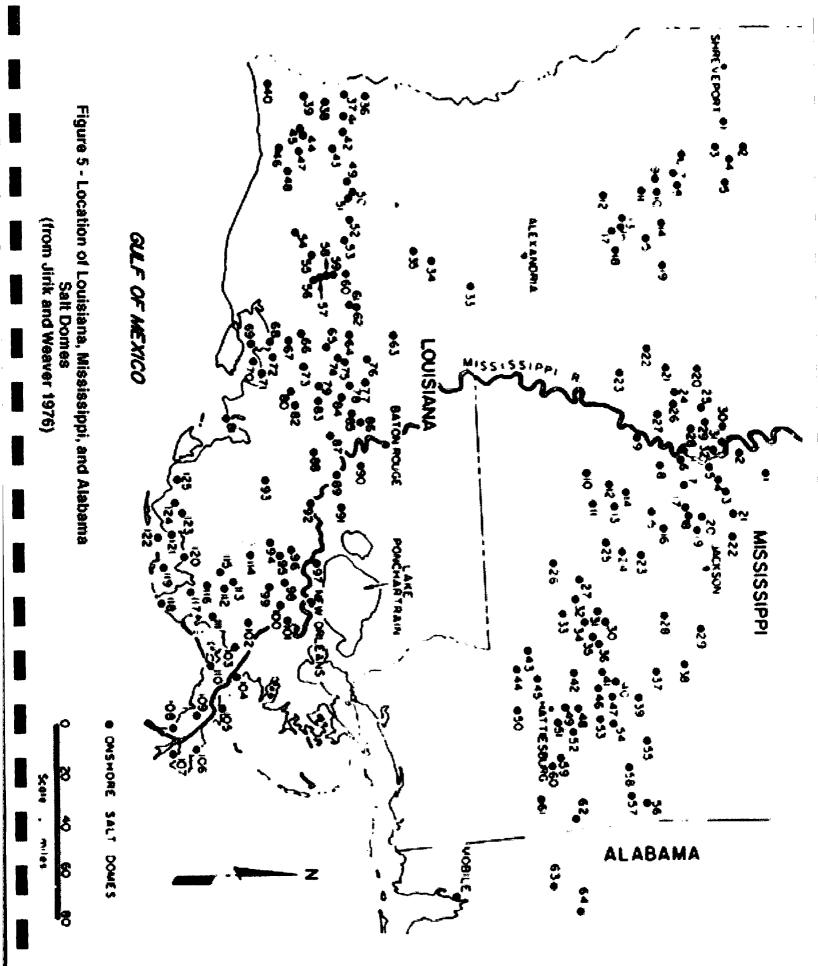
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FIGURE 6 Idealized Cavern in a Salt Dome Formation

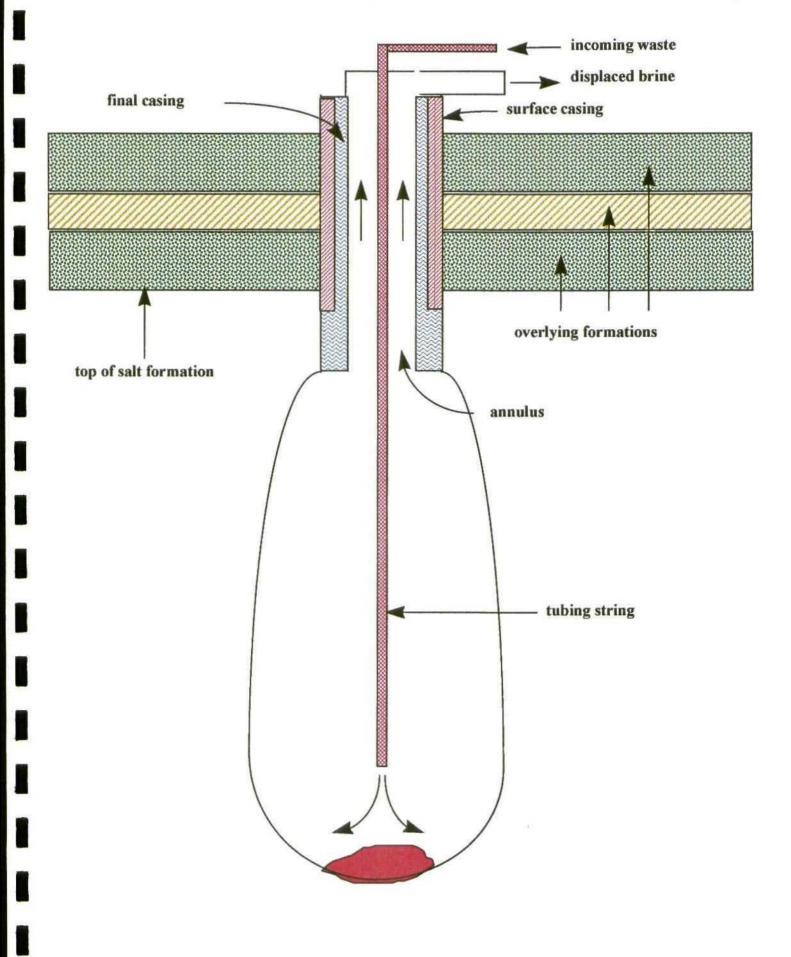
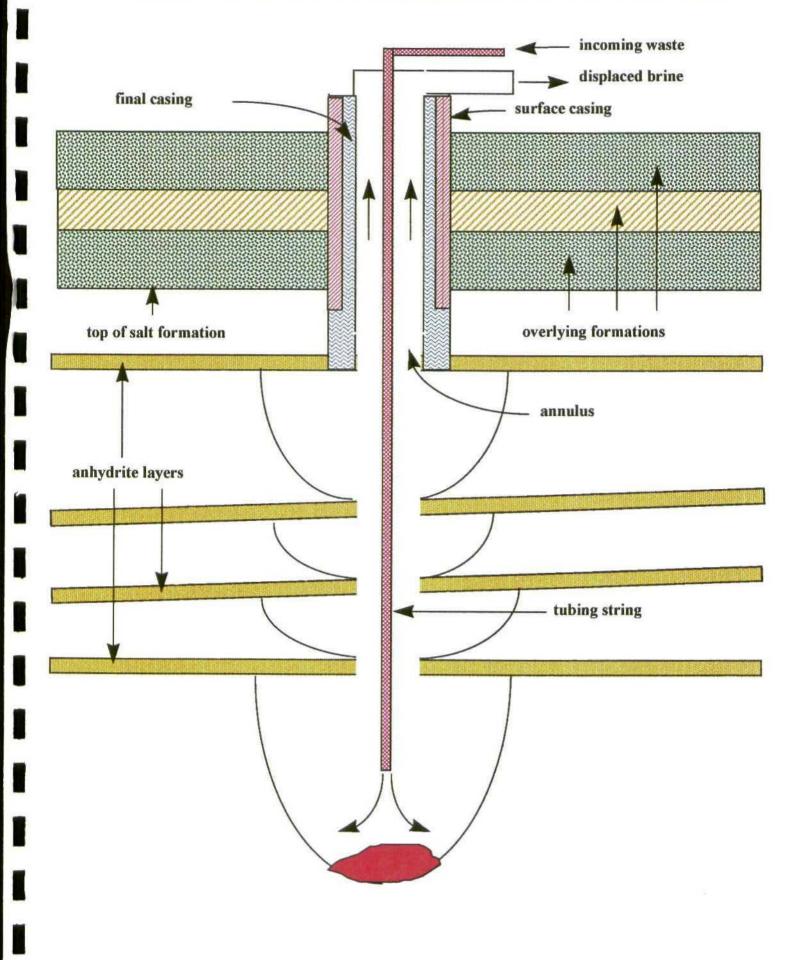


FIGURE 7 Idealized Cavern in a Bedded Salt Formation



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Permian Brine Sales, Inc.

6067 West 10 th Street Odessa, Texas 79763 (915) 381-0531 Fax: (915) 381-9316

FAX TRANSMISSION COVER SHEET

Date: August 6, 1996

To: Mr. Mark Ashley

Fax: 505-827-8177

Re: Rule 9

Sender: A.L. Hickerson

YOU SHOULD RECEIVE 10 PAGE(S), INCLUDING THIS COVER SHEET. IF YOU DO NOT RECEIVE ALL THE PAGES, PLEASE CALL (915) 381-0531.

TEXAS MID-CONTINENT OIL & GAS ASSOCIATION

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June 4, 1996

Mr. Jeb Boyt, Staff Attorney Environmental Section Office of General Counsel Railroad Commission of Texas P. O. Box 12967 Austin, Texas 78711-2967

Re: Draft Proposed Amendments to Rule 9, Disposal Wells

Dear Mr. Boyt:

Texas Mid-Continent Oil & Gas Association (TMOGA) appreciates your giving us this opportunity to comment on the Railroad Commission's proposed draft amendments to Statewide Rules 9 and 81 pertaining to disposal of oil and gas wastes in solution-mined salt caverns and brine mining injection wells, respectively.

The changes which have been made to the draft amendments since the September 13, 1995, conference are very positive. The commission has focused more on defining the expectations as opposed to setting prescriptive requirements. This approach will allow the specific conditions at each cavern disposal well to be considered and will require the operator to prepare a properly engineered design, operating plan and closure plan.

We do recommend that the revisions set out in this draft proposal be written into a new rule rather than as amendments to existing Statewide Rule 9. We feel that cavern disposal wells and the application of cavern disposal are so rare compared to regular disposal wells that Rule 9 ought to be left alone. However, to distinguish Rule 9 from Rule 46 and Rule "New" it would be appropriate to revise the title of Rule 9 to something like, "Disposal Wells in Non-Productive Reservoirs" We also recommend that existing approved permits for cavern disposal be administratively converted to the new rule.

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Proposed Amendments to Rule 9 June 4, 1996 Page two

Our membership strongly believes that acceptance of existing and newly created solution-mined salt caverns for disposal of exempt oil and gas wastes is a positive step. In recognizing this as a viable, environmentally safe method of disposal and providing for its proper permitting, the Commission can give industry another efficiency tool with which to reduce operating costs, thus extending the lives of producible hydrocarbon reserves while maintaining or even lowering the risk to precious underground sources of drinking water. Simultaneously, you are creating a valuable "new lease on life" for many existing solutionmined caverns formerly used for hydrocarbon product storage.

There is a long history of safe, contained storage in underground salt caverns which we feel is the ultimate performance-driven data needed to prove the viability of salt caverns as a sealed, safe container into which to place oil and gas waste.

Our specific comments are detailed in the attached table showing your proposed amended language on the left and our recommendations on the right. The italicized annotations provide some thoughts on why we made certain specific recommendations. These comments have been prepared in the context of the proposed Rule 9 structure. If a new rule is written as we suggest, it would be necessary to adjust the rule structure and adapt into the new rule from Rule 9 subsections (a)(4), Notice and opportunity for hearing, (a)(5), Subsequent Commission action, (a)(7), Casing, (a)(9) - (10), Well record and Monitoring and reporting, and (a)(13), Penalties.

We appreciate the opportunity to comment on this draft and would be pleased to discuss our comments with you in more detail. If you would like to discuss our comments, please contact Jim Collier with Amoco at (713) 366-3371 or Gene Montgomery with Shell at (713) 544-3426.

Sincerely

RL:ad Attachment

Preliminary Technical and Legal Evaluation of Disposing of Nonhazardous Oil Field Waste into Salt Caverns

Prepared for:

U.S. Department of Energy Office of Fossil Energy under Contract W-31-109-ENG-38

Prepared by:

Argonne National Laboratory Washington, DC

John Veil Deborah Elcock Mary Raivel Dan Caudle Robert C. Ayers, Jr. Ben Grunewald



June 1996

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Figure 7 - Idealized Cavern in a Bedded Salt Formation

Disposal of Oil Field Wastes into Salt Caverns

Acknowledgements

The authors wish to express their appreciation for the many persons who provided copies of ports and papers, spoke with us about various salt cavern issues, and provided comments on the two drafts of the report. We particularly extend thanks to Richard Ginn of the Railroad Commission of Texas, R.D. Hickerson of Permian Brine Sales, Inc., and H.W. Diamond of the Solution Mining Research Institute. Mr. Diamond coordinated an extensive review of the second draft report. The review panel consisted of the following persons:

William Barlow	Texas Brine
Charles Chabannes	Sofregaz US Inc.
Dennis Crist	Ohio Department of Natural Resources
Fritz Crotogino	Kavernen Bau- und Betriebs GmbH
Ken E. Davis	Envirocorp Services & Technology, Inc.
H.W. Diamond	Solution Mining Research Institute
Norbert Heitmann	PB-KBB, Inc.
James Linn	Sandia National Laboratories
Joe L. Ratigan	RE/SPEC, Inc.
Robert Thoms	AGM, Inc.
Frank Whelpy	Sonar and Well Testing Service
Scott Whitelaw	Texas Brine

The final report reflects the contributions of each of these persons.

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Preliminary Technical and Legal Evaluation of Disposing of

Nonhazardous Oil Field Waste into Salt Caverns

J. Veil, D.Elcock, M. Raivel, D. Caudle, R.C. Ayers, Jr., and B. Grunewald

Executive Summary

Bedded and domal salt deposits occur in many states. If salt deposits are thick enough, salt caverns can be formed through solution mining. These caverns are either created incidentally as a result of salt recovery or intentionally to create an underground chamber that can be used for storing hydrocarbon products or compressed air or for disposing of wastes. This report evaluates the suitability, feasibility, and legality of disposing of nonhazardous oil and gas exploration, development, and production wastes (hereafter referred to as oil field wastes, unless otherwise noted) in salt caverns.

In 1988, the U.S. Environmental Protection Agency (EPA) published a list of those oil field wastes that were exempt from regulation as hazardous wastes under Subtitle C of the Resource Conservation and Recovery Act (RCRA). EPA's Underground Injection Control (UIC) regulations allow most of those oil field wastes to be injected into Class II UIC wells. Efforts are currently under way to obtain clarification from EPA whether all exempted oil field wastes can be injected into Class II wells. At the state level, only the Railroad Commission of Texas (TRC) has formally authorized disposal of oil field wastes into salt caverns. The TRC has issued permits for six facilities, but as of May 1996, only four of these were active. In April 1996, the TRC released draft proposed amendments to TRC Rule 9, the regulation that governs injection into a formation not productive of oil, gas, or geothermal resources. Ten other states were contacted about their interest in disposing of oil field waste into salt caverns. Many of these states were interested in following the TRC program to see how it worked, but at this time, only New Mexico has received an application for disposal of oil field wastes into salt caverns. There are no apparent regulatory barriers to the use of salt caverns for disposal of most types of oil field wastes at either the federal level or in the eleven states discussed in this analysis.

The types of oil field waste that are planned for disposal in salt caverns are those that are most troublesome to dispose of through regular Class II injection wells, because they contain excessive levels of solids. The solids-containing oil field wastes most likely to be disposed of in salt caverns include used drilling fluids, drill cuttings, completion and stimulation waste, produced sand, tank bottoms, and soil contaminated by crude oil or produced water.

The location and design of waste disposal caverns play an important role in ensuring long-term waste isolation from the surface water or groundwater resources. Hundreds of caverns have been used safely for storing hydrocarbons. The hydrocarbon storage industry has developed useful, detailed standards and guidance for designing and constructing storage caverns

Disposal of Oil Field Wastes into Salt Caverns

FROM PERMIAN BRINE SALES 915 381 9316

that are also appropriate for creating solution-mined caverns for other uses. Several factors should be considered in selecting sites for disposal of oil field wastes in caverns, including distance to populated areas; proximity to other industrial facilities; current and future use of adjacent properties; handling of brine or other displaced fluid; proximity to environmentally sensitive wetlands, waters, and fresh water aquifers; proximity to the salt boundary; and proximity to other existing and abandoned subsurface activities, such as neighboring caverns for brine or hydrocarbon storage. Detailed knowledge of the geology should be supported by adequate documentation. Operators should be able to demonstrate that the caverns they plan to use — either new caverns developed specifically for oil field waste disposal, or existing caverns that are being converted — will remain stable in the future.

Disposal caverns act like large oil/water/solids separators. The solids in the incoming waste settle to the bottom of the cavern while the lighter oils and hydrocarbons rise to the top of the cavern, where they can be removed. When placing waste in a cavern, the cavern space is best utilized by filling evenly and uniformly, with no large voids. One method for emplacing the waste in the cavern is to inject it through the tubing to the bottom of the cavern. Under this scenario, an operator of an oil field waste disposal cavern would inject waste until the end of the tubing is covered or the back pressure from the accumulated waste precludes further injection. At this point, the operator would use a small controlled explosive charge to cut off the end of the tubing/casing annulus into the top of the cavern and allow the waste to settle to the bottom. A third Texas operator has installed two wells in the cavern, one for injection and the other for brine withdrawal. Under any of these waste emplacement scenarios, cavern pressure should be monitored and controlled before the cavern is filled with oil field waste, throughout the waste emplacement cycle, and optimally, for some period of time after waste emplacement has ended.

There is no actual field experience on the long-term impacts that might arise from salt cavern disposal of oil field wastes. The literature contains many theoretical studies that speculate what might happen following closure of a cavern. Although different authors agree that pressures will build in a closed brine-filled cavern due to salt creep (domal salt only) and geothermal heating, they do not specifically address caverns filled with oil field wastes. Caverns filled with oil field wastes having specific gravities greater than that of brine will have a lower likelihood of failure than caverns filled with brine. More field research on pressure buildup in closed caverns is desirable.

Based on this preliminary research, we believe that disposal of oil field wastes into salt caverns is feasible and legal. If caverns are sited and designed well, operated carefully, closed properly, and monitored routinely, they represent a suitable means of disposing of oil field wastes. Page 2

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VI CONSER,

April 19, 1996

MR. WILLIAM J. LEMAY State of New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division 2040 South Pacheco Santa Fe, New Mexico 87505

Card Free H

APR 2 2 1996

Environmental Euradu Oil Conservation Division

Re: (GW-226) Permian Brine Sales (UIC-CL1-006) P & S Brine Sales

Dear Mr. LeMay:

I am enclosing additional information regarding referenced permit applications. Hopefully, this documentation will encourage denial of referenced.

Thank you.

Sincerely, Gail Power

GP/jh

- Enclosures: 1. RRC of Texas Proposed Amendments April 4, 1996
 - 2. Exxon Newsletter April 8, 1996
 - 3. Midland Reporter-Telegram Article August 23, 1995
 - 4. CRI Letter Dated March 15, 1996

('AROLE KEFTON RVLANDER, CLARAM BARRY WILLIAMVIN, CLAMMESTMER CLARLES R. ΜΑΓΤΗΕΨS, CLAMMESTMER



LINDIL C. ΡΟΨΙΣΑ, JA., GIMERAI CLYNGEL ΤΕΧΑΙ ΕΛΤΟΝ, AST, DURTCH M ΕΝΥΤΟΝΙΩΣΤΑΙ, SECTRYN

RAILROAD COMMISSION OF TEXAS OFFICE OF GENERAL COUNSEL

April 4, 1996

Notice of Draft Proposed Amendments to Rule 9, Disposal Wells, and a Conforming Amendment to Rule 81, Brine Mining Injection Wells

890 5

APR 2 2 1996

Environmental Buleau Oil Conservation Division

Attached for review and comment is a draft of proposed amendments to Rule 9, Disposal Wells, and a conforming amendment to Rule 81, Brine Mining Injection Wells. The draft amendments specify requirements for the disposal of oil and gas waste in solution-mined salt caverns.

Please submit your written comments on the draft of proposed amendments to Rule 9 and the conforming amendment to Rule 81 by 5:00 p.m. on June 4, 1996. Comments should be addressed to Jeb Boyt, Staff Attorney, Environmental Section, Office of General Counsel, Railroad Commission of Texas, P.O. Box 12967, Austin, Texas 78711-2967.

If you have any questions regarding the draft amendments, please contact Jeb Boyt at 512/463-7562 or Richard Ginn, Deputy Assistant Director for Underground Injection Control, at 512/463-6796.

Jeb Boy Environmental Section Staff Attorney

1701 NORTH CONGRESS AVENUE # POST OFFICE BOX 12967 # AUSTIN, TEXAS 28711-2967 # PHONE: S12/4634294 FAX: S12/4634989 1701/ 100235/3919 OR TUY S124417284 - An FONAL OPPOLEMENTE EMPLOYER

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located or	26	waste, as that term is defined in Chapter 27 of the Texas Water	26
leaseholde	25	"cavern disposal well" as a well used to dispose of oil and gas	25
well permi	24	oil and gas waste in salt caverns. Subsection (b) defines a	24
under subs	23	Proposed §3.9(b) addresses issues specific to the disposal of	23
cavern dis	22	property.	22
Propo	21	well permit if operation of the well is dangerous to life or	21
to cavern o	20	that the commission may modify, suspend, or terminate a disposal	20
penalties.	19	"General requirements" and by amending paragraph (5)(A) to clarify	61
monitoring	18	The commission proposes to amend §3.9(a) by adding the title	1 A
paragraph	17	requirements of §3.9(a) are met.	ر. ا
subsequent	16	requirements of these proposed rules and the applicable	۲ ا
notice and	15	cavern may be converted for use as a cavern disposal well if the	1 5
the provis	14	formations. Under the proposed rule amendments, an existing salt	
subsection	13	caverns may be located in either salt domes or bedded salt	
Propos	12	of oil and gas wastes in solution-mined salt caverns. Such salt	12
material."	11	The proposed amendments would apply to wells used to dispose	11
sludge, dr	10	during active solution-mining operations.	10
plants. Th	9	waste is subject to regulation as a brine mining injection well	¢
processing	8	used to solution-mine a cavern for the disposal of oil and gas	æ
incidental	r	concerning brine mining injection wells, to clarify that a well	7
artificial	6	commission also proposes a conforming amendment to §3.77,	£
underground	רט	to modification, suspension, or termination of permits. The	تر
or geotherm	4	solution-mined salt caverns and modify provisions of §3.9 relating	د
arising out	نی	\$3.9 specify requirements for the disposal of oil and gas wastes in	
defined une	2	amend §3.9, concerning disposal wells. The proposed amendments to	• :
Code, in a	1	The Railroad Commission of Texas (commission) proposes to	
Railroad Comm Oil and Gas D		Railinad Commission of Texas Oil and Gas Division Page 1 of 32	

Railroad Commission of Texas Cavern Disposal Amendments to Pule 9 page 2 of 32 Code, in a solution-mined salt cavern. "Oil and gas waste" as defined under §27.002(6) of the Texas Water Code means "waste arising out of or incidental to drilling for or producing oil, gas, or geothermal resources, waste arising out of or incidental to the underground storage of hydrocárbons other than storage in artificial tanks or containers, or waste arising out of or incidental to the operation of gasoline plants, natural gas processing plants, or pressure maintenance or repressurizing plants. The term includes but is not limited to salt water, brine, sludge, drilling mud, and other liquid or semi-liquid waste material."

Proposed S3.9(b)(1)(A) specifies the following requirements of subsection (a) that apply to cavern disposal wells in addition to the provisions of subsection (b): paragraph (4), relating to notice and opportunity for heating; paragraph (5), relating to subsequent commission action, paragraph (7), relating to casing; paragraph (9), relating to whit record; paragraph (10), relating to monitoring and reporting; and paragraph (13), relating to penalties. The remaining provisions of subsection (a) do not apply to cavern disposal wells.

proposed §1.9(b)(1)(B) describes notice requirements for cavern disposal wells that supplement the requirements described under subsection (a)(4)(A). An applicant for a cavern disposal well permit must give notice of the application to each salt leaseholder of the tract on which the cavern disposal well will be located or of any tract adjoining the tract on which the cavern

21 2.4 3 22 20 12 25 19 18 1.1 Ē 7 3 2 5 ٩ œ the not b disposal well will be used to dispose of oil and gas waste in §3.9(b)(3)(A) included in a Water disposal is freshwater strata waste disposal of stating property. unless revoked, modified, existing permits dispose underground salt cavern application, the notice must indicate that the proposed disposal well will be located. Railroad Commission of Texas Oil and Gas Division types letter permit from the commission. maximum pollute Proposed Proposed Proposed 0f Code, into from of oil and gas waste in a cavern disposal well must obtain that 011 Paragraph not freshwater sand. \$27.033 oil volume the the and surface the §3.9(b)(2) §3.9(b)(1)(C) provides that persons who requires cavern §3.9(b)(3) and gaø for Texas cavern creation in that 0f wastes gas (2) cavern disposal wells will remain in disposal well permit оr oil and that an Natural also requires that an applicant submit a provides that a cavern disposal well waste disposal well subsurface or suspended by the commission identifies area ő or Proposed §3.9 (b) (1) (D) provides that gas be and use application Also, when publishing a notice of and that Resource This letter is disposed waste Cavern Disposal Amendments to Rule 9 Page 3 of 32 the of the water information injection of ď will Conservation the application. 0f be include a list 0r salt cavern 'n formation disposed not endanger required the that endanger oilsalt cavern; Commission propose of used by life Proposed and must for in 0f effect cavern Texas the may gas the the for the be 0r ď an H 21 20 19 18 17 16 15 14 ы ы 12 10 23 22 25 24

salt cavern; waste to facilitate disposal; the substances that will be the size and shape of the cavern mixed with the oil and gaø ag 26

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determined by a recent sonar survey or an estimate of the size and to prepare the estimate; and an estimate of the cavern's size after been completed, shape method used to disposal of the operations cease, including a description of the model or cavern upon completion, if solution-mining has not prepare the estimate. including a description of the model or method used

specific caverns disposal proposed cavern disposal well. specific bedded salt formation, anhydrite layers, and the must formations. information caverns Proposed submit in salt well. evaluation in geologic formation. regarding the salt For specified §3.9(b)(3)(B) domes and those in There are separate information requirements caverns information relating domes, of the This information in bedded salt formations, salt an requires that an application include suitability information will be applicant stock, formations above and below the bedded salt regarding caprock, of the location ő must the the formations. submit and proposed used in a an bedded surrounding applicant specific for cavern site salt the for For

g subsidence wells, caverns, This information surface cavern integrity list of all wells within a 1/4 mile radius of the proposed cavern Proposed disposal features of 0r the solution-mined §3.9(b)(3)(C) requires other ğ well is required į'n other the area of dissolution permit excavations of to determine if include the proposed cavern cavern. features that that information the An applicant must an galt there тау application formation are disposal compromise g any wells provide ñ nearby for well. any and the ച

inc	25	for the closure of the proposed cavern disposal well. The closure	25
del	24	Proposed §3.9(b)(3)(B) requires an applicant to provide a plan	24
	23	models that will be used for monitoring such affect.	23
inf	22	dissolution of the cavern, and a description of the methods or	22
cav	21	operations may have on the size of the cavern, due to incidental	21
	20	also include a plan for monitoring any affect that disposal	20
ac	19	the chemical constituents in the brine. The operating plan must	19
the	19	oilfield use, the operating plan must include a plan for monitoring	18
in)	17	displaced brine. If the displaced brine is to be sold for non-	7.1
not	16	injection methods, and plans for the disposal, use, or sale of the	16
top	15	whether an oil pad will be used in the cavern, the proposed	1 %
is t	14	plan must describe the surface facilities, downhole equipment,	14
pres	13	operating plan for a proposed cavern disposal well. The operating	ډ ۱
betw	12	Proposed §3.9(b)(3)(D) requires that an applicant submit an	12
(A	11	facility.	
Thie	10	mile of the property boundaries of the proposed cavern disposal	10
and	ę	showing surface water bodies and subsidence features within one	ئ
is į	8	application must also include a topographic map or other map	x
to o	7	quarter of a mile of the proposed cavern disposal well. An	<i>t.</i>
wel]	6	the location and depth of any sulphur mining wells within one-	r
must	υ	caverns, salt mines, or other excavations of the salt formation and	ŗ
	4	of any hydrocarbon storage caverns, disposal caverns, brine mining	د
plug	ω	the depth, diameter, and volume, and a map indicating the location	~
duri	2	improperly plugged. The application must include information on	۰.
any	1	disposal well and identify any wells that are unplugged or	-
Rail) Oíl a		Paulroad Commission of Texas Cavein Disposal Amendments to Rule 9 Oil and Gas Division Page 5 of 32	,

plan must provide for monitoring the shut-in pressure and releasing for the closure of the proposed cavern disposal well. The closure

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igging. ing the time between cessation of disposal operations and pressure that may accumulate in a shut in cavern disposal well

p of the cavern. A post-closure pressure increase calculation is 1 hydrostatic pressure gradients by the height of the cavern. essure gradient between the top and the bottom of the cavern, C 6 predicted by multiplying the difference between the lithostatic confine the injected fluids. The post-closure pressure increase cavern) is much less for bedded salt than for domal salt. the depth to the bottom of the cavern, and D is the depth to the it demonstrate that any pressure increase in the cavern after the bedded salt are not as tall as caverns in domal salt and because ween the top and bottom of the cavern, B is the hydrostatic required for caverns in bedded salt formations because caverns rate of salt creep (the rate at which the salt moves to close is plugged will not affect the ability of the well or cavern is expressed as a formula where the pressure increase equals For a cavern disposal well in a salt dome, the closure B) (C - D), where A is the lithostatic pressure gradient plan

vern disposal well permit must include the financial security formation required under proposed §3.9(c)(1). Proposed §3.9(b)(3)(F) provides that an application for a

requirements of the proposed operating plan, as required under including conditions to provide legate may establish, on a case-by-case basis, permit conditions Proposed §3.9(b)(3)(G) provides that the for compliance with any commission or ite

23 24 2.2 21 20 9 **1**8 1.1 --5 <u>ہ</u> <u>بر</u> 2 Ξ 5 10 æ property. record of the volume of any substance, including fresh water, that on Suhparagraph (B) storage must request cancellation of any brine active solution mining of the cavern must cease and the operator of this cavern disposal well permits must also comply with the requirements operation pollution or maintenance of the information necessary to demonstrate that the creation, delegate may paragraph (3)(E) paragraph Railroad Commission of Texas Oil and Gas Division record purpose cavern disposal well be equipped with a pressure observation valve is used to facilitate disposal or that is injected downhole and the the tubing and each annulus of the well. Proposed Proposed Proposed §3.9(b)(3)(H) provides that information sufficient to determine for paragraph. permit 0£ (3)(D), of surface or subsurface water or danger to which the substance is used. a cavern disposal well. §3.9(b)(4)(C) requires that the §3.9(b)(4) request of this paragraph requires that the wellhead of a prior or proposed closure Under subparagraph (A) of this paragraph, cavern disposal well will not that 5 describes standards beginning an applicant Cavern Disposal Amendments to Rule 9 Page 7 of 32 Persons holding existing plan, mining or the An operator must also disposal applicable submit as required under the salinity commission operator keep hydrocarbon operations. operation, additional regult life ő or the of its 0r in ρ 17 23 22 21 20 19 16 15 14 Ę, 12 11 10 24 18 ം 1 σ σī بر œ 4 ŵ N

undersaturated other than brine that weighs ten pounds per gallon, because if substances that are mixed with the waste to facilitate disposal, fluids are used to facilitate disposal, further 26 25

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> dissolution Railroad Commission of Texas Oil and Gas Division of the salt may occur, thereby increasing the cavern's Cavern Disposal Amendments to Rule 9 Page 8 of 32

§3.9(b)(3)(A)(v), disposed of; limit the maximum injection and shut-in pressure of a plugged, unless otherwise specified in the permit or commission other than non-hazardous oil and capacity of the cavern and a description of the methods or models that will monitoring any effect that disposal operations may have on the size permits will §3.9(b)(3)(D)(iii). Persons holding existing cavern disposal well submitted consistent of the cavern. cavern disposal well; and require that an operator monitor the size order, of the generator, type, volume, and percent solids of waste operator enforcement action against the operator disposal well permit. or its delegate may then require that the operator amend the cavern the operator must notify the commission in writing. The commission estimate of the cavern's ultimate size by twenty percent or more. cancel, or suspend the permit as described in §3.9(a)(5) be used for monitoring such effect. Proposed §3.9 (b) (4) (D) - (F) prohibit the disposal of any wastes maintain a record until the cavern disposal well with with be required to submit to the commission a plan for the the permit using the Any increase Alternatively, the commission may modify, estimate of the cavern's ultimate methods application, in gas wastes; require that the or If a cavern exceeds the cavern's size must models as required under described or take 8ize in be ig an

disposal Proposed §3.9(b)(4)(G) requires that an operator of a well maintain financial security ae required under cavern

Balliond ("emerging of Texas Cavern Disposal Amendments to Bage 9 of 13 proposed 53.9(c). 1 of Cl caver of Sposal well is plugged. 11 the operator fransfers the for cavern disposal well for another person, the original operator must maintain the waste record for the record required under 53.9(b)(4)(0) and for an another sposed 53.9(b)(4)(0) and for an another sposed 53.9(b)(4)(1) requires that any revisions or cl 11 proposed 53.9(b)(4)(1) requires that any revisions or cl 12 amendments to an operating plan must be submitted to the commission for an amended for cavern disposal well demonstrate the maximum lateral for care 11 permit if the revised operator by means of a sonar survey, three- 20 of a sither cl 11 permit de disposal cavern by means of a sonar survey, three- 20 <	disp	sal well permits must also comply with the requirements	2.6
<pre>printed ("empired Texam Cavern Disposal Amendments to puls and "isa division" Page 9 of 32 proposed \$1.9(c). Fropnsed \$1.9(c) (d) (e) requires the operator to retain any records required to be maintained by the operator under subsections (a)(9)-(10) and (b)(4)(2) and (F) of this section for at least three years after the operator must maintain the waste record required under proposed \$3.9(b)(4)(1) for three years after the cavern disposal well to another person, the original operator must maintain a copy of the record requires that any revisions or proposed \$3.9(b)(4)(1) requires that any revisions or amendments to an operating plan must be submitted to the commission at least 15 days prior to any change in operation for an amended permit if the revised operations. Proposed \$3.9(b)(4)(1) requires that the operator of an existing cavern disposal well demonstrate the maximum lateral proposed \$3.9(b)(4)(1) requires that the operator of an amendments to an operating plan deviates materially from the permit if the revised operations. Proposed \$3.9(b)(4)(1) requires that the operator of an amended permit of the disposal well demonstrate the maximum lateral extent of the disposal cavern by means of a sonar survey, three- dimensional selemic survey, use of perimeter monitoring wells, or another approved method within 180 days after the effective date of these rule amendments.</pre>	25 any hydr	cavern disposal wells. Persons holding existing	25
priproc of tream Cavern Disposal Amendments to Full proposed §3.9(r). Preposed §3.9(r) precords required to be maintained by the operator under subsections 1 (a)(9)(10) and (b)(4)(1) requires the operator under subsections 2 (a)(9)(10) and (b)(4)(2) and (F) of this section for at least 4 three years after the operator ceases to own or control the cavern 5 disposal well. The operator must maintain the waste record 5 cavern disposal well to another person, the original operator must 1 proposed §3.9(b)(4)(1) required under \$3.9(b)(4)(0) and 1 provide the original record to the new operator. 1 Proposed §3.9(b)(4)(1) requires that any revisions or 1 amendments to an operating plan must be submitted to the commission 1 at least 15 days prior to any change in operator of an amended 1 permit if the revised operating plan must be submitted to the commission 1 at least 15 days prior to any change in operator of an amended 1 permit if the revised operating plan deviates materially from the 1 permitted operating conditions. 1 1 proposed \$3.9(b)(4)(J) requires that the operator of an 1 premitted ope	24 operatio	§3.9(b)(5) establishes testing and surveying	24
printional formation of Texas Cavern Disposal Amendments to Friege of 3 proposed §3.9(c). Proposed §3.9(c) Proposed §1.9(c). Proposed §3.9(b)(4)(1) requires the operator to retain any records required to be maintained by the operator under subsections (a)(9)(10) and (b)(4)(C) and (F) of this section for at least three years after the operator ceases to own or control the cavern disposal well. The operator must maintain the waste record cavern disposal well is plugged. If the operator must maintain the vaste record severn disposal well to another person, the original operator must maintain a copy of the record required under §3.9(b)(4)(D) and provide the original record to the new operator. Proposed §3.9(b)(4)(1) requires that any revisions or amendments to an operating plan must be submitted to the commission at least 15 days prior to any change in operation for an amended permit if the revised operating plan deviates materially from the permitted operating conditions. Proposed \$3.9(b)(4)(1) requires that the operator of an existing cavern disposal well demonstrate the maximum lateral set of the disposal well demonstrate for a sonar survey, three- 20 dimensional set survey, use of perimeter monitoring wells, or 21 another approved method within 180 days after the effective date of 22	23 operator	rule amendments.	23
<pre>proposed \$3.9(b)(4)(1) requires the operator under subsections proposed \$3.9(c). 1 Proposed \$3.9(c)(4)(1) requires the operator to retain any records required to be maintained by the operator under subsections (a)(9)(10) and (b)(4)(c) and (F) of this section for at least three years after the operator ceases to own or control the cavern disposal well. The operator must maintain the waste record required under proposed \$3.9(b)(4)(D) for three years after the cavern disposal well is plugged. If the operator transfers the cavern disposal well to another person, the original operator must maintain a copy of the record required under \$3.9(b)(4)(D) and provide the original record to the new operator. Proposed \$3.9(b)(4)(1) requires that any revisions or amendments to an operating plan must be submitted to the commission at least 15 days prior to any change in operations. The commission may require that the operator file an application for an amended permit if the revised operating plan deviates materially from the permitted operating conditions. Proposed \$3.9(b)(4)(J) requires that the operator of an existing cavern disposal well demonstrate the maximum lateral if the disposal avell demonstrate the maximum lateral if an application of a sonar survey, three- 20 dimensional selemic survey, use of perimeter monitoring wells, or</pre>		approved method within 180 days after the effective date of	22
<pre>pailined ("mmission of Tween Cavern Disposal Amendments to pute 9 proposed \$3.9(c). Proposed \$3.9(b)(4)(1) requires the operator to retain any records required to be maintained by the operator under subsections (a)(9).(10) and (b)(4)(C) and (F) of this section for at least three years after the operator ceases to own or control the cavern disposal well. The operator must maintain the waste record required under proposed \$3.9(b)(4)(D) for three years after the cavern disposal well is plugged. If the operator must maintain a copy of the record required under \$3.9(b)(4)(D) and provide the original record to the new operator. Proposed \$3.9(b)(4)(I) requires that any revisions or amendments to an operating plan must be submitted to the commission may require that the operator file an application for an amended permitted operating conditions. Proposed \$3.9(b)(4)(I) requires that the operator of an extent of the revised operating plan deviates materially from the for a sore disposal well of the set the the operator of an extent of the disposal cavern by means of a sonar survey, three: 20 </pre>	21 surface	seismic survey, use of perimeter monitoring wells, or	21
<pre>proposed for the preview of the preview p</pre>	of	of the disposal cavern by means of a sonar survey, three-	20
proposed \$3.9(c). Preposed \$3.9(c). Preposed \$3.9(c). Preposed \$3.9(c). Preposed \$3.9(c). Preposed \$3.9(c). Preposed \$3.9(c). Preposed \$3.9(c). Preposed \$3.9(c). Preposed \$3.9(c). (a)(9)-(10) and (b)(4)(C) and (F) of this section for at least three years after the operator ceases to own or control the cavern disposal well. The operator ceases to own or control the cavern disposal well. The operator ceases to own or control the cavern frequired under proposed \$3.9(b)(4)(D) for three years after the cavern disposal well to another person, the original operator must maintain a copy of the record required under \$3.9(b)(4)(D) and provide the original record to the new operator. Proposed \$3.9(b)(4)(1) requires that any revisions or anendments to an operating plan must be submitted to the commission at least 15 days prior to any change in operation for an amended permit if the revised operator file an application for an amended permit if the revised operations. Proposed \$3.9(b)(4)(J) requires that the operator of an 10 11 12 13 14 15 16 17 17 17 18 19 19 19 10 10 11 11 11 12 13 14 15 15 16 16 17 17 17 18 18 19 19 10 10 10 11 11 11 12 13 14 15 15 15 15 15 16 17 17 17 18 18 19 19 10 10 11 11 11 12 13 14 15 15 16 17 17 18 18 19 19 10 10 11 11 11 11 12 13 14 15 16 17 17 18 18 19 19 10 10 10 11 11 11 12 13 14 15 15 16 17 17 17 18 18 19 19 10 10 11 11 11 11 11 12 13 14 15 16 17 17 17 18 18 19 19 19 10 10 10 11 11 11 11 11 12 13 14 15 16 17 17 18 18 19 19 19 10 10 10 11 11 11 11 11 11 11	19 Proj	cavern disposal well demonstrate the maximum lateral	61
<pre>pailtond ("mmilseion of Texas Cavern Disposal Amendments to Rule 3 proposed \$3.9(c). Proposed \$3.9(b)(4)(H) requires the operator to retain any records required to be maintained by the operator under subsections (a)(9)·(10) and (b)(4)(C) and (F) of this section for at least three years after the operator ceases to own or control the cavern disposal well. The operator must maintain the waste record required under proposed \$3.9(b)(4)(D) for three years after the cavern disposal well is plugged. If the original operator must maintain a copy of the record required under \$3.9(b)(4)(D) and provide the original record to the new operator. Proposed \$3.9(b)(4)(1) requires that any revisions or at least 15 days prior to any change in operations. The commission may require that the operator file an application for an amended permit if the revised operating plan deviates materially from the 11 12 13 14 15 15 16 17 17 17 17 17 17 17 17 17 17</pre>	18 permits	§3.9(b)(4)(J) requires that the operator of an	Яľ
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("mmission of Texam Cavern Disposal Amendments to Rule 9 As Division Page 9 of 32 (1 §3.9(c). (1) requires the operator to retain any 2 required to be maintained by the operator under subsections 3		and (b)(4)(C) and (F) of this section for at	د
of Texam Cavern Disposal Amendments to Rule 9 Page 9 of 32 1 .9(b)(4)(H) requires the operator to retain any 2		required to be maintained by the operator under	*
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of this paragraph. Operators must pressure test each well and cavern before disposal operations begin and annually thereafter. The operator must monitor the status of the salt cavern roof by running a density interface survey or alternate monitoring method approved by the commission or its delegate at least once every five years.

Proposed §3.9(b)(5)(C) and (D) incorporate the provisions of §3.9(a)(11)(D)-(E), which require the operator to notify the Histrict office at least 48 hours prior to running any test or survey and that a complete record of all tests must be filed with the district office within 30 days after the testing.

Proposed §3.9(b)(6) requires an operator to notify the district office immediately if a fluid loss or pressure decrease occurs during the operation of a cavern disposal well. The operator must then pressure test the well and cavern in accordance with proposed §3.9(b)(%) unless otherwise instructed by the district office. Persons hulding existing cavern disposal well permits must also comply with the requirements of this paragraph.

Proposed \$3.9(b)(7) requires that, upon permanent abandonment of a cavern disposal well, all oil and gas waste remaining at the surface must be disposed of, all surface equipment and facilities must be closed or removed, and the well must be plugged. An sperator must also monitor shut-in well pressures after disposal operations are completed and prior to plugging the well and remove any hydrocarbon pad from the cavern before closing a cavern disposal well. Prior to plugging a cavern disposal well, an

26 Railroad Commission	In	may be granted upon written request and for good cause shown.	26
25 writing to Jeb Boy		commission. An extension of the time for filing financial security	2.5
24 Comments on 1	with the 2	receive waste unless financial security has been filed wi	24
3 [Public Benefi	inue to 23	subsection, an existing cavern disposal well may not continue	23
22 [Fiscal Note t	of the 2	disposal well. After one year from the effective date	22
1 mining injection we	cavern 21	with the commission prior to receipt of waste at a new	21
0 Environmental Prote	e filed 20	the requirements of the subsection as to form and issuer, be filed	20
9 effective upon d	neeting 19	in an amount approved by the commission or its delegate and meeting	19
8 for the disposal of	credit, 18	Proposed §3.9(c)(3) requires that a bond or letter of c	18
7 such a well include:	17	for notice and hearing in certain situations.	1.1
6 the definition of	provide 16	review for both new and existing cavern disposal wells and provide	16
5 A conforming a	ion for 15	submission of financial security information to the commission	1 5:
4 authorized to do bu	s for 14	Proposed §3.9(c)(1) and (2) describe requirements	14
3 must be issued by	13	for any cavern disposal well.	13
2 Proposed §3.9(e filed 12	subsection (c) which would require that financial security be	12
1 equivalent to the m	ganew 11	The commission proposes to further amend §3.9 by adding	11
0 financial security	10	§3.9(b)(7).	01
9 of plugging costs,	proposed	permits must also comply with the requirements of pr	9
8 cavern disposal wel	well	closure plan. Persons holding existing cavern disposal	8
7 equal to or greater	final	revised plan or reasoned justification and approved the	٤.
6 professional engine		be plugged until the commission or its delegate has reviewed the	5
5 security be estimat		plan does not need to be revised. A cavern disposal well may not	5
4 Proposed §3.9 (closure /	closure plan or a reasoned justification stating why the c	4
3 proposed financial	revised	commission's Environmental Services section either a r	-
2 automatically extend	to the 2	that was submitted with the application and submit t	`-
1 addition, the time		operator must evaluate the need for any changes to the closure plan	_'
Railroad Commission of Oil and Gas Division	o Rule 9 11 of 32	Railroad Commission of Texas Cavein Disposal Amendments to Rule 9 Oil and Gam Division Page 11 of 32	

ad Commission of Texas Cavern Disposal Amendments to Rule 9 nd Gas Division Page 12 of 32 ion, the time period for filing financial security is

addition, the time period for filing financial security is automatically extended pending final commission action on review of proposed financial security.

Proposed §3.9(c)(4) specifies that the amount of financial security be estimated by or under supervision of a registered professional engineer. The amount of financial security must be equal to or greater than the maximum amount necessary to close the cavern disposal well at any time during the permit term, exclusive of plugging costs, but no less than \$10,000. The amount of financial security required may be reduced by \$25,000, an amount equivalent to the minimum P-5 financial assurance amount.

Proposed §3.9(c)(5) specifies that bonds and letters of credit must be issued by a corporate surety or bank, respectively, authorized to do business in the State of Texas.

A conforming amendment to §3.77 is proposed that will amend the definition of "brine mining injection well" to provide that such a well includes a well used to actively solution-mine a cavern for the disposal of oil and gas wastes. Section 3.77 will become effective upon delegation to the commission by the U.S. Environmental Protection Agency of the authority to regulate brine mining injection wells under the Federal Safe Drinking Water Act. [Fiscal Note to be provided at a later date.]

ublic Benefit/Cost Note to be provided at a later date.]

Comments on the proposed amendments may be submitted in iting to Jeb Boyt, Staff Attorney, Office of General Counsel, ilroad Commission of Texas, P.O. Box 12967, Austin, Texas 78711-

"cavern disposal well" m	26	§3.77 Texas Water Code §27.036.	26
accordance with this s	25	S27.034.	25
obtain a permit from the	24	and 91.109; Texas Water Code, §27.031 and	24
dispose of oil and gas w	23	§3.9 Texas Natural Resources Code, §§85.042(b), 91.101	23
of subsection (a) of t	22	proposal:	2.2
(b) Cavern disposa	21	The following statutes, articles, or codes are affected by the	21
(6)-(13) (No c	20	regulate brine mining.	20
<u>danger to life or proper</u>	19	for brine mining and adopt rules necessary to administer and	61
(vi) ope	18	authorizes the commission to issue permits for injection wells used	18
disposal zone <u>; or</u> [.]	17	which grants the commission jurisdiction over brine mining and	1.1
(v) injec	16	under Chapter 27 of the Water Code; and Texas Water Code, $\$27.036$,	16
facts during the permit	15	procedures reasonably required for the performance of its duties	<u>ا</u> ۲
(iv) the	14	Code, §27.034, which authorizes the commission to develop rules and	14
(i)-(iii)	13	injection wells used to dispose of oil and gas waste; Texas Water	13
if:	12	§27.031, which authorizes the commission to issue permits for	12
Commission for just cause	11	a person permitted to manage oil and gas waste; Texas Water Code,	11
disposal may be modif	10	require performance bonds or other forms of financial security from	10
A permit	9	Natural Resources Code, §91.109, which authorizes the commission to	φ
(5) Subsequent	8	and permits relating to the disposal of oil and gas wastes; Texas	8
(1)-(4) (No ch	7	prevent pollution of surface and subsurface waters, including rules	L.
chapter 27, and Title 3	6	authorizes the commission to adopt rules and issue permits to	5
be responsible for comply	თ	to life or property; Texas Natural Resource Code, §91.101, which	ر
formation not productive	4	adopt rules for the prevention of operations in the field dangerous	2
saltwater or other oil a	ω	Resources Code, §85.042(b), which authorizes the commission to	بد
(a) <u>General requir</u>	2	The commission proposes these amendments under Texas Natural	٠.,
§3.9 Disposal Wells	1	2967. Comments must be submitted by	
Railroad Commission of Texas Oil and Gas Division		Railroad Commission of Texas Cavern Disposal Amendments to Rule 9 Orl and Gas Division Page 13 of 32	,

Cavern Disposal Amendments to Rule 9 Page 14 of 32

lying with this section, Texas Water Code, and gas waste by injection into a porous of the Natural Resources Code. of oil, gas, or geothermal resources shall rements. Any person who disposes of

hange.)

t commission action.

he after notice and opportunity for hearing, fied, suspended, or terminated by the for saltwater or other oil and gas waste

) (No change.)

applicant has misrepresented any material issuance process; [or]

cted fluids are escaping from the permitted

eration of the disposal well presents a

rty. change.)

wastes in a solution-mined salt cavern must al wells. Notwithstanding the requirements means an injection well used to dispose of section. ne commission authorizing such disposal in this section, any person who proposes to For purposes of this section.

	Railtuad Comminsion of Texas Oil and Gas Division Page 15 of 32	
-	oil and gas waste, as that term is defined in chapter 27 of the	1
••	<u>lexas Water Code, in a solution mined salt cavern. The provisions </u>	N
*	of this subsection (b) apply only to cavern disposal wells.	ω
دنه	<u>(1) General.</u>	4
ىر	(A) Applicable requirements of subsection (a). The	J.
6	provisions of subsection (a)(4)-(5), (7), (9)-(10), and (13) of	6
7	this section also apply to cavern disposal wells. The remaining	7
8	provisions of subsection (a) do not apply to cavern disposal wells.	8
9	(B) Additional notice requirements. In addition to	9
0	the notice required under subsection (a) (4) (A) of this section, the	10
-	applicant shall also give notice. in the manner required under	11
2	subsection (a)(4)(B) of this section, to each salt leaseholder of	12
يما	the tract on which the cavern disposal well will be located and of	13
4	any tract adjoining the tract on which the cavern disposal well	14
5	will be located. In addition to the provisions for publication of	15
6	notice of the application under subsection (a)(4)(B) of this	16
٢.	section, the following statement shall be included in the published	17
8	nctice of application: "The proposed cavern disposal well will be	18
9	<u>used to dispose of oil and gas waste in an underground salt</u>	19
0	<u>cavern.</u> "	20
-	(C) Cavern disposal well permit. Oil and gas waste.	21
N	as that term is defined in chapter 27 of the Texas Water Code, may	22
س	be disposed of, upon application to and approval by the commission	23
4	or its delegate, by injection into a solution-mined salt cavern.	24
Ś	Every applicant who proposes to dispose of oil and gas waste into	25
6	a solution-mined salt cavern must obtain a permit from the	26

Railroad Commission of Texas Oil and Gas Division commission or its delegate authorizing the disposal in accordance Cavern Disposal Amendments to Rule 9 Page 16 of 32

with this section.

cavern disposal well permits issued before the effective date of suspended by the commission or its delegate. <u>subsection</u> shall continue in effect until revoked, modified, or (b) (4) - (7) and (c). this subsection shall comply with the provisions of subsections wells issued by the commission before the effective date of this (D) Existing permits. Permits for cavern disposal Persons holding

submit a letter from the Texas Natural Resource Conservation be created, operated, or maintained only in an impermeable salt strata in that area and that the formation used for disposal is not oil and gas waste into the cavern will not endanger the freshwater salt cavern for disposal of oil and gas waste and the injection of subsurface water or danger to life or property. The applicant must formation in a manner that will not cause pollution of surface or <u>Commission, Austin, Texas, stating that the creation or use of the</u> freshwater sand (2) Geological requirements. A cavern disposal well may

shall be filed with the appropriate district office filed with the commission in Austin. On the same date, one copy gas waste by injection into a solution-mined salt cavern shall be (3) Application. The application to dispose of oil and

well: information regarding the operation of the proposed cavern disposal A An application shall include the following

26

created, the projected depth of the top of the cavern: and	26	stratigraphy and lithology of the salt stock, caprock, and	26
<u>commission or its delegate, or, if the cavern has not yet been</u>	25	the area of the proposed cavern disposal well showing the	25
cavern based on a density log or alternative method approved by the	24	(I) a cross-section of the salt dome in	24
(II) the actual depth of the top of the	23	(i) for a cavern located in a salt dome:	23
nearby well or test hole showing the same features:	22	include the following geologic information:	22
disposal well or, if the well has not yet been drilled, a log of a	21	(B) An application for a cavern disposal well shall	21
identifying the confinement strata using a log of the cavern	20	used in preparing this estimate.	20
layers, and formations above the bedded salt and, in particular.	19	disposal operations cease and a description of the model or method	19
to the underlying formations showing the bedded salt. anhydrite	18	(v) an estimate of the cavern's size after	18
stratigraphy and lithology of the formations from the land surface	17	and	1.1
(1) geologic information on the	16	description of the model or method used in preparing this estimate:	16
formation:	15	cavern upon completion of solution-mining operations and a	51
(ii) for a cavern located in a bedded salt	14	has not been completed, an estimate of the size and shape of the	14
hole showing the same features: or	13	(II) if solution-mining of the salt cavern	1 1
the well has not yet been drilled, a log of a nearby well or test	12	<u>or</u>	12
showing the salt stock, caprock, and overlying formations, or, if	11	cavern, if solution-mining of the salt cavern has been completed;	11
(V) a log of the cavern disposal well	10	(I) the most recent sonar survey of the	10
and	9	determined_by:	÷
of the cavern and the thickness of the salt roof above the cavern:	හ	(iv) the size and shape of the salt cavern as	æ
(IV) information on the depth of the top	7	mixed with the oil and gas waste to facilitate disposal:	۲.
other geophysical information characterizing the salt dome:	6	(iii) a list of the substances that will be	5
(III) any available seismic surveys or	л	disposal:	ŗ
<u>overhangs:</u>	4	be disposed of in the salt cavern prior to any mixing to facilitate	د
<u>galt stock showing its boundaries and any salt and caprock</u>	ω	(ii) the maximum volume of oil and gas waste to	
(II) a description of the geometry of the	2	to be disposed of in the salt cavern:	۰.
surrounding formations:	1	(i) a list of the types of oil and gas wastes	- 1
Railroad Commission of Texas Oil and Gas Division Page 18 of 32		Pailroad Commission of Texas Oil and Gas Division Page 17 of 32	

			:
	Ballioad Commission of Texas (avern Disposal Amenaments to Kule 9 (a) and Gas Division		Railro Oil an
• *	(111) information on the thickness and	1	<u>surfa</u>
`~	o <u>cher characteristics of the salt or other strata sufficient to</u>	2	featu
3	demonstrate the integrity of the cavern roof.	ω	
4	(C) An application shall include the following	4	for t
5	siting information:	თ	
6	(i) a list of all wells, within a 1/4 mile	6	equip
۲.	radius of the proposed cavern disposal well, that penetrate the	7	opera
в	salt formation in which the cavern disposal well will be located.	8	use.
6	<u>The list must identify any wells:</u>	9	
10	(I) that the applicant actually knows to	10	brine
11	<u>be unplugged or improperly plugged; or</u>	11	uge.
12	(II) that appear, from a review of the	12	brine
13	data of public record, to be unplugged or improperly plugged:	13	
14	(ii) information on the depth, diameter, and	14	that_
5	volume of any hydrocarbon storage caverns, disposal caverns, brine	15	descr
16	mining caverns, salt mines, or any other excavations of the salt	16	monit
1.1	formation and information on the depth of any sulphur mining wells	17	
18	within a 1/4 mile radius of the proposed cavern disposal well:	18	the p
19	(iii) a map indicating the location of any	19	
20	<u>sulphur mining wells, hydrocarbon storage caverns, disposal</u>	20	press
21	caverns, brine mining caverns, salt mines, or any other excavations	21	shut-
22	of the salt formation within a 1/4 mile radius of the proposed	22	dispo
23	<u>cavern disposal well:</u>	23	and
24	(iv) a topographic or other map depicting the	24	
25	surface that extends one mile beyond the property boundaries of the	25	demon
26	proposed cavern disposal facility and that depicts the facility.	26	the a

Railroad Commission of Texas Cavern Disposal Amendments to Rule 9 Oil and Gas Division Page 20 of 32 <u>Surface water bodies, and any subsidence or other dissolution</u> <u>features</u>;

(D) An application shall include an operating plan the proposed cavern disposal well that:

(i) describes the surface facilities, downhole equipment, any oil pad that will be maintained during disposal operations, proposed injection methods, and plans for the disposal, use, or sale of displaced brine:

(ii) addresses the management of the displaced ine and, if the displaced brine will be sold for non-oilfield se, provides for monitoring of the chemical constituents in the cine:

(iii) includes a plan for monitoring any effect hat disposal operations may have on the size of the cavern and a escription of the methods or models that will be used for onitoring such effect.

(F) An application shall include a closure plan for ne proposed cavern disposal well that:

(i) addresses the monitoring of the shut-in ressure and the release of any pressure that may accumulate in a hut-in cavern disposal well during the period between cessation of isposal operations and the plugging of the cavern disposal well:

(ii) if the cavern is located in a salt dome. demonstrates that post-plugging pressure increases will not affect the ability of the well and cavern to confine the injected fluids.

	Bailroad Commission of Texas Cavern Disposal Amendments to Rule 9 Oul and Gas Division Page 21 of 32	
-	The applicant shall calculate post closure pressure increases using	1
۰.	<u>the following formula:</u>	2
*	<u> Pressure Increase = (A - B) (C - D)</u>	ω
د	Mnere:	4
ر	A = Lithostatic pressure gradient between the top and bottom	თ
5	<u>of the cavern:</u>	6
ť.	<u>B - Hydrostatic pressure gradient between the top and bottom</u>	7
Э	<u>of the cavern:</u>	8
ç	C = Depth to the bottom of the cavern; and	9
10	D = Depth to the top of the cavern.	10
11	(F) An application shall include the financial	11
12	security information required under subsection (c)(1) of this	12
13	<u>section.</u>	13
14	(G) The commission or its delegate may establish	14
15	permit conditions, as required on a case-by-case basis, including	15
16	conditions to provide for and assure compliance with any	16
17	requirements of the proposed operating plan or proposed closure	17
18	<u>plan.</u>	18
61	(H) The commission or its delegate may require	19
20	additional information necessary to demonstrate that creation.	20
21	operation, or maintenance of the cavern disposal well will meet the	21
22	requirements of paragraph (2) of this subsection.	22
23	(4) Operating requirements.	23
24	(A) Prior to beginning disposal operations, the	24
25	operator shall cease active solution-mining operations, if any, and	25
26	shall request cancellation of any existing brine mining or	26

disposal well

sufficient to determine the salinity of substances, other than brine that weighs ten pounds per gallon, that are mixed with the oil and gas waste to form a slurry for injection into the cavern Railroad Commission of Texas Cavern Disposal Amendments to Rule 9 oil and Gas Division Page 22 of 32 hydrocarbon storage permit for the well. For any cavern disposal well that begins disposal operations after the effective date of this subparagraph, a sonar survey of the completed cavern shall be filed with the commission in Austin prior to the start of disposal operations. (B) The wellhead shall be equipped with a pressure

observation valve on the tubing and each annulus of the well. <u>(C)</u> The operator shall keep a record of the volume of any substance, including fresh water, that is used to facilitate disposal or that is injected downhole and the purpose for which the substance is used. The operator shall record information

(D) No waste other than non-hazardous oil and gas waste may be injected into a cavern disposal well. Until the cavern disposal well is plugged, or unless otherwise specified by the permit or Commission order, the operator shall maintain a record of all waste received at the facility. For each waste received, the record shall indicate the generator, type, volume. salinity, and percent solids of such waste.

(B) The maximum injection pressure at the shoe of the lowermost casing shall not exceed 0.8 psi per foot of depth. Shut-in pressure at the surface on the brine withdrawal string or annulus shall not be greater than 100 psig.

,	Cavein Disposal Amendments to Rule 9 Oil and Gam Division of Texas Cavein Disposal Amendments to Rule 9	
1	(F) The operator shall monitor and record the size	H
ы	of the cavern in accordance with the methods or models described in	Ν
\$	<u>subsection (b)(3)(D)(iii) of this section. Persons holding cavern</u>	ω
4	disposal well permits issued before the effective date of this	4
ഗ	<u>subsection shall submit, within 90 days of the effective date of</u>	ა
6	these amendments, a plan for monitoring any effect that disposal	б
L.	operations may have on the size of the cavern and a description of	7
8	the methods or models that will be used for monitoring such effect.	89
9	The operator shall notify the commission if information indicates	9
10	that the size of the cavern exceeds its permitted size by 20% or	10
11	more. Such notice shall be made in writing to the commission in	11
12	Austin within 10 days after the operator knows or has reason to	12
13	know that the cavern disposal well has exceeded its permitted size	13
]4	by twenty percent or more. The notice shall include a description	14
7 5	of the information that indicates that the permitted cavern	15
16	capacity has been exceeded, and an estimate of the current cavern	16
1.1	capacity. Upon receipt of such information, the commission or its	17
18	delegate may take any one or more of the following actions:	18
61	(i) require the operator to file an application	19
20	to amend the cavern disposal well permit:	20
21	(ii) modify, cancel, or suspend the permit as	21
22	provided in subsection (a) (5) (A) of this section: or	22
23	(iii) take enforcement action.	23
24	(G) The operator of a cavern disposal well shall	24
25	<u>maintain financial security as required under subsection (c) of</u>	25
26	this section.	26

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> Cavern Disponal Amendments to Rule 9 Page 24 of 32

(H) For at least three years after the operator ceases to own or control the cavern disposal well, the operator shall retain all records that contain the information specified under subsections (a) (9)-(10) and (b) (4) (C) and (F) of this section. In addition, the operator shall maintain the waste record required under subsection (b) (4) (D) for three years after the cavern disposal well is plugged. If the operator transfers ownership or control of the cavern disposal well before it is plugged, he or she shall maintain a copy of the record required under subsection (b) (4) (D) and shall provide the original record to the transferse.

(1) Any revisions or amendments to an operating plan shall be submitted to the commission in Austin at least 15 days in advance of any change in operations. If the commission or its delegate determines that the revised or amended operating plan deviates materially from the permitted operating conditions, the operator shall file an application for an amended permit.

(J) 180 days after the effective date of this subsection, any person holding a cavern disposal well permit issued before the effective date of this subsection shall demonstrate the maximum lateral extent of the disposal cavern by means of a sonar survey, three-dimensional seismic survey, use of perimeter monitoring wells, or other methods approved by the commission or its delegate.

(5) Testing and surveying.

(A) Before disposal operations begin and annually

Cavern_

operator shall remove any hydrocarbon pad that is present in the

(A) Prior to closing a cavern disposal well, the

subsection, to determine whether the proposed closure plan should operator shall review the proposed closure plan submitted with the be revised permit application, as required by paragraph (3)(B) of this closure plan. (D) Prior to plugging, the operator shall submit to (C) Prior to plugging a cavern disposal well, the

described in paragraph (3)(E) of this subsection or an amended

monitor shut in well pressures in accordance with the closure plan

prior to plugging a cavern disposal well, the operator shall

(B) After disposal operations are completed and

and the well shall be plugged in a manner approved by the accordance with applicable commission rules. permits. or orders: located at the surface shall be closed, dismantled, or removed in commission rules, permits, or orders; all equipment and facilities

commission or its delegate.

need to be revised. reasoned justification as to why the proposed closure plan does not the commission in Austin either a revised closure plan or a

Cavern Disposal Amendments to Rule 9 Page 26 of 32

the district office.

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a cavern disposal well, all oil and gas waste remaining at the

(7) Closure and plugging.

Upon permanent abandonment of

surface

shall

be

disposed of in accordance with applicable

	Railroad Commission of Texas Oil and Gas Division	Cavern Disposal Amendments to Rule 9 Page 27 of 32	
-	(E) The operator shall not	<u>shall not plug the cavern disposal</u>	1
2	well prior to receiving final ar	approval of the plugging procedures	N
÷	from the commission or its delegate	ate.	ω
4	(F) The operator shall	shall file a notice of intent to	4
сл	plug with the district office	at least five days prior to	თ
6	commencement of plugging operations.	0 08	6
7	(G) A pluging	report shall be filed with the	7
8	commission in Austin within 30 days after plugging.	lays after plugging.	8
6	(c) Financial security for c	security for cavern disposal wells. In addition	9
0	to the financial security regul	security required under \$3.76(c) of this title.	10
-	the holder of a cavern disposal	<u>a cavern disposal well permit shall file financial</u>	11
12	security in an amount approved by	an amount approved by the commission or its delegate as	12
ũ	provided in this subsection and	subsection and meeting the requirements of this	13
4	subsection as to form and is	issuer. The provisions of this	14
с.	subsection (c) apply only to car	apply only to cavern disposal wells.	15
16	(1) Application.		16
17	(A) New permits,	Any application for a new or	17
8	amended cavern disposal well permit	mit filed after the effective date	18
61	of this subsection shall include:	f	19
20	(i) a writt	a written estimate of the maximum amount	20
21	necessary to close the cavern di	necessary to close the cavern disposal well prepared in accordance	21
22	with the provisions of paragraph	the provisions of paragraph (4) of this subsection that shows	22
3	all assumptions and calculations used to develop the	vsed to develop the estimate:	23
24	(ii) a copy of	of the form of the bond or letter	24
55	of credit that will be filed wit	be filed with the commission: and	25
26	(iii) inform	information concerning the issuer of the	26

examiner shall recommend a final action by the commission.

Existing Permits.

Notice of filing of

shall not be required. In the event approval of the financial under a permit in effect as of the effective date of this security proposed to be filed for a cavern disposal well operating information required under paragraph (1) (B) of this subsection this subsection. subsection is denied administratively, the applicant shall have the right to a hearing upon written request.

subparagraphs (B) or (C) of this paragraph, a cavern disposal well (3) Filing of Instrument. (A) New Permits. Except as provided in

After hearing.

the

Cavern Disposal Amendments to Rule 9 Page 28 of 32

subsection including the issuer's name and address and evidence of bond or letter of credit as required under paragraph (5) of this Railroad Commission of Texas Oil and Gas Division authority to issue bonds or letters of credit in Texas.

disposal well permit issued on or before the effective date of this effective date of this subsection, the holder of any cavern in subparagraph (A) of this paragraph. subsection shall file with the commission the information specified (B) Existing permits. Within 180 days of the

(2) Notice and Hearing.

opportunity for hearing, shall apply to review and approval of of subsection (a) (4) of this section, regarding notice and financial security proposed to be filed to meet the requirements of issued after the effective date of this subsection, the provisions (A) New Permits. For cavern disposal well permits

	Railroad Commission of Texas Cavern Disposal Amendments to Rule 9 Oil and Gas Division Page 29 of 32
	<u>may not receive oil and gas waste after the effective date of this</u>
2	<u>paragraph until a bond or letter of credit in an amount approved by</u>
نى	the commission or its delegate under this subsection and meeting
4	the requirements of this subsection as to form and issuer has been
J	filed with the commission.
9	(B) Existing Permits. Except as otherwise provided
7	in subparagraph (C) of this paragraph, after (a date one year after
90	effective date of subsection), a cavern disposal well permitted on
9	or before the effective date of this subsection may not continue to
10	receive oil and gas waste unless a bond or letter of credit in an
11	amount approved by the commission or its delegate under this
12	subsection and meeting the requirements of this subsection as to
13	form and issuer has been filed with the commission.
14	(C) Extensions for Existing Permits. On written
15	request and for good cause shown, the commission or its delegate
16	may authorize a cavern disposal well permitted before the effective
17	date of this subsection to continue to receive oil and gas waste
18	after (a date one year after the date of this subsection) even
19	though financial security required under this subsection has not
20	been filed. In the event the commission or its delegate has not
21	taken final action to approve or disapprove the amount of financial
22	security proposed to be filed by the owner or operator under this
23	subsection by (a date one year after the effective date of the
24	subsection), the period for filing financial security under this
25	subsection is automatically extended to a date 45 days after such
26	final action.

11 12 13 10

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(4) Amount.

(A) Except as provided in subparagraphs (B) or (C) of this paragraph, the amount of financial security required to be filed under this subsection shall be an amount approved by the commission or its delegate as being equal to or greater than the maximum amount necessary to close the cavern disposal well. exclusive of plugging costs, at any time during the permit term in accordance with all applicable state laws, commission rules and orders, and the permit, but shall in no event be less than \$10,000. (B) The owner or operator of a cavern disposal well

may reduce the amount of financial security required under this subsection by \$25,000 if he or she holds only one cavern disposal well permit.

(C) The owner or operator of more than one cavern disposal well may reduce the amount of financial security required under this subsection for one such cavern disposal well by \$25,000. The full amount of financial security required under subparagraph (A) of this paragraph shall be required for the remaining cavern disposal wells.

(D) A qualified registered professional engineer shall prepare or supervise the preparation of a written estimate of the maximum amount necessary to close the cavern disposal well as provided in subparagraph (A) of this paragraph. The written estimate shall be submitted under seal of a qualified registered professional engineer to the commission as required under paragraph (1) of this subsection.

25	24	23	22	21	20	61	18	1.1	16	15	14	13	12	11	10	9	8	7	9	ო	ھ	~	2	٦	• .
is authorized by the commission or its delegate.	the conditions of the letter of credit have been met or its release	shall provide that it will be renewed and continued in effect until	of the Texas Business and Commerce Code. The letter of credit	standby letter of credit subject to the requirements of Chapter 5	operate in Texas. The letter of credit shall be an irrevocable.	by and drawn on a bank authorized under state or federal law to	satisfaction of the requirements of this subsection shall be issued	(B) Letter of Credit. Any letter of credit filed in	or its delegate.	bond have been met or its release is authorized by the commission	bond be renewed and continued in effect until the conditions of the 14	The form of bond filed under this subsection shall provide that the 13	shall be a corporate surety authorized to do business in Texas. 12	bond filed in satisfaction of the requirements of this subsection 11	(A) Bond. The issuer of any cavern disposal well 10	[5] Issuer and Form.	to pay for the plugging of such well or wells.	the commission under subsection (c) of this section is insufficient	facility if the financial security for plugging costs filed with 6	commission to pay the costs of plugging any well or wells at the	financial security filed under this subsection may be used by the	this paragraph is exclusive of plugging costs, the proceeds of	necessary to close the cavern disposal well as determined under 2	(E) Notwithstanding the fact that the maximum amount	Railroad Commission of Texas Oil and Gas Division Page 31 of 32
											4	ί.J	Ν	1	0	ę	8	7	υı	01		5		-	

§3.77. Brine Mining Injection Wells

26

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Railroad Commission of Texas Oil and Gas Division

this section, shall have the following meanings, unless the context (a) Definitions. The following words and terms when used in Cavern Disposal Amendments to Rule 9 Page 32 of 32

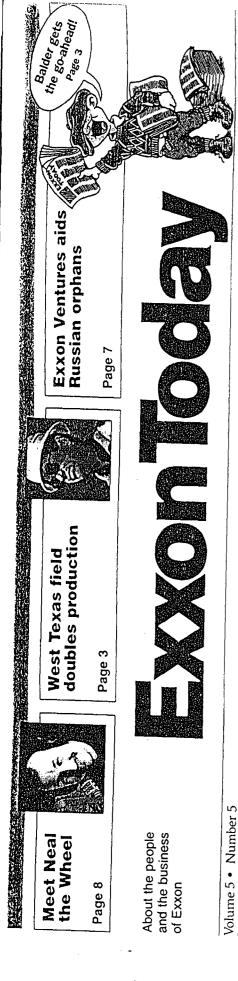
clearly indicates otherwise.

(1)-(2) (No Change.)

does not include a well used to inject fluid for the purpose of subsurface salt formation. The term "brine mining injection well" thermofluid mining process to inject fluid for the purpose of extracting sulphur by the the disposal of waste other than oil and gas waste, or a well used leaching a cavern for the underground storage of hydrocarbons or fluid for the purpose of extracting brine by the solution of a (3) Brine mining injection well--A well used to inject

(4)-(11) (No Change.)

(b) - (1) (No Change.)



VIEWPOINT

April 8, 1990

Reserve sales not an answer

Some Washington policy makers think that selling some of our country's stored oil reserves is a way to reduce the federal deficit. Their plan is to sell oil from the nation's emergency stockpile known as the Strategic Petroleum Reserve.

The public paid for and owns nearly 600 million barrels of oil, stored in salt domes in Louisiana and Texas, as insurance against any dramatic supply loss.

Budget negotiators hope to sell 39 million barrels from a storage facility at Weeks Island, Louisiana. Thirty-two million barrels would be sold to reduce the deficit and 7 million barrels would be used to cover the costs of transferring oil and shutting down the facility, which is relosing because rof technical problems

problems In 1994, our national oil stockpile equaled a 75-day supply of net oil imports. Because imports are rising, the level is expected to be down to a 57-day supply by 2000. Any oil that is sold will further cut the number of days that our country can operate during an emergency.

Selling any of the reserves to address budgetary issues undermines their purpose: to replace disrupted supplies and sustain confidence in the economy while government leaders work through a crisis. The message to allies and potential aggressors alike is that federal government leaders are willing to increase the country's vulnerability to a potential crisis in return for shortterm political gain.

The Strategic Petroleum Reserve plays a vital role in U.S. national security. Draining the volumes lowers that security.

Exxon strongly supports the goal of cutting the deficit. But the culprit is spending growth, not income that's too low. The best way to control the federal deficit is for the government to stop spending more than it takes in. **Prices jump**

NEW YORK - Crude oil prices jumped to another two-month high 1 Tuesday as the contract for Sep tember delivery expired.

Today \$17.00 Previous Ciose \$16.75 Year Ago \$15.25

Much of the buying appeared to originate from refiners looking to stock up amid declining supplies nationwide and from market speculators who were reversing previous bets that prices would fall from Monday's two-month high.

West Texas Intermediate for delivery in September settled at \$18.54 per barrel, up 29 cents on the New York Mercantile Exchange. The October contract

gained 4 cents to \$17.88 per barrel. Local crude purchasers raised their posted price 25 cents to \$17. Natural gas contracts for delivery

in September settled at \$1,567 per 1,000 cubic feet, down 5.1 cents.

After trading concluded, the American Petroleum Institute issued its supply figures for the week ending last Friday that showed further declines.

Crude oil stocks fell 8.38 million barrels to 301.38 million. Gasoline stocks fell 3.84 million barrels to including heating oil, fell 15,000 barrels to 124.60 million. The percentage of refinery capacity in Cart operation fell 0.1 point to 93.5 percent.

Marketing seminar

An announcement from the University of Texas of the Permian Basin Small Business Development Center about Thursday's seminar, "Marketing and Your Business" gave a wrong location. The seminar will be held at the

Center for Energy and Economic Diversification, Highway 191 and FM 1788 in Midland from 8 a.m. to 8:30 a.m. to noon,

Cost is \$30 and reservations' can be made by calling 5520-2455.

Dollar steady

NEW YORK - The dollar was littie changed Tuesday as the Federal Reserve left interest rates alone, as expected and the market held steady as it focused on possible rate easing by the German central bank.

By late Tuesday in New York the dollar was quoted at 96.85 Japanese yen, just down from 96.87 yen late Monday. The dollar also was ! changing hands at 1.4875 German marks, up from 1.4771 marks.

Other late dollar rates in New York, compared with late Monday: 1.2335 Swiss francs, up from K 1.2260; 5.0845 French francs, up from 5.0585; 1,619 Italian lire, down from 1,623; and 1.3576 Canadian dollars, down from

1.3593 The British pound was quoted at \$1,5320, down from \$1.5405,

Markets hold

NEW YORK- The stock market reaped scattered gains Tuesday while Wall Street registered little reaction to news that federal policy makers refrained from lowering interest rates.

The Dow Jones industrial aver-age finished up 5.64 at 4,620.42. The NYSE composite index. crawled ahead 0.25 to 300.16 and Standard & Poor's 500 list logged an increase of 1.41 to close at 559.52. The American Stock Exchange market value index

POSTED \$17.00 DOE races \$15.25 DOE races clock to empty SPR cavern

By N.Y. Times News Service

New Iberia, Louisiana - U.S. energy officials are battling the clock to empty a salt cavern holding 12 percent of the nation's Strategic Petroleum Reserve before a crevice gives way and causes a massive oil spill.

The project can't move forward until the Department of Energy gets con-gressional approval to sell 7 million of the 72 million barrels of oil in Louisiana's Weeks Island salt mine. That will raise the \$100 million needed to move the oil to other reserve caverns in Texas and Louisiana.

Timing_is_critical_because=ground water_is_leaking_into_the_storage area through a crevice. If the fracture enlarges, water could surge into the mine, forcing the oil out of the cavern and into nearby marshes, threatening shrimp; crab and fish. If all 3 billion, gallons escaped, the spill would be 275 times greater than the 1989

Exxon Valdez spill of milition gallons. Without_question_the_longer we

delay, the higher the probability goes that we will have an environmental cat-astrophe said Bob Porter spokesman for the DOE's office of fossil energy.

That prospect frightens neighbors of the mine, many of whom make their living in the environmentally sensitive central Louisiana industries of shrimping, agriculture, tourism and commer-cial and recreational fishing.

"It would have a tremendous impact economically," said Mike Richard, a wholesale nursery owner in Iberia Parish

Added resident Wilma Subra of Subra Co., a consulting firm donating its services to a local environmental advocacy group: "Any release of oil or concentrated brine into that ecosystem will have a tremendous detrimental effect, not only instantaneously but long term.

The Strategic Petroleum Reserve was authorized by Congress in 1976 to amass crude oil that could protect the U.S. (rom a shortage similar to the one that occurred in 1973 during the Arab oil embargo.

The reserve, housed in five massive underground salt cayerns, contains 592 million barrels of oil. The caverns could hold as much as 750 million barrels.

The fracture at Weeks Island, a former Morton Salt Co. mine, was detected in 1992 after a security guard found a 35-foot-diameter sinkhole at the edge of the mine. Below the sinkhole, a fracture split the wall of the salt cavern.

Since then, more sinkholes have developed around the mine boundaries, and a second fracture has been found.

To stabilize the structure, the DOE has drilled 55 small wells around the first sinkhole and filled them with cryogenically cooled brine that froze the water



Motorola oper

By Associated Press

AUSTIN — Motorola Inc. opened a \$1 billion microchip complex Tuesday, with company officials saying the fabrication plant and research lab will take it to a new era of technology.

With the finishing touches put on the facility, the company can begin making chips and finding new ways to build them.

The complex will turn out Motorola's latest microprocessors and be home for researchers who will invent the "recipes" for at least four future generations of advanced microchips.

Motorola officials and city leaders Tueşday dedicated the complex, which is called MOS 13 and the Advanced Products Research and Development Laboratory

"MOS 13 and APRDL are our pathfinders to the next generations of technology," said Barry Waite, the Motorola executive whose business group designs and sells the circuits that will be produced in the new complex.

MOS 13 is the company's most

BUSINESS SCENE ustin mortgage company

By Mella McEwen

An Austin-based mortgage company has opened a branch in Midland's Mission Square shopping center, 4400 N. Big Spring, Suite 122. Branch manager of HARRIS TRUST

COMPANY is Dayna Beikirch, who lived

in Midland for 22 vanne hafana

Please see SPR/2C

loans for 15 or 30-year mortgages. Fixed rate or adjustable rate mortgages are available.

Appointments are requested to make applications, which are taken Monday through Friday from 7:30 a.m. to 6 p.m. and from noon to 2 p.m. Saturday.

Midlanders Michael and Jackie Waters have opened IN HOME CARE version. Union Pacific could

cal refineries in Texas and Louisiana could be a particular says, the best solution is to give Justice an advisory role - but give the final decision on rail

1994 sales of Burlington ern and Santa Fe would been about \$1.8 billion l

SPR: Fractures threaten to let oil spill

(From 1C)

inside, creating a dam of ice to block any flow through the crevice.

The measure is only temporary. In September 1994, the Strategic Petroleum Reserve project man-ager recommended Weeks Island

be abandoned as an oil storage site. The report by William C. Gibson Jr. said there is "a high probability of additional stress fractures' and "the integrity of the Weeks Island mine cannot be assured."

The Department of Energy hopes to begin moving the oil in October. The House of Representatives and a Senate committee have approved the sale of 7 million barrels from the reserve to pay for shutting down the site and moving the oil as part of the \$12 billion appropriations bill for the Energy and Interior departments.

The spending plan must be approved by the entire Senate and then go to a conference committee in September to resolve differences between the two versions before it is sent to President Clinton. The differences don't involve the Weeks Island plan,

Some congressmen, including Rep. Billy Tauzin, R-Louisiana, and Rep. Don Schaefer, R-Colorado, oppose the sale of reserve oil, saying it sets a dangerous precedent for the government to sell more of the critical reserve to cover funding shortfalls.

The DOE said the Weeks Island problem is an unforeseeable emergency, and wouldn't be a precedent for more sales.

Tauzin and others also have questioned the wisdom of selling the crude at prices significantly below the average cost of the stored oil. The reserve's 592 million barrels were acquired at an average price of \$27.50 a barrel, and the cost of the reserve caverns and maintenance boost the price to about \$30 a barrel.

During the past three months, benchmark West Texas Interme-diate crude has sold for an average \$18.01 a barrel.

Porter said the last 7 million barrels bought for the reserves were purchased at a price of about \$17 a barrel. "We don't, quite frankly,

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buy the argument we will be incur-ring a tremendous loss," he said. The marketability of the oil is

another issue. The Weeks Island oil is a "heavy crude" that is less desirable because it is harder to refine. If DOE can't sell the Weeks Island oil, it will considering selling the 7 million barrels from another reserve site, Porter said.

The Weeks Island situation raises the question of whether the remaining reserve caverns could develop similar problems. Weeks Island will be the second original storage site to be abandoned

because of the potential for leaks in 1991, the DOE decided to empty the Sulphur Mines cavern near Lake Charles, Louisiana, saying that the 26-million-barrel cavern was the least economical of the reserve sites to operate.

The DOE later acknowledged that the_Sulphur_Mines site had "inherent storage risks" because its geological characteristics posed the risk of leaks. its

"They're all going to face simi-lar problems," Subra said. "The others have subsidence problems, just not as severe as these" at

Weeks Island, she said. The DOE said Weeks Island is unique, partly because its structure - two chambers supported by pillars makes settling Inevitable. In addition, the mine's top lies just 700 feet below the sur-

In the other reserve caverns, wells were drilled in underground salt domes as much as 2,000 feet below the surface. Water then was pumped in to leach out huge cav-erns as much as 2,000 feet deeper, large enough to hold New York's World Trade Center. "At that depth, the natural geo-

logic pressure on the salt is enough to heal any fracture that devel-ops," Porter said. "We do not see the potential for a Weeks Islandtype of problem to develop at any of our other sites.

Louis Dellwig, a retired University of Kansas geologist who has worked as a salt dome consultant to government and industry, said caverns that were leached out shouldn't develop cracks that won't heal themselves, and should be deep enough underground to escape subsidence

Porter, the DOE spokesman, said the department's geologists were aware of the potential for sinkholes and subsidence at the Weeks Island when it was chosen as a reserve site. The risks were outs eighed by the rush to stockpile oil after the Arab embargo, when Americans saw prices soar and stood in gas station lines."

'Americans saw oil prices quadruple over several months," Porter said. "The clear guidance was to find places to store oil and move oil into those places very

GTE, unio keep talkir

IRVING, Texas (AF Southwest and the Co tions Workers of Ame agreed to continue "e contract negotiations af of recurrent midnight the company said Tues

GTE spokesman Dav said the two sides have keep talking until th reach an agreement or negotiations. "That way have to go through the deadline extensions," h

The union, which has authorize a walkout, has give the company 24-hou it intends to wage a strik said.

The union represents s workers in Texas, Oklal Arkansas.

The Irving, Texas-ba telephone company's with the union expired A negotiations have contir then. The union is seeking security in the wake o GTE layoffs in recent y ųч

o Bachelor's ar



Midland Independent School District offers career and technology education programs in Agriculture, Business, Cosmetology, Health Occupations, Home Economics, Industrial Technology, Marketing Education, and Trade and Industry. Admission to these programs is based on the student's needs, aptitudes, abilities, and course selection.

CRI

CONTROLLED RECOVERY INC.

P.O. BOX 369, HOBBS, NM 88241 (505) 393-1079

March 15, 1996

MR. WILLIAM J. LEMAY State of New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division 2040 South Pacheco Santa Fe, New Mexico 87505

Re: (GW-226) Permian Brine Sales (UIC-CL1-006) P & S Brine Sales

Dear Mr. LeMay:

On behalf of Controlled Recovery, Inc. I respectfully request the referenced permit applications be denied.

As a Lea County business owner and taxpayer, Controlled Recovery, Inc. is extremely concerned about the possibility of waste disposal into a salt cavern. I believe this disposal method would have a negative impact on surrounding property owners in Lea County, New Mexico. The salt cavern(s) could develop leaks and possibly collapse allowing migration of waste into the precious and irreplaceable water aquifer. Any damage to the underground water supply would most likely cause health and safety risks for all persons in this region of New Mexico.

If my request to deny these applications is not implemented, I respectfully request a public hearing to review these applications be conducted by the Oil Conservation Commission. Please enter Controlled Recovery, Inc. (Gail Power) as a registered protestant in these cases.

CRI

CONTROLLED RECOVERY INC.

P.O. BOX 369, HOBBS, NM 88241 (505) 393-1079

May 28, 1996

State of New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division Santa Fe, New Mexico 87505

Re: (UIC-CL1-006) P. & S. Brine Sales-Sec. 16, T-25-S, R-37-E (GW-226) Permian Brine Sales-Sec. 34, T-29-S, R-36-E OCD Hearing, May 28, 1996, Hobbs, New Mexico

Dear Madam or Sir:

Thank you for permitting me to speak at this hearing today.

My name is Gail Power. I am employed by Controlled Recovery, Inc. of Hobbs, New Mexico. CRI is in the surface waste disposal business and crude oil reclamation business. I will stipulate at this time Permian and P&S would be competition to CRI if their permit applications are approved. Additional competition is not the issue and purpose of this hearing.

We are all present today to listen to various statements from interested parties in order that the OCD can accept and review all testimony pro and con to determine if the applications for salt cavern disposal operations should be permitted and allow Permian and P&S to accept for disposal permitted waste into brine-mined salt cavities.

Before the New Mexico OCD considers the issuance of these permits several factors should be considered. These factors are:

- 1. Applicants should be required to provide thorough geologic information about the characteristics of the salt stock, including sufficient data to image underneath all overhangs and to delineate the edge of the salt stock.
- 2. Applicants should be required to provide adequate financial assurance to indemnify all parties that could be adversely effected by a leak of waste into surface waters or underground water aquifers. Obviously as waste volumes increase the financial assurance should be expanded proportionately.
- 3. Applicants should be required to demonstrate public necessity exists for the permitting of waste injection into salt cavities.

- 4. Applicants should be required to explain and prove that all safety considerations have been met to the satisfaction of the New Mexico OCD to include:
 - a. Waste will not migrate (applicants should be able to prove the no-escape performance standard will be continuously met).
 - b. Gas pressure and liquids will not build up in the salt cavern.
 - c. All waste received will be properly classified.
- 5. Applicants should be required to satisfy the OCD that the public interest will be served and protected if the permits are issued. Possibly, the OCD should consider including the State of New Mexico Department of Health in the review process to ascertain all risks associated with this disposal method.
- 6. Applicants should be required to demonstrate proven waste containment and retrieval procedures in the event of a collapse, shift or leak in the sub-surface salt cavities.
- 7. The OCD may consider verification that no conflicts exist that are contrary or in violation of 40 CFR, Parts 144, 145, 146, 241, 243, 256, 257 and 268.

I respectfully request the OCD to consider all of my aforementioned recommendations.

In recent years the New Mexico Oil and Gas Industry, with the support, advise and regulatory assistance of the OCD has devoted great effort to reverse a long standing distrust and unfavorable image by the farming and ranching interest coupled with very poor ratings in the media and inferior regard among the general citizenry. The Oil and Gas Industry and the OCD have made great strides to improve this overall sub-standard profile by adhering to safe and prudent operations with specific concern for environmental issues.

With all the progress heretofore to improve the Oil and Gas Industry public standing, now is not the time to allow any wavering of these past gains and improvements by permitting any operations that are vulnerable to public safety, health and environmental risks and questions which could be counter-productive and, in fact, would adversely effect the entire Oil and Gas Industry in New Mexico and its Regulatory Agency. The honorable and dedicated commitment of the Oil and Gas Industry and the OCD should not be impugnable by authorizing high risk and unnecessary endeavors.

I respectfully request my remarks be included and made a part of the record of this hearing. A written transcript of my testimony is available for the record.

Thank you again for granting me time to address this hearing.

Sincerely,

GP/jh

COSTS FOR OFF-SITE DISPOSAL OF NONHAZARDOUS **OIL FIELD WASTES: SALT CAVERNS VERSUS OTHER DISPOSAL METHODS**

Topical Report

By John A. Veil

September 1997

Performed Under Contract No. W-31-109-Eng-38

Argonne National Laboratory **Environmental Assessment Division** Argonne, IL

> **National Petroleum Technology Office U. S. DEPARTMENT OF ENERGY** Tulsa, Oklahoma





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DOE/BC/W-31-109-Eng-38-2 Distribution Category UC-122

Costs For Off-Site Disposal Of Nonhazardous Oil Field Wastes: Salt Caverns Versus Other Disposal Methods

Topical Report

By John A. Veil

September 1997

Work Performed Under Contract No. W-31-109-Eng-38

Prepared for BDM-Oklahoma/ U.S. Department of Energy Assistant Secretary for Fossil Energy

Rhonda Lindsey, Project Manager National Petroleum Technology Office P.O. Box 3628 Tulsa, OK 74101

Prepared by: Argonne National Laboratory Environmental Assessment Division 9700 S. Cass Avenue Argonne, IL 60439

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ACKNOWLEDGMENTS

I wish to express appreciation for the assistance received from many state officials and commercial disposal company officials who participated in the survey described in this report. Their willingness to share technical and cost information enabled me to compile a meaningful database on commercial waste disposal methods and costs. I also acknowledge Nancy Johnson, U.S. Department of Energy, Office of Fossil Energy, without whose support and guidance the project would not have taken place.

COSTS FOR OFF-SITE DISPOSAL OF NONHAZARDOUS OIL FIELD WASTES: SALT CAVERNS VERSUS OTHER DISPOSAL METHODS

by

John A. Veil Argonne National Laboratory

SUMMARY

According to an American Petroleum Institute production waste survey reported on by P.G. Wakim in 1987 and 1988, the exploration and production segment of the U.S. oil and gas industry generated more than 360 million barrels (bbl) of drilling wastes, more than 20 billion bbl of produced water, and nearly 12 million bbl of associated wastes in 1985. Current exploration and production activities are believed to be generating comparable quantities of these oil field wastes. Wakim estimates that 28% of drilling wastes, less than 2% of produced water, and 52% of associated wastes are disposed of in off-site commercial facilities. In recent years, interest in disposing of oil field wastes in solution-mined salt caverns has been growing. This report provides information on the availability of commercial disposal companies in oil-and gas-producing states, the treatment and disposal methods they employ, and the amounts they charge. It also compares cavern disposal costs with the costs of other forms of waste disposal.

At the federal level, the majority of oil field wastes are considered to be exempt from the hazardous waste provisions of the Resource Conservation and Recovery Act (RCRA). These wastes are instead regulated at the state level. All oil- and gas-producing states allow some oil field wastes to be disposed of on-site. The commonly used on-site disposal methods include underground injection, on-site burial, land spreading or other land treatment, evaporation, surface discharge, and recycling. Argonne National Laboratory conducted interviews with oil and gas officials in 31 oil- and gas-producing states to learn how oil field wastes are disposed of in their states and to identify commercial off-site disposal companies. Argonne then surveyed these disposal companies to learn what types of wastes they disposed of, what disposal methods they used, and how much they charged their customers.

There appear to be two major trends in off-site disposal. The first trend is exemplified in nine oil- and gas-producing states, where many commercial disposal companies are dedicated to handling oil field wastes. They use the same disposal methods as those used for on-site disposal. In addition, in one of these states — Texas — the Railroad Commission has issued permits to allow several salt caverns to be used for disposal of oil field wastes. The second trend is exemplified by

22 other oil- and gas-producing states, where few or no companies are dedicated to disposing of oil and gas industry waste. The off-site commercial disposal companies available either handle only general industrial wastes or operate sanitary landfills.

In most cases, operators can dispose of their oil field wastes for a lower cost on-site than off-site; thus, they choose on-site disposal. In other cases, operators send their wastes off-site. The cost of off-site commercial disposal varies, depending on the disposal method used, the state in which the disposal company is located, and the degree of competition in the area. This report contains tables that provide cost data for disposing of three waste categories: (1) solid and oily wastes, which correspond to associated (small-volume wastes related to oil and gas exploration and production that are not drilling or water wastes) and oil-based drilling wastes; (2) produced water, rain water, and other types of dirty-water wastes; and (3) water-based drilling wastes. Disposal costs for solid and oily wastes range from \$0 to \$57/bbl, \$6.50 to \$50/yd, and \$12 to \$150/ton. Disposal costs for produced water, rain water, and other types of dirty-water wastes range from \$0.01 to \$8/bbl, although most costs fall in the \$0.25 to \$1.50/bbl range. Disposal costs for water-based drilling wastes range from \$0.20 to \$14.70/bbl, \$5 to \$37.50/yd, and \$15 to \$55/ton.

Solution-mined salt cavern disposal costs are presently competitive in the Texas waste disposal market. However, they are likely to rise in the near future as the Railroad Commission of Texas adopts regulations governing cavern disposal. It is unclear how the increased costs will affect the competitiveness of these disposal caverns in the future, since costs for disposal at competing facilities will likely change. The use of commercial disposal caverns for oil field waste could spread to other states, but it will be limited by the availability of suitable salt formations and the size of the off-site commercial disposal market in those states. The market, in turn, is affected by the stringency of state regulations on disposing of oil field waste. Thus, future changes to state regulations on disposal of oil field waste will act as an a important catalyst to stimulate new cavern disposal operations.

1 INTRODUCTION

As companies explore for and produce oil and gas, they generate various nonhazardous liquid, semisolid, and solid wastes. When on-site disposal of these wastes is allowed, it is generally the least expensive disposal option. Consequently, the majority of nonhazardous wastes are disposed of on-site. The term "on-site" includes waste disposal that occurs (1) on the same lease site as the one occupied by the oil and gas operation that generates the wastes and (2) at a location that is off the lease site but is owned or operated by the same company that operates the well that generates the wastes. Wastes are handled by off-site commercial disposal companies if state regulations preclude on-site disposal or if operators elect to avoid the responsibility of on-site waste disposal.

Works by Wakim (1987, 1988) summarize the results of a major, industrywide survey on waste production volumes and disposal methods conducted by the American Petroleum Institute (API) in 1985. Wakim (1987) found that more than 102 million barrels (bbl) or about 28% of drilling wastes and only a small fraction of produced water (less than 2%) were disposed of off-site. Wakim (1988) found that more than 6 million bbl or about 52% of other wastes associated with oil and gas production were disposed of off-site. The Wakim studies provide good information on waste generation and disposal practices in the mid-1980s. To get more current information, API sent out a new waste management survey in the fall of 1996. Results are expected to be available in 1997.

Little information has been compiled on the number, location, type, and cost of commercial oil and gas waste disposal facilities. This report provides information on the commercial disposal options available to operators in selected oil- and gas-producing states. The costs of different disposal options are also provided.

Interest in using solution-mined salt caverns to dispose of oil field wastes has been growing. Recently, Argonne National Laboratory (ANL), under a U.S. Department of Energy (DOE) contract, evaluated the suitability, feasibility, and legality of disposing of nonhazardous oil field wastes in salt caverns (Veil et al. 1996). That report, which examined only solution-mined salt caverns and not excavated caverns, concluded that using salt caverns to dispose of oil field wastes is technically feasible and legal under both federal and state regulations. If caverns are well-sited and welldesigned, operated carefully, closed properly, and monitored routinely, they represent a suitable means of disposing of oil field wastes. ANL is also conducting a qualitative risk assessment of salt caverns used to dispose of nonhazardous oil field wastes. Because DOE has a continuing interest in exploring new and alternative waste disposal methods, especially those that are less costly or risky than existing methods, this report compares cavern disposal costs with the costs of other forms of waste disposal.

2 OIL FIELD WASTES AND DISPOSAL METHODS

2.1 TYPES OF OIL FIELD WASTE

Most oil field wastes that arise from or are associated with oil and gas exploration and production are considered to be nonhazardous by virtue of being specifically exempted from federal hazardous waste requirements. A more detailed discussion of this subject is found in Section 4. Table 1 is a list of oil field wastes exempted from the federal hazardous waste requirements of the Resource Conservation and Recovery Act (RCRA). These nonhazardous oil field wastes can be assigned to several categories: drilling wastes, produced water, and associated wastes. The categories are described below.

2.1.1 Drilling Wastes

Drilling wastes include drilling muds, drill cuttings, wash water, and other related wastes.

- Drilling muds are used in the drilling process to lubricate the drill bit, control wellbore pressure, and remove cuttings from the well. Mud systems can be freshwater-based (65%), saltwater-based (23%), oil-based (3%), or other (Wakim 1987). Wakim found that in 1985, drilling muds made up nearly 62% of drilling wastes.
- Drill cuttings are the particles of rock that are ground up by the drill bit during the drilling process. Cuttings are mixed with and covered with drilling muds. They made up about 10% of the volume of drilling wastes (Wakim 1987).
- Water used to wash the drilling rig and for other drilling-related purposes made up about 24% of the volume of drilling wastes (Wakim 1987).
- Drilling wastes may contain oil and grease, inorganic salts, or other components of concern, depending on the type of mud system and additives used. These constituents can affect the way in which the wastes are disposed of. For example, most freshwater-based muds and cuttings are disposed of onsite, while oil-based muds may need to be sent off-site for disposal.

TABLE 1 Oil and Gas Wastes Exempted from RCRA Hazardous Waste Requirements(53 FR 25446, July 6, 1988)

Produced water **Drilling fluids** Drill cuttings Rigwash Drilling fluids and cuttings from offshore operations disposed of onshore Well completion, treatment, and stimulation fluids Basic sediment and water and other tank bottoms from storage facilities that hold product and exempt waste Accumulated materials, such as hydrocarbons, solids, sand, and emulsion from production separators, fluid treating vessels, and production impoundments Pit sludges and contaminated bottoms from storage or disposal of exempt wastes Workover wastes Gas plant dehydration wastes, including glycol-based compounds, glycol filters, filter media, backwash, and molecular sieves Gas plant sweetening wastes for sulfur removal, including amines, amine filters, amine filter media, backwash, precipitated amine sludge, iron sponge, and hydrogen sulfide scrubber liquid and sludge Cooling tower blowdown Spent filters, filter media, and backwash (assuming the filter itself is not hazardous and the residue in it is from an exempt waste stream

Packing fluids

Produced sand

Pipe scale, hydrocarbon solids, hydrates, and other deposits removed from piping and equipment prior to transportation

Hydrocarbon-bearing soil

Pigging wastes from gathering lines

Wastes from subsurface gas storage and retrieval

Constituents removed from produced water before it is injected or otherwise disposed of

Liquid hydrocarbons removed from the production stream but not from oil refining

Gases from the production stream, such as hydrogen sulfide and carbon dioxide, and volatilized hydrocarbons

Materials ejected from a producing well during the process known as blowdown

Waste crude oil from primary field operations and production

Light organics volatilized from exempt wastes in reserve pits or impoundments or production equipment

2.1.2 Produced Water

Produced water is the water brought to the surface along with the oil and gas. It occurs naturally in the formations where oil and gas are found and is typically salty or brackish. The ratio of produced water to oil and gas increases over the life of the well. Produced water contains inorganic salts, oil and grease, and organics.

2.1.3 Associated Wastes

Associated wastes are small-volume wastes that are generated as a result of activities related to oil and gas exploration and production but are not drilling wastes or produced water. Wakim (1988) estimated that in 1985, the U.S. oil and gas industry generated about 11.8 million bbl of associated wastes. Nearly half of that total (48%) consisted of well treatment fluids (e.g., workover fluids, completion fluids). Other waste classes that contributed significantly to the volume of associated wastes include oil debris and contaminated soils (11%), produced sands (11%), and tank bottoms (10%).

2.2 AVAILABLE DISPOSAL METHODS

Several methods to dispose of oil field wastes are available to operators. The most commonly used options are listed here:

- Underground injection (disposal wells, enhanced oil recovery wells, annular injection, salt caverns);
- On-site burial (pits, landfills);
- Land treatment (land spreading, land farming, road spreading);
- Evaporation;
- Surface discharge;
- Recycling; or
- Sending waste off-site for commercial disposal (the off-site facility would use one of the same methods as those used by the operator, as described above);

Operators select a disposal option after considering the characteristics of the waste, federal and state regulations, and the availability and cost of commercial off-site disposal.

The following sections summarize information on disposal option preferences taken from Wakim's studies (1987 and 1988) and a more recent study sponsored by DOE and the Interstate Oil and Gas Compact Commission (DOE/IOGCC 1993). The data from DOE/IOGCC (1993) were not intended to be statistically representative of actual waste management practices but rather were determined on the basis of the best judgment of state regulators. Each study groups the potential disposal options somewhat differently, so the results cannot be exactly compared. Nevertheless, these studies provide a good indication of how operators disposed of wastes in the mid-1980s and early 1990s.

2.2.1 Drilling Wastes

Wakim (1987) provides detailed information, by state, on the percentages of drilling wastes managed by means of different disposal methods. Table 2 summarizes these data. In the United States, 29% of drilling wastes were evaporated, 28% were hauled off-site to a commercial disposal facility, 13% were injected, 12% were buried on-site, 10% were discharged to surface waters, and 7% were land spread. Most states followed this trend, but in some states, one disposal method predominated (e.g., off-site burial in California, Michigan, and Ohio; land spreading in West Virginia; surface discharge in Arkansas; evaporation in Colorado, Kansas, and New Mexico; and annular injection in Alaska and Mississippi).

Table 3 is taken from DOE/IOGCC (1993). Since the table does not provide data for all states, no quantitative estimate of national disposal options selected in 1992 could be calculated. A qualitative analysis indicates that on-site burial was the most commonly selected option, with subsurface injection, land treatment, annular disposal, and off-site commercial disposal being selected in many other cases. Evaporation, the most commonly selected option found in Wakim (1987), was rarely used in the opinion of the state regulators surveyed by DOE/IOGCC (1993).

2.2.2 Produced Water

Table 4, which shows the proportion of produced water disposed of by means of different methods in 1985, is taken from Wakim (1987). The vast majority of produced water was injected; 62% was injected into enhanced oil recovery projects and 30% into disposal wells. About 6% of produced water was discharged to surface waters. In Louisiana, surface discharge was an important disposal mechanism. In California, 16% of produced water was disposed of by means of some other process, probably evaporation.

TABLE 2 Percentage of Drilling Waste Volumes for Each Disposal Method in 1985 Estimated in Wakim (1987)

State	Off-Site Disnosal	Buried On-Site	Land Spread	Surface Discharge	Evaporation	Annular Injection	Solidification
2000							
Alabama	28	01	s	13	30	14	0
Alaska	18	13	0	18	0	51	0
Arkansas	20	£	0	63	14	0	0
California	75	17	I	0	S	0	2
Colorado	17	18	0	13	51	0	0
Florida	25	10	ę	23	15	24	0
Illinois	11	16	13	0	0	0	0
Indiana	36	15	S	2	40		
Kansas	12	21	Q	6	55	0	0
Kentucky	39	6	ŝ	2	43	2	
Louisiana	16	4	4	43		33	0
Michigan	88	6	0	0	2	0	
Mississippi	-	9	0	11	-	75	0
Montana	. 39	29	0	0	01	23	0
Nebraska	23	18	æ	9	42	3	-
Nevada	29	10	9	7	35	13	0
New Mexico	9	12	0		81	0	-
New York	37	10	5		42	2	~
North Dakota	55	22	0	1	61	2	0
Ohio	84	15	0	0	-	0	0
Oklahoma	43	16	0	0	30	11	0
Pennsylvania	57	17	0	14	Ś	7	0
Texas	25	11	13	2	39	10	0
Utah	39	14	0	11	34	2	0
West Virginia	°	12	77	80	0	0	0
Wyoming	36	15	0	2	44	£	0
Total ^a	28	12	7	10	29	13	0

Costs for Off-Site Disposal of Nonhazardous Oil Field Waste

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^a Total also includes minor contributions from several other states not shown.

(1993) ^a
in DOE/IOGCC (199
Estimated in
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Volumes for Ea
Waste
Percentage of Drilling
TABLE 3 1

State	Off-Site Disposal	Buried On-Site	Land Spread	Surface Discharge	Evaporation	Annular and Subsurface Injection ^b	Recycling/Closed Drilling System
Alabama	J					υ	ల
California	c	IJ	J	ບ		IJ	J
Colorado	ပ	ပ	c		ა		υ
Kansas	20	75			ŝ	1	l
Louisiana	22		51			27	υ
Michigan		65			e	32	J
Mississippi			IJ	50		U	IJ
Montana	ల	75-85	IJ		v	U	U
New Mexico		ပ	J				J
North Dakota	3	42				54	1
Ohio	3-4	27-36				60-70	⊽
Oklahoma	54		12			33	J
Pennsylvania	7	09	38	4			₽
Texas	2	83	<4	<0.5		11	
Utah	c	J					
West Virginia	6	13	77	7			
Wyoming	J	υ	IJ			J	S

^b DOE/IOGCC (1993) provides separate categories for subsurface injection and annular injection but provides no explanation for that distinction; both categories are combined here.

^c Indicated practice is allowable and may be used in the state; no other data are available.

_	Disposal	Enhanced Oil	Surface	Other
State	Wells	Recovery	Discharge	Ouler
	05	15	0	0
Alabama	85	15		-
Alaska	29	71	0	0
Arkansas	46	54	0	0
California	23	54	6	16
Colorado	8	92	0	0
Illinois	5	95	0	0
Kansas	60	39	0	0
Kentucky	100	0	0	0
Louisiana	46	10	44	1
Michigan	35	65	0	0
Mississippi	96	4	0	0
Montana	16	83	1	0
Nebraska	60	39	0	1
New Mexico	17	83	0	0
North Dakota	72	28	0	0
Oklahoma	9	91	0	0
Texas	31	64	3	2
Utah	36	63	1	0
West Virginia	100	0	0	0
Wyoming	55	28	17	0
Total ^a	30	62	6	3

TABLE 4 Percentage of Produced Water Volumes for Each DisposalMethod in 1985 Estimated in Wakim (1987)

^a Total also includes minor contributions from several other states not shown.

Results shown in Table 5, taken from DOE/IOGCC (1993), are very similar to those shown in Table 4. In most states, a high percentage of produced water was reinjected. Several states discharged a significant quantity of produced water to surface waters, although the volume of produced water discharged to surface waters is declining. In California, an estimated 20% of produced water was evaporated.

2.2.3 Associated Wastes

Table 6, which shows the proportion of associated wastes disposed of by means of different methods in 1985, is taken from Wakim (1988). Nationally, more than half of the associated waste (52%) was taken to off-site commercial facilities, 14% was spread on roads, 9% was land spread, 7% was recycled, 7% was injected, and 5% was buried on-site. States showed substantial variation in their use of the most commonly selected options.

Table 7, which lists data from DOE/IOGCC (1993) on disposal of associated wastes, reveals no clear trends. Subsurface injection, commercial off-site disposal, land treatment, and on-site burial all are used to dispose of more than 95% of the associated wastes in at least one state.

	Disposal	Enhanced Oil	Surface		Off-Site	Annular Injection	Road	Other
State	Wells	Kecovery	Discnarge	Evapulation	incodeira			
A laborational gas				-				q
Alauailia, Uli/conventione 645	•		4					q
Alabama, coalbed methane gas	٩		0	0				14
California	25	32	6	20				<u>t</u> -
Colorado			q	q	a			٥
	60	39					7	
Kansas	8	<u>,</u>				°,		
Louisiana	46	×	44			1	7	
Michigan	63	37				•	7	
Mississipni	Ą	q				a		
Montana	16	83	7	7				
New Mexico			q	q				
North Dakota	72	28				c	•	
Ohio						7	t	
Oklahoma	28	72	v					-
Dennevlvania	Ą	Ą	Ą		Ą		q	۵
Tavas	37	61	1.6	0.2	0.2			
Utah	22	51	25	2				
West Virginia			;	¢				
Wvoming	6	58	31	7				

Costs for Off-Site Disposal of Nonhazardous Oil Field Waste

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^b Indicated practice is allowable and may be used in the state; no other data are available.

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State	Off-Site Disposal	Buried On-Site	Land Spread	Surface Discharge	Evaporation	Annular Injection	Recycled	Road Spreading	Other
Alahama	-	en	2	0	10	41	38	2	2
Alacka	• •		0	0	12	69	0	0	0
and a second	2	, 6	5	1	ø	13	45	10	0
Al Kalisas California	07		· v î	0		0	2	51	-
California	₽ ₽	45	0	0	1	46	2	2	1
Culutauo Florida	- 40	. O	0	0	2	0	4	0	0
Illinois		0	16	0	0	0	65	18	0
Vancas	. 16	61	1	0	S	ŝ	15	37	0
Lauisiana	59	-	0	.4	10	1	20	-	4
Michigan	s 28	0	0	0	2	7	S	0	1
Mississioni		£	-	0	15	8	68	-	0
Nantana	10	2	0	0	0	0	0	0	0
Mahracka	75		0	0	-	-	5	11	0
	2 8		c	0	-	-	4	0	0
		. c		- c	C	0	2	0	0
North Dakota	90	5		о с	, c		V	6	7
Oklahoma	69	7	0	7	7	-		1 4	. c
Техаз	57	£	17	0	S	1	6	n	7
Utah	33	14	6	0	31	-	٢	0	Ś
West Virginia	I	0	16	0	2	0	-	0	0
Wvomine	39	s	-	0	28	0	23	6	3
Total ^a	52	, S	6	-	3	7	7	14	2

^a Total also includes minor contributions from several other states not shown.

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State	Off-Site Disposal	Buried On-Site	Land Spread	Surface Discharge	Subsurface Injection	Recycled	Road Spreading	Other
Alabama	Ą				Ą			
California	Ą				Ą			
Colorado	Ą		95		þ			
Kansas	17	30			-	20	32	
Louisiana	Ą							
Michigan	. 26					ю		
Mississippi	100			þ	þ		q	Ą
Montana	þ	>50	Ą			7	5	
New Mexico		Ą	q		p	Ą		Ą
North Dakota	Ą					20		
Ohio	Ą	90-95			Ą			
Oklahoma	>80	Ą	q		q	Э	p	
Pennsylvania	q	q	Ą					q
Texas								
Workover/completion wastes		S			95			
Basic sediments	-	93					S	
Other oily wastes	-	-	16		1			
Utah	p	20				q		
West Virginia	42	18				40		
Wyoming	24% is recyc	led; of the ren	naining volur	ne, 90% is disp	24% is recycled; of the remaining volume, 90% is disposed of on-site and 10% is disposed of off-site.	nd 10% is dispo	sed of off-site.	

^a Based on best judgment of state regulators.

^b Indicated practice is allowable and may be used in the state; no other data are available.

3 BACKGROUND ON SALT CAVERNS

Veil et al. (1996) discusses many aspects of salt formations and salt caverns. Relevant portions of that information are summarized in this section. Both Veil et al. (1996) and this report consider only solution-mined salt caverns. Underground chambers or caverns can also be formed in salt deposits through room-and-pillar mining, which involves mechanical excavation of the salt deposits. To the author's knowledge, only solution-mined caverns have been proposed for use as disposal caverns for nonhazardous oil and gas wastes. Room-and-pillar mining is not discussed further in this report.

3.1 TYPES AND LOCATIONS OF U.S. SUBSURFACE SALT DEPOSITS

Figure 1 (redrawn from Johnson and Gonzales 1978) shows the locations of the major U.S. subsurface salt deposits. There are two types of subsurface salt deposits in the United States: salt domes and bedded salt. Salt domes are large, generally homogeneous formations of salt that are

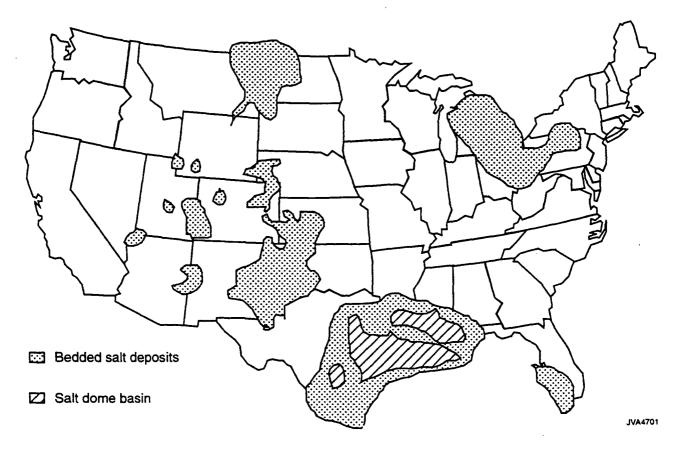


FIGURE 1 Map Showing Major U.S. Rock Salt Deposits

formed when a column of salt migrates upward from a deep salt bed, passing through the overlying sediments. Salt dome deposits are found in the Gulf Coast region of Texas, Louisiana, Mississippi, and Alabama.

Bedded salt formations occur in layers bounded on the top and bottom by impermeable formations and are interspersed with nonsalt, sedimentary materials having varying levels of impermeability, such as anhydrite, shale, and dolomite. Unlike salt domes, which are large masses of relatively pure sodium chloride, bedded salt deposits are tabular deposits of sodium chloride that can contain significant quantities of impurities. Major bedded salt deposits occur in several parts of the United States.

Although salt deposits occur in many parts of the United States, in most states, the occurrence of salt in the quantities and locations that would promote commercial mining is very limited. There are 16 states in which salt occurs in sufficient quantity to be mined by either excavation, solution mining, or solar evaporation: Alabama, Arizona, Colorado, Kansas, Louisiana, Michigan, Mississippi, Montana, New Mexico, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, Texas, and Utah.

Of the states listed above, Kansas, Louisiana, Michigan, New Mexico, New York, Ohio, and Texas have the most significant salt mining operations. These states either now contain or have the potential to contain a cavern suitable for oil and gas waste disposal. Pennsylvania contains caverns that are currently permitted for hydrocarbon storage but could be converted to waste disposal caverns. Utah has some potential for future disposal cavern operations, although it is a relatively small oil and gas waste generator. The remaining states have only a limited number of salt production sites and are not likely candidates for future cavern storage operations.

3.2 CREATION OF SALT CAVERNS

Salt caverns are created by injecting fresh water into a salt formation and withdrawing the resulting brine solution. Figures 2 and 3 show the idealized construction for caverns in domal salt and bedded salt, respectively. The petroleum industry has constructed many salt caverns to store hydrocarbons. To provide guidance for designing and operating hydrocarbon storage salt caverns, several organizations have developed standards documents (CSA 1993; API 1994; IOGCC 1995). Details on the design, location, and construction of salt caverns are provided in these reports.

3.3 USE OF SALT CAVERNS

The most common use for salt caverns is to store hydrocarbons such as propane, butane, ethane, ethylene, fuel oil, gasoline, natural gas, and crude oil (Querio 1980). In 1975, the

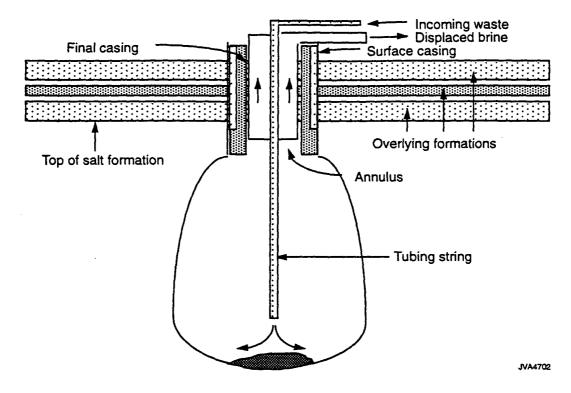


FIGURE 2 Idealized Cavern in a Salt Dome Formation

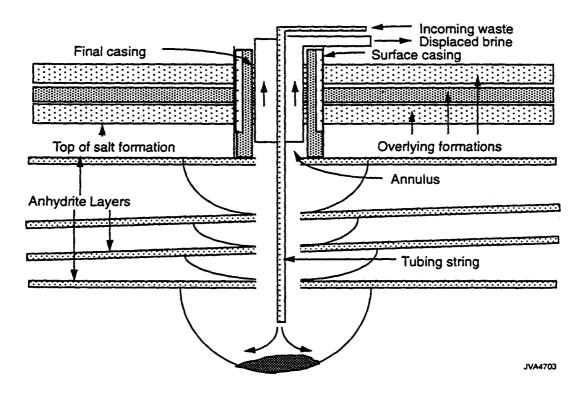


FIGURE 3 Idealized Cavern in a Bedded Salt Formation

T f

U.S. Congress created the Strategic Petroleum Reserve (SPR) program to provide the country with sufficient petroleum reserves to reduce any impacts that might be caused by future interruptions in the oil supply. The SPR consists of 62 leached caverns in domal salt with a total capacity of 680 million bbl. DOE has prepared a plan for, but is not currently pursuing, the development of an additional 250 million bbl of storage capacity. Highly compressed air has also been stored in some caverns, where it can later be withdrawn to generate electricity.

A second use for salt caverns is to dispose of various wastes. In the United States and other countries, only a limited number of salt caverns have been issued permits for waste disposal. The Railroad Commission of Texas has issued permits for disposal of nonhazardous oil field waste in six caverns. Four of these are presently operating as disposal caverns. At least two caverns in Canada have been permitted for disposal of nonhazardous oil field waste. Veil et al. (1996) describes other types of cavern disposal activities in the United Kingdom, Germany, the Netherlands, and Mexico.

3.4 WASTE DISPOSAL PROCESS

Initially, caverns are filled with clean brine. Wastes are introduced as a slurry of waste and a carrier fluid (brine or fresh water). A carrier fluid that is not fully saturated with salt will eventually leach salt from the cavern walls or roof. Expansion of cavern diameter is generally not a problem as long as the anticipated degree of expansion is accounted for in the cavern design and the actual degree of expansion is monitored throughout the waste emplacement cycle. To avoid excessive leaching of the cavern roof, operators may intentionally introduce a hydrocarbon pad that, by virtue of its lower density, will float to the top of the cavern and keep the unsaturated carrier fluid from coming in contact with the cavern roof.

As the waste slurry is injected, the cavern acts as an oil/water/solids separator. The heavier solids fall to the bottom of the cavern, forming a pile. Any free oils or hydrocarbons that are associated with the waste float to the top of the cavern. Clean brine displaced by the incoming slurry is removed from the cavern and either sold as a product or disposed of in an injection well. When the cavern is filled, the operator removes the hydrocarbon pad and plugs the cavern.

3.5 CAVERN CLOSURE

There is no actual field experience on the long-term impacts from disposing of oil field wastes in salt caverns. Theoretical studies estimate what might happen after such a cavern is closed. Various authors agree that pressures will build up in a closed cavern because of salt creep and geothermal heating. However, these authors do not specifically address caverns filled with oil field wastes. Several experienced researchers in the field interviewed by the authors of Veil et al. (1996) believe that caverns filled with oil field wastes would be much less likely to leak than would caverns

filled with less dense liquids. However, other experienced researchers believe that until the pore space of the waste pile is reduced through creep-induced compaction, a solids-filled cavern will behave in the same way as a fluid-filled cavern.

Some disposal caverns might leak after closure because of elevated pressures; however, the time needed for pressures to build to the point of cavern failure is not defined. Argonne's risk assessment of disposal caverns, due to be completed in late 1997, may shed some light on the consequences of cavern failure. Additional research on the likelihood and rates of cavern failure following closure would be useful to better understand this issue.

4 REGULATORY CONSIDERATIONS

This section describes the federal and state requirements that apply to the disposal of oil field wastes. Three federal statutes govern disposal of oil field wastes — the Resource Conservation and Recovery Act (RCRA), Safe Drinking Water Act (SDWA), and Clean Water Act (CWA).

4.1 RCRA EXEMPTS OIL FIELD WASTES FROM HAZARDOUS WASTE REQUIREMENTS

The most important distinction between oil field wastes and many other types of industrial wastes is that the former are exempted from the hazardous waste requirements of RCRA. On July 6, 1988, the U.S. Environmental Protection Agency (EPA) issued a regulatory determination that exempted any wastes arising from the exploration, development, and production of crude oil, natural gas, and geothermal energy from regulation as hazardous wastes under RCRA Subtitle C (53 FR 25477). The list of wastes exempted from RCRA Subtitle C is reproduced in Table 1. On March 22, 1993, the EPA clarified the 1988 determination and exempted many other wastes that were uniquely associated with exploration and production operations from RCRA Subtitle C requirements (58 FR 15284). The clarification restates the EPA's position that wastes derived from treatment of an exempted waste generally remain exempt, and that off-site transportation does not negate the exemption. Some wastes derived from treatment of an exempt waste may not be exempt, however.

The EPA has emphasized the need to work with states to encourage changes in their regulations to improve the management of wastes from oil and gas exploration and production. Given the federal exemption from RCRA for oil field wastes, the waste management requirements faced by most operators will be state requirements.

4.2 SDWA REGULATES SALT CAVERNS FOR OIL FIELD WASTE DISPOSAL AS CLASS II INJECTION WELLS

Unlike most other methods for disposing of nonhazardous oil field waste, salt caverns and injection wells are subject to the requirements of the SDWA's Underground Injection Control (UIC) program. All injection wells are assigned to five classes. Salt caverns for disposing of oil field waste and wells for disposing of produced water are Class II wells.

States seeking authority to administer the UIC program may obtain primacy in two ways. Under Section 1422 of the SDWA, states must demonstrate that their regulations are at least as stringent as those adopted by the EPA. To provide greater flexibility for states administering Class II

programs, Congress added Section 1425 to the SDWA, which requires states seeking delegation to have an underground injection program that meets the requirements of Section 1421(b)(1)(A)-(D) and would be effective enough to prevent any underground injection that would endanger drinking water sources.

4.3 CWA REGULATES DISCHARGES OF OIL FIELD WASTES INTO SURFACE WATER

Under the CWA, the EPA must establish effluent limitations guidelines (ELGs) for most major industrial categories. The ELGs prohibit the majority of oil and gas exploration and production wells from discharging oil field wastes. However, offshore wells and wells in Cook Inlet, Alaska, are allowed to discharge most types of oil field wastes, subject to the requirements of National Pollutant Discharge Elimination System (NPDES) permits. The ELGs also do not establish any requirements for stripper oil wells (wells producing less than 10 bbl per day of oil). Wells in the agricultural and wildlife use subcategory may discharge produced water to surface water under the requirements of an NPDES permit. Some western U.S. operators can dispose of their relatively fresh produced waters to irrigation ditches under this subcategory.

Surface water discharge is not an available option for onshore wells, other than those in the stripper well and agricultural and wildlife use subcategories, and onshore wells make up the largest segment of U.S. oil and gas wells. Onshore wells must dispose of oil field wastes on-site or off-site at land-based or underground facilities. Some onshore wells may discharge produced water or other aqueous wastes to sanitary sewer systems.

4.4 STATES REGULATE WASTE MANAGEMENT

The DOE/IOGCC (1993) study provides a thorough overview of the waste management requirements of 17 oil- and gas-producing states. Some regulatory changes have occurred since 1993, but the majority of the information in that report remains accurate. As of 1992 (the year in which data for a 1993 report would have been collected), all of the 17 states surveyed allowed most types of oil field wastes to be disposed of on-site by means of a variety of methods. Not every state allows all disposal methods (e.g., Kansas does not allow land spreading of drilling wastes; Louisiana does not allow pits in coastal areas; and Michigan and North Dakota prohibit annular injection), but each state allows several disposal options. Appendix B of DOE/IOGCC (1993) provides a detailed state-by-state discussion of oil and gas waste management requirements and approved disposal methods.

Most states follow the EPA's determination to exempt oil field wastes from hazardous waste requirements. California is an exception to this policy; it does not offer a blanket exemption from

hazardous waste requirements. California requires testing of all wastes; wastes that test as hazardous, regardless of their source, must be handled as hazardous wastes.

The IOGCC has also developed waste management guidelines for state oil and gas regulatory programs that recognize and support on-site disposal of nonhazardous oil and gas wastes (IOGCC 1994). Individual states are not bound by the IOGCC guidelines, but the guidelines serve as a good indication of what types of practices states do allow. IOGCC (1994) contains general and administrative criteria and technical criteria for on-site pits, land spreading, burial and landfilling, road spreading, tanks, and off-site commercial and centralized disposal facilities.

5 AVAILABILITY AND COST OF OFF-SITE COMMERCIAL DISPOSAL FACILITIES

Section 2 documented that much of the associated wastes and some drilling wastes are sent to off-site commercial facilities for disposal. However, the references cited in that section do not provide information on the types of disposal methods employed by the commercial disposal facilities or the price an operator must pay for disposal at those facilities. This section describes the results of a survey conducted by Argonne National Laboratory from July 1996 to March 1997 that collected such information. The information contained here is derived from either written materials provided by commercial disposal companies or telephone interviews between the author and the disposal companies.

5.1 APPROACH AND FOCUS OF THE SURVEY

The initial intent of the survey was to compare the disposal costs at the four salt cavern disposal facilities currently in operation in Texas with the costs of other, more established disposal methods. The findings were then to be used to assess whether cavern disposal could compete on a cost basis with the other disposal methods. Consequently, the survey was initially limited to those states that both produced significant levels of oil and gas and contained salt formations that were thick enough and near enough to the surface to be economically used for cavern disposal.

The resulting data were sparse enough that the survey was expanded to include commercial disposal activities in all other major oil- and gas-producing states. Thus the survey developed a second focus; it was the basis for assembling a national database on commercial waste disposal costs.

Commercial off-site produced water disposal wells are found in many of the oil- and gasproducing states. The survey was not initially intended to consider commercial off-site disposal facilities for produced water. However, some commercial disposal companies operate separate facilities — some for disposal of solid or semisolid wastes like drilling wastes or associated wastes, and others for disposal of produced water. Those companies provided information on disposal costs for both categories of waste. Therefore, the survey was expanded to include some information on a limited number of commercial companies that dispose of produced water. The data presented here are believed to be a reasonable representation of commercial disposal costs for the states in which those disposal companies are located. Those costs may or may not be transferable to other oil- and gas-producing states.

Data were collected in two steps. First, representatives of state oil and gas regulatory agencies were contacted to determine if a list of permitted commercial disposal companies was

available. Then, if such a list existed, each company on the list was contacted by phone. If a state agency had no list of commercial disposal companies, state officials were asked to describe how operators in that state disposed of their nonhazardous oil field waste. Commercial disposal companies were asked what type of wastes they accepted, what type of disposal method they employed, and how much they charged for disposal, exclusive of transportation costs. The majority of companies surveyed willingly provided information. A few companies elected not to participate, primarily out of concern that the cost information might be used to their competitive disadvantage. These companies are not discussed in the following sections or listed in the tables on disposal companies. The resulting information on the availability and cost of off-site commercial disposal companies is provided by state in the following sections.

5.2 STATES WITH INDUSTRY-SPECIFIC OFF-SITE COMMERCIAL DISPOSAL

In several states, there are many off-site commercial disposal companies that are dedicated to accepting only oil field wastes. In these states, this type of facility handles most of the oil field waste that is sent off-site. In other states, a combination of oil-industry-specific disposal facilities and other more general industrial waste disposal facilities receive oil field waste that is sent off-site. This section describes the availability of off-site disposal and the disposal methods used at these commercial sites. Table 8 lists companies that dispose of solid and oily wastes (which correspond to associated wastes and oil-based drilling wastes). Table 9 lists companies that dispose of produced water, rain water, and other dirty-water-type wastes. Table 10 lists companies that dispose of water-based drilling wastes. As noted in the previous section, only a few off-site commercial companies for disposal of produced water are included in the discussion.

The inclusion of disposal companies in Tables 8-10 does not constitute an endorsement of those companies or provide any indication of their performance capabilities. The companies are included solely to provide an indication of the types of commercial disposal options available to operators in the 1996-1997 time frame.

5.2.1 Arkansas

Hampton Bussey of the Arkansas Oil and Gas Commission indicated that if sufficient surface casing has been set to satisfy state and EPA requirements, drilling fluids are injected into wells on-site. Drilling fluids that are not injected into the wellbore are either recycled or buried

State	Company	Type	Cost ^a	Comments
AR	B&C Oilfield Construction	Recycle	\$0-\$40/hour	Tank bottoms only; no charge for first 4 hours, \$40/hour after that; they clean tanks, accumulate tank bottoms, and sell to a refinery
AR	Arkansas Service Company	Recycle	\$45/hour	Tank bottoms only; they clean tanks, accumulate tank bottoms, and sell to a refinery
CA	VenVirotek	Chem. treat/reuse	\$15-\$25/ton	After treatment, used for landfill cover
CA	Terrain Technology	Chem. treat/reuse	\$12-\$25/ton	Make dust control product; drilling muds are evaporated and reused, \$3-\$6/bbl
CA	Morton Recycling	Bio. treat/reuse	\$12.50-\$28.50/yd ³	After treatment, used for fill dirt
CA	Crosby and Overton	Thermal treat/reuse	\$10.50/bbl	Cost is for bulk liquids; solids are \$50/drum (\$38/bbl); used as soil
CA	Demeno Kerdoon	Treatreuse	\$0 -\$4.20/bbl	Cost is based on % of water; only takes liquids and sludges; no solids
CA	Liquid Waste MgmtMcKittrick	Treat/reuse	\$45/ton	Used for road base material
СА	Evergreen Oil	Reuse	\$52-\$77/bbl	Tank bottoms only; collects other wastes but sends to a third party for disposal
CA	Laidlaw-Lokern	Landfill	\$30-\$60/ton	\$4.20-\$18.90/bbl for liquids
CA	Laidlaw-Imperial Valley	Landfill	\$45/ton	Liquids can be solidified and landfilled at \$150/ton
CA	Simi Valley Landfill	Landfill	\$30-\$40/ton	
CA	Rollins OPC	Landfill - haz.waste	\$150/ton	Cost is for contam. soil; no treatment at this site, sent off-site
CA	Chem. Waste MgmtKettleman	Landfill - haz. waste	\$125/ton	
СА	Filter Recycling	Landspread	\$95/ton	\$38/bbl; no treatment at this site; it packages in bulk and sends off-site
8	Waste Management-Aurora	Landfill	\$12-\$20/yd3	Some waste is biologically treated to speed up breakdown of hydrocarbons
88	Conservation Services Laidlaw-Erie	Landfill Landfill	\$12-\$22/yd ³ \$10.80/yd ³	Some waste is landspread at \$10.50-\$18.90/bbl
CO	Strategic Environ. Solutions	Thermal treatment	\$30-\$100/ton	Operated as stationary or mobile units; may incorporate wastes into asphalt

TABLE 8 Disposal Costs for Solid and Oily Nonhazardous Oil Field Wastes

Company	Type	Cost ^a	Comments
Rinker-Miami	Incinerator	\$26-\$30/ton	Costs are for tank bottoms or contaminated soils
Campbell Wells-Mermentau	Land spread	\$9.50/bbl	
Campbell Wells-Elm Grove	Land spread	\$9.50/bbl	
Campbell Wells-Bourg	Land spread	\$9.50/bbl	
Campbell Wells-Bateman Island	Land spread	\$9.50/bbl	
Newpark-Morgan City	Treatinjection	\$8.50-\$11/bbl	Depends on oil and gas (o&g) content; treated solids sold for landfill cover material
Newpark-Fourchon	Treat/injection	\$8.50-\$11/bbl	Depends on o&g content; treated solids sold for landfill cover material
Newpark-Venice	Treatinjection	\$8.50-\$11/bbl	Depends on o&g content; treated solids sold for landfill cover material
Newpark-Intracoastal City	Treatinjection	\$8.50-\$11/bb	Depends on o&g content; treated solids sold for landfill cover material
Newpark-Cameron	Treat/injection	\$8.50-\$11/bbl	Depends on o&g content; treated solids sold for landfill cover material
BFI-Gulf Pines	Landfill	\$20-\$25/ton	
BFI-Big River	Landfill	\$19-\$25/yd ³	
BFI-Little Dixie	Landfill	\$20-\$25/ton	\$23-\$36/bbl for liquids
BFI-Three Rivers	Landfill	\$20/ton	
Transamerican Central	Landfill	\$18.50-\$24/ton	
WMI-Plantation Oaks	Landfill	\$35/ton	
WMI-Prairie Bluff	Landfill	\$35/ton	
WMI-Pecan Grove	Landfill	\$35/ton	
WMI-Pine Ridge	Landfill	\$35/ton	
Chambers-Clearview	Landfill	\$26.50/ton	\$18.90/bbl for liquids
C&C	Land spread	\$24/yd3	Contaminated soils only
Goo-Yea	Land spread	\$20/ton	Contaminated solid only
	Rinker-Miami Campbell Wells-Mermentau Campbell Wells-Banorg Campbell Wells-Banorg Campbell Wells-Bateman Island Newpark-Morgan City Newpark-Fourchon Newpark-Venice Newpark-Venice Newpark-Intracoastal City Newpark-Cameron Newpark-Cameron Self-Gulf Pines BFI-Gulf Pines BFI-Gulf Pines BFI-Cameron BFI-Little Dixie BFI-Three Rivers BFI-Little Dixie BFI-Three Rivers Cramsencican Central WMI-Prairie Bluff WMI-Prairie Bluff WMI-Preard Grove WMI-Pine Ridge Chambers-Clearview Cambers-Clearview		Incinerator Land spread Land spread Land spread Treat/injection Treat/injection Treat/injection Treat/injection Landfill

Costs for Off-Site Disposal of Nonhazardous Oil Field Waste

TABLE 8 (Cont.)

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State	Company	Type	Cost ^a	Comments
	Campbell Wcil-Zapata	Land spread	\$6.67-\$8.25/bbl	
	RCM Oil	Land spread	\$22.50/yd ³	Contaminated soils only
	Soil Recovery Systems	Land spread	\$57/bbi	\$30-\$40/yd ³
	Basic Remediation	Land spread	\$18/yd ³	
	J. Moss	Land spread/landfill	\$5.50-\$7/bbl	Solids - \$25/yd ³
	Westex Notrees	Landfill	\$3.25/bbl	\$15.50/yd ³
	Westex Sacroc	Landfill	\$3.25/bbl	\$15.50/yd ³
	Williams Oil Field Disposal	Pits/landfill	\$2.25/bbl	Dry solids - \$6.50/yd ³
	Eco Mud Disposal	Chem. treat/pit	\$9-\$12/bbl	$30/yd^3$, chemical stabilization of waste, then fill in caliche pit
	Lapoint Recycle and Storage	Pit	\$15/yd ³	Cost is for contaminated soil; tank bottoms at \$0.55/bbl
	Nick Stevenson	Pit	\$7/yd ³	Contaminated soils
	Water Disposal	Biol. treat./pit	\$0.50/bbl	Contaminated soils and tank bottoms
	Waste Inc Evanston	Pit	\$37.50/yd ³	Drilling wastes
	Waste IncLaBarge	Pit	\$37.50/yd ³	Drilling wastes
	Sierra Construction	Pit	\$6/bbl	
	Jim's Water Service-Blakes Pit	Pit	\$10.50/bbl	
	Jim's Water Service-Cannon Land	Pit	\$10.50/bbi	
	Jim's Water Service-McBeth Pits	Pit	\$10.50/bbl	
	Jim's Water Service-Werner Ranch	Pit	\$10.50/bbl	
	Oilfield Disposal Service	Recycle	\$6/bbl	Tank bottoms
	Great Plains Environmental	Treat/injection or NPDES	\$2-\$5/bbl	This is a general industrial wastewater treatment facility
	Sweetwater Co. Solid Waste	Landspread	\$50-\$55/ton	Contaminated soils and drilling wastes

^a Costs were provided by disposal companies between June 1996 and March 1997 and may not reflect current costs.

TABLE 8 (Cont.)

Wastes
Water-Type
Other
and
Water,
Rain
Water,
Produced
Costs for
9 Disposal (
TABLE 9

Comments	Produced water; injection cost is \$0.06/bbl; this company is nonprofit				Cost is for produced water; \$0.45-\$0.95 for rainwater	and rainwater					Produced water and other water-type wastes	and rainwater		For prod. water and other water-type wastes; dirty water up to \$3/bbl		Cost is for produced water; \$0.75 for other water-type wastes	Cost is for produced water; dirty water and rainwater = \$3-\$6.50/bbl	Cost is for produced water; dirty water and rainwater = \$3-\$6.50/bbl	Cost is for produced water; dirty water and rainwater = \$3-\$6.50/bbl	Do not take produced water; dirty water and rainwater = \$3\$-9.50/bbl	Produced water, dirty water, and rainwater	Produced water, dirty water, and rainwater	Produced water, dirty water, and rainwater	
Cost ^a	\$0.01-\$0.09/bbl Produced water:	\$1/bbl	\$0.40/bbl Produced water	\$0.20/bbl Produced water	\$0.35/bbl Cost is for produ	\$0.40/bbl Produced water and rainwater	\$0.50-\$0.75/bbi Produced water	\$0.50/bbl Produced water	\$0.31/bbl Produced water	\$0.36-\$0.42/bbl Produced water	\$0.35/bbl Produced water	\$0.29/bbl Produced water and rainwater	\$0.75/bbl Produced water	\$0.50-\$0.75/bbl For prod. water	\$0.60/bbl Produced water	\$0.50/bbl Cost is for prod-	\$0.40/bbl Cost is for prod	\$0.40/bbl Cost is for prod-	\$0.50/bbl Cost is for prod	Do not take pro	\$4.50/bbl Produced water	\$4.50/bbl Produced water	\$4.50/bbl Produced water,	\$4 \$0\hhi Produced water
Type	Evap./injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Injection	Inization
Company	Valley Waste Disposal	Magnum Drilling	L&S Service	Pool Company	J&R Systems-Lafayette	J&R Systems-Vermillion	Venvirotek	SWD Inc.	Saline Injection Systems	Oil Field Brine Disposal	FAS Services	Habetz Oilfield Saltwater Service	Hallar Enterprises	Houma Salt Water Disposal	Louisiana Tank	Teutsch	Campbelt Wells-Mermentau	Campbell Wells-Elm Grove	Campbell Wells-Bourg	Campbell Wells-Bateman Island	Newpark-Morgan City	Newpark-Fourchon	Newpark-Venice	
State	СА	КҮ	ΓV	LA	ΓA	ΓA	LA	LA	ΓA	LA	LA	ΓA	LA	LA	ΓA	LA	ΓA	ΓA	ΓA	ΓA	ΓA	ΓV	۲V	V I

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	Company	Type	Cost ^a	Comments
	CRI	Evaporation	\$0.25/bbl	Produced water
	Sundance	Evaporation	\$0.25/bbl	Produced water
	TNT Construction	Evaporation	\$0.81/bbl	Produced water
	Loco Hills	Evaporation	\$0.35/bbl	Produced water
	Sunco	Evap./injection	\$0.69/bbl	Produced water
	Basin Disposal	Injection	\$0.69/bbl	Produced water
	Eola Muds	Injection	\$0.30/bbl	Produced water
	Franklin Brine Treatment	Treat/NPDES	\$1-\$1.50/bbl	Produced water and other water-type wastes
	Hart Chemical	Treat/NPDES	\$1.80-\$2.10/bbl	\$2.10/bbl for produced water; \$1.80/bbl for nonsalty water
	Waste Treatment	Treat/NPDES	\$1.50/bbt	Produced water and other water-type wastes
	Allegheny Liquid Systems	Treat/POTW	\$1.25-\$1.80/bbl	Produced water and other water-type wastes
	Keystone Vacuum Services	POTW/road spread	\$1.30-\$4.20/bbl	Produced water is roadspread in summer; other water-type wastes go to POTW
	Moshannon Valley Treatment Plant	POTW	\$0.65/bbl	Other water-type wastes
	Beilefonte Treatment Plant	POTW	\$1.50/bbl	Other water-type wastes
	Williams Oil Field Disposal	Injection	\$0.30/bbl	Produced water
_	Permian Brine Sales-Big Springs	Injection	\$0.32-\$0.50/bbl	Produced water
	Taylor Service Company	Injection	\$0.35/bbl	Produced water
	Lundy Vacuum Services-Armour	Injection	\$0.30/bbl	Produced water
_	Lundy Vacuum Services-Wittig	Injection	\$0.30/bbl	Produced water
	Mo-Vac Service	Injection	\$0.35/bbl	Produced water
-	Basic Remediation	Injection	\$0.23-\$0.35/bbl	Produced water
	Newpark-Port Arthur	Injection	\$4.50/bbl	Produced water, dirty water, and rainwater
	Newpark-Ingleside	Injection	\$4.50/bbl	Produced water, dirty water, and rainwater

TABLE 9 (Cont.)

State	Company	Type	Cost ^a	Comments
	Lapoint Recycle and Storage	Evaporation	\$0.55/bbl	Produced water
	Ace Disposal	Evaporation	\$0.75/bbl	Produced water
	Hansen Disposal	Evaporation	\$0.50/bbl	Produced water
	Water Disposal	Evaporation	\$0.50/bbl	Produced water
	Montezuma Well Service	Evaporation	\$0.65-\$0.75/bbl	Produced water; costs are based on truck loads
	D&B Disposal	Evaporation	\$1.50//bbl	condensates
	Waste Inc Evanston	Evaporation	\$1.75-\$2.50/bbl	\$1.75/bbl for produced water; \$2.50 for other water-type wastes
	Waste IncLaBarge	Evaporation	\$1.10-\$2.50/bbl	\$1.10/bbl for produced water; \$2.50 for other water-type wastes
	Sierra Construction	Evaporation	\$0.60/bbl	Produced water
	Jim's Water Service-Blakes Pit	Evaporation	\$1/bbl	Produced water
	Jim's Water Service-Cannon Land	Evaporation	\$1/bbi	Produced water
	Jim's Water Service-McBeth Pits	Evaporation	\$1/bbl	Produced water
	Jim's Water Service-Werner Ranch	Evaporation	\$1/bbl	Produced water
	Oilfield Disposal Service	Evaporation	\$0.75-\$1.25/bbl	Produced water
	Mexican Flats Water Disposal	Evaporation	\$1.95/bbl	Produced water
	Great Plains Environmental	Treat/injection or NPDES	\$0.96/bbl	Produced water
	Wyoming Waste Water Disposal	Injection	\$1-\$2.50/bbl	Produced water
	Prima Exploration	Injection	\$0.60/bbl	Produced water
	Cortez Fraerov	Injection	\$0.75-\$8/bbl	Produced water and other water-type wastes

TABLE 9 (Cont.)

^a Costs were provided by disposal companies from June 1996 to March 1997 and may not reflect current costs.

State	Company	Type	Cost	Comments
СА	VenVirotek	Chem.treat/reuse	\$15-\$25/ton	After treatment, used for landfill cover
ΓV	Campbell Weils-Mermentau	Land spread	\$7.50-\$9.50/bbl	
LA	Campbell Wells-Elm Grove	Land spread	\$7.50-\$9.50/bbl	
LA	Campbell Wells-Bourg	Land spread	\$7.50-\$9.50/bbl	
LA	Campbell Wells-Bateman Island	Land spread	\$7.50-\$9.50/bbl	
ΓA	Newpark-Morgan City	Treat/injection	\$7.50/bbl	Treated solids sold for landfill cover material
ΓV	Newpark-Fourchon	Treat/injection	\$7.50/bbl	Treated solids sold for landfill cover material
LA	Newpark-Venice	Treat/injection	\$7.50/bbl	Treated solids sold for landfill cover material
LA	Newpark-Intracoastal City	Treat/injection	\$7.50/bbl	Treated solids sold for landfill cover material
LA	Newpark-Cameron	Treat/injection	\$7.50/bbl	Treated solids sold for landfill cover material
MN	CRI	Evaporation/landfill	\$2.50/bbl	\$14/yd ³ for solids
MN	Sundance	Evaporation/landfill	\$2.75/bbl	
MN	Gandy-Marley	Land spread	\$14/yd3	
WN	Envirotech	Land spread	\$18/yd3	
MN	TNT Construction	Land spread	\$20/yd3	
Ψz	Tierra	Land spread	\$16-\$18/yd ³	
ok	Briggett	Pit	\$0.90/bbl	
ОК	FPC Disposal	Pit	\$0.35/bbl	
ОĶ	Gray	Pit	\$0.75/bbl	Cost for solids - \$5.20-\$6.25/yd ³
оĶ	Eola Mud	Pit	\$0.75/bbl	
OK	Guard-Giles	Pit	\$0.60-\$0.75/bbl	
oK	Guard	Pit	\$0.60-\$0.75/bb}	
OK	Smith	Pit	\$0.88/bbl	
oK	O'Danicl Gravel	Pit	\$0.50/bbl	
OK	Safe Earth	Pit	\$0.75-\$1.75/bbl	Cost for muds depends on chloride content; cuttings - \$8.30-10/yd ³
Х	Poteet Oil	Pit	\$0.67-\$1/bbl	

TABLE 10 Disposal Costs for Water-Based Drilling Wastes

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Comments		Surcharges for solids and oil					Depends on solids & o&g content; discounts of \$1-\$1,5/bbl for high oil content	Depends on solids & o&g content; discounts of \$1-\$1.5/bb! for high oil content							\$10/yd3 for solids	Cost is for muds; cuttings - \$5/yd ³			Depends on oil and chlorides content		Cost is for muds; cuttings - (5.50) /yd ³ ; soil - 15/yd ³	Treated solids sold for landfill cover material	Treated solids sold for landfill cover material	
Cost	\$2.50-\$3.50/bbl	\$1.25-\$14.70/bbl	\$3.40-\$8.40/bbl	\$2.50-\$12.60/bbl	\$1.50/bbl	\$0.65/bbl	\$1.95-\$2.85/bbl	\$1,95-\$2.85/bbl	\$6/bbl	\$2.75/bbl	\$0.31-\$0.80/bbl	\$0.31-\$0.80/bbl	\$0.38/bbl	\$5/bbl	\$1/bbl	\$0.20/bbl	\$0.38/bbl	\$0.19/bbl	\$1.50-\$7/bbl	\$1/061	\$2/061	\$7.50/bbl	\$7.50/bbl	\$1.50/bbl
Type	Treat/NPDES	Treat/POTW	Treat/NPDES	Treat/NPDES	POTW	POTW	Cavern	Cavern	Cavern	Cavern	Land spread	Land spread	Land spread	Land spread	Land spread	Land spread	Land spread	Land spread	Land spread	Pit	Pit	Treat/injection	Treat/injection	Pit
Сотрапу	Franklin Brine Treatment	Allegheny Liquid Systems	Hart Chemical	Waste Treatment	Bellefonte Treatment Plant	Moshannon Valley Treatment Plant	Permian Brine Sales-Andrews	Permian Brine Sales-Big Springs	Taylor Service Co.	Voskamp Exploration	Lundy Vacuum Service-Beasley	Lundy Vacuum Service-Humphreys	F. W. Fontenot	Waste Facilities, Inc.	Karon Smith	Earl Nunneley	Keith Overby	Goetz Services	Campbell Wells-Zapata	Mo-Vac Service	J. Moss	Newpark-Port Arthur	Newpark-Ingleside	Ace Disposal
State	PA	PA	PA	ΡA	PA	PA	TX	ТХ	ТX	ТХ	ТХ	ТХ	ТХ	ТX	ТХ	ТХ	ТХ	ТХ	ТХ	ТX	ТХ	ТX	ТХ	UT

(Cont.)	
TABLE 10	

Comments								This is a general industrial wastewater treatment facility	
Cost	\$37.50/yd ³	\$37.50/yd ³	\$1-\$2/bbl	\$10.50/bbl	\$10.50/bbl	\$10.50/bbl	\$10.50/bbl	\$2-\$5/bbl	\$50-\$55/ton
Type	Pit	Pit	Pit	Pit	Pit	Pit	Pit	Treat/injection or NPDES	Landspread
Company	Waste Inc Evanston	Waste IncLaBarge	Sierra Construction	Jim's Water Service-Blakes Pit	Jim's Water Service-Cannon Land	Jim's Water Service-McBeth Pits	Jim's Water Service-Werner Ranch	Great Plains Environmental	Sweetwater Co. Solid Waste
State	ΨY	ΨY	ΨY	ΨY	ΨY	ΨY	ΨY	ΨY	γY

^a Costs were provided by disposal companies from June 1996 to March 1997 and may not reflect current costs.

on-site. He also stated that tank bottoms are handled by commercial reclaimers.¹ Dennis Endel of the Oil and Gas Commission provided a list of several reclaimers. All were contacted, but only two provided information. These two are listed in Table 8. The reclaimers come to the oil field site and clean out tank bottoms. They then take the tank bottoms back to their facility, where the bottoms accumulate until their volume is sufficient to be sold to a refinery.

5.2.2 California

William Guerard and Hal Bopp of the California Department of Conservation indicated that although there are commercial oil field waste disposal companies in California, no formal comprehensive list of them is available. They provided the names of several companies, who, in turn, provided the names of other companies. M.G. Mefferd of the Conservation Committee of California Oil and Gas Producers provided an additional list of disposal companies. All facilities identified through this process were contacted. Facilities that provided information are listed in Tables 8-10. Table 8 lists five hazardous and nonhazardous waste landfills that accept oil field waste and six facilities that chemically, biologically, or thermally treat solid and oily wastes and convert them into usable by-products. One of these facilities also treats water-based drilling wastes for reuse, as shown in Table 10. Table 8 also identifies a facility that receives oil field wastes, assembles them in bulk, and transports them to an off-site land spreading operation. Table 9 identifies one facility that disposes of produced water through injection and evaporation and fresh water through irrigation.

5.2.3 Louisiana

Carroll Wascom of the Department of Natural Resources provided a list of approved commercial disposal facilities. Every facility on the list was contacted. Those facilities that provided information are listed in Tables 8-10. Tables 8 and 10 identify four land spreading sites and five sites that treat the wastes, inject the liquids, and recycle the solids as landfill cover material. Table 9 shows 23 commercial injection wells operated by 15 companies.

¹ Although the practice of reclaiming tank bottoms may occur throughout a large portion of the United States, the data collected for this study are not adequate to draw nationwide conclusions. Many of the state representatives we interviewed did not provide information on reclaiming activities in their states. When reclaimers were identified, they were contacted, and if they provided information, it is included in Table 8. In EPA (1994), there is a table (Table B-1) that summarizes a study by the Interstate Oil and Gas Compact Commission and identifies reclaimers in 15 oil- and gas-producing states.

5.2.4 New Mexico

Mark Ashley and Denny Faust of the New Mexico Oil Conservation Division provided a list of approved commercial disposal facilities. Every facility on the list was contacted. Facilities that provided information are listed in Tables 8-10. Table 8 identifies six land spreading operations and two facilities that use evaporation and landfills for disposing of solid and oily wastes. Table 9 shows that four facilities use evaporation, one uses injection, and another uses both evaporation and injection for disposing of produced water. Table 10 identifies four land spreading operations and two facilities that use evaporation and landfills for disposing of water-based drilling wastes.

5.2.5 Oklahoma

Bruce Langhus of the Oklahoma Corporation Commission provided a list of active commercial disposal pits that are authorized to accept only water-based drilling wastes. All facilities on that list were contacted. The 10 facilities that provided information are listed in Table 10. One of these facilities also operates a injection well for produced water disposal, as shown in Table 8. A lengthy list of commercial well companies for disposal of produced water was also provided. These companies were not contacted and are not shown on Table 9.

5.2.6 Pennsylvania

James Erb of the Pennsylvania Department of Environmental Protection indicated that most nonhazardous oil field wastes are disposed of on-site. Although operators could take wastes to landfills, he was not aware of any operators that did. Ron Gilius, also of the Department of Environmental Protection, provided a list of commercial facilities that receive oil field waste. Most of these disposal facilities dispose of only produced water and were not contacted. Several other facilities that dispose of both produced water and drilling and frac fluids were contacted. Table 9 lists one facility that treats the waste and then discharges it to a publicly owned treatment works (POTW), two facilities that are POTWs, and three facilities that treat the waste and then discharge it to surface waters through in a National Pollutant Discharge Elimination System (NPDES) permit. All of these facilities also dispose of water-based drilling wastes and are listed in Table 10.

One other company, referred to by Mr. Gilius as a service company, collects wastes and transports them to a POTW. This company also spreads produced water on roads during the summer, which is considered a beneficial use of a waste material by the Department of Environmental Protection. There are other service companies operating in Pennsylvania, but they were not identified or contacted.

5.2.7 Texas

Jill Hibner of the Railroad Commission of Texas provided a list of approved commercial disposal facilities. Every facility on the list was contacted. Facilities that provided information are listed in Tables 8-10. Table 8 identifies 17 facilities that dispose of solid and oily wastes, including seven land spreading operations, four facilities that use salt caverns, four that use pits or landfills (one of which chemically stabilizes the waste first), and two that process solid wastes for reuse and inject liquid wastes.

Table 9 identifies nine facilities that employ injection for disposing of produced water, rain water, and other water-type wastes. Table 10 identifies 17 facilities for disposing of water-based drilling wastes, including nine land spreading operations, four facilities that use salt caverns, two that use pits or landfills, and two that process solid wastes for reuse and inject liquid wastes.

5.2.8 Utah

Gil Hunt of the Utah Department of Natural Resources provided a list of approved disposal pits. Every facility on the list was contacted. Facilities that provided information are listed in Tables 8-10. Table 8 identifies three facilities that accept contaminated soils. Two of those facilities also accept tank bottoms. Table 9 lists five facilities that dispose of produced water through evaporation in pits. Table 10 lists one facility that disposes of water-based drilling wastes.

5.2.9 Wyoming

Bob Lucht and Larry Robinson of the Wyoming Department of Environmental Quality provided a list of approved disposal pits. Every facility on the list was contacted. Facilities that provided information are listed in Tables 8-10. Table 8 identifies seven facilities that dispose of solid and oily wastes in pits, one that land spreads, and one that recycles tank bottoms. Table 9 identifies 10 facilities that evaporate produced water and other water-type wastes, three that employ injection, and the industrial treatment facility described above. Table 10 lists seven facilities that dispose of water-based drilling wastes in pits and one that land spreads. One additional facility, which treats the waste in an industrial treatment plant and then either injects it to a well or discharges it to surface waters through an NPDES permit, is listed in all three tables.

5.3 STATES WITHOUT INDUSTRY-SPECIFIC OFF-SITE COMMERCIAL DISPOSAL

Some oil- and gas-producing states support a network of industry-specific commercial disposal facilities; these are described in the previous section. Most other oil-and gas-producing states are unable to support this type of network. In this second group of states, most nonhazardous oil field wastes are disposed of on-site. The wastes that must go off-site for disposal are sent to local sanitary landfills, industrial disposal facilities not specific to the oil and gas industry, or out of state. The information obtained through interviews with representatives of these states is described below. Since sanitary landfills represent the primary off-site disposal option for operators in many of these states, information on landfill availability and cost was gathered from several states that represent different parts of the country: California, Colorado, Mississippi, and Ohio.

5.3.1 Alabama

David Bolin of the Alabama Oil and Gas Board indicated that most nonhazardous oil field waste is disposed of on-site. Tank bottoms are generally sent off-site to a commercial disposal facility. He was unable to identify any disposal facilities that specifically handle oil and gas industry wastes. Tank bottoms and other wastes that are sent off-site probably go to a local landfill or hazardous waste disposal facility or to an out-of-state facility for disposal.

5.3.2 Alaska

Jack Hartz of the Alaska Oil and Gas Conservation Commission indicated that all nonhazardous oil field wastes in Alaska are disposed of on-site.

5.3.3 Arizona

Steve Rauzi of the Arizona Geological Survey, which provides staff support for the Oil and Gas Conservation Commission, reported that all oil field wastes are either disposed of on-site or sent to disposal facilities in neighboring states.

5.3.4 Colorado

Robin Reade of the Colorado Oil and Gas Conservation Commission indicated that much of Colorado's oil and gas waste is disposed of on-site or at off-site land farms owned and operated by the oil companies for their own wastes. Table 8 lists three sanitary landfills that accept oil field wastes. One landfill offers biological treatment before landfilling to speed up degradation. A second landfill also offers land spreading. A fourth company provides thermal treatment for contaminated soils but does not treat or dispose of other types of oil field wastes.

5.3.5 Florida

Don Hargrove, Paul Attwood, and Ed Garrett of the Florida Geological Survey indicated that drilling wastes are disposed of on-site. Contaminated soils and tank bottoms are incinerated. One commercial incinerator is identified in Table 8.

5.3.6 Illinois

Lawrence Bengal of the Illinois Department of Natural Resources reported that Illinois has 12 commercial produced water disposal wells. These companies were not contacted and do not appear in Table 9. Most other oil field wastes are disposed of on-site. Those wastes that are sent offsite are taken to sanitary landfills or sent out of state.

5.3.7 Indiana

Mike Nickolaus of the Indiana Department of Natural Resources reported that most wastes are disposed of on-site. Some wastes may be sent to "special waste" landfills.

5.3.8 Kansas

William Bryson of the Kansas Geological Survey and Richard Bronaugh and Joe Cronin of the Kansas Department of Health and Environment were interviewed. They suggested that most oil field wastes generated in Kansas are disposed of on-site. None of these officials were aware of any commercial waste disposal facilities in Kansas that are operated solely for handling oil field wastes, although there might be some commercial disposal wells for produced water. Wastes that cannot be disposed of on-site are probably sent to local sanitary or industrial landfills or to commercial disposal facilities in other states.

5.3.9 Kentucky

James Hale and Dan Juett of the Kentucky Department for Environmental Protection indicated that drilling wastes are disposed of on-site by land spreading. Produced water is disposed of through underground injection, enhanced evaporation, or NPDES-permitted discharge. Tank bottoms and other nonhazardous wastes are sent to landfills permitted to accept such wastes. Hale and Juett reported that two commercial injection wells dispose of produced water. One of these companies is identified in Table 9. The other company could not be contacted.

5.3.10 Maryland

Molly Gary of the Maryland Department of the Environment reported that cuttings are disposed of on-site but that drilling fluids are taken to an out-of-state disposal facility.

5.3.11 Michigan

Tom Segall and Joan Peck of the Michigan Department of Environmental Quality were interviewed. Neither official was aware of any commercial waste disposal facilities in Michigan that are operated solely to handle oil field wastes. Wastes that cannot be disposed of on-site are probably sent to local sanitary or industrial landfills or commercial disposal facilities in other states.

5.3.12 Mississippi

Fred Hille of the Mississippi Oil and Gas Board indicated that there are presently no commercial waste disposal companies in Mississippi that are operated solely for handling nonhazardous oil field wastes. Several facilities are licensed to handle naturally occurring radioactive material (NORM) associated with oil and gas activities. This report does not focus on NORM disposal, so those facilities were not identified. Jeff Lundy, also of the Oil and Gas Board, indicated that in early 1997, an oil field waste disposal company had expressed interest in operating a disposal facility in Mississippi. This facility is not currently licensed or operational and is therefore not included in Tables 8-10.

Wastes that cannot be disposed of on-site are sent to local sanitary or industrial landfills or to commercial disposal facilities in other states. Because Mississippi was selected as an example of a Gulf Coast state in which solid waste landfills are used for oil field waste disposal, additional data on landfills were collected. Mark Williams and James Crawford of the Mississippi Department of Environmental Quality provided a list of Mississippi's 17 active municipal solid waste landfills. Eleven of those facilities, located in oil- and gas-producing parts of the state, were contacted. One of these landfills does not accept oil field wastes. The remaining 10 landfills are listed in Table 8.

5.3.13 Missouri

Evan Kifer of the Missouri Department of Natural Resources indicated that drilling wastes are disposed of on-site but that contaminated soils are sent to landfills. James Williams, also of the Department of Natural Resources, reported that some coal bed methane production wastewater has been transported out of state for disposal.

5.3.14 Montana

Tom Richmond of the Montana Board of Oil and Gas Conservation reported that the majority of oil field wastes are disposed of on-site. There is one special landfill in Montana that can accept oil field wastes if necessary.

5.3.15 Nebraska

Stan Belieu of the Nebraska Oil and Gas Commission suggested that most oil field wastes generated in Nebraska are disposed of on-site. He was unaware of any commercial waste disposal facilities in Nebraska that are operated solely for handling oil field wastes. Wastes that cannot be disposed of on-site are probably sent to local sanitary or industrial landfills or to commercial disposal facilities in other states.

5.3.16 Nevada

Russ Land of the Nevada Department of Conservation and Natural Resources indicated that all produced waters are disposed of through injection wells and all nonhazardous drilling and associated wastes are disposed of on-site. John Snow of the Nevada Division of Minerals reported that heavily contaminated soils and tank bottoms are sent to two thermal treatment facilities or a hazardous waste landfill, as listed in Table 8.

5.3.17 New York

Brad Field of the New York Department of Environmental Conservation indicated that some wastes are disposed of on-site but that many oil field wastes are sent either to sanitary landfills or to out-of-state disposal facilities.

5.3.18 North Dakota

Charles Koch of the North Dakota Industrial Commission reported that most wastes are disposed of on-site but contaminated soils are taken to an approved landfill for disposal. North Dakota has numerous commercial disposal wells. These were not identified or contacted and do not appear in Table 9.

5.3.19 Ohio

Dennis Crist of the Ohio Department of Natural Resources indicated that there are no commercial waste disposal companies in Ohio operated solely for handling nonhazardous oil field wastes. Most oil field wastes generated in Ohio are disposed of on-site. Wastes that cannot be disposed of on-site are sent to local sanitary or industrial landfills or to commercial disposal facilities in other states. Because Ohio was selected as an example of a northern state in which solid waste landfills are used for oil field waste disposal, additional data on landfills were collected. George Kaiser of the Ohio Environmental Protection Agency provided a list of Ohio's licensed solid waste landfills. Five of those landfills, located in oil- and gas-producing parts of the state, were contacted and are listed in Table 8.

5.3.20 South Dakota

Mac MacGillivray of the South Dakota Department of Environment and Natural Resources reported that most oil field wastes are disposed of on-site or by neighboring operators. If wastes need to go off-site, they are sent to sanitary landfills or taken out of state.

5.3.21 Virginia

Bob Wilson of the Virginia Department of Mines, Minerals, and Energy indicated that drill cuttings are disposed of on-site but other solid wastes are sent off-site to approved landfills or other general waste disposal facilities. Liquid wastes are disposed of in injection wells or taken out of state to licensed facilities for disposal.

5.3.22 West Virginia

Jamie Sturm of the West Virginia Department of Natural Resources indicated that most nonhazardous oil field waste is disposed of on-site. Tank bottoms are generally sent off-site to a commercial disposal facility. He identified three Pennsylvania facilities that handle oil field wastes.

Other West Virginia operators may send their wastes to local landfills. Gene Smith, also of the Department of Natural Resources, reported that West Virginia has six commercial disposal wells for produced water. These companies were not contacted and do not appear in Table 9.

5.4 COSTS OF OFF-SITE COMMERCIAL DISPOSAL

Tables 8-10 list the costs for the off-site commercial disposal of solid and oily wastes, produced water (including rain water and other water-type wastes), and water-based drilling wastes, respectively. These costs are discussed by waste type and disposal method in the text that follows. The costs represent only the cost for disposal and do not include other costs associated with transportation or vehicle washout. Many companies indicated they would offer discounts from their standard rates for large volumes of waste.

The costs included in Tables 8-10 are those that were provided by each disposal company to the author during June 1996 and March 1997. They are included in this report for comparative purposes at one point in time. There is no guarantee that those costs reflect the actual costs that would be charged to customers or that these companies still charge the same costs.

Costs are expressed in different units of measurement. Most costs are expressed as $\frac{1}{2}$ but others are expressed as $\frac{1}{2}$ unit is often used when the wastes are predominantly solids, and the $\frac{1}{2}$ on unit is commonly used by landfills because costs for disposal of municipal solid waste are based on $\frac{1}{2}$ on $\frac{1}{2}$ only an approximation, one can convert the latter two units into $\frac{1}{2}$ bbl, although the result is only an approximation, at best. To convert a volume-based unit (barrels or cubic yards) to a weight-based unit (tons), the specific gravity of the waste must be considered. If one assumes that oil field waste has a specific gravity that is 1.5 times that of water, the conversion factors are 1 yd³ = 4.81 bbl and 1 ton = 3.81 bbl. The conversions are not shown in Tables 8-10 but are provided in several places in the following sections to describe overall cost patterns.

5.4.1 Solid and Oily Waste

Costs for these wastes are found in Table 8. Overall, disposal costs range from 0-57/bbl, $6.50-50/yd^3$ (comparable to 1.35-10.40/converted bbl), and 12-150/ton (comparable to 3.15-39.40/converted bbl). The highest cost per bbl, 57/bbl, appears to be a true outlier. At the facility that charges that price, it costs less to dispose of a cubic yard of waste than a barrel of waste. This apparent anomaly can be attributed to the facility's reluctance to handle individual barrels rather than handling bulk wastes. After removing that anomalous value, the range becomes 1.95-38/bbl. Several of the facilities that charge high per-ton rates are facilities that also accept hazardous wastes for disposal.

Land spreading operations have a significant share of the commercial disposal market. Prices are 5.50-57/bbl and 14-40/yd³, with most costs falling in the range of 7-9.50/bbl and 18-25/yd³. Two land spreading facilities quoted a per-ton rate of 20-95/ton.

Landfills and pits represent another important disposal option for solid and oily wastes. Prices in Texas are 2.25-3.25/bbl and 6.50-25/yd³, while Wyoming prices are 6-10.50/bbl and 37.50/yd³. Two Utah facilities charge 7-15/yd³, and another charges 0.50/bbl. Two New Mexico facilities evaporate the liquid fraction of the waste and then send the solids to landfills. They charge 2.50-2.75/bbl and 14/yd³ for solids.

The Texas, Wyoming, Utah, and New Mexico landfills and pits in Table 8 are dedicated to receiving just oil field wastes, while the landfills in the other states are general solid waste or hazardous waste landfills that typically charge by the ton. Costs for disposing of solid wastes at landfills vary somewhat, depending on the state. For example, weight-based rates in Mississippi are \$18.50-\$35/ton; those in Ohio are \$17-\$29/ton; and those in California are \$30-\$40/ton at nonhazardous landfills and \$30-\$150/ton at hazardous waste landfills. One Nevada landfill charges \$31/ton. Three Colorado landfills charge \$10.80-\$22/yd³. Two Mississippi landfills will accept liquids at a much higher rate of \$18.90-\$36/bbl, and one Mississippi landfill charges \$19-\$25/yd³.

Several other disposal facilities treat the wastes before disposing of or reusing them. Five Louisiana facilities and two Texas facilities treat and reuse the solid part of the waste and inject the liquid part at a cost of \$8.50-\$11/bbl. Another Texas facility first chemically stabilizes the waste and then landfills it at a cost of \$9-\$12/bbl and \$30/ton. Five California facilities biologically or chemically treat waste and then reuse it at a cost of \$12-\$45/ton, \$12.50-\$28.50/yd³, and \$0-\$6/bbl. One of these facilities charges \$0-4.20/bbl but only accepts liquids and sludges.

Several facilities use thermal treatment or incineration followed by reuse or disposal of the residues. Costs are \$10.50-\$38/bbl and \$20-\$100/ton.

One California commercial facility evaporates liquid wastes in a surface impoundment at a cost of $4.20-18.90/yd^3$.

Several companies identified in this survey reclaim tank bottoms. Two Arkansas reclaimers charge by the hour. One charges \$45/hour, and the other charges nothing for the first four hours and \$40/hour for each additional hour. One New Mexico company and one Wyoming company reclaim tank bottoms at costs from \$2.50-\$6/bbl.

A Wyoming company operates a sophisticated industrial wastewater treatment plant that either injects the treated waste or discharges it to the sanitary sewer. This plant charges \$2-\$5/bbl.

The remaining disposal method for solid and oily wastes, salt caverns, appears to be among the least costly off-site disposal options at this time. Disposal at three cavern facilities located in west Texas costs \$1.95-\$2.85/bbl. Disposal at the fourth operating disposal cavern, located in east Texas, costs \$6/bbl or \$50/yd³ for contaminated soils. One reason the salt caverns cost less is that the Railroad Commission of Texas does not yet have regulations specifically targeted at disposal caverns. The four Texas disposal caverns are operating under permits issued by the Commission. However, in April 1996, the Commission proposed draft regulations. Most observers agree that when the regulations become final, the requirements placed on cavern operators will be more stringent than those currently specified by their permits. At that time, cavern siting, operating, monitoring, and closure costs are likely to increase, and the cavern operators will pass the increased costs to their customers. It is not possible to estimate the magnitude of the increase in costs that will follow final cavern disposal regulations.

The costs shown in Tables 8-10 do not include transportation costs, which can be substantial. Limited data collected during the survey indicate that trucking costs are \$42-\$63/hour. There are economic incentives for operators to send their wastes to disposal facilities located within a reasonably short distance from the oil and gas production site. Generally, operators will not transport waste more than 50-75 miles unless no other alternatives are available. Although disposal costs are important to an operator when determining which commercial waste disposal company to choose, the total of disposal costs, transportation costs, and other costs weigh heavily in the operator's final decision.

Examination of the data from a geographic perspective provides additional insights into disposal costs. As noted above, the disposal caverns in west Texas are much less costly than the disposal cavern in east Texas. One possible explanation for this cost dichotomy is competition. Figure 4 shows the locations of the four disposal caverns, with 75-mile-radius circles drawn around them. There are no other commercial disposal companies within the 75-mile-radius circle of the east Texas disposal cavern. There are several other commercial disposal companies within the 75-mile-radius circle of the three west Texas disposal caverns. All three facilities rank among the lowest-cost facilities for their disposal method.

5.4.2 Produced Water, Including Rain Water and Other Water-Type Wastes

Costs for disposing of these wastes are listed in Table 9. Overall, disposal costs are \$0.01-\$8/bbl, although most are \$0.25-\$1.50/bbl. The highest cost, \$8/bbl, is charged at one facility for particularly dirty wastes that need pretreatment before injection. The same facility charges as low as \$0.75/bbl for cleaner wastes. The lowest cost is charged by a nonprofit facility in California that operates as a cooperative for several member users.

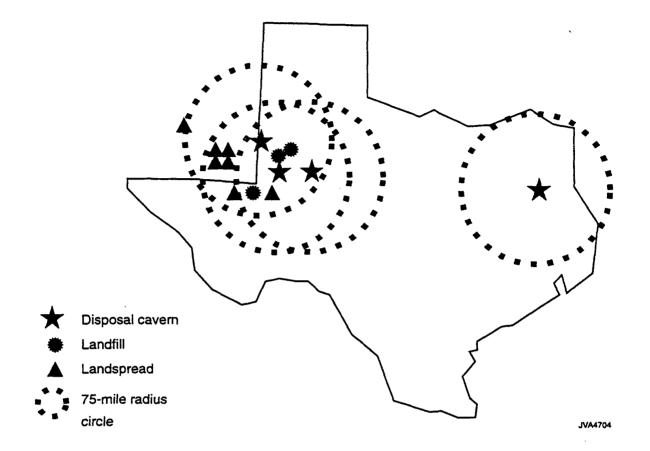


FIGURE 4 Locations of Disposal Caverns and Other Commercial Solid and Oily Waste Disposal Facilities within 75-Mile Radiuses

By far, the most common commercial disposal method for produced water is injection. As mentioned previously, the waste disposal cost survey did not focus on produced water disposal costs, and no attempt was made to obtain costs from most or all commercial produced water disposal companies. The range of costs for injection is the same as that described in the previous paragraph.

Ten companies in Wyoming, five companies in Utah, and four companies in New Mexico use evaporation to dispose of produced water. The cost is \$0.25-\$2.50/bbl. Another New Mexico company uses a combination of evaporation and injection, at a cost of \$0.69/bbl. The nonprofit California company described above, which also uses a combination of evaporation and injection, charges \$0.01-\$0.09/bbl.

Six companies in Pennsylvania utilize surface water discharge options. Three of these companies treat and blend produced water and discharge it directly through an NPDES permit. Another company treats the waste and discharges it to a sanitary sewer that leads to a municipal wastewater treatment plant. They charge \$1-\$2.10. Two municipal wastewater treatment plants accept water-type wastes but not produced water. They charge \$0.65-\$1.50/bbl. Another company

in Pennsylvania spreads produced water on roads in the summer and discharges to a municipal wastewater treatment plant in the winter. This company charges \$1.30-4.20/bbl.

Salt caverns have not been used for commercial produced water disposal because they are more costly than the other available produced water disposal options. Caverns are not likely to be used in the future, either, partly because a barrel of brine is brought to the surface for each barrel of produced water that is placed into the cavern. Unless there is a market for the brine, the costs will become prohibitive when compared with those of other locally available options.

5.4.3 Water-Based Drilling Wastes

Costs for these wastes are found in Table 8. Overall, disposal costs are \$0.20-\$14.70/bbl, \$5-\$37.50/yd³ (comparable to \$1.04-\$7.80/converted bbl), and \$15-\$55/ton (comparable to \$3.93-\$14.43/converted bbl).

Land spreading appears to be the most common commercial disposal method for waterbased drilling wastes. Prices vary in different states. In Texas, land spreading costs are 0.20-7/bl and $5-10/yd^3$. In Louisiana, land spreading costs are somewhat higher — 7.50-9.50/bl. New Mexico's commercial land spreading companies charge $14-20/yd^3$. One Wyoming company charges 50-55.

Another common commercial disposal method for water-based drilling waste is disposal pits. Ten Oklahoma pits charge 0.35-1.75/bbl, and two Texas pits charge 1-2/bbl. Solids are handled at several of the pits; costs are 5.20-15/yd³. One Utah pit charges 1.50/bbl. Seven Wyoming pits charge 1-10.50/bbl and 37.50/yd³.

Several other commercial disposal companies use a combination of treatment and disposal methods. Five Louisiana facilities and two Texas facilities treat the waste, reuse the solids as landfill cover, and inject the liquid, at a cost of \$7.50/bbl. Two New Mexico companies evaporate the liquids and landfill the solids at a cost of \$2.50-\$2.75/bbl or \$14/yd³ for solids.

Three Pennsylvania companies treat water-based drilling wastes and discharge them to surface waters under an NPDES permit. A fourth company treats the wastes and then discharges them to a local sanitary sewer that leads to a municipal wastewater treatment plant. These companies charge \$2.50-\$14.70/bbl. Two municipal wastewater treatment plants accept water-based drilling wastes and charge \$0.65-\$1.50/bbl. A Wyoming company operates a sophisticated industrial wastewater treatment plant that either injects the treated waste or discharges it to the sanitary sewer. This plant charges \$2-\$5/bbl.

One California company treats the wastes and reuses the solids as landfill cover at a cost of \$15-\$25/ton.

Salt caverns can be used to dispose of water-based drilling wastes. Cavern disposal costs are \$1.95-\$6/bbl.

6 CONCLUSIONS

According to Wakim (1987, 1988), in 1985, the U.S. exploration and production segment of the oil and gas industry generated more than 360 million bbl of drilling wastes, more than 20 billion bbl of produced water, and nearly 12 million bbl of associated wastes. Current exploration and production activities are believed to be generating comparable quantities of waste. Wakim estimates that 28% of drilling wastes, less than 2% of produced water, and 52% of associated wastes are sent to off-site commercial facilities for disposal. Little has been published on the availability of commercial disposal companies in different states. This report provides information on the availability of commercial disposal companies, the treatment and disposal methods they employ, and the amounts they charge. The conclusions are summarized below.

- At the federal level, the majority of oil field wastes are considered to be exempt from the hazardous waste provisions of RCRA. This nonhazardous classification simplifies the disposal of oil field waste and allows for reduced disposal costs. All oil- and gas-producing states except California accept this nonhazardous classification. California tests each waste for hazardous characteristics; if the waste fails, it is considered hazardous.
- Oil field wastes are regulated at the state level. All oil- and gas-producing states allow some on-site disposal of oil field wastes. Commonly used methods include underground injection, on-site burial, land spreading or other land treatment, evaporation, surface discharge, and recycling.
- Many drilling wastes and associated wastes are sent to off-site commercial disposal facilities. Interviews with oil and gas officials in 31 oil- and gasproducing states suggest that there are two off-site disposal trends.
 - Nine states contain numerous commercial disposal companies dedicated to handling only oil field wastes. These companies use the same disposal methods as those used for on-site disposal. In addition, the Railroad Commission of Texas has issued permits allowing several salt caverns to be used for disposal of oil field wastes.
 - 2. Twenty-two other oil- and gas-producing states contain few or no disposal companies dedicated to oil and gas industry waste. The only off-site commercial disposal companies available are general industrial waste disposal facilities or sanitary landfills.

- The cost of off-site commercial disposal varies, depending on the disposal method used, the state in which the disposal company is located, and the degree of competition in the area.
- In most cases, companies can dispose of their oil field wastes at a lower cost on-site than off-site and therefore choose on-site disposal. When wastes must be sent off-site for regulatory, economic, or other reasons, operators closely examine the total cost of off-site disposal. The total cost includes transportation and vehicle washout costs as well as disposal costs.
- Disposal caverns are presently cost-competitive in the Texas waste disposal market. However, disposal cavern costs are likely to increase in the near future as the Railroad Commission of Texas adopts regulations governing cavern disposal. It is unclear how the increased costs will affect the competitiveness of disposal caverns in the future, since costs at competing waste disposal facilities are likely to change.
- Regulatory officials in Louisiana, New Mexico, and Mississippi are presently considering how to manage cavern disposal in their states. The use of caverns to dispose of oil field waste will spread to other states, depending on the availability of suitable salt formations and the size of the off-site commercial disposal market in those states. The market, in turn, is affected by the stringency of state regulations on disposal of oil field wastes. Thus, future changes to state oil field waste disposal regulations will be an important catalyst to encourage new cavern disposal operations.
- This report does not evaluate the economic feasibility of using salt caverns to dispose of oil field wastes on-site. The author is not aware of any U.S. proposals to operate on-site disposal caverns, but one such project for Husky Oil in Saskatchewan, Canada, to dispose of its own wastes has been approved.

7 REFERENCES

API, 1994, "Design of Solution-Mined Underground Storage Practices," Recommended Practice 1114, American Petroleum Institute, Washington, D.C., June.

CSA, 1993, "Storage of Hydrocarbons in Underground Formations — Oil and Gas Industry Systems and Materials," Standard Z341-93, Canadian Standards Association, Rexdale, Ontario, Canada, July.

DOE/IOGCC, 1993, Oil and Gas Exploration and Production Waste Management: A 17-State Study, DOE/FE-62017-H1, prepared by ICF Resources, Inc., Washington, D.C., for U.S. Department of Energy, Washington, D.C., and Interstate Oil and Gas Compact Commission, Oklahoma City, Okla., June.

EPA, 1994, Associated Waste Report: Crude Oil Tank Bottoms and Oily Debris, draft, U.S. Environmental Protection Agency, Washington, D.C., March.

IOGCC, 1994, IOGCC Environmental Guidelines for State Oil & Gas Regulatory Programs, Interstate Oil and Gas Compact Commission, Oklahoma City, Okla., May.

IOGCC, 1995, Natural Gas Storage in Salt Caverns — A Guide for State Regulators, Interstate Oil and Gas Compact Commission, Oklahoma City, Okla., Oct.

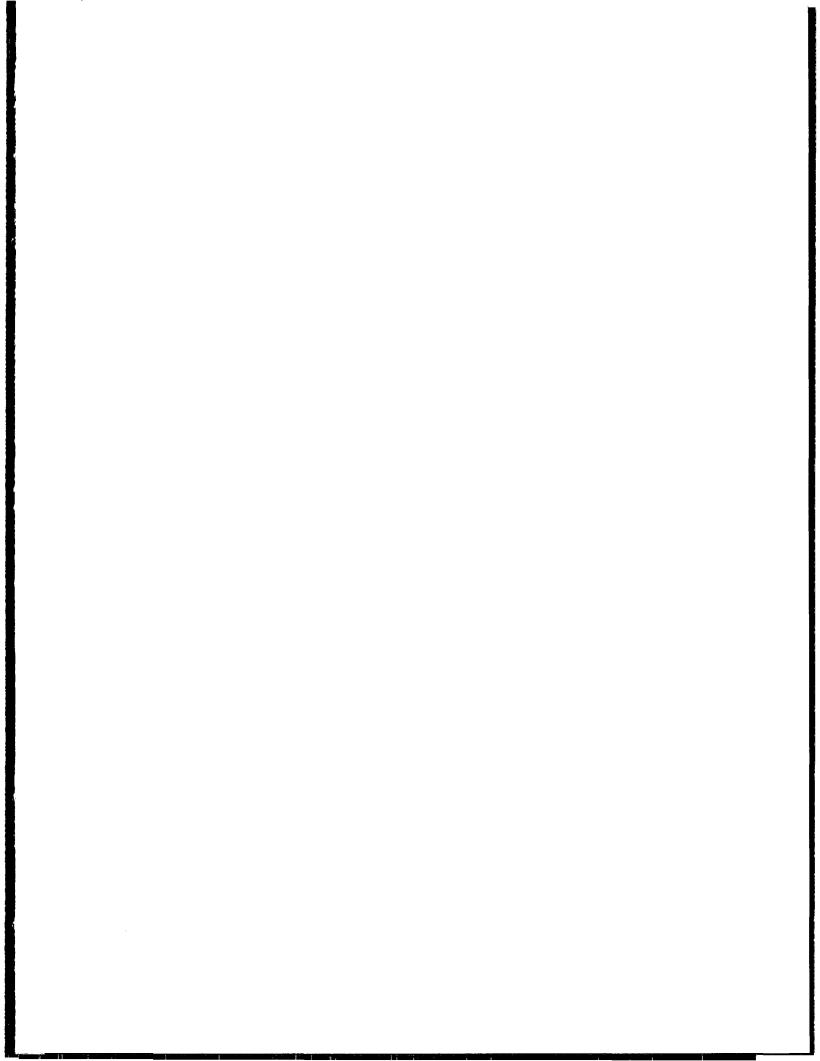
Johnson, K.S., and S. Gonzales, 1978, Salt Deposits in the United States and Regional Geologic Characteristics Important for Storage of Radioactive Wastes, Y/OWI/SUB-7414/1, prepared by Earth Resources Associates, Inc., Athens, Ga., for U.S. Department of Energy, Office of Waste Isolation, March.

Querio, C.W., 1980, "Design and Construction of Solution-Mined Caverns for LPG Storage," presented at Solution Mining Research Institute's fall meeting, Minneapolis, Minn., Oct. 12-15.

Veil, J. et al., 1996, Preliminary Technical and Legal Evaluation of Disposing of Nonhazardous Oil Field Waste into Salt Caverns, prepared by Argonne National Laboratory, Washington, D.C., for the U.S. Department of Energy, June.

Wakim, P.G., 1987, API 1985 Production Waste Survey, Statistical Analysis and Survey Results, American Petroleum Institute, Washington, D.C., Oct.

Wakim, P.G., 1988, API 1985 Production Waste Survey, Part II — Associated and Other Wastes, Statistical Analysis and Survey Results, American Petroleum Institute, Washington, D.C., June.



GUIDELINES FOR THE PREPARATION OF DISCHARGE PLANS AT BRINE EXTRACTION FACILITIES

(Revised 05-91)

Introduction

The New Mexico Oil Conservation Division (OCD) regulates brine extraction activities and disposal of non-domestic wastes resulting from this industry pursuant to authority granted in the New Mexico Water Quality Act and the Oil and Gas Act. OCD administers, through delegation by the New Mexico Water Quality Control Commission (WQCC), all Water Quality Act regulations pertaining to surface and ground water except sewage. However, if the sewage is in a combined waste stream, the OCD will have jurisdiction.

Sections 3-104 and 3-106 of the WQCC Regulations stipulate that, unless otherwise provided for by the regulations, no person shall cause or allow effluent or leachate to discharge so that it may move directly or indirectly into the ground water unless such discharge is pursuant to a discharge plan approved by the director. Additionally, Section 5-101 requires in situ extraction wells, including those extracting brine, to have approved discharge plans prior to operation. The Oil and Gas Act (Section 70-2-12.B(22)) authorizes the OCD to regulate the disposition of nondomestic, non-hazardous wastes at oil field facilities to protect public health and the environment. The OCD has combined these requirements into one document, (a "discharge plan") that will provide protection to ground water, surface water and the environment through proper regulation of brine extraction facilities and associated transfer, storage, and disposal of materials at the facility.

A proposed discharge plan shall set forth in detail the methods or techniques the discharger proposes to use which will ensure compliance with WQCC regulations and the Oil and Gas Act. The proposed discharge plan must provide the technical staff and the director of the regulating agency (in this case, the OCD) with sufficient information about the operation to demonstrate that the discharger's activities will not cause state regulations or ground water standards (WQCC Section 3-103) to be violated.

In addition to meeting the Part 5 WQCC requirements for injection wells, the discharge plan must address surface facility operations including storage pits, tankage and loading areas. Inadvertent discharges of liquids (ie. leaks and spills, or any type of accidental discharge of contaminants) or improper disposal of waste solids still have a potential to cause ground water contamination or threaten public health and the environment.

For existing brine extraction facilities presently operating under an approved discharge plan, WQCC UIC regulation 5-101.G stipulates that the expiration date of the plan shall be extended provided the following conditions are met: (1) A discharge plan renewal application should be submitted to the OCD at least 180 days prior to plan expiration, and (2) the discharger is in compliance with the existing plan on the original date of expiration. The extension of the existing plan is effective until the OCD approves or disapproves the renewal application. The renewal application should follow the attached guidelines with emphasis on the items that are not included in the original plan.

After a discharge application plan has been received, the OCD must publish a public notice pursuant to Section 3-108 of the regulations, and allow 30 days for public comment before a discharge plan may be approved or otherwise resolved. If significant public interest is indicated, a public hearing will be held which will delay a decision on plan approval.

Once a plan has been approved, discharges must be consistent with the terms and conditions of the plan. Similarly, if there is any facility expansion or process change that would result in any significant modification of the approved discharge of water contaminants, the discharger is required to notify this agency, and have the modification approved prior to implementation. Approval of a discharge plan application by OCD will not relieve the operator of the necessity to become familiar with other applicable state and federal regulations.

The review of a proposed discharge plan often requires several months depending on complexity. This includes time for requests to the discharger for additional information and clarification, inhouse information gathering and analysis, and field investigations of the discharge site, and a public notice and comment period. Review time will, to a large extent, be dependent on the extent to which a facility has generally self-contained processes to prevent movement of fluids and leaching of solids from the work area into the environment.

For example, the review process will be expedited when effluent, process or other fluids are routed to tanks, or lined pits with underdrains for leak detection, when accurate monitoring of fluid volumes and pressure and/or integrity testing is performed for leak detection in below grade or underground tanks, and when the possibility of accidental spills and leaks is addressed by adequate contingency plans (e.g. containment by curbing and drainage to properly constructed sumps). Other examples allowing faster review include recycling of waste oils, proper disposal of dried sludges to minimize potential ground water contamination, and closure of previously used ponds. A more rapid review of discharge plans for such facilities is possible because much less geologic and hydrologic study of the site is required in order to delineate impact.

Similarly, longer review times will be required for operators seeking to continue to use unlined ponds or to utilize other procedures that have a high probability of allowing infiltration and movement of effluent and leachate to the subsurface. For these instances large amounts of technical data generally will be required including: 1) detailed information on site hydrogeology, natural and current water quality, and movement of contaminants; 2) processes expected to occur in the vadose and saturated zones to attenuate constituents to meet WQCC standards at a place of present or reasonably foreseeable future use of ground water; and 3) monitoring of ground water (including post operational monitoring as necessary).

If an operator desires to change or modify effluent or solid waste disposal practices it is not necessary to have completed all such changes prior to plan approval. A commitment to make the changes together with submittal of proposed modification details and a timely completion schedule can be included in the plan. These become plan requirements after the plan is approved.

The following discharge plan application guidelines have been prepared for use by the discharger to aid in fulfilling the requirements of Sections 3-106, 3-107 and Part 5 (UIC) of the WQCC regulations and to expedite the review process by minimizing OCD requests for additional information. It sets up a logical sequence in which to present the information required in a discharge plan for this type of facility. It is suggested that you read the entire document before preparing your application. Not all information discussed in the guidelines may be applicable to your facility. However, all sections of the application form must be completed for new or renewal discharge plan applications.

If there are any questions on the preparation of a discharge plan, please contact OCD's Environmental Bureau (P. O. Box 2088, Santa Fe, New Mexico 87501-2088 or by telephone at (505) 827-5812).

DISCHARGE PLAN GUIDELINES

I. Name of Facility

Provide complete name. Indicate whether this is a new or renewal application.

II. Name of Operator or Legally Responsible Party and Local Representative

Include address and telephone number.

III. Location of Facility

Give a legal description of the location (i.e. 1/4. 1/4, Section, Township, Range) and county. Use state coordinates or latitude/longitude on unsurveyed land. Submit a large scale topographic map, facility site plan, or detailed aerial photograph for use in conjunction with the written material. It should depict the location of the injection well, storage tanks and/or ponds, process equipment, relevant objects, facility property boundaries, and other site information required in Sections V through IX below. If within an incorporated city, town or village provide a street location and map.

IV. Landowners

Attach the name and address of the landowner(s) of record of the facility site.

V. Type and Ouantities of Fluids Stored or Used at the Facility

List all fluids stored or used at the facility (e.g. High TDS salt water, hydrocarbons, etc.). Include source, average daily volume produced, estimated volume stored, location, and type of containers.

VI. Transfer, Storage and Disposal of Fluids and Solids

- A. Provide sufficient information to determine what water contaminants may be discharged to the surface and subsurface within the facility. Information desired includes whether tanks, piping, and pipelines are pressurized, above ground or buried. If fluids are drained to surface impoundments, skimmer pits, emergency pits, sumps, etc. for further transfer and processing, provide size and show if these units are lined or unlined. Provide fluid flow schematics with sufficient detail to show individual units.
 - 1. Tankage and Chemical Storage Areas Storage tanks for fluids other than fresh water must be bermed to contain a volume one-third more than the largest tank. If tanks are interconnected, the berm must be designed to contain a volume one-third more than the total volume of the interconnected tanks. Chemical and drum storage areas must be paved, curbed and drained such than spills or leaks from drums are contained on the pads or in lined sumps.
 - 2. Surface impoundments Date built, use, type and volume of materials stored, area, volume, depth, slope of pond sides, sub-grade description, liner type and thickness, compatibility of liner and stored materials, installation methods, leak detection methods, freeboard, runoff/runon protection.
 - 3. Leach fields Type and volume of effluents, leach field area and design layout. If non-sewage or mixed flow from any process units or internal drains is, or has been, sent to the leach fields, include dates of use and disposition of septic tank sludges.
 - 4. Solids disposal Describe types volumes frequency and location of on-site solids dried disposal. Typical solids include sands, sludges, filters, containers, cans and drums.
- B. For each of the transfer/storage/disposal methods listed above:
 - 1. Describe the existing and proposed measures to prevent or retard seepage such that ground water at any place of present or future use will meet the WQCC Standards of Section 3-103, and not contain any toxic pollutant as defined in Section 1-101.UU.
 - 2. Provide the location and design of site(s) and method(s) to be available for sampling, and for measurement or calculation of flow.

- 3. Describe the monitoring system existing or proposed in the plan to detect leakage or failure of any discharge system. If ground water monitoring exists or is proposed, provide information on the number, location, design, and installation of monitoring wells.
- C. Off-Site Disposal

If wastewaters, sludges, solids etc. are pumped or shipped off-site, indicate general composition (e.g. waste oils), method of shipment (e.g. pipeline, trucked), and final disposition (e.g. recycling plant, OCD-permitted or domestic landfill, Class II disposal well). Include name, address, and location of receiving facility. If receiving facility is a sanitary or modified domestic landfill show operator approval for disposal of the shipped wastes.

- D. Proposed Modifications
 - 1. If protection of ground water cannot be demonstrated pursuant to Section B.1. above, describe what modification (including closure) is proposed to meet the requirements of the Regulations. Describe in detail the proposed changes. Provide the information requested in A. and B. above for the proposed modified facility and a proposed time schedule for construction and completion. (Note: OCD has developed specific guidelines for lined surface impoundments that are available on request.)
 - 2. For ponds, pits, leach fields, etc. where protection of ground water cannot be demonstrated, describe the proposed closure of such units so that existing fluids are removed, and emplacement of additional fluids and runoff/runon of precipitation are prevented. Provide a proposed time schedule for closure.
- E. If the facility contains underground piping, the age and specification (i.e., wall thickness, fabrication material, etc.) of said piping should be submitted. Upon evaluation of such information, mechanical integrity testing of piping may be necessary as a condition for discharge plan approval. If such testing (e.g. hydrostatic tests) has already been conducted, details of the program should be submitted.
- F. Inspection, Maintenance and Reporting
 - 1. Describe proposed routine inspection procedures for surface impoundments and other transfer, storage, or disposal units including leak detection systems. Include frequency of inspection, how records are to be maintained and OCD notification in the event of leaks.
 - 2. If ground water monitoring is used to detect leakage or failure of the surface impoundments, leach fields, or other approved transfer/storage/disposal systems provide:

- a. The frequency of sampling, and constituents to be analyzed.
- b. The proposed periodic reporting of the results of the monitoring and sampling.
- c. The proposed actions and procedures (including OCD notification) to be undertaken by the discharger in the event of detecting leaks or failure of the discharge system.
- 3. Discuss general procedures for containment of precipitation and runoff such that water in contact with process areas does not leave the facility, or is released only after testing for hazardous constituents. Include information on curbings, drainage, disposition, notification, etc.
- 4. Describe methods used to detect leaks and ensure integrity of above and below ground tanks, and piping. Discuss frequency of inspection and procedures to be undertaken if significant leaks are detected.
- 5. Submit a general closure plan describing what actions are to be taken when the facility discontinues operations. These actions must include:
 - 1. Removal of all fluids, contaminants and equipment.
 - 2. Grading of facility to as close to the original contour as is practical.
 - 3. Proper disposal of fluids, sludges and solids pursuant to rules and regulations in effect at the time of closure.

VII. Brine Extraction Well(s)

Insitu brine extraction wells must meet the requirements of Part 5 of the Water Quality Control Commission Regulations in addition to other applicable requirements of WQCC and Oil Conservation Division Rules and Regulations.

A. Drilling, Deepening, or Plug Back Operations

Before drilling, deepening, or plug back operations, the operator of the well must file the following plans, specifications, and pertinent documents with the Oil Conservation Division 90 days prior to start-up of the planned operation.

1. Form C-101 "Application for Permit to Drill, Deepen, or Plug Back" (OCD Rule 1101).

- 2. A "Notice of Intent to Discharge" in accordance with WQCC regulation 1-201 (New facilities only).
- 3. A map showing the number, name, and location of all producing oil and gas wells, injection wells, abandoned holes, surface bodies of water, watercourses, springs, mines, quarries, water wells, and other pertinent surface features within 1/4 mile from the wellbore(s).
- 4. Maps and cross-sections indicating the general vertical and lateral limits of all ground water having 10,000 mg/l or less TDS within one mile of the site. Show the position of such ground water within this area relative to the injection formation. Indicate the direction of water movement, where known, for each zone of ground water.
- 5. List all abandoned wells/shafts or other conduits in the area of review which penetrate the injection zone. Identify those which may provide a pathway for migration of contaminant through being improperly sealed, completed or abandoned. Detail what corrective action will be taken prior to start up of operations to prevent any movement of contaminants into ground water of less than/equal to 10,000 mg/l TDS through such conduits due to the proposed injection activity (e.g. plugging open holes). Include completion and plugging records.

If information becomes available after operations have begun, which indicates the presence of a conduit that will require plugging then the injection pressure will be limited to avoid movement of contaminants through such a conduit into protected groundwater.

- 6. Maps and cross-sections detailing the geology and geologic structure of the local area.
- 7. A proposed formation testing program to obtain an analysis or description of fluids in the receiving formation.
- 8. Schematic drawings of the surface and subsurface construction details.
- 9. The proposed drilling, evaluation, and testing, programs. Include logging procedures, coring program, and deviation checks.
- 10. The proposed stimulation, injection, and operation procedures (Note WQCC 5-206 limitations).

- 11. A plan for plugging and abandonment of the well that meets the requirements of WQCC regulations section 5-209. A plugging bond pursuant to OCD Rule 101 is required prior to commencement of any new well drilling operations.
- B. Workover Operations

Before performing remedial work, altering or pulling casing, plugging or abandonment, or any other workover, approval of OCD must be obtained. Approval should be requested on OCD Form C-103 "Sundry Notices and Reports on Wells" (OCD Rule 1103-A).

C. Additional Information Required with Discharge Plan

In addition to all of the information required above in Part VII.A. (Drilling, Deepening, or Plug Back Operations), include the following with your discharge plan application.

- 1. Provide evaluation, completion and well workover information. Include all logs, test results, completion reports and workover descriptions.
- 2. Provide the proposed maximum and average injection pressures and injection volume. If one well is to be used for injection and extraction, fresh water must be injected down the annulus and brine must be recovered up the tubing. Reverse flow will be allowed for up to once a month for 24 hours for clean out. If an alternative operating method is desired then a written request must be submitted to the OCD which describes the proposed operating procedures and how the mechanical integrity of the casing will be guaranteed.
- 3. Submit a proposed mechanical integrity testing program. OCD requires a casing pressure test isolating the casing from the formation using either a bridge plug or packer prior to start of operation, and repeated at least once every five years or during well work over. In addition, OCD requires an open hole pressure test to 500 PSI for 4 hours on an annual basis.
- 4. Provide an analysis of the injection fluid and brine. Include location and design of site(s) and method(s) of sampling. Analysis will be for concentrations of Total Dissolved Solids, Sodium, Calcium, Potassium, Magnesium, Bromide, Carbonate/Bicarbonate, Chloride and Sulfate.
- 5. Compare volumes of fresh water injected to volume of brine to detect underground losses and specify method by which volumes are determined. After approval, submittal of a quarterly report listing, by month, the volume of fluids injected and produced will be required.

6. For renewal application for facilities in operation in excess of 15 years, provide information on the size and extent of the solution cavern and geologic/engineering data demonstrating that continued brine extraction will not cause surface subsidence of catastrophic collapse.

VIII. Spill/Leak Prevention and Reporting Procedures (Contingency Plans)

It is necessary to include in the discharge plan submittal a contingency plan that anticipates where any leaks or spills might occur. It must describe how the discharger proposes to guard against such accidents and detect them when they have occurred. The contingency plan also must describe the steps proposed to contain and remove the spilled substance or mitigate the damage caused by the discharge such that ground water is protected, or movement into surface waters is prevented. The discharger will be required to notify the OCD Director in the event of significant leaks and spills. This commitment and proposed notification threshold levels must be included in the contingency plan.

A. Prevention

Describe how spills and leaks will be prevented at the facility. Include specifically how spillage/leakage will be prevented during truck loading and at major transfer points within the facility. Discuss general "housekeeping" procedures for areas not directly associated with the above major processes.

B. Containment and Cleanup

Describe procedures for containment and cleanup of major and minor spills at the facility. Include information as to whether areas are curbed, paved, and drained to sumps; final disposition of spill materials; etc.

C. Notification

Propose a schedule for OCD notification of spills. OCD requires immediate notification at major spills or within 24 hours and written subsequent notification of minor spills or within 10 days (OCD Rule 116).

IX. <u>Site Characteristics</u>

A. The following hydrologic/geologic information is required to be submitted with all discharge plan applications. Some information already may be included in this application or may be on file with OCD and can be provided to the applicant on request.

- 1. Provide the name, description, and location of any bodies of water, streams (indicate perennial or intermittent), or other watercourses (arroyos, canals, drains, etc.); and ground water discharges sites (seeps, springs, marshes, swamps) within one mile of the outside perimeter of the facility. For water wells, locate wells within one-quarter mile and specify use of water (e.g. public supply, domestic, stock, etc.).
- 2. Provide the depth to and total dissolved solids (TDS) concentration (in mg/l) of the ground water most likely to be affected by any discharge (planned or unplanned). Include the source of the information and how it was determined. Provide a recent water quality analysis of the ground water, if available, including name of analyzing laboratory and sample date.
- 3. Provide the following information and attach or reference source information as available (e.g. driller's logs):
 - a. Soil type(s) (sand, clay, loam, caliche);
 - b. Name of aquifer(s);
 - c. Composition of aquifer material (e.g. alluvium, sandstone, basalt, etc.); and
 - d. Depth to rock at base of alluvium (if available).
- 4. Provide information on:
 - a. The flooding potential at the discharge site with respect to major precipitation and/or run-off events; and
 - b. Flood protection measures (berms, channels, etc.), if applicable.
- B. Additional Information

Provide any additional information necessary to demonstrate that approval of the discharge plan will not result in concentrations in excess of the standards of WQCC Section 3-103 or the presence of any toxic pollutant (Section 1-101.UU.) at any place of withdrawal of water for present or reasonably foreseeable future use. Depending on the method and location of discharge, detailed technical information on site hydrologic and geologic conditions <u>may</u> be required to be submitted for discharge plan evaluation. This material is most likely to be required for unlined surface impoundments and pits, and leach fields. Check with OCD before providing this information. However, if required it could include but not be limited to:

- 1. Stratigraphic information including formation and member names, thickness, lithologies, lateral extent, etc.
- 2. Generalized maps and cross-sections;
- 3. Potentiometric maps for aquifers potentially affected;
- 4. Porosity, hydraulic conductivity, storactivity and other hydrologic parameters of the aquifer;
- 5. Specific information on the water quality of the receiving aquifer; and
- 6. Information on expected alteration of contaminants due to sorption, precipitation or chemical reaction in the unsaturated zone, and expected reactions and/or dilution in the aquifer.

X. <u>Other Compliance Information</u>

Attach such other information as is necessary to demonstrate compliance with any other OCD rules, regulations and/or orders. Examples include previous Division orders or letters authorizing operation of the facility or any surface impoundments at the location.

State of New Mexico Energy, Minerals and Natural Resources Department OIL CONSERVATION DIVISION P.O. Box 2088 Santa Fe, NM 87501

DISCHARGE PLAN APPLICATION FOR BRINE EXTRACTION FACILITIES (Refer to OCD Guidelines for assistance in completing the application.)

	\Box NEW \Box RENEWAL	
Ι.	FACILITY NAME:	
II.	OPERATOR:ADDRESS:PHONE:	
III.	LOCATION:/4/4 Section Township Range Submit large scale topographic map showing exact location.	
IV.	Attach the name and address of the landowner of the facility site.	
V.	Attach a description of the types and quantities of fluids at the facility.	
VI.	Attach a description of all fluid transfer and storage and fluid and solid disposal facilities.	
VII.	Attach a description of underground facilities (i.e. brine extraction well).	
VIII.	Attach a contingency plan for reporting and clean-up of spills or releases.	
IX.	Attach geological/hydrological evidence demonstrating that brine extraction operations will r adversely impact fresh water.	lot
X.	Attach such other information as is necessary to demonstrate compliance with any other OC rules, regulations and/or orders.	CD
XI.	CERTIFICATION	
	I hereby certify under penalty of law that I have personnaly examined and am familiar with t information submitted in this document and all attachments and that, based on my inquiry of the individuals immediately responsible for obtaining the information, I believe that the information is tra accurate and complete. I am aware that there are significant penalties for submitting false informati including the possibility of fine and imprisonment.	ose ue,
	Name: Title:	

Signature: ____

Date:

DISTRIBUTION: Original and one copy to Santa Fe with one copy to appropriate Division District Office.

5,91

RECEIVED REGION 6 1445 ROSS AVENUE, SUITE 1200 AND RECEIVED ALLAS, TX 75202-2735

MIL 1 1 1996

Mr. George Rauscher John Gandy Corporation Texas Commerce Bank Plaza 200 River Pointe Dr. Suite 310 Conroe, TX 77304-2718

Dear Mr. Rauscher:

This letter is in response to your Freedom of Information request for a list of all names, addresses, and contacts for Class I well operators in the Region. Region 6 does not actively maintain this information for each state and/or tribe. In Region 6, each state administers the underground injection control (UIC) program and the Environmental Protection Agency administers the UIC program for certain Indian lands. Therefore, to assist you in obtaining this information, we have enclosed a list of state UIC program contacts and the address for the only Class I well operator on Indian lands in the region.

Control number 6RIN-01160-96 has been assigned to your request. Please reference this number if any further information is needed. In addition, you may contact Ray Leissner of my staff at (214) 665-7183.

Sincerely yours, Larry Wright Larry Wright

Larry Wright Acting Chief Source Water Protection Branch

Enclosure

cc: Mr. Gerald Delavan, ADPC&E Mr. Carroll Wascom, LDNR, OC Mr. Preston Manning, NMED Mr. Roger Anderson, NMOCD Mr. Rod Horton, ODEQ Mr. Ben Knape, TNRCC

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CRI

CONTROLLED RECOVERY INC.

P.O. BOX 369, HOBBS, NM 88241 (505) 393-1079

May 28, 1996

State of New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division Santa Fe, New Mexico 87505

Re: (UIC-CL1-006) P. & S. Brine Sales-Sec. 16, T-25-S, R-37-E (GW-226) Permian Brine Sales-Sec. 34, T-29-S, R-36-E OCD Hearing, May 28, 1996, Hobbs, New Mexico

Dear Madam or Sir:

Thank you for permitting me to speak at this hearing today.

My name is Gail Power. I am employed by Controlled Recovery, Inc. of Hobbs, New Mexico. CRI is in the surface waste disposal business and crude oil reclamation business. I will stipulate at this time Permian and P&S would be competition to CRI if their permit applications are approved. Additional competition is not the issue and purpose of this hearing.

We are all present today to listen to various statements from interested parties in order that the OCD can accept and review all testimony pro and con to determine if the applications for salt cavern disposal operations should be permitted and allow Permian and P&S to accept for disposal permitted waste into brine-mined salt cavities.

Before the New Mexico OCD considers the issuance of these permits several factors should be considered. These factors are:

- 1. Applicants should be required to provide thorough geologic information about the characteristics of the salt stock, including sufficient data to image underneath all overhangs and to delineate the edge of the salt stock.
- 2. Applicants should be required to provide adequate financial assurance to indemnify all parties that could be adversely effected by a leak of waste into surface waters or underground water aquifers. Obviously as waste volumes increase the financial assurance should be expanded proportionately.
- 3. Applicants should be required to demonstrate public necessity exists for the permitting of waste injection into salt cavities.

- 4. Applicants should be required to explain and prove that all safety considerations have been met to the satisfaction of the New Mexico OCD to include:
 - a. Waste will not migrate (applicants should be able to prove the no-escape performance standard will be continuously met).
 - b. Gas pressure and liquids will not build up in the salt cavern.
 - c. All waste received will be properly classified.
- 5. Applicants should be required to satisfy the OCD that the public interest will be served and protected if the permits are issued. Possibly, the OCD should consider including the State of New Mexico Department of Health in the review process to ascertain all risks associated with this disposal method.
- 6. Applicants should be required to demonstrate proven waste containment and retrieval procedures in the event of a collapse, shift or leak in the sub-surface salt cavities.
- 7. The OCD may consider verification that no conflicts exist that are contrary or in violation of 40 CFR, Parts 144, 145, 146, 241, 243, 256, 257 and 268.

I respectfully request the OCD to consider all of my aforementioned recommendations.

In recent years the New Mexico Oil and Gas Industry, with the support, advise and regulatory assistance of the OCD has devoted great effort to reverse a long standing distrust and unfavorable image by the farming and ranching interest coupled with very poor ratings in the media and inferior regard among the general citizenry. The Oil and Gas Industry and the OCD have made great strides to improve this overall sub-standard profile by adhering to safe and prudent operations with specific concern for environmental issues.

With all the progress heretofore to improve the Oil and Gas Industry public standing, now is not the time to allow any wavering of these past gains and improvements by permitting any operations that are vulnerable to public safety, health and environmental risks and questions which could be counter-productive and, in fact, would adversely effect the entire Oil and Gas Industry in New Mexico and its Regulatory Agency. The honorable and dedicated commitment of the Oil and Gas Industry and the OCD should not be impugnable by authorizing high risk and unnecessary endeavors.

I respectfully request my remarks be included and made a part of the record of this hearing. A written transcript of my testimony is available for the record.

Thank you again for granting me time to address this hearing.

Sincerely. Gail Power

GP/jh

QUESTIONS FOR OCD HEARING

MAY 28, 1996-HOBBS, NEW MEXICO

- RE: (UIC-CL1-006) P. & S. BRINE SALES-SEC. 16, T-25-S, R-37-E (GW-226) PERMIAN BRINE SALES-SEC. 34, T-19-S, R-36-E
- 1. CAN BRINE-MINED CAVERNS (CAVITIES) GUARANTEE THE CONTAINMENT OF AQUEOUS E&P WASTE?
- 2. HOW ARE ACCIDENTAL E&P AND NON-E&P WASTE EVENTS HANDLED?
- 3. HOW CAN THE DIMENSIONS OF THE CAVITIES BE CERTIFIED BEFORE AND AFTER DISPOSAL OPERATIONS?
- 4. HOW WILL COMPATIBILITY OF THE WASTE STREAM WITH THE INJECTION FORMATION BE DETERMINED?
- 5. HOW WILL WASTE BE RETRIEVED IN THE EVENT OF BREACH OF THE CAVITY?
- 6. WHAT WILL BE METHOD OF LOCATING LEAKS?
- 7. HOW WILL THE INTEGRITY OF THE CAVITY BE CERTIFIED BOTH BEFORE AND AFTER DISPOSAL OPERATIONS?
- 8. WHAT WILL BE THE LENGTH OF PERMITTED OPERATIONS?
- 9. WHAT VOLUME OF WASTE INJECTIONS WILL BE PERMITTED?
- 10. WHAT WILL BE THE OPERATIONAL REQUIREMENTS?
- 11. WHAT IS THE POTENTIAL FOR SUBSIDENCE AND COLLAPSE?
- 12. WHO WILL CONDUCT ENVIRONMENTAL IMPACT STUDY TO DETERMINE RISK TO PUBLIC HEALTH AND ENVIRONMENT?
- 13. WHAT CONSIDERATION WILL BE GIVEN TO HISTORICAL OPERATIONAL PROBLEMS IN-CLUDING LOSS-CIRCULATION IN THE AREA?
- 14. WHY IS BRINE WELL #3 AT CLIMAX LOCATION IN PERMIAN APPLICATION NOT IDENTI-FIED AS HAVING SUB-SURFACE COMMUNICATION WITH WELLS #1 AND #2?
- 15 HOW DOES DISPOSAL INTO SALT CAVERNS OR SALT CAVITIES COMPARE WITH DIS-POSAL INTO SURFACE DISPOSAL FACILITIES?
- 16. WHAT PROCEDURE WILL BE USED TO CLOSE A BRINE DISPOSAL CAVITY AND WHAT GUARANTEE WILL INSURE THE LONG-TERM STABILITY OF THE WASTE?
- 17. WHAT ARE THE OPERATIONAL CLOSURE AND POST-CLOSURE MONITORING REQUIREMENTS?
- 18. WHAT WILL BE THE CAVITY DEGRADATION AFTER CLOSURE?

19. HOW CAN NO MIGRATION OF WASTE BE CERTIFIED AFTER CLOSURE?

- 20. WILL A CLOSURE PLAN, INCLUDING COST ESTIMATES SUFFICIENT TO CLOSE FACILITY TO PROTECT PUBLIC HEALTH AND ENVIRONMENT, BE REQUIRED?
- 21. WILL THERE BE FINANCIAL ASSURANCE REQUIRED TO COVER CLOSURE PLAN AND AT WHAT INTERVALS WILL CLOSURE PLAN AND RELATED COSTS BE REVIEWED AND UPDATED?

.

- 22. WHAT MEASURES WILL BE TAKEN TO MONITOR AND CONTROL PRESSURE AND TEMPER-ATURE INCREASES OVER THE YEARS THAT MAY CAUSE UNKNOWN PROBLEMS IN THE FUTURE?
- 23. HOW DOES THE STATE OF NEW MEXICO OIL CONSERVATION DIVISION PERMITTING OF BRINE-MINED DISPOSAL SITES COMPARE TO THE PERMITTING OF OTHER SUB-SURFACE WASTE DISPOSAL FACILITIES BY OTHER STATE OF NEW MEXICO AGENCIES?
- 24. HAS THE STATE OF NEW MEXICO OIL CONSERVATION COMMISSION DETERMINED IF CURRENT PERMITS/APPLICATIONS FOR BRINE-MINED WASTE DISPOSAL FACILITIES VIOLATE ANY FEDERAL STATUTES OR REGULATIONS?
- 25. WILL THE SALT CAVERN APPLICANTS BE OBLIGATED TO COMPLY WITH ALL RE-QUIREMENTS OF OCD RULE 711?
- 26. WILL THE BUREAU OF LAND MANAGEMENT AND/OR STATE OF NEW MEXICO PERMIT WASTE FROM FEDERAL LEASES TO BE INJECTED INTO THE DISPOSAL CAVITIES?
- 27. WILL THE BUREAU OF LAND MANAGEMENT AND/OR STATE OF NEW MEXICO ALLOW THE BRINE MIXED WITH WASTE TO BE USED ON FEDERAL LEASES?
- 28. IF EITHER OF THESE PERMITS ARE GRANTED, WILL THIS ESTABLISH A PRECEDENT FOR OTHER BRINE WELLS IN THE STATE OF NEW MEXICO TO BE CONVERTED INTO DISPOSAL SITES?
 a. HOW MANY DIFFERENT SALT STRUCTURES ARE LOCATED IN NEW MEXICO?
 b. IS THE DISPOSAL RISK THE SAME FOR DIFFERENT TYPE SALT STRUCTURES?
- 29. WILL THE BRINE PRODUCED BE A NON-EXEMPT INDUSTRIAL WASTE?
- 30. WHAT TESTING WILL BE DONE ON THE MIXED WASTE BEFORE DISTRIBUTION TO OTHER WELLS AND IN THE ENVIRONMENT?
- 31. WHAT RECORDS AND WASTE MANIFEST WILL BE REQUIRED PERTAINING TO BRINE DIS-TRIBUTION?
- 32. WHAT WILL BE IMPACT ON SURROUNDING LAND OWNERS AND RESIDENTS?
- 33. WHAT WILL BE IMPACT ON AREA MINERAL OWNERS?
- 34. ARE THE SALT FORMATIONS A NATURAL RESOURCE?
- 35. IS THIS DISPOSAL METHOD A DILUTION OF A WASTE STREAM?
- 36. ARE VALUABLE RECOVERABLE HYDROCARBONS BEING WASTED?



United States Department of the Interior

TO

BUREAU OF LAND MANAGEMENT ROSWELL DISTRICT OFFICE 1717 West Second Street Roswell, New Mexico 88202



IN REPLY REFER TO: 1703 (06010)

MAY 28 1996

William J. LeMay, Director New Mexico Oil Conservation Division 2040 South Pacheco Santa Fe, New Mexico 87505

Dear Mr. LeMay:

Please accept the following comments and questions from the Bureau of Land Management (BLM) regarding the proposed discharge plans GW-226 and UIC-CLI-006. The BLM requests admission of these comments and questions during the hearing scheduled for 3:00 p.m. May 28, 1996 in Hobbs, New Mexico. These comments and questions are in addition to the comments presented in our letter dated May 9, 1996. The comments and questions in this letter apply equally to both proposals.

<u>Ouestions</u>

- What on-site testing requirements will the Oil Conservation Division (OCD) impose to ensure the waste delivered to the proposed facilities for disposal meets all the Resource Conservation and Recovery Act (RCRA) subtitle C requirements for the oil field waste exemptions?
- 2. Does the brine proposed for use in the disposal process constitute a mixing of a waste stream with a usable product?
- 3. Do the proposed disposal processes negate the assumed RCRA exempt status of the waste?
- 4. Do the proposed processes constitute waste treatment as defined by RCRA?
- 5. How does the OCD plan to ensure the proposed waste streams meet the RCRA requirements for exempt status?
- 6. How does the OCD plan to define the size, shape and integrity of the proposed containers (salt caverns)? If the OCD does not plan to define the size, shape and integrity of the containers, how do the operators of the disposal processes plan to define the size, shape and integrity of the proposed containers?
- 7. Do the proposed disposal processes and containers meet or exceed the requirements for waste disposal as defined by RCRA subtitles C and D and the New Mexico Solid Waste regulations? Please provide specific regulatory citations and precisely how the proposals meet or exceed these requirements.
- 8. Do the processes and approval processes include mining a natural resource (salt)?

2

- 9. Do the proposals adequately protect available groundwater resources?
- 10. Do the processes and proposals include spill prevention plans that concur with regulations.

<u>Comments</u>

- 1. Both sites are adjacent to public lands and natural resources managed by the BLM. The proposals do not adequately address potential impact to the adjacent land or natural resources.
- 2. The size, shape and integrity of the proposed containers is not defined. The size and shape of the containers may impact public land or resources. Since the processes described recovery of brine and implied additional solution of salt, the size and shape of the container may change over time. If federal lands or resources are impacted by the proposed processes, the proposals constitute a violation of the Federal Land Policy and Management Act (FLPMA).
- 3. The proposals may not meet BLM disposal standards established by Onshore Order Number 7 and BLM New Mexico policy. Disposal processes that do not meet these standards are not authorized for use by federal lessees.
- 4. The National Environmental Policy Act (NEPA) requires completion of an Environmental Assessment (EA) or Environmental Impact Statement (EIS) if the processes meet or exceed the disposal standards established by Onshore Order Number 7 and BLM New Mexico policy. BLM requires this documentation before BLM approves transfer or disposal of any waste from federal leases at the proposed facilities.

Please contact Al Collar at 505-627-0272 if you have any questions.

Sincerely,

extur. Cone

Leslie M. Cone District Manager

cc: Coby Muckelroy NM Environment Department HRMB 2044 Galisteo Dr Santa Fe, NM 87502

Linda Freedman NM State Land Office P.O. Box 1148 Santa Fe, NM 87504-1148

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age 7C idland Reporter-Telegram iday, May 24, 1996

BUSINESS

Stocks/8-9C

Second round of SPR oil sales end

Three bids accepted

Innee blos accepted
 Wednesday brought \$21 million
 in revenues.

By N.Y. Times News Service

Washington — The Energy Department ended the second round of sales of oil from the nation's strategic reserves without accepting any additional bids.

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the government's acceptable price threshold," the DOE said. The department began the sale Wednesday, holding it open an additional day to see if it would produce additional

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bidders bought a total of 1.075 million barrels, produced \$21.02 million in revenue, the DOE said Thursday.

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■ Exxon Co. USA bought 200,000 barrels at \$19.65 a barrel, for a total of \$3.93 million. The oil will be delivered by

pipeline in May or June.
Basis Petroleum Inc. bought 475,000
t barrels at \$19.61 a barrel, for a total of \$9.31 million. The oil will be delivered by tanker in May.

■ Coastal Corp.'s Coastal States Trading Inc. subsidiary bought 400,000 barrels at \$19.45 each, for a total of \$7.78 million. Delivery will be by tanker in June. A third round of bids will be accepted June 3. and additional rounds will be

scheduled if necessary, the DOE said.

The three bids produced about onetenth of the \$227 million the government plans to raise from the sale of the reserve

oil. The department hopes to sell a total of 12 million barrels during fiscal 1996 for

an average price of \$18.91 a barrel. Congress ordered the sale as part of budget legislation. The Clinton administration expedited the sale, saying it hoped the extra oil on the market would depress prices and stem a rise in gasoline prices at the pump. The sale is viewed by market watchers

The sale is viewed by market watchers as an election-year political move. Twelve million barrels is less than one day's worth of domestic consumption, experts say. The White House has also come under fire for using the nation's emergency reserves in a time of nonemergency.

The sale is the government's iargest single reserve sale since a 17 million-barrel offering during the Persian Gulf war. That sale, combined with U.S. actions in the region, drove the price of oil about \$10 a barrel lower, an Energy Department official said.

The oil is coming out of the department's Weeks Island storage facility in Louisiana, which is being decommissioned because of a structural fault.

Crude prices have fallen in the weeks since the strategic petroleum reserve sale was announced on April 29. Imp.orts and production have picked up, casing concern that supply would be too low to meet demand in the summer driving season. In addition, Iraq is resuming oil sales for the first time since 1990, when the United Nations imposed sanctions following Iraq's invasion of Kuwait.



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Stocks/8-9C

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RAY POWELL, M.S., D.V.M. COMMISSIONER (505) 827-5760 FAX (505) 827-5766

310 OLD SANTA FE TRAIL P.O. BOX 1148 SANTA FE, NEW MEXICO 87504-1148

July 3, 1996

Permian Brine Sales, Inc. 6067 West Tenth Odessa, Texas 79763

Attn: A.L. Hickerson

Re: Application for Disposal of Nonhazardous Oilfield Waste in Salt Cavern

Dear Mr. Hickerson:

Thank you for your letter of June 24 and the packet of information on disposal of nonhazardous oilfield waste in salt caverns. As you also suggested, the State Land Office intends to send personnel to the Petroleum Environmental Conference in Albuquerque in September.

In your letter was a request that the Commissioner of Public Lands withdraw his objection to approval of your application to dispose of waste material in a salt cavern in Section 34, Township 19 South, Range 36 East. This section is adjacent to State Trust lands which could be impacted by these activities.

At this time, the Commissioner of Public Lands objects to the approval of nonhazardous oilfield waste in salt caverns based on the following factors:

1. Current Oil Conservation Division (OCD) rules contain no design standards for qualification of salt caverns for waste disposal. Standards should be developed prior to approval of applications, and should address siting, operation, maintenance, and performance requirements for waste disposal. These standards must be developed to prevent migration of waste or contamination of brine produced for sale from the operations.

2. OCD rules currently do not require a closure plan that includes a demonstration of stability for the abandoned cavern or sonar surveys for determination of the initial and final shapes, and areal extent of the caverns.

3. There is a lack of understanding of fluid dynamics within the waste injection formation, where previous studies have indicated transient high-pressure waterflows along distinct horizons of bedding planes at clastic-evaporite interfaces.







Page Two Permian Brine Sales, Inc. July 2, 1996

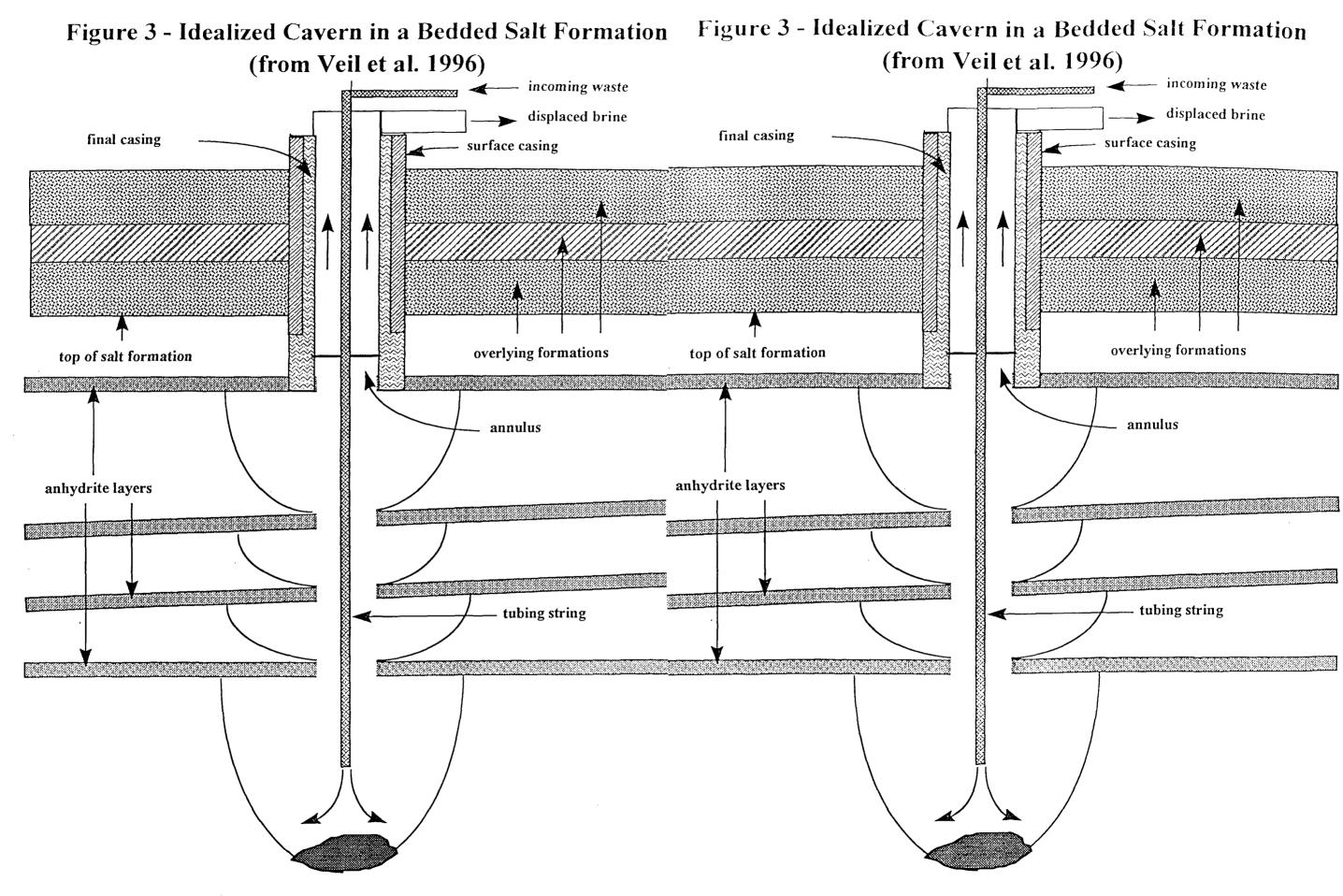
Until new rules, which must be grounded on a sound technical foundation, are enacted through a public hearing process, and until specific studies on fluid flow within the Salado Formation in this area are completed, the Commissioner is reluctant to withdraw his objection to the operation. Please do, however, continue to send us information on new methods of oilfield solids disposal.

Sincerely,

Larry Kehoe, Assistant Commissioner Mineral Resources

cc: William J. LeMay - NMOCD Mark Schmidt

LK/jb





United States Department of the InteriorAston.



BUREAU OF LAND MANAGEMENT ROSWELL DISTRICT OFFICE 1717 West Second Street Roswell, New Mexico 88202

IN REPLY REFER TO: 1703 (06010)

MAY 28 1996

William J. LeMay, Director New Mexico Oil Conservation Division 2040 South Pacheco Santa Fe, New Mexico 87505

Dear Mr. LeMay:

Please accept the following comments and questions from the Bureau of Land Management (BLM) regarding the proposed discharge plans GW-226 and UIC-CLI-006. The BLM requests admission of these comments and questions during the hearing scheduled for 3:00 p.m. May 28, 1996 in Hobbs, New Mexico. These comments and questions are in addition to the comments presented in our letter dated May 9, 1996. The comments and questions in this letter apply equally to both proposals.

Questions

- What on-site testing requirements will the Oil Conservation Division (OCD) impose to ensure the waste delivered to the proposed facilities for disposal meets all the Resource Conservation and Recovery Act (RCRA) subtitle C requirements for the oil field waste exemptions?
- Does the brine proposed for use in the disposal process constitute a mixing of a waste stream with a usable product?
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- 8. Do the processes and approval processes include mining a natural resource (salt)?

- 9. Do the proposals adequately protect available groundwater resources?
- 10. Do the processes and proposals include spill prevention plans that concur with regulations.

Comments

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- 1. Both sites are adjacent to public lands and natural resources managed by the BLM. The proposals do not adequately address potential impact to the adjacent land or natural resources.
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Please contact Al Collar at 505-627-0272 if you have any questions.

Sincerely,

extum. Cone

Leslie M. Cone District Manager

cc: Coby Muckelroy NM Environment Department HRMB 2044 Galisteo Dr Santa Fe, NM 87502

Linda Freedman NM State Land Office P.O. Box 1148 Santa Fe, NM 87504-1148 2

May 21, 1996 Santa Fe, New Mexico Contact: Lester Swindle 505-827-1375

PUBLIC MEETING ON DISPOSAL APPLICATIONS SET

The Oil Conservation Division of the Energy, Minerals and Natural Resources Department has received two applications for disposal of oil field wastes. The applications involve plans for utilizing abandoned drilling operations' tubing or casing for injection of non-hazardous oil field waste into salt caverns. The applications also include such items as construction, operation and monitoring of the wells along with plans for emergencies such as spills, leaks and other accidents. The Division has called a public meeting at the New Mexico Junior College in Hobbs, New Mexico, on May 28, 1996 at 3:00 PM.

Permian Brine Sales has submitted an application for disposal of waste into a salt cavern located west of Monument, New Mexico. Approximately 5,000 barrels per day of non-hazardous oil field waste slurry will be injected into an abandoned well to the bottom of the salt cavern, approximately 2,500 feet. P. & S. Brine Sales has submitted an application for disposal into a salt cavern located northeast of Jal, New Mexico. Approximately 2,500 barrels per day of slurry will be injected down the tubing of a previously plugged brine well to a depth of approximately 1,582 feet.

The operations would cause brine to be pushed to the surface as a result of the injection. Both applicants are in the business of selling the brine to other companies as an agent to facilitate the drilling process.

Any interested person may attend the meeting to be held in the Bob Moran Multi-Purpose meeting room at the school, or written comments may be submitted to: Director, New Mexico Oil Conservation Division, 2040 South Pacheco, Santa Fe, New Mexico 87505.

END



Becky Jo Doom HCR 68 Box 188 Jal, New Mexico 88252 (505) 395-2877

May 28, 1996

Mr. William J. Lemay State of New Mexico Energy, Minerals and Natural Resources Division 2040 South Pacheco Santa Fe, N. M. 87505

(GW-226) Permian Brine Sales Re.: (UIC-CL1) P & S Brine Sales

Dear Mr. LeMay:

I respectfully enter my opposition to the granting of the two above listed requests for permits for the disposal of oil field waste into the salt caverns. The disposal of any type of waste is too dangerous to the precious, scarce fresh waters of our area.

Not too long after Climax Chemical facility was first built, our 35 foot deep water well near the mid-point of section 12, township 24 south, range 37 east became contaminated. This well is located in the Monument Draw and is in the same stream as Climax Chemical. I do not recall exactly what measures were taken at the source as my father, J. J. Smith, was then alive and running the ranch. However I do know that it was many years before the water cleared up. We have not had it tested in the past two years, but will again this year.

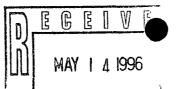
My parents bought land in Lea County in 1934, but my aunt and her husband homesteaded 86 years ago on land that is a part of our current ranch. In fact, our ranch has recently been designated as a Heritage Ranch.

There is already too much oil field related water contamination without allowing such a dangerous addition disposal method.

What will this area be without potable water?

Sincerely,

cky Jo Doom





United States Department of the Interior

BUREAU OF LAND MANAGEMENT ROSWELL DISTRICT OFFICE 1717 West Second Street Roswell, New Mexico 88202



IN REPLY REFER TO: 1703 (06010)

MAY 0 9 1996

William J. LeMay, Director New Mexico Oil Conservation Division 2040 South Pacheco Santa Fe, New Mexico 87505

Dear Mr. LeMay:

This letter provides written comments and concerns on the proposed discharge plans GW-226 and UIC-CLI-006. The Bureau of Land Management (BLM) first expressed comments on March 14, 1996, during a phone conversation between Mr. Roger Anderson of your office and Al Collar, the Carlsbad Resource Area Hazardous Materials Specialist.

Both proposed discharge plans involve injection and underground disposal of oilfield waste in salt caverns located in Lea County, New Mexico. Our comments and concerns apply equally to both proposals.

- 1. The proposals suggest the injection and disposal process involves only nonhazardous oilfield waste. The BLM is not certain there is adequate testing of the waste before disposal to establish the waste status as nonhazardous. The proposal may involve waste defined in the Resource Conservation and Recovery Act (RCRA) as exempt from regulation as a hazardous waste, but that does mean it is non-hazardous. The BLM is also concerned there is a lack of adequate protection or process that guarantees the disposal process involves only RCRA exempt oilfield waste.
- 2. Both sites are adjacent to public land and resources managed by the BLM. The proposals do not contain language, techniques, or processes that ensure protection of the public lands and resources from adverse impact should an accidental release occur at the proposed facility. The National Environmental Policy Act (NEPA) and Federal Land Policy and Management Act (FLPMA) require prior approval for processes that impact public land or resources.
- 3. The techniques and processes do not provide apparent protection of federal resources from subsurface migration of contaminants.

4. The techniques and processes described in the proposals indicate there is potential for solution mining of adjacent federal resources (salt). NEPA and FLPMA require prior approval for processes that impact public land or resources.

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The BLM respectfully requests that New Mexico Oil Conservation Division hold a public hearing for these proposals.

Sincerely,

lum. Cone

Léslie M. Cone District Manager

Affidavit of Publication

) ss.

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STATE OF NEW MEXICO

COUNTY OF LEA

Joyce Clemens being first duly sworn on oath Adv. Director deposes and says that he is of THE LOVINGTON DAILY LEADER, a daily newspaper of general paid circulation published in the English language at Lovington, Lea County, New Mexico; that said newspaper has been so published in such county continuously and uninterruptedly for a period in excess of Twenty-six (26) consecutive weeks next prior to the first publication of the notice hereto attached as hereinafter shown; and that said newspaper is in all things duly qualified to publish legal notices within the meaning of Chapter 167 of the 1937 Session Laws of the State of New Mexico.

That the notice which is hereto attached, entitled

Notice Of Publication

analahhhhhhan
COMMEXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
entire issue of THE LOVINGTON DAILY LEADER and
not in any supplement thereof, CHARACASASAN ANACASA SHA ANA SHA
samaxaayxaaxaaxaaxaa for one (1) day
down with the issue of
and ending with the issue of
And that the cost of publishing said notice is the

which sum has been (Paid) (Assessed) as Court Costs
Joine Clemens
Subscribed and sworn to before me this
day of May 19.96
Notary Public Las County New Maria
Notary Public, Lea County, New Mexico
My Commission Expires Sept. 28 19 98

LEGAL NOTICE NOTICE OF PUBLICATION STATE OF NEW MEXICO ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT OIL CONSERVATION DIVISION

Notice is hereby given that a public meeting will be held to solicit input regarding the following discharge plan applications, for disposal of oil field waste into the Salado Formation, that have been submitted to the Director of the Oil Conservation Division, 2040 South Pacheco, Santa Fe, New Mexico 87505, Telephone (505) 827-7131: (GW-226) - Permian Brine Sales, A.L. Hickerson, 6067 W Tenth, Odessa, Texas 79763, has submitted a discharge plan application for disposal of non-hazardous semi-solid oil field waste in abandoned salt caverns located in the SE/4 SE/4 of Section 34, Township 19 South, Range 36 East, NMPM, Lea County, New Mexico. Approximately 5,000 barrels per day of non-hazardous oil field waste slurry will be injected down the tubing of the abandoned Climax Chemical Company Foster No. 1 to the bottom of the salt cavern, approximately 2,500 feet, and brine will be produced up the annulus for sale. Ground water most likely to be affected in the event of an accidental discharge is at a depth of approximately 35 to 60 feet with a total dissolved solids concentration ranging from 500 to 3000 mg/l. The discharge plan addresses construction, operation and monitoring of the well and associated surface facilities and how spills, leaks, and other accidental discharges to the surface will be managed.

(UIC-CL1-006) - P. & S. Brine Sales, Paul Prather, P.O. Box 1768, Eunice, New Mexico, 88231 has submitted a discharge plan application for disposal of non-hazardous oil field waste in salt caverns located in Section 16, Township 25 South, Range 37 East, NMPM, Lea County, New Mexico. Currently, under discharge plan BW-007, fresh water is injected through the casing of the Arnott Ramsey State No. 4 into the Salado Formation at an approximate depth of 1,260 feet and brine is extracted through the tubing. The average total dissolved solids concentration of the brine is approximately 290,000 mg/l. The discharge plan application proposes to reenter the previously plugged Arnott Ramsey State No. 5 brine well to allow for the injection of approximately 2,500 barrels per day of non-hazardous oil field waste slurry. Injection will be through the tubing into the existing salt cavern to approximately 1,582 feet. The Arnott Ramsey State No. 4 will be used for brine returns through the tubing. Ground water most likely to be affected by any accidental discharge is at a depth of approximately 400 feet with a total dissolved solids concentration of approximately 1,025 mg/l. Pockets of ground water may exist in the area at depths as shallow as 50 feet, with higher or lower total dissolved solids concentrations. The discharge plan addresses construction, operation and monitoring of the well and associated surface facilities and provides a contingency plan in the event of accidental spills, leaks and other accidental discharges to the ground surface.

The public meeting will be held at the New Mexico Junior College, Bob Moran Multi-Purpose meeting room, on May 28, 1996 at 3:00 PM. Any interested person may attend to present comments. Written requests may be submitted to the Director of the Oil Conservation Division at the address given above.

Published in the Lovington Daily Leader May 15, 1996.

AFFIDAVIT OF PUBLICATION

State of New Mexico, County of Lea.

I, Kathi Bearden

Publisher

of the Hobbs Daily News-Sun, a daily newspaper published at Hobbs, New Mexico, do solemnly swear that the clipping attached hereto was published once a week in the regular and entire issue of said paper, and not a supplement thereof for a period.

of _____

_____ weeks. Beginning with the issue dated

<u>May 19</u>, 1996

and ending with the issue dated

<u>May 19</u>_____1996

Publisher

Sworn and subscribed to before

me this _____ _ day of

Notary Public.

My Commission expires August 29, 1999 (Seal)

1

This newspaper is duly qualified to publish legal notices or advertisements within the meaning of Section 3, Chapter 167, Laws of 1937, and payment of fees for said publication has been made.

LEGAL NOTICE May 19, 1996 PUBLIC NOTICE STATE OF NEW MEXICO ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT OIL CONSERVATION DIVISION

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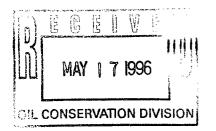
The public meeting will be held at the New Mexico Junior College, Bob Moran Multi-Purpose meeting room, on May 28, 1996 at 3:00 PM. Any interested person may attend to present comments. Written requests may be submitted to the Director of the Oil Conservation Division at the address given above. #14562



Since 1849. We Read You.

AD NUMBER: 502095

NEW MEXICO OIL CONSERVATION ATTN: SALLY MARTINEZ 2040 S. PACHECO ST. SANTA FE, NM 87505



	LEGAL NO: 59651	<u>P.O. #:</u> 96199002997
207	LINES once	at\$_82.80
Affidavits:		5.25
Tax:		5.50
Total:		\$ 93.55

ACCOUNT:56689

AFFIDAVIT OF PUBLICATION

STATE OF NEW MEXICO COUNTY OF SANTA FE

_____being first duly sworn declare and I, BETSY PERNER say that I am Legal Advertising Representative of THE SANTA FE NEW MEXICAN, a daily news paper published in the English language, and having a general circulation in the Counties of Santa Fe and Los Alamos, State of New Mexico and being a Newspaper duly qualified to publish legal notices and advertisements under the provisions of Chapter 167 on Session Laws of 1937; that the publication #59651 a copy of which is hereto attached was published in said newspaper once each for one consecutive week(s) and that the noweek tice was published in the newspaper proper and not in any supplement; the first publication being on the 15th day of 1996 and that the undersigned has personal MAY knowledge of the matter and things set forth in this affida-<vit. /S/ LEGAL ADVERTISEMENT REPRESENTATIVE Subscribed and sworn to before me on this 15th day of MAY A.D., 1996 **OFFICIAL SEAL** Candace C. Rulz NOTARY PUBLIC - STATE OR NEW MEXIC 202 East Marcy Street • P.O. Box 2048 • Santa Fel New Mexico 87501

505~983~3303 • (FAX)505~984~1785

NOTICE OF PUBLICATION

STATE OF NEW MEXICO

ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION DIVISION

Notice is hereby given that a public meeting will be held to solicit input regarding the following discharge plan applications, for disposal of oil field waste into the Salado Formation, that have been submitted to the Director of the Oil Conservation Division, 2040 South Pacheco, Santa Fe, New Mexico 87505, Telephone (505) 827-7131:

(GW-226) - Permian Brine Sales, A. L. Hickerson, 6067 W. Tenth, Odessa, Texas 79763, has submitted a discharge plan application for disposal of non-hazardous semi-solid oil field waste in abandoned salt caverns located in the SE/4 SE/4 of Section 34, Township 19 South, Range 36 East, NMPM, Lea County, New Mexico. Approximately 5,000 barrels per day of non-hazardous oil field waste slurry will be injected down the tubing of the abandoned Climax Chemical Company Foster No. 1 to the bottom of the salt cavern, approximately 2,500 feet, and brine will be produced up the annulus for sale. Ground water most likely to be affected in the event of an accidental discharge is at a depth of approximately 35 to 60 feet with a total dissolved solids concentration ranging from 500 to 3000 mg/L. The discharge plan addresses construction, operation and monitoring of the well and associated surface facilities and how spills, leaks, and other accidental discharges to the surface will be managed.

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(egal #59651 Pub. May 15, 1996

Oil Conservation Division 2040 S. Pacheco Santa Fe. New Mexico 87505

May 10, 1996

Hobbs Daily News Sun P. O. Box 860 Hobbs, New Mexico 88240 **RE:** NOTICE OF PUBLICATION

ATTN: ADVERTISING MANAGER

Dear Sir/Madam:

Please publish the attached notice one time immediately on receipt of this request. Please proofread carefully, as any error in a land description or in a key word or phrase can invalidate the entire notice.

Immediately upon completion of publication, please send the following to this office:

- Publisher's affidavit in duplicate. 1.
- 2. Statement of cost (also in duplicate.)
- 3. **CERTIFIED** invoices for prompt payment.

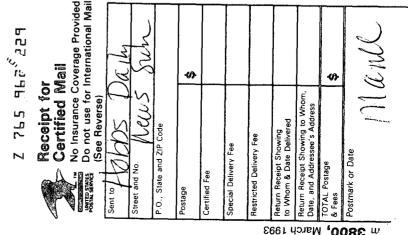
We should have these immediately after publication in order that the legal notice will be available for the hearing which it advertises, and also so that there will be no delay in your receiving payment.

Please publish the notice no later than May 17, 1996.

Sincerely,

Administrative Secretary

Attachment



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NEW MEXICO NERGY, MINERALS & NATURAL RESOURCES DEPARTMENT

May 10, 1996

LOVINGTON DAILY LEADER P. O. Box 1717 Lovington, New Mexico 88260 **RE:** NOTICE OF PUBLICATION

ATTN: ADVERTISING MANAGER

Dear Sir/Madam:

Please publish the attached notice one time immediately on receipt of this request. Please proofread carefully, as any error in a land description or in a key word or phrase can invalidate the entire notice.

Immediately upon completion of publication, please send the following to this office:

- 1. Publisher's affidavit in duplicate.
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We should have these immediately after publication in order that the legal notice will be available for the hearing which it advertises, and also so that there will be no delay in your receiving payment.

Please publish the notice no later than May 17, , 1996.

Sincerely,

Sally E. Martinez

Administrative Secretary

Attachment

Provided ional Mail use for International .82CB1 052 2 Coverage for Mail \$ 765 963 OWNOLON Daily e O O Insurance Reverse) **PUINGTON, N**M O. - BOX - of not Showing urn Receipt Showing icted Delivery Fee See Addressee' ecial Delivery Fee റ്റ Receipt Sh m & Date ertified Fee pug

PS Form **3800,** March 1993





May 10, 1996

THE NEW MEXICAN 202 E. Marcy Santa Fe, New Mexico 87501 **RE:** NOTICE OF PUBLICATION

PO #96-199-002997

ATTN: Betsy Perner

Dear Sir/Madam:

Please publish the attached notice one time immediately on receipt of this request. Please proofread carefully, as any error in a land description or in a key word or phrase can invalidate the entire notice.

Immediately upon completion of publication, please send the following to this office:

1. Publisher's affidavit.

2. Invoices for prompt payment.

We should have these immediately after publication in order that the legal notice will be available for the hearing which it advertises, and also so that there will be no delay in your receiving payment.

Please publish the notice on Wednesday, May 15 , 1996.

Sincerely,

Administrative Secretary

Attachment

PUBLIC NOTICE STATE OF NEW MEXICO ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT OIL CONSERVATION DIVISION

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196 RP- H AM B J The Santa Fe New Mexican

Since 1849. We Read You.

AD NUMBER

NEW MEXICO OIL CONSERVATION ATTN: SALLY MARTINEZ 2040 S. PACHECO SANTA FE, N.M. 87505

.

	AD NUMBER: 481405	ACCOUNT: 56689
	LEGAL NO: 59318	<u>P.O. #9</u> 6199002997
216	LINES <u>twice</u>	at\$ <u>86.40</u>
Affidavits:		5,25
Tax:		5.73
Total:		\$ 97.38

ACCOUNT, ECCO

AFFIDAVIT OF PUBLICATION

STATE OF NEW MEXICO COUNTY OF SANTA FE

I. BETSY PERNER being first duly sworn declare and say that I am Legal Advertising Representative of THE SANTA FE NEW MEXICAN, a daily news paper published in the English language, and having a general circulation in the Counties of Santa Fe and Los Alamos, State of New Mexico and being a Newspaper duly gualified to publish legal notices and advertisements under the provisions of Chapter 167 on Session Laws of 1937; that the publication # 59318 _____ a copy of which is hereto attached was published in said newspaper once each week for two consecutive week(s) and that the notice was published in the newspaper proper and not in any supplement; the first publication being on the 22nd day of 1996 and that the undersigned has personal MARCH knowledge of the matter and things set forth in this affidavit. /S/ LEGAL ADVERTISEMENT REPRESENTATIVE Subscribed and sworn to before me on this 3rd day of APRIL A.D., 1996 0K NA 4-9.86 OFFICIAL SEAL Candace C. Ruiz NOTARY PUBLIC - STATE OF NEW MEXICO My Commission Expir

202 East Marcy Street • P.O. Box 2048 • Santa Fe, New Mexico 8750 505~983~3303 • (FAX) 505~984~1785

NOTICE OF PUBLICATION

STATE OF NEW MEXICO

Energy, Minerals and Natural Resources Department

Oil Conservation Division

Notice is hereby given that pursuant to New Mexico Water Quality Control Commission Regulations, the following discharge plan application has been submitted to the Director of the Oil Conservation Division, 2040 South Pacheco, Santa Fe, New Mexico, 87505, Telephone (505) 827-7131:

(GW-226) - Permian Brine Sales, A. L. Hickerson, 6067 W. Tenth, Odessa, Texas 79763, has submitted a discharge plan application for disposal of non-hazardous semi-solid oil field waste in abandoned salt caverns located in the SE/4 SE/4 of Section 34, Township 19 South, Range 36 East, NMPM, Lea County, New Mexico. Approximately 5,000 barrels per day of non-hazardous oil field waste slurry will be injected down the tubing of the abandoned Climax Chemical Company Foster No. 1 to the bottom of the salt cavern, approximately 2,500 feet, and brine will be produced up the annulus for sale. Ground water most likely to be affected in the event of an accidental discharge is at a depth of approximately 35 to 60 feet with a total dissolved solids concentration ranging from 500 to 3000 mg/l. The discharge plan addresses construction. operation and monitoring of the well and associated surface facilities and how spills, leaks, and other accidental discharges to the surface will be managed.

(GW-240) - Diamond Rental, Inc., Harry Teague, (505) 392-6498, 3400 Industrial, Hobbs, New Mexico 88240, has submitted a Discharge Plan Application for the Diamond Rental, Inc. Facility located in the NW/4 NW/4 of Section 21, Township 18 South, Range 38 East, NMPM, Lea County, New Mexico. Approximately 16 gallons per day of waste water is stored in bermed above ground closed top steel tanks. All wastes are disposed of at an OCD permitted offsite Class II injection well. Groundwater most likely to be affected by a spill, leak, or accidental discharge to the surface is at a depth of approximately 50 feet with a total dissolved solids concentration of approximately 750 mg/L. The discharge plan addresses how spills, leaks, and other accidental discharges to the surface will be managed.

Any interested person may obtain further information from the Oil Conservation Division and may submit written comments to the Director of the Oil Conservation Division at the address given above. The discharge plan application may be viewed at the above address between 8:00 a.m. and 4:00 p.m., Monday thru Friday. Prior to ruling on any proposed discharge plan or its modification, the Director of the Oil Conservation Division shall allow at least thirty (30) days after the date of publication. of this notice during which comments may be submitted to him and a public hearing may be requested by any interested person. Requests for a public hearing shall set forth the reasons why a hearing shall-be-held. A hearing

will be held if the Director determines there is significant public interest

If no hearing is held, the Director will approve or disapprove the plan based on the information available. If a public hearing is held, the director will approve the plan based on information in the

discharge plan application and information submitted at the hearing.

GIVEN under the Seal of New Mexico Oil Conservation Commission at Santa Fe, New Mexico, on this 15th day of March, 1996. STATE OF NEW MEXICO OIL CONSERVATION DIVISION WILLIAM J. LEMAY, Director Legal #59318



Since 1849. We Read You.

NEW MEXICO OIL CONSERVATION

ATION	AD NUMBER: 481405	ACCOUNT: 56689
	LEGAL NO: 59318	<u>P.O. #9</u> 6199002997
216	LINES once	at\$_86.40
Affidavits:		5.25
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50' WATH X	TOS OF APPORTMIELY 750 m	<i>g/l</i> ,
	AFFIDAVIT OF PUBLIC	

NOTICE OF PUBLICATION gallons per day of waste wa-ter is stored in bermed above

Energy, Minerals and Natural Resources Department

STATE OF NEW MEXICO ground closed top steel tanks. All wastes are disposed of at an OCD permitted offsite Class II injection well. Groundwater most likely to Oil Conservation Division be affected by a spill, leak, or

accidental discharge_to-the Notice is hereby given that surface is at a depth of ap-pursuant to New Mexico Wa proximately 150 mg/L. The ter Quality Control Commis- discharge plan addresses sion Regulations, the follow how spills, leaks, and other STATE OF NEW MEXICO ing discharge plan applica accidental discharges to the COUNTY OF SANTA FE tion has been submitted to surface will be managed. the Director of the Oil Con-

phone (505) 827-7131:

charge plan application for the above address between Range 36 East, NMPM, Lea Conservation Division shallabandoned Climax Chemical may be requested by any inbrine will be produced up the ing shall be held. A hearing annulus for sale. Ground wa- will be held if the Director de ter most likely to be affected termines there is significant in the event of an accidental public interest. discharge is at a depth of ap-

a total dissolved solids con- rector will approve or disapcentration ranging from 500 prove the plan based on the to 3000 mg/l. The discharge information available. If a plan addresses construction, public hearing is held, the dioperation and monitoring of rector will approve the plan the well and associated sur-based on information in the face facilities and how spills, discharge plan application leaks, and other accidental and information submitted discharges to the surface will at the hearing. be managed.

Inc., Harry Teague, (505) tion Commission at Santa Fe, 392-6498, 3400 Industrial, New Mexico, on this 15th day Hobbs, New Mexico 88240, of March, 1996. has submitted a Discharge STATE OF NEW MEXICO Plan Application for the Dia- OIL CONSERVATION mond Rental, Inc. Facility Io- DIVISION cated in the NW/4 NW/4 of WILLIAM J. LEMAY, Section 21, Township 18 Director South, Range 38 East, Legal #59318 NMPM, Lea County, New Pub. March 22, 1996 Mexico. Approximately 16

servation Division, 2040 Any interested person may I, <u>BETSY PERNER</u> South Pacheco, Santa Fe, obtain further information I, <u>BETSY PERNER</u>

Company Foster No. 1 to the terested person. Requests Vit. bottom of the salt cavern, ap- for a public hearing shall set/S/_____proximately 2,500 feet, and forth the reasons why a hear

proximately 35 to 60 feet with If no hearing is held, the Di-

GIVEN under the Seal of (GW-240) - Diamond Rental, New Mexico Oil Conserva-

_____being first duly sworn declare and New Mexico, 87505, Tele from the Oil Conservation Di- say that I am Legal Advertising Representative of THE SANTA vision and may submit write FE NEW MEXICAN, a daily news paper published in the English (GW-226) - Permian Brine of the Oil Conservation Divi language, and having a general circulation in the Counties of W. Tenth, Odessa, Texas above. The discharge plan Santa Fe and Los Alamos, State of New Mexico and being a News-79763, has submitted a dis-application may be viewed at paper duly qualified to publish legal notices and advertisecharge plan application for the above address between disposal of non-hazardous 8:00 a.m. and 4:00 p.m., Mon- ments under the provisions of Chapter 167 on Session Laws of semi-solid oil field waste in day thru Friday. Prior to rul- 1937; that the publication # 59318 a copy of which is abandoned salt caverns to ing on any proposed dis-cated in the SE/4SE/4of Sec- charge plan or its modifica hereto attached was published in said newspaper once each tion 34, Township 19 South, tion, the Director of the Oil week for <u>one</u> consecutive week(s) and that the no-County, New Mexico. Ap- allow at least thirty (30) days tice was published in the newspaper proper and not in any proximately 5,000 barrels after the date of publication supplement; the first publication being on the <u>22nd</u> day of per day of non-hazardous oil of this notice during which supplement; the first publication being on the <u>22nd</u> day of tield waste slurry will be in- comments may be submitted <u>MARCH</u> 1996 and that the undersigned has personal jected down the tubing of the to him and a public hearing knowledge of the matter and things set forth in this affida-LEGAL ADVERTISEMENT REPRESENTATIVE MIGRETED W REPUBLISHE GRETETED & REPUBLISHE ON 4-3-96 MA 3-29,96 Subscribed and sworn to before me on this A.D., 1996 22nd day of MARCH **OFFICIAL SEAL** Candace C. Ruiz NOTARY PUBLIC - STATE OF NEW MEXICO My Commission Ex P.O. Box 2048 • Santa Fe

983 - 3303 (FAX) 505 - 984 - 1785

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$CONTROLLED RECOVERY \stackrel{\text{result}}{\longrightarrow} I \tilde{N} C.$

P.O. BOX 369, HOBBS, NM 88241 (505) 393, 1079 114 191 8 52

April 26, 1996

MR. WILLIAM J. LEMAY State of New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division 2040 South Pacheco Santa Fe, New Mexico 87505

Re: (GW-226) Permian Brine Sales (UIC-CL1-006) P & S Brine Sales

Dear Mr. LeMay:

I am enclosing a copy of Petition for Judicial Review filed by the State of Texas vs. United States Environmental Protection Agency which outlines in general terms the same concerns I have expressed in previous correspondence requesting denial of referenced permit applications. Specifically, the overwhelming risks associated with salt cavern waste storage/disposal located proximate to water aquifiers is imminent.

Hopefully, this information will aid in your evaluation of the Permian and P & S applications.

Sincerely. Gail Power

GP/jh

Enclosure

xc: Mr. Jerry Sexton

UNITED S FOR DIST	STATES COURT OF APPE RICT OF COLUMBIA CIPO RECEIVED APR - 9 1996	IN THE UNITED STATES COU FOR THE DISTRICT OF COLUMBI		154 <u>1</u> 5
L	CLERK	·		
	STATE OF TE	XAS,	ş	
		Petitioner,	§ § 8	
	VS.		§ No	
	U.S. ENVIROR	MENTAL PROTECTION AGENCY,	§ 96-1109	
	and		9 § 6	
		OWNER, ADMINISTRATOR, MENTAL PROTECTION AGENCY,	s § § §	
		Respondents.	š	

PETITION FOR JUDICIAL REVIEW OF AGENCY REGULATION

PRELIMINARY STATEMENT

PETITIONER, the State of Texas ("Texas"), by its Attorney General, Dan Morales, seeks judicial review pursuant to 28 U.S.C. § 2344, 5 U.S.C. §§ 701-06, and § 18 of the Waste Isolation Pilot Plant Land Withdrawal Act, Pub, L. 102-579 (the "WIPP Act"), of the "Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 C.F.R. Part 191 Disposal Regulations," 61 Fed Reg. 5224 (Feb. 9, 1996)(the "Compliance Criteria"), issued by the United States Environmental Protection Agency ("EPA").

JURISDICTION AND VENUE

1. This case arises under the WIPP Act, § 18; the Hobbs Act, 28 U.S.C. § 2342(4); and the judicial review provisions of the Administrative Procedure Act, 5 U.S.C. §§ 701-06.

PARTIES

2. Petitioner, the State of Texas, is represented by its Attorney General, Dan Morales. The Attorney General of Texas is authorized to sue on behalf of Texas as a governmental entity and on behalf of the interests of the people of Texas in recreation, their natural resources, and their environment.

3. Respondent EPA is an executive agency of the United States. Respondent Carol M. Browner is the Administrator of the EPA. Pursuant to § 8(c) of the WIPP Act the Administrator of the EPA is charged with the responsibility of issuing criteria for the determination of compliance by the Waste Isolation Pilot Plant ("WIPP") with the radioactive waste disposal regulations, 40 C.F.R. Part 191, Subpart B (the "Disposal Regulations").

STANDING

4. Texas and its citizens are vitally interested in the lawful and scientifically correct determination of WIPP's compliance with the Disposal Regulations and, therefore, in the issuance of Compliance Criteria which lawfully and correctly carry out the purpose of the Disposal Regulations as to WIPP. The Compliance Criteria issued by EPA, however, are invalid and ineffective in carrying out the purpose of the Disposal Regulations. Following such criteria, EPA may certify that WIPP complies with the Disposal Regulations when it would not otherwise do so or may fail to impose terms and conditions of certification which it would otherwise impose. In such circumstances:

(a) The WIPP site would continue to be withdrawn from public use pursuant to $\S\S$ 3 and \$(d)(2)(B) of the WIPP Act.

(b) The operation of WIPP may result in the escape of nonnatural radiation.

-2-

5. WIPP is located in southeast New Mexico. The WIPP site is only 15 miles from the Texas border and 30 miles from the Pecos River, which flows from New Mexico into Texas. Pursuant to Texas law, Texas owns the water in the Pecos River once that water enters Texas. TEX. WATER CODE ANN. § 11.021 (Vernon 1988). Texas therefore has an interest in protecting its state property.

6. The Pecos River is a major source of irrigation for Pecos, Reeves, Loving, and Ward Counties in west Texas. Texas has a significant economic interest in protecting the quality of Pecos River water.

7. Furthermore, there are several water-bearing formations that overlie and underlie the WIPP repository horizon. These water-bearing formations exist both in Texas and New Mexico. Groundwater from one of these formations, the Rustler, is currently used in Texas for oil and gas activities. There is the potential that this groundwater will be used more extensively in the future. Any contamination of these formations could result in a corresponding contamination of Texas groundwater.

8. Because of Texas's close proximity to the WIPP site, a release of radiation and/or hazardous substance from the WIPP site would have a detrimental impact on Texas's air, land, and water. The impact of such a release could be devastating to the State of Texas, Texas's citizens, its natural resources, and its economy, particularly the agricultural industry located just miles from the WIPP site.

9. Two of the major routes that the U.S. Department or Energy ("DOE") has proposed for the transportation of waste to WIPP cross Texas. Interstate 20 passes through Dallas, Ft.

-3-

Worth, Abilene, Midland, and Odessa. Interstate 40 passes through Amarillo. The transportation of these wastes to WIPP through Texas poses a risk to the citizens of Texas because of the possibility of releases of radioactive and hazardous materials to land, air, or water.

10. Texas has monitored WIPP since the plant's inception. Interests of Texas are within the zone of interests of the statute involved in this action.

NATURE OF THE CLAIMS

11. DOE has constructed WIPP and plans to operate it as the world's first geologic repository for radioactive waste. However, WIPP has not been found to be in compliance with the Disposal Regulations, nor is it authorized to receive radioactive waste.

12. The WIPP Act places EPA over DOE as independent regulator at WIPP. EPA is charged therein with:

(a) issuing final Disposal Regulations;

(b) issuing the Compliance Criteria containing WIPP-specific standards for application of the Disposal Regulations; and

(c) ultimately determining whether WIPP will comply with the Disposal Regulations and the Compliance Criteria.

13. Texas is compelled to seek this Court's review of the Compliance Criteria by EPA's multiple violation of the principles of notice-and-comment rulemaking, including the following:

(a) after the public comment period, and after EPA had decided on the terms of a final rule, EPA engaged in closed-door discussions with the Office of Management and Budget ("OMB"), DOE, and DOE's outside contractors. Based on those discussions, and relying upon data and information supplied to EPA in those discussions, EPA made major changes in the final rule. OMB, DOE, and the DOE contractors are not authorized by law to have such a role

-4-

in the issuance of the Compliance Criteria. The data and information which convinced EPA to make such major changes were not available for comment during the public comment period and have never been put in the public record;

(b) EPA prevented public participation in the Compliance Criteria rulemaking by failing to give the required public notice and to disclose the bases for the proposed rule. Thus, the final rule contains provisions which were not even suggested by the proposed rule, EPA in the final rule has changed both the underlying rationale and the substance of other provisions, and EPA has withheld critical technical studies until long after the public comment period; (c) several of the Compliance Criteria provisions conflict with the mandate of the WIPP Act, which directs EPA to issue "criteria for the Administrator's certification of compliance with the final disposal regulations" (§ 8 (c) (2)), in that they do not contain criteria, or the criteria they contain conflict with the Disposal Regulations; and

(d) several of the Compliance Criteria provisions are arbitrary and capricious under the standards consistently applied by this Court on review of administrative regulations (e.g., in that they contain terms which are at odds with the EPA' s stated rationale or have no rational basis at all).

14. The actions by EPA complained of herein have no remedy in any court except this Court of Appeals. The Compliance Criteria is reviewable in this Court. Texas has suffered legal wrong and is adversely affected and aggrieved by the action complained of herein.

-5-

RELIEF REQUESTED

Petitioner requests that the Court find that the Compliance Criteria, as issued, are arbitrary, capricious, and contrary to law; vacate them; and remand them to EPA for further rulemaking in compliance with law.

Respectfully submitted,

DAN MORALES Attorney General or Texas

JORGE VEGA First Assistant Attorney General

SAM GOODHOPE Special Assistant Attorney General

nger NANCY/E. OLINGER (/

Assistant Attorney General

P. O. BOX 12548 Austin, TX 78711-2548 (512) 463-2012

Attorneys for the State of Texas

CERTIFICATE OF SERVICE

I, Nancy E. Olinger, do hereby certify that on this <u></u>th day of April, 1996, caused a copy

of the foregoing Petition to be served by first class mail on:

U.S. Environmental Protection Agency 401 M Street, S.W. Washington, D.C. 20460

Carol M. Browner, Administrator U.S. Environmental Protection Agency 401 M Street, SW Washington, D.C. 20460

Such service conforms to the requirements of Circuit Rule 27(a)(1) and Appellate Rule 2E

Nancy E. Olinger Nancy E. Olinger

ONSERVE ON DIVISION REAL VED In 8 52 Lea County, New Mexico Courthouse Box 4-C . Lovington, New Mexico 88260-4030 BUS: (505) 396-8521 . BUS: (505) 393-7816 . FAX: (505) 396-5684 April 17, 1996 0 Mr. Jerry Sexton P.O. Box 1980 Hobbs, NM 88241 Dear Mr. Sexton: The Lea County Board of Commissioners recently received some comments from the public with regard to the two proposed disposal sites to be located in nearby salt caverns. At the County Commission meeting on April 4, 1996, the Commissioners voted to request that the Oil Conservation Commission hold a public hearing so that Lea County residents have the opportunity to voice their concerns. Sincerel Dennis M. Holmberg Lea County Manager DMH:1de D= BILL LEMAN - ROGGR ANDERSON 1.91



PERMIAN BRINE SALES, INC.

BRINE - FRESHWATER - WATER DISPOSAL - SOLIDS DISPOSAL

6067 W. TENTH • ODESSA, TEXAS 79763 (915) 381-0531 (915) 530-0664 FAX (915) 381-9316

21. CONSERVE AN DIVISI REC: VED 195 AP + 12 AM 8 52

April 9, 1996

Mr. William J. LeMay State of New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division 2040 South Pacheco Santa Fe, NM 87505

RE: (GW-226) Our request for brine well permit and for non-hazardous oil field waste disposal permit in abandoned Climax salt cavern wells in S/2 of S/2 of Section 34, T-19-S, R-36-E in Lea County.

Dear Mr. LeMay:

It is our understanding that there have been several requests that our permit be denied. We therefore look forward to being able to present our proposal at a hearing.

This utilization of idle caverns in the rock salt underlying the Permian Basin presents the oil industry with an excellent opportunity to safely dispose of their semi-solid wastes in a place far below all fresh water aquifers, where it will safely remain throughout eternity.

One of our competitors (CRI, Inc.) has requested the Lea County Commissioners to join in a protest against the approval of our permit. Obviously because CRI is not a legally concerned party - except as a competitor. The County Commissioners naturally are interested and have agreed to let us tell them about what we are doing in our Texas caverns and what our plans are at Monument at their next meeting on April 17th in Lovington.

We appreciate this opportunity. I have invited your Mr. Jerry Sexton at Hobbs to visit our disposal cavern facility at Andrews, Texas and to attend the County Commissioners meeting. We would also like to invite interested people in your Santa Fe staff to visit our facility before the hearing on our application. We believe that you will agree with the <u>Hart's Oil and Gas World</u> magazine's committee in awarding us the *Best Environmental Project in the Permian Basin* in 1995.

I believe that I am more familiar with salt caverns than anyone! Please see the attached copy of my resume. There are 102 LPG storage caverns and 73 brine well caverns in the Permian Basin. (See attached map.) I appreciate your attention. If you or your staff need additional information, just let us know.

Very truly yours, PERMIAN BRINE/SALES, INC.

doorsam

A.L. Hickerson CEO

ALH/rdw Attachments

A.L. HICKERSON

Professional Engineer - Texas #1183OK 6067 WEST 10th STREET • ODESSA, TX 79763 • Telephone: (915)381-0531

EDUCATION

Oklahoma State University B.S. in Chemical Engineering - 1939

Sales Analysis Institute - Chicago Illinois

EXPERIENCE

Permian Brine Sales, Inc. CEO-Owner-Manager - (1958 - Present)

Phillips Petroleum Company Various Supervisory Engineering and Operating Positions - 14 Years

Phillips Petroleum Company Process and Design Engineer - 6 Years

SALT CAVERN EXPERIENCE

- Project Engineer on installation of 5 LPG storage caverns at Borger, Texas for Phillips Petroleum Company in 1951.
- Project Engineer on cavern at Goldsmith, Texas for Phillips Petroleum Company.
- Consultant on Hydrocarbon storage caverns as follows: Texas Gulf at Odessa, Texas

Chevron Pipeline at Wink, Texas

Amarillo Oil Company at Pampa, Texas

Diamond Shamrock at Sunray, Texas

Santa Fe Pipeline at Andrews, Texas

Three Bar Underground Storage at Andrews, Texas

Edmonson LPG at Edmonson, Texas

United Gas at Levelland, Texas

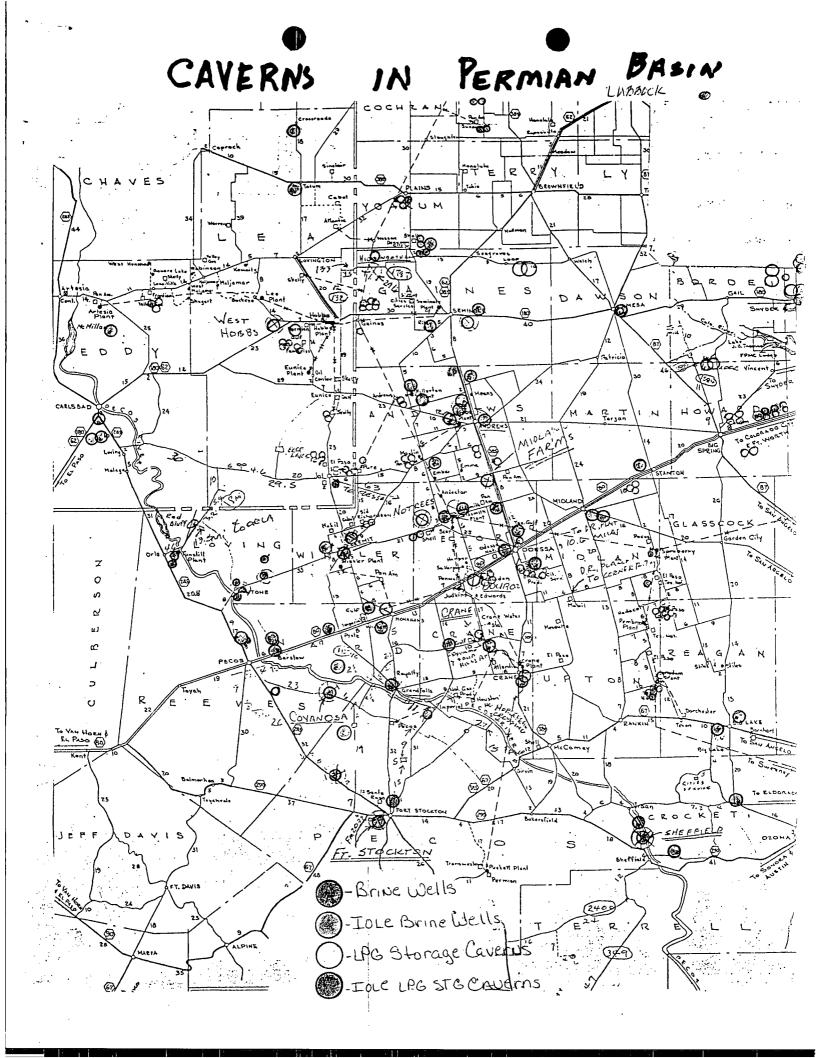
HYDRO GAS Juarez at Goldsmith, Texas

Sid Richardson at Kermit, Texas

Installed and operated propane cavern for Chevron at Kermit, Texas Installed, owned and operated thirty-five caverns in West Texas, New Mexico, and Oklahoma for production and sale of brine

CONSULTANT ON OTHER BRINE WELLS

- Basin H_2O , Inc. in Andrews, Texas
- Petro-Thermo Corporation in Hobbs, New Mexico
- Chief Well in Monahans, Texas
- D.B.I., Inc. in Seminole, Texas



PAM HOWARD 3813 TREVINO HOBBS, NM 88240

SH CONSERVE ON DIVISION RECEIVED

April 3, 1996

Mr. William J. LeMay State of New Mexico Oil Conservation Division 2040 South Pacheco Santa Fe, NM 87505

RE: (GW-226) Permian Brine Sales (UIC-CL1-006) P & S Brine Sales

Dear Mr. LeMay:

Please register my name as an opponent of the above mentioned applications. I am of the opinion that the risks of this method of disposal far exceed the possible benefits.

 If the applicants are unable to <u>absolutely</u> guarantee that no leaks of waste will occur and possibly contaminate the under ground water, then the wise choice would be to deny these requests.

I have been a resident and rancher in Lea County all of my life. My children are fifth generation Lea Countians. My predecessors and myself have been ranchers and landowners in Lea County since the early 1900's.

I am presently president of the Lea County Chapter of the New Mexico Cattle Grower's Association.

I urge you to deny these applications.

Sincerely,

Pam Howard

BRUCE A. CARLIN P.O. BOX 61 HOBBS, NEW MEXICO 88241 APRIL 3, 1996

TO CONSER, ON DIVISION RECEIVED 195 APP R EM 8 52

Mr. William J. LeMay State of New Mexico Oil Conservation Division 2040 South Pacheco Sante Fe, NM 87505

RE: (GW-226) Permian Brine Sales (UIC-CLI-006) P & S Brine Sales

Dear Mr. LeMay:

I am opposed to referenced permit applications. The salt caverns could collapse or develop leaks which would cause damage to our precious and irreplaceable water aquifer. The risk to the environment and related public safety and health hazards are over whelming.

My family settled in Lea County in 1906 and we have been residents and ranchers in Lea County since that time.

I urge you to deny these applications.

Yours truly,

Aruce a Caslin

Bruce A. Carlin

SIMS FARMS & RANCHES

TELEPHONE (505) 393-3024

119 NORTH DALMONT

OTL CONSERVICE ON DIVISION RECTIONED

'96 AP+ ! AM 8 52

HOBBS, NEW MEXICO 88240

March 29, 1996

Mr. William J. LeMay State of New Mexico Energy, Minerals, and Natural Resources Department Oil Conservation Division 2040 South Pacheco Santa Fe, NM 87505

Re: (GW-226) Permian Brine Sales

Dear Mr. LeMay:

Please enter my name as an opponent of referred application. The indicated risks of this method of disposal far exceed any possible benefit.

If the applicants cannot absolutely guarantee no leaks of waste will occur and possibly contaminate underground water, then the wise and prudent indication is to deny this request.

My family and myself are ranchers in Lea County, New Mexico, with land near the proposed site. I was born in Lea County seventy-four (74) years ago and have maintained a permanent residence for this time.

I sincerely believe the best decision in this case is to deny the application.

Thank you,

eo Sims

CLYDE "RED" ARSBON 219 WEST ST. ANNE PLACE HOBBS, NEW MEXICO 88240 OIL CONSERVE UN DIVISION REC. VED 196 AP 1 АЛ 8 52

March 29, 1996

Mr. William J. LeMay State of New Mexico Energy, Minerals, and Natural Resources Division 2040 South Pacheco Santa Fe, NM 87505

Re: (GW-226) Permian Brine Sales (UIC-CL1-006) P & S Brine Sales

Dear Mr. LeMay:

I am opposed to the issuance of referred permits.

The salt cavern disposal method has too many risks associated with possible leaks of liquid waste into the water aquifer. If a break in the salt did occur, the waste would be irretrievable.

I have been a resident of Lea County, New Mexico for more than fifty years. I am a rancher and own land in Lea County and am also in the oil business. I have previously served two terms as Chairman of the Lea County Commission.

To issue these permits would not be prudent to the people of Lea County. The possible damage to the environment and related risk to public safety is infinite.

Thank you for your consideration,

1yde "Red" Arsbon

JIMMIE T. COOPER

P. O. Box 55

Monument, New Mexico 88265

RECEIVED

March 15, 1996

196 MA 28 AM 8 52

MR. WILLIAM J. LEMAY State of New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division 2040 South Pacheco Santa Fe, New Mexico 87505

Re: (GW-226) Permian Brine Sales

Dear Mr. LeMay:

I respectfully request referenced permit application be denied. As a land owner with property adjacent to referenced site in Section 34, Township 19 South Range 36 East, NMPM Lea County, New Mexico, I am very concerned the disposal of various waste into a salt cavern would have an adverse impact on my property. Specifically, the salt cavern could collapse or develop a leak which possibly would allow migration of waste into the underground water aquifer and cause irreversible damage to the environment and would detrimentally effect the health and safety of area residents and workers.

In the event this permit application is not denied and the Oil Conservation Commission decides to conduct a public hearing, I wish to register as a protestant with the opportunity to appear before the Oil Conservation Commission to submit documentation to support my very strong opposition to the request submitted by Permian Sales.

Sincerely,

Jimmie T. Cooper

March 19, 1996

NEW MEXICAN 202 E. Marcy Santa Fe, New Mexico 87501

RE: NOTICE OF PUBLICATION

PO #96-199-002997

ATTN: BETSY PERNER

Dear Sir/Madam:

(5) Please publish the attached notice one time. Please proofread carefully, as any error in a land description or in a key word or phrase can invalidate the entire notice.

Immediately upon completion of publication, please send the following to this office:

- 1. Publisher's affidavit.
- 2. Invoices for prompt payment.

We should have these immediately after publication in order that the legal notice will be available for the hearing which it advertises, and also so that there will be no delay in your receiving payment.

Please publish the notice on Friday, March 22, 1996

Sincerely,

24 Marting Sally E. Martinez

Administrative Secretary

Attachment

OFFICE OF THE SECRETARY - P. O. BOX 6429 - SANTA FE, NM 87505-6429 - (505) 827-5950 ADMINISTRATIVE SERVICES DIVISION - P. O. BOX 6429 - SANTA FE, NM 87505-6429 - (505) 827-5925 ENERGY CONSERVATION AND MANAGEMENT DIVISION - P. O. BOX 6429 - SANTA FE, NM 87505-6429 - (505) 827-5900 FORESTRY AND RESOURCES CONSERVATION DIVISION - P. O. BOX 1948 - SANTA FE, NM 87504-1948 - (505) 827-5830 MINING AND MINERALS DIVISION - P. O. BOX 6429 - SANTA FE, NM 87505-6429 -(505) 827-5970 OIL CONSERVATION DIVISION - P. O. BOX 6429 - SANTA FE, NM 87505-6429 - (505) 827-7131 PARK AND RECREATION DIVISION - P. O. BOX 1147 - SANTA FE, NM 87504-1147 - (505) 827-7465

Santa Fe, New Mexico 87505





March 22, 1996

LOVINGTON DAILY LEADER P. O. Box 1717 Lovington, New Mexico 88260 **RE:** NOTICE OF PUBLICATION

ATTN: ADVERTISING MANAGER

Der Jir/Madam:

Please publish the attached notice one time immediately on receipt of this request. Plea. proofread carefully, as any error in a land description or in a key word or phrase can invalida the entire notice.

Immediately upon completion of publication, please send the following to this office:

- 1. Publisher's affidavit in duplicate.
- 2. Statement of cost (also in duplicate.)
- 3. CERTIFIED invoices for prompt payment.

We should have these immediately after publication in order that the legal notice will *l* available for the hearing which it advertises, and also so that there will be no delay in you receiving payment.

Please publish the notice no later than March 29, 1996.

Sincerely,

Sally E. Martinez Administrative Secretary

> . .

Attachment

VILLAGRA BUILDING - 408 Galistee Forestry and Resources Conservation Division

P.O. Box 1948 87504-1948 827-5830 Park and Recreation Division P.O. Box 1147 87504-1147 827-7465 2040 South Pecheco Office of the Secretary 827-5950

Administrative Services 827-5925 Energy Conservation & Managemer

827-5900 Mining and Minerals 827-5970 Oil Conservation 827-7131

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Receipt for Certified Mail No Insurance Coverage Provided Do not use for International Mail (See Reverse)

1	Sent to							
-	Lovington Daily Leader Strand No. Box 1717							
	P. Lovington, NM 88260							
	Postage	\$						
	Certified Fee							
	Special Delivery Fee							
1993	Restricted Delivery Fee							
	Return Receipt Showing to Whom & Date Delivered							
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PS Form 3800, March 1993	TOTAL Postage & Fees	\$						
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NOTICE OF PUBLICATION STATE OF NEW MEXICO ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT OIL CONSERVATION DIVISION

Notice is hereby given that pursuant to the New Mexico Water Quality Control Commission Regulations, the following discharge plan applications have been submitted to the Director of the Oil Conservation Division, 2040 South Pacheco, Santa Fe, New Mexico 87505, Telephone (505) 827-7131:

(GW-226) - Permian Brine Sales, A. L. Hickerson, 6067 W Tenth, Odessa, Texas 79763, has submitted a discharge plan application for disposal of nonhazardous semi-solid oil field waste in abandoned salt caverns located in the SE/4 SE/4 of Section 34, Township 19 South, Range 36 East, NMPM, Lea County, New Mexico. Approximately 5,000 barrels per day of non-hazardous oil field waste slurry will be injected down the tubing of the abandoned Climax Chemical Company Foster No. 1 to the bottom of the salt cavern, approximately 2,500 feet, and brine will be produced up the annulus for sale. Ground water most likely to be affected in the event of an accidental discharge is at a depth of approximately 35 to 60 feet with a total dissolved solids concentration ranging from 500 to 3000 mg/l. The discharge plan addresses construction, operation and monitoring of the well and associated surface facilities and how spills, leaks, and other accidental discharges to the surface will be managed.

(GW-240) - Diamond Rental, Inc., Harry Teague, (505) 392-6498, 3400 Industrial, Hobbs, New Mexico 88240, has submitted a Discharge Plan Application for the Diamond Rental, Inc. Facility located in the NW/4 NW/4 of Section 21, Township 18 South, Range 38 East, NMPM, Lea County, New Mexico. Approximately 16 gallons per day of waste water is stored in bermed above ground closed top steel tanks. All wastes are disposed of at an OCD permitted offsite Class II injection well. Groundwater most likely to be affected by a spill, leak, or accidental discharge to the surface is at a depth of approximately 50 feet with a total dissolved solids concentration of approximately 750 mg/L. The discharge plan addresses how spills, leaks, and other accidental discharges to the surface will be managed.

Any interested person may obtain further information from the Oil Conservation Division and may submit written comments to the Director of the Oil Conservation Division at the address given above. The discharge plan applications may be viewed at the above address between 8:00 a.m. and 4:00 p.m., Monday thru Friday. Prior to ruling on any proposed discharge plan or its modification, the Director of the Oil Conservation Division shall allow at least thirty (30) days after the date of publication of this notice during which comments may be submitted to him and a public hearing may be requested by any interested person. Requests for a public hearing shall

set forth the reasons why a hearing shall be held. A hearing will be held if the director determines that there is significant public interest.

If no hearing is held, the Director will approve or disapprove the plan based on the information available. If a public hearing is held, the Director will approve the plan based on the information in the discharge plan application and information presented at the hearing.

GIVEN under the Seal of New Mexico Oil Conservation Commission at Santa Fe, New Mexico, on this 15th day of March, 1996.

STATE OF NEW MEXICO OIL CONSERVATION DIVISION 0 Q WILLIAM J. LEMAY, Director

SEAL

RECEIVEL

ONSERVE ON DIVISION MAR 2 0 1996 NOTICE OF PUBLICATION '96 AP STATE OF NEW MEXICO ENERGY, MINERALS AND NATURAL RESOURCES DEPART **OIL CONSERVATION DIVISION**

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Environmental Bureau Oil Conservation Division APR 2 2 1996

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GIVEN under the Seal of New Mexico Oil Conservation Commission at Santa Fe, New Mexico, on this 15th day of March, 1996.

NO EFFECT FINDING The described action will have no effect on listed species, wetlands, or other important wildlife resources.	OIL CONSERVATION DIVISION
SEAL April 18, 1996 Consultation # _GWOCD96-1 Approved by U.S. FISH and WILDLIFE SERVICE NEW-MEXICO ECOLOGICAL SERVICES FIELD OFFICE ALBUQUERQUE, NEW MEXICO	WILLIAM J. LEMAY, Director

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GIVEN under the Seal of New Mexico Oil Conservation Commission at Santa Fe, New Mexico, on this 15th day of March, 1996.

STATE OF NEW MEXICO OIL CONSERVATION DIVISION 0 WILLIAM J. LEMAY, Director

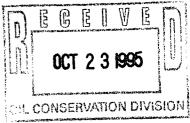
SEAL



United States Department of the Interior

FISH AND WILDLIFE SERVICE New Mexico Ecological Services Field Office 2105 Osuna NE Albuquerque, New Mexico 87113 Phone: (505) 761-4525 Fax: (505) 761-4542

October 18, 1995



William J. Lemay, Director Oil Conservation Division State Land Office Building P.O. Box 2088 Santa Fe, New Mexico 87504-2088

Dear Mr. Lemay:

This responds to your agency's public notice dated September 22, 1995, regarding the State of New Mexico Energy, Minerals and Natural Resources Department's proposal to approve the discharge plan for the applicant listed below.

(GW-226) - Permian Brine Sales. A. L. Hickerson has submitted a discharge plan application for the disposal of semi-solid oil field waste in abandoned salt caverns located in the SE/4 SE/4 of section 34, T. 19 S., R. 36 E. Lea County, New Mexico. Approximately 5000 barrels of solid waste per day will be injected down tubing to the bottom of a salt cavern.

On October 16, 1995, we learned from your staff (R. Anderson, pers. comm.), that the abandoned salt caverns were artificially created through prior brine removal. No adverse effects to wildlife, threatened or endangered species, or wetlands are anticipated.

Thank you for the opportunity to review and comment on this discharge plan application. If you have any questions, please contact Joel D. Lusk at (505) 761-4525.

Sincerely,

ennifer_Fowler-Props **Field Supervisor**

cc:

Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico

STATE OF NEW MEXICO County of Bernalillo

Bill Tafoya being duly sworn declares and says that he is Classified Advertising manager of The Albuquerque Journal, and that this newspaper is duly qualified to publish legal notices or advertisements within the meaning of Section 3, Chapter 167, Session Laws of 1937, and that payment therefore has been made of assessed as court cost; that the notice, copy of which is hereto, attached, was published in said paper in the regular daily edition, >)_day for times, the first publication being of the of __, 1995, and the subsequent consecutive publications

OFFICIAL SEAL Sworn and subscribed to before me, a notar's Public in Corrina Duncan and for the County of Bernalillo and State of New NOTARY PUBLIC Mexico, this STATE OF NEW MEXICO 10:2 My Commission Expires: 0-8 ¢5 non

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PRICE Statement to come at end of month.

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1995

CLA-22-A (R-1/93) ACCOUNT NUMBER

NOTICE OF PUBLICATION STATE OF NEW MEXICO ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT OIL CONSERVATION Notice is hereby given that pursuant to the New Mexico Water Quality Control Commission Regulations, the following discharge plan application, the has been submitted to the Director of the Oil Conservation Division, 2040 South Pacheco, Santa Fe, New mex 87505, Telephone (505) 827-

ico 8 7131: (GW-226) - Permian Brine Sales, A. L. Hickerson, 6067 W. Tenth, Odessa, Texas 79763, has submitted a discharge plan application for disposal of non-hazardous semi-solid oil field waste in abandoned salt caverns loabandoned sait caverns to cated in the SE/A SE/A of Section 34, Township 10 II CONSERVATION Division South, Range 36 East, NMPM, Lea County, New Mexico. Approximately 5.000 barrels per day of solid waste slurry will be injected down the tubing of the abandoned Climax Chemical Company Foster No. 1 to the company roster No. I to the bottom of the salt cavern, approximately 2,500 feet, and brine will be produced up the annulus for sale. Ground water most likely to be affected in the event of an accidental discharge is at a depth of approximately 35 to 60 feet with a total dissolved solids concentration rang-ing from 500 to 3000 mg/l. The discharge plan addres-ses how spills, leaks, and other accidental discharges to the surface will be managed.

Any interested person may obtain further information from the Oil Conservation Division and may submit written comments to the Direct set the Oil Conservation Division algebre address given above. The dischaige plan applications may be viewed at the above address between 8:00 a n. the above address between stort a mand 4:00 p.m., Monday thru *Price J*. prior to ruling on any prope ad discharge plan or its modification, that Director of the Oil Conservation Division shall allow at least thirty (30) days after the date of publication of this notice during which comments may be submitted to him and public hearing may be requested by any interested person. Request for public hearing shall set forth the reasons why a hearing shall be held. A hearing will be held if the director determines that there is significant

determines that there is significant public interest. If no hearing is held, the Director will approve or disapprove the plan based on the information available. If a public hearing is held, the Director will approve the plan based on the information in the plan and informa-tion presented at the hearing.

GIVEN under the Seal of New Mexico Oil Conservation Commission Santa Fe, New Mexico, on this 22nd day of September, 1995. STATE OF NEW MEXICO

OIL CONSERVATION DIVISION s/WILLIAM J. LEMAY, Director Journal: September 30, 1995.

RECEIVED

OCT ~ 6 1995

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Affidavit of Publication

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STATE OF NEW MEXICO

COUNTY OF LEA

Joyce Clemens being first duly sworn on oath deposes and says that he is of Adv. Director THE LOVINGTON DAILY LEADER, a daily newspaper of general paid circulation published in the English language at Lovington, Lea County, New Mexico; that said newspaper has been so published in such county continuously and uninterruptedly for a period in excess of Twenty-six (26) consecutive weeks next prior to the first publication of the notice hereto attached as hereinafter shown; and that said newspaper is in all things duly qualified to publish legal notices within the meaning of Chapter 167 of the 1937 Session Laws of the State of New Mexico.

That the notice which is hereto attached, entitled
Notice Of Publication

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	*XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	a regular and
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October 3	
and ending with the issue of	
October 3	

And that the cost of publishing said notice is the 44.80 sum of \$.....

which sum has been (Paid) (AXXXXXXXX	BA) as (Court	Costs
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Subscribed and sworn to	before	me th	is	11th
day of October			, 19	95
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Notary Fublic,				exico
My Commission Expires	Sept.	28	, 19	98

LEGAL NOTICE NOTICE OF PUBLICATION STATE OF NEW MEXICO ENERGY, MINERALS AND

NATURAL RESOURCES DEPARTMENT

Notice is hereby given that pursuant to New Mexico Water Quality Control Commission Regulations, the following discharge plan application have been submitted to the Director of the Oil Conservation Division, 2040 South Pacheco, Santa Fe, New Mexico 87505, Telephone (505)827-7131:

(GW-226) - Permian Brine Sales, A.L. Hickerson, 6067 W. Tenth, Odessa, Texas 79763, has submitted a discharge plan application for disposal of non-hazardous semi-solid oil field waste in abandoned salt caverns located in the SE/4 SE/4 of Section 34, Township 19 South, Range 36 East, NMPM, Lea County, New Mexico. Approximately 5,000 barrels per day of solid waste slurry will be injected down the tubing of the abandoned Climax Chemical Company Foster No. 1 to the bottom of the salt cavern, approximately 2,500 feet, and brine will be produced up the annulus for sale. Ground water most likely to be affected in the event of an accidental discharge is at a depth of approximately 35 to 60 feet with a total dissolved solids concentration ranging from 500 to 3000 mg/l. The discharge plan addresses how spills, leaks, and other accidental discharges to the surface will be managed.

Any interested person may obtain further information from the Oil Conservation Division and may submit written comments to the Director of the Oil Conservation Division at the address given above. The discharge plan application may be viewed at the above address between 8:00 a.m. and 4:00 p.m., Monday through Friday. Prior to ruling on any proposed discharge plan or its modification, the Director of the Oil Conservation Division shall allow at least thirty (30) days after the date of publication of this notice during which comments may be submitted to him and public hearing may be requested by any interested person. Requests for public hearing shall set forth the reasons why a hearing should be held. A hearing will be held if the Director determines there is significant public interest.

If no public hearing is held, the Director will approve or disapprove the proposed plan based on information available. If a public hearing is held, the director will approve or disapprove the proposed plan based on information in the plan and information submitted at the hearing.

GIVEN under the Seal of the State of New Mexico Oil Conservation Commission at Santa Fe, New Mexico, on this 22nd day of September, 1995.

		STATE OF NEW MEXICO
1. 1.	•	OIL CONSERVATION DIVISION
10, ·		WILLIAM J. LEMAY, Director
SEÂL	at specifi	
Published	l in the Lovi	ngton Daily Leader October 3, 1995.

ENERGY, MINERALS and NATURAL RESOURCES DEPARTMENT Santa Fe, New Mexico 87505

September 26, 1996

ALBUQUERQUE JOURNAL P. O. Drawer J-T Albuquerque, New Mexico 87103

RE:	NOTICE	OF PUBLICATION
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ATTN: ADVERTISING MANAGER

Dear Sir/Madam:

Please publish the attached notice one time immediately on receipt of this request. Please proofread carefully, as any error in a land description or in a key word or phrase can invalidate the entire notice.

Immediately upon completion of publication, please send the following to this office:

- 1. Publisher's affidavit in duplicate.
- 2. Statement of cost (also in duplicate.)
- 2. CERTIFIED invoices for prompt payment.

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We should have these immediately after publication in order that the legal notice will be available for the hearing which it advertises, and also so that there will be no delay in your receiving payment.

Please publish the notice no later than October 3 , 1995.

Sincerely,

Administrative Secretary

Attachment

VILLAGRA BUILDING - 408 Galisteo Forestry and Resources Conservation Division P.O. Box 1948 87504-1948 827-5830 Park and Recreation Division P.O. Box 1147 87504-1147 827-7465

2040 South Pacheco Office of the Secretary 827-5950 Administrative Services 827-5925 Energy Conservation & Managament 827-5900 Mining and Minerals 827-5970 Oli Conservation 827-7131

P 614 928 250

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State of New Mexico ENERGY, WERALS and NATURAL RESOURCES DEPARTMENT Santa Fe, New Mexico 87505



September 26, 1995

LOVINGTON DAILY LEADER P. O. Box 1717 Lovington, New Mexico 88260 **RE: NOTICE OF PUBLICATION**

ATTN: ADVERTISING MANAGER

Dear Sir/Madam:

Please publish the attached notice one time immediately on receipt of this request. Please proofread carefully, as any error in a land description or in a key word or phrase can invalidate the entire notice.

Immediately upon completion of publication, please send the following to this office:

- 1. Publisher's affidavit in duplicate.
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Please publish the notice no	o later than	Octobe <u>r 3</u>	, 1995.
Sincerely,	P 614 -	128 448	
Sally E. Martinez Administrative Secretary Attachment	US Postal Service Receipt for Ce No Insurance Coverag Do not use for Internal Sent to Server & Nureber Fost Office, Seare, & Zirk C	je Provided. lional Mail <i>(See reverse)</i> Ily Loocor	
19 A.	Certified Fee		-
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VILLAGRA BUILDING - 408 Galisteo	Restricted Delivery Fee		2040 South Pecimeno
Forestry and Resources Conservation Division P.O. Box 1948 87504-1948	Return Receipt Showing to Whom & Date Delivered		Office of the Secretary 827-5950
827-5830 / Park and Recreation Division	Return Receipt Showing to Whor Date, & Addressee's Address	n,	Administrative Services 827-5925
P.O. Box 1147 87504-1147 827-7465	TOTAL Postage & Fees	\$	Energy Conservation & Management 827-5900
	Postmark or Date	- 1	Mining and Minerals 827-5970
	Postmark or Date		Oil Conservation 827-7131

State of New Mexico Energy, Minerals and Natural Resources Department OIL CONSERVATION DIVISION P.O. Box 2088 Santa Fe, NM 87501

11/90

DISCHARGE PLAN APPLICATION FOR BRINE EXTRACTION FACILITIES (Refer to OCD Guidelines for assistance in completing the application.)

FACILITY NAME: Monument Station I. II. OPERATOR: PERMIAN BRINE SALES. INC. ADDRESS: 6067 West 10th Street Odessa, Texas 79763 PHONE: (915)381-0531 CONTACT PERSON: A.L. Hickerson_ LOCATION: SE /4 Section 34 Township19 South Range 36 East III. Submit large scale topographic map showing exact location. IV. Attach the name and address of the landowner of the facility site and landowners of record within one-half mile of the site. Enclosed Attach a description of the sources and quantities of fluids at the facility. V. Enclosed Attach a description of all fluid transferring and handling facilities. VI. Enclosed Attach a description of underground facilities. VII. Enclosed Attach a contingency plan for reporting and clean-up of spills or releases. VIII. Enclosed IX. Attach geological/hydrological evidence demonstrating that disposal of oil field wastes will not adversely impact fresh water. Enclosed Attach such other information as is necessary to demonstrate compliance with any other OCD Χ. rules, regulations and/or orders. Enclosed XI. CERTIFICATION I hereby certify that the information submitted with this application is true and correct to the best of my knowledge and belief. Title: C.E.O. Name: A.L. Hickerson Date: 9

DISTRIBUTION: Original and one copy to Santa Fe with one copy to appropriate Division District Office.

Alla

Signature:

BRINE WELL APPLICATION FOR PERMIAN BRINE SALES, INC. MONUMENT STATION

Item IV. Names and addresses of landowners within one-half mile of site. A section map is enclosed.

Sec 34 T-19-S R-36-E

James W. Foster - 160 acres Landowner at well site 1901 West Avenue J Lovington, New Mexico 88260

Betty T. Cooper - 320 acres PO Box 55 Monument, New Mexico 88265

G.T. Sims - 160 acres PO Box 1046 Eunice, New Mexico 88231

Sec 35 T-19-S R-36-E

Climax Chemical - 560 acres PO Box 1595 Hobbs, New Mexico 88241

Jimmy T. Cooper Trust - 40 acres Betty T. Cooper Trust Star Route A, Box 55 Monument, New Mexico 88265

State Land - 40 acres

Sec 3 T-20-S R-36-E

Federal Land Lessee E.H. Lkein Estate PO Box 1503 Hobbs, New Mexico 88241

Sec 2 T-20-S R-36-E

NW/4Lot 140.16 acres - State Land leased to ClimaxLot 240.21 acres - State Land Leased to ClimaxLot 340.25 acres - State Land leased to ClimaxLot 44.31 acres - Owned by Climax

Rest of section is state land leased to James F. Byrd.

Item V. Description, source and quantity of fluid at the facility.

Source - produced water, drilling mud, tank bottoms, work overs fluids, and other oil and gas wastes that contian solids from wells in the area.

Quantity - Estimated 5000 BPD.

Storage - 1-500 steel pit (slurry tank).

Brine Water - from brine well. Stored in three (3) 1000 barrel tanks for subsequent hauling to drilling sites for use as a drilling and completion fluid.

Brine water - from shallow water wells on site.

Item VI. Description of fluid transferring and handling facilities.

Well Head Piping 3-1000 bbl brine tanks 1-1000 bbl rinse water tank Structural Pipe (wash racks, fences, sheds) Steel (walkways, ladders, splash guards) Portable Buildings (office, storage, shed, bathroom) Sump Pump #1 Positive Displacement Pump (5x10 Duplex) #2 Positive Displacement Pump (5x8 Duplex) Steel Pit with Agitators (slurry tank) Pipe and pipe fittings for mud system (hoses, wash rack, blending, strainers) Electric Panel, Conduit, switches, lights (8 starters, main disconnect, etc. Concrete - $110' \times 170'$ (truck unloading area) Concrete blocks - 50 Dirt work 300' caliche pad and dikes Fencing - Gate Trees, landscaping Pick-up truck Mobil Home (septic, gas, electric, parking, fence) Front end loader 2 skim oil tanks

Item VII. Description of underground facilities.

Casing and cementing records are enclosed for wells No 1 and No 2 along with plat showing locations.

Item VIII. Contingency plan for reporting and clean-up of spills or releases.

The fluid handling area will be surrounded by and earthen dike. The unloading area and sump will be concrete – draining to a sump with sump pumps – for pumping back into storage. Operator will be on site so that any major spills can be reported.

Item IX. Geological and hydrological data as prepared by Ken Davis for Climax Chemical enclosed.

Item X. Enclosed are plats, sketches, and forms C-101 and C-102.

Pressure integrity tests will be performed on each well to insure proper cementing before any operation is performed. Also enclosed are the records of all wells within one-half mile of well No. 1.

Climax well No.1 was washed down the tubing and out the casing from 1962 until January, 1970. Then, due to ledge sloughing problems and inability to make saturated brine by continuing to wash down the tubing, the flow was reversed, with fresh water going down the casing and up the tubing which was hanging at 1469 feet, so they could make saturated brine.

This resulted in the "clover leaf" shape at the top of the cavern, which I have shown in my sketch of the wells. This also happened on No. 2 well.

We are requesting a permit for two wells, just in case we can not get clean brine for sale out of No.1 well at the same time we are injecting waste into the bottom of the cavern, we can re-enter No.2 and make brine for sale.

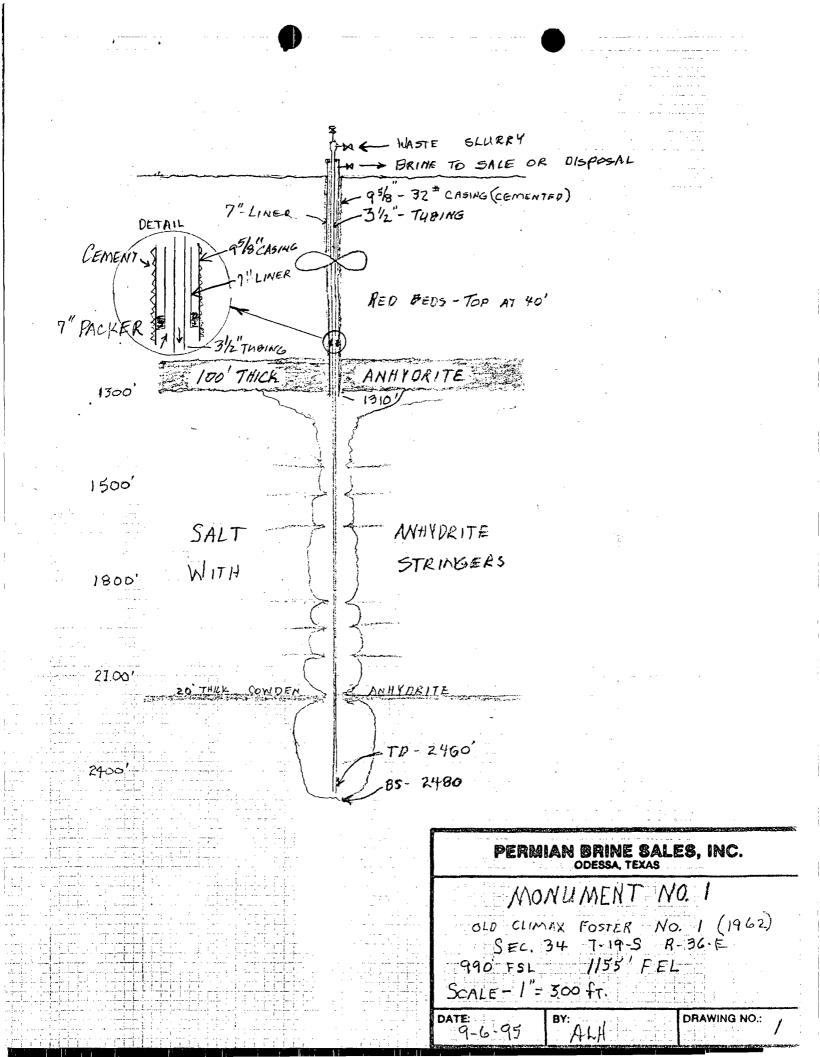
We propose to hang a 7" liner inside the 9 casing on a packer. The 3 1/2 inch tubing for injection of the solid waste=slurry will be made through the inside of the 3 1/2" tubing to the bottom of hte cavern. Solids will settle into the cavern bottom and clean brine will return to the surface through the 7"-3 1/2" annulus. The hanging of the 7" lener will prevent the brine from coming into contact with the outer cemnted 9 " casing.

We have not filed any public notice and will not do so until we hear from you.

Plan for plugging and abandonment:

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In order to plug and abandon the well, the tubing will be pulled from the well, a cast iron bridge plug will be set in the casing within 100 feet of the casing shoe. The casing will then be filled with cement and a steel cap welded on the casing. An identification marker will then be welded on the casing, according to New Mexico's requirements.



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PERMIAN BRINE SALES, INC.

BRINE - FRESHWATER - WATER DISPOSAL - SOLIDS DISPOSAL

6067 W. TENTH • ODESSA, TEXAS 79763 (915) 381-0531 (915) 530-0664 FAX (915) 381-9316

September 18, 1995

Mr Roger Anderson Oil Conservation Division 2040 South Pacheco Santa Fe, New Mexico 87505

- 2 copies

GW-226

RE: Request for brine well permit and for non-hazardous oil field waste disposal permit in abandoned Climax wells in S/2 of S/2 of Section 34 T-19-S, R-36-E in Lea County.

Dear Sir;

Permission is requested to re-enter two of the subject wells and for a permit to dispose of non-hazardous semi-solid oil field waste, as well as to sell brine from the wells.

Enclosed is the application cover page, description of items I through XI, forms C 101 and C 102, records of wells within 1/2 mile, sketch of well casing plan, and a detail plot plan of the proposed facility.

Your approval will be appreciated.

As you requested, I am sending this to you. If you have any questions, or if additional information is needed, please let us know.

Sincerely,

PERMIAN BRINE SALES, INC. A.L. Hickerson CEO

ALH/lji

Enclosures

C. Jerry Sexton NMOCD office - Hobbs 1000 West Broadway Hobbs, New Mexico 88241



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State of New Mexico Energy, Minerals and Natural Resources Department OIL CONSERVATION DIVISION P.O. Box 2088 Santa Fe, NM 87501

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	CONTACT PERSON: A.L. Hickerson PHONE: (915) 381-0531
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IV.	Attach the name and address of the landowner of the facility site and landowners of record within one-half mile of the site.
v.	Enclosed Attach a description of the sources and quantities of fluids at the facility.
VI.	Enclosed Attach a description of all fluid transferring and handling facilities.
VII.	Enclosed Attach a description of underground facilities. Enclosed
VIII.	Attach a contingency plan for reporting and clean-up of spills or releases.
IX.	Attach geological/hydrological evidence demonstrating that disposal of oil field wastes will not adversely impact fresh water. Enclosed
X. .	Attach such other information as is necessary to demonstrate compliance with any other OCD rules, regulations and/or orders.
XI.	CERTIFICATION
•	I hereby certify that the information submitted with this application is true and
	correct to the best of my knowledge and belief.
·	Name: <u>A.L. Hickerson</u> Title: C.E.O.
	Signature: A. A. Mallali Date: 9/11/95

DISTRIBUTION: Original and one copy to Santa Fe with one copy to appropriate Division District Office.

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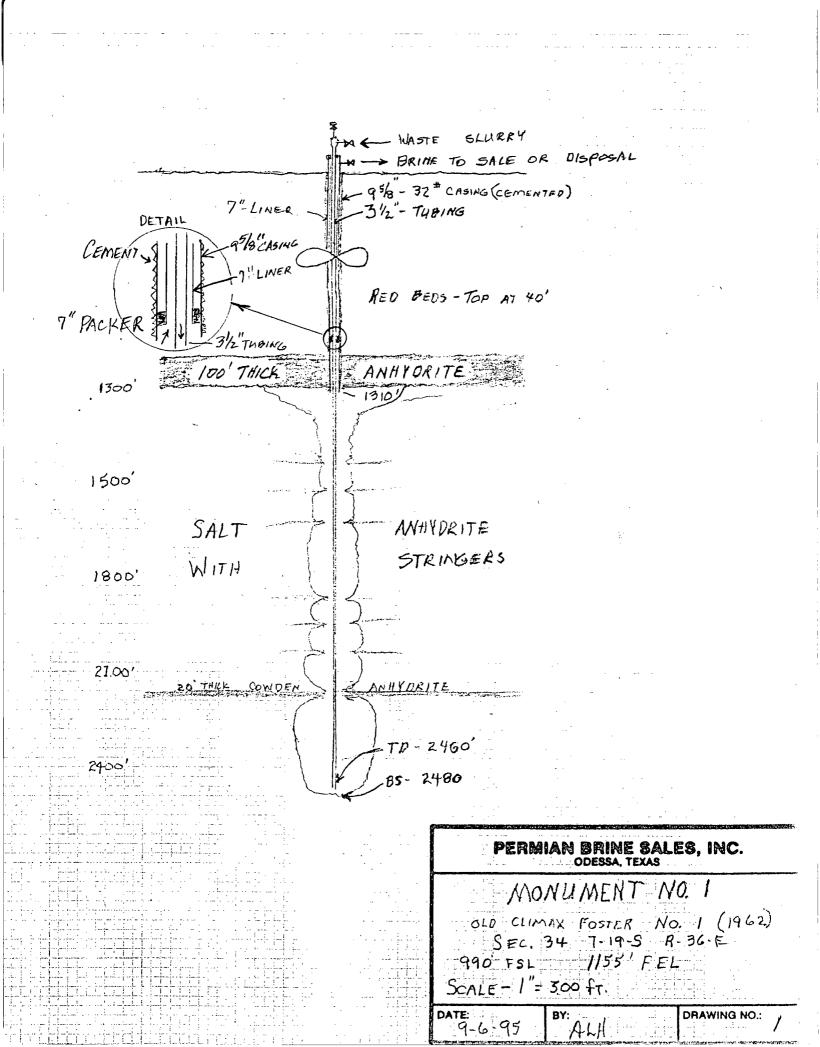
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= [star Tor) 15 BATALIE arminit's to be 11000 504145 5120 A42 ARO (FUINAL SHE IDDEE) STEAM RAEA G Ø 2 " S'essind (and HIGH courses stor DIAMALAL CONCRETE Acqua 184 0 Conta . 11 2004 150 12 1Sine TRANS Pers. Baner Ferssiel BRINE 1000 BAL BRINE BRINE BR. FROM 1000 .884 1000 BAL > "DB ZP LLI RINGE WATCH 1000 BAL FOH- 7-17-95 A 11=12'FEET 16 12171 -11'F WASTE DISPOSAL LAYOUT



District I PO Box 1980, Hobbs, NM 88241-1980 District II PO Drawer DD, Artesia, NM 88211-0719 District III 1000 Rio Brazos Rd., Azzec, NM 87410 District IV PO Box 2088, Santa Fe, NM 87504-2088

State of New Mexico Energy, Minerais & Natural Resources Department

OIL CONSERVATION DIVISION PO Box 2088 Santa Fe, NM 87504-2088 Form C-101 Revised February 10, 1994 Instructions on back Submit to Appropriate District Office State Lease - 6 Copies Fee Lease - 5 Copies

____AMENDED REPORT

APPLICATION FOR PERMIT TO DRILL, RE-ENTER. DEEPEN, PLUGBACK, OR ADD A ZONE

DEDMI	AN BRT	NE SAI	ES, INC		me and Address.					, O	GRID Number
6067	West 1	Oth St	reet	•						3	API Number
Odess	a, Tex	as 79	9763							30 - 0	
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			Formerl	y Clima	x Chemica	l Saline N	/el	1 No.1 Fos	ter		1
•					⁷ Surface	Location					
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UL or lot no.	Section	Townshi	p Range	Lot Ida	Feet from the	North/South li	h line Feet from the East/			West line County	
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" Work 1	Type Code		"Well Typ			e/Rotary		¹⁴ Lesse Type Co	de	¹⁶ Ground Level Elevation	
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ļ											·····
²² Describe the	proposed p	meram. I	this applicat	ion is to DEE	PEN or PLUG BA	CK give the date		he present product	ive mee	and prop	and new productive
zone. Describe Re-et	¹ Describe the proposed program. If this application is to DEEPEN or PLUG BACK give the data on the present productive zone and proposed new productive zone. Describe the blowout prevention program, if any. Use additional sheets if necessary. Re-entry, drill out cement and bridge plug Hang \mathbf{J}_2^1 tubing to T.D.										
			1								
²³ I hereby certi of my knowledg			etven above is	true and com	plete to the best	OI	LC	ONSERVA	TION		SION
Signature:					6	Approved by:					
Printed name:	A.L. H	ickers				Tive:					
	C.E.O,	10/10/10	<u></u>			Approval Date: Expiration Date:				······································	
Date:	-11-6	75	Phone:	(915)38	81-0531	Conditions of Appr Attached	roval :	4			

C-101 Instructions

Measurements and dimensions are to be in feet/inches. Were postions will refer to the New Mexico Principal Meridian.

IF THIS IS AN AMENDED REPORT CHECK THE BOX LABLED "AMENDED REPORT" AT THE TOP OF THIS DOCUMENT.

- 1 Operator's OGRID number. If you do not have one it will be assigned and filled in by the District office.
- 2 Operator's name and address
- 3 API number of this well. If this is a new drill the OCD will assign the number and fill this in.
- 4 Property code. If this is a new property the OCD will assign the number and fill it in.
- 5 Property name that used to be called 'well name'
- 6 The number of this well on the property.
- 7 The surveyed location of this well New Mexico Principal Meridian NOTE: If the United States government survey designates a Lot Number for this location use that number in the 'UL or lot no.' box. Otherwise use the OCD Unit Letter.

8 The proposed bottom hole location of this well at TD

9 and 10. The proposed pool(s) to which this well is beeing drilled.

- 11 Work type code from the following table:
 - N New well
 - E Re-entry
 - D Drill deeper
 - P Plugback
 - A Add a zone
- 12 Well type code from the following table:
 - O Single oil completion
 - G Single gas completion
 - M Mutiple completion
 - I Injection well
 - S SWD well W Water supply we
 - W Water supply well C Carbon dioxide well
- 13 Cable or rotary drilling code
 - C Propose to cable tool drill
 - Propose to rotary drill
- 14 Lease type code from the following table:

F Federal

- S State
- P Private
- N Navajo
- J Jicarilla U Uta
- U Ute
 - Other Indian tribe
- 15 Ground level elevation above sea level
- 16 Intend to mutiple complete? Yes or No
- 17 Proposed total depth of this well

- 18 Geologic formation at TD
- 19 Name of the intended drilling company if known.
- 20 ... Anticipated spud date.
- 21 Proposed hole size ID inches, proposed casing OD inches, casing weight in pounds per foot, setting depth of the casing or depth and top of liner, proposed camenting volume, and estimated top of cament
- 22 Brief description of the proposed drilling program and BOP program. Attach additional sheets if necessary.
- 23 The signature, printed name, and title of the person authorized to make this report. The data this report was signed and the telephone number to call for questions about this report.

•					ستان المان الم	• • • • • • • • • • • • • • • • • •	. <u></u>
		MEXICO OIL		ľi.	6653-66	N PLAT	102 FORM C-128 Revised 5/1/57
	SEE INSTRU	ICTIONS FOR COM	PLETING	THIS FORM O	H THE RE	VERSE SIDE	4
1	· · ·		SECTIO	АИ		11 2	
perator	X CHEMICAL COR	F	1 Lease	SALINE WA	TOD WE	. 1	Veli No. 1
ait Letter	and the second se	waship	Res		County		
Р		19 SOUTH		EAST		LEA	
ctual Footage Lo 990	cation of Vell:		, 1155			EAST	
	feet from the SOUTH		a	fee	t from the		line
ound Level Elev	Producing Format	100	Pool				Dedicated Acteage: Actea
another. (65- If the answer to wise? YES	3-29 (e) NMSA 1935 Co	omp.) ' have the interests wer is ''yes,'' Type	of all the	owners been co lidation	onsolidated	l by communit	self or for himself and ization agreement or other-
wDCl		· · · · · · · · · · · · · · · · · · ·		Land Descript			
	· · · · · · · · · · · · · · · · · · ·						
		ECTION B					
		I I					CERTIFICATION
					s.	in SECTIO piere to the belief Name M.L.	ertify that the information DN A above is true and com- te best of my knowledge and Dest of my knowledge and A. Supt.
• •			• .			Position C/// Company Date	- 4 - 62-
						plotfedto	De Slatio SEGTION B. was m field acces of actual
<u> </u>				(-+		upperiaio	ade by me or under my n, and that the same is true t to the best of my knowled W MEN OHN W. N
				,066	155' ->		yed
	protocology			L. I.		·	m/U/Wast
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NEW M CO OIL CONSERVATION COMMI

Form C-101 Revised (12/1/55)

Santa Fe, New Mexico

NOTICE OF INTENTION TO DRILL /N

Notice must be given to the District Office of the Oil Conservation Commission and approval obtained before drilling or recompletion hegins. If changes in the proposed plan are considered advisable, a copy of this notice showing such changes will be returned to the sender. Submit this notice in QUINTUPLICATE. One copy will be returned following approval. See additional instructions in Rules and Regula-tions of the Commission. If State Land submit 6 Copies Attach Form C- 128 in triplicate to first 3 copies of form C-101

January 16, 1962 Hobbs, New Mexico (Place) (Date)

OIL CONSERVATION COMMISSION SANTA FE, NEW MEXICO

	•		<i>,</i> .	(Company or Operator)
	·····	Fost	er (Lease)	(Company or Operator) Well No. 1, in. P. The well i
				e
				line of Section
	•		SECTION	
		~		If State Land the Oil and Gas Lease is No
<u> </u>			[If patented land the owner is
D	С	В	A	Address
			1 1	Adarcs.
				We propose to drill well with drilling equipment as follows: Rotary tools from surface
E	F	G	н	We propose to drill well with drilling equipment as follows: Rotary tools from surface
E	F	G	Н	We propose to drill well with drilling equipment as follows: Rotary tools from surface to bottom Rustler Anhydrite. Cable tools Base Anhy. to Base Sa
E	F	G	H	We propose to drill well with drilling equipment as follows: Rotary tools from surface to bottom Rustler Anhydrite. Cable tools Base Anhy. to Base Sa
	-	G	I	We propose to drill well with drilling equipment as follows: Rotary tools from surface to bottom Rustler Anhydrite. Cable tools Base Anhy. to Base Sal The status of plugging bond is \$5,000 bond approved
	-] C		We propose to drill well with drilling equipment as follows: Rotary tools from surface to bottom Rustler Anhydrite. Cable tools Base Anhy. to Base Sal The status of plugging bond is \$5,000 bond approved

We propose to use the following strings of Casing and to cement them as indicated:

Size of Hole	Size of Casing	Weight per Foot	New or Second Hand	Depth	Backs Cement
<u>12-1/4</u> "	9 <u>-</u> 5/8 ⁱⁱ	32	New	1310'	Circulate to su
8-3/1.11	5-1/211	15.5	New	Will hang insi	de 9-5/8" casing

and use as input for fresh water to wash Salt section and return Brine water If changes in the above plans become advisable we will notify you immediately.

ADDITIONAL INFORMATION (If recompletion give full details of proposed plan of work.)

proved cept as foll	ows:	 	 	,	
	1				
		-		-	
			2		/
		1			/

<u>(</u>

By.....

Sincerely yours,

Climax Chemical Company By

Position......Agent Send Communications regarding well to W. H. Kolins Name. Box 1595 Hohha Now Maxim

						<u>.</u>					
•			NEW MEXI	CO OIL	CONS	SERVA	TION	COMMISSI	Ń		FORM C-103 (Rev 3-55)
			MISCEI	LANEC)US F	REPO	RTS O	N WELLS	i		
		(Sul	omit to approj	oriate Dist	rict O	ffice as	per Con	nmission Ru	le 1106)		
Name of Con	npany			······································		Addre	ss Ss	di di di	2 112		
Lease	Climax /	Chaml	cal Compan	Well No.	II.	t Letter	Isaatia	Hobbas N	aw Maxic	2	
	Saline Wat	ham L		weii 140.		n Letter	34	· ·	South	Rang	6 East.
Date Work P			ool	-				County	20000		0 104040
January 1	30,31 1962 -		Unded1	natod S A REPOR	T OF:	(Check	abbrobri	ate block)	lea		
Beginni	ing Drilling Oper	ations		asing Test				Other (E	Explain):		<u> </u>
Pluggin			4	emedial Wor		•		· ·	•		
	ount of work don	e. natu	e and quantity	of material	ls used	and rea	sults obta	uned.		······································	
	•	•				-			led te da	onth a	f 1300 fest.
	joints H-40										
											5 sax Diamaz
	L, 100 sax 1										
											tween hole and
											hole and cir-
											ted about 25
											hole to stand
	r and ran be										
				ole rem	ained	l dry	after	bailing '	Lest. Dr.	llling	new hole below
casing w	dth Cable (tools	Đ								
						om 2:	45 P.M	., Janua	ry 30, 19	962 un	til 3:00 A.M.
February	7 1, 1962 be	efore	plug was	drilled	•						
Witnessed by	,		<u>-</u>	Position	<u>n</u>			Company			
Cherle	 	•			Acc	nt Climax C				hanical Company	
			FILL IN BE		the second s			EPORTS OF	VLY		
D F Elev.		D		PBI		WELL		Producing	Interval	İCo	mpletion Date
Tubing Diam	eter	Tı	ibing Depth			Oil Stri	ing Diame	eter	Oil St	ring Dep	ih
D (11						I					
Perforated In	terval(s)		·								
Open Hole In	terval					Produc	ing Form	ation(s)			· · · · · · · · · · · · · · · · · · ·
•							U				
	r			RESU	LTS O	FWOR	KOVER				
Test	Date of Test		Oil Productio BPD		Produ MCFP			Production BPD	GOI Cubic fee		Gas Well Potential MCFPD
Before Workover							<u> </u>	<u></u>			
After Workover											
				. 				fy that the in my knowleds		ven abov	e is true and complete

OIL CONSERVATION COMMISSION	to the best of my knowledge.
Approved by	Name Charles Co Miller
Title	Position
Date	Company

THE PLATE PARTY HE

馆装

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Date

Sec. Date

	If drill	-stem or oth		D OF DRILL-STE							
			• ·	TOOLS	USED			•	• •		
Rotary tool	ls were u	sed from	O feet	to1300	feet an	d from			feet to		feet
				to 2482	-			1			
			•• · · ·					•		•	1
	•			PRODU	UTION			•	•		
Put to Pro	ducing	•••••	••••••	, 19	Salin	le wate	r well	. No	test for	oil or	888
OIL WEL	L: The	production	during the first 24 l	hours was		barr	els of liq	uid of v	which		% wa
	was	oil;	% was	emulsion;		% water;	and		% w	as sedimen	t. A.P.I
•	Gra	vitv							· · ·		•
· · · · · · · · · · · ·										· · •	•
GAS WEL	L: The	production	during the first 24	hours was	N	f.C.F. plu				b	arrels o
•	liqu	id Hydrocar	bon. Shut in Pressu	elbs.			· ·	ŝ.	•		• •
Tannsh of	Time St			. '							
Neingen of	TIME OF		•••••••••••••••••••••••••••••••••••••••	······				1			
PLEA	SE IND	ICATE BE	LOW FORMATIO	N TOPS (IN CON	FORMÁNC	E WITH	GEOGR	APHIC	AL SECTIO	N OF ST	ATE):
	-	•	Southeastern New					4	thwestern N	•• •	
		-	•	Γ. Devonian Γ. Silurian	••••••		т.		amo		
									d-Fruitland		
	•	· · · ·		r. Montoya					gton		1
			•••••••••••••••••••••••••••••••••••••••	Γ. Simpson					d Cliffs		
			······	F. McKee F. Ellenburger					e .ookout		
+				Г. Gr. Wash							
-	-			Г. Granite							
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		1		FORMATIO	N RECO	RD					
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0 95	95	95 470	Send Rad hads		1865 1860	1880 1905	15 25	Sal Sal	Lt & poly	halite	

95 565 635 875 1065 1200 1297 1335	565 635 875 1065 1200 1297 1335 1370	470 70 240 190 135 97 38 35	Red beds Red beds and sand Hed beds, sand, shale Red beds Red beds & sdy. red shal Anhydrite & shells Salt Anhydrite & shale	1860 1905 1965 1995 2005 2123 2143 2143	1905 1965 1995 2005 2123 2143 2175 2275	25 60 30 10 118 20 32	Salt Salt & polyhalite Salt Salt & polyhalite Salt & polyhalite Anhydrite & salt Salt
1370 1360 1415 1440 1480 1535 1610 1640 1655	1380 1415 1440 1480 1535 1610 1640 1655 1675	10 35 25 40 55 75 30 15 20	Anhydrite Anhydrite Shale & salt Hed shells Shell & salt Salt & shale Salt & shale Salt & anhy. streaks Salt Anhydrite	2275 2315 2480	2315	40 165 2	Salt & polyhalite Salt Anhydrite
1675	1865	190	Salt				

ATTACH SEPARATE SHEET IF ADDITIONAL SPACE IS NEEDED

I hereby swear or affirm that the information given herewith is a complete and correct record of the well and all work done on it so far as can be determined from available records.

March 19, 1962

(Date)

......................

MARTIN PARTY

Company or Operator. Climax Chemical Company Miller Larly Name.

Address Hobbs, New Mexico

Position or Title

HAE WASTE SLURRY H-> BRINE TO SALE OR DISPOSAL 9 % - 32 * CASING (CEMENTED) 31/2" - TUBING 7"FINER DETAIL CEMENIT LINER $7^{\prime\prime}$ RED BEDS - TOP AT 40' PACKER. PACKER ON 7" to 95/3" UBING ANHYORITE OO' THICK 1300 1354 1600 ANHYDRITE SALT STRINGERS WITH 1900' 2100 NHYDRITE CONDEN TD - 2425 BASE-OF-SALT 2445 2400 PERMIAN BRINE SALES, INC. MONUMENT NO. 2 OLD CLIMAX FOSTER No 2 SEC. 34 F.19-5 R-36-E (1969) 600 DRAWING NO .: BY:

District I PO Box 1980, Hobbs, NM 88241-1980 District II PO Drawer DD, Artesia, NM 88211-0719 District III 1000 Rio Brazos Rd., Aztec, NM 87410 District IV PO Box 2088, Santa Pe, NM 87504-2088

...

State of New Mexico Energy, Minerais & Natural Resources Department

OIL CONSERVATION DIVISION PO Box 2088 Santa Fe, NM 87504-2088 Form C-101 Revised February 10, 1994 Instructions on back Submit to Appropriate District Office State Lease - 6 Copies Fee Lease - 5 Copies

2 10 2007

AMENDED REPORT

APPLICATION FOR PERMIT TO DRILL, RE-ENTER, DEEPEN, PLUGBACK, OR ADD A ZONE

			t.	Operator Na	ne and Address.				¹ OC	RID Number
6067 1		NE SALE Oth Str as 797	eet		•				30 - 0	PI Number
	rty Code			v Clima		roperty Name Nell No.2 F	oster			• Well No. 2
•		<u>`</u>			⁷ Surface		<u>, , , , , , , , , , , , , , , , , , , </u>			
UL or lot no.	Section 34	Township 19-5	Range 36-E	Lot Ids	Feet from the	North/South line	Feet from the		Ventune) ft	County Lea
		·		Bottom	Hole Locat		ent From Sur	face		.1
UL or lot no.	Section	Township	Range	Lot Idn	Feet from the	North/South line		_	Vest line	County
	<u> </u>	' Propo	ed Pool I	I		.	1º Propo	sed Pool	2	
	Type Code		' Weli Typ		l' Cable		¹⁴ Lease Type C	ode		nd Level Elevation
	E		ine -		Rotar		Р		3618	
" Mi No	ltipie		" Proposed 2449	Depth	"Fon Salad	nation D	" Contractor		¹⁴ Spud Date	
			21	Propos	ed Casing a	nd Cement P	rogram		• • • • • • •	
Hole Si	DE		ng Size		ng weight/foot	Setting Dept		of Cemen		Estimated TOC
12 ¹ / ₄		95/	8		32.3	1359	500	0		irc
zone. Describe Re- e	the blowou entry,	it prevention	program, i auto cer	fany. Use a	PEN or PLUG BA schillonal sheets if i d bridge p	becessary,	a the present produc	tive zone	and propos	ed asw preductive
²⁵ I hereby certif of my knowledg Signature:	fy that the in a soft belief	formation give	eel above is	My and com		OIL	CONSERVA	TION	I DIVIS	SION
Printed name:	AID	(A	<u>ICH</u>	L/LA		Title:				
Title:	C.E.O	lickers				Approval Date:		Expiration	on Date:	••••••••••••••••••••••••••••••••••••••
Date:	2-11-		Phone:	(915)3	A1 AE21 II	Conditions of Approv Attached	al :	L		

	Measure	monte ani	dimensions ar o to be in f	aat/inchas, Wer	C-101 Inst			co Principal Meridian	
			AMENDED REPORT CHEC RT AT THE TOP OF THIS	·	ABLED	18	Geologic fa	ermation at TD	
	1	0	's OGRID number. If you	de net heve en-	14	19	Name of th	e intended drilling company if know	vn.
	,	-	ned and filled in by the Dis			20	Anticipated	i spud date.	
	2	Operator	's name and address			21		ole size ID inches, proposed casing ght in pounds per foot, setting d	
	3		ber of this well. If this is a no number and fill this in.	s new drill the O(CD will		casing or	depth and top of liner, proposed destimated top of cement	•
	4		code. If this is a new ne number and fill it in.	property the OC	D will	22		iption of the proposed drilling progr Attach additional sheets if necossor	
	5	Property	name that used to be call	ed 'well name'		23		ture, printed name, and title of to make this report. The date this	
	6	The num	ber of this well on the pro	operty.				I the telephone number to call fo	
	7	The surv	eyed location of this wei	New Mexico Pr	incipal				
			NOTE: If the United Sta	•	,				
			es a Lot Number for this id IL or lot no.' box. Othern						
		Lotter.							
	8	The prop	osed bottom hole location	of this well at T	D				
	9 and 10) The pro	posed pool(s) to which thi	is well is beeing (drilled.				
	11	Work ty	oo code from the following	table:					
		N	New well						
		E	Re-entry		•				
		D	Drill deeper						
		Ρ	Plugback						
. ••		A	Add a zone						
	12	Well typ	e code from the following	table:					
	,	0	Single oil completion						
<i>.</i>	•	G	Single ges completion		A				
ţ.	a de la composición d	M	Mutiple completion		· ·				
•		A Constant	Injection well						
		S	SWD well	· · ·					
	2 C 1	W	Water supply well						
۰.	(1,2,2,2,2)	C	Carbon dioxide well						
	. 13	Cable as	rotary drilling code						
	13	Cable or	Propose to cable tool dril	.					
		P	Propose to rotary drill	4				, .	
-	14	Losse ty	pa codo from the followin	g table:	,				
		F	Federal	•					
4 4		S	State						
0.00		P	Private						
		N	Navajo						
		J	Jicarilla						
		U	Ute					· · · · ·	••
	. · ·	. 1	Other Indian tribe		. (1799)		,		•
	. 15	Ground	evel elevation above see l	aval					
					nan Sinta ay		· · ·		
	18	Intend to	mutiple complete? Yes o	r No 🥊 👘 💷		a ne .	. • •		
	17 17	•	i total depth of this well	an an that a start a st	лан (тр. 1927) 1947 - С. 1947 1947 - Прессение Прессение (тр. 1947)		^ ^ -		
	- -				eren er in				
	$\hat{\sigma}_{-n} = \sigma_{n+1}$	5 A. T. T.		1. 1980 - 1 1	and the second sec	$\sum_{i=1}^{n-1} \sum_{j=1}^{n-1} \sum_{i=1}^{n-1} \sum_{j=1}^{n-1} \sum_{i=1}^{n-1} \sum_{j=1}^{n-1} \sum_{j=1}^{n-1} \sum_{i=1}^{n-1} \sum_{j=1}^{n-1} \sum_{i=1}^{n-1} \sum_{j=1}^{n-1} \sum_{j=1}^{n-1} \sum_{i=1}^{n-1} \sum_{j=1}^{n-1} \sum_{i=1}^{n-1} \sum_{j=1}^{n-1} \sum_{j=1}^{n-1} \sum_{i=1}^{n-1} \sum_{j=1}^{n-1} \sum_{i=1}^{n-1} \sum_{j=1}^{n-1} \sum_{j=1}^{n-1} \sum_{j=1}^{n-1} \sum_{j=1}^{n-1} \sum_{i=1}^{n-1} \sum_{j=1}^{n-1} $, 1		. –
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NO. OF COPIES RECEIVED			Form C-103
DISTRIBUTION			Supersedes Old C-102 and C-103
SANTAFE	NEW MEXICO OIL CONSERVATION	COMMISSION	Effective 1-1-65
FILE	-		
U.S.G.S.			5a. Indicate Type of Lease
LAND OFFICE	-		State Fee X
OPERATOR			5, State Oil & Gas Lease No. Patented Land
(DO NOT USE THIS FORM FOR PU USE "APPLICA	RY NOTICES AND REPORTS ON WELLS	TERENT RESERVOIR.	
I. OIL GAS WELL WELL	other- Saline Water Well #2		7. Unit Agreement Name None
2. Name of Operator		<u> </u>	8. Farm or Lease Mame
CLIMAX CHEMICA	LCOMPANY		-Foster-Saline Ma
Address of Operator	· · ·		9. Well No. M
<u>Bax 1595 - Habl</u>	s, New Mexico 88240		2
Location of Well UNIT LETTER NONE	300" FEET FROM THE East LINE AND	10 20 FEET PRO	10. Field and Pool, or Wildcat Monument
THE LINE, SECT	ION 34 TOWNSHIP 19 RANGE	36E NMPN	
	15. Elevation (Show whether DF, RT, CR, 3618 G. R.	etc.)	12. County Lea
	Appropriate Box To Indicate Nature of N NTENTION TO: PLUG AND ABANDON REMEDIAL W	SUBSEQUEN	INEE DATA T REPORT OF: ALTERING CASING
TEMPORARILY ABANDON	CHANGE PLANS	DRILLING OPNS.	PLUG AND ABANDONMENT
OTHER Drill New Well	OTHER		L
17. Describe Proposed or Completed (work) SEE RULE 1 103.	perations (Clearly state all pertinent details, and give	pertinent dates, includin	g estimated date of starting any propos
with 500 (sacks) incor will pits. Bumped insert floc	9. Drilled 1359.53 12 1/4" hole. S h 2% calcium chloride and 200 meets tt (set 1 joint off bottom of string) with K. 9 5/8" casing cemented at 1359.5	acks. Girculated	150isacks) cement into ed casing to 1500 [#] PSI.
	plug and drilled to 2449 ^s base of salt to support tubing. Well completed 1		
	• • *		
	•		

18. I hereby certify that the information above is true and complete to the best of my knowledge and belief.

APPROVED BY ACCOUNTIONS OF APPROVALUTE ANY:

••• • ••• ••• •• NEW Y CO OIL CONSERVATION COMMISSION WELL LOLATION AND ACREAGE DEDICATION PLAT All distances must be from the outer boundaries of the Section 5 0. C. C.

1

Form C-102 Supersedes C-128 Effective 1.1.45 65

	EH	ecti	¥.	1	-1-	e
•						

Operator CLIMAX CHEMICAL CO	RP.	Lecse S	ALINE WA	TERWEL	г ^ـ -рн '70	Well No. 2
P 34	wnship 19 SOUTH	Range 3	6 EAST	County L	.EA	
Actual Footage Location of Well: 1020 feet from the SOU	TH	300	· ,		EAST	· · · · · · · · · · · · · · · · · · ·
Ground Level Elev. Producing Formatic		Pool	100	t from the		line cated Acreage;
						Acres
 Outline the acreage dedicated If more than one lease is ded interest and royalty). 		-			•	it below.
If answer is "no;" list the own this form if necessary.) No allowable will be assigned to	zation, force-poolin er is "yes," type of ers and tract descr o the well until all	ng. etc? f consolidati riptions which interests ha	on have ac ve been c	tually bee	en consolidated. ed (by communit	(Use reverse side of
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to propose to drill this test with Hotary tools to a total depth of approximately 3900', we will get and semant 10-3/4" 32/ pasing at a depth of about 300 foot and count same with sufficient nement to circulate back into caller, we will cut an 8-3/4" hole below surface cacing to a depth of approximately 3500 feet and enous cacing with a two-stage job, using 300 sucks on the bettem ob and 250 sacks through two-stage tool at 1275 rest.

we propose to diamond core the hole from shoe of pay string b total dopth.

I understan	d that this plan of work must receive approval in writing by the	Geological Survey before operations may be commenced.
ompany	R. S. Koss	
dress	1503 First Nat'l. Bank Bld'g.	
	Dallas, Toxas.	By Charles P. Miller
		Title Acono

(Form C-110 (Revised 7/1/52 CO OIL CONSERVATION COMMISSION be approved before this form can be approved an an *initial* allowable be assigned to any well. Submit this form in QUADRUPLICATE necessary that Form to any completed Wil or Gas CERTIFICATE OF COMPLIANCE AND AUTHO ZATION TO TRANSPORT OIL AND NATURAL GAS

Oil well Location of Tanks..... Approx 175! FSL 450! FEL of Lot 2

thorized Transporter. Warren Petroleum Corporation Address of Transporter

r cent of Oil or Natural Gas to be Transported......109........ Other Transporters authorized to transport Oil or Natural Gas

(Principal Place of Business)

CHANGE IN OWNERSHIP.....

OTHER (Explain under Remarks).....

Ionument, New Mexico Tulsa, Oklahoma (Local or Field Office) (Principal Place of Business)

Filed for casinghead gas

(EASON FOR FILING: (Please check proper box)

REMARKS:

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VEW WELL.

CHANGE IN TRANSPORTER......

The undersigned certifies that the Rules and Regulations of the Oil Conservation Commission have been complied with. H. S. MOSS **唐宝 1955** OIL CONSERVATION COMMISSION rona Title Vid hi

(See Instructions on Reverse Side,

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Santa Fe, New Mexico Interesting that Form C-10's has approved in the form on the approved an end bit approved in the form is QuADRAPPLICATE. CERTIFICATE OF COMPLIANCE AND AUTHORIZATION 1553 TO TRANSPORT OIL AND NATURAL GAS Jompany or Operator Hobbs, New Merico Unit. B., Well(1) No. Lease Jomeany or Operator Kind of Lease: Yell (1) No. Sec. Jowell Lease: Yell (2) No. Lease Vell (2) No. Sec. Jowell Location of Tanks Approx. YES Per cent of Oil or Natural Gas to be Transported. Jome Mew Mexico He undersigned certifies that the Rules and Regulations of the Oil Conservation Commission have been complied with Executed this the Zuda of Merice Yes The undersigned certifies that the Rules and Regulations of the Oil Conservation Commission have been complied with Executed this the Zuda of Merice Yes The undersigned certifies that the Rules and Regulations of the Oil Conservation Commission have been complied with Executed this the Zuda Charles of Merice Merice		• • •				(Form C-110) (Revised 7/1/52)
CERTIFICATE OF COMPLIANCE AND AUTHORIZATION 1953 TO TRANSPORT OIL AND NATURAL GAS Sompany or Operator R. St. MOSB Address Hobbs, (Mew Mexico Address Hobbs, (Mew Mexico Unit	110:	S NEW ME	XICO OIL CONS Santa Fe, I	ERVATION CO New Mexico	MMISSION	• •
TO TRANSPORT OIL AND NATURAL Image: State of the second of the secon	I necessary that	Form C-104 be, approved bef	ore this form can be a cell. Submit this form i	pproved an an <i>initia</i> n QUADRUPLICA	l allowable be assigned	a thank completed call an Cas
Address Hobbs, New Morico Dallas, Teres UnitB, Well(s) No1 , Sec. 3, T2O.S., R.36E, Pool. Monumont County. Lea Kind of Lease: Federal land If Oil well Location of Tanks Approx. 175: fr. Sl. & 450: fr. EL. of. Lot. 2, section. 3. Authorized Transporter. Texas. New Mexico Houston, Taxes. Function Texas New Mexico Houston, Taxes. Per cent of Oil or Natural Gas to be Transported. 100 Other Transporter submission Per cent of Oil or Natural Gas to be Transported. 100 Other Transporter submission Mexico		TO TRAN	NSPORT OIL	AND NAT	URAL GAS	ASERVAL OR COMMISSION
Unit B , Well(s) No. 1 , Sec. 3. , T2OS , R.36E , Pool MONUMENT. County Lea Kind of Lease: Federal land If Oil well Location of Tanks Approx. 175'. fr. SL & 450'. fr. EL of Lot 2, section 3. Authorized Transporter Texas New Mexico Houston, Texas . Funice, New Mexico Houston, (respect of Bueneo) Per cent of Oil or Natural Gas to be Transported 100. Other Transporters authorized to transport Oil or Natural Gas to be Transported from this unit are NOB						
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If Oil well Location of Tanks Approx. 175'. fr. SL & 450'. fr. EL of Lot 2, section 3 Authorized Transporter. Texas. New Mexico. Pipeline Company. Address of Transporter. Builde. New Mexico. Liceal or Field Office: Per cent of Oil or Natural Gas to be Transported. 100. Other Transporter sauthorized to transport Oil or Natural Gas from this unit are. NOne % REASON FOR FILING: (Please check proper box) NEW WELL CHANGE IN OWNERSHIP. CHANGE IN TRANSPORTER OTHER (Explain under Remarks) REMARKS: The undersigned certifies that the Rules and Regulations of the Oil Conservation Commission have been complied with Executed this the. 2nd				1.1		
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NEW WELL CHANGE IN TRANSPORTER OTHER (Explain under Remarks) REMARKS: The undersigned certifies that the Rules and Regulations of the Oil Conservation Commission have been complied with Executed this the 2nd March 1957 OIL CONSERVATION COMMISSION By Match Match			· · · · · · · · · · · · · · · · · · ·			%
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REMARKS: The undersigned certifies that the Rules and Regulations of the Oil Conservation Commission have been complied with Executed this the 2nd Approved $3 - 9$ OIL CONSERVATION COMMISSION By	NEW WELL			CHANGE IN	OWNERSHIP	
The undersigned certifies that the Rules and Regulations of the Oil Conservation Commission have been complied with Executed this the 2nd day of Merch, 19.53. Approved 3 - 9, 195.7 H. S. MOSS OIL CONSERVATION COMMISSION By By By By	CHANGE IN T	RANSPORTER		OTHER (Expl	ain under Remark	s)
The undersigned certifies that the Rules and Regulations of the Oil Conservation Commission have been complied with Executed this the and day of Merch, 19.53. Approved 3 - 9, 195.7 H. S. MOSS OIL CONSERVATION COMMISSION By By By By	REMARKS:	en a serigina a pole de a serie de pole ha antigo antigo a	n an Start Start Start Start 19 - An Start St 19 - Al Start St	and States and States and States and States and States and States and States and States and States and States	an a	
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Executed this the 2nd day of Merch, 19.53. Approved 3 - 9					· • ·	•
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Approved 3 - 9						
Approved 3 - 9 1953 OIL CONSERVATION COMMISSION By Charles Philler	Executed in	S the	day 01			
	Approved	3-9	, 19 5 3	\square		An•
By A Q Q Yunkhally Title Agent	OIL CO	DNSERVATION COMM		By Cha	ches O.V.	filler
Title Justis Inspects	\wedge	\sim V_{\star}	gh	Title Age	n t	·
	Title	A isris Inspecto	1	-		

- *							
Submit 5 Copies Appropriate District Office DISTRICT 1	E	inergy, M			w Mexico rul Resources Departmer	nt	Form C-104 Revised 1-1-89 See Instructions
P.O. Box 1980, Hobbs, NM 88240 DISTRICT II	(DIL C	ONSI	ERVA' P.O. Bo	TION DIVISION	ł	at Bottom of Page
P.O. Drawer DD, Anesia, NM 88210 DISTRICT III		Sar	nta Fe,		xico 87504-2088		
1000 Rio Brazos Rd., Aztec, NM 87410					LE AND AUTHORIZ		
I. Operator		IO IHA	NSPO	HIOL	AND NATURAL GA	S Well Al	PI No.
Lynx Petroleum (Consul	tants	, In				
P. O. Box 1979,	Hobbs	, NM	882	41			
Reason(s) for Filing (Check proper bax) New Well		Change in	Transport	er of:	Other (Please explain	n)	
Recompletion Change in Operator	Oil Casinghead	d Gas [Dry Gas Condens	ale 📋			
If change of operator give name <u>CONC</u>	oco In	<u>ic. 10</u>	Des	ta Dr	ive, Suite 100	<u>о W, M</u>	idland, TX 79705
II. DESCRIPTION OF WELL	AND LEA	den e di se se i i se se i					······································
Leave Name Reed Sanderson Unit	t	Well No. 4		nt-Ya	gFormation tes-7 Rivers-	Kind of XSMAX, F	Lease Lease No. Edderal of Res LC-030143A
Location Unit LetterB		02	-		rth Line and 165:	2 Fee	r From The East Line
Section ³ Township	20	<u>s</u>	Range	36	Е , NMPM,		Lea <u>County</u>
III. DESIGNATION OF TRANS		R OF O	· · · · · · · · · · · · · · · · · · ·	<u>NATUI</u>		ch anorourd	copy of this form is to be sent)
ARCO Pipe Line Com	pany	0.00000	[200 ARCO Place	••	
Name of Authonized Transponer of Casing Warren Petroleum Co		, X	or Dry (Gas			copy of this form is to be sent)
If well produces oil or liquids, give location of tanks.		Soc.	Twp.	Rge.	BOX 1589, Tul is gas actually connected?	When	
If this production is commingled with that in IV. COMPLETION DATA	from any ou	ner lease or	pool, giv	e comming)	ing order number:	I	
	~~~~	Oil Well		las Well	New Well Workover	Deepen	Plug Back Same Res'v Diff Res'v
Designate Type of Completion		pi. Ready to	o Prod.		Total Depth		P.B.T.D.
Elevations (DF, RKB, RT, GR, etc.)		roducing F			Top Oil/Gas Pay		Tubing Depth
Perforations		-					Depth Casing Shoe
HOLE SIZE		IUBING, SING & TI			CEMENTING RECORI DEPTH SET	)	SACKS CEMENT
	+	- · · · · · · · · · · · · · · · · · · ·					
V. TEST DATA AND REQUES OIL WELL (Test must be after r Date First New Oil Run To Tank		oial volume		oil and must	be equal to or exceed top allo Producing Method (Flow, pu		s depth or be for full 24 hours.) itc.)
Length of Test	Tubing Pr	511125	<u></u>		Casing Pressure		Choke Size
Actual Prod. During Test	Oil - Bbls	i.			Water - Bbis.		Gas- MCF
GAS WELL	<u> </u>	<u></u>	<u></u>		<u> </u>		
Actual Prod. Test - MCF/D	Length of	Test			Bbls. Condensate/MMCF		Gravity of Condensate
Festing Method (pitot, back pr.)	Tubing Pi	ressure (Shi	n-iv)		Casing Pressure (Shut-in)		Choke Size
VI. OPERATOR CERTIFIC		FCÓ			-\		
I hereby certify that the rules and regu Division have been complied with and is true and complete to the best of my	ilations of th t that the inf	e Oil Conse ormation gi	rvation				ATION DIVISION JUL 1 7 '92
Hury U	for	iy.			Date Approve		BY JERRY SEXTON
Signature Gary W. Fonay	Vi	ce-Pr	esid	ent		STRICT I S	UPERVISOR
Briniad Nanje 7-13-92	39	2-695	Title		Title		
Date			lephone l	<b>vo.</b>			
INSTRUCTIONS: This for			complia	ance with		ette side southestide	n Mar an air an Mar Chail in 2015 i tha an An Chail an Chair Chair Chair an Ann an Ann an Ann an Ann an Ann an An Ann an Ann

1) Request for allowable for newly drilled or deepened well must be accompanied by tabulation of deviation tests taken in accordance with Rule 111.

2) All sections of this form must be filled out for allowable on new and recompleted wells.

Fill out only Sections I, II, III, and VI for changes of operator, well name or number, transporter, or other such changes.
 Separate Form C-104 must be filed for each pool in multiply completed wells.

	가 감독하는 것을 다 있는 것을 가 있다. 
Form 9-331	Form Approved.
UNITED STATES P. C. 1973	Jdget Bureau No. 42-R1424
DEPARTMENT OF THE INTERIOR	5. LEASE LC-030143 (A)
GEOLOGICAL SURVEY	6. IF INDIAN, ALLOTTEE OR TRIBE NAME
	·
SUNDRY NOTICES AND REPORTS ON WELLS	7. UNIT AGREEMENT NAME
(Do not use this form for proposals to drill or to deepen or plug back to a different reservoir. Use Form $9-331-C$ for such proposals.)	8. FARM OR LEASE NAME
1. oil gas	REED SANDERSON UNIT
1. oil gas well well other	9. WELL NO.
2. NAME OF OPERATOR	
CONOCO INC. 3. ADDRESS OF OPERATOR	10. FIELD OR WILDCAT NAME EUMONT VATES 7 RVRS. QN.
P. O. Box 460, Hobbs, N.M. 88240	11. SEC., T., R., M., OR BLK. AND SURVEY OR
4. LOCATION OF WELL (REPORT LOCATION CLEARLY. See space 17	AREA
AT SURFACE: 1002 FNL+ 1652 FEL	SEC. 3, T-205, R-36E 12. COUNTY OR PARISH 13. STATE
AT TOP PROD. INTERVAL:	LEA NM
AT TOTAL DEPTH:	14. API NO.
16. CHECK APPROPRIATE BOX TO INDICATE NATURE OF NOTICE,	
REPORT, OR OTHER DATA	15. ELEVATIONS (SHOW DF, KDB, AND WD)
REQUEST FOR APPROVAL TO: SUBSEQUENT REPORT OF:	OF LAND MIL
TEST WATER SHUT-OFF	(NOTE: Report results of multiple completion or zon
FRACTURE TREAT	(ST ALULIVED ST
REPAIR WELL	(NOTE: Report results of multiple completion or zon
PULL OR ALTER CASING	change on Form \$1507 16 1983
	$\langle \cdot \rangle$
ABANDON*	TOP DIST. 6 N. M. O
	TELL SETTION
17. DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly stationary proposed work of well is	te all pertinent details, and give pertinent dates, directionally drilled give subsurface locations and
including estimated date of starting any proposed work. If well is a measured and true vertical depths for all markers and zones pertine	· · · · · · · · · · · · · · · · · · ·
MIRU 7/11/83. REAMED HOLE TO	3875' SET RBP@ 2000'.
TESTED CSG FOR LEAKS, RESET RBP (	2 980'. SET PKR @ 288'.
SQUEEZED 415'-724' W/ 300 5x5 C CMT 435'- 672'. REL RBP. COTO	LASS "C". REL PKR. DO
CMT 435'- 672'. REL RBP. COTO	3897. SET PKR @ 3790.
ACIDIZED OH 3809'-3897' W/60 BBLS	
10 PPG BRINE W/ GUAR GUM & ROCKSAL	
SWBD. INHIBITED OH W/2 DRUMS C	
TFW, REL PKR. SET RBP @ 3790'.	SPOTTED 7 BBLS 15% ACID
3600'- 3790'. PERF W/I JSPF @ 363	30', 35, 40, 45, 67, 72, 77,
82,87,92,97,3702,07,12,37,40,1	13, 46, 66, 4 3780. SET
PKR @ 3558! ACIDIZED PERFS W/4	
Subsurface Safety Valve: Manu. and Type	Set @ Ft.
18. I hereby certify that the foregoing is true and correct	
SIGNED Wy a Future Title Administrative Super	11/15/83
ALLP IED FOR ACCORD (This space for Federal or State of	
PETER W. CHESTER	DATE
	UAIL
MAK 1 1304	
*See instructions on Reverse	Side
	· · · · ·
	· · · · · ·

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# REED SANDERSON UNIT NO.4

FLUSHED W/34 BBLS TFW. FRAC'D W/408 BBLS FRAC FLUID & 26,300 LBS 20/40 SAND. SWBD. Rel PKR. CO TO 3785'. REL RBP. CO TO 3900'. RAN PRODUCTION EQUIPMENT. PUMPED 8 BO, 36 BW, & 274 MCF IN 24 HRS 9/29/83.

		t.	·	. 1
Suprit 1 Copies V Appropriator Distata Offices	State of New Mex Energy, Minerals and Natural Res			Form C-103 Revised 1-1-89
DISTRICT I P.O. Box 1980, Hobbs, NM 88240	OIL CONSERVATION		WELL API NO.	
DISTRICT II P.O. Drawer DD, Artesia, NM \$\$210	P.O. Box 2088 Santa Fe, New Mexico 8		3( S. Indicate Type of Les	0-025-04162
DISTRICT III				STATE FEE X
1000 Rio Brazos Rd., Aztec, NM 87410			6. State Oil & Gas Lea	se Na.
( DO NOT USE THIS FORM FOR PR DIFFERENT RESE (FORM (	FICES AND REPORTS ON WELL IOPOSALS TO DRILL OR TO DEEPEN ( RVOIR. USE "APPLICATION FOR PER C-101) FOR SUCH PROPOSALS.)	OR PLUG BACK TO A	7. Lease Name or Unit	
1. Type of Well: OL CAS WELL X WEL	] 071-828		NORTH MONUME BLK. 18	INT G/SA UNIT
2. Name of Operator			8. Well No.	1
AMERADA HESS CORPO 3. Address of Operator	KATION	<u></u>	9. Pool name or Wilde	4
POST OFFICE DRAWER	D, MONUMENT, NEW MEXICO	88265	EUNICE MONUN	1ENT G/SA
	60 Feet From TheNORTH	Line and66	0 Feet From The	e WEST Line
Section 2			NMPM	LEA County
	10. Elevation (Show whether	DF, RKB, RT, GR, esc.)		
	Appropriate Box to Indicate N	•	•	
NOTICE OF IN	ITENTION TO:	SUB	SEQUENT REF	PORT OF:
		REMEDIAL WORK		
	CHANGE PLANS	COMMENCE DRILLING	GOPNS. · L PL	
		CASING TEST AND C		
OTHER:		OTHER: Casin	g Test. Tempe	Mary Alazader X
<ol> <li>Describe Proposed or Completed Op- work) SEE RULE 1103.</li> </ol>	erations (Clearty state all pertinent details, at	nd give pertinent dates, inclu	iding estimated date of sk	arting any proposed
07-05-93 Thru 07-16-	93 NMGSAU #1804	•		
tbg. as work string. a 6" 600 manual BOP. jts. 2-7/8" 10V tbg. in 4-1/2" liner. TO drill bit. TIH with 2-3/8" tbg. and 122 circulated casing wi 3,739' and 4-1/2" li in 30 mins. Checked found no pressure or	rigged up pulling unit. Flowed gas from casing TIH with a 3-7/8" dril Tagged liner top at 3, H with 125 jts. 2-7/8" 1 a 4-1/2" Elder Cast Irc jts. 2-7/8" tbg. Set CI th 120 bbls. fresh water ner from 3,739' to 3,929 surface-intermediate an flow. Circulated casin	and removed 6" 1 bit, bit sub, 742' and top of OV tbg., 8 jts. BP at 3,850', p Pressure tes '. Pressure de intermediate- g with 120 bbls (Con	600 tubinghea 8 jts. 2-3/8 fill at 3,92 2-3/8" 10V th setting tool a ulled setting ted 6-5/8" cas creased from 8 production cas	ad flange. Install '10V tbg. and 125 V', for 1' of fill og., bit sub and and SN on 8 jts. tool to 3,841' and sing from 0' to 560 psi to 540 psi sing annuli and d and TOH laying
I hereby certify that the information above is	s true and complete to the book of my knowledge an			
SKONATURE	J. Harry T	m <u>æ Staff Aŝsis</u>	tant	DATE 07-16-93
TYPE OR PRINT NAME	erry L. Harvey			ТЕLЕРНОМЕ NO. <u>393-2144</u>
Ď	AL SIGNED BY JERRY SEXTON			AUG 1 3 1993
CONDITIONS OF APPROVAL, IP ANY:			al of Tempora Expires	

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-( 1018-	·'		() agent)	or more than	twenty days	after completion of	ew Mexico, or its pro- well. Fallow instruct	ons OD C
			in the	Rules and R	egulations of	the Commission. I T IN TRIPLICATE	Indicate questionable	Inta 04S
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f Governn	nent land (	he permittee	is	<del>a pitato p</del> i	vilise <del>ne-vilie</del>	, vAddress	1514	1855 - <u>5514</u>
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## EW MEXICO OIL CONSERVATION COMMISSION

Santa Fe, New Mexico

# HOBBS OFFICE OCC

## MISCELLANEOUS NOTICES

Submit this notice in TRIPLICATE to the District Office, Oil Conservation Commission, before the wark specified in to Begin. A copy will be returned to the sender on which will be given the approval, with any modifications considered advisable, or the rejection by the Commission or agent, of the plan submitted. The plan as approved should be followed, and work should not begin until approval is obtained. See additional instructions in the Rules and Regulations of the Commission.

Indicate Nature of Notice by Checking Below

Notice of Intention	Notice of Intention to	Notice of Intention	
to Change Plans	Temporarily Abandon Well	to Drill Deeper	
Notice of Intention	Notice of Intention	Notice of Intention	
to Plug Well	to Plug Back	to Set Liner	
Notice of Intention	Notice of Intention	Notice of Intention	
to Squeeze	to Acidize	to Shoot (Nitro)	
Notice of Intention	Notice of Intention	NOTICE OF INTENTION	
to Gun Perforate	(Other)	(OTHER) <b>Dual Complete</b> X	

OIL CONSERVATION COMMISSION SANTA FE, NEW MEXICO

Monument, New Mexico

April 15, 1954

Gentlemen:

Approved

By

Title.

OIL CONSI

Follo	wing is a Notic	e of Intentio	on to do c	ertain work as de	scribed below at	the	.E. Uait	ner			
Amera	ada Petrol	eum Corp	oratio	n	· .		Well No	1	in	I	
		(Company or	Operator)				-Well No.	- Gas		(Unit)	
NE	1/4 SE		34	т. <b>19</b> S	R 36-E	NMPM	Monumen	t = 011		Po	പ
(40	acre Subdivision)			,			*****************		••••••••••••••••••••••••••••••••••••••		01

Lea.....County.

## FULL DETAILS OF PROPOSED PLAN OF WORK (FOLLOW INSTRUCTIONS IN THE RULES AND REGULATIONS)

3950' T.D. - 6-5/8" OD Csg. set @ 3819' and cemented w/100 sacks cement and 5" liner set from 3780' to 3950' and cemented w/50 sacks cement. Oil is being produced from the perforated interval of 3932' to 3948' from Monument Pool. It is our intention to dual complete well by perf. 6-5/8" OD Csg. from 3425' to 3820' in the Seven-Rivers Queen Formation, Eumont Gas Pool and produce gas through csg. We will continue to produce oil through the tubing from the Monument Pool.

124-113

· 4 1954 MAY Approved ... Except as follows:

MISSION

Amerada Petroleum Corporation

Position Send Communications regarding well to:

Name Amerada Petrolenm Corporation

Address Drawer D. Monument, New Mexico

·/	N. 		NE	WIMEXIC			<b>NSERVATI</b>		OMMISSI	ON 1
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			in th	e Rules and	Regulations	of th	e Commission. IN TRIPLICAT	Indicat	e questionable 008	data CSO
LOCAT	REA 640 ACI E WELL COR	RES	. <b>Dy</b> 1	ollowing it wit	053	ta	200		0801	008
,		(.eftriny	p of Aul	1185' To	)	20	95		1185	0001
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If patented	land the ow	ner is				. cr.15	, Address_		<u>2075</u>	<u>0.00 r</u>
If Governm	nent land th	• ne permittee	1818	Setti arre	.0417mbvg/ .001:	(	, Address_		8888 8885	2003
The Lesse	a is Amar	ada Patro	Laum Cor	paration	an dear	toil	, Addrèss_	Tuls	a. Öklaho	
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The inform	nation given	is to be kep	t confident	ial until	) • (ct?.		95 <b>.</b> [		19	0943
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Include da	ita on rate	of water infl	ow and ele	evation to w	hich water	, rose	in hole. 🖁	ţ	7717 Ur 85	INSC - Vals
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SIZE	SHELL		PLOSIVE OI					TH SHO	שייים שרו סד	CLEANED OUT

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Submit 3 Copies 19 Appropriate District Office	Ener Minerals and Natural R		Form C-103 Revised 1-1-89
DISTRICT I P.O. Box 1980, Hobbs, NM 88240	OIL CONSERVATIO	88	WELL API NO. 30-025-31982
DISTRICT II P.O. Drawer DD, Artesia, NM 88210	Santa Fe, New Mexico	87504-2088	5. Indicate Type of Lease
DISTRICT III 1000 Rio Brazos Rd., Aziec, NM 87410			STATE FEE X
	CES AND REPORTS ON WE		
(FORM C-	POSALS TO DRILL OR TO DEEPEN VOIR. USE "APPLICATION FOR PE 101) FOR SUCH PROPOSALS.)		7. Lease Name or Unit Agreement Name
I. Type of Well: OIL OAS			
2. Name of Operator	OTHER		J.A. FOSTER 8. Well No.
DAVID H. ARRINGTON	OIL & GAS, INC.		#3
3. Address of Operator	·		9. Pool name or Wildcat
P.O. BOX 2071, MID	LAND, TEXAS 79702		I MONUMENT ABO
Unit Letter <u>P: 660</u>	Feet From The SOUTH	Line and330	Feet From The EAST Lin
Section 34	Township 19-S Ru	inge 36-E	NMPM Lea County
	10. Elevation (Show whether	•	
11. Check A	Appropriate Box to Indicate I		aport or Other Data
NOTICE OF INT			SEQUENT REPORT OF:
		REMEDIAL WORK	
	CHANGE PLANS		OPNS.
PULL OR ALTER CASING		CASING TEST AND CE	MENT JOB
OTHER:		OTHER: COMPLE	TE DRILLING OPERATIONS
<ol> <li>Describe Proposed or Completed Operati work) SEE RULE 1103.</li> </ol>	ions (Clearly state all pertinent details, ar	nd give pertinent dates, includ	ling estimated date of starting any proposed
CASING @300' N	WITH 400 SXS CLASS		OLE TO 300', SET 13 3/8" SXS. WOC 12 HRS. TESTING
	/4" HOLE TO 2613'. HALIBURTON LT & 20	0 SXS PREMIU	SG. @ 2613'. CEMENT M PLUS. TOC @ 1240' BY
TEMP SURVEY. 7 /25/93 - DRILLED TO TD	TEST CSG TO 1000 PS	SI, OK.	
1/27/93 - RAN 5 1/2" CSC HALIBURTON LT TOOL. CEMENTEI	G. TO 8035'. DV TOC & 560 SXS CI	H. CIRC 105 SXS HALIBURTO	MT 1St. STAGE W/250 SXS SX CEMENT OUT FROM DV H LT + 650 SXS CL C. DID am 10/27/93.
<u></u> .		. •	2
I hereby certify that the information above is true	and complete to the best of my knowledge and	belia.	
SIONATURE SECTION		resident	12/15/93
TYPE OR PRINT NAME	5		Telephone no.
DIST	SIGNED BY JERRY SEXTON		DEC 20 1993
ONDITIONS OF APPROVAL, IF ANY:	πη		DATE

:

					2 - A		_1_
. (5 Copies			lew Mexico				Form C-104
DISTRICT I	Energ	y, Minerals and Na	tural Resour	ces Departme	ent	,	Revised 1-1-89 See Instructions
P.O. Box 1980; Hobbs, NM 88240	ОП	CONSERVA	ATTON T	NUTSIO	N		at Bottom of Page
DISTRICT II P.O. Drawer DD, Artesia, NM \$8210	UIL		lox 2088	111310	1 4		
		Santa Fe, New M		04-2088			
DISTRICT III 1000 Rio Brazos Rd., Aziec, NM 87410		·					
•		FOR ALLOWA					
I. Operator	101	RANSPORT OI	L AND NA	IUHAL GA		PI No.	·····
						•	
DAVID H. ARRINGT		GAS, INC.	<u></u>			025-3198	12
P.O. BOX 2071. N	TDLAND.	EXAS 7970	2				
Reason(s) for Filing (Check proper box)	•			et (Please expla	in)	······	
New Well KX	-	e in Transporter of:					
	Oil Casinghead Gas	Condensate					•
Change in Operator	Cititigneta Citi		KATT KLED K		1.5 1.5 1		
and address of previous operator			·····	••••			
II. DESCRIPTION OF WELL	AND LEASE	No. 12	NITES OF	Cha 11		· and ()	
Lasse Name	the second s	to. Pool Name, Includ	ing Formation	4/1/94		( Lesse	Lease No.
J.A. Foster		Monumen	t_Abo_/	-10091	Statex	Sedentior Fee	
Ligation							
Unit LetterP	_: <u> 660     </u>	Feet From The	South um	and 330		t From TheE	ast Line
	10 0				•_		
Section 34 Townshi	p <u>19-S</u>	Range 36-E	, NI	ирм,	Lea	···· · · · · · · · · · · · · · · · · ·	County
IL DESIGNATION OF TRAN	SPORTER OF	OIL AND NATU	PAL GAS				
Name of Authorized Transporter of Oil	at Ca			e address to whi	ich approved	copy of this form	is to be sent)
	I XX FIC SE	M. TOC.		ox 580 Ho			-
Name of Authorized Transporter of Casing	the second s	مجمادات والمتكاديب ومرطب كفاكن بالمدور إياد ججير متعادي				copy of this form	is to be sent)
Warren Petroleum	CORD	· · · · · · · · · · · · · · · · · · ·				NM 8826	
If well produces oil or liquids,	Unit Sec.	Twp. Rge.	Is gas actually	connected?	When	?	
rive location of tanks.	LP 34		T		<u>11</u>	/20/93	
f this production is commingled with that :	from any other lease	or pool, give comming	ling order sumt	жг.			·····
V COMPLETION DATA	l Oil V	Vell Gas Well	New Well	Workover		Dive Deals In	Dig Basta
Designate Type of Completion				workover	Deepen	Plug Back Sa	me Res'v Diff Res'v
Date Spudded	Date Compl. Read	y to Prod.	Total Depth		I	P.B.T.D.	
10/6/93	11/20/9	3	8050			7987	
Elevations (DF, RKB, RT, GR, etc.)	Name of Producing		Top Oil/Cas F	yay yay		Tubing Depth	
3614' GR. 3627 KF	Abo		7323			718	12
Perforations						Depth Casing S	106
7323'-7428' (30	Holes)					8035'	
	·····	G, CASING AND			<u>)                                    </u>		
HOLE SIZE		TUBING SIZE		DEPTH SET	-		KS CEMENT
17 1/2	13_3/8_		300'			_4.0.0_sxs	Lt + 200  sx C
$-\frac{12}{7}$	<u>85/8</u> 51/2		8035'	······			t & 560 H
	2 3/8		7182			650 Cl (	
7. TEST DATA AND REQUES							
		me of load oil and must					will 24 hours.)
Date First New Oil Run To Tank	Date of Test		-	thod (Flow, pun	np, gas iyi, ei	c.)	
<u>11/20/93</u> rength of Tex	11/23/9 Tubing Pressure	13	Pum Casing Pressu			Choke Size	
	Luoing Freesure						
2.4 Actual Prod. During Test	Oil - Bbls.		Water - Bbis.			Gal- MCF	
		22	2	30		35	
GAS WELL							······································
Actual Prod. Test - MCF/D	Length of Test		Bbls. Conden	HIE/MMCF		Gravity of Cond	chiale
esting Method (pilot, back pr.)	Tubing Pressure (S	հա-տ)	Casing Pressu	re (Shut-in)		Choke Size	
	<u> </u>		4			i	
1. OPERATOR CERTIFIC	ATE OF CON	<b>MPLIANCE</b>	-		000		
hereby certify that the rules and regul:				DIL CON	SERVA	ATION DI	VISION
Division have been complied with and the first state and complete to the best of my h					n F	EC 20 199	8
and the star complete to the best of my I	monitorie and pelle		Date	Approved	1 t		
1-07-11-20	5			-			TORY REVEAL
Signature		<u> </u>	By_	<u> </u>			ERRY SEXTON
David H. Arringt	on /Presi				DIST	RICT I SUPER	U I DUR
Printed Name	016 6	Tille 82-6685	Title.		· · · · · · · · · · · · · · · · · · ·		
Date		82-0085 Telephone No.					
and the second		a and a state and the state of	attates, eterlasite star astad	and be a constrained on a large state of the	an di Borgan, an traditation d	and the attrict to be sent	ist it have been also a spirit the second second second second
INSTRUCTIONS: This form							• • •
1) Request for allowable for a				anied by tab	ulation of	deviation tests	taken in accordance
with Rule 111. 2) All sections of this form r		<b>.</b>					

All sections of this form must be filled out for allowable on new and recompleted wells.
 Fill out only Sections I, II, III, and VI for changes of operator, well name or number, transporter, or other such changes.
 Separate Form C-104 must be filed for each pool in multiply completed wells.

ł

							•
NUMBER OF COPIES RECEIVED DISTRIBUTION SANTA FI				L CONSERVA	TION CON SION	F	ORM C-110 (Rev. 7-60)
U.S.G.S. LAND OFFICL TRANSPORTER OIL GAS PROMATION OFFICE OPERATOR		CERTIFI	CATE OF CO	MPLIANCE	AND AUTHÖR NATURAL, GA	AZATION 0	C. C.
		FILE THE O	RIGINAL AND 4	COPIES WITH T	HE APPROPRIATE (	OFFICE .	1.84
Company or Operator Chilf Oil Corr				- I have	Lease Northrest Bur	nont Unit	Well No. 34-140
Unit Letter N	Section	Township <b>19-S</b>	Range 36	-B	County Lea		
Pool					Kind of Lease (State	, Fed,Fee)	, <b>1997 - Table Constanting (1998 - 1997 - 1997</b> - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 199
	duces oil or con	densate	Unit Letter	Section	Township	Range	
give	location of tan	<s< td=""><td>0</td><td>34</td><td>19-S ddress to which approve</td><td></td><td><b>-E</b></td></s<>	0	34	19-S ddress to which approve		<b>-E</b>
Authorized transporter Texa 8-New Mex		ine Co.	ctually Connecto	od? YesXX	Midlard, Texa		
Authorized transporter	of casing head	gas 🚺 or dry gas	Date Con- nected	Address (give a	ddress to which approve	ed copy of this form	, is to be sent)
Warren Pet. C	lorp.		Unic	Box 1589,	Tulsa, Oklahom	na .	•
<b>To change the</b>	Change in T Oil Casing h	ransporter (check on Dry ead gas . Con Operators le	e) Gas [_] densate [_]	Other (explain	ershig below)		
Eumont Unit h requested to well No. to N	as been fo change th lorthwest	ormed, offec e name of th Rumont Unit,	tive 4-1-64 e operator t ,Well No. 34	with Gulf a o gulf and -14.	A. Foster No. s operator. I change the nam	Permission in a of the le	s hereby
ine undersigned cei				ONPELIATION COM		angeren metite	
	Executed	i this the 30th	day ofMarch		, 19 <u>64</u> .		
OII	L CONSERVA	TION COMMISSION	•	By	ORIGINAL SIC	он бы а <b>ү</b> Сату	
1A-				Title Area Pro	duction Manage		
Trile Engine	er District	1	· .	Company Chilf Oil	Corporation	· · ·	
Date		· · · · · · · · · ·		Address Box 620	Holabor Norr Mo	where an an	

-36	N.		1 1		:		(Revised 7/1/52) (Form C-105)
	╺-╪─╍╾┞			NEWAT BARNELOC	OIL CONSE		OM MEETON
<u>K</u>				NEW MEXICO			OMMISSION
i inga i	17.1.2.				Santa Fe, N	ew Mexico	
			Т			i i <u>L</u> it	0 14 MI 2:24
	1-1-1	1	.9		WELL R	ECORD	
	1 your and	····					
			8 Mail to Dist	rict Office Oil C	ontervation Corr	mission to whi	ch Form C-101 was sent not
	╪╶╎─┼		later than tw	enty days after co	mpletion of well	. Follow instruct	ions in Rules and Regulations
	REA 640 ACF		of the Comm	ission. Submit in (	QUINTUPLICA	.TE	
LOCAT	E WELL COR	RECTLY					
••••••		Company or Opera				Lease)	
Wall No	, '						R
	-			-			
							line
	•						
							ar4
Name of Dril	ling Contrac	tor	a.Petroleum	Corporation			
Address			bs., New Mexi	co			
Elevation abo	ve sea level a	t Top of Tubing	Head		The info	ormation given i	is to be kept confidential until
	confiden	tial	, 19				•
				L SANDS OR ZO			
•							.,to
No. 2, from		to	•••••	No. 5,	from	••••••	to
No. 3, from		to		No. 6,	from	••••••	to
			TMPOT	RTANT WATER	GANDS		
Include data	on rate of u	inflow and	elevation to which		-		
					•		
		•	to				••••••
			to				
			to				и.
No. 4, from	· · · · · · · · · · · · · · · · · · ·		to			feet	
				CASING RECOI	RD		
	WEIG	HT NEW C	28	KIND OF	CUT AND		<u>,</u>
SIZE	PER FO			SHOE	PULLED FROM	PERFORATIO	DNS PURPOSE
8-5/8"	32#	New	288.63				Surface string
	15.	54 New	3937.85	Larkin		3910 - 393	5' 011 string
		····		· ·			
***** · · · · · · · · · · · · · · · · ·		I	<u></u>				······································
			MUDDING	AND CEMENT	NG RECORD		
SIZE OF	SIZE OF	WHERE	NO. SACKS	METHOD		MUD	AMOUNT OF
HOLE	CASING	SET	OF CEMENT	USED		RAVITY	MUD USED
	8-5/8"	3101	250	<u>Fum &amp; Pl</u>		Cemented	to surface
	5-1/2"	39501	750	Pump & Pl			
					.		
			RECORD OF	PRODUCTION A	ND STIMULA	TION	
		(Decord A)	ha Daaraa			Anothed on sheet	<b>\</b>
			he Process used, N	-	-		
						•	eallons Sandfrac
Dowel	1) conte	nining 1-1/	2 # sand/eal	10n.			
•••••••••••••••••••••••••••••••••••••••				*******			
	دم	•					
Denili of P	duala - 0.1		()	at the+-	A 3113 3	BOND fhan-	I on lif 21 hours -
						1347.12.11.11.12.13.12.13.12.13.12.13.12.13.12.13.12.13.12.13.12.13.12.13.12.13.12.13.12.13.12.13.12.13.12.13.12	1 on 46.31 barrals
1. 1n 4.9	<u>hours)</u>	thru 16/6	+" choke. F	TP 450 psi.	oor 143.		

/

Depth Cleaned Out.

~ /	<u> </u>	يەت يە سول	· ·		·		·			
	DIES CECEIVED		NEV	MEXICO (		ONSER	() VATION	COMMISSIO	N	FORM C-103
U.L.C.L.				ICCEL IN A	arem 1	CDED				(Rev 3-55)
PRORATION O	01L 6A3			ISCELLA						•
OPERATOR			(Submit t	o appropriate	Distric	t Office	as per Con	nmission Rule	1106	5
Name of Con Ame	erada Petr	oleum	Corporation			0. Bo		Hobbs, New	·	
·	E. Gaither			1 No. Unit	Letter J	34	1	95	Rang	36E
Date Work P 5-27-63	to 5-31-6		Pool Eumor	nt			County	Lea		
				REPORT OF:						
	ing Drilling Op	erations		g Test and Cen	nent Job	<b>&gt;</b> [	Other (E	Explain):		
Pluggin			ure and quantity of n				· · · · · · · · · · · · · · · · · · ·			
pay. Cl open ho	Leaned out Le from 38'	open 701 t	1 - 400 grains hole from 393 o 3940' with 5 Resumed proc	3 <b>3' to</b> 394 500 gals.	01. :	Ran tu	bing and	packer,	Acid	r ft, of ized eran
Witnessed by			1	Position			Company	· · · · · · · · · · · · · · · · · · ·		
A. J. 1	roop			Asst. Dis				a Petroleu	m Co	rporation
			FILL IN BELOW	ORIGINAL			PORTS OF	NLY		
DF Elev.		TD	·······	PBTD			Producing		Co	mpletion Date
3630 Tubing Diam		ī	3940 ¹ Tubing Depth	1	011 5	ng Diame		to 3940 ¹ Oil Strin		6-6-56
2-3/8			3 <b>921</b>			<b>5-1/</b> 2			3870	
Perforated In	terval(s)			· .		•				
Open Hole In 38701	terval to 39401	<u> </u>			Produci	ing Forma Stu				
				RESULTS OF	WOR					
Test	Date of Test		Oil Production BPD	Gas Produc MCFPI			roduction PD	GOR Cubic feet/I	зы :	Gas Well Potential MCFPD
Before Workover	5-25-63		<b>8</b> _28	132			2.76	15,960	)	
After Workover	6-1-63		40	245			7	6,116		
	OIL CONS	ERVAT	ION COMMISSION	•			y that the in my knowledg		n abov	e is true and complete
Approved by	A	1		P	Name	21	1.	con-		
Jule	e te		<u> </u>	·······	Positi		it mint a	uperintend	ant	
Date		观	· · · · · · · · · · · · · · · · · · ·		Compa	any		m Corporat		

1-				Γ	JIID	NEVMENTO	O OIL CONS	ERVATION	I COMME	SSION	
A		-  -		T			O Some Fer	New Merico	•		
ratio (chan int)	Sec.	34		19 <b>i</b>		1050					
		\$4		8		1906	WELL	<b>ČEČO</b> ŘĚ	<b>b</b>		
		1 8 Y N			•	55			en e to		
				. 1	dail to Dist	trict Office, Oil	Conservation Co	mmission, to	which Form	C-101 w	as sent
				ls of	ater than tw f the Comm	venty days after c	ompletion of we OUINTUPLIC	ll. Follow inst ATE: If	ructions in I State Land	Rules and submit	Regulati 6 Copie
LOCAT	REA 640 E WELL	ACRES	LY								•
norada	Petro	loum (	lorpora	tion		*****	M.E.	Gaither	• 195 <b>.</b>		
eusel A an			any or Operi								
						nd Gas Lease No.					
ectionr		Morr	If St 96	tate Lan	nd the Oil an	nd Gas Lease No. 19 <b>56</b> Drillin	ji	Sina L	• { • • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • • • • •	
ling Com	nenced	<u>Fley</u>	EV.		kont Dei	1920 Drillin	g was Completed	ourio M	<b>Å</b>	1	, 19
•										4	•
						·····					
ation abo	ve sea lev	el at Top	o of Tubing	g Head.	Not Det	ermined	The in	formation give	en is to be	kept confi	dential u
nt Conf	ident	al		, 19					1	Sec. 1	
									;	• • • • •	• • •
					~ ~ 7	T RANTOR OT 7	C 12772 M				
	387	31 -		39		L SANDS OF Z				• •	· · · · ·
					401	No. 4	, from				
2, from	******		to	D,	401	No. 4	; from	t	to		•••••
2, from	******		to	D,	401	No. 4	; from	t	to		•••••
2, from	******		to	D,	401	No. 4	i, from i, from i, from	t	to		•••••
2, from 3, from			to	0	401 DEPO	No. 4 No. 5 No. 6	t, from j, from j, from <b>; from</b>	t	to		•••••
2, from 3, from lude data	on rate o	of water i	to	0 0 0 clevatio	401 IMPO on to which	No. 4 No. 5 No. 6 BTANT WATEE	i, from i, from i, from <b>: BANDS</b> le.	t	to		•••••
2, from 3, from lude data 1, from	on rate o Non	of water i	inflow and	0 0 l elevatio	401 IMIPO on to which to	No. 4 No. 5 No. 6 BTANT WATER . water rose in hol	i, from i, from i, from i, from i, from i, from	t	to		•••••
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2, from 3, from lude data 1, from 2, from 3, from	on rate o Non	of water i	to	0 0	401 IMIPO on to which to	No. 4 No. 5 No. 6 BTANT WATEE . water rose in hol	i, from i, from i, from i BANDS ie.	feet	to		•••••
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2, from 3, from lude data 1, from 2, from 3, from 4, from 51ZE -5/8N	on rate o Non Wi FEI	e water i e s s s s s s s s s s s s s s s s s s	inflow and	0 clevation 0 clevation 0 0 0 0 0 0 0 0	401 IMPO on to which to to to to to to to to to	CASING RECO	i, from i, from i	feet feet		1 ' 1 ' 1 ' 1 ' 1 ' 1 ' 1 '	
2, from 3, from lude data 1, from 2, from 3, from 4, from 51ZE -5/8H	on rate o Non Wi FEI	e water i e s s s s s s s s s s s s s s s s s s	inflow and	0	401 IMIPO on to which to to to to to to to to to to to	CASING RECO	, from	feet feet feet feet	to		) 1 1 1 1 1 1 1 1 1 1 1 1 1
2, from 3, from lude data 1, from 2, from 3, from 4, from 81ZE -5/8N -1/2N SIZE OF	on rate o Non Wi FEI 2 1	ef water i <b>2</b> <b>3</b> <b>5</b> <b>5</b> <b>5</b> <b>4</b> <b>4</b> <b>5</b> <b>5</b> <b>5</b> <b>4</b> <b>5</b> <b>5</b> <b>5</b> <b>4</b> <b>5</b> <b>5</b> <b>5</b> <b>7</b> <b>7</b> <b>7</b> <b>7</b> <b>7</b> <b>7</b> <b>7</b> <b>7</b>	NEW (USE) New (USE) New (USE)	0 0 0 0 0 0 0	401 IMIPO on to which to to to MOUNT 13141 38701 MUDDING	CASING RECO KIND OF BHOE Guide Float	i, from	feet feet feet feet feet feet	to	<pre></pre>	) 1 1 1 1 1 1 1 1 1 1 1 1 1
2, from 3, from lude data 1, from 2, from 3, from 4, from 81ZE -5/8H -1/2H B1ZE OF HOLE	on rate o Non Wi PEI 2 1 3 SIZE 0 CASING	ef water i Elohr Elohr 4# 5.5#	NEW (USE) NEW (USE) New (USE) New (USE)	OR D OR D C OR D C C OF C	401 IMIPO on to which 	CASING RECO KIND OF SHOE Guide Float	h, from	feet feet feet feet feet	to	· · · · · · · · · · · · · · · · · · ·	) 1 1 1 1 1 1 1 1 1 1 1 1 1
2, from 3, from lude data 1, from 2, from 3, from 4, from 5/8 -5/8 -1/2 8 IZE OF HOLE 224 1	on rate o Non PEI 2 3 SIZE 0 CASING 8-5/8	6 water i 6 6 6 6 6 6 6 7 7 7 7 7 7 7 7 7 7 7 7 7	NEW of USE1	olevation	401 IMPO on to which to to to AMOUNT 13141 38701 MUDDING SACES CEMENT U	CASING RECO KIND OF SHOE Guide Float AND CEMENT METHOD USED Hailiburto	h, from	feet feet feet feet feet feet	to	<pre></pre>	) 1 1 1 1 1 1 1 1 1 1 1 1 1
2, from 3, from lude data 1, from 2, from 3, from 4, from 81ZE -5/8N -1/2N S1ZE OF HOLE	on rate o Non Wi PEI 2 1 3 SIZE 0 CASING	6 water i 6 6 6 6 6 6 6 7 7 7 7 7 7 7 7 7 7 7 7 7	NEW (USE) NEW (USE) New (USE) New (USE)	OR D OR D C OR D C C OF C	401 IMPO on to which to to to AMOUNT 13141 38701 MUDDING SACES CEMENT U	CASING RECO KIND OF SHOE Guide Float	h, from	feet feet feet feet feet feet	to	<pre></pre>	) 1 1 1 1 1 1 1 1 1 1 1 1 1
2, from 3, from lude data 1, from 2, from 3, from 4, from 81ZE 5/8N -1/2N 81ZE OF HOLE 224N	on rate o Non PEI 2 3 SIZE 0 CASING 8-5/8	6 water i 6 6 6 6 6 6 6 7 7 7 7 7 7 7 7 7 7 7 7 7	NEW of USE1	olevation	401 IMPO on to which to to to AMOUNT 13141 38701 MUDDING SACES CEMENT U	CASING RECO KIND OF SHOE Guide Float AND CEMENT METHOD USED Hailiburto	h, from	feet feet feet feet feet feet	to	<pre></pre>	) 1 1 1 1 1 1 1 1 1 1 1 1 1

24 gravity refined oil and 20,000# Sand. Maximum pressure 2600#, minimum pressure 2200#,

final pressure 1600#, injection rate 20 bbls. per minute. Flushed with 190 bbls. oil.

Result of Production Stimulation Swabbed in. After Flowing load oil. Flowed 75.76 bbls. oil and no water in 2 hrs. on 1/2" choke, tubing pressure 320#, casing pressure 700#, gas volume 790,050 cu. ft. per day, GOR 869, gravity 34.5 corrected. Depth Cleaned Out.

## NEW EXICO OIL CONSERVATION COL ISSION Santa Fe, New Mexico

## NOTICE OF INTENTION TO DRILL

Notice must be given to the Oil Conservation Commission or its proper agent and approval obtained before drilling begins. If changes in the proposed plan are considered advisable, a copy of this notice showing such changes will be returned to the sender. Submit this notice in triplicate. One copy will be returned following approval. See additional instructions in Rules and Regulations of the Commission.

	Hobbs, New Mex.	4-19-36
OIL CONSERVATION COMMIS	Place	Date
Santa Fe, Ne Gentlemen: You are hereby notified th		1 - January an
Shell Petroleum Co	at it is our intention to commence the drilling of a well to prporation Foster Well No.	
of Sec <b>34</b> , T. <u>19-S</u> ,	R 36-K. M. P. M. Monument Field,	LeaCounty.
N.	The well is 660? feet [N.] [SI] of the S	line and 660' feet
	[EX] [W.] of the E line of Sec 34	
	(Give location from section or other legal subdivision lines.	Crossout wrong directions.)
	If state land the oil and gas lease is No A	ssignment No
	If patented land the owner is J. H. Foster	·
	AddressHobbs, N M	
	If government land the permittee is	
	Address	
	The lessee is Shell Petroleum Corpora	tion
AREA 640 ACRES LOCATE WELL CORRECTLY	Address Houston Texas	
Rotary (	We propose to drill well with drilling equipment as fol	lows:

The status of a bond for this well in conformance with Rule 39 of the General Rules and Regulations of the Commission is as follows:______

We propose to use the following strings of casing and to land or cement them as indicated:

Size of Hole	Size of Casing	Weight Per Foot	New or Second Hand	Depth	Landed or Cemented	Sacks Cement
17 <del>1</del> 12 8-3/4	12 <del>1</del> 9-5/8 7"	50 36 24	SH New *	250 1200 3725	Cem T	150 450 250

If changes in the above plan become advisable we will notify you before cementing or landing casing. We estimate that the first productive oil or gas sand should occur at a depth of about <u>3800</u> feet. Additional information:

Sincerely yours,

3.40 1N Approved except as follows: 1.56 11 OIL CONSERVATION COMMISSION,

ż

PEFROLUEM SH CORPORATION District Engineer Position

Send communication regarding well to Name Shell Petrolaum Corporation Address Box p Hobbs N M

Appropriate State of	Now Mexico Ingral Resources Department	C	
DISTRICTI OIL CONSERV	ATION DIVISION Box 2088	WELL API NO.	
	Aexico 87504-2088	30-025-0411 5. Indicate Type of Les	
DISTRICT III 1000 Rio Brazos Rd., Aziec, NM 87410		6. State Oil & Gas Los	STATE FEE K
SUNDRY NOTICES AND REPORTS ( DO NOT USE THIS FORM FOR PROPOSALS TO DRILL OR TO DIFFERENT RESERVOR. USE "APPLICATIO (FORM C-101) FOR SUCH PROPOS	DEEPEN OR PLUG BACK TO A FOR PERMIT	7. Lease Name or Unit NORTH MONUM	Agreement Name IENT G/SA UNIT
1. Type of Well: OL OL OAS WELL OTHER			· · · · · · ·
2. Name of Operator	· · · · · · · · · · · · · · · · · · ·	BLOCK 13 8. Well No.	· ·
AMERADA HESS CORPORATION		9. Pool name or Wildo	
3. Address of Operator DRAWER D, MONUMENT, NM 88265 4. Well Location		EUNICE MONU	-
· · ·	TH Line and 66	0 Feet From The	EAST Line
Section 34 Township 195	Range 36E	NMPM LEA	County
10. Elevation (St	w whether DF, RKB, RT, GR, etc.)		
11. Check Appropriate Box to I	dicate Nature of Notice.	Report or Other Dr	//////////////////////////////////////
NOTICE OF INTENTION TO:		BSEQUENT REF	
TEMPORARILY ABANDON CHANGE PLANS			UG AND ABANDONMENT
PULL OR ALTER CASING	CASING TEST AND		
OTHER:	OTHER: TESTED		[
12. Describe Proposed or Completed Operations (Clearly state all periine 6-24 1 ARUE 180393	t details, and give pertiment dates, inc	luding estimated date of sta	rting any proposed
MIRU DA&S WELL SER. PULLING UNIT & TOH LINER AND FOUND PUMP STUCK. BACKED OFF SUCKER RODS. REMOVED 9-5/8" HINDERLITE 9-5/8" ADAPTER FLANGE AND A 6" 900 MANU 4-1/4" DRILL BIT, TAGGED TOP OF LINER A 5" ELDER LOK-SET RETRIEVABLE BRIDGE PLU WATER & PRESS. TESTED CASING FROM O' TO 30 MINS. CHECKED INTERMEDIATE-PRODUCTI RELEASED RBP AT 3,855' & TOH. SCHLUMBE TOP OF 5" LINER AT 3,662' & TD AT 3,935	RODS & RECOVERED 2 3 TUBINGHEAD PACKING L BOP. STRIPPED OUT 3,664' & PBD AT 3,9 . SET AT 3,855'. CI 3,855'. PRESS. DECR N CASING ANNULUS AND .GER RIH WITH GR-CCL-	/4" X 8' PONY R AND SLIP ASSEMB RODS AND TUBIN 67'. TOH WITH RC. CASING WITH EASED FROM 580 FOUND NO PRESS CNL TOOLS. SCH	CODS AND 45 3/4" GLY AND INSTALLED IG. TIH WITH BIT. TIH WITH A I 130 BBLS. FRESH PSI TO 535 PSI IN GURE OR FLOW. ILUMBERGER FOUND
		-	1
I hereby certify that the Information above is true and complete to the best of any skonature	more ind belief.	N. SER.	- DATE
TYPE OR PRINT NAME ROY L. WHEELER, JR.			ТЕLEPHONE NO. 393-2144
(This spece for State Uss)	Orig. Signe Paul Kau Geologia		DATE JUL 16 1993
APPROVED BY	Geolog #		DATEJUL LU 1333

<b>.</b>					CC	) PY TO O.C.C.	
Form 9-330 (Rev. 5-68)		LINIT -		SUBMIT D	N DUPLICA	1	approved.
			) STATES OF THE IN		(See ot structi	her in-	et Bureau No. 42-R355.5.
-			AL SURVEY		reverse		ATION AND SERIAL NO.
WELL CC			MPLETION			6. IF INDIAN, AL	LOTTEE OR TRIBE NAME
1a. TYPE OF WE			C			7. UNIT ACREEME	
b. TYPE OF CON	wi	ell Mell	D DHYEY	Jother 14 AM	65	Mescalero f	
NEW X		EP- PLUG BACK	DIFF. RESVR.	Other		S. FARM OR LEAS	
2. NAME OF OPERA Ernest A.		<u></u> .			· • •	Mescalero I	Ridge Unit "35
3. ADDRESS OF OPP		• • • • • •		· · · · · · · · · · · · · · · · · · ·		9. WELL NO.	
		well, New M				10. FIELD AND PO	
4. LOCATION OF WE At surface	LL (Report locat		FSL & 990'		nts)*	Pearl Queer	
		Sec.	35, T-19-S,		M.P.M.	OR AREA	., OR BLOCK AND SURVEY
At top prod. in	terval reported b		ounty, New		i.	Sec. 35, T-	-19-S, R-34-E
At total depth							13. STATE
•			14. PERMIT NO	1	ISSUED	12. COUNTY OR PARISH	New Mexico
15. DATE SPUDDED	16. DATE T.D.	REACHED   17. DAT	E COMPL. (Ready	to prod.)   18. ELE		RKB, RT, GR, ETC.)* 19.	ELEV. CASINGHEAD
8/16/65	9/7/6	I	/20/65		3711	KB	3701'
20. TOTAL DEPTH, MD 5200'	& TVD 21. PL	ug, back t.d., md & 5189'	TVD 22. IF MUI HOW M	LTIPLE COMPL.,	23. INTER DRILL		CABLE TOOLS
24. PRODUCING INTE		COMPLETION-TO	P, BOTTOM, NAME (	MD AND TVD)*		E CAR	25. WAS DIRECTIONAL SURVEY MADE
4576' - 50	036' Queen	Formation	· .	1	•		No
26. TYPE ELECTRIC	AND OTHER LOGS	RUN				27.	WAS WELL CORED
Gamma-Ray,	/Density/C	allper					Yes
28. CASING SIZE	WEIGHT, LB.		ING RECORD (Re	port all strings set		NTING RECORD	
8-5/8"	23#			12"		irc. to surf.	AMOUNT PULLED
5-1/2"	15½#		92	7-7/8" 3	50 sx.	<u>.</u>	None
			· · · · · · · · · · · · · · · · · · ·		- <u></u>		
29.		LINER RECORD	I		30.	TUBING RECORD	
SIZE	TOP (MD)	BOTTOM (MD)	SACKS CEMENT*	SCREEN (MD)	SIZE	DEPTH SET (MD)	- PACKER SET (MD)
					2-3/8"	4575	None
31. PERFORATION RE	COPP (Internal a	ine and number)	, <u>, , , , , , , , , , , , , , , , , , </u>	1			
		4576', 459	5' 4597'	32. AC		FRACTURE, CEMENT SQ	
			61', 4885',			500 acid, 20,000	
	31', 5024'					1 & 20,000 lbs	
				4745 - 5		500 acid, 20,000	-
33.*		•	PRO	DUCTION	Ϋ́	1 & 16,000 lbs	
DATE FIRST PRODUCT			Flowing, gas lift, p	umping-size and	type of pump	) WELL STAT	US (Producing or
9/20/65			/32" tubing				Producing
9/20/65	HOURS TESTED	CHOKE SIZE	PROD'N. FOR TEST PERIOD	OIL-BBL.	GAS-MCF.	WATER-BBL.	GAS-OIL BATIO
FLOW. TUBING PRESS.	CASING PRESSU		OILBBL.	GAS-MCF.	w	ATER-BBL. OIL	GRAVITY-API (CORR.)
34. DISPOSITION OF C	AS (Sold, used to	r juel, vented, etc.)	47			TEST WITNESSED	
Sold					:. 	Schram	• • • •
35. LIST OF ATTACH		L. 10. 32			· · ·		
2 - Gamma- 36. I hereby contre	Hay/Densi	ty/Caliper	information is comp	plete and correct a	s determined	from all available record	8
SIGNED	Smit	R. Ha	DO MITLE	Opera			/20/65

*(See Instructions and Spaces for Additional Data on Reverse Side)

11.1

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-11

	ILE		ONSERVATION COMMISS	Form C-104 Supersedes Old C-104 and C-110 Effective 1-1-65
	U.S.G.S.	AUTHORIZATION TO TRA	NSPORT OIL AND NATURAL G	as 44 M '65
	IRANSPORTER GAS GAS	· · · · · ·		
1.	PRORATION OFFICE			,
	Ernest A. Hanson	<u>n</u>		
1	Address P. 0. Box 1515,	Roswell, New Mexico		
	Reason(s) for filing (Check proper box) New Well X Recompletion Change in Ownership	Change in Transporter of: Oil Dry Ga Casinghead Gas Conden		
	f change of ownership give name and address of previous owner		••	
	DESCRIPTION OF WELL AND I	EASE		
	Lease Name Mescalero Ridge Unit "3 Location	Well No. Pool Nar	me, Including Formation url Queen	Kind of Lease State, Federal or Fee Federal
		80_Feet From TheNorth Lin	e and Feet From 7	rhe West
	Line of Section 35 , Tow	nship <b>19–5</b> Range	34-Е , ммрм, Le	2 County
III. 1	DESIGNATION OF TRANSPORT	ER OF OIL AND NATURAL GA	S	•
	Name of Authorized Transporter of Oil	or Condensate	Address (Give address to which appro-	
	Shell Pipe Line Corp. Name of Authorized Transporter of Cas		Box 1598, Hobbs, New Ma Address (Give address to which appro-	ved copy of this form is to be sent).
	Phillips Petroleum Co.	Unit Sec. Twp. Rge.	Bartlesville, Okla. Is gas actually connected?	en
	give location of tanks.	F 35 19-S 34-E	Yes	Aug. 15, 1965
	If this production is commingled wit COMPLETION DATA	•		
	Designate Type of Completio	n - (X) Oil Well Gas Well X	New Well Workover Deepen	Plug Back Same Res'v. Diff. Res'v.
	Date Spudded	Date Compl. Ready to Prod.	Total Depth	Р.В.Т.D. 5116'
	July 25, 1965	August 15, 1965 Name of Producing Formation	5200' dolo. Top Oil/Gas Pay	Tubing Depth
	Pearl Queen	Queen Fm.	45681 5014 & 5016	4565 ¹ Depth Casing Shoe
	1 SPF @ 4568, 4588,		4875, 4877, 4879, 5012, D CEMENTING RECORD	
	HOLESIZE	CASING & TUBING SIZE	DEPTH SET	SACKS CEMENT
	<u>11"</u> 7-7/8"	<u>8-5/8"</u> 5-1/2"	246' 5126'	125 sx. circulated
		2-176		
v.	TEST DATA AND REQUEST F(		l Ifter recovery of total volume of load oil epth or be for full 24 hours)	and must be equal to or exceed top allow
	Date First New Oil Run To Tanks	Date of Test	Producing Method (Flow, pump, gas l	ft, etc.)
	August 15, 1965 Length of Test	August 15, 1965 Tubing Pressure	Rmping           Casing Pressure	Choke Size
	24 hours Actual Prod. During Test	Oil-Bbis.	Water-Bbls.	2 ^u Gas-MCF
		52	8	
	GAS WELL	,		
	Actual Prod. Test-MCF/D	Length of Test	Bbls. Condensate/MMCF	Gravity of Condensate
	Testing Method (pitot, back pr.)	Tubing Pressure	Casing Pressure	Choke Size
VI.	CERTIFICATE OF COMPLIAN	CE		ATION COMMISSION
	Commission have been complied v	regulations of the Oil Conservation with and that the information given best of my knowledge and belief.	APPROVED	, 19
			TITLE	
	Remain Rom	Hanson		compliance with RULE 1104. wable for a newly drilled or deepened
		alure)	well, this form must be accomp tests taken on the well in acco	anied by a tabulation of the deviation
	Operat	O <b>r</b>	All sections of this form m	ust be filled out completely for allow-
	August 18		well name or number, or transpo	, and VI only for changes of owner tter, or other such change of condition
			Separate Forms C-104 mu completed wells.	st be filed for each pool in multiply

Inter than trenty days after completion of well. Follow instructions in Rules and Regulat of the Commission. Submit in QUINTUFLICATE.         Inconfiguration       Shell 011 Company         Pogtag       (Company of Derivation)         (Company of Derivation)	Santa Fe, New Mexico AL OOC         1957 UNL E:3 UN         19         19         19         19         19         10         10         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         12         12         13         14         15         15         16         16         17         18         18         19         111         111         111         111         111         1111         1111         1111         1111         1111         1111          11	1 1	R-3645	·			- -			(Revised 7/1/52) (Form C-105)
Santa Fe, New Mixtor NC C000         Isonation 30         Isonation 30 <td>Santa Fe, New Mexico AL OOC         1957 UNL E:3 UN         19         19         19         19         19         10         10         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         12         12         13         14         15         15         16         16         17         18         18         19         111         111         111         111         111         1111         1111         1111         1111         1111         1111          11</td> <td></td> <td>╾┼╾╾┼╌╾┝╼</td> <td></td> <td>i sing tana a a latin Nggan</td> <td>NEW MEXIC</td> <td>O OIL CONSE</td> <td>RVATION</td> <td>сомм</td> <td>SSION</td>	Santa Fe, New Mexico AL OOC         1957 UNL E:3 UN         19         19         19         19         19         10         10         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         11         12         12         13         14         15         15         16         16         17         18         18         19         111         111         111         111         111         1111         1111         1111         1111         1111         1111          11		╾┼╾╾┼╌╾┝╼		i sing tana a a latin Nggan	NEW MEXIC	O OIL CONSE	RVATION	сомм	SSION
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WELL RECORD         Mail to District Office, Off Conservation Commission, to which Form C-101 was sent later than twenty days after completion of well. Follow instructions in Rules and Regulat of the Commission. Submit is QUINTUPLICATE.         LOCATES WELCORD         Shall 011 forpany         Total of Operatory         Shall 021 for operatory         State Land the Oil and Gas Lease No. is         Section       Janua 521 for         Section       Shall 12.         Section       State Land the Oil and Gas Lease No. is         Section       State Land the Oil and Gas Lease No. is         Section       State Land the Oil and Gas Lease No. is         Section 13.       State La	WELL RECORD         Well to District Office, Oil Conservation Commission, to which Form C-101 was sent lase than towersy days after completion of well. Follow instructions in Rules and Regulat Other Commission. Submit in QUINTUFLICATE.         Loc., ATE AN CORRECTLY         Shall 0.11 Company         Shall 0.11 Company         Yes 100 Commission. Submit in QUINTUFLICATE.         Loc., ATE AN CORRECTLY         Shall 0.11 Company         Shall 0.11 Company         Yes 100 Commission. Submit in QUINTUFLICATE.         Loc., ATE AN CORRECTLY         Shall 0.11 Company         Shall 0.11 Company         Yes 0.11 Commission. Submit in QUINTUFLICATE.         Loc., ATE AND CORRECTLY         Shall 0.11 Company         Section			<u> </u>	2					
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LOGATE WELL CORRECTLY           Shell Cli formpany         For \$ 60F           (Company or Operator)           Company         For \$ 60F           Company         For \$ 60F           Company         Company           Loss         Company           Base in the Cli and Sa Lease No. is	Locars well, conserving         Postor           Shall 011 Company         Tool, Classo           Company or opening)           South colspan="2">Company or opening)           Company or opening)           Company or opening)           Company or opening)           Company or opening           Company or openi				later than tv	venty days after c	ompletion of well	. Follow instru		
IN         2-A         in         14         04         05         14         05         14         16         16         7	BIL No.         2-A         in. ST         14 of	LOCAT	E WELL CORRI	ECTLY	lompany			Foste	F	
Section	iii 660       test from       BON th       line and       2310       feet from       SENSE         Section       34       If State Land the Oil and Gas Lease No. is.       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7       7<	ell No	2-A	, in <b>S</b> V				-19-8	, R	
Section 34 If State Land the Oil and Gas Lease No. is	Section 34. If State Land the Oil and Cas Lease No. is	ell.is				-			• •	
Interest       C * # # # 31       Drilling Contractor       C * # # # 3621         Idress       B R I       Box 2, MiAlatd, 7sins         Idress       B R I       Box 2, MiAlatd, 7sins         valion above sea level at Top of Tubing Head       3621       The information given is to be kept confidential to Box 2000 and 1000  and	Idress       R. R. I.       Rox 2. MIAIAL4. Zaxas         evation above sea level at Top of Tubing Head       3621       The information given is to be kept confidential u         BOL. confidantial									•
BAR       B	OIL SANDS OR ZONES           2. 1, from         10         3561         No. 4, from         10           2. 2, from         10         No. 5, from         10         10           3. 3, from         10         No. 6, from         10         10           3. 3, from         10         No. 6, from         10         10           3. 3, from         10         No. 6, from         10         10           IMPORTANT WATER SANDS           Clude data on rate of water inflow and elevation to which water rose in hole.           3. 1, from         10         feet.         10         10         10           3. 3, from         10         10         feet.         10         10         10           3. 3, from         10         10         feet.         10         10         10           CASING RECORD           MUEIOHT NEW OR USED AMOUNT KIND OF PERFORATIONS PURPOSE           State or WEIGHT NEW OR USED AMOUNT OF PERFORATIONS Suppression           MUDDING AND CEMEENTING RECORD           MUDDING AND CEMEENTING RECORD           MUDDING AND CEMEENTING RECORD           MUDDING AND CEMEENTING RECORD <td< td=""><td></td><td></td><td></td><td></td><td>•</td><td></td><td></td><td></td><td></td></td<>					•				
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BOL confidential       , 19         OIL SANDS OR ZONES         0.1, from       3555         0.2, from       to         0.2, from       No. 4, from         0.2, from       No. 5, from         0.3, from       to         0.3, from       No. 6, from         0.3, from       to         IMPORTANT WATER SANDS         Clude data on rate of water inflow and elevation to which water rose in hole.         0.1, from       to         0.2, from       to         0.3, from       to         0.4, from       to         0.5, from       feet.         0.2, from       to         0.3, from       to         0.4, from       to         CASING RECORD         SIZE         VEIGHT         NEW OR         AMOUNT         KIND OF         VULLED FROM         PERFORATIONS         PULPOSE         MUDDING AND CEMENTING RECORD	BOL CONTINENT       19									
OIL SANDS OR ZONES         b. 1, from	OIL SANDS OR ZONES         1, from       3561       No. 4, from       to         2, from       No. 5, from       to       to         3, from       No. 6, from       to       to         3, from       No. 6, from       to       to         3, from       No. 6, from       to       to         IMPORTANT WATER SANDS         Clude data on rate of water inflow and clevation to which water rose in hole.         5, 1, from       to       feet.         5, 2, from       to       feet.         5, 3, from       to       feet.         5, 4, from       to       feet.         5, 4, from       to       feet.         CASING RECORD         SIZE PERFORT NEW OR AMOUNT KIND OF PURPOSE         MUDDING AND CEMENTING RECORD         MUDDING AND CEMEENTING RECORD         MUDDING AND CEMENTING RECORD      <					1	The inf	ormation giver	n is to be	kept confidential until
b. 1, from       3565       to       3961       No. 4, from       to         b. 2, from       to       No. 5, from       to       to         b. 3, from       to       No. 6, from       to         IMPORTANT WATER SANDS         Clude data on rate of water inflow and elevation to which water rose in hole.         b. 1, from       to       feet.         b. 2, from       to       feet.         b. 3, from       to       feet.         b. 2, from       to       feet.         b. 3, from       to       feet.         b. 4, from       to       feet.         c. 4, from <td>b. 1, from       3561       No. 4, from       to         b. 2, from       No. 5, from       to         b. 3, from       No. 5, from       to         b. 3, from       No. 6, from       to         IMPORTANT WATER SANDS         Clude data on rate of water inflow and elevation to which water rose in hole.         b. 1, from      </td> <td><b>no.l</b>Q())</td> <td>nfidantia</td> <td><b>.</b></td> <td>, 19</td> <td></td> <td></td> <td></td> <td></td> <td></td>	b. 1, from       3561       No. 4, from       to         b. 2, from       No. 5, from       to         b. 3, from       No. 5, from       to         b. 3, from       No. 6, from       to         IMPORTANT WATER SANDS         Clude data on rate of water inflow and elevation to which water rose in hole.         b. 1, from	<b>no.l</b> Q())	nfidantia	<b>.</b>	, 19					
A. 2, from	2, from				0)	IL SANDS OR Z	ONES			
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A, from	b. 4, from	•								·
CASING RECORD         SIZE       WEIGHT PER FOOT       NEW OR USED       AMOUNT       KIND OF SHOE       CUT AND PULLED FROM       PERFORATIONS       PURPOSE         5/8*       32#       new       29.5!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!       92.95!	CASING RECORD         SIZE       WEIGHT PER FOOT       NEW OR USED       AMOUNT       KIND OF SHOE       CUT AND PULLED FROM       PERFORATIONS       PURPOSE         15/5*       32*       Daw       29.51       Sprfcds ?tx       Sprfcds ?tx         1/2*       15.53       new       36.61       0.011       String         MUDDING AND CEMENTING RECORD         MUDDING AND CEMENTING RECORD         SIZE OF HOLE       WHERE CASING       No. SACKS OF CEMENT       METHOD USED       MUD GRAVITY       AMOUNT OF MUD USED         1/4*       8.5/8*       30.0       FUEED & Fling       Casented to curfuide	•							••••••	
SIZE     WEIGHT PER FOOT     NEW OR USED     AMOUNT     KIND OF SHOE     CUT AND PULLED FROM     PERFORATIONS     PURPOSE       3/8*     324     new     295!     Sprfcde ?t:       1/2*     15.54     new     3856!     Oil String       MUDDING AND CEMENTING RECORD	SIZE     WEIGHT PER FOOT     NEW OR USED     AMOUNT     KIND OF SHOE     CUT AND PULLED FROM     PERFORATIONS     PURPOSE       5/3*     32#     new     29.5!     Sprfc.ds * tr Sprfc.ds * tr       1/2*     15.5#     new     3856!     Oil String       MUDDING AND CEMENTING RECORD       SIZE OF HOLE     SiZE OF CASING     WHERE SET     NO. SACRS OF CEMENT     METHOD USED     MUD GRAVITY     AMOUNT OF MUD USED       1/4*     8 5/8*     204     300     FUMp & Flug     Cepented to curfside	o. 4, from			to			feet	•••••	
MUDDING AND CEMENTING RECORD	MUDDING AND CEMENTING RECORD       Size of Hole     Size of CASING     WHERE SET     NO. SACKS OF CEMENT     METHOD USED     MUD GRAVITY     AMOUNT OF MUD USED       1/4*     8 5/8*     300     Fump & Fing     Cemented to curface	SIZE				KIND OF	CUT AND	PERFORAT	TIONS	PURPOSE
MUDDING AND CEMENTING RECORD	S1/2*     15.54     new     3856*     Oil String       MUDDING AND CEMENTING RECORD     MUDDING AND CEMENTING RECORD     AMOUNT OF       Size of Hole     Size of CASING     WHERE SET     NO. SACKS OF CEMENT     METHOD USED     MUD GRAVITY     AMOUNT OF MUD USED       1/4*     8 5/8*     204     300     Fump & Fing     Cemented to curfade	5/8*	12#	ney	2051					Sprfede Strin
	Size of Hole     Size of CASING     WHERE SET     NO. SACKS OF CEMENT     METHOD USED     MUD GRAVITY     AMOUNT OF MUD USED       1/4*     8 5/8*     204     300     Fump & Fing     Cemented to curface	1/2"	15.5#		38561					011 String
	SIZE OF HOLE     SIZE OF CASING     WHERE SET     NO. SACKS OF CEMENT     METHOD USED     MUD GRAVITY     AMOUNT OF MUD USED       1/4*     8 5/8*     204     300     Fump & Fing     Cemented to curface			····						······································
	1/4* B 5/8* 304 300 Fump & Fing Comented to curfinge	SIZE OF	SIZE OF			METHOD		MUD	]	AMOUNT OF
										INUD UOLD
7/5° 51/2° 3866 750 Pump & Plug Canantes to surflide	7/5" 5 1/2" 3666 750 Pum & Plum					• •	***	190 60 FU	AL ALGE	•
RECORD OF PRODUCTION AND STIMULATION				(Decord of	Property in a l	Vo of O++ o+ O-		ALL REAL OF ST		
(Record the Process used, No. of Qts. or Gals. used, interval treated or shot.) Treated down subing & omsing w/20,000 callons Control-frac w/10/callen and & fluid-1	Treated down tubing & casing w/20,000 gallons Control-frac w/10/gallen aand & fluid-le	••••		bing & oa	aing w/20,00	0 callons C	ontrol-frac	w/10/201	len øs	
(Record the Process used, No. of Qts. or Gals. used, interval treated or shot.)	Trented down tubing & casing w/20,000 callons Control-frac w/13/gallen sand & fluid-le additive.		¥£	bling & oa	aing w/20,00	00 callons C	ontrol-frac	<u>v/10/m1</u>	len os	
(Record the Process used, No. of Qts. or Gals. used, interval treated or shot.) Treated down tubing & casing w/20,000 gallons Control-frac w/10/gallon cand & fluid-7. additive.	Treated down tubing & casing w/20,000 callons Control-frac w/10/gallen cond & fluid-lo additive.		¥£	bing & ca	aing w/20,00	0 callons C	ontrol-frac	<u>v/10/m1</u>	len 98	
(Record the Process used, No. of Qts. or Gals. used, interval treated or shot.) Treated down tubing & casing w/20,000 gallons Control-frac w/10/gallen asad & fluid-2 additive.	Trented down tubing & casing w/20,000 gallons Control-frac w/13/gallen cond & fluid-le additive. Result of Production Stimulation On OPT flowed 141 BOFD 4 5 BW thru 14/64" choke. FTP 400 psi.		¥£	bing & ca bing &	opt flowed	0 callons C 141 BOPD +	ontrol-frac	<u>v/10/m1</u>	len 98	

Submit 3 Copies	State C Energy, Minerals and	of New Mexic			Form C-10
District Office	EIRIGY, MIIRIAIS AIRI	Naturar Resol	irces Department		Revised 1-1
<u>DISTRICT I</u> P.O. Box 1980, Hobbs, NM 88240	OIL CONSER	VATION ). Box 2088	DIVISION	WELL API NO.	
DISTRICT II P.O. Drawer DD, Artesia, NM 88210	Santa Fe, Nev	v Mexico 87	504-2088	5. Indicate Type of	10-025-04164 V
DISTRICT III 1000 Rio Brazos Rd., Aztec, NM 87410	0	<b>.</b> .		6. State Oil & Ga	STATE X s Lease No. 3-1543-1
( DO NOT USE THIS FORM FOR F DIFFERENT RES	DTICES AND REPORTS PROPOSALS TO DRILL OR T SERVOIR. USE "APPLICATION A C-101) FOR SUCH PROPO	o deepen or N for permi	PLUG BACK TO A		Unit Agreement Name
1. Type of Well: OK GAS WELL X WELL [	ОТНЕЯ		· · · · · · · · · · · · · · · · · · ·	NORTH MON	UMENT G/SA UNI
2. Name of Operator				8. Well No.	0
AMERADA HESS CORPOR 3. Address of Operator				9. Pool name or V	9 Wildcat
DRAWER D. MONUMENT.	NEW MEXICO 8826	5		EUNICE MON	UMENT G/SA
4. Well Location Unit Letter :	980 Feet From The	SOUTH	Line and 6	50 Feet From	n TheEAST
<b>9</b> artice 2	<b>m</b>	205 Ranne	36E		LEA
Section 2			RKB, RT, GR, etc.)	NMPM	
					<u> </u>
	k Appropriate Box to	Indicate Na	-		
NOTICE OF I	NTENTION TO:		SUE	SEQUENT F	REPORT OF:
		ЮН 🗌 Р	REMEDIAL WORK		ALTERING CASING
	CHANGE PLANS		OMMENCE DRILLIN	GOPNS.	PLUG AND ABANDO
PULL OR ALTER CASING	]		ASING TEST AND C		
OTHER:	-		THER: Casi		
12. Describe Proposed or Completed Op			·····	••••••••••••••••••••••••••••••••••••••	
<pre>work) SEE RULE 1103. 03-24-93 Through 04 MIRU Ram Well Ser. w/6-1/8" bit to 3,7 Press. tested 7" cs re-set RBP at 634'. 7" csg. lipped in. top RBP. Beveled o Installed &amp; tested National tbg. head. sand off RBP, latch bailed out to 3,855 Removed BOP &amp; set T</pre>	& TOH w/rods & pu 93' & TOH. TIH w g. to 500# for 30 Circ. hole clea Re-installed BOP ut inside 7" csg. 11" 3000# x 9-5/8 Set slips in cs ed onto RBP & TOH '. Lowered bit t AC at 3,611' w/15	/7" RBP & min. He n. Rēmovo & re-set Cut off " Nationa g. head w, . TIH w/0 o PBD at 3 ,000# ten	set at 3,675 ld OK. Chart ed BOP & Hind RBP at 3,634 & removed 9- l csg. head & /90,000# tens 5-1/8" bit & 3,911'. TOH	<pre>'. Circ. hc attached. erliter tbg. '. Spotted 5/8" Hinderl 7-1/16" 300 ion. TIH w/ tagged up at w/bit. TIH</pre>	ble w/fresh wai PUlled up hole head. Found 4 sks. 12/20 s liter csg. head 00# x 11" 3000# (retrieving head 3,793'. Drld w/7" TAC on 2-
cleaned location & Test of 04-07-93? Thereby certify that the information above in	Prod. 40 BO, 80 B	W, & 7 MC		urs.	2
SIONATURE	under f	TITLE	SUPV, ADMI	N. SERV.	DATE04-13-9
TYPE OR PRINT NAME ROY	<u>L. Wheeler, Jr.</u>		· · · · · · · · · · · · · · · · · · ·		TELEPHONE NO. 39
(This space for State Use) Or	ig. Signed by				

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		T IN TRIPLICA		····	7. If Unit or CA, Agroement Designation
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2. Name of Operator					17
Amerada Hess 3. Address and Telephone 1	Corporation				9. API Well No.
•	onument, New Mexi	co 88265	(505) 393-21	44	30-025-0417400 10. Field and Pool, or Exploratory Area
4. Location of Well (Foota)	ge, Sec., T., R., M., or Survey	Description)			Eunice Monument G/S
660' FNL & 6	60' FEL, Sec. 3,	T20S, R36E			11. County or Parish, State
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2. CHECK	APPROPRIATE BOX	(s) TO INDICA	TE NATURE OF NO	DTICE, REPORT	, OR OTHER DATA
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NMGSAU #1817 Rowland Truc No pressure cement to su and charted Steve Caffey	cking moved in an . Note: 10-3/4" urface. Pressure 30 min. casing i v w/Bureau Of Lar	x 7-5/8" a tested 5-1 ntegrity te d Managemen	nnulus and 7-5/8 /2" and 4-1/2" 1 st. Well lost 2 t. Released cas	3" x 5-1/2" a liner, CIBP a 20# to 520#. sing pressure	annulus both have at 3,830', to 540# Test witnessed by e. Rowland Trucking
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*See Instruction on Reverse Side

#### GEOLOGY

#### PHYSIOGRAPHY

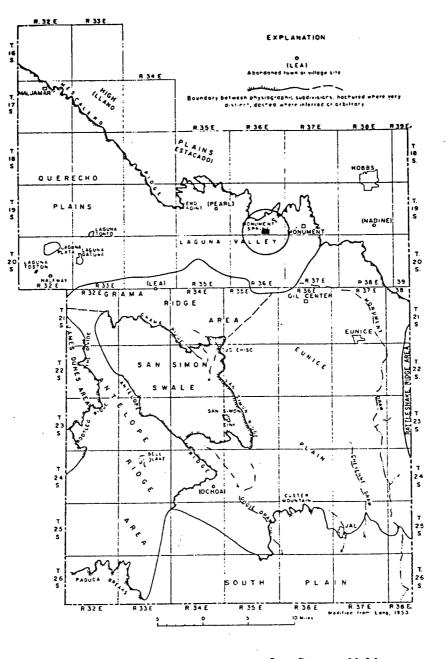
The Climax Chemical plant is located near Monument, Lea County, New Mexico, approximately 20 miles west of the Texas - New Mexico border (Plate 1). The nearest populated area is Hobbs, located ten miles northeast of Monument. The climate of the area ranges from dry subhumid to arid, and is characterized by low annual precipitation, low humidity and high average annual temperature. Mean annual precipitation ranges from 15.68 to 12.63 inches per year and the mean annual temperature is about 62°F (Nicholson and Clebsch, 1961). Due to the low precipitation and rapid infiltration into the surficial sediments, flood potential is extremely low.

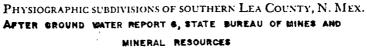
Lea County is divided into two physiographic subdivisions of the Great Plains physiographic province, the Pecos Valley section and the High Plains section. As illustrated in Figure 3.1, the proposed well location is in the Pesos Valley section which is divided into the Querecho Plains, Laguna Valley, Grama Ridge Area, Eunice Plains, San Simon Swale, Antelope Ridge Area and the South Plain (Nicholson and Clebsch, 1961).

To the north of Climax Chemical, the southern extent of the High Plains section is marked by the Mescalero Ridge of the Llano Estacado. An abrupt change in topography is the primary contrast between the Llano Estacado and the Pecos Valley. The Llano Estacado is an almost uniform depositional surface of low relief sloping southeastward. In contrast, the Pecos Valley is a very irregular erosional surface

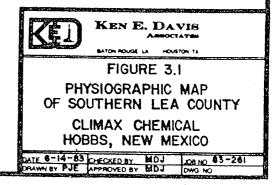
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sloping toward the Pecos River (westward). Total relief of the area is about 1,300', having altitudes ranging from 4,000' mean sea level (MSL) to 2,900' MSL. A geologic map depicting the physiographic subdivisions of southern Lea County is included as Plate 2 and a brief description of the divisions follow:

#### Mescalero Ridge and High Plains

Mescalero Ridge is the most prominent topographic feature in southern Lea County and as previously stated, marks the southern limit of the High Plains section. The ridge is a nearly perpendicular cliff capped by a thick layer of resistant caliche, locally called caprock.

The High Plains is a uniformly flat surface sloping about 17' per mile southeast. The only significant relief features are small sand dunes and shallow depressions called buffalo wallows. These depressions range in size from a few feet to more than a quarter of a mile and can be up to 20' deep. Buffalo wallows collect rainfall and contain it until removed by evaporation or seepage.

#### Querecho Plains and Laguna Valley

Immediately southwest and south of Mescalero Ridge is a vast sand dune area of approximately 400 square miles called Querecho Plains (to the west) and Laguna Valley (to the east). As shown on Figure 3.1, the Climax Chemical plant is located in Laguna Valley. The Querecho Plains - Laguna Valley area is almost entirely covered by dune sand which is stable or semi-stable over most of the area. The sand is generally underlain by Recent alluvium and may be underlain by caliche in places. Drillers logs indicate surface sand underlain by caliche is found to depths of about 35'.

The most significant feature in the area is a group of four playas or dry lakes. These playas are irregularly shaped, flat-bottomed, and are underlain by fine sediments with some pebble gravel and precipitated salt and gypsum.

#### Grama Ridge Area

The Grama Ridge Area is directly south of the Querecho Plains-Laguna Valley area and is topographically higher, indicating it may be an outlier, or detached portion of the High Plains. It is characterized by a hard caliche surface with a texture and composition indicating it was once part of the Llano Estacado. The surface of the Grama Ridge Area has many shallow depressions which do not have integrated drainage.

#### Eunice Plain

The area east of Laguna Valley and Grama Ridge is referred to as the Eunice Plain. It is bounded on the north by the Llano Estacado and on the southwest by San Simon Ridge and Antelope Ridge. The westward extension of the Eunice Plain is the Grama Ridge area. Dune sands almost entirely cover the Eunice Plain and it is usually underlain by a hard caliche surface. In some places; however, it is underlain by alluvial sediments. A sand cover is generally 2' to 5' thick, but may be 20' to 30' thick locally.

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#### Rattlesnake Ridge

Toward the east, the Eunice Plain rises into a north-trending topographic high called Rattlesnake Ridge. It parallels the state line for most of its length and is regarded as the drainage divide between the Pecos Basin and the Colorado River Basin, Texas.

#### San Simon Swale

To the west of Eunice Plain is San Simon Swale, a large depression covering about 100 square miles. Most of San Simon Swale is covered by stabilized dune sand and shows no apparent drainage pattern. The deepest point of the swale is San Simon Sink, being 100' deep and a half mile across. Calcareous silt and fine sand are the predominant fill material in the sink.

#### Antelope Ridge Area

The area to the west and southwest of Antelope Ridge has been called the Antelope Ridge Area, located in southwestern Lea County. The area is relatively flat, sand-covered surface similar to the Eunice Plain and it is also partially underlain by caliche. Towards the south, the area appears to be underlain by Quaternary fill and loamy soil similar to the San Simon Swale. Because the Antelope Ridge is an anomalous geographic feature similar to the High Plains, it is thought to be an outlying remnant of the High Plains.

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# 3.2 HISTORICAL GEOLOGY

The Precambrian history of Southern Lea County is a complex history of mountain building, metamorphism and erosion. Active deposition was taking place in the area during most of the Paleozoic In later Paleozoic time, the south-central United States was a Era. region of crustal unrest with the most significant activity in the West Texas-New Mexico area taking place in Pennsylvanian time. During this time and earlier in the the Paleozoic, a geosyncline (the Llanoria geosyncline) formed across West Texas and adjacent states. (A geosyncline is a linear trough which has subsided throughout time accumulating large volumes of clastic sediment). Strong compressional forces from the southeast caused the geosynclinal area to be raised into mountain ranges which some refer to as the Marathon folded belt. Although much of the folded belt was eroded, it remained high during most of Permian time. During the Pennsylvanian Period, what is now the Central Basin Platform was also emergent in the form of mountain ranges and the area was subject to erosion.

At the close of the Pennsylvanian, the major features of the Permian Basin formed as the whole area subsided. The Central Basin Platform subsided more slowly than the Delaware and Midland Basins and received fewer sediments under different depositional conditions. The basins were areas of accumulation of large amounts of sediment. Limestone tended to form in higher areas, such as the Central Basin Platform, while the formation of evaporites took place at the fringes

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of the sea. At the very edge of the seas, redbeds were formed by the deposition of sediments from nearby land masses.

During Wolfcamp time (early Permian), seas spread over the region and later became restricted causing deposition of redbeas, evaporites and limestones. The final event of the Permian was the retreat of evaporite-depositing waters from the West Texas region which caused the deposition of a thin layer of redbeds known as the Ochoan Series.

The end of the Permian, and therefore the end of the Paleozoic Era, marks a major time break in the geologic column. During most of the Triassic (except late Triassic) and Jurassic, most of southern Lea County was emergent and undergoing erosion.

During early to middle Cretaceous time, Southeastern New Mexico was covered by a large shallow sea which deposited a thick sequence of Cretaceous rocks. In the late Cretaceous, during the uplift of the Rocky Mountains, seas retreated from the Lea County area and intense erosion took place removing almost all Cretaceous rocks.

In the Pliocene Age, the Ogallala Formation was evenly deposited across the High Plains area, effectively removing the irregular surface formed by previous episodes of erosion. An erosional cycle again began during the Quaternary, removing much of the Ogallala Formation and eroding Triassic rocks for the third time at some locations. Accordingly, erosion by the major rivers of New Mexico and Texas caused the isolation of a large remnant of the Ogallala Formation, the Llano

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Estacado. The climate of the region became more arid in the late Quaternary, and detrital material was reworked by wind creating the large sand dune deposits in the area.

#### 3.3 STRATIGRAPHY

The Climax Chemical plant is located in the Central Basin Platform of the Permian Basin. According to the work of Nicholson and Clebsch (1961), approximately 8,000' of geologic strata overlie the Precambrian basement rocks in the Central Basin Platform. Only strata of middle Permian age and younger are pertinent to this study. Included as Figure 3.2 is a generalized stratigraphic column for Southeastern New Mexico and a regional cross-section is shown in Plate 3. In addition, a colored stratigraphic column based on driller's logs near the site is depicted in Figures 3.3 and 3.4. Following in ascending order is a brief description of the stratigraphy beneath the proposed well site.

#### Guadalupian Series (Middle Permian)

The Guadalupian Series in the Central Basin Platform consists of the San Andres Formation and the Whitehorse Group. The Whitehouse Group consist of a fine-grained sandstone with thin layers of black shale and argillaceous limestone and, according to King (1942), can also be referred to as the Artesia or Chalk Bluff Group. The Whitehorse Group of the Central Basin Platform is correlative to the Delaware Mountain Group of the Delaware Basin. In the Monument area, it

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## TABLE 3.1

## GEOLOGIC CROSS SECTION AT CLIMAX PLANT SITE SECTION 35, TOWNSHIP 19S, RANGE 36W MONUMENT, NEW MEXICO ELEVATION -3595'

	THICKNES	SS	
FROM TO	IN FEET	FORMATION	TDS RANGE IN MG/L
0 - 2	2	Soil	
2 - 22	20	Calichi	
22 - 45	23	Ogallala	600->3250
45 - 1008	963	Red Beds	
(Top c	of Anhydrite	e @ 1008')	
1008 - 1160	152	Dockum Group	
1160 - 2303	1143	Salt	
2303 -2423	120	Tansill	
2423 - 2853	430	Yates	
2853 - 3225	372	7-Rivers	
3225 - 3570	345	Queen	
(Top o	f Penrose @	3380')	13-19,000
3570 - 3800	230	Grayburg	15 - 34,000
3800 - 5150	1350	San Andres	15,000+
(Top o Dispo	f Oil/Water	<pre>contact = 3995') 00'=5150'+)</pre>	

(Disposal Zone 4300'-5150'+)

Revised 2/13/84

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#### Ochoan Series (Upper Permian)

The lowermost formation of the Ochoan Series is the "Salt" Formation, consisting of anhydrite and some halite. It rests unconformably on the Whitehorse Group in the Central Basin Platform but does not extend beyond the basin margins. Total thickness of the anhydrite and halite at the plant site is approximately 1200'. Halite was mined by Climax Chemical Company in the subsurface interval between 1400' to 2616'.* Three brine wells previously used to leach salt have been plugged and abandoned by Climax. The base of mineable salt was found to be at a depth of approximately 2610'.

The "Salt" Formation is unconformable in places with the overlying Rustler Formation. The top of the Rustler is considered to be the top of the first continuous anhydrite bed penetrated by oil and gas wells in southeastern New Mexico and occurs at a depth of 1008' in the Climax area. The Rustler is characterized as dolomitic limestone with some sandstone and chert pebble conglomerates at the base. Eastward, in the area of Monument, the limestone is overlain by anhydrite, redbeds and halite which is considered an upper member. In Lea County, the Rustler is between 90' to 360' thick and appears to be 100'<u>+</u> thick at the proposed well site.

The "Salt" Formation and Rustler Formation together compose the Salado Group or Ochoan Series as shown in Figure 3.2.

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Revised 2/13/84

### Upper Permian or Triassic

Above the Rustler Formation are the undifferentiated redbeds of Permian or Triassic age. They consist of micaceous red siltstone, sandstone, shale and are cemented with gypsum. They are thought to retard the movement of water between the rocks of the Permian and the overlying aquifers (Nicholson and Clebsch, 1961). The Middle and Upper Triassic consists of a sequence of redbeds, the Dockum Group, which rest unconformably on the lower undifferentiated redbeds. The Dockum can usually be differentiated into the Santa Rosa Formation and the uppermost Chinle Formation. The Santa Rosa is a fine-to-coarse-grained sandstone containing minor shale layers and ranging in thickness from 140' to 300'. The Santa Rosa and the Chinle are similar lithologically and in some places have been mapped as the Dockum Group, undifferentiated.

The Chinle Formation consists of red and green claystone which is interbedded with fine-grained sandstone and siltstone. The Chinle has been eroded in the west; however, it reaches a thickness of 1,270' near the Monument area. About 2 miles southeast of Monument, the Chinle grades into a micaceous red clay (Nicholson and Clebsch, 1961).

Both the Dockum Group and the undifferential redbeds are estimated to be 888' thick at the plant site with the top at approximately 120' below the surface.

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#### Cretaceous

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The rocks of Cretaceous age, although once present in Lea County, have been almost entirely removed by erosion. The only known exposure of Cretaceous rocks in Lea County are found in a gravel pit of the Lea County Concrete Company about seven miles south of Hobbs. At the site, the limestone is white, light gray or buff and highly fossiliferous. There are no known deposits of Jurassic rocks in Lea County.

#### Tertiary

Beneath the surficial deposits, at the proposed location, are rocks of the Tertiary System represented by the Ogallala Formation of Pliocene age. It is a heterogeneous complex of terrestrial sediments, consisting chiefly of a calcareous, unconsolidated sand containing clay, silt, and gravel. Conditions of deposition varied rapidly during Ogallala time causing well-sorted sediments to be interbedded with poorly sorted sediments. The Ogallala Formation ranges from a few feet to as much as 300' thick and is a major aquifer where it has sufficient thickness.

#### Quaternary System

In the Monument area, sediments of the Quaternary System exist in the form of alluvial deposits of Pleistocene and Recent age and dune sands of Recent age. The older alluvium is exposed locally in small duneless patches, or in pits and it underlies the areas of Querecho Plains, Laguna Valley, San Simon Swale and several smaller areas. The alluvium ranges in thickness from a few inches to more than 400' in San Simon Sink.

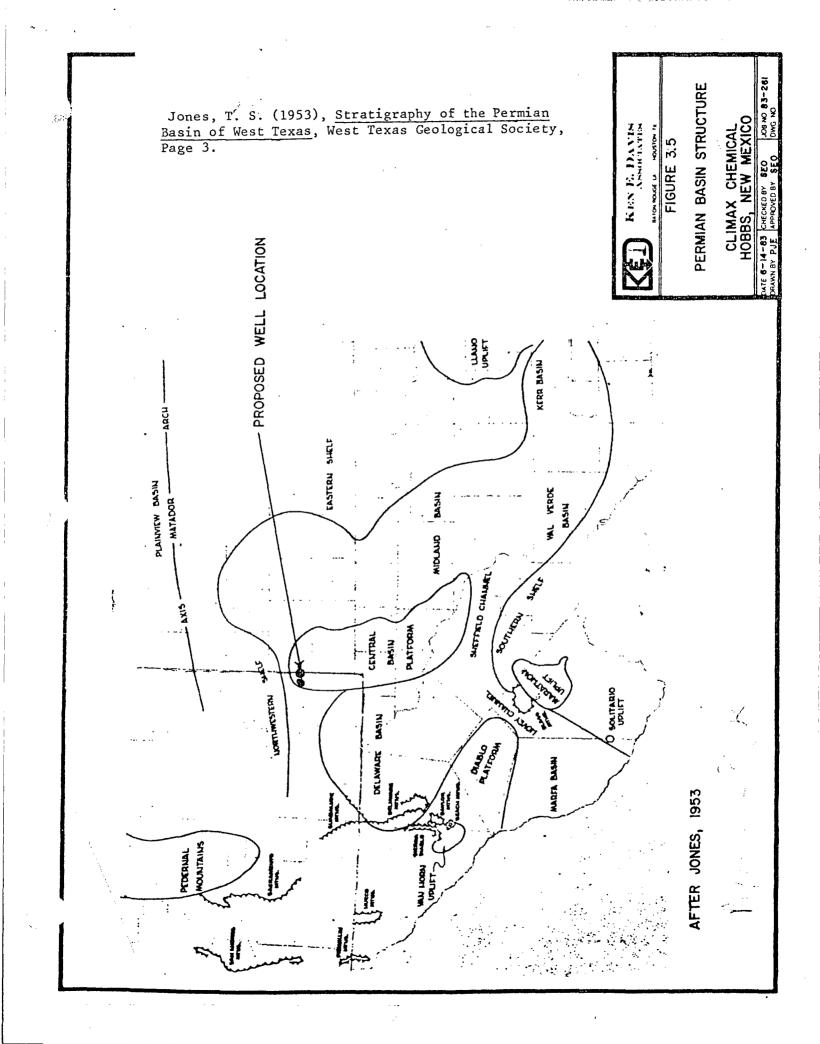
The most extensive Quaternary unit is the cover of red dune sand called the Mescalero Sands. This fine-to-medium grained, reddish-brown sand, which covers 80% of Lea County, parts of Eddy County, and West Texas, was probably derived from the Permian and Triassic rocks of the Pecos Valley. In the vicinity of Climax, the alluvial deposits consist of unconsolidated fine to coarse sand and gravel with stringers of silt and clay, and Eaolian sands cover the surface. (Geohydrology Associates, 1982).

#### 3.4 STRUCTURAL GEOLOGY

#### Regional Structure

West Texas and half of Southern New Mexico is part of a large subsurface structural feature known as the Permian Basin, which is subdivided into several smaller areas. As previously mentioned, Climax Chemical Plant is located on the Central Basin Platform (See Figure 3.5) and is bounded by the Northwestern Shelf on the North, the Delaware Basin on the West, the Sheffield Channel and Southern Shelf on the south and the Midland Basin on the East. Basins are depressed areas that may vary in size and shape and are formed by subsidence of an area or uplift of the surrounding regions. In most cases, basins probably result from both subsidence and uplift (Huffington, et al 1951).

KEN E. DAVIS



#### 905 NORTH DALMONT

DEFICE PHONE EX 3-2961 RES, PHONE EX 3-2062

#### MILLER ENGINEERING & GEOLOGICAL CO.

POST OFFICE BOX 417 ZIP CODE 88240 HOBBS, NEW MEXICO July 28, 1978

Climax Chemical Company P. O. Box 1595 Hobbs, New Mexico 88240

### Attn: Mr. Ed Smith

Dear Ed:

l Brine well

The enclosed tabulation of Casing records and total depths drilled on wells located in sections 34 and 35 of township 19 South, range 36 E; and sections 3 and 4 of township 20 South, range 36 E, of the Monument Field may be of some informative value.

This data was compiled, to a large extent, from Oil Scout reports and to a limited from personal investigation of the Oil Conservation records. It is somewhat of a reconnaissance survey and if we find the need to go into more detail, the Oil Conservation records should be consulted.

Yours very truly,

Charles P.

 $\mathtt{cpm}$ 

	Gulf Oil	Ξ	=	-	=	2	Amerada	2		:	=	Shell	=	Resler &					2	Gulf Oil		Climax Ch		=	<b>.</b>	Amerada (	COMPANY &
	Weir	=	=	2	=	=	Weir	=	=	= 2	=	Foster	Ξ	Sheldon Smith	=	=	=	=	Ξ	Smith	-	Chem	. <b>=</b>	=		Gaither	SI'SE
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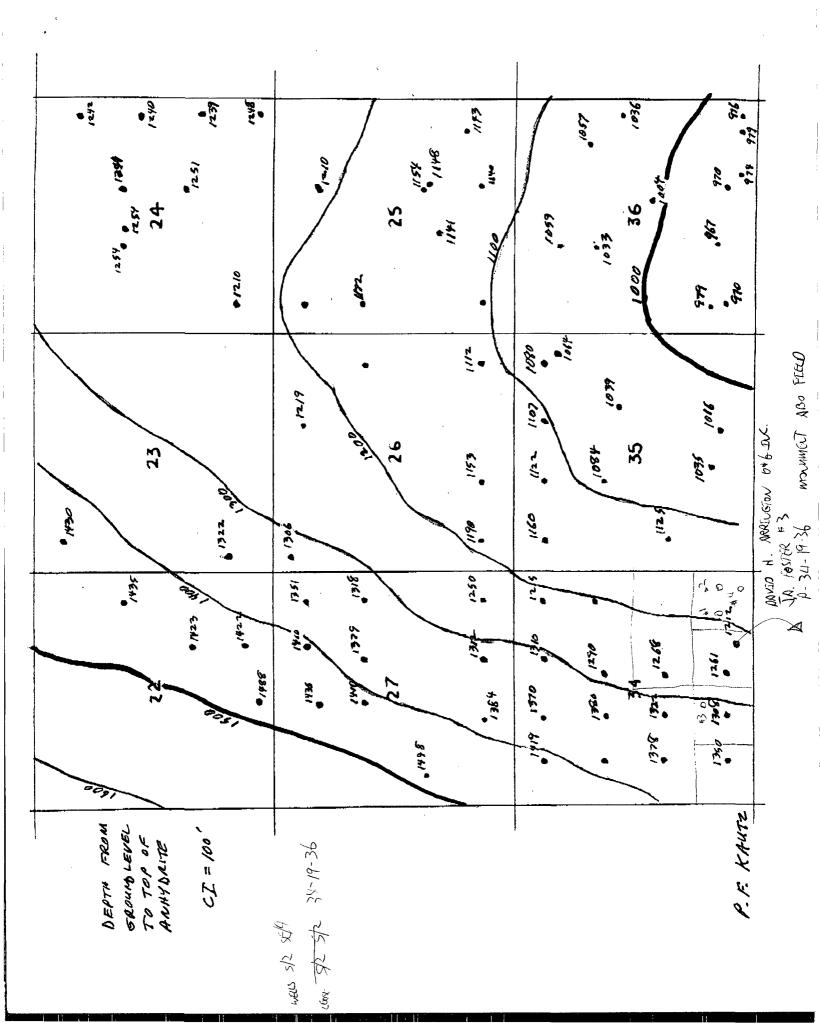
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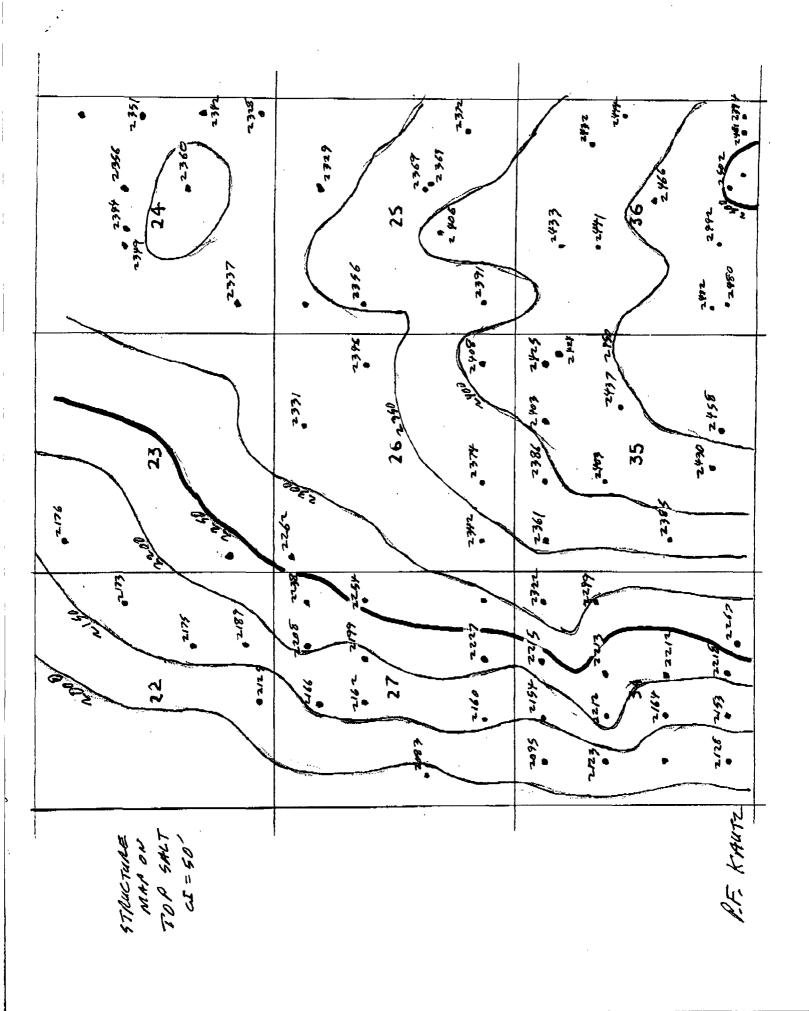
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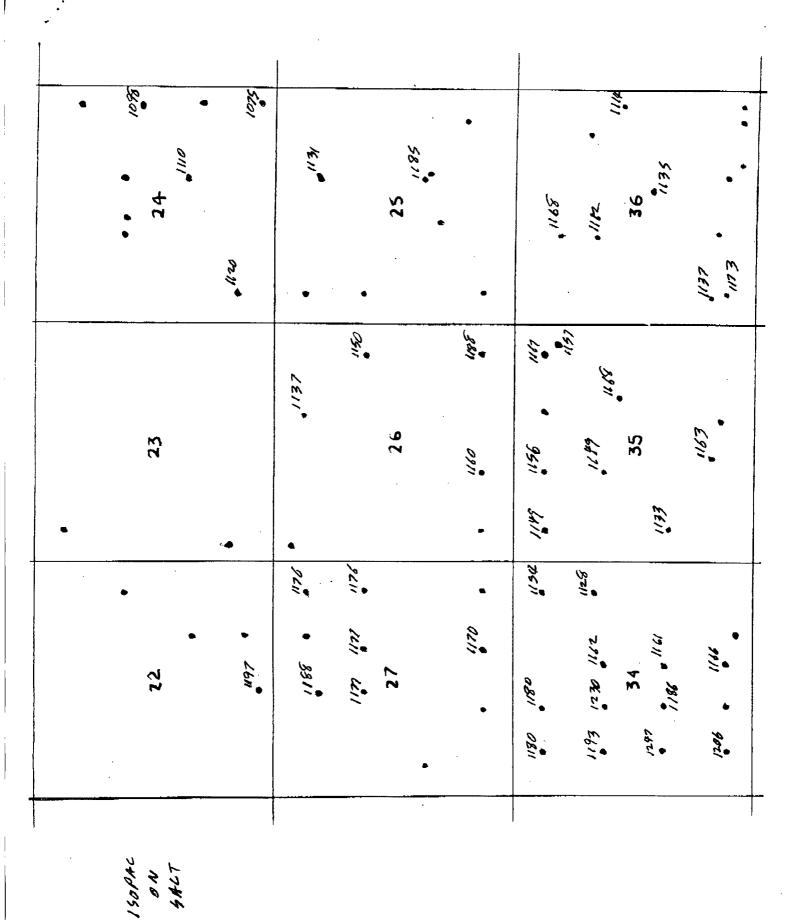
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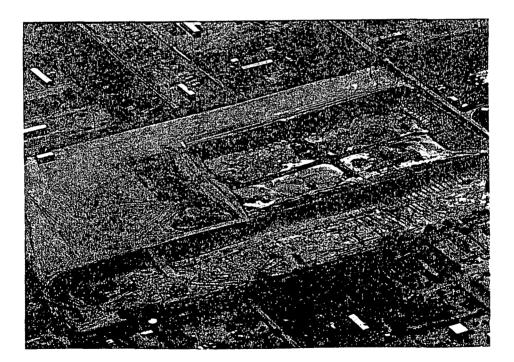








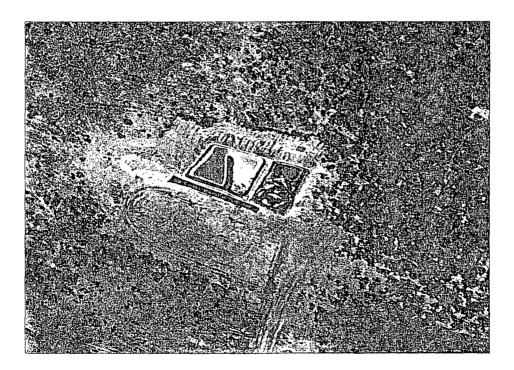
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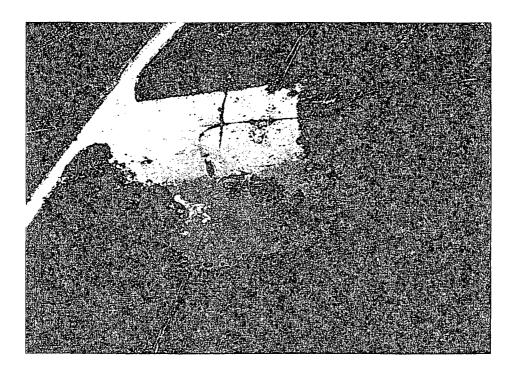
DRILLING RIG WITH EARTHEN PIT



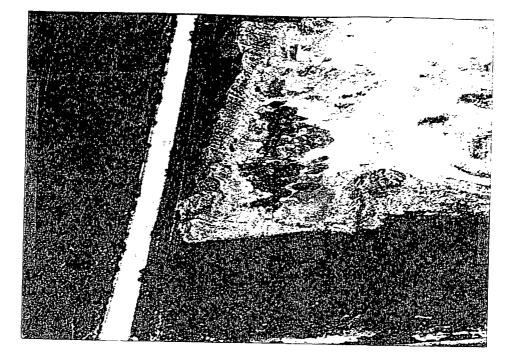
DRILLING RIG PITS DRYING UP



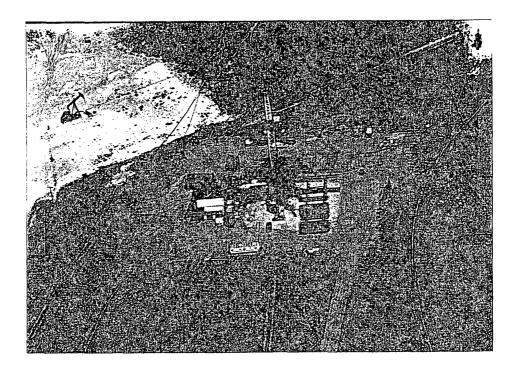
OIL SPILL



OLD DRILLING PITS WITH SALT SHOWING



ILLEGAL DUMPING OF SALTY AND OILY WASTE



DRILLING RIG USING ROLL OFF BOXES AND CLOSED LOOP SYSTEM (NO EARTHEN PITS)

NOTE SALTY OLD COVERED PIT IN TOP LEFT OF PHOTO

# VILANTAD VILANTALIV

# **BEST IN THE BASIN**



The Odessa American: Larry Beckne

Al Hickerson, CEO of Permian Brine Sales Inc., holds a copy of Hart's Oil Environmental Project for its innovative use of salt caverns for disposal and Gas World magazine, which awarded his company the Best of non-hazardous oil field wastes.

# Publication recognizes five companies

#### By George Van Dam Odessa American

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Five companies with tics to the Permian Basin have been singled out by a major oil and gas publication as being the best in the Permian Basin region.

Odessa's Permian Brine Sales Inc. and Marathon Oil Co., and Union Royalty Inc., Midland Resources Inc, and Conoco Inc., all of Midland, were recognized in the June 1995 issue of Hart's Oil and Gas World for outstanding performance in the Permian Basin.

Permian Brine Sales Inc. of Odessa won the Best Environmental Project award for its innovative use of salt caverns for disposal of non-hazardous oil field wastes.

"The judges appreciated the more efficient, costeffective way Permian Brine Sales disposes of " field wastes," said Don Lyle, editor of Hart's.

A 400,000-barrel cavern, created from washing out an underground salt bed, is located on property leased by Permian Brine Sales, eight miles east of Big Springs, Lyle said.

The cavern is used to dispose of non-hazardous oil field wastes that are safely stored well below the water table, he added.

Lyle said the cost-effectiveness of this method of disposing of wastes extends the life of marginal wells by reducing lease operating costs.

E.L. Hickerson, CEO for Permian Brine Sales, said he is pleased with his company's recognition by Hart's, and is optimistic about the future use of salt caverns in disposing of wastes.

"I believe the oil industry continues to endeavor to operate in an environmentally safe manner," Hickerson said. "And the use and disc safe place to put a lot of waste."

flow throughout

Hickerson predicted that other industries, not just oil and gas, will soon use salt caverns to contain non-hazardous and hazardous wastes.

non-hazardous and hazardous wastes. "And ii'll help make the world more environmentally clean," Hickerson said.

Permiany clean, "Increasion state," Permian Brine Sales was also recognized as a challenger in the Best New Technology category for using salt caverns to dispose of non-hazardous oil field wastes, but Marathon Oil Co.'s operations in Midland took the honors, Lyle said.

Marathon developed a technique using its own coiled tubing instead of traditional pulling units for its low-pressure marginal gas wells, Lyle said.

The technique prevents formation damage, puts wells on line faster and reduces costs, he added. Marathon used a system that allows wells to

# B. Quick, Inc. Application for Permit Class I Non-hazardous Salt Cavern Disposal Wells for Oilfield and Non-hazardous Waste

Lea County, New Mexico

Safety & Environmental Solutions, Inc. 703 E. Clinton Suite 103 Hobbs, New Mexico 88240 (505) 397-0510

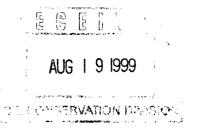


P.O. Box 1613 703 E. Clinton Suite 103 Hobbs, New Mexico 88240 505/397-0510 fax 505/393-4388

Safety & Environmental Solutions, Inc.

August 13, 1999

Mr. Wayne Price New Mexico Oil Conservation Division 2040 South Pacheo Street Santa Fe, New Mexico 87508



Dear Wayne:

After further consideration of the request to amend our application for a Class I Disposal permit submitted to you on behalf of B. Quick, Inc. to include disposal of Naturally Occurring Radioactive Material (NORM), we have decided to withdraw this request at this time

If you should require additional information, please contact me.

Sincerely,

Bob Allen REM, CET, CES President

BA/jra

-enclosures



P.O. Box 1613 703 E. Clinton Suite 103 Hobbs, New Mexico 88240 505/397-0510 fax 505/393-4388

# Safety & Environmental Solutions, Inc.

August 9, 1999

Mr. Wayne Price New Mexico Oil Conservation Division 2040 South Pacheo Street Santa Fe, New Mexico 87508 RECEIVED

AUG1 0 1999

Environmenial Bureau Oil Conservation Division

Dear Wayne:

Please amend the application for a Class I Disposal permit submitted to you on behalf of B. Quick, Inc. to include disposal of Naturally Occurring Radioactive Material (NORM). I believe that the Salt Cavern method of disposal is a safe and economically sound alternative to conventional NORM disposal methods.

I have enclosed, for your information, copies of three (3) studies, conducted by different agencies, which focus on NORM disposal, salt caverns, and risk analysis of salt caverns.

Please contact me prior to your next trip to Lea County and I will set up a tour of the Salt Cavern Disposal facility located in Andrew, Texas. I feel the tour would be of great benefit to you and any members of the approval committee.

I your should require additional information, please contact me.

Sincerely,

Bob Allen REM, CET, CES President

BA/jra enclosures



OIL CONSERVATION DIVISION 2040 South Pacheco Street Santa Fe, New Mexico 87505 (505) 827-7131

## Price, Wayne

From:	Price, Wayne
Sent:	Friday, August 13, 1999 2:14 PM
То:	'ballen@sesi-nm.com'
Subject:	FW: B-Quick Class I cavern Disposal well(S)

#### Also!

All submittals must be in duplicate to OCD Santa Fe and a copy to Hobbs! We only received one copy!

From:	Price, Wayne
Sent:	Friday, August 13, 1999 1:58 PM
To:	'ballen@sesi-nm.com'
Subject:	B-Quick Class I cavern Disposal well(S)

Dear Bob:

Please note the application submitted is referencing the old P&S UIC-CLI-006 number. This is incorrect! This number has been retired! It was withdrawn and will remain with the old system. Please do not use this reference #.

The NMOCD will assign a new number!



OIL CONSERVATION DIVISION 2040 South Pacheco Street Santa Fe, New Mexico 87505 (505) 827-7131

Price, Wayne

#### Sent: Friday, August 13, 1999 1:06 PM

----IMA12d5d52.37b4/mail.SESI-NM.COM Content-Type: text/plain; charset=us-ascii

Message delivered successfully to ballen@mail.SESI-NM.COM

----IMA12d5d52.37b4/mail.SESI-NM.COM Content-Type: message/delivery-status

Reporting-MTA: mail.SESI-NM.COM Final-Recipient: rfc8222;ballen@mail.SESI-NM.COM Action: delivered Status: 2.0.0

----IMA12d5d52.37b4/mail.SESI-NM.COM Content-Type: message/rfc822

Received: from xconn.state.nm.us [164.64.5.16] by mail.SESI-NM.COM with ESMTP (SMTPD32-5.01) id AD4E258020E; Fri, 13 Aug 1999 14:00:46 EST Received: by xconn.state.nm.us with Internet Mail Service (5.5.2448.0) id <QZRRVDMP>; Fri, 13 Aug 1999 11:54:40 -0600 Message-ID: <1D079F6056F3D211BC0F00A0C9EA33FC06FBC6@NMEMNRDDEPT> From: "Price, Wayne" <WPrice@state.nm.us> To: "ballen@sesi-nm.com" <ballen@sesi-nm.com> Subject: B-Quick Class I Cavern Disposal Date: Fri, 13 Aug 1999 11:48:29 -0600 Return-Receipt-To: "Price, Wayne" <WPrice@state.nm.us> MIME-Version: 1.0 X-Mailer: Internet Mail Service (5.5.2448.0) Content-Type: multipart/mixed; boundary="----_=_NextPart_000_01BEE5B4.EA4674B4"

----IMA12d5d52.37b4/mail.SESI-NM.COM--



OIL CONSERVATION DIVISION 2040 South Pacheco Street Santa Fe, New Mexico 87505 (505) 827-7131

Price, Wayne

From:	Price, Wayne
Sent:	Friday, August 13, 1999 11:48 AM
To:	'ballen@sesi-nm.com'
Subject:	B-Quick Class   Cavern Disposal

In order for OCD to issue public notice we must know specifics about the system! The permit application cannot be approved on probable information! The way the application was issued to OCD we cannot continue the review process! Also pursuant to our telephone conversation your ideal of having a meeting in Santa Fe is most welcomed!

Please find attached a public notice that was issued sometime ago! Please Provide the correct information required under 20 NMAC 6.2 3108.C.

Example:



ENAIL bALLEN@ SESI + NM,



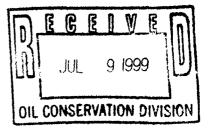


P.O. Box 1613 703 E. Clinton Suite 103 Hobbs, New Mexico 88240 505/397-0510 fax 505/393-4388 SA CALS

# Safety & Environmental Solutions, Inc.

July 8, 1999

Mr. Mark Ashley Geologist New Mexico Oil Conservation Division 2040 South Pacheco Santa Fe, New Mexico 87505



Dear Mark:

Enclosed please find the response to your letter of June 11, 1998 to Mr. Bill Quick in which you requested additional information in order to complete his application for Class I Non-hazardous Salt Cavern Disposal Wells in Lea County, New Mexico.

This information is to be considered an application for the Class I designation for the following wells located in Letter P, Section 34, T19S, R36E, Lea County, New Mexico:

Climax Chemical Saline Water Well # 1 Climax Chemical Saline Water Well # 2 Climax Chemical Saline Water Well # 3 Climax Chemical Saline Water Well # 4

The original drilling and casing records are included for you reference in Figure 1 of the application document.

B. Quick, Inc. feels that salt caverns are an ideal final resting place for oilfield and other OCD approved non-hazardous waste. Several studies have been conducted which conclude that salt caverns are a safe, economical and environmentally friendly method of disposal for certain classes of waste. I have enclosed and made part of this application the study of oil field waste disposal in salt caverns prepared by Argonne National Laboratory in Washington, DC for the U.S. Department of Energy under Contract W-31-109-ENG-38. As I am sure you are aware, this study addresses operations similar to the facility that we plan to operate in Monument.

I believe this project has a great deal of merit and Mr. Quick intends to continue his efforts to permit this operation. I remain ready and available to work with your office in order to facilitate this permitting process.

Thank you for your time to review this application. If you should require additional information or if I may be of further service, please contact me.

Sincerely,

Bob Allen REM, CET, CES President

BA/jra

cc: Bill Quick 3340 Quail View Dr. Nashville, Tn 37214

|

IN DIVISION PERMIAN BRINE SALES, INC. RECTORED

(SER)



BRINE - FRESHWATER - WATER DISPOSAL - SOLIDS DISPOSAL '95 JU 24 AM 8 52 6067 W. TENTH . ODESSA, TEXAS 79763 (915) 381-0531 (915) 530-0664 FAX (915) 381-9316

July 21, 1995

Mr. Roger Anderson Environmental Bureau Chief 2040 So. Pacheco St. Santa Fe, New Mexico 87505

Dear Sir:

We propose to re-enter the old plugged and abandoned Climax brine wells near Monument, New Mexico and install facilities for disposing of nonhazardous oil field solid waste into the abandoned caverns. Salt was mined in the brine form from 1962 until 1982.

Enclosed is a discussion of the process, along with sketches and personal and company data.

We would like to come to Santa Fe and meet with you (and any other interested parties) to get acquainted and answer questions and to discuss with you the proper procedures for getting required New Mexico Permits. The facility will operate very much the same as a brine well except that we will be pumping a solid waste slurry into the cavern instead of fresh water. When a barrel of slurry is pumped into the cavern, we will, of course, have a barrel of clear brine return. This brine may be sold for drilling fluid, or to a nearby waterflood for use as a make-up water. Surplus brine will then go to a regular disposal well.

I met with Mr. Jerry Sexton (whom I have known for a number of years) last week in Hobbs and he suggested I work with you. We have previously had brine wells in New Mexico, but have none at the present.

After you have read this, please give me a call and we can schedule a mutually satisfactory time for a meeting.

Very truly yours,

PERMIAN BRINE SALES, A.L. Hickerson CEO

ALH/rdw

## CAVERN SOLIDS WASTE DISPOSAL

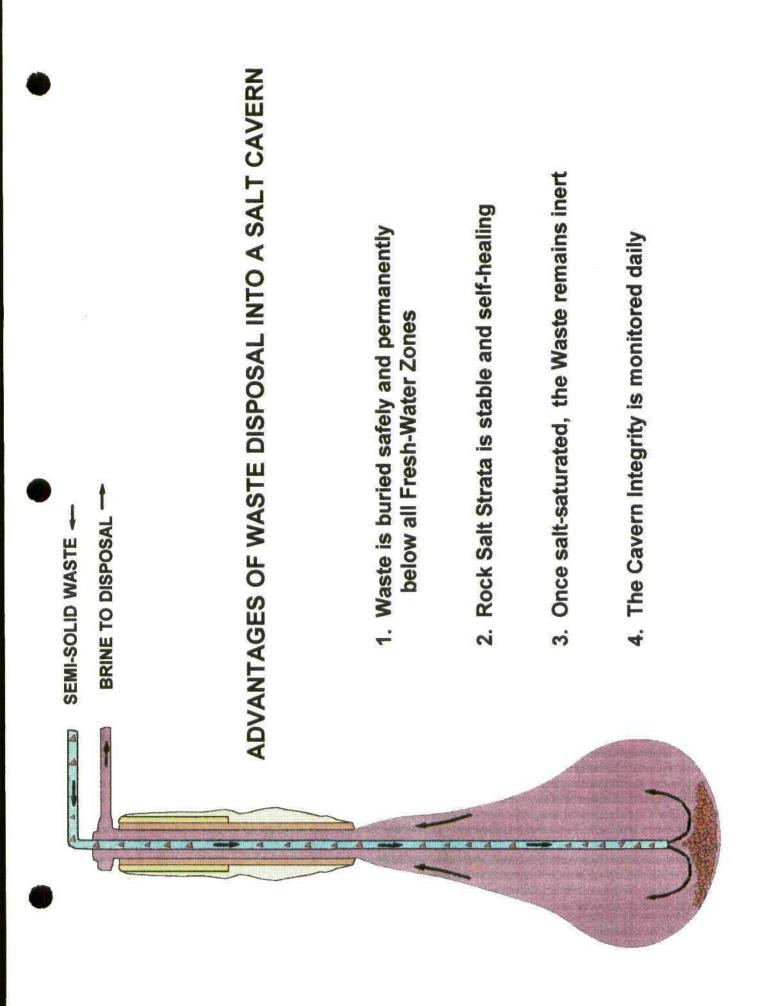
## PERMIAN BRINE SALES INC.

JULY 1995

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SOLIDS INJECTION WELL HEAD O Big spring To 5

CONCRETE UNLOADING RAMP AT SOLIDS DISPOSAL CAVERN FACILITY

at Big spring

### CAVERN SOLIDS WASTES DISPOSAL

PERMIAN BRINE SALES, INC.

July 1995

### I. AN OVERVIEW OF FIELD OPERATIONS OF "CAVERN SOLID WASTE DISPOSAL"

A. Solids Waste is generally hauled to cavern disposals in vacuum trucks, dump trucks, or roll off boxes. Vacuum trucks function by connecting the lower portion of the tank truck by hose with the fluid to be transported (from a tank, a pit, or from the ground). An air vacuum pump then withdraws air from the upper portion of the tank truck, thus pulling fluid into the tank through the hose. Vacuum trucks are well known for sucking up everything near the hose (fluid, as well as solids in the form of dirt, rocks, gloves, grass, bolts, nuts, rust, sludge, scale, pocket combs, etc.). Vacuum trucks are the preferred method of transporting wastes that contain solids.

Ordinary oilfield transport trucks function by actually pumping the fluid they handle. Their pumps have great difficulty pumping fluid out of pits or off the ground because doing so requires the pump to pull a vacuum (which they do not do very well) and the solids plug up and tear up the pump.

Roll off boxes are similar to portable trash bins that are seen around construction sites. When the roll off box is full, it is exchanged for an empty one and the full one hauled to a solids disposal system.

The advent of roll off boxes and solids disposal sites makes it possible to drill oil and gas wells without digging large drilling pits. These types of earthen pits are lined with thin plastic and when drilling operations are completed, the free water is removed and the rest is allowed to dry up and soak in and then covered "on site".

The solids waste we handle is common to all oilfield operations. It is essentially the same as oilfield waste fluids, except it is un-injectable due to it viscosity or solids content. This waste stream will "plug up" a conventional oilfield injection well in just a few hours.

The old policy of "out of site, out of mind" and just burying the solids laden waste near the surface has sometimes proven disastrous in the oilfield and other industrial enterprises.

The underground injection of waste, far below the environment we live in and below underground sources of drinking water is an effective method of waste management. The 53,000 injection wells in Texas dispose of about 10,000,000,000 (ten billion) barrels of waste water annually. This method of oilfield produced water disposal works very well but these type wells cannot handle solids or semi-solids wastes.

Clearly, deep underground semi-solid waste injection is effective, workable, and far better than near surface disposal from an environmental and land use perspective.

From an economic perspective, the use of existing caverns for solids disposal is all but unparalleled in the oil industry.

Existing caverns are widespread, available, and have **proven** track records of mechanical integrity.

The caverns will provide the oil and gas industry a cost effective method of "keeping their house clean." Other methods of disposal are available (plastic lined pits, incineration, treatment, land farming, etc.) that will be a part of the waste handling picture, but most are generally more expensive and riskier than cavern disposal.

Permian Brine's current rates for disposal in the Permian Basin are usually the lowest available, thus enabling the oil and gas industry to continue to operate their wells economically and in an environmentally sound manner.

### II. FORMS OF WASTE HAULED TO SOLIDS DISPOSAL CAVERNS

- A. Waste received at a solids disposal facility
  - 1. Roll off boxes and dump trucks.

Roll off boxes and dump trucks transport dry solids waste, sand, salt, scale, drill cuttings, filter media, etc. The waste is blended with brine that returns from the disposal cavern. The resulting slurry is injected into the bottom of the cavern. This method only fills the cavern and does not leach any salt.

### 2. Vacuum trucks from oilfield spills

An oil or disposal water spill is usually discovered in the field by oil company personnel. In the past the salvageable oil was sucked up by a vacuum truck and returned to the oil stock tanks. The dirty oil as well as the salty disposal water was left to dry or covered with dirt. Now, if a solids disposal facility is available nearby, the salvageable oil is recovered and the salty water and contaminated dirt is sucked up or scraped up and transported to the solids disposal cavern in vacuum trucks, roll off boxes, and/or dump trucks.

### 3. Vacuum trucks from workover pits

wells that are being repaired, cleaned out, At re-cemented, deepened, fractured, acidized, etc., small shallow pits are commonly dug and lined with thin plastic to temporarily contain waste fluids any generated at the site. This waste would be mostly fluids, but would contain rust, scale, excess cement slurries, frac sand, acids, traces of xylene and toluene, produced sand and other contaminates used on the well or blown out of the well after the remedial operation. If solids render the fluid un-injectable, the solids and fluids mixture is hauled to a solids disposal facility. Previous to solids disposal systems, free water was removed and the rest covered up on site. If the solids disposal facility employs plastic lined pits, the powerful solvents in the waste may attack the plastic liners and dramatically reduce the liners If the solids waste facility is a salt integrity. cavern type, this types of waste solvents will have no effect on the long term isolation of the waste. The fluid from these pits is not always salt saturated and may leach some salt.

### 4. Vacuum trucks from drilling rigs with earthen pits

During the course of drilling an ordinary well (oil or gas) the drill cuttings, drilling mud, drilling additives, excess cement slurries, etc. are circulated through the mud system and pits. When drilling is complete, most operators remove the free water and allow the pit to dry up and cover the entire pit system with dirt. Hauling the salty drilling mud and other contaminants to a solids disposal facility that employs lined pits is seldom done because it is plastic expensive and most operators recognize the folly of hauling waste from one plastic lined surface pit to another plastic lined surface pit.

When such waste is received at a cavern disposal facility, it is nearly always fully saturated with salt and only serves to fill the cavern with solids and does not leach any more salt.

### 5. Roll off boxes from closed loop drilling system.

Some operators use a closed loop drilling system that "filters" the drilling mud mechanically (no earthen pits are required). The cuttings and solids waste are directed into a roll off box at the well site and hauled to a disposal system. At a cavern disposal, the waste is blended with brine and only serves to fill the cavern and does not leach any more salt.

### 6. Vacuum trucks from washdown pits.

the past oilfield trucks and equipment (pumps, In pulling units, etc.) were cleaned off in the back of contractors service yards or at well sites. This practice led to many contaminated sites. Now most oilfield contractors have permitted pits or catch basins where they wash trucks and equipment that have accumulated sand, oil, rust, dirt, sludge, etc. from The waste in these pits oilfield operations. is un-injectable into normal water disposal wells. These pits are periodically sucked out with a vacuum truck and must be taken to a solids waste disposal facility. The fluid in these loads is not saturated and does leach However, to minimize disposal and trucking some salt. costs, the loads from these pits have a very high solids Typically a truck load from such a clean out content. is 75% solids, and only 25% fluid.

Permian Brine has a truck washout system at Big Spring. Return brine from the disposal cavern is used and therefore does not leach any salt. The truckers in the area appreciate having a safe, efficient place to rinse out their tank trailers.

### 7. Solids waste from tank clean outs

Some oil producing formations produce sand mixed in the oil. Over time (months or years) sand as well as rust, scale, and heavy asphalt like sludge settles to the bottom of the oil production tanks. When this "sludge mixture" interferes with oil production or the tank is to be moved, patched, or taken out of service, the sludge must be removed. In the past, and sometimes now, this horrible, stinking, cruddy muck was physically cleaned out of the tank and buried on site. No plastic liner or treatment at all is involved.

If a solids waste disposal facility is near by, this sludge **can now** be sucked up in a vacuum truck and transported to the facility. It is blended with return brine from the disposal cavern and injected. After blending, the fluid in this waste is near saturated and does not leach appreciable salt.

### **III. CAVERN DISPOSAL SURFACE OPERATIONS**

The wastes are received at the cavern disposal site, and off loaded into a 10 ft x 10 ft x 6 ft concrete pit. Brine is jetted into the pit and a mechanical mixer blends the fluid into a more or less uniform slurry. Loads that contain measurable oil can be skimmed and the oil reclaimed. The slurry is then pumped into a steel tank that is constantly re-circulated by pump. Finally the slurry is injected down the tubing of the well to the bottom of the cavern with a mud pump. Injection pressure is between 160# and 200#, depending on the viscosity and specific gravity of the fluid.

### IV. INJECTED HYDROCARBONS

Minute traces of oil, or other hydrocarbon based fluids that are carried into the cavern will migrate upward.

It is known that in moderate sized hydrocarbon storage caverns in bedded salt (50,000 barrels to 150,000 barrels), about 10% of the hydrocarbons are trapped under the ledges. We are thus sure that the small amounts of hydrocarbons in the injected waste will also be trapped under ledges as the well fills with solids.

Like oil blankets that are intentionally floated in caverns during washing to protect the cavern roof, this residual oil will serve the same purpose. The oil film under each ledge and the cavern roof will prevent or reduce uncontrolled upward leaching.

This tiny amount of oil in a solids disposal cavern will have no effect on cavern integrity.

#### V. RE-USE OF RETURN BRINE

Saturated brine is used in the oilfield for drilling, completions, well workovers, fracing, and pressure control. The brine does not damage producing formations, and drills a better well.

The freshwater that brine is made from is produced from nearby water wells, thus, normal day to day oilfield operations (just like nearly all human endeavors) depletes valuable fresh water resources.

The use of surplus return brine from a disposal cavern for oilfield operations will conserve large quantities of Texas ground water.

Untreated, ordinary produced water when used for some well workovers or treating, poses virtually no environmental risk and is a form of recycling. The use of return brine in the oilfield is beneficial and is also a form of recycling. Attached is: 1) an article "Congress Moves to Revamp U.S. Laws on Environmental" (Oil and Gas Journal - July, 1995) that mentions the recycling of water based drilling muds as a "voluntary environmental action." 2) part of a newspaper article outlining the water problems of West Texas, and 3) a page from "Waste Minimization in the Oil Field" published by the Texas Railroad Commission that encourages recycling.

The re-use of the return brine from a cavern disposal facility is beneficial.

We do not re-use the brine at Big Spring because it is only 85% salt saturated.

### VI. FINAL CAVERN FILL

When the cavern becomes full of solids, it will be immediately detected at the surface. Slurry will be pumped in and a slurry will return. No damaging or catastrophic events will occur.

At that point the cavern should be left open for 3 to 6 months until residual leaching ceases and the well reaches equilibrium.

Then by properly plugging the well bore with cement the waste will be **permanently** and safely isolated from the environment.

The cavern itself, just like any excavation that has been filled up, will be stable and not subject to collapse or subsidence.

### VII. SOLIDS WASTE DISPOSAL

### A. Cavern Operations

Salt cavern stability has **never** been a problem in man made caverns leached in bedded salt in West Texas. Caverns have been leached to enormous size (millions of barrels) with no stability problems.

In a bedded salt cavern, regardless of size or shape, so long as the cavern is 1) stable 2) overlaid and interbedded with anhydrite or other impervious, hard rock, the filling of the cavern with solids will render the cavern **more stable** than the cavern was before solids were injected.

Water, whether it is produced along with oil or whether it is fresh water or brine, when used for a drilling fluid in West Texas will virtually always become salty. The Salado salt formation is a layer of rock salt that extends throughout West Texas, Eastern New Mexico, Oklahoma, and much of Kansas. All oil or gas wells must drill through this layer of salt, hence their drilling pits become full of salty fluid when they drill through the rock salt layer, even if they were originally drilling with fresh water. The enclosed caliper survey of the salt layer from adjacent wells, drilled near Goldsmith, Texas (one drilled with fresh water and one drilled with brine) vividly shows the amount of salt washed out when drilled with fresh water. Thus the drilling fluid becomes salty while drilling through the salt layer.

### VIII. CALCULATION OF RATE OF CAVERN FILL DURING SOLIDS INJECTION BASED ON STATISTICS OF GENERAL OPERATION

At Big Spring (Permit No. 09812) to date through May 1995, 230,000 barrels of waste has been received.

Average:

salt saturation	of injected slurry	45%
solids content		15%
salt saturation	of return brine	85%

Therefore, for each 100 barrel load of incoming slurry: Each 100 barrel load is 85% water of 45% salt saturated fluid and has 15% solids - thus 15 barrels of solids.

85 barrels of 45% salt saturated water will dissolve the equivalent to 34 barrels of fresh water, assuming the return brine is 85% salt saturated.

Each barrel of brine contains 111 pounds of salt.

Therefore, each 100 barrel load of waste slurry is equivalent to injecting 34 barrels of freshwater:

- 34 barrels x 111 lbs = 3,774 lbs of salt removed per 100 barrels of waste injected
- 3,777 ÷ 140 (lbs per cu.ft. of salt) = 34 cu. ft. of cavern made
- 34 5.61 (cu. ft. per barrel) = 6.06 barrels of cavern made by each average load of slurry injected.

Each 100 barrel load contain 15 barrels of solids, therefore, each load results in a **net cavern fill up of 8.94 barrels**.

Please note that this calculation is based on brine return being only 85% salt saturated, as it is at Big Spring.

This happens because the Big Spring cavern is a relatively "short" cavern and the rock salt face is about 62 feet from the injection tubing. This saturation will gradually decrease as the cavern fills up with solids. Caverns that are taller will dissolve salt primarily in about 200 feet just above the injection point. When the cavern is filled to the top, very little salt dissolution will occur during the final 100 feet of cavern filling because the injected fluid will "short circuit" back out the casing and not dissolve additional salt.

The Big Spring cavern had an originally calculated size of 400,000 barrels - based on salt removed. The cavern had a vertical dimension of 219 feet. This calculates to be an average diameter of:

400,000 x 5.61 (cu, ft. per barrel) = 2,244,000 cu. ft. 2,244,000  $\div$  219 (vertical dimension of cavern) = 10,246 sq. ft. area in cavern cross section. 10,246  $\div$  3.1416( $\mathcal{N}$ ) = 3,261 for the radius squared  $\sqrt{3261}$  = 57.1 ft radius of cavern 57.1 x 2 = 114.2 ft. cavern diameter

The salt in West Texas is about 15% insolubles, this increases the horizontal dimension to approximately 124 ft.(10 feet more), an inconsequential amount.

2,244,000 cu. ft. ÷ 186 (219-15%) = 12,064 12,064 ÷ 3.1416 = 3,840 √3849 = 62' radius 62 ft. X 2 = 124 ft. cavern diameter

Assuming the angle of repose for the solids being deposited to be 45 degrees, you therefore have an available space of 1,951,517 cu. ft. or 347,864 barrels for receipt of solids.

To fill 347,864 barrels of cavern with solids, an additional approximately 150,000 barrels of cavern will be leached. This figure is based on present leaching rates until the cavern has less than 100 feet between the waste and the casing shoe, and only nominal leaching thereafter.

The "solids filled" cavern diameter will then be approximately 150 feet in the top 100 feet of the "solids filled" cavern.

Waste fluid is injected into porous formations in about 53,000 disposal wells in Texas (10,000,000 barrels per year). The fluid injected is isolated from the environment vertically, just like caverns, by impervious horizontal layers of rock and clay. Horizontally, fluid travel is only estimated. Fluid injected into these porous formations travels for **thousands** of feet laterally from the well bore. This practice is safe and effective in isolating waste fluid from the environment and underground sources of drinking water.

Solids waste in caverns can be isolated vertically and horizontally <u>AS WELL AS OR BETTER THAN</u> traditional fluid injection.

### IX. DISCUSSION OF SOLUTION MINING OF SALT IN WEST TEXAS

The rock salt underlying West Texas was "laid down" when the Permian Sea evaporated about 225,000,000 years ago. This and similar salt formations have been successfully used for the storage of oil, propane, butane, high pressure natural gas, and an array of other hydrocarbons. Salt has also been used as a disposal zone for hazardous waste in other countries. The Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico is still on track (scheduled to open in 1998) to dispose of low level nuclear waste in the Salado salt.

The salt lies in layers interspersed with layers of anhydrite. Anhydrite is an impervious, marble like rock.

Each oil or gas well that is drilled in West Texas must drill through the salt section. To prevent washing out a large hole in the salt, the wells are drilled, using a saturated brine solution as a drilling fluid.

Permian Brine Sales put in the first brine well to make saturated  $\bigvee$  brine for drilling, in 1958. Before that companies used sack salt added to their drilling mud to prevent excessive leaching of the rock salt while drilling through it.

We have learned a great deal about leaching out the salt in order to make saturated brine from over 50 brine wells that we have operated through the years.

We know it is better to pump the fresh water into the bottom of  $\checkmark$  the well in order to make a better brine well. Direct circulation wells plug up with solids and salt less often. Attached sketch 1, shows the difference in cavern formation, between bottom injection and top injection of the fresh water. Permian Brine's disposal caverns have been leached by direct circulation.

When injecting water into the bottom, you leach out a series of lenses. We know from experience that when washing at our normal rate of 60 to 100 gallons per minute, that the water will become 100% saturated with salt when about 200 feet of salt is exposed. Therefore we know that most of the cavern will be created in the lower part of a tall cavern. However, as each lens of the cavern becomes larger, some of the fresh water tends to "short circuit" to the top of each lens and thus gradually washes out a cavern towards the top of the salt. This "short circuit" occurs because fresh water has a specific gravity of 1.0, while brine has a specific gravity of 1.2. Fresh water, being lighter, immediately starts to the top, and as the distance to the rock salt face becomes greater more unsaturated brine moves upward to the next "lens".

Sketch 2 was made by Neal E. Van Fossan, with Texas Brine, for a article written for the Symposium on Salt. His conception of the

size and shape of caverns formed in "layered" salt agrees with ours.

Several years ago, while filling a layered cavern with propane we very carefully measured the volumes of propane injected into the cavern, with the change in static pressure at the surface and by knowing the specific gravity of the propane column and the brine column, we were able to calculate the diameter of the cavern after each 5,000 barrel injection of propane.

Sketch 3 shows the configuration and shape of that cavern. You will note that these caverns were washed by alternating bottom and intermediate injection of fresh water in order to get the desired dimensions. If this cavern had been washed entirely from the bottom, the lower lens would be somewhat larger.

Warren Petroleum Company checked the size and shape of their LPG cavern located south of Big Spring by using the same method. Other operators have used this same, accurate method for years.

### X. CONCLUSION

Mawyyears of experience by the oil and propane storage industry and by our operations in cavern formation gives us complete confidence in the shape of caverns and that underground disposal of waste is safe and effective.

The use of existing caverns for disposal of oil and gas solids waste will help protect the environment, make beneficial use of an existing resource, conserve water, and reduce operating costs for oil and gas operators. Clearly a winning situation!



# PERMIAN BRINE SALES, INC.

24-HOUR SERVICE/TEXAS - OKLAHOMA

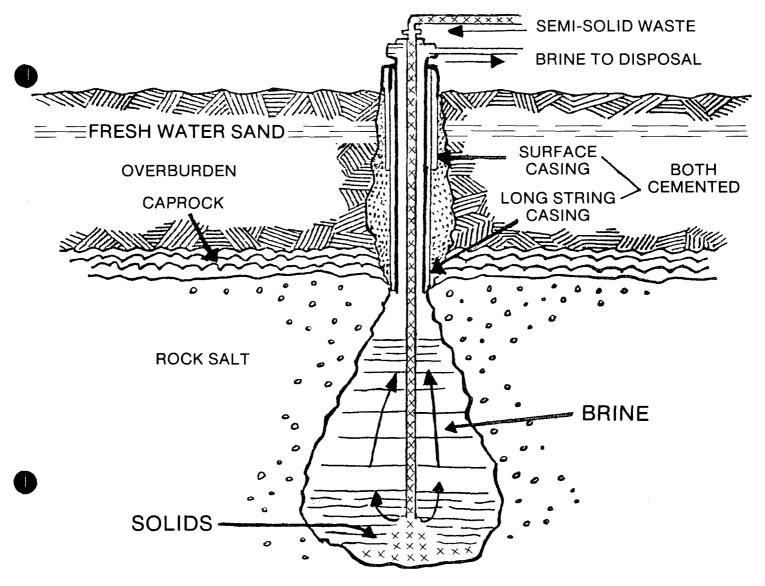
BRINE - FRESHWATER - DISPOSAL

6067 W. TENTH ST. • ODESSA, TEXAS 79763 (915) 381-0531 (915) 563-4730 FAX (915) 381-9316





# Non-Hazardous Oilfield Solids Waste Disposed Into Cavern In Rock Salt Strata Below All Freshwater Sands



# ADVANTAGES OF DISPOSING OF NON-HAZARDOUS OIL AND GAS WASTES INTO A CAVERN LEACHED OUT OF A ROCK SALT LAYER.

- AFTER BECOMING SALT SATURATED, THE WASTE IS INERT.
- THE WASTE IS FOREVER BURIED SAFELY BELOW ALL FRESH WATER ZONES.
- THE ROCK SALT STRATA IS STABLE AND SELF-HEALING.
- THE CAVERN IS MONITORED DAILY.

# ACCEPTABLE NON-HAZARDOUS WASTES:

DRILLING MUD DRILL CUTTINGS RIG WASH WORKOVER WASTES PIT SLUDGES PRODUCED SANDS WASTE CRUDE BLOW DOWN FLUIDS BASIC SEDIMENT PACKING FLUIDS PIPELINE PIGGING WASTES

- Truck Washout Available -

Permian Brine Sales, Inc. employees have over 100 years of combined experience in working with salt caverns.

CALL 915-381-0531 FOR MORE INFORMATION.

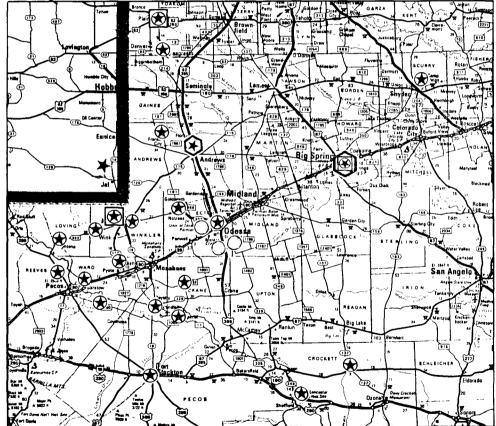
# LOCATIONS

## **Big Spring**, Texas

N.E. Corner of I.H. 20 and Salem Rd. 8 Miles East of Big Spring Permit #09812 915-393-5965

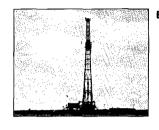
TEXAS PANHANDLE

## WEST TEXAS



★ INDICATES BRINE SERVICE POINTS
 O INDICATES FRESHWATER SERVICE POINTS
 ☐ INDICATES DISPOSAL SERVICE POINTS
 ∩ INDICATES SOLIDS DISPOSAL





### BRINE FOR DRILLING

Saturated salt water drilling fluid prevents washing and leaching out of the salt layer—insures hole size and straightness—prevents key seats—saves money on cementing—prevents swelling and sloughing of the red bed—stops hydration of the bentonites and heaving of the shales—reduces drilling time—increases bit life holds back formation pressures. Brine is also an ideal drilling fluid for directional and horizontal wells utilizing hydraulic downhole motors.



#### BRINE FOR WORKOVERS, FRACTURING AND WELL COMPLETIONS.

10 pound brine is ideal for killing wells—displacing mud to prevent water blocking for hydration of shales in production zones—controls high bottom hole pressures cleans hole after fracturing. Jelled brine used for fracturing is economical, safe and reliable.



### **BRINE FOR WATER SOFTENING**

Ready-made saturated brine is an excellent clean, clear economical regeneration agent for Zeolite water softeners. Delivered in clean plastic lined transports as needed, a saturated solution ready for immediate use.

Deionized water is also available for chemical blending, spot-free steam cleaning, and industrial radiator coolant.



### BRINE CAVERNS FOR SOLIDS DISPOSAL

Deep, stable and impervious, leached caverns in the salt strata are permanent repositories for non-hazardous oil and gas waste. Tank bottoms, sludge, iron sulfide, drilling mud, produced sands, etc., are pumped to the bottom of a cavern far below any fresh water zones.

BRINE – FRESHWATER – WATER DISPOSAL – SOLIDS DISPOSAL – DEIONIZED WATER

TEXAS - OKLAHOMA

### BRINE DATA - For BRINE AT 60° F.

_ . ____

1 bbl. (42 gals.) saturated brine contains 111.174 lbs. of salt, 309.960 lbs. water, making a total weight of 421.134 lbs.

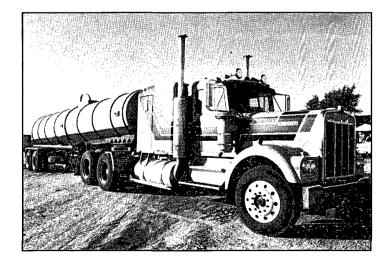
Bbls. saturated brine x .0556 equals tons saturated salt. Dry salt lbs. x .377 equals gals. saturated brine.

Salometer Degrees 60°F.	Wt. of a Gallon of Brine Lbs.	Specific Gravity 60°F.	Baume Degrees 60°F.	Per cent Sodium Chloride By Wt.	Pounds per Gallon of Brine NaCl Water		
2	8.362	1.004	0.6	5.28	.044	8.318	
4	8.386	1.007	1.1	1.056	.089	8.297	
6	8.420	1.011	1.6	1.584	.133	8.287	
8	8.453	1.015	2.1	2.112	.178	8.275	
10	8.486	1.019	2.7	2.640	.224	8.262	
12	8.520	1.023	3.3	3.167	.270	8.250	
14	8.545	1.026	3.7	3.695	.316	8.229	
16	8.578	1.030	4.2	4.223	.362	8.216	
18	8.611	1.034	4.8	4.751	.409	8.202	
20	8.644	1.038	5.3	5.279	.456	8.188	
22	8.678	1.042	5.8	5.807	.503	8.175	
24	8.711	1.046	6.4	6.335	.552	8.159	
26	8.744	1.050	6.9	6.863	.600	8.144	
28	8.778	1.054	7.4	7.391	.649	8.129	
30	8.811	1.058	7.9	7.919	.698	8.113	
32	8.844	1.062	8.5	8.446	.747	8.097	
34	8.878	1.066	9.0	8.974	.797	8.081	
36	8.911	1.070	9.5	8.502	.847	8.064	
38	8.944	1.074	10.0	10.030	.897	8.047	
40	8.978	1.078	10.5	10.558	.948	8.030	
42	9.011	1.082	11.0	11.086	.999	8.012	
44	9.044	1.086	11.5	11.614	1.050	7.994	
46	9.078	1.090	12.0	12.142	1.102	7.976	
48	9.111	1.094	12.5	12.670	1.154	7.957	
50	9.144	1.098	12.9	13.198	1.207	7.937	
52	9.178	1.102	13.4	13.725	1.260	7.918	
54	9.211	1.106	13.9	14.253	1.313	7.898	
56	9.244	1.110	14.4	14.781	1.366	7.878	
58	9.278	1.114	14.8	15.309	1.420	7.858	
60	9.311	1.118	15.3	15.837	1.475	7.836	
62	9.344	1.112	15.8	16.865	1.529	7.815	
64	9.378	1.126	16.2	16.893	1.584	7.794	
66	9.411	1.130	16.7	17.421	1.639	7.772	
68	9.452	1.135	17.2	17.949	1.697	7.755	
70	9.486	1.139	17.7	18.477	1.753	7.733	
72	9.519	1.143	18.1	19.004	1.809	7.710	
74	9.552	1.147	18.6	19.532	1.866	7.686	
76	9.594	1.152	19.1	20.060	1.925	7.669	
78	9.627	1.156	19.6	20.588	1.982	7.645	
80	9.660	1.160	20.0	21.116	2.040	7.620	
82	9.694	1.164	20.4	21.644	2.098	7.596	
84	9.735	1.169	21.0	22.172	2.158	7.577	
86	9.769	1.173	21.4	22.700	2.218	7.551	
88	9.810	1.178	21.9	23.228	2.279	7.531	
90	9.844	1.182	22.3	23.755	2.338	7.506	
92	9.877	1.186	22.7	24.283	2.398	7.479	
94	9.919	1.191	23.3	24.811	2.459	7.460	
96	9.952	1.195	23.7	25.339	2.522	7.430	
98	9.994	1.200	24.2	25.867	2.585	7.409	
100	10.027	1.204	24.6	26.395	2.647	7.380	

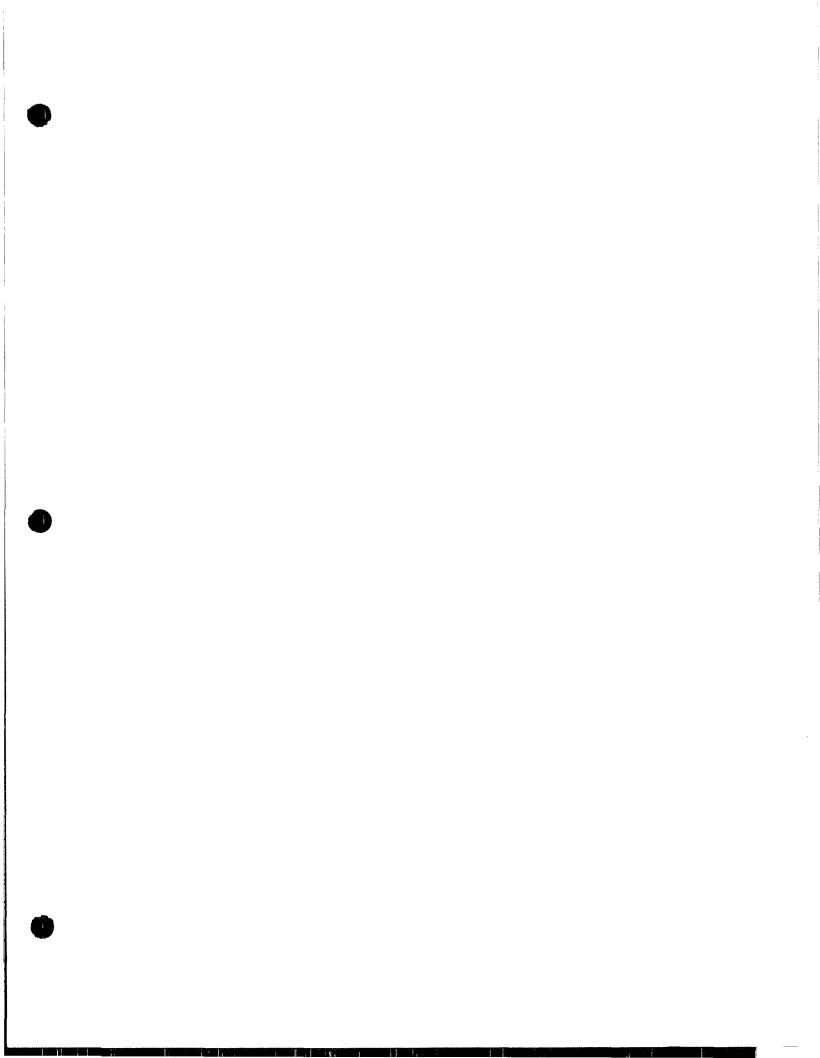
# Permian Brine Sales, Inc.

915-381-0531 ODESSA, TX 79763

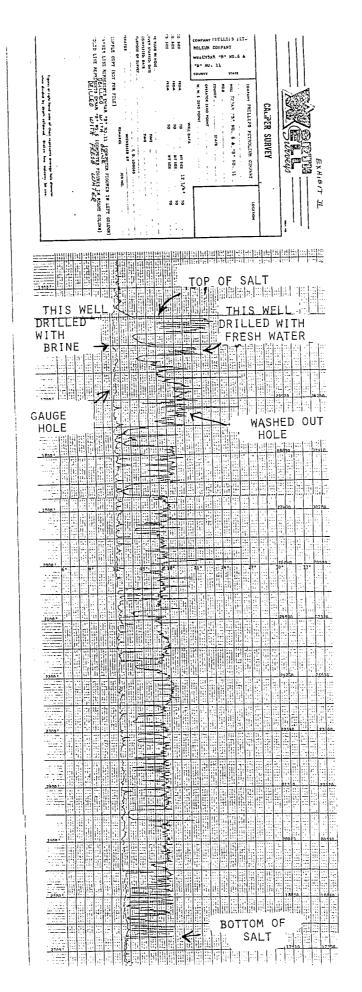
Pou	PSI	De		FOR WEIGHTING UP FRESH WATER WITH 10# BRINE										
Final Desired Weight Pounds Per Gallon	Hydrostatic PSI Per 100	Degrees Sa		SIZE OF TRANSPORT LOAD										
od We	Pressure Feet	Salometer	10	00	11	10	12	20	13	30	13	35	14	10
eigh on	sur	əter	BAR	RELS	BAR	RELS	BAR	RELS	BAR	RELS	BAR	RELS	BAR	RELS
-	0		BRINE	WATER	BRINE	WATER	BRINE	WATER	BRINE	WATER	BRINE	WATER	BRINE	WATER
8.33	43.3	0	0	100	0	110	0	120	0	130	0	135	0	140
8.5	44.2	11	10	90	11	99	12	108	13	117	14	121	14	126
8.6	44.7	18	16	84	18	92	19	101	21	109	22	113	22	118
8.7	45.3	24	22	78	24	86	26	94	29	101	30	105	31	109
8.8	45.8	30	28	72	31	79	34	86	36	94	38	97	39	101
8.9	46.3	36	34	66	37	73	41	79	44	86	46	89	48	92
9.0	46.8	42	40	60	44	66	48	72	52	78	54	81	56	84
9.1	47.4	48	46	54	51	59	55	65	60	70	62	73	64	76
9.2	47.9	54	52	48	57	53	62	58	68	62	70	65	73	67
9.3	48.4	60	58	42	64	46	70	50	75	55	78	57	81	59
9.4	48.9	66	64	36	70	40	77	43	83	47	86	49	90	50
9.5	49.4	71	70	30	77	33	84	36	91	39	95	40	<del>9</del> 8	42
9.6	49.9	77	76	24	84	26	91	29	99	31	103	32	106	34
9.7	50.5	83	82	18	90	20	98	22	107	-23	111	24	115	25
9.8	51.0	88	88	12	97	13	106	14	114	16	119	16	123	17
9.9	51.5	94	94	6	103	7	113	7	122	8	127	8	132	8
10.0	52.0	99	100	0	110	0	120	0	130	0	135	0	140	0



ZEOLITE BRINE DELIVERY TRUCK

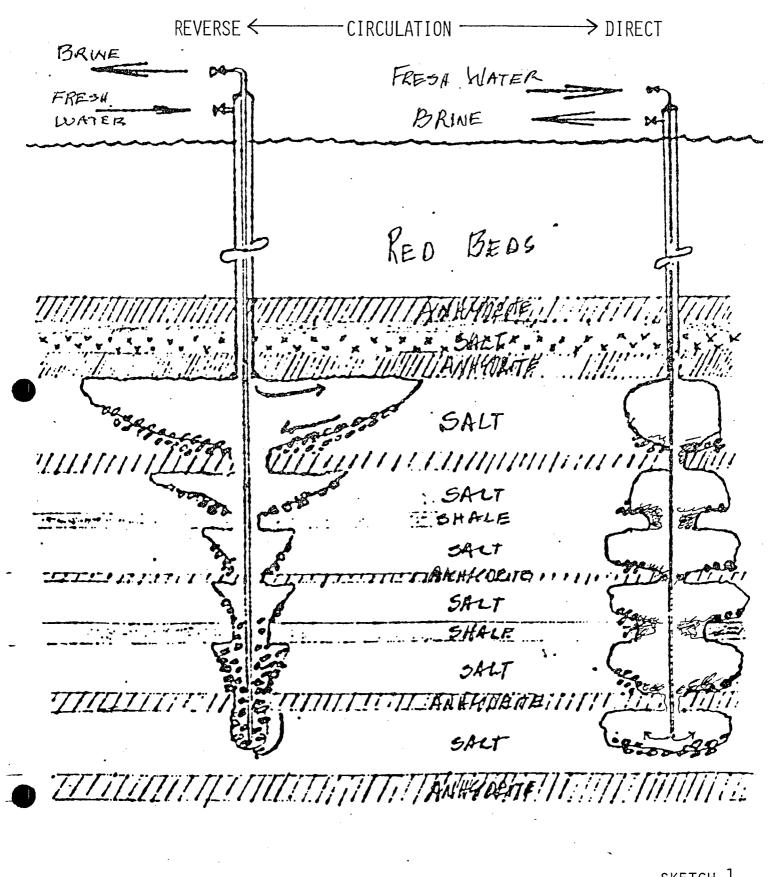


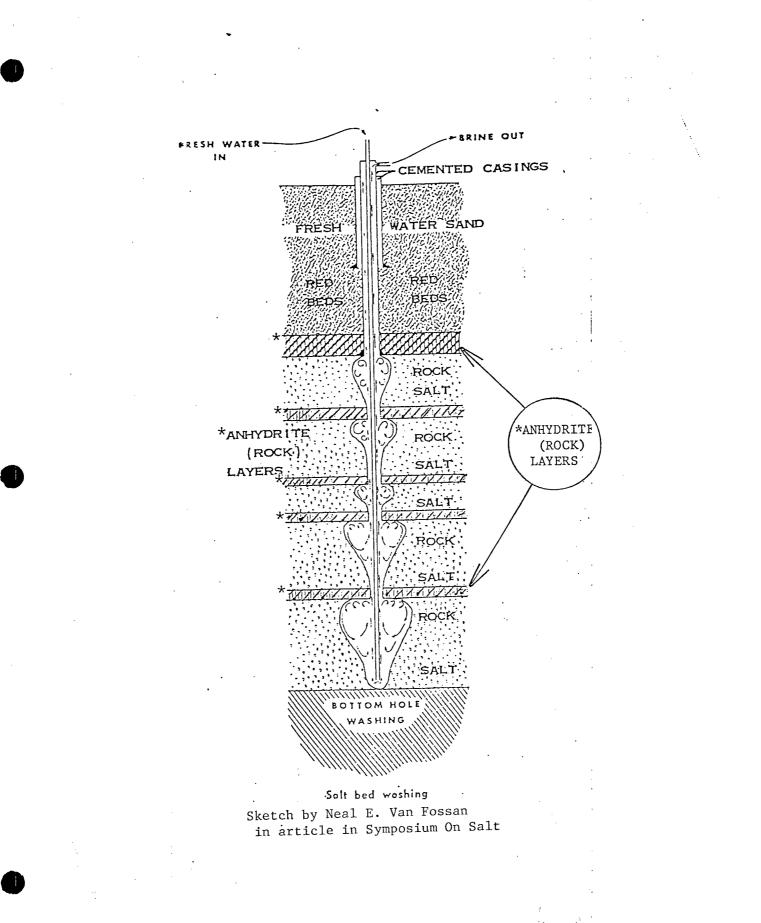
CALIPER SURVEY OF OFFSET WELLS NEAR GOLDSMITH, TEXAS



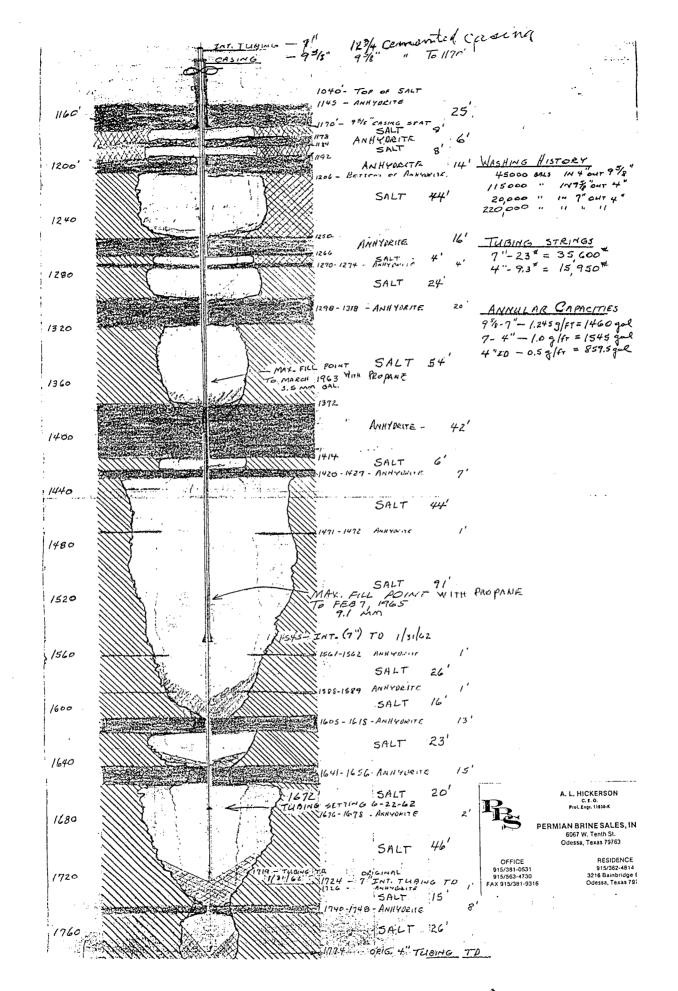
TYPICAL BRINE WELL CONFIGURATION

IN BEDDED SALT

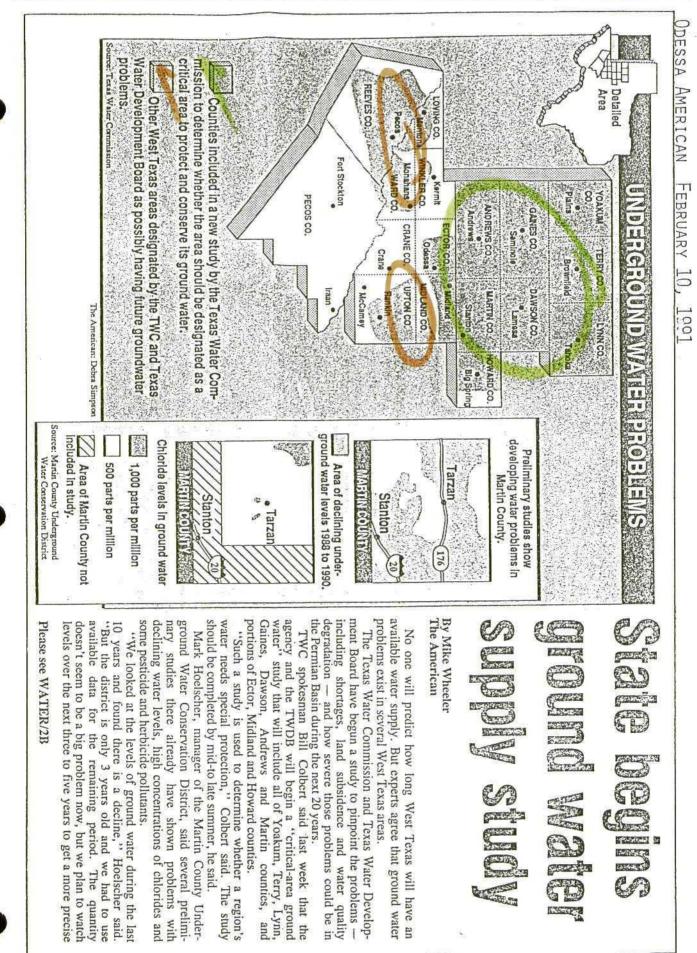




SKETCH 2



SKETCH 3



# NOTICE OF PUBLICATION STATE OF NEW MEXICO ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT OIL CONSERVATION DIVISION

Notice is hereby given that pursuant to the New Mexico Water Quality Control Commission Regulations, the following discharge plan application has been submitted to the Director of the Oil Conservation Division, 2040 South Pacheco, Santa Fe, New Mexico 87505, Telephone (505) 827-7131:

(GW-226) - Permian Brine Sales, A. L. Hickerson, 6067 W Tenth, Odessa, Texas 79763, has submitted a discharge plan application for disposal of nonhazardous semi-solid oil field waste in abandoned salt caverns located in the SE/4 SE/4 of Section 34, Township 19 South, Range 36 East, NMPM, Lea County, New Mexico. Approximately 5,000 barrels per day of solid waste slurry will be injected down the tubing of the abandoned Climax Chemical Company Foster No. 1 to the bottom of the salt cavern, approximately 2,500 feet, and brine will be produced up the annulus for sale. Ground water most likely to be affected in the event of an accidental discharge is at a depth of approximately 35 to 60 feet with a total dissolved solids concentration ranging from 500 to 3000 mg/l. The discharge plan addresses how spills, leaks, and other accidental discharges to the surface will be managed.

Any interested person may obtain further information from the Oil Conservation Division and may submit written comments to the Director of the Oil Conservation Division at the address given above. The discharge plan applications may be viewed at the above address between 8:00 a.m. and 4:00 p.m., Monday thru Friday. Prior to ruling on any proposed discharge plan or its modification, the Director of the Oil Conservation Division shall allow at least thirty (30) days after the date of publication of this notice during which comments may be submitted to him and public hearing may be requested by any interested person. Request for public hearing shall set forth the reasons why a hearing shall be held. A hearing will be held if the director determines that there is significant public interest.

If no hearing is held, the Director will approve or disapprove the plan based on the information available. If a public hearing is held, the Director will approve the plan based on the information in the plan and information presented at the hearing.

GIVEN under the Seal of New Mexico Oil Conservation Commission at Santa Fe, New Mexico, on this 22nd day of September, 1995.

STATE OF NEW MEXICO OIL CONSERVATION DIVISION

Disti

WILLIAM J. LEMAY, Director

SEAL

NOTICE OF PUBLICATION

# STATE OF NEW MEXICO ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT OIL CONSERVATION DIVISION

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GIVEN under the Seal of New Mexico Oil Conservation Commission at Santa Fe, New Mexico, on this 22nd day of September, 1995.

STATE OF NEW MEXICO OIL CONSERVATION DIVISION

WILLIAM J. LEMAY, Director

SEAL

### NEW EXICO OIL CONSERVATION COL 'ISSION

Santa Fe, New Mexico

### NOTICE OF INTENTION TO DRILL

Notice must be given to the Oil Conservation Commission or its proper agent and approval obtained before drilling begins. If changes in the proposed plan are considered advisable, a copy of this notice showing such changes will be returned to the sender. Submit this notice in triplicate. One copy will be returned following approval. See additional instructions in Rules and Regulations of the Commission.

	Hobbs, New Mex.	4-19-36
OIL CONSERVATION COMMISSION,	Place	Date
Gentlemen: Santa Fe, New Mex		
You are hereby notified that it is	our intention to commence the drilling of a well	to be known as
Shell Petroleum Corpor	ation Foster Well No	<u>1 in SE 1 of SE 1</u>
of Sec34, T.19-S, R	or Operator Lease 56-K. M. P. M., Monument Fie	ld, Lea County.
	well is 660' feet [N.] [3] of the S	
	[W.] of the E line of Sec 34	
(Giv	elocation from section or other legal subdivision lin	es. Crossoutwrong directions.)
	te land the oil and gas lease is No	_
	tented land the owner is J. H. Foste	
Addı	essHobbs, N_M	
	vernment land the permittee is	
Addr	ess	
The	lessee is Shell Petroleum Corpo	ration
AREA 640 ACRES Addr	essHouston Texas	
LOCATE WELL CORRECTLY	propose to drill well with drilling equipment as	follows:

The status of a bond for this well in conformance with Rule 39 of the General Rules and Regulations of the Commission is as follows:______

We propose to use the following strings of casing and to land or cement them as indicated:

Size of Hole	Size of Casing	Weight Per Foot	New or Second Hand	Depth	Landed or Cemented	Sacks Cement
17 <del>1</del>	121	50	SH	250	Cem	150
12	9-578	36	New	1200	17	450
8-3/4	71	24	Ħ	3725	11	250

If changes in the above plan become advisable we will notify you before cementing or landing casing. We estimate that the first productive oil or gas sand should occur at a depth of about <u>3800</u> feet. Additional information:

IN STAN Approved. 19. except as follows: enter de la construction de la const A second sec second sec OIL CONSERVATION COMMISSION, 4/Vene Title

Sincerely yours,

SHELL PETROLUEM CORPORATION
company or Operator
R. A. Achulale
Position District Engineer
Send communication regarding well to

Name Shell Petrolaum Corporation Address For p Hobbs N M

nil 3 Copies Appropriate jatrict Office		tate of New Mes and Natural Res	cico sources Department	Ċ	Porm C-163 Revised 1-1-89
DISTRICT I 20. Box 1980, Hobbs, NM 88240 DISTRICT II		N DIVISION 8 87504-2088	WELL API NO. 30-025-0	4112	
O. Drawer DD, Artesia, NM 88210	Santa re,	New Mexico	675042088	5. Indicate Type o	
DISTRICT III 000 Rio Brazos Rd., Aziec, NM 874	10			6. State Oil & Gas	Lesse No.
DO NOT USE THIS FORM FOR DIFFERENT RE (FOR	OTICES AND REPO PROPOSALS TO DRILL SERVOR. USE 'APPL M C-101) FOR SUCH P	OR TO DEEPEN	OR PLUG BACK TO A		Unit Agreement Name NUMENT G/SA UNIT
Type of Well: OIL CAS WELL WELL		OTHER		BLOCK 1	3
Name of Operator AMERADA HESS CORPORAT	TION		· · · · · · · · · · · · · · · · · · ·	1. Well No. 1	8
Address of Operator DRAWER D, MONUMENT,	NM 88265			9. Pool name or V EUNICE M	Wildcat ONUMENT G/SA
Well Location Unit Letter :	660 Feet From The	SOUTH	Line and66(	) Feet From	n The <u>EAST</u> L
Section 34	1 A MININA		nge 36E DF, RKB, RT, GR, etc.)	NMPM LEA	County
			Nature of Notice, H	-	
NOTICE OF	INTENTION TO	<b></b>		BSEQUENT	REPORT OF:
ERFORM REMEDIAL WORK	PLUG AND /	ABANDON	REMEDIAL WORK		ALTERING CASING
EMPORARILY ABANDON	CHANGE PL	ANS 🗌	COMMENCE DRILLIN	IG OPNS.	PLUG AND ABANDONMENT
ULL OR ALTER CASING			CASING TEST AND	CEMENT JOB	
THER:			OTHER: TESTED	CASING	

MIRU DA&S WELL SER. PULLING UNIT & TOH WITH A 1-1/4" X 22' POLISHED ROD WITH A 1-1/2" X 12' LINER AND FOUND PUMP STUCK. BACKED OFF RODS & RECOVERED 2 3/4" X 8' PONY RODS AND 45 3/4" SUCKER RODS. REMOVED 9-5/8" HINDERLITER TUBINGHEAD PACKING AND SLIP ASSEMBLY AND INSTALLED A 9-5/8" ADAPTER FLANGE AND A 6" 900 MANUAL BOP. STRIPPED OUT RODS AND TUBING. TIH WITH 4-1/4" DRILL BIT, TAGGED TOP OF LINER AT 3,664' & PBD AT 3,967'. TOH WITH BIT. TIH WITH A 5" ELDER LOK-SET RETRIEVABLE BRIDGE PLUG. SET AT 3,855'. CIRC. CASING WITH 130 BBLS. FRESH WATER & PRESS. TESTED CASING FROM 0' TO 3,855'. PRESS. DECREASED FROM 580 PSI TO 535 PSI IN 30 MINS. CHECKED INTERMEDIATE-PRODUCTION CASING ANNULUS AND FOUND NO PRESSURE OR FLOW. RELEASED RBP AT 3,855' & TOH. SCHLUMBERGER RIH WITH GR-CCL-CNL TOOLS. SCHLUMBERGER FOUND TOP OF 5" LINER AT 3,662' & TD AT 3,935'. LOGGED FROM 3,932' TO 2,865'. FOUND GR READINGS (CONT)

I hereby certify that the Information above is true and complete to the best of my know	indge and balief.	
SKONATURE & CULAULAN	SUPV. ADMIN. SER.	DATE7-12-93
1		202 0144
TYPE OR PRINT NAME ROY L. WHEELER, JR.		TELEPHONE NO. 393-2144
(This space for Suste Use)	Orig. Signed by Paul Kautz Geologist	
APPROVED BY	Geologist	DATE JUL 1 6 1993
CONDITIONS OF AFTROVAL, IF ANY:		
·		

2

District I PO Box 1980, Hobbs. NM 88241-1980 District II PO Drawer DD, Artesia, NM 88211-0719 District III 1000 Rio Brazos Rd., Aztec, NM 87410 District IV PO Box 2088, Santa Fe, NM 87504-2088

### State of New Mexico Energy, Minerais & Natural Resources Department

OIL CONSERVATION DIVISION PO Box 2088 Santa Fe, NM 87504-2088 Form C-101 Revised February 10, 1994 Instructions on back Submit to Appropriate District Office State Lease - 6 Copies Fee Lease - 5 Copies

AMENDED REPORT

# APPLICATION FOR PERMIT TO DRILL, RE-ENTER, DEEPEN, PLUGBACK, OR ADD A ZONE

PERMIAN BRINE SALES, INC.     Control Number       6067 West 10th Street     'AFR Number       0dessa, Texas 79763     'Preperty Name       'Property Code     'Preperty Name       'Property Code     'Surface Location       'Ut or lot en     34       19-S     36-E       'Proposed Bottom Hole Location If Different From the Eat/West like     Covery       'Proposed Bottom Hole Location If Different From Surface     Covery       'Ut or lot en     Section     Twenship Range       'Werk Type Code     ''Wail Type Code     ''CableRotery       ''Werk Type Code     ''Wail Type Code     ''CableRotery       ''Werk Type Code     ''Wail Type Code     ''CableRotery       ''Nullade     ''Proposed Costing and Cement Program       ''Werk Type Code     ''Wail Type Code     ''CableRotery       ''Nullade     ''Proposed Casing and Cement Program       ''Proposed Casing and Cement Program       ''Proposed Post     Section Depth       ''Proposed Post     Section Event East Proposed Casing and Cement Program       ''Proposed Post     Section Event East Proposed Casing Section Program       ''Not Size     Cables Roter From Event East Proposed Casing Section Program       ''Describe the proposed program. If the spplotable is to DEEPEN or PLUG BACK for the data as the present productive more and proposed section Program       '						me and Address.					, 00	RID Number	
"API Neaser Odessa, Texas 79763         "API Neaser 30 - 0         "Preparty Code         "Preparty Code         "Surface Location         "Surface Location         Ut or let an         36-E         34 19-S         36-E         A large Lot Ide         Proposed Bottom Hole Location If Different From Surface         "Prepart Poil I         "Prepart Poil I <td col<="" td=""><td>PERMI</td><td>AN BRI</td><td>NE SAL</td><td></td><td>•</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td>	<td>PERMI</td> <td>AN BRI</td> <td>NE SAL</td> <td></td> <td>•</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	PERMI	AN BRI	NE SAL		•							
Odessa, Texas     79763     30-0       'Property Name     'Property Name     'Well No.1 Foster       1     -     'Surface Location     'Well No.1 Foster       'Surface Location       Ut or lot no.     Section     Tormahip     Range     Lot 1ds     Peer from the     Membr/South line     Feet from the     East/MPR lise     Constry       'Surface Location       Ut or lot no.     Section     Tormahip     Range     Lot 1ds     Peer from the     East/MPR lise     Constry       'Note of the section       'Strate       'Note of the section       'Nothip to first colspan <td>6067</td> <td>West 1</td> <td>Oth St</td> <td>reet</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>· · ·</td> <td>PI Number</td>	6067	West 1	Oth St	reet							· · ·	PI Number	
Formerly Climax Chemical Saline Well No.1 Foster     1       'Surface Location       'Ut or lot no. Section       34     19-S     36-E     Lot lato     Peer from the gradient line     Feet from the Location If Different From Surface       "Proposed Bottom Hole Location If Different From Surface     "Least Newth Social line     Feet from the Location If Different From Surface       "Ut or lot no.     Section     Torposed Peal I     "Proposed Feel I     County"       "Work Type Code     "Well Type Code     "CollorRotary     P East Type Code     "Granted Level Elevelon       "Work Type Code     "Well Type Code     "CollorRotary     P 3618     "Speed Dete       "Work Type Code     "Proposed Deta I     "Formation     "Coating and Cement Program     3618       "Multiple     "Proposed Deta I     "Formation     "Coating to formation     "Speed Deta       No     2480 ft.     Saliado     Secting Depth     Secting Coating to formation     Extension       "Multiple     "Proposed Casing and Cement Program     Sector Createst Extension     Extension Coating to formation     Coating to formation       "Decide the proposed program. If this application is to DEEPEN or FLUG BACK for the data on the present productive more and proposed new productive more and pre	Odess	a, Tex	as 79	763									
Formerly Climax Chemical Saline Well No.1 Foster     1       'Surface Location       'Ut or lot no. Section       34     19-S     36-E     Lot lato     Peer from the gradient line     Feet from the Location If Different From Surface       "Proposed Bottom Hole Location If Different From Surface     "Least Newth Social line     Feet from the Location If Different From Surface       "Ut or lot no.     Section     Torposed Peal I     "Proposed Feel I     County"       "Work Type Code     "Well Type Code     "CollorRotary     P East Type Code     "Granted Level Elevelon       "Work Type Code     "Well Type Code     "CollorRotary     P 3618     "Speed Dete       "Work Type Code     "Proposed Deta I     "Formation     "Coating and Cement Program     3618       "Multiple     "Proposed Deta I     "Formation     "Coating to formation     "Speed Deta       No     2480 ft.     Saliado     Secting Depth     Secting Coating to formation     Extension       "Multiple     "Proposed Casing and Cement Program     Sector Createst Extension     Extension Coating to formation     Coating to formation       "Decide the proposed program. If this application is to DEEPEN or FLUG BACK for the data on the present productive more and proposed new productive more and pre	' Prope	rty Code			, , , <del>, , , , ,</del> ,	• Pi	operty Name	_				* Weli No.	
7 Surface Location         UL or lot no.       Section       Termahip       Range       Lot idn       Feet from the       East/WRN tise       Constry         19-5       36-E       Work/South tise       Feet from the       East/WRN tise       Constry         1155 ft       Lea         * Proposed Bottom Hole Location If Different From Surface         Ut or tot se.       Section       Tormaking Range       Cot idn       Feet from the       East/WRN tise       Constry         "Proposed Pool 1       "Proposed Pool 2         "Model Fool 1       "Construction       "Ground Level Elevation         * The proposed Pool 1       "Contruction       "Ground Level Elevation         * The proposed Depth       * Free from the       East/Work tase         * The proposed Depth       * Free from the       Contruction         * The proposed Depth       * East/Weilling       Contruction         * The proposed Depth				Former]	v Clima		• •	Wel	1 No.1 Fos	ter		1	
UL or lot no.       Section       Township       Range       Lot Ide       Feet from the       Head/With the:       Conser         34       19-5       36-E       *       900 ft.       1155 ft       Lea         * Proposed Bottom Hole Location If Different From Surface         UL or lot no.       *       Proposed Bottom Hole Location If Different From Surface         UL or lot no.       Section       Township       Range       Lot Ide       Feet from the       Feet from the       Environment       Environment       Constr         *         *       Proposed Pool I       *       *       Proposed Pool I       *       Constr       2       Constr       2         *       Weak Type Code       *       *       Reage       Constr       *       Section       *       Section       3618       *       *       Section       3618       *       *       Section       *       Section       *       Section       *       Section       *       Section       Constractor       *       Section       *       Section       Constractor       *       Section       Constractor       *       Section       Constractor       *       <	L				<u> </u>						<u>_</u>		
34       19-S       36-E       990 ft.       1155 ft       Lea         * Proposed Bottom Hole Location If Different From Surface       * Orassity Rame       Construction       Construction       Construction         * Torenship       Rame       Lat Ida       Free form the       North/South Use       Feet from the       East West Use       Construction         * Work Type Code       * Well Type Code       * Cable/Rotary       * Lesse Type Code       * Ground Level Dervalor       3618         ** Multiple       * Proposed Depth       Salado       * Contractor       * Sped Date         No       2480 ft.       Salado       * Contractor       * Sped Date         1225       9 5/8       32.3       Salado       * Conceast       Eatlemated TOC         1225       9 5/8       32.3       Safaf (From Surface)       Eatlemated TOC       * Sped Date         * Decribe the proposed program. If this application to DEEPEN or PLUE BACk give the data on the prosent productive East and proposed are productive East and proproductive East and proposed East productive E	IT an lat no	Gentles	Tomati	0	Listida				Ford from the	East/N	Hilling Harry	Canaba	
19:34       19:35       19:35       19:35       19:35       19:35       19:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35       10:35 <td< td=""><td>UL OF 106 80.</td><td>_</td><td></td><td>1</td><td>Lot Ida</td><td>reatiront use</td><td></td><td>ine i</td><td>reatirona une</td><td></td><td></td><td>1.</td></td<>	UL OF 106 80.	_		1	Lot Ida	reatiront use		ine i	reatirona une			1.	
UL or iot no.       Section       Township       Range       Lot Ida       Free from the       North/South line       Free from the       East/West line       Constr         'Proposed Pool 1         "Proposed Pool 2         "Work Type Code       "Well Type Code       "Cable/Retary       "Lesse Type Code       "Ground Level Elevation         E       Brine - I       Rotary       P       3618         "Multiple       "Proposed Depth       Salado       "Constructor       "Spud Date         21         Proposed Casing and Cement Program         Hole Size       Casing Size       Casing weight/foot       Setting Depth       Sacks of Cement       Eatimated TOC         12½       9       5/8       32.3       \$237       \$7710"       440       Circ         "Multiple         Proposed Casing and Cement Program         Hole Size       Casing Size       Casing Weight/foot       Setting Depth       Sacks of Cement       Eatimated TOC         12½       9       5/8       32.3       \$237       \$710"       440       Circ         "Proposed Casing size of the blow out provestion program. If this applicalion is to DEEPEN or PLUG BACK by: the data		34		and and an		L	Lange and the second se			L			
"Proposed Pool 1         "Proposed Pool 2         "Work Type Code       "Well Type Code       "Cable/Rotary       "Lease Type Code       "Ground Level Elevation         E       Brine - I       Rotary       P       3618         "Multiple       "Proposed Depth       Salado       "Contractor       "Spud Date         No       2480 ft.       Salado       "Contractor       "Spud Date         1 Proposed Casing and Cement Program         Hole Size       Casing Size       Casing weight/foot       Setting Depth       Sacks of Cenent       Eatimated TOC         12%       9       5/8       32.3       \$297       710"       440       Cinc         "Decribe the proposed program. If this application is to DEEPEN or PLUG BACK give the data on the present productive table and proposed new productive table and prove table and prove table and proposed new productive table and protable and prove table and prove table and prove table			• P	roposed		Hole Locat		_		_			
"Work Type Code       "Well Type Code       "Cable/Restary       "Lease Type Code       "Ground Level Eleveline 3618         "Multiple       "Proposed Depth       Salado       "Contractor       "Speed Date         No       2480 ft.       Salado       "Contractor       "Speed Date         "No       2480 ft.       Salado       "Contractor       "Speed Date         "No       2480 ft.       Salado       "Contractor       "Speed Date         "Ibrestize       Casing Size       Casing weight/foot       Secting Depth       Sacks of Cencest       Ealmated TOC         124       9       5/8       32.3       \$297 [310]       440       Circ         "Describe the proposed program. If this application is to DEEPEN or FLUG BACK give the data on the present productive zone and proposed new productive zone and proprove by:         "1 hereby	UL or lot no.	Section	Township	Range	Lot Ida	Foet from the	North/South	ine	Feet from the	East/V	Vest line	County	
"Work Type Code       "Well Type Code       "Cable/Restary       "Lease Type Code       "Ground Level Eleveline 3618         "Multiple       "Proposed Depth       Salado       "Contractor       "Speed Date         No       2480 ft.       Salado       "Contractor       "Speed Date         "No       2480 ft.       Salado       "Contractor       "Speed Date         "No       2480 ft.       Salado       "Contractor       "Speed Date         "Ibrestize       Casing Size       Casing weight/foot       Secting Depth       Sacks of Cencest       Ealmated TOC         124       9       5/8       32.3       \$297 [310]       440       Circ         "Describe the proposed program. If this application is to DEEPEN or FLUG BACK give the data on the present productive zone and proposed new productive zone and proprove by:         "1 hereby													
E     Brine - I     Rotary     P     3618       "Multiple No     "Proposed Depth 2480 ft.     "Formation Salado     "Contractor     "Spud Date       21 Proposed Casing and Cement Program			' Prop	sed Pool (					" Propo	ed Pool	2		
E     Brine - I     Rotary     P     3618       "Multiple No     "Proposed Depth 2480 ft.     "Formation Salado     "Contractor     "Spud Date       21 Proposed Casing and Cement Program													
E     Brine - I     Rotary     P     3618       "Multiple No     "Proposed Depth 2480 ft.     "Formation Salado     "Contractor     "Spud Date       21 Proposed Casing and Cement Program													
"Multiple       Description       Proposed Depth       "Formation       "Contractor       "Spud Date         No       2480 ft.       Salado       "Contractor       "Spud Date         21 Proposed Casing and Cement Program         Bole Size       Casing Size       Casing weight/foot       Setting Depth       Sacks of Cenent       Estimated TOC         1214       9 5/8       32.3       1237 (7)0       440       Circ         "Describe the proposed program. If this applications is to DEEPEN or PLUG BACK give the data on the present productive mose and proposed new productive	"Work 7	Type Code		" Well Typ	e Code	¹³ Cable	Rotary		¹⁴ Lease Type Co	de			
No       2480 ft.       Salado ²¹ Proposed Casing and Cement Program         Hole Size       Casing Size       Casing weight/foot       Setting Depth       Sacks of Cement       Estimated TOC         12½       9 5/8       32.3       3237 (7)0 ⁻¹ 440       Cinc ¹¹ Describe the proposed program. If this application is to DEEPEN or PLUG BACK give the data on the present productive more and proposed new productive productive more and proposed n		E	В	rine -	I				Р		3618	3	
121: Section of Control Section of Contro		ltipie									²⁰ Spud Date		
Hole Size       Casing Size       Casing weight/foot       Setting Depth       Sacks of Ceneent       Eatimated TOC         12½       9       5/8       32.3       1297 (310)       440       Circ         **       Describe the proposed program. If this application is to DEEPEN or PLUG BACK give the data on the present productive mose and proposed new productive mose. Describe the blowout prevention program, if any. Use additional sheets if accessary.       Re-entry, drill out cement and bridge plug Hang 3½ tubing to T.D.         **       I hereby certify that the information given above if true and complete to the best of my knowledge and belief.       OIL CONSERVATION DIVISION         Signature:       A.L. Hickerson       Title:       Title:         Title:       C.E.O,       Approval Date:       Expiration Date:         Date:       Promet       Conditions of Approval Date:       Expiration Date:	No			2480 11		Salauo							
Hole Size       Casing Size       Casing weight/foot       Setting Depth       Sacks of Ceneent       Eatimated TOC         12½       9       5/8       32.3       1297 (310)       440       Circ         **       Describe the proposed program. If this application is to DEEPEN or PLUG BACK give the data on the present productive mose and proposed new productive mose. Describe the blowout prevention program, if any. Use additional sheets if accessary.       Re-entry, drill out cement and bridge plug Hang 3½ tubing to T.D.         **       I hereby certify that the information given above if true and complete to the best of my knowledge and belief.       OIL CONSERVATION DIVISION         Signature:       A.L. Hickerson       Title:       Title:         Title:       C.E.O,       Approval Date:       Expiration Date:         Date:       Promet       Conditions of Approval Date:       Expiration Date:				21	Propos	ed Casing a	nd Cement	: Pro	ogram				
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Printed name:     Title:       A.L. Hickerson     Title:       Title:     C.E.O,       Date:     Phone:   Conditions of Approval :	Signature:	L.A	d	ech	MAR	6	Approved by:						
Title:     C.E.O.,     Approval Date:     Expiration Date:       Date:     Phone:     Conditions of Approval :	Printed name:	A.I. H	ickers				litle:						
Date: Phone: (915)381-0531 Conditions of Approval: 411ached	Title:						Approval Date:			Expirati	on Date:		
	Date: QP	-11-6	75	Phone:	(915)3	21.0521 #		roval :					

### C-101 Instructions

Measurements and dimensions are to be in feet/inches. Wer ocations will refer to the New Mexico Principal Meridian.

IF THIS IS AN AMENDED REPORT CHECK THE BOX LABLED "AMENDED REPORT" AT THE TOP OF THIS DOCUMENT.

- Operator's OGRID number. If you do not have one it will be assigned and filled in by the District office.
- 2 Operator's name and address
- 3 API number of this well. If this is a new drill the OCD will assign the number and fill this in.
- 4 Property code. If this is a new property the OCD will assign the number and fill it in.
- 5 Property name that used to be called 'well name'
- 6 The number of this well on the property.
- 7 The surveyed location of this well New Mexico Principal Meridian NOTE: If the United States government survey designates a Lot Number for this location use that number in the 'UL or lot no.' box. Otherwise use the OCD Unit Letter.

8 The proposed bottom hole location of this well at TD

9 and 10 The proposed pool(s) to which this well is beeing drilled.

11 Work type code from the following table:

- N New well
- E Re-entry
- D Drill deeper
- P Plugback
- A Add a zone
- 12 Well type code from the following table:
  - O Single oil completion
  - G Single gas completion
  - M Mutiple completion
  - I Injection well
  - S SWD well
  - W Water supply well
  - C Carbon dioxide well
- 13 Cable or rotary drilling code
  - C Propose to cable tool drill
  - Propose to rotary drill
- 14 Lease type code from the following table:
  - F Fedoral
  - S State
  - P Private
  - N Navajo
  - J Jicarilla U Ute
  - I Other Indian tribe
- 15 Ground lavel elevation above sea level
- 16 Intend to mutiple complete? Yes or No
- 17 Proposed total depth of this well

- 18 Geologic formation at TD
- 19 Name of the intended drilling company if known.
- 20 Anticipated spud date.
- 21 Proposed hole size ID inches, proposed casing OD inches, casing weight in pounds per foot, setting depth of the casing or depth and top of liner, proposed cementing volume, and estimated top of cement
- 22 Brief description of the proposed drilling program and BOP program. Attach additional sheets if necessary.
- 23 The signature, printed name, and title of the person authorized to make this report. The data this report was signed and the telephone number to call for questions about this report.

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	WEL!	NEW MEXIC			î î		FINE COC	FORM C-128 Revised 5/1/57
	SEE IN	STRUCTIONS P	OR COMPL	ETINGT	HIS FORM	ON THE RE	VERSE SIDE	
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perator Clinical	X CHEMICAL	Copp		(2) S		ATER WE		Vell No.
ait Letter	Section	Township	-100	Range		County		
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ctual Footage Lo. 990	cation of Vell:			1155			EAST	
round Level Elev	feet from the S		line Lna	Pool	f	eet from the		line
CONT CEASE FLEA	. Froducing r	ormation	ſ	-001			Ue	dicated Acreage: Acrea
ubo bas the rig another. (63-3 U the answer to wise? YES	bt to drill into an 3-29 (e) NMSA 19 9 question one is NO 1	d to produce /ros 335 Comp.) "'no," have the If answer is "'ye	m any pool interests of s,'' Type of	and to app all the o f Consolid	waers been lation	e production consolidated	either for himsel i by communitize	"Owner" means the perso   or  or himsel  and tion agreement or other-
If the answer to	question two is	"no," list all th	e owners al	nd their re	espective in	nterests belo	w;	
Wher					and Descr	iption		•
		······································						
		SECTION	ł B					RTIFICATION
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330 660 00	0 1320 1650 M	100 2300 X40	2000	1500	066 4 1000	500	and/or Land	rofessional Engineer Surveyor, JOHN WE WES
					~~~~	·	A. N P.E	. & L.S. NO. 373

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Santa Fe, New Mexico

Form C-101 Revised (12/1/55)

NOTICE OF INTENTION TO DRILL

-- 74

1040

CO OIL CONSERVATION COMM

Notice must be given to the District Office of the Oil Conservation Commission and approval obtained before drilling or recompletion hegins. If changes in the proposed plan are considered advisable, a copy of this notice showing such changes will be returned to the sender. Submit this notice in QUINTUPLICATE. One copy will be returned following approval. See additional instructions in Rules and Regulations of the Commission. If State Land submit 6 Copies Attach Form C- 128 in triplicate to first 3 copies of form C-101

ң	obb s , N	lew Mex	(Place)	· ·	January	16, 196	2	
OIL CONS Santa fe						(Date)		·
Gentlemen:								
			سميش كالأخخ مستسلا	intention to commence the Drillin EMICAL COMPANY				
				Company or Operation, Well	tor)	*****************		
		Foster		, Well	No	, in	P	
				South				
				line of Section				
(GIVE LO					•	•	•	
				If State Land the Oil and Gas I	Lease is No			
1				If patented land the owner is	J. W. F	oster		·····
D	С	В	A	Address				
				We propose to drill well with dr	rilling couloment as fo	llows Rot	arv tool	s from surfac
				to bottom Rustler Anh				
E	F	G	н	The status of plugging bond is.				
				-				
L	к	J	I	Drilling Contractor .Notdet				
	1		D	·	·······			
М	N	ο	Р	We intend to complete this wel				
ŀ'	. 1			formation at an approximate d	epth of approxim	ately 25	20 feet	fcct.
				CASING PROGR				
347		an the fall		Contain and the second share as "	and in second s			

We propose to use the following strings of Casing and to cement them as indicated:

Size of Hole	Size of Casing	Weight per Foot	New or Second Hand	Depth	Backs Cement
12-1/4"	9-5/8"	32	New	1310'	Circulate to su
8-3/4"	5-1/2"	15.5	New	Will hang insi	de 9-5/8" casing

and use as input for fresh water to wash Salt section and return Brine water. If changes in the above plans become advisable we will notify you immediately.

ADDITIONAL INFORMATION (If recompletion give full details of proposed plan of work.)

Approved..... 19. Except as follows:

By.

OIL CONSERVATION COMMISSION

Sincerely yours,

max Chemical Company

Position	Agent
	Send Communications regarding well to
Name	W. H. Kolins
Address	Box 1595, Hobbs, New Mexico

	FORM C-103 (Rev 3-55)					
(CELLANEOU			mission Rule 1106)	
Name of Company		· · · · ·	Addres	s • • • • • •	and the in the	<u> </u>
Climax Cha	mical Co			F	lobbs. New Max	CO
Lease		Well No.	Unit Letter	Section	Township	Range .
(Foster) Salina Water	Me11	1	P	34	19 South	36 East
Date Work Performed	Pool		-		County	
January 30,31 1962	Und	nai cantod			tee	
	T	HIS IS A REPORT	OF: (Check	appropria	te block)	
Beginning Drilling Operatio	ns [Casing Test an	id Cement Job		Other (Explain):	
Plugging		Remedial Work				

Detailed account of work done, nature and quantity of materials used, and results obtained.

Spudded 12-1/4" hole with Botary tools January 26, 1962. Drilled to depth of 1300 feet. Ran 42 joints H-40 32.3# 3.3% tasing with Halliburton Float shoe. Tagged bottom of hole then picked casing up one foot and cemented same with 145 sax Incor cement, 145 sax Diamax A 6% jel, 160 sax regular cement. Plug pumped down at 2:45 P.M. January 30, 1962. Cement did not circulate. At 3:00 P.M. January 31, 1962 ran 1" tubing down annulus between hole and casing and found firm cement forty feet below ground level. Pumped water into hole and circulated to pits to lighten mud load in annulus. Thenpumped 50 sacks Regular cement to bottom of uncemented hole and circulated cement to surface. Estimated to have circulated about 25 sax cement back to pits. Bailed hole dry to top of plug at 1260 feet. Allowed hole to stand one hour and ran bailer again. Found no increase in fluid. Drilled plug and shoe, then allowed hole to stand one hour. Hole remained dry after bailing test. Drilling new hole below casing with Cable tools.

Cement allowed to set on 9-5/8" casing from 2:45 P.M., January 30, 1962 until 3:00 A.M. February 1, 1962 before plug was drilled.

Witnessed by		I	Position		Company					
	a P. 1411.		Act	mt			x Chemic	1 Company		
		FILL IN BELOW	FOR REMI	EDIAL V	ORK REPORTS	ONLY				
			ORIGINAL	WELL I	DATA			<u></u>		
D F Elev.	T D	<u></u>	PBTD		Produc	ing Interv	val	Completion Date		
Tubing Diame	ter	Tubing Depth	1	Oil Stri	ng Diameter		Oil String D	epth		
Perforated Int	erval(s)	- <u>L</u> .		1	<u>.</u>					
Open Hole Int	erval			Producing Formation(s)						
			RESULTS C	FWOR	KOVER			······································		
Test	Date of Oil Productio Test BPD		Gas Produ MCFF		Water Production BPD		GOR bic feet/Bbl	Gas Well Potential MCFPD		
Before Workover				· · · · · · · · · · · · · · · · · · ·						
After Workover				· ·						
	OIL CONSERV			I here to the	eby certify that the best of my know	e informat ledge.	tion given at	pove is true and complete		
Approved by				Name Charles P. Meller						
Title	and the second s		<u></u>	Positi	•					
Date	· · ·			Comp	any Agen	B				

.	If drill-stem or other special tere or		OF DRILL-STEM ation surveys were a		12 au		ate shee	t and at	tach hereto	· ····	· · · · · ·
			TOOLS U	SED							ł
Rot	ary tools were used fromf	eet to	1300	feet, and fr	om			feet to			feet
	ble tools were used from 1300 f			•			1				
			PRODUC	TION			•				1
Put	to Producing				water	well	. No	test	for oi	l or	×88.
	L WELL: The production during the first 2				*			.•			
011						-					
	was oil;% v	was er	nulsion;	%	water; a	nd			% was se	diment.	A.P.I.
	Gravity	•••••					•				
GA	S WELL: The production during the first 2	4 hou	1rs was	M.C.	F. plus					ba	rrels of
	liquid Hydrocarbon. Shut in Pres	isure	lbs.			•	ļ				
Le	ngth of Time Shut in										
	PLEASE INDICATE BELOW FORMAT	ION	TOPS (IN CONF	ORMANCE	WITH G	EOGF	APHI	CAL SE	CTION O	F STA	TE):
	Southeastern N		lexico				No	rthweste	rn New I	lexico	
Т.	Anhy1196	т.	Devonian		·····	т.	Ojo A	lamo			
Т.	Salt	Т.	Silurian			Т.	Kirtla	nd-Fruitl	and	······	•••••
В.	Salt	т.	Montoya			Т.	Farmi	ngton			
Т.	Yates	т.	Simpson			т.	Pictur	ed Cliffs.			
т.	7 Rivers	Т.	McKee	•••••		т.	Menef	ee			
Т.	Queen	т.	Ellenburger			т.	Point	Lookout.			
Т.	Grayburg	т.	Gr. Wash			т.	Manco	S			
т.	San Andres	Т.	Granite			Т.	Dakot	a			
Т.	Gloricta	Т.				Т.	Morri	on			
т.	Drinkard	Т.	•			Т.		· · ·			
т.	Tubbs	т.	••••••			т.	4	1			
Т.	Abo	т.				т.			·		
т.	Penn	т.	•••••••••••••••••••••••••••••••••••••••			т.	••••••	••••••	•		••••••

FORMATION RECORD

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Т.

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1335 1370 35 Anhydrite & shale 2175 2275 100 Salt 1370 1380 10 Anhydrite 2275 2315 40 Salt & polyhalite 1360 1415 35 Shale & salt 2315 2480 165 Salt 1415 1440 25 Red shells 2480 2482 2 Anhydrite 1440 1480 1535 55 Salt & salt 2480 2482 2 Anhydrite 1480 1535 1610 75 Salt Salt Anhydrite 1535 1610 75 Salt Salt Anhydrite 1610 1640 30 Salt & anhy. streaks 4 4 4 4 1655 1675 20 Anhydrite 4 4 4 4 1675 1865 190 Salt 4 4 4 4	95 565 635 875 1065 1200 1297 1335 1300 1415 1440 1480 1535 1610 1640 1655	565 635 875 1065 1200 1297 1335 1370 1380 1415 1440 1480 1535 1610 1640 1655 1675	470 70 240 190 135 97 38 35 35 25 40 55 75 30 15 20	Red beds Red beds and sand Red beds, sand, shale Red beds Red beds Red beds Red beds & sdy. red shal Anhydrite & shells Salt Anhydrite & shale Anhydrite Shale & salt Red shells Shell & salt Salt & shale Salt Salt & anhy. streaks Salt Anhydrite	1880 1905 1965 1995 2123 2143 2175 2275 2315 2480	1905 1965 1995 2005 2123 2143 2175 2275 2315 2480	25 60 30 10 118 20 32 100 40 165 2	Salt Salt & polyhalite Salt Anhydrite & polyhalite Salt & polyhalite Anhydrite & salt Salt Salt & polyhalite Salt & polyhalite Salt

ATTACH SEPARATE SHEET IF ADDITIONAL SPACE IS NEEDED

I hereby swear or affirm that the information given herewith is a complete and correct record of the well and all work done on it so far as can be determined from available records. March 19, 1962 (Date)

Operator Climex Chemical Company Company or alu P. Miller Name.

T. Miss.....

Address Hobbs, New Mexico

 $7^{\prime\prime}$

THE WASTE SLURRY + -> BRINE TO SALE OR DISPOSAL 95/8 - 32 * CASING (CEMENTED) 31/2"- TUBING 7"FINER DETAIL CEMENT LINER RED BEDS - TOP AT 40' PACKER PACKER ON 7" to 95/8" TUBING ANHYORITE 100' THICK 1300 -1359 1600 ANHYDRITE SALT STRINGERS WITH 1900' 2100 CONDEN TD - 2425 BASE OF SALT 2445 2400 PERMIAN BRINE SALES, INC. MONUMENT NO. 2 OLD CLIMAX FOSTER No 2 (1969) SE4. 34 F-19+5 8-36-E 1020 FSL - BOO'FE4 300-17 DRAWING NO .: BY:

District 1 PO Box 1980, Hobbs, NM 88241-1980 District II PO Drawer DD, Artesia, NM 88211-0719 District III 1000 Rio Brazos Rd., Aztec, NM 87410 District IV PO Box 2088, Santa Fe, NM 87504-2088

State of New Mexico Energy, Minerais & Natural Resources Department

OIL CONSERVATION DIVISION PO Box 2088 Santa Fe, NM 87504-2088

Form C-101 Revised February 10, 1994 Instructions on back Submit to Appropriate District Office State Lease - 6 Copies Fee Lease - 5 Copies

AMENDED REPORT

APPLICATION FOR PERMIT TO DRILL, RE-ENTER, DEEPEN, PLUGBACK, OR ADD A ZONE

				i (Operator Nat	ne and Address.					¹ O	GRID Number
	AN BRI									ļ		API Number
	west 10 a, Texa		stre 797(30 - 0	
and the second se	rty Code						Property Name					• Well No.
			Fo	ormerl	y Clima	x Saline	Well No.2	Fos	ter			2
•						⁷ Surface	Location					
UL or lot no.	Section	Town	qide	Range	Lot Idn	Feet from the		ine	Feet from the	-	Vest line	County
	34	19	_	36-E			1020 ft			1) ft	Lea
		_				the second s	tion If Diffe		المصادقاتين فتيوجون كالمتابعة			
UL or lot no.	Section	Town	skip	Range	Lot Idn	Feet from the	North/South L	ine	Feet from the	East/V	Vest line	County
		· "	10000	ed Pool I	l	<u> </u>	1		" Propo	sed Pool :	2	
		-									-	
L												
1	Type Code			Well Type			ie/Rotary		" Lesse Type Co	ode	F	und Level Elevation
	E		_	ine -		Rota	ry		Р		361	
" Mu No	litiple			' Proposed 2449	Depth	"Fo Sala	rmation		" Contractor			¹⁰ Spud Date
						1		L				
Hole Si			Cash				and Cement	بيصيفي والمصاري				Fatimated TOC
12 ¹ / ₄		9	5/	ng Size	╺╼╍╪╼╺╼╾╼╾╼	ag weight/foot	Setting D 1359	epth	500)		irc
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²⁰ Re - e Hang	the blowou entry, 3 ¹ / ₂ tut	dril dril bing	ntion 1 o to	program. W utc cen T.D.	faby.Usead	ddidonal aberta i	faccesary. plug					and new productive
of my knowledg	e and belief		A	/ /	1				ONSERVA			SIUN
Signature:	<u>A(1)</u>		A	<u>l CH</u>	<u>L/A</u>	elly	Approved by:					
Printed name:	A.L. 1	lické	ersc	n			Title:					
Title:	C.E.0		- Real and the second				Approval Date:			Expiration	on Date:	
Date:	2-11-	-9.	9	Phone:	(915)3	81-0531	Conditions of App Attached	rovai :				

C-101 Instructions

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- Property code. If this is a new property the OCD will 4 assign the number and fill it in.
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- 6 The number of this well on the property.
- 7 The surveyed location of this well New Mexico Principal Meridian NOTE: If the United States government survey designates a Lot Number for this location use that number in the 'UL or lot no.' box. Otherwise use the OCD Unit Letter.
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9 and 10 The proposed pool(s) to which this well is beeing drilled.

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 - Μ **Mutiple** completion
 - Injection well Ł S
 - SWD well W
 - Water supply well С Carbon dioxido well
- 13 Cable or rotary drilling code
 - Propose to cable tool drill С
 - R Propose to rotary drill
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- S State
- Ρ Private
- Ν Navajo
- Jicarilla J
- U Ute
- Other Indian tribe L
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- Intend to mutiple complete? Yes or No 16
- 17 Proposed total depth of this well

- 18 Geologic formation at TD
- 19 Name of the intended drilling company if known.
- 20 Anticipated spud date.
- 21 Proposed hole size ID inches, proposed casing OD inches, casing weight in pounds per foot, setting depth of the casing or depth and top of liner, proposed cementing volume, and estimated top of cement
- Brief description of the proposed drilling program and BOP 22 program. Attach additional sheets if necessary.
- 23 The signature, printed name, and title of the person authorized to make this report. The date this report was signed and the telephone number to call for questions about this report.

International State and Provided And Pr								
Distribution NEW MEXICO OIL CONSERVATION COMMISSION Processed interval interv	NO. OF COPIES RECEIVED			$u \in \{0, 2, 2\}^{n-1}$	ë n			
US.C.S. LAND OFFICE OPERATOR APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK A LOUGHT OF THE DRILL OF THE SALE OF	DISTRIBUTION	NEW		VATION COMMISSION	4	Form C-101		
US. 0.4. LAND OFFICE OFFERATOR APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK The Type of Weil DEFEN PLUG BACK APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK The Type of Weil DEFEN PLUG BACK APPLICATION FOR PERMIT TO DRILL, DEEPEN, OR PLUG BACK APPLICATION FOR DEEMINE DEFEN PLUG BACK APPLICATION FOR DEEMINE A LONG TO CAREAU A LONG TO WHILE ALCOUNT OF WHILE	SANTA FE				n 54 570	Revised 1-1-6	5	
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SANTA FE	NEW MEXICO OIL CONS	ERVATION COMMISSION	Effective 1-1-65
U.S.G.S.	4		5a. Indicate Type of Lease
LAND OFFICE	4		
OPERATOR	4		5. State Oil & Gas Lease No.
OPERATOR]		Patented Land
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CLIMAX CHEMICA	LCOMPANY		-Foster-Saline Mai
3. Address of Operator			9. Well No. W
Box 1595 - Hobb	s, New Mexico 88240		2
4. Location of Well		1020	10. Field and Pool, or Wildcat
UNIT LETTER NONE	BOO" FEET FROM THE East	LINE AND FEE	Monument
South	on <u>34</u> township <u>19</u>	RANGE 36E	_NMPM.
	15. Elevation (Show whether 3618 G. R.	DF, RT, GR, etc.)	Lea
	Appropriate Box To Indicate N NTENTION TO:	-	or Other Data QUENT REPORT OF:
PERFORM REMEDIAL WORK	PLUG AND ABANDON	REMEDIAL WORK COMMENCE DRILLING OPNS. CASING TEST AND CEMENT JQB OTHER	ALTERING CASING PLUG AND ABANDONMENT
OTHER Drill New Well			

17. Describe Proposed or Completed Operations (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any propose work) SEE RULE 1103.

Started drilling 12-30-69. Drilled 1359.53 12 1/4" hole. Set 9 5/8" H-40-32.30[#] casing cemented with 500 sacks incor with 2% calcium chloride and 200 neet sacks. Circulated 150 sacks cement into pits. Bumped insert float (set 1 joint off bottom of string) with plug and pressured casing to 1500[#] PSI. Casing held pressure O.K. 9 5/8" casing cemented at 1359.53 from rotary bushing 12^a above ground.

After cement set drilled plug and drilled to 2449' base of salt 2445. Set 5 1/2" J-55-15.5[#] tubing to 2425' using Braden Head to support tubing. Well completed 1-9-70 and put in service

information above is true and	

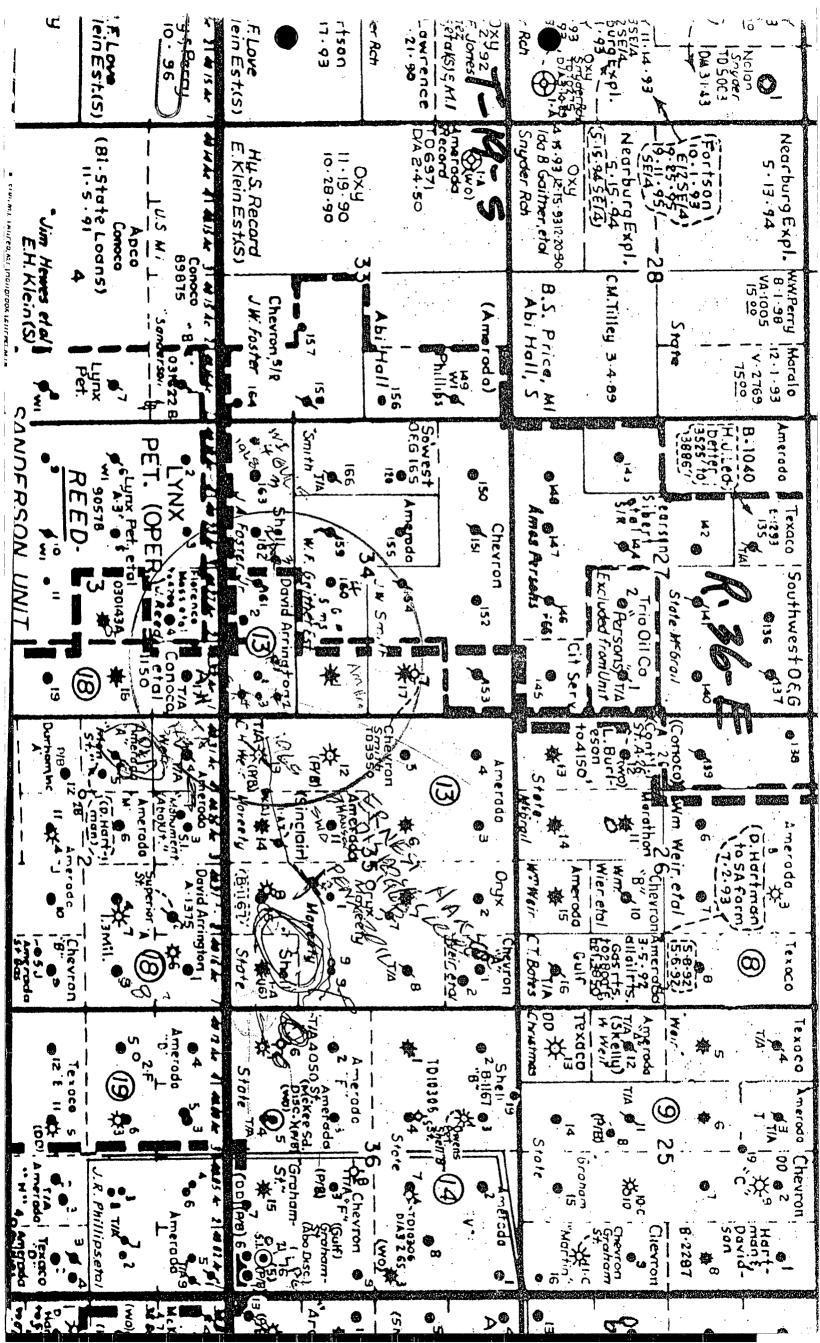
signed Entracth	Mechanical Superintendent	DATE 7-15-70
APPROVED BY ACCORDEN	- SUPERVISOR DISTRICT	AUG 17 1970

NEW AT CO OIL CONSERVATION COMMISSION

Form C-102 Supersedes C-128 Effective 1-1-65

All distances must be from the outer boundaries of the Section E 0. C. C.

1		All distances must be	from the o	ater boundariés	of the Section	m. C. U. L. L.	•
Operator CL	IMAX CHEMICAL	CORP.	Lease -	SALINE Y	ATERW	5	Well No. 2
Unit Letter	Section. 34	Township 19 SOUT	rH Rom	36 EAST	County	LEA	
Actual Footage Loc	ation of Well:						
1020	feet from the	SOUTH line and	300	f	eet from the	EAST	line
Ground Level Elev:	Producing For	mation	Pool				Dedicated Acreage:
				<u></u>			Acres
1. Outline th	e acreage dedica	ted to the subject w	vell by co	olored pencil	or hachur	e marks on th	e plat below.
							-
	nan one lease is nd royalty).	dedicated to the we	ll, outlin	e each and io	lentify the	e ownership th	nereof (both as to working
3. If more the	an one lease of di	ifferent ownership is	dedicate	d to the well	, have the	interests of	all owners been consoli-
		nitization, force-pool				·	
· Yes	No If an	nswer is "yes," type	of consol	idation			
If answer	is "no" list the	owners and tract de-	crintion=	which have	actually h	een consolid	ated. (Use reverse side of
	f necessary.)	und und und uder ucs			D		The reverse side of
		ed to the well until a	ll interes	ts have been	consolide	ated (hy com	munitization, unitization,
							approved by the Commis-
sion.	J					,	rr
						r	
	ł			1			CERTIFICATION
	1			i			
1	l i			1			ertify that the information con-
	1			i -			ein Is true and complete to the
1	4			1		best of my	knowledge and belief.
1	.1			1			
	l I					Norme	ININ. D'
	+	+		-			NA MOUNS
· .	l l					Position	X
	NEFR & N.			1		Vice-	President
	AGIN-F-CAR					Company	
1/2:1	STATE ON U					Climax	Chemical Company
		2		1		Date	
	676	JEY		1		Decem	ber 30, 1969
				1			
	THE MEXICO			1			
	MET	/		1			certify that the well location
	OHN W. WEST			1			this plat was plotted from field
$\Phi = \frac{1}{2} \left(\frac{1}{2} \left(\frac{1}{2} - \frac{1}{2} \right) \right) + \frac{1}{2} \left(\frac{1}{2} - \frac{1}{2} \right) \left(\frac{1}{2} - 1$							ictual surveys made by me or
1				1			supervision, and that the same nd correct to the best of my
	1			1			and belief.
L	+			↓ · → ·		nive reage	
No. 194	•			1	No. 2		
	•		·		0- <u>300'</u>	Date Surveye	d
	•			1		Sale Surveye	^a 12-27-69
			• .			Registered D	rofessional Engineer
4	i			1	No.	and/or Land	
· ·	1	· · · ·		1			1
l	j			1	, L I	L.	Am W/Went
	Ç					Certificate N	^{o.} 676
0 330 860	0 1320 1650 1980	2310 2640 200	0.1500	1000	800 0	-	010



within 1/2 mile

	•				
Form 9–831 a (March 1942)			ED STATES	s Interior	Budget Bureau No. 42-R358. Approval expires 11-30-46. Land Office LAS CIUCOS Loase No. 030143-4 Unit

SUNDRY NOTICES AND REPORTS ON WELLS

NOTICE OF INTENTION TO DRILL	SUBSEQUENT REPORT OF WATER SHUT-OFF
NOTICE OF INTENTION TO CHANGE PLANS	SUBSEQUENT REPORT OF SHOOTING OR ACIDIZING
NOTICE OF INTENTION TO TEST WATER SHUT-OFF	SUBSEQUENT REPORT OF ALTERING CASING
NOTICE OF INTENTION TO RE-DRILL OR REPAIR WELL	SUBSEQUENT REPORT OF REDRILLING OR REPAIR
NOTICE OF INTENTION TO SHOOT OR ACIDIZE	SUBSEQUENT REPORT OF ABANDONMENT
NOTICE OF INTENTION TO PULL OR ALTER CASING	SUPPLEMENTARY WELL HISTORY
NOTICE OF INTENTION TO ABANDON WELL	
	<u> </u>

(INDICATE ABOVE BY CHECK MARK NATURE OF REPORT, NOTICE, OR OTHER DATA)

			Yobiuary 1	, 19 53
Well No is loca	ted 1002.54	from N line	and 1652. from E line	of sec
nwl wat soc. 3	203	36 N	N.M.Y.M.	
(14 Sec. and Sec. No.)	(Twp.)	(Range)	(Meridian)	
Nonument	Le		Non Mozic	0
(Field)	(Cou	nty or Subdivision)	(State or Territ	югу)

The elevation of the derrick floor above sea level is ft.

DETAILS OF WORK

(State names of and expected depths to objective sands; show sizes, weights, and lengths of proposed casings; indicate mudding jobs, cementing points, and all other important proposed work)

we propose to drill this test with notary tools to a total depth of approximately 3900'. We will set and commt 10-3/4" 324 making at a depth of about 300 feet and commt same with sufficient penent to circulate back into celler. We will out an 8-3/4" hole pelow sufface casing to a depth of approximately 3500 feet and cases saving with a two-stage job, using 300 sacks on the bottom ob and 250 seeks through two-stage tool at 1275 feet.

we propose to dismond core the hale free shoe of pay string a total depth.

I understand	d that this plan of work must receive approval in writing b	y the Geological Survey before operations may be commenced.
ompany	R. S. Koss	
dress	1503 pirst Nat*1. Bank Bld*	
	Dalles, Taxes.	By Charles P. Miller
: }		Title Acono

	·		_	(Form C-110)
				(Revised 7/1/52)
NEW MEXICO OIL	CONSERVAT	ION COMMISSI	ON .	_
necessary that Form C-104 be approved before this form c well. Submit this	1 Fc, New Mer	kico	THE DEFICE OCI	Ú
necessary that Form C-104 be approved before this form c	an be approved a	n an initial allowable	be assigned to any compl	cted Oil or Gas
well. Submit this	s form in QUAD	RUPLICATE.	100 2 MM 9	
CERTIFICATE OF COM	PLIANCE	AND AUTH	ORIZATION	
TO TRANSPORT				
npany or Operator		Lease	J. L. Reed	••••••
Ircss1503First.National.BankBuilding. (Local or Field Office)		Dalla (Princ	s. Texas	
it B , Well(s) No 1 , Sec 3	, T 20 :	S , R 36E ,	PoolMonumen	t
intyKind of L	T	adamal Leased		
	ease:		I	
Oil well Location of TanksApprox.175!.FSL	450' FEL	of Lot 2	•••••••••••••••••••••••••••••••••••••••	
thorized Transporter. Warren Petroleum C	orporation		Addrcss o	of Transporter
fonument, New Mexico	·····	Tulsa	b. Oklahoma	
r cent of Oil or Natural Gas to be Transported100	Other 7	-	-	r Natural Gas
		-	•	
om this unit are	e Line Co.	·····		•••••
2 2 2				%
EASON FOR FILING: (Please check proper box)				
NEW WELL.	🗌 СНАІ	NGE IN OWNER	SHIP	
CHANGE IN TRANSPORTER	[] OTH	ER (Explain unde	r Remarks)	🖪
REMARKS:				
Filed for casinghead ga	8			
	۱			

The undersigned certifies that the Rules and Regulations of the Oil Conservation Commission have been complied with.

H. S. MOSS 唐银 11 1955, 19...... Approved..... and OIL CONSERVATION COMMISSION By By. strong Title: 0 Nam Agent ei la j. 111 Sec. 234 Title ... (See Instructions on Reverse Side)

•	•			(Form (Revised)
			ONSERVATION COMMISSION Fe, New Mexico	• •
f necessary that	Form C-104 be. app	roved before this form car	be approved an an <i>initial</i> allowable be assign	a in the sound is the second
		well. Submit this I	orm in QUADRUPLICATE.	BUSGUE
	CERTIFICA	TE OF COMPI	LIANCE AND AUTHORIZ	ATTON 1953
			DIL AND NATURAL GAS	
Company or Op	erator	S. Moss	LeaseJ. La.	Reed CFFICE
			Dallas, Texas	
			, T. 20.5 , R 36 E, Pool	
•			se: Federal land	
			SL & 450 fr. EL of Lot	
Authorized Tran	sporter Texas .	New Mexico Pi	peline Company	Address of Transj
		w Marioo		
	FuniceNe	Pl	Houston, Taxas,	*
			Houston, Taxes. (Principal Place	
Per cent of Oil c				
	or Natural Gas to be	e Transported 100		
	or Natural Gas to be	e Transported 100	Other Transporters authorized to t	
from this unit as	r Natural Gas to be	e Transported 100	Other Transporters authorized to t	
from this unit as REASON FOR	re NONS FILING: (Please	e Transported 100	Other Transporters authorized to t	ransport Oil or Natura
from this unit as REASON FOR NEW WELL	re NONS FILING: (Please	e Transported 100	CHANGE IN OWNERSHIP	ransport Oil or Natura
from this unit as REASON FOR NEW WELL	re NONS FILING: (Please	e Transported 100	CHANGE IN OWNERSHIP	ransport Oil or Natura
from this unit as REASON FOR NEW WELL	r Natural Gas to be re	e Transported 100 check proper box)	CHANGE IN OWNERSHIP OTHER (Explain under Remarl	ransport Oil or Natura
from this unit as REASON FOR NEW WELL CHANGE IN T	r Natural Gas to be re	e Transported 100 check proper box)	CHANGE IN OWNERSHIP	ransport Oil or Natura
from this unit as REASON FOR NEW WELL CHANGE IN T	FILING: (Please	e Transported 100 check proper box)	CHANGE IN OWNERSHIP OTHER (Explain under Remarl	ransport Oil or Natura
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from this unit as REASON FOR NEW WELL CHANGE IN T	FILING: (Please	e Transported	 Other Transporters authorized to t CHANGE IN OWNERSHIP OTHER (Explain under Remarl 	ransport Oil or Natura
from this unit as REASON FOR NEW WELL CHANGE IN T REMARKS:	re Natural Gas to be re NORS FILING: (Please	e Transported 100	CHANGE IN OWNERSHIP OTHER (Explain under Remarl	ransport Oil or Natura
from this unit as REASON FOR NEW WELL CHANGE IN T REMARKS: The unders	FILING: (Please	e Transported 100 check proper box)	CHANGE IN OWNERSHIP OTHER (Explain under Remarl	ransport Oil or Natura
from this unit as REASON FOR NEW WELL CHANGE IN T REMARKS: The unders	FILING: (Please	e Transported 100 check proper box)	CHANGE IN OWNERSHIP OTHER (Explain under Remarl	ransport Oil or Natura
from this unit as REASON FOR NEW WELL CHANGE IN T REMARKS: The unders	FILING: (Please TRANSPORTER igned certifies that	e Transported 100 check proper box) t the Rules and Regula	CHANGE IN OWNERSHIP OTHER (Explain under Remark OTHER (Explain under Remark March H. S. Moss	ransport Oil or Natura (ks)
from this unit as REASON FOR NEW WELL CHANGE IN T REMARKS: The unders	FILING: (Please TRANSPORTER igned certifies that	e Transported 100 check proper box)	CHANGE IN OWNERSHIP OTHER (Explain under Remark OTHER (Explain under Remark March H. S. Moss	ransport Oil or Natura (ks)
from this unit as REASON FOR NEW WELL CHANGE IN T REMARKS: The unders Executed th Approved	FILING: (Please TRANSPORTER igned certifies that	e Transported 100 check proper box) t the Rules and Regula dday of	CHANGE IN OWNERSHIP OTHER (Explain under Remark OTHER (Explain under Remark March H. S. Moss	ransport Oil or Natura (ks)

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Appropriate District Office DISTRICT I 2.0. Box 1980, Hobbs, NM 88240			finerals	and Natur	w Mexico ral Resources Departmen			Form C-104 Revised 1-1-89 See Instructions at Bottom of Page
DISTRICT II P.O. Drawer DD, Anesia, NM 88210	•			P.O. Bo		1		
2 <u>15TRICT III</u> 000 Rio Brazos Rd., Aziec, NM 87410					E AND AUTHORIZ			
Operator		<u>TO TRA</u>	NSPO	RTOIL	AND NATURAL GAS	S Well A	PI No.	
Lynx Petroleum (Consul	tants	<u>s, In</u>	с.	·			
Address P. O. Box 1979,	Hobbs	, NM	882	41				
Reason(s) for Filing (Check proper box) New Well	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Change in			Other (Please explain)		
Recompletion	Oil Casinghea		Dry Gas Condens					
					ive, Suite 100) W, M	idland,	TX 79705
I. DESCRIPTION OF WELL	AND LE	ASE						
Reed Sanderson Uni	t	Well No. 4	Eumo	ont-Ya	gFormation tes-7 Rivers-	1	l Lease Federal de Rex	Lease No. LC-030143A
Location B	. 10	02	Quee		rth Line and 1652) [t From The	ast Line
3				361		F0	Lea	
Section Township					<u></u>			County
III. DESIGNATION OF TRAN Name of Authorized Transporter of Oil		or Conde			Address (Give address to whit			
ARCO Pipe Line Com Name of Authonized Transporter of Casing		X	or Dry (Gas [77]	200 ARCO Place Address (Give address to white			
Warren Petroleum C	ompany	/			Box 1589, Tuls	sa, OK	74102	
If well produces oil or liquids, give location of tanks.	Unit	Soc.	Twp.	Rgc.	Is gas actually connected?	When	?	
If this production is commingled with that IV. COMPLETION DATA	from any ot	her lease of	r pool, giv	e commingl	ing order number:			· · · ·
Designate Type of Completion	- 00	Oil We	u c	las Well	New Well Workover	Deepen	Plug Back	Same Res'v Diff Res'v
Dute Spudded		ipl. Ready i	10 Prod.		Total Depth		P.B.T.D.	
Elevations (DF, RKB, KT, GR, etc.)	Name of 1	Producing I	Formation		Top Oil/Gas Pay		Tubing Depth	
Perforations							Depth Casing	Shoe
		TIDING						
HOLE SIZE		SING & T			CEMENTING RECORD DEPTH SET)	S	ACKS CEMENT
							-	
V. TEST DATA AND REQUE					1			
OIL WELL (Test must be after) Date First New Oil Rug To Tank	Date of T		e of load o	oil and must	be equal to or exceed top allo Producing Method (Flow, put			or full 24 hours.)
Length of Test	Tubing P		Web		Casing Pressure		Choke Size	
	-							
Actual Prod. During Test	Oil - Bbl	5.			Water - Bbis.		Gas- MCF	
GAS WELL							·····	
Actual Prod. Test - MCF/D	Length o	f Test			Bbls. Condensate/MMCF		Gravity of C	ondensate
Testing Method (pilot, back pr.)	Tubing P	ressure (Sh	uu-in)		Casing Pressure (Shut-in)		Cioke Size	
VI. OPERATOR CERTIFIC I hereby certify that the rules and regination have been complied with and is true and complete to the best of my	ulations of the in-	ne Oil Com formation g	servalion given abov		OIL CON Date Approve			DIVISION 17'92
Signature	tor	ny			By	SIGNED	BY JERRY S	EXTON
Gary W. Fonay		<u>ce-Pr</u>	Tila	<u>ent</u>	ÐI	STRICT I	SUPERVISOR	•
Printed Name 7-13-92	39	2-695	0	No	Title			
Date	a dilada cista accorditad	T.	elephone l	190. 		an in the set	a de seconde de alle de la composition	

INSTRUCTIONS: This form is to be filed in complia ince with Rule 1104

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1) Request for allowable for newly drilled or deepened well must be accompanied by tabulation of deviation tests taken in accordance with Rule 111.

2) All sections of this form must be filled out for allowable on new and recompleted wells.

Fill out only Sections I, II, III, and VI for changes of operator, well name or number, transporter, or other such changes.
 Separate Form C-104 must be filed for each pool in multiply completed wells.

Form 9-331 Dec. 1973	Eorm Approved. Jdget Bureau No. 42-R1424
UNITED STATES TP. C.	5. LEASE
DEPARTMENT OF THE INTERIOR	LC - 030143 (A) 6. IF INDIAN, ALLOTTEE OR TRIBE NAME
SUNDRY NOTICES AND REPORTS ON WELLS	7. UNIT AGREEMENT NAME
(Do not use this form for proposals to drill or to deepen or plug back to a different reservoir, Use Form 9-331-C for such proposals.)	8, FARM OR LEASE NAME
1. oil gas m	REED SANDERSON UNIT
well well other	9. WELL NO.
2. NAME OF OPERATOR CONOCO INC.	10. FIELD OR WILDCAT NAME
3. ADDRESS OF OPERATOR	EUMONT VATES 7 RVRS. QN.
P. O. Box 460, Hobbs, N.M. 88240	11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA
4. LOCATION OF WELL (REPORT LOCATION CLEARLY. See space 17 below.)	SEC. 3, T-205, R-36E
AT SURFACE: 1002 'FNL+ 1652' FEL AT TOP PROD. INTERVAL:	12. COUNTY OR PARISH 13. STATE
AT TOTAL DEPTH:	LEA NM 14. API NO.
16. CHECK APPROPRIATE BOX TO INDICATE NATURE OF NOTICE,	
REPORT, OR OTHER DATA	15. ELEVATIONS (SHOW DF, KDB, AND WD)
REQUEST FOR APPROVAL TO: SUBSEQUENT REPORT OF:	OF LAND M
TEST WATER SHUT-OFF Image: Constraint of the second se	EN OFFFINIENTE
SHOOT OR ACIDIZE	ST NLULIVED T
REPAIR WELL Image: Construction PULL OR ALTER CASING Image: Construction	(NOTE: Report results of routiple completion or zon change on Form 9450V 16 1983
	10 1983
CHANGE ZONES	BO DIST. 6 N. M.
(other)CHEMICALLY INHIBIT	Stur and a start
17. DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly sta	te all pertinent details, and give pertinent dates,
Including estimated date of starting any proposed work. If well is a measured and true vertical depths for all markers and zones pertine	nt to this work.)*
MIRU 7/11/83. REAMED HOLE TO	3875! SET RBP@ 2000!
TESTED COG FOR LEAKS, RESET RBP (2 980'. SET PKR @ 288'.
SQUEEZED 415'-724' w/ 300 5x5 0	LASS "C". REL PKR. DO
CMT 435'- 672', REL RBP. COTO	3897. SET PKR @ 3790
ACIDIZED OH 3809'-3897' W/GO BBLS 10 PPG BRINE W/ GUAR GUM + ROCKSAL	T ENGLED W/20 AND TEN
SWBD. INHIBITED OH W/2 DRUMS C	
TFW. REL PKR. SET RBP@ 3790'.	SPOTTED 7 BBLS 15% ACID
3600'- 3790'. PERF W/ I JSPF @ 363	30', 35, 40, 45, 67, 72, 77,
82,87,92,97,3702,07,12,37,40,1	+3; 46, 66; + 3780; SET
PKR @ 3558 ACIDIZED PERFS W/4 Subsurface Safety Valve: Manu. and Type	UBBLS 15% ACID. (ATTACHMENT)
	Set @ Ft.
18. I hereby certify that the foregoing is true and correct	11 lie los
	<u>Isor Date 11/15/83</u>
PETER W. CHESTER	fice use)
ONDITIONS OF APPROVAL IF, ANY: 1 ADD A	DATE
MAR 1 1984	
*See Instructions on Reverse	Side
	• • • •

REED SANDERSON UNIT NO.4

FLUSHED W/34 BBLS TFW. FRAC'D W/408 BBLS FRAC FLUID & 26,300 LBS 20/40 SAND. SWBD. Rel PKR. CO TO 3785'. REL RBP. CO TO 3900'. RAN PRODUCTION EQUIPMENT. PUMPED 8 BO, 36 BW, & 274 MCF IN 24 HRS 9/29/83.

Surfrit 3 Copies 4 Appropriate 4 June 24 Office	State of New Mex Energy, Minerals and Natural Res		Form C-103 Revised 1-1-59
DISTRICT I P.O. Box 1980, Hobbs, NM 88240	OIL CONSERVATION P.O. Box 2088	3	WELL API NO. 30-025-04162
DISTRICT II P.O. Drawer DD, Artesia, NM 88210	Santa Fe, New Mexico 8	37504-2088	S. Indicate Type of Lease STATE FEE
DISTRICT III 1000 Rio Brazos Rd., Aztec, NM 87410	·		6. State Oil & Gas Lease Na.
(DO NOT USE THIS FORM FOR PR DIFFERENT RESE	ICES AND REPORTS ON WELL OPOSALS TO DRILL OR TO DEEPEN O RVOR. USE "APPLICATION FOR PER C-101) FOR SUCH PROPOSALS.)	OR PLUG BACK TO A	7. Lease Name or Unit Agreement Name
I. Type of Well: OL QAS WEL X WEL] 011+22		NORTH MONUMENT G/SA UNIT BLK. 18
2. Name of Operator AMERADA HESS CORPOR		***	8. Well No.
3. Address of Operator			9. Pool name or Wildcat
POST OFFICE DRAWER	D, MONUMENT, NEW MEXICO	88265	EUNICE MONUMENT G/SA
	50 Feet From TheNORTH	Line and66	50 Feet From The WEST
Section 2	Township 20S Rai 10. Elevation (Show whether in Appropriate Box to Indicate N		NMPM LEA Count
NOTICE OF IN	••••		BSEQUENT REPORT OF:
		REMEDIAL WORK	
	CHANGE PLANS	COMMENCE DRILLIN	IG OPNS.
PULL OR ALTER CASING		CASING TEST AND C	
OTHER:		OTHER: Casir	ng Test. Temponary Alazonar
 Describe Proposed or Completed Oper work) SEE RULE 1103. 	rations (Clearly state all pertinent details, an	nd give pertinent dates, incl	luding estimated date of starting any proposed
07-05-93 Thru 07-16-9	93 NMGSAU #1804		
tbg. as work string. a 6" 600 manual BOP. jts. 2-7/8" 10V tbg. in 4-1/2" liner. TO drill bit. TIH with 2-3/8" tbg. and 122 circulated casing wi 3,739' and 4-1/2" li in 30 mins. Checked	Flowed gas from casing TIH with a 3-7/8" dril Tagged liner top at 3, H with 125 jts. 2-7/8" 1 a 4-1/2" Elder Cast Iro jts. 2-7/8" tbg. Set CI th 120 bbls. fresh water ner from 3,739' to 3,929 surface-intermediate an	and removed 6 1 bit, bit sub, 742' and top of OV tbg., 8 jts. DN Bridge Plug, BP at 3,850', p Pressure tes D'. Pressure de intermediate- ng with 120 bbls	jts. 2-7/8" and 8 jts. 2-3/8" " 600 tubinghead flange. Inst , 8 jts. 2-3/8" 10V tbg. and 1 f fill at 3,927', for 1' of fi . 2-3/8" 10V tbg., bit sub and setting tool and SN on 8 jts. pulled setting tool to 3,841' sted 6-5/8" casing from 0' to ecreased from 560 psi to 540 p -production casing annuli and s. packer fluid and TOH laying ntinued On Back)
I hereby certify that the information above is	true and complete to the best of my knowledge and		
SKONATURE	J. Maring n	mæ <u>Staff Aŝsi</u> s	stant 07-16-9
TYPE OR PRINT NAME	erry L. Harvey		TELEPHONE NO. 393-21
D	L SIGNED BY JERRY SEXTON	m.e	AUG 1 3 19
CONDITIONS OF APPROVAL, IF ANY:			val of Temporary

	N.			NE	IVI CNITTI SI	180170180	CONSERVAT	ION COMMISSIC	N
			HTARASI (ل کل کیفری جم بر روینی میں میں میں میں میں م		Fo, Now Meric		FROM
							IN FERT	······································	In Qui as
				ornion	d Substi	Collar an	 a.r.	16 10238 1	t to the second
-						, brint,	10	1 2 2 d	1.8
					:	Maoff DaWE			.88
					sla	Sand Red Sand	15	90	75
						Red Sand Broken Sa	+	180 134	09 r
	. ()	0d 190	f ∄∋r	Tap of)	hrun has		New Mexico, or its pr	120 134 mag
(1018	जे हे होता	हाय एख	et II) agei	it not more th	han twenty day	s siter completion	of well. Fallow instruct	lons OGT
				in.,t	he Rules and	Regulations o		Indicate questionable	
LOCA	AREA 640	ACRES CORRECT	LY	.1.s	and shel	Red bods	295	745	450
1001		connici		Ð.	end shal	Red rock	153	808	745
merad	a Petro	loum Co	orpore	tion		Hed rock	Weit #2	930	868
		Company				hofinbyn/.	30	Lease 030	930
			W	9	Endia been	Nont ben	–	т <u>1014</u> 10 2 8	20 090 NEOT
3	6	, N. M. H	Р. М.,	Monum		t Field gan	1 268	1000	\$101 Sounty.
ell is	860100.	L od tr	6TUTE:	Porth Tin	and 46	Cocrebas.	st of the East lin	8-20-36	0001 2301
								1,203	1100
State la	nd the oil	and gas				Assignmen	t No	1218	1.203
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L CA New MEXICO OIL CONSERVATION COMMISSION

Santa Fe, New Mexico

HOBBS OFFICE OCC

MISCELLANEOUS NOTICES

Submit this notice in TRIPLICATE to the District Office, Oil Conservation Commission, before the way specified in to Begin. A copy will be returned to the sender on which will be given the approval, with any modifications considered advisable, or the rejection by the Commission or agent, of the plan submitted. The plan as approved should be followed, and work should not begin until approval is obtained. See additional instructions in the Rules and Regulations of the Commission.

Indicate Nature of Notice by Checking Below

Notice of Intention	Notice of Intention to	Notice of Intention
to Change Plans	Temporarily Abandon Well	to Drill Deeper
Notice of Intention	Notice of Intention	Notice of Intention
to Plug Well	to Plug Back	to Set Liner
Notice of Intention	Notice of Intention	Notice of Intention
to Squeeze	to Acidize	to Shoot (Nitro)
Notice of Intention	Notice of Intention	Notice of Intention
to Gun Perforate	(Other)	(Other) Dual Complete X

OIL CONSERVATION COMMISSION SANTA FE, NEW MEXICO

Monument, New Mexico

April 15, 1954

Gentlemen:

Amera	da Petroleum (orporation		<i>.</i> .		Well No. 1	in]	1
		ny or Operator)				Well No Gas		(Unit)
NE		Sec. 34	т 19-3	_R 36-Е	NMPM	Monument - 011		Pool
(40-8	acre Subdivision)		,					
	7 .							

(Place)

Lea.....County.

FULL DETAILS OF PROPOSED PLAN OF WORK (FOLLOW INSTRUCTIONS IN THE RULES AND REGULATIONS)

3950' T.D. - 6-5/8" OD Csg. set @ 3819' and cemented w/100 sacks cement and 5" liner set from 3780' to 3950' and cemented w/50 sacks cement. Oil is being produced from the perforated interval of 3932' to 3948' from Monument Pool. It is our intention to dual complete well by perf. 6-5/8" OD Csg. from 3425' to 3820' in the Seven-Rivers Queen Formation, Eumont Gas Pool and produce gas through csg. We will continue to produce oil through the tubing from the Monument Poel.

79-103

Approved. MAY 24 1954	19	Amerada	Petroleum Corporation
Except as follows:		в	Company of Operator
1	7	• Position	Foreman
Approved OIL CONSERVATION COMMISSION			Send Communications regarding well to:
By N/ () Stanley		Name	Amerada Petrolemm Corporation
Title Engineer District 1		Address	Drawer D. Monument, New Mexico

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Submit 3 Copies te Appropriate E District Office	Minerals and Natural F		Form C-103 Revised 1-1-89
	DIL CONSERVATIO		WELL API NO.
DISTRICT II	P.O. Box 20 Santa Fe, New Mexico		30-025-31982
P.O. Drawer DD, Artesia, NM 88210	Salla I C, New MCXIC	6750+2000	5. Indicate Type of Lease STATE FEE
DISTRICT III 1000 Rio Brazos Rd., Aziec, NM 87410			6. State Oil & Gas Lease No.
(DO NOT USE THIS FORM FOR PROPO DIFFERENT RESERVO	ES AND REPORTS ON WE DSALS TO DRILL OR TO DEEPEN WR. USE "APPLICATION FOR PE I) FOR SUCH PROPOSALS.)	N OR PLUG BACK TO A	7. Lease Name or Unit Agreement Name
1. Type of Well: OIL WELL VY WELL	OTHER		
2. Name of Operator			J.A. FOSTER 8. Well No.
DAVID H. ARRINGTON C	IL & GAS, INC.		#3
3. Address of Operator			9. Pool name or Wildcat
P.O. BOX 2071, MIDLA 4. Well Location	•		MONUMENT ABO
Unit Letter P: 660	Feet From The <u>SOUTH</u>	Line and 330	Feet From TheEAST
Section 34	Township 19-S R		NMPM Lea Cour
	10. Elevation (Show whether	DF, RKB, RT, GR, etc.)	V/////////////////////////////////////
	<u>3614' GR,</u>		
	propriate Box to Indicate		· •
NOTICE OF INTER	VTION TO:	SUB	SEQUENT REPORT OF:
		REMEDIAL WORK	
TEMPORARILY ABANDON	CHANGE PLANS	COMMENCE DRILLING	
PULL OR ALTER CASING	. —	CASING TEST AND CE	
OTHER:		OTHER: COMPLE	TE DRILLING OPERATIONS
12. Describe Proposed or Completed Operations work) SEE RULE 1103.	. (Clearly state all pertinent details, c	Ind give pertinent dates, inclu	ding estimated date of starting any proposed
CASING @300' WI CASING TO 800 P 1/93 - DRILLING 12 1/4 WITH 1200 sxs H TEMP SURVEY. TE 5/93 - DRILLED TO TD 8 7/93 - RAN 5 1/2" CSG. HALIBURTON LT TOOL. CEMENTED	TH 400 SXS CLASS SI, OK. "HOLE TO 2613'. ALIBURTON LT & 2 ST CSG TO 1000 P 050'. RAN LOGS. TO 8035'. DV TO & 560 SXS C	C. CIRC 200 SET 8 5/8" C 00 SXS PREMIU SI, OK. OL @ 4984'. C L H. CIRC 105 SXS HALIBURTO	M PLUS. TOC @ 1240' BY MT 1St. STAGE W/250 SXS SX CEMENT OUT FROM DV H LT + 650 SXS CL C. DIN
			i a
I hereby certify that the information above is true and	complete to the best of my knowledge an	d belief.	
SIGNATURE	Π	ne President	DATE 12/15/93
TYPE OR PRINT NAME			TELEPHONE NO.
(This space for State Use) ORIGINAL SIC	SNED BY JERRY SEXTON		
	CT I SUPERVISOR		DEC 20 1993

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roprials District Office	Energy, N	State of N Ainerals and Nat	ew Mexico tural Resour		en		Form C Revised	
OISTRICT 1 P.O. Box 1980, Hobbs, NM 88240	ОПС	ONSERVA	TION	DIVISIO	N	,		tructions om of Page
DISTRICT II P.O. Drawer DD, Artesia, NM 88210		P.O. B	ox 2088					
DISTRICT III 1000 Rio Brazos Rd., Ariec, NM 8741	0	nta Fe, New M						
1.	REQUEST FO	NSPORT OIL						
Operator	- <u>************************************</u>					VPI No.	<u></u>	<u></u>
DAVID H. ARRIN	GTON OIL & GA	AS, INC.				025-31	382	
P.O. BOX 2071.		(AS 7970)						
Reason(s) for Filing (Check proper box New Well		Transporter of:		et (Please expli	1in)			
Recompletion		Dry Gas						•
f change of operator give name			~~~~ 카라크 :	aab Atoop	The Property	.~1,		
ad address of previous operator 1. DESCRIPTION OF WEL	LAND LEASE		n <u>na s</u> er	Eta / ,		· int is	<u></u>	**************************************
Lase Name	Well No.	Pool Name, Includi		4/1/99		X Lease		use No.
J.A. Foster	3	Monumen	L Abo /	-10091	SLEEX	Redenalizer Fee		
Unit LetterP	. 660	Feet From The	Southu	e and <u>330</u>). Fe	et From The _	East	Une
Section 34 Town	nip <u>19-5</u>	Range 36-E	, N	мрм,	Lea			County
IL DESIGNATION OF TRA	NSPORTER OF OI	L AND NATU	RAL GAS		·			
Name of Authorized Transporter of Oil	or Condent		Address (Giv	e address to w				ni)
Kelly McClasky (Name of Authorized Transporter of Cas	singhead Gas	or Dry Gas		Box 580 H				ni)
Warren Petroleu	n (K)CD		P.O. I	Box 67, M	onument	, NM 88	265	
I well produces oil or liquids,	Unit Sec.		Is gas actuall	y connected?	When 11	1 /20/93		
this production is commingled with th	at from any other lease or p	<u>19 9 36]</u> xool, give commingi		ber:	lllll			·
COMPLETION DATA	Oil Well	Gas Well	New Well	Workover	Deepen	Plug Back	Same Party	Diff Res'v
Designate Type of Completic	on - (X)	i	i	l workover		FIUS DACK	Same Kes v	
Date Spudded 10/6/93	Date Compl. Ready to	Prod.	Total Depth			P.B.T.D.		
Elevations (DF, RKB, RT, GR, etc.)	11/20/93 Name of Producing Fo	mation	8050 Top Cil/Cas	Pay		7987 Tubing Deput	·	
3614' GR, 3627	KB Abo		7323			7.	182	<u></u>
	O_Holes)					Depth Casing 8035		
	TUBING,	CASING AND	CEMENT		D			
HOLE SIZE	CASING & TU	BING SIZE		DEPTH SET		<u> </u>	ACKS CEME	INT
12 1/4	13 3/8		300'					200 sx
	5 1/2		8035'			450 sx		
TEST DATA AND REQU	EST FOR ALLOWA	BLE	7182			650 Cl	_C	
	r recovery of total volume of		be equal to or	exceed top allo	wable for this	depih or be fo	r full 24 hour	·s.)
Date First New Oil Run To Tank	Date of Test		_	ethod (Flow, pu	mp, gas lift, e	(c.)		
<u>11/20/93</u> .ength of Tex	11/23/93 Tubing Pressure		Pun Casing Press			Choke Size		
24							·····	
Actual Prod. During Test	Oil - Bbls.	22	Water - Bbis	230		GM- MCF		
GAS WELL		22	t	<u></u>		<u></u>		
Actual Prod. Test - MCF/D	Length of Test		Bbls. Conden	BALE/MMCF		Gravity of Co	mdensate	
ering Method (pilol, back pr.)	Tubing Pressure (Shut-	<u>نه)</u>	Casing Press	ire (Shut-in)		Choke Size		
1. OPERATOR CERTIFI	CATE OF COMP	LIANCE		<u></u>				
I hereby certify that the rules and reg	gulations of the Oil Conserv	ration		DIL CON	ISERV	ATION E	DIVISIC	N
Division have been complied with as is true and complete to the best of m		a above		Approve	10 h	EC 201	993	
	6							
Signature	1		Ву_		DRIGINAL	SIGNED BY	JERRY SE	XTON
David H. Arring	ton /Preside	nt Tille			עוע	MULT 1 301	-n TIØWR	
12/15/93	915-682	-6685	Title	<u> </u>				
Date	Telep	ohone No.		ee				
INSTRUCTIONS: This for 1) Request for allowable for with Rule 111.	orm is to be filed in co	ompliance with 1		panied by tab	oulation of	deviation te	sts taken in	accordance

All sections of this form must be filled out for allowable on new and recompleted wells.
 Fill out only Sections I, II, III, and VI for changes of operator, well name or number, transporter, or other such changes.
 Separate Form C-104 must be filed for each pool in multiply completed wells.

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DISTRIBUTION			NEW MEXICO OI	L CONSERVA	TION CON SION	F	ORM C-110
L K 8, G. S.				TA FE, NEW			(Rev. 7-60)
AND OFFICE		CERTIFI	CATE OF CO	MPLIANCE	AND AUTHOR	ZATION 0.	C. C.
GAS GARATION OFFICE			O TRANSPOR	RT OIL AND	NATURAL.GA	1 2	<u> </u>
		FILE THE O	RIGINAL AND 4 C	COPIES WITH T	HE APPROPRIATE O	FFICE	
Company or Operator Julf Otl Corr	oration		4 St.	- Ima	Lease Northwest Em	ont Unit	Well No. 34-142
nit Letter N	Section	Township 19-S	Range 36	-E	County		
ool B ame	mt				Kind of Lease (State,	Fed,Fee)	
If well pro-	duces oil or con location of tan		Unit Letter	Section	Township 19-8	Range 26	-E
uthorized transporter			U		ddress to which approved		
lexas-New Mex	dico Pipel	· · · · · · · · · · · · · · · · · · ·			Midland, Texas		
		· · · · · · · · · · · · · · · · · · ·	ctually Connecte		No	l annu af shi- f-	is to be const
uthorized transporter	of casing head	gas 🚺 or dry gas	Date Con- nected	Address (give a	ddress to which approved	a copy of this form	is io de sentj
Warren Pet. C	orp.		Unic	Box 1589,	Tulsa, Oklahom	8.	
gas is not being sol	d, give reasons	and also explain its	present disposition:				
To change the	Casing h	ead gas . Dry cad gas . Con	densate 🗍	number.			
Eumont Unit h	as been f change th	ormed, effec e name of the	tive 4-1-64 v e operator t	with Gulf and	a A. Foster No is operator. Pa change the name	ermission i	s hereby
he undersigned cer				onservation Com	mission have been con	mplied with.	
• •	Execute	i this the 30th	day ofMarch	· · · · · · · · · · · · · · · · · · ·	, 19 _64 .		
	L CONSERVA	TION COMMISSION	ر	By	ORIGINAL SIC C. D. BORL	ар 1911 ад	
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ate				Chilf Oil Address	Corporation		
	•	1304		Box 670,	Hobs, Nor Mas	co	
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2. from			to.		·· ·	6		to	
					No. 5.	ITOIN			
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			N						COMMISSIO	N N	FORM C-103 (Rev 3-55)
PROBATION OFF	01L 6A3		(Submi	- 1 . j	·	(N WELLS	1106	L
Name of Comp Ame	rada Petro	leum C				Addres	s O. Bo	<u>****</u> x 668 -	Hobbs, New	<u>]</u> 4	<u></u>
Lease	E. Gaither		• • • • • • • • • • • • • • • • • • •	Well No. 4	Unit	Letter J	Section 34	Township	95	Rang	
Date Work Per 5-27-63	formed to 5-31-63	Po		ont	4 ,		1	County	Lea	- I	
			THIS IS	A REPORT	0F: ((Cbeck	approprie	ate block)			
Beginnin Beginnin	g Drilling Oper	rations	Cas	sing Test an	d Cem	ent Job		Other (1	Explain):		
Plugging	5		🚺 Ren	nedial Work							
3870' to pay. Cl open hol. tubing,	ods, pump a 3933*. R saned out from 387 pump and r	un #1 open h 0 1 to	 400 grai ole from 3 3940! with 	.ns per f 3 933' to 1 500 gal	2940 3940	of pay)'. F 5% N.	and lan tu E. ac	Run #2 - bing and id. Pul	400 grain packer.	ns pe Acid g. R	r ft. of ized eran
<u>A. J. T</u>	roop	· <u> </u>	FILL IN BEL								
		·				WELL D				· ·	
D F Elev. 363 6	1	тр 3	9401	PBTD)			Producing 3870	Interval to 39401	Co	mpletion Date 6-6-56
Tubing Diamer 2-3/8		Tuł	oing Depth 3 921		19	Oil Strin	g Diame 5-1/ 2		Oil Strin	18 Dept 3870	
Perforated Into		l		· .	·····		<u>/-//~</u>	' <u></u>	<u>-</u>	2010	
Open Hole Inte 3870	to 39401				I	Producia	ng Forma Stu	ation(s) a rt			
		· · · · · · · · · · · · · · · · · · ·		RESULT	rs of	WORK	OVER		· · · · · · · · · · · · · · · · · · ·		
Test	Date of Test		Oil Production BPD		roduct CFPD			Production PD	GOR Cubic feet/	ВЫ 2	Gas Well Potential MCFPD
Before Workover	5-25-63		8,28	1	132			2.76	15,960	<u>)</u>	
After Workover	6-1- 63		40	2	245			7	6,116		
N.	OIL CONSE	RVATIO	N COMMISSION	i .	•			ly that the in my knowled		n abov	e is true and complete
Approved by	AT	1		ţz		Name	21	1.	eon	.	
Title					,	Positio		strict S	uperintend	ient	
Date	, <u></u> ,	T.				Compa	ny		m Corporat		

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Anil to District Office, Oil Conservation Commission, to which Form C-101 was sent a Mail to District Office, Oil Conservation of well. Follow Intractions in Rules and Republic of the Commission. Submit in QUINTUFFICATE. 14 State and Republic of the Commission. Submit in QUINTUFFICATE. NAMEA 400 ATRES ATREA 400 ATRES Attent to meany day sider completion of well. Follow Intractions in Rules and Republic of the Commission. Submit in QUINTUFFICATE. 14 State Land the Coll and Cost Days of the Commission. Submit in QUINTUFFICATE. No. 4 in RW 14 of S5 14, of Sc. 14 T. 19-3 R 36-K NMP Coll Mark 26 19 S5 NMP Fool Last Count Contractor. 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Form 9-330 (Rev. 5-68)		ы. С. (П АЦ	STATES	SUBM	T IN DUPI		Form approved.
•	DEPART	MENT OF		TERIOF	C (Se struc	other in-	Budget Bureau No. 42-R355.5
		GEOLOGICA			revei	nse side) 5. LEASE	
WELL CO	MPLETION	OR RECOM	PLETION	REPORT	AND LO	G*	DIAN, ALLOTTEE OR TRIBE NAMI
1a. TYPE OF WEI	LL: OIL WELI	GAS WELL	DHEL	Jother 71	11. 200	7. UNIT	AGREEMENT NAME
b. TYPE OF COM	PLETION:			1 14	-11-55		ero Ridge
NEW WELL	WORK DEEP OVER EN	PLUG BACK	DIFF. RESVR.	Other	· · · · ·		OR LEASE NAME
2. NAME OF OPERAT Ernest A.	Hanson	• •	· · · · · · · · · · · · · · · · · · ·			9. WELL	ero Ridge Unit "3!
3. ADDRESS OF OPE P. O. Box	1515, Roswe	11, New Mex	(1co			13 10. FIELD	AND POOL, OB WILDCAT
4. LOCATION OF WE	LL (Report location		cordance with an ISL & 990'		ements)*	Pear1	
At surface			5, T-19-S,		N.M.P.M.	11. SEC., OR AI	T., R., M., OR BLOCK AND SURVE
At top prod. int	terval reported belo	1707	inty, New I			Sec 3	5, T-19-S, R-34-E
At total depth					-	Jec. J	3, 1-13 3, K 34 2
			14. PERMIT NO.		DATE ISSUED	12. COUN PARIS	T
	1.10	· · · · · · · · ·		<u></u>		Lea	New Mexico
15. DATE SPUDDED 8/16/65	16. DATE T.D. RE 9/7/65	9/2	COMPL. (Ready t 20/65		371		3701'
20. TOTAL DEPTH, MD 5200 '	& TVD 21. PLUG,	BACK T.D., MD & T 5189'	D 22. IF MUL HOW M	TIPLE COMPL.,			5200' 0 - 210'
24. PRODUCING INTER	RVAL(S), OF THIS C		BOTTOM, NAME (1	MD AND TVD)*	· · · · ·		25. WAS DIRECTIONAL
4576' - 50	36' Queen F	ormation					NO NO
26. TYPE ELECTRIC A					- <u></u>		27. WAS WELL COBED
Gamma-Ray/	Density/Cal	1per		· · · ·			Yes
28. CASING SIZE			G RECORD (Rep			MENTING RECORD	an an transmission and the second
8-5/E"	23#	T. DEPTH SET		LE SIZE		circ. to su	AMOUNT PULLED
5-1/2"	15/3#	519		7-7/8"	350 SX.		None
			·····	-			
				·		.≓ 4 ~ 1.	
29.		INER RECORD		1		TUBING RI	
SIZE	TOP (MD)	BOTTOM (MD) s	ACKS CEMENT*	SCREEN (MI	2-3/8	DEPTH SET	
			· · · · · · · · · · · · · · · · · · ·		2 2-3/0		
31. PERFORATION REC	COBD (Interval, size	and number)	→ .	32.	ACID, SHOT	, FRACTURE, CEMI	ENT SQUEEZE, ETC.
1 - 0.50"	jet/ft. 0 4	576', 4595	', 4597',		ERVAL (MD)		KIND OF MATEBIAL USED
4605', 461	7', 4519',	4745', 488	1', 4885',	4576	- 4619'	the second se	0,000 gals. lease
49291, 493	31', 5024' 8	1 50361.		4745	- 5036 '		1bs. sand. 0,000 gals. lease
			,			011 & 16,000	
33.*			PROI	DUCTION			
DATE FIRST PRODUCT		TION METHOD (FL		• • • • • • • • • • • • • • • • • • • •	and type of pun	np) WE	LL STATUS (Producing or shut-in)
9/20/65	Pump1	ng w/1-25/			:		^{hut-in} Producing
9/20/65	24	CHOKE SIZE	PROD'N. FOR TEST PERIOD	оіц—вві. 47	GAS	CF. WATER	BBL. GAS-OIL BATIO
FLOW. TUBING PRESS.	CASING PRESSURE		OIL-BBL.	GAS	MCF.	WATER-BBL.	OIL GRAVITY-API (CORR.)
		>	47			3	360
34. DISPOSITION OF G	AS (Sold, used for f	uel, vented, etc.)		······			NESSED BY
Sold 35. LIST OF ATTACH	MENTS		· · · · · · · · · · · · · · · · · · ·	•		j Sch	iram
	-Ray/Density	/Caliper	: .				
36. I hereby corthu	that the foregoing	and attached info	ormation is comp	lete and corre	ct as determine	ed from all availabl	e records
SIGNED	Sand	& Mon	M TTTT	Op	erator		9/20 /65
						· · · · · · · · · · · · · ·	
	*(See	Instructions and	Spaces for A	dditional D	Data on Reve	erse Side)	

NEW MEXICO OIL CONSERVATION COMMISSION Santa Fe, New Mexico ICE 0.00 1577 UM 203 Hit 7:19 WELL RECORD 19 WELL RECORD WELL RECORD Mail to District Office, Oil Conservation Commission, to which Form C-101 was sent not of the Commission State of the Commission, to which Form C-101 was sent not of the Commission State of Conservation Commission, to which Form C-101 was sent not of the Commission State of Conservation Commission, to which Form C-101 was sent not of the Commission State of Conservation Commission, to which Form C-101 was sent not of the Commission State of Conservation Commission, to which Form C-101 was sent not of the Commission State of Conservation Commission, to which Form C-101 was sent not of the Commission State of Conservation Commission, to which Form C-101 was sent not of the Commission Commission, to which Form C-101 was sent not the Commission Commission, to which Form C-101 was sent not the Commission Commission, to which Form C-101 was sent not the Commission Commission, to which Form C-101 was sent not the Commission Commission, to which Form C-101 was sent not the Commission Commission, to which Form C-101 was sent not the Commission Commission, to which Form C-101 was sent not the Commission Commission, to which Form C-101 was sent not the Commission Commission, to the Commission Commission Commission, to the Commission Commission, to the Reput confidential until mOL SANDS OR ZONEB No. 1, form	. <u> </u>	R-3645	()					(Revised 7/1/52) (Form C-105)	
Partial of 24 2 Santa Fe, New Mexico NE 0000 19 19 WELL RECORD 10 10 NELL RECORD 11 Nell to District Office, OII Conservation Commission, to which Form C.101 was sent net all there than toward days date completion of well. Follow instructions in Rules and Regulations of the Commission. Submit in QUINTUPLICATE. 100.000 AEEA 400 AREA 400 AREA Postor 100.000 AEEA 400 AREA 400 AREA Postor 100.000 AEEA 400 AREA 400 AR					NEW MENICY	OU CONST	UNATION C	MANIESTON .	
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Well is 660 feet from 601 kh line and 2310 feet from 648 k line of Section 34 If State Land the Oil and Gas Lease No. is	well no							•	
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Name of Drilling Contractor	Di Section		II State	Land the On a	10 57 Drilling	was Completed	Innuar	v 16 to 57	
Address R.R.1. BOX.2, HIAJALA, ZERS Elevation above sea level at Top of Tubing Head 3621. The information given is to be kept confidential until BOS.2001f12an51a1									
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(Record the Process used, No. of Qts. or Gals. used, interval treated or shot.)	Trente	d down tul	lng & casir	ng w/20,00	0 callons C	ontrol-frac	w/10/2011	en oand & fluid-lose	
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Treated down tubing & casing w/20,000 callons Control-frac w/12/gellen mend & fluid-less additive. Result of Production Stimulation On OPT flowed 141 BOPD / 5 BW thru 14/64" choks. FTP 400 psi.			PCP 1	1000 pel.	00R 821				
Treated down tubing & casing w/20,000 callons Control-frac w/15/gallen sand & fluid-less	•			•		·····	Denth Clear	3961	
Treated down tubing & casing w/20,000 calions Control-frac w/15/gallon sand & fluid-loss additive. Result of Production Stimulation. On OPT flowed 141 BOPD f 5 BM thru 14/64" choke. FTP 400 pei. PCP 1000 pei. GOR 621	×							*	

•	OPIES RECEIVED				1		5. (
	ISTRIBUTION	E	W MEXIC		ONSERVAT	ION COMM	SCER	Form C-104	
	ILE		RE	QUEST I	OR ALL	OWABLE		Supersedes O Effective 1-1	ld C-104 and C-110 •65
	/ U.S.G.S.		ATION .					1. I I I I I I I I I I I I I I I I I I I	
	LAND OFFICE	AUTHORIZ	ATION	IU IRA	NSPURI		IC 21 1	A5	
•'	TRANSPORTER OIL					11	024 11	44 AM '65	
	GAS								
	OPERATOR				• * .			i	
I.	PRORATION OFFICE							<u>1.</u>	· · · · · · · · · · · · · · · · · · ·
	Ernest A. Hanso	n							
	Address			·					
	P. 0. Box 1515,	Roswell, Ner	w Mexi	00	•				-
	Reason(s) for filing (Check proper box)		•		10	Other (Please e	xplain)		
	New Well	Change in Trar	aporter of	:					
	Recompletion	Oil		Dry Gas					
	Change in Ownership	Casinghead Ga	a 🛄 .	Conden	sate				
	If change of ownership give name					•			
	and address of previous owner								
¥¥	DESCRIPTION OF WELL AND	EASE							
	DESCRIPTION OF WELL AND 1 Lease Name	LEASE	Well No.	Pool Nan	e, Including	Formation		Kind of Lease	
	Mescalero Ridge Unit "3	5" ·	12	Pea	rl Quee	n		State, Federal or Fee	Federal
	Location .			.		·····		L	
	Unit Letter E ; 19	80 Feet From Th	, No	rth Line	and 99	01	Feet From T	h. West	
		·····							
	Line of Section 35 , Tow	mship 19-S	R	ange	<u>34-e</u>	, NMPM,	Lea		County
					_				
un.	DESIGNATION OF TRANSPORT			RAL GA	S Address (C	ive address to	which approv	ed copy of this form is	to be sent)
	Shell Pipe Line Corp.					98, Hobbe			
	Name of Authorized Transporter of Cas	inghead Gas	or Dry Gas	8 🛄	Address (C	ive address to	which approv	ed copy of this form is	to be sent).
	Phillips Petroleum Co.				Bartle	sville, (kla.		
	If well produces oil or liquids,	Unit Sec.	Twp.	Rge.		ally connected		n	
	give location of tanks.	; F ; 35	19-S	<u>; 34E</u>	Yes		A	ug. 15, 1965	
	If this production is commingled wit	h that from any oth	ner lease	or pool,	give commi	ngling order	number:		
IV.	COMPLETION DATA	Oil We	11	rs Well	New Well	Workover	Deepen	Plug Back Same R	es'v. ' Diff. Res'v.
	Designate Type of Completion		1	is well	New well	workover	l I	Plug Back Same R	es.v. Din. Res.v.
	Date Spudded	Date Compl. Ready			Total Dep	 h	· · · ·	P.B.T.D.	i
	July 25, 1965	August 1		5		200' dola)	5116'	
	Pool	Name of Producing	Formation	1	Top Oil/G		/•	Tubing Depth	<u> </u>
	Pearl Queen	Queen Fm	•		4	5681		4565 '	
	Perforations						4 & 5016	Depth Casing Shoe	
	1 SPF @ 4568, 4588,							51261	
					CEMENT	ING RECORD		SACKS C	
	HOLE SIZE	CASING & T	/8"	SIZE		DEPTH SE		SACKS CE	
	7-7/8"		/2"			246' 5126'		125 sx. cir 350 sx.	curated
	/=//8)=1	16					<u> </u>	
		· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·						
v.	TEST DATA AND REQUEST F	OR ALLOWABLE	E (Test	must be a	fter recovery	of total volum	e of load oil	and must be equal to o	exceed top allow-
	OIL WELL		able	for this de		full 24 hours)			
	Date First New Oil Run To Tanks August 15, 1965	Date of Test August 15	1065	<		Method (Flow,	pump, gas (i)	t, etc.)	
	Length of Test	Tubing Pressure	, 170,	,	Casing Pr		•	Choke Size	
	24 hours							2"	
	Actual Prod. During Test	Oil-Bbls.			Water - Bb	.9.		Gas - MCF	······
		52	2			8			_
	GAS WELL								
	Actual Prod. Test-MCF/D	Length of Test			Bbls. Con	densate/MMCF	•	Gravity of Condensa	te
		making management			Oracia Da			Choke Size	
	Testing Method (pitot, back pr.)	Tubing Pressure			Casing Pr	essure		Choke Size	
υT	CERTIFICATE OF COMPLIAN				f	011 0		TION COMMISSI	ONI
	. CERTIFICATE OF COMPLIAN	CE							
	I hereby certify that the rules and	regulations of the	Oil Cons	ervation	APPRO	YED			. , 19
	Commission have been complied	with and that the	informati	on given					
	above is true and complete to th	e best of my know	ledge an	d belief.	BY	Launoot	There is i))	
					TITLE	i Lotterar i a	· · · · · · · · · · · · · · · · · · ·		<u></u>
	V V	0			TL	is form in to	he filed in a	compliance with RU	LE 1104.
	I all han the	Havon						vable for a newly dri	
	(Sign	alure)			well, th	is form must	be accompa	nied by a tabulation	of the deviation
	Operat	or			14			dance with RULE 1	
	······································	ile)	*			new and rec		st be filled out com ells.	ALCICLY FOR ALLOWS
	August 18				Fi Fi	1 out Section	ns I, II, III,	and VI only for ch	anges of owner,
	(D	ate)			11			er, or other such cha t be filed for each	
					11	ed wells.	-104 mus	. Te mer fot sacu	For multiply
	-								

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			С. <u>к</u>
Submit 3 Copies Mappropriate District Office	State of New Me Energy, Minerals and Natural Re		Form C-103 Revised 1-1-89
DISTRICT I	OIL CONSERVATIO	N DIVISION	WELL API NO.
P.O. Box 1980, Hobbs, NM 88240 DISTRICT II	P.O. Box 208 Santa Fe, New Mexico		30-025-04164
P.O. Drawer DD, Artesia, NM 88210	Santa Fe, New Mexico	87304-2088	5. Indicate Type of Lease STATE X FEE
DISTRICT III 1000 Rio Brazos Rd., Aztec, NM 87410			6. State Oil & Gas Lease No. B-1543-1
	CES AND REPORTS ON WEL		
	POSALS TO DRILL OR TO DEEPEN VOIR. USE "APPLICATION FOR PEI 101) FOR SUCH PROPOSALS.)		7. Lease Name or Unit Agreement Name
1. Type of Well: OIL WELL X WELL	OTHER	**************************************	NORTH MONUMENT G/SA UNIT BEK: 18
2. Name of Operator	U 112A		8. Well No.
AMERADA HESS CORPORAT 3. Address of Operator	ION		9
Address of Operator DRAWER D, MONUMENT, N Well Location	EW MEXICO 88265		9. Pool name or Wildcat EUNICE MONUMENT G/SA
-	0 Feet From The SOUTH	Line and66	O Feet From The EAST Line
Section 2	200		NMPM LEA County
11. Check A NOTICE OF INT	Appropriate Box to Indicate		eport, or Other Data SEQUENT REPORT OF:
		REMEDIAL WORK	
	CHANGE PLANS		
PULL OR ALTER CASING		CASING TEST AND CE	
OTHER:	D		g Test.
	tions (Clearly state all pertinent details, a	nd give pertinent dates, inclu	ting estimated date of starting any proposed
work) SEE RULE 1103. 03-24-93 Through 04-0	1_03		
		moved wellhead,	installed BOP & TOH w/tbg. TIH
w/6-1/8" bit to 3,793	' & TOH. TIH w/7" RBP	& set at 3,675	. Circ. hole w/fresh water.
			attached. PUlled up hole & erliter tbg. head. Found top of
7" csg. lipped in. R	e-installed BOP & re-s	et RBP at 3,634	. Spotted 4 sks. 12/20 sand on
top RBP. Beveled out	inside 7" csg. Cut o	ff & removed 9-5	78" Hinderliter csg. head.
Installed & tested 11	" 3000# x 9-5/8" Natio	w/90 000# tens	7-1/16" 3000# x 11" 3000# on. TIH w/retrieving head, cir
sand off RBP, latched	onto RBP & TOH. TIH	w/6-1/8" bit & 1	agged up at 3,793'. Drld. &
bailed out to 3,855'.	Lowered bit to PBD a	t 3,911'. TOH w	//bit. TIH w/7" TAC on 2-3/8" t
		ension & SN at 3	8,893'. TIH w/pump & rods. RDPU
cleaned lcoation & re Test of 04-07-933 Pr	od. 40 BO, 80 BW, & 7	MCFGPD in 24 hou	irs.
I hereby certify that the information aboveris tru			
SKONATURE	herles T	ne <u>SUPV, ADMI</u>	L. SERV. DATE 04-13-93
TYPE OR PRINT NAME ROY L.	Wheeler, Jr.		TELEPHONE NO. 393-2144
(This space for State Use) Orig.	Signed by		
Pau	ul Kautz Sologist		APR 1 6 196
APPROVED BY	ہ سرو	TLE	DATE DATE
CONDITIONS OF APPROVAL, IF ANY:			

1 1 1				WCMEXIC	A CONTRACTOR OF A CONTRACTOR O	Fe, New Mexico	0	or Ly	мояч
				<u> </u>		TNEET		<u></u>	
			heren i	ma kiloofi	- ^			108	FO.
				la bas pro		L RECORD		119	
				se band so				OR7	
							inex.	Notice of the second	
				ball be				544	
			BUCAT	nt not make the	witwenty days	ssion, Santa Fe, after completion	of well.	Follow Instruc	ctions
	<u> </u>		in t	he Rules and	Regulations of	the Commission. IT IN TRIPLICA	Indicat	te questionable	data
LOCAT	REA 640 A E WELL C	CRES ORRECTLY		Det De	эн,			1090	
			a E Corta - P	ettrbyde		Qraham S		1110	
<u> </u>	ULF UI	Corporati	AND COLORA I	The loop in		Telian o	Lease	1518	
	. 2	V	Well No	<u>36 8</u>	NG GB	of Sec	R	7791T.	208
56	E	N. M. P. M.,_	Monu	menters with	Field,	Lea		THAS	County.
	80	af Lada	an attal	witch B80		t of the East lin		NESE	
								2088	
If State lan	nd the oil	and gas lease i	s No			No		8113	
If patented	land the	owner is	<u> </u>	<u>11t – </u>		, Address_		<u>8059</u>	
If Governn	nent land	the permittee.	ېدرې ودپال	nyarry hrvitister		, Address_			
The Lesse		Julf 011 00	porati	on dars with	<u>rå</u>	, Address_		lan, Okla	homa
Drilling co		Jan. 11.	and the	atlaha 55	th Drilling	was completed.	F	ab. 24,	19 88
		ontractor - 1	Con PPT Sand	Buogantin	τή Dimme	(T)	lsa.	Quishoma	
Name of d	irilling co	level at top of	Webuild "e	Hind a standing	, A	ddress		2677	1
								0473	
The inform	nation giv	en is to be kep	ot confiden	tial untipilor	<u>181. T</u>			<u> </u>	ļ
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GEOLOGY

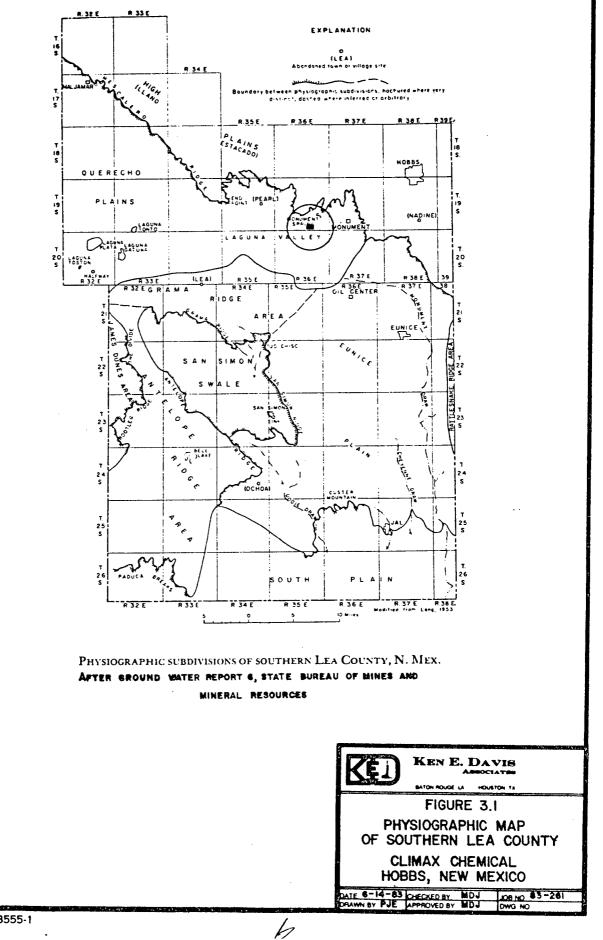
PHYSIOGRAPHY

The Climax Chemical plant is located near Monument, Lea County, New Mexico, approximately 20 miles west of the Texas - New Mexico border (Plate 1). The nearest populated area is Hobbs, located ten miles northeast of Monument. The climate of the area ranges from dry subhumid to arid, and is characterized by low annual precipitation, low humidity and high average annual temperature. Mean annual precipitation ranges from 15.68 to 12.63 inches per year and the mean annual temperature is about 62°F (Nicholson and Clebsch, 1961). Due to the low precipitation and rapid infiltration into the surficial sediments, flood potential is extremely low.

Lea County is divided into two physiographic subdivisions of the Great Plains physiographic province, the Pecos Valley section and the High Plains section. As illustrated in Figure 3.1, the proposed well location is in the Pesos Valley section which is divided into the Querecho Plains, Laguna Valley, Grama Ridge Area, Eunice Plains, San Simon Swale, Antelope Ridge Area and the South Plain (Nicholson and Clebsch, 1961).

To the north of Climax Chemical, the southern extent of the High Plains section is marked by the Mescalero Ridge of the Llano Estacado. An abrupt change in topography is the primary contrast between the Llano Estacado and the Pecos Valley. The Llano Estacado is an almost uniform depositional surface of low relief sloping southeastward. In contrast, the Pecos Valley is a very irregular erosional surface

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sloping toward the Pecos River (westward). Total relief of the area is about 1,300', having altitudes ranging from 4,000' mean sea level (MSL) to 2,900' MSL. A geologic map depicting the physiographic subdivisions of southern Lea County is included as Plate 2 and a brief description of the divisions follow:

Mescalero Ridge and High Plains

Mescalero Ridge is the most prominent topographic feature in southern Lea County and as previously stated, marks the southern limit of the High Plains section. The ridge is a nearly perpendicular cliff capped by a thick layer of resistant caliche, locally called caprock.

The High Plains is a uniformly flat surface sloping about 17' per mile southeast. The only significant relief features are small sand dunes and shallow depressions called buffalo wallows. These depressions range in size from a few feet to more than a quarter of a mile and can be up to 20' deep. Buffalo wallows collect rainfall and contain it until removed by evaporation or seepage.

Querecho Plains and Laguna Valley

Immediately southwest and south of Mescalero Ridge is a vast sand dune area of approximately 400 square miles called Querecho Plains (to the west) and Laguna Valley (to the east). As shown on Figure 3.1, the Climax Chemical plant is located in Laguna Valley. The Querecho Plains - Laguna Valley area is almost entirely covered by dune sand which is stable or semi-stable over most of the area. The sand is generally

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underlain by Recent alluvium and may be underlain by caliche in places. Drillers logs indicate surface sand underlain by caliche is found to depths of about 35'.

The most significant feature in the area is a group of four playas or dry lakes. These playas are irregularly shaped, flat-bottomed, and are underlain by fine sediments with some pebble gravel and precipitated salt and gypsum.

Grama Ridge Area

The Grama Ridge Area is directly south of the Querecho Plains-Laguna Valley area and is topographically higher, indicating it may be an outlier, or detached portion of the High Plains. It is characterized by a hard caliche surface with a texture and composition indicating it was once part of the Llano Estacado. The surface of the Grama Ridge Area has many shallow depressions which do not have integrated drainage.

Eunice Plain

The area east of Laguna Valley and Grama Ridge is referred to as the Eunice Plain. It is bounded on the north by the Llano Estacado and on the southwest by San Simon Ridge and Antelope Ridge. The westward extension of the Eunice Plain is the Grama Ridge area. Dune sands almost entirely cover the Eunice Plain and it is usually underlain by a hard caliche surface. In some places; however, it is underlain by alluvial sediments. A sand cover is generally 2' to 5' thick, but may be 20' to 30' thick locally.

Rattlesnake Ridge

Toward the east, the Eunice Plain rises into a north-trending topographic high called Rattlesnake Ridge. It parallels the state line for most of its length and is regarded as the drainage divide between the Pecos Basin and the Colorado River Basin, Texas.

San Simon Swale

To the west of Eunice Plain is San Simon Swale, a large depression covering about 100 square miles. Most of San Simon Swale is covered by stabilized dune sand and shows no apparent drainage pattern. The deepest point of the swale is San Simon Sink, being 100' deep and a half mile across. Calcareous silt and fine sand are the predominant fill material in the sink.

Antelope Ridge Area

The area to the west and southwest of Antelope Ridge has been called the Antelope Ridge Area, located in southwestern Lea County. The area is relatively flat, sand-covered surface similar to the Eunice Plain and it is also partially underlain by caliche. Towards the south, the area appears to be underlain by Quaternary fill and loamy soil similar to the San Simon Swale. Because the Antelope Ridge is an anomalous geographic feature similar to the High Plains, it is thought to be an outlying remnant of the High Plains.

3.2 HISTORICAL GEOLOGY

The Precambrian history of Southern Lea County is a complex Active history of mountain building, metamorphism and erosion. deposition was taking place in the area during most of the Paleozoic Era. In later Paleozoic time, the south-central United States was a region of crustal unrest with the most significant activity in the West Texas-New Mexico area taking place in Pennsylvanian time. During this time and earlier in the the Paleozoic, a geosyncline (the Llanoria geosyncline) formed across West Texas and adjacent states. (A geosyncline is a linear trough which has subsided throughout time accumulating large volumes of clastic sediment). Strong compressional forces from the southeast caused the geosynclinal area to be raised into mountain ranges which some refer to as the Marathon folded belt. Although much of the folded belt was eroded, it remained high during most of Permian time. During the Pennsylvanian Period, what is now the Central Basin Platform was also emergent in the form of mountain ranges and the area was subject to erosion.

At the close of the Pennsylvanian, the major features of the Permian Basin formed as the whole area subsided. The Central Basin Platform subsided more slowly than the Delaware and Midland Basins and received fewer sediments under different depositional conditions. The basins were areas of accumulation of large amounts of sediment. Limestone tended to form in higher areas, such as the Central Basin Platform, while the formation of evaporites took place at the fringes

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of the sea. At the very edge of the seas, redbeds were formed by the deposition of sediments from nearby land masses.

During Wolfcamp time (early Permian), seas spread over the region and later became restricted causing deposition of redbeos,) evaporites and limestones. The final event of the Permian was the retreat of evaporite-depositing waters from the West Texas region which caused the deposition of a thin layer of redbeds known as the Ochoan Series.

The end of the Permian, and therefore the end of the Paleozoic Era, marks a major time break in the geologic column. During most of the Triassic (except late Triassic) and Jurassic, most of southern Lea County was emergent and undergoing erosion.

During early to middle Cretaceous time, Southeastern New Mexico was covered by a large shallow sea which deposited a thick sequence of Cretaceous rocks. In the late Cretaceous, during the uplift of the Rocky Mountains, seas retreated from the Lea County area and intense erosion took place removing almost all Cretaceous rocks.

In the Pliocene Age, the Ogallala Formation was evenly deposited across the High Plains area, effectively removing the irregular surface formed by previous episodes of erosion. An erosional cycle again began during the Quaternary, removing much of the Ogallala Formation and eroding Triassic rocks for the third time at some locations. Accordingly, erosion by the major rivers of New Mexico and Texas caused the isolation of a large remnant of the Ogallala Formation, the Llano

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Estacado. The climate of the region became more arid in the late Quaternary, and detrital material was reworked by wind creating the large sand dune deposits in the area.

3.3 STRATIGRAPHY

The Climax Chemical plant is located in the Central Basin Platform of the Permian Basin. According to the work of Nicholson and Clebsch (1961), approximately 8,000' of geologic strata overlie the Precambrian basement rocks in the Central Basin Platform. Only strata of middle Permian age and younger are pertinent to this study. Included as Figure 3.2 is a generalized stratigraphic column for Southeastern New Mexico and a regional cross-section is shown in Plate 3. In addition, a colored stratigraphic column based on driller's logs near the site is depicted in Figures 3.3 and 3.4. Following in ascending order is a brief description of the stratigraphy beneath the proposed well site.

Guadalupian Series (Middle Permian)

The Guadalupian Series in the Central Basin Platform consists of the San Andres Formation and the Whitehorse Group. The Whitehouse Group consist of a fine-grained sandstone with thin layers of black shale and argillaceous limestone and, according to King (1942), can also be referred to as the Artesia or Chalk Bluff Group. The Whitehorse Group of the Central Basin Platform is correlative to the Delaware Mountain Group of the Delaware Basin. In the Monument area, it

Revised 2/13/84

TABLE 3.1

GEOLOGIC CROSS SECTION AT CLIMAX PLANT SITE SECTION 35, TOWNSHIP 19S, RANGE 36W MONUMENT, NEW MEXICO ELEVATION -3595'

	THICKNES	SS	
FROM TO	IN FEET	FORMATION	TDS RANGE IN MG/L
0 - 2	2	Soil	
· 2 - 22	20	Calichi	
22 - 45	23	Ogallala	600->3250
45 - 1008	963	Red Beds	
(Top of	Anhydrite	e @ 1008')	
1008 - 1160	152	Dockum Group	
1160 - 2303	1143	Salt	
2303 -2423	120	Tansill	
2423 - 2853	430	Yates	
2853 - 3225	372	7-Rivers	
3225 - 3570	345	Queen	
(Top of	Penrose (3380')	13-19,000
3570 - 3800	230	Grayburg	15 - 34,000
3800 - 5150	1350	San Andres	15,000+
(Top of (Dispos	0il/Water al Zone 43	• contact - 3995') 300'-5150' <u>+</u>)	

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Ochoan Series (Upper Permian)

The lowermost formation of the Ochoan Series is the "Salt" Formation, consisting of anhydrite and some halite. It rests unconformably on the Whitehorse Group in the Central Basin Platform but does not extend beyond the basin margins. Total thickness of the anhydrite and halite at the plant site is approximately 1200'. Halite was mined by Climax Chemical Company in the subsurface interval between 1400' to 2616'.* Three brine wells previously used to leach salt have been olugged and abandoned by Climax. The base of mineable salt was found to be at a depth of approximately 2610'.

The "Salt" Formation is unconformable in places with the overlying Rustler Formation. The top of the Rustler is considered to be the top of the first continuous anhydrite bed penetrated by oil and gas wells in southeastern New Mexico and occurs at a depth of 1008' in the Climax area. The Rustler is characterized as dolomitic limestone with some sandstone and chert pebble conglomerates at the base. Eastward, in the area of Monument, the limestone is overlain by anhydrite, redbeds and halite which is considered an upper member. In Lea County, the Rustler is between 90' to 360' thick and appears to be $100' \pm$ thick at the proposed well site.

The "Salt" Formation and Rustler Formation together compose the Salado Group or Ochoan Series as shown in Figure 3.2.

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Upper Permian or Triassic

Above the Rustler Formation are the undifferentiated redbeds of Permian or Triassic age. They consist of micaceous red siltstone, sandstone, shale and are cemented with gypsum. They are thought to retard the movement of water between the rocks of the Permian and the overlying aguifers (Nicholson and Clebsch, 1961). The Middle and Upper Triassic consists of a sequence of redbeds, the Dockum Group, which rest unconformably on the lower undifferentiated redbeds. The Dockum can usually be differentiated into the Santa Rosa Formation and the uppermost Chinle Formation. The Santa Rosa is a fine-to-coarse-grained sandstone containing minor shale layers and ranging in thickness from 140' to 300'. The Santa Rosa and the Chinle are similar lithologically and in some places have been mapped as the Dockum Group. undifferentiated.

The Chinle Formation consists of red and green claystone which is interbedded with fine-grained sandstone and siltstone. The Chinle has been eroded in the west; however, it reaches a thickness of 1,270' near the Monument area. About 2 miles southeast of Monument, the Chinle grades into a micaceous red clay (Nicholson and Clebsch, 1961).

Both the Dockum Group and the undifferential redbeds are estimated to be 888' thick at the plant site with the top at approximately 120' below the surface.

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Cretaceous

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The rocks of Cretaceous age, although once present in Lea County, have been almost entirely removed by erosion. The only known exposure of Cretaceous rocks in Lea County are found in a gravel pit of the Lea County Concrete Company about seven miles south of Hobbs. At the site, the limestone is white, light gray or buff and highly fossiliferous. There are no known deposits of Jurassic rocks in Lea County.

Tertiary

Beneath the surficial deposits, at the proposed location, are rocks of the Tertiary System represented by the Ogallala Formation of Pliocene age. It is a heterogeneous complex of terrestrial sediments, consisting chiefly of a calcareous, unconsolidated sand containing clay, silt, and gravel. Conditions of deposition varied rapidly during Ogallala time causing well-sorted sediments to be interbedded with poorly sorted sediments. The Ogallala Formation ranges from a few feet to as much as 300' thick and is a major aquifer where it has sufficient thickness.

Quaternary System

In the Monument area, sediments of the Quaternary System exist in the form of alluvial deposits of Pleistocene and Recent age and dune sands of Recent age. The older alluvium is exposed locally in small duneless patches, or in pits and it underlies the areas of Querecho Plains, Laguna Valley, San Simon Swale and several smaller areas. The

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alluvium ranges in thickness from a few inches to more than 400' in San Simon Sink.

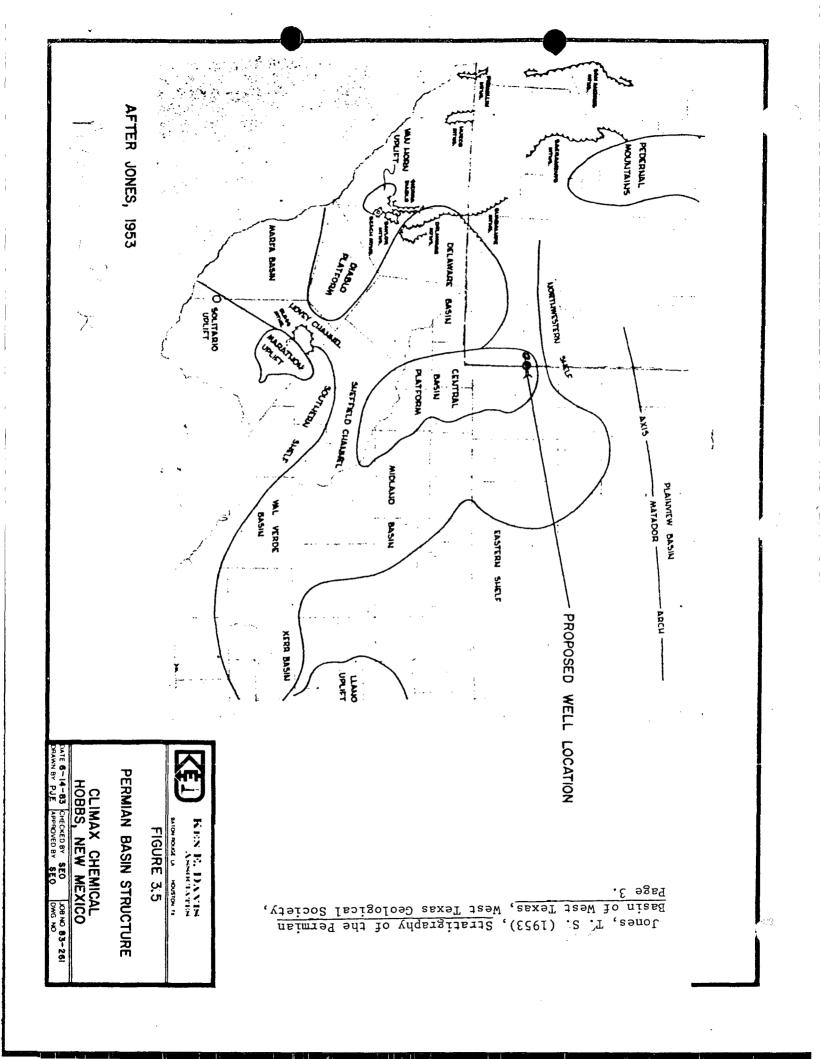
The most extensive Quaternary unit is the cover of red dune sand called the Mescalero Sands. This fine-to-medium grained, reddish-brown sand, which covers 80% of Lea County, parts of Eddy County, and West Texas, was probably derived from the Permian and Triassic rocks of the Pecos Valley. In the vicinity of Climax, the alluvial deposits consist of unconsolidated fine to coarse sand and gravel with stringers of silt and clay, and Eaolian sands cover the surface. (Geohydrology Associates, 1982).

3.4 STRUCTURAL GEOLOGY

Regional Structure

West Texas and half of Southern New Mexico is part of a large subsurface structural feature known as the Permian Basin, which is subdivided into several smaller areas. As previously mentioned, Climax Chemical Plant is located on the Central Basin Platform (See Figure 3.5) and is bounded by the Northwestern Shelf on the North, the Delaware Basin on the West, the Sheffield Channel and Southern Shelf on the south and the Midland Basin on the East. Basins are depressed areas that may vary in size and shape and are formed by subsidence of an area or uplift of the surrounding regions. In most cases, basins probably result from both subsidence and uplift (Huffington, et al 1951).

KEN E. DAVIS



OFFICE PHONE EX 3-2961 RES. PHONE EX 3-2062

MILLER ENGINEERING & GEOLOGICAL CO. ll Brime well # 4 Brime well

Post Office Box 417 712 CODE 88240 HOBBS. NEW MEXICO

July 28, 1978

Climax Chemical Company P. O. Box 1595 Hobbs, New Mexico 88240

Attn: Mr. Ed Smith

Dear Ed:

Cpm

The enclosed tabulation of Casing records and total depths drilled on wells located in sections 34 and 35 of township 19 South, range 36 E; and sections 3 and 4 of township 20 South, range 36 E, of the Monument Field may be of some informative value.

This data was compiled, to a large extent, from Oil Scout reports and to a limited from personal investigation of the Oil Conservation records. It is somewhat of a reconnaissance survey and if we find the need to go into more detail, the Oil Conservation records should be consulted.

Yours very truly,

Charles P. Miller

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